Groundwater Data Acquisition in Edwards, Kinney and Val Verde Counties, Texas

Prepared for:

Plateau Region Water Planning Group
and
Texas Water Development Board

July 2009
Revised March 2010

LBG-Guyton Associates
1101 S. Capital of Texas Highway
Suite B-220
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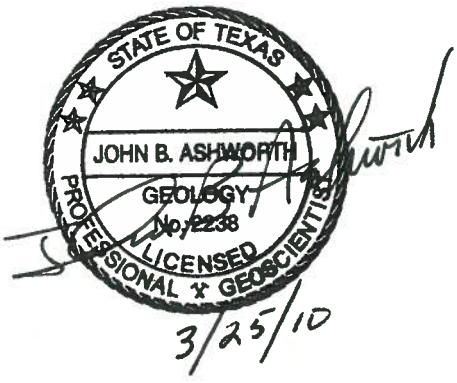


Table of Contents

List of Tables

List of Figures

1.0 Executive Summary

The purpose of this project is to assist in the further characterization of the Edwards and associated aquifers in Kinney, Val Verde and southern Edwards Counties by acquiring additional hydrologic data that was not available during the development of the Edwards-Trinity Plateau Groundwater Availability Model (GAM) (September 2004) and the most recent revision of the Edwards Balcones Fault Zone (BFZ) aquifer model. It is anticipated that this additional hydrologic data will improve the existing models or provide sufficient data for the construction of a new model that will produce a more useful groundwater supply management tool. To accomplish this mission, data acquisition is organized into four general tasks: (1) review of existing aquifer evaluations, field studies and new well data; (2) performance of dye tracer tests to analyze groundwater flow direction and speed; (3) measurement of water levels in wells during two seasonal periods; and (4) review of recent water quality sampling projects.

International Boundary and Water Commission (IBWC) reports document the extent of aquifer water-level rise, change in flow direction, and increase in spring flow as a result of the construction and subsequent filling of the Amistad reservoir on the Rio Grande. Spring flow hydrographs of major springs illustrate change in flow volume over time. Numerous new wells have been drilled in Edwards, Kinney, and Val Verde Counties since 2004 and are documented in Appendix A. Recent aquifer reports provide new aquifer characterization of the study area.

Three dye tracer tests were conducted for this project, one in the Pinto Valley of Kinney County and two in the vicinity of Del Rio in Val Verde County. The dye tracer tests entailed introducing dye into the aquifer at designated locations and monitoring its rate and direction of travel over time. After more than two months of monitoring, dye was detected in a number of sites. This type of information is beneficial when assessing contamination issues, water supply availability, and other groundwater related evaluations.

Two synoptic water-level measurement events were conducted during February and September 2008. Wells selected for this project included those that are annually measured by the Texas Water Development Board (TWDB) and the Real-Edwards Conservation and Reclamation District (CRD). Additional wells were selected with the assistance of the Kinney County Groundwater Conservation District (GCD) and the Real-Edwards CRD. TWDB staff also participated in the project by measuring water levels in wells on the Texas Nature Conservancy's Devils River Preserve and in other wells in Val Verde County. The results of these synoptic water-level measurements are provided in figures and tables. Water levels were generally higher during the February measurement; however, a few wells had the opposite trend. Water-level maps provided in other recent studies are also included in this report.

Chemical analyses of water samples collected between January 2004 and August 2007 are available on the TWDB groundwater database. A map detailing well locations that were sampled within this timeframe and their corresponding total dissolved solids concentrations (TDS) are included in this report. Also, recent isotope studies are summarized.

2.0 Introduction

The purpose of this project is to assist in the further characterization of the Edwards and associated aquifers in Kinney, Val Verde and southern Edwards Counties by acquiring additional hydrologic data that was not available during the development of the Edwards-Trinity Plateau Groundwater Availability Model (GAM) (September 2004) and the most recent revision of the Edwards BFZ aquifer model. It is anticipated that this additional hydrologic data will improve the existing models or provide sufficient data for the construction of a new model that will produce a more useful groundwater supply management tool.

To accomplish this mission, data acquisition is organized into four general tasks: (1) review of existing aquifer evaluations, field studies and new well data; (2) performance of dye tracer tests to analyze groundwater flow direction and speed; (3) measurement of water levels in wells during two seasonal periods; and (4) review of recent water quality sampling projects. It is hoped that by providing this additional hydrologic data to the growing set of available aquifer characterization information, future aquifer modeling and water supply management will benefit.

To assist in appraising the scientific validity of project design and data collection methodology, a science review committee consisting of appropriate groundwater science and management experts was formed. The committee included individuals that are familiar with the water resources in the study area, and that were instrumental in procuring access to properties and wells. Members of this committee and their credentials are:

- Mr. Lee Sweeten - Manager, Real-Edwards Conservation and Reclamation District
- Mr. Scott McWilliams - Texas Nature Conservancy, Devils River Project Director
- Dr. Joe Goebel - Consultant for the Kinney County Groundwater Conservation District

Special appreciation is extended to the Kinney County GCD and the Real-Edwards CRD for providing open access to their well data files, and to the Texas Nature

Conservancy for providing access to water wells on the Devils River Preserve. Appreciation is also extended to the Edwards Aquifer Authority for providing analysis of dye-tracer sample and to the TWDB for assisting with water-level measurements.

Funding for this project was primarily provided through the TWDB regional water planning process. The City of Del Rio and the Kinney County Groundwater Conservation District also provided additional funds.

3.0 Aquifer Data Review

3.1 IBWC Post Reservoir Reports

Numerous reports prepared by the International Boundary and Water Commission (IBWC) were reviewed to assess the hydrologic impact that occurred to the Edwards aquifer as a result of the construction and subsequent filling of the Amistad reservoir on the Rio Grande. Four of the more important IBWC memo reports are listed in the references section of this report. The reports document the extent of aquifer water-level rise, change in flow direction, and increase in spring flow. Following are conclusions and a summary table [Table 3.1 (IBWC Table 1(A1))] from the IBWC June 1987 report.

> *Effects on Ground Water*
>
> *Storage of water behind Amistad Dam, which began in 1968 had a noticeable and almost immediate effect on ground water in the reservoir area. Ground water levels rose rapidly with the increase in storage in Amistad Reservoir. This rise in ground water was due to leakage from the reservoir and the backing up of some of the spring flow that had, under pre-reservoir conditions, discharged in the reservoir area. With the rising ground water levels, ground water in storage around the reservoir increased and the direction of ground water flow changed. With the change in direction of ground water flow, there was increased flow in downstream springs and streams as discussed in subsequent sections.*
>
> *Effects on Ground Water Movement*
>
> *Prior to storage of water behind Amistad dam, the regional ground water movement in the United States was southwesterly and in Mexico was northeasterly toward the Rio Grande with local ground water movement towards the major tributaries of the areas. East of Brackettville the regional ground water gradient was south to southeast along the Balcones Fault Zone.*
>
> *Since operation of Amistad dam and reservoir began, groundwater movement in the vicinity of Amistad Reservoir has shifted predominantly south away from the reservoir except on the north where it is still toward the reservoir. The ground water movement at a distance away from the reservoir in the United States is still southwesterly and in Mexico is still northeasterly toward the Rio Grande.*
>
> *Despite higher ground water levels around the periphery of the Amistad Reservoir caused by storage in the reservoir, there is no ground water movement out of the Rio Grande Basin to the West Nueces Basin.*

Effects on Spring Inflow

After impoundment of Amistad Reservoir began, a large number of springs that formerly flowed into the reservoir area have been inundated. These springs are combinations of three components of the post-reservoir conditions namely: 1) as spring flow into the reservoir; 2) as part of ground water storage; and 3) as increased stream and spring flows downstream of the dam.

Effects on Downstream Flow

Seven treaty streams were studied which include: San Felipe Creek, Pinto Creek on United States side and Arroyo de Las Vacas, Rio San Diego, Rio San Rodrigo, Rio Escondido, and Rio Salado on Mexican side.

Eleven non-treaty streams and springs were studied which include: Eight Mile Creek, McKee Spring, Cienegas Creek, Mud Spring, Las Moras Spring, and Elm Creek on United States side, and Maris Spring, Ernestina Spring, Rosita Spring, Arroyo del Buey, and Arroyo de la Treinta y Una on Mexican side. However, due to low flows and discontinued flow measurement and no apparent effect by the reservoir, Ernestina Spring, Rosita Spring, Las Moras Springs, and Elm Creek were excluded from further analysis.

The combined average base flow of treaty streams for pre-reservoir and for post-reservoir conditions were 190,610 and 313,150 acre-feet per year respectively, an increase of about 64%. The combined average base flow of seven non-treaty streams and springs for pre-reservoir and for post-reservoir conditions were 10,900 and 45, 760 acre-feet per year respectively, an increase of 320%.

It is believed that the increased flow of treaty and non-treaty streams and springs downstream of the Amistad Dam are attributed in a large measure to the effects of the reservoir. Table 1 (A1) shows a summary of the increases of the streams and springs due to Amistad Reservoir. As of December 1984, the combined increased flow due to the reservoir were 122,880 acre-feet per year and 33,690 acre-feet per year for treaty and non-treaty streams, respectively.

The IBWC reports conclude that construction of Amistad Reservoir has not resulted in groundwater movement out of the Rio Grande Basin to the West Nueces Basin, although Table 3.1 does list increased stream and spring flow in Mud and Pinto Creeks in west-central Kinney County. More recent observations suggest, however, that Amistad Reservoir's impact on water level elevations and groundwater flow direction does not extend into Kinney County. As of the

summer of 2009 with the reservoir relatively full, Sycamore Creek, which partially defines the Kinney – Val Verde County boundary, is dry; while spring-fed Mud Creek to the east of Sycamore is flowing. This suggests that flow in Mud Creek is controlled by a separate recharge area, where many of the springs that contribute to flow in the creek occur at higher elevations than the elevation of the full reservoir. Contrary to this observation, there remains some local sentiment that the reservoir does indeed impact groundwater in Kinney County.

Table 3.1 Estimated Increase in Flows of Downstream Streams and Springs 1/
(from IBWC June 1987 Report)

Treaty Streams

Stream	Pre-Reservoir Flow 2/ ac-ft/yr	Post-Reservoir Flow 2/ ac-ft/yr	Post-Reservoir Flow Due to Precipitation ac-ft/yr 3/	Post-Reservoir Flow Due to Reservoir ac-ft/yr
		United States		
San Felipe Creek	58,140	91,010	54,190	36,820
Pinto Creek	5,640	7,050	3,240	3,810
Subtotals	63,780	98,060	57,430	40,630
		Mexico		
Arroyo de las Vacas	3,890	4,790	3,770	1,020
Rio San Diego	68,280	108,400	75,710	32,690
Rio San Rodrigo	23,510	38,070	22,120	15,950
Rio Escondido	24,890	32,640	24,630	8,010
Rio Salado	6,260	31,200	6,620	24,580
Subtotals	126,830	215,100	132,850	82,250
TOTALS	190,610	313,160	190,280	122,880

Non-Treaty Streams and Springs

Stream	Pre-Reservoir Flow ac-ft/yr	Post-Reservoir Flow ac-ft/yr	Post-Reservoir Flow Due to Precipitation ac-ft/yr 3/	Post-Reservoir Flow Due to Reservoir ac-ft/yr
		United States		
Eight Mile Creek	30	2,030	30	2,000
McKee Spring	1,020	4,940	1,810	3,130
Cienegas Creek	3,040	10,450	3,510	6,940
Mud Spring	5,520	11,850	5,170	6,680
Subtotals	9,610	29,270	10,520	18,750
		Mexico		
Maris Spring	510	8,740	640	8,100
Arroyo del Buey	400	5,100	490	4,610
Arroya de la Treinta y Una	380	2,650	420	2,230
Subtotals	1,290	16,490	1,550	14,940
TOTALS	10,900	45,760	12,070	33,690

1/ As of December 1984
2/ With flood flow excluded and diversions or consumptive use included
3/ Estimated from correlation of pre-reservoir flow with precipitation

3.2 Springs

Springs represent natural discharge points of aquifers. Because this study area occupies the downgradient extent of the Edwards (Plateau) aquifer, numerous springs are a major component of the aquifer flow system (Figure 3.1).

The following figures and tables provide flow hydrographs and monthly data for several major springs and for several measurement points along the Devils River.

- Figure 3.2 - Discharge hydrograph of Las Moras Springs (1938-2008)
- Figure 3.3 - Discharge hydrograph of Las Moras Springs (2001-2008)
- Figure 3.4 - Discharge hydrograph of San Felipe Springs (1961-2007)
- Figure 3.5 - Devils River Flow Measurements (2006)
- Figure 3.6 - Annual Flow Comparison in Las Moras, Pinto and Mud Springs (1966-2003)
- Table 3.2 - Las Moras Springs Monthly Flow Measurements
- Table 3.3 - Pinto Springs Monthly Flow Measurements
- Table 3.4 - Mud Springs Monthly Flow Measurements

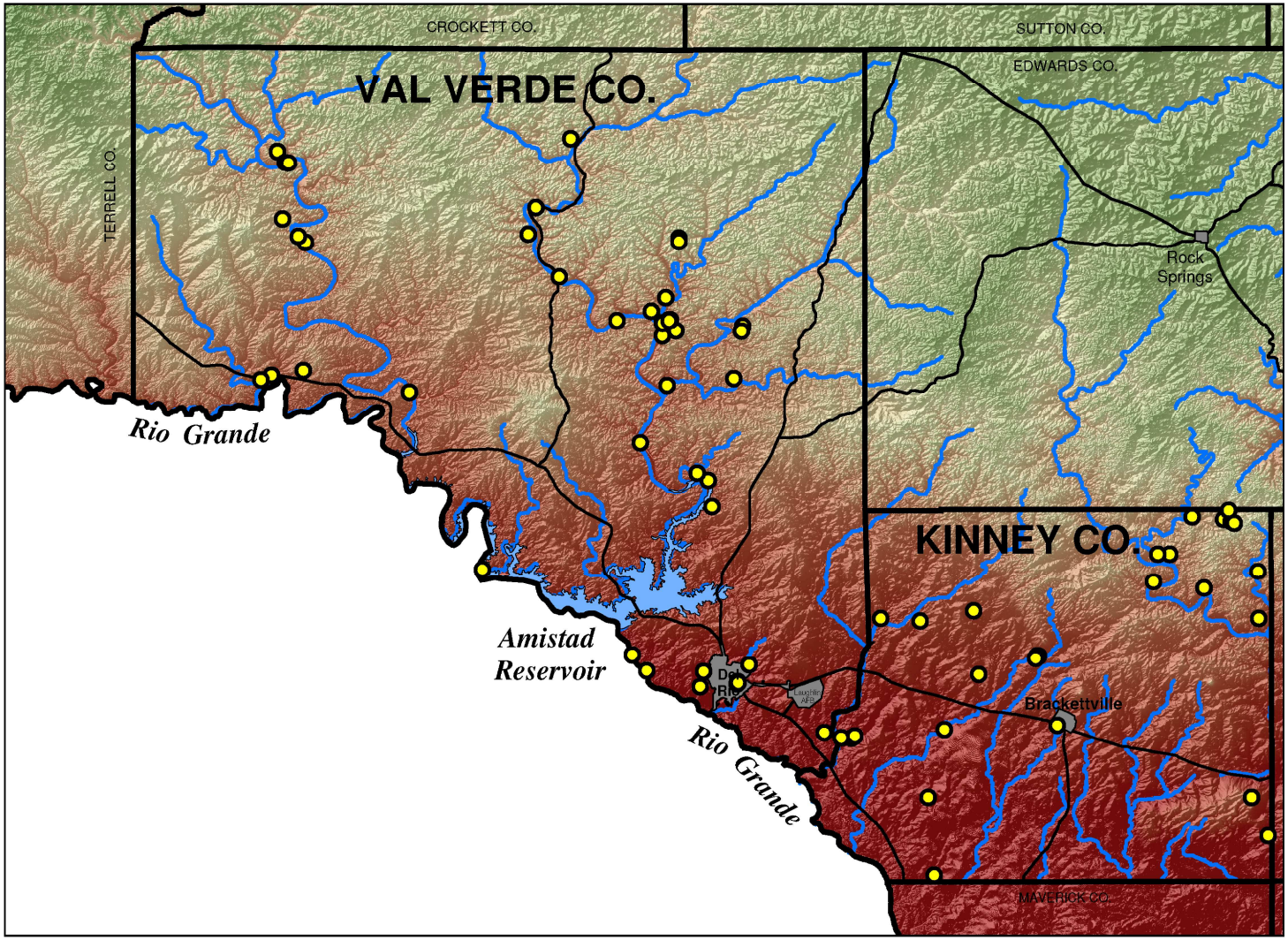


Figure 3.1 Springs of Kinney and Val Verde Counties

Source: Ashworth and Stein, 2005

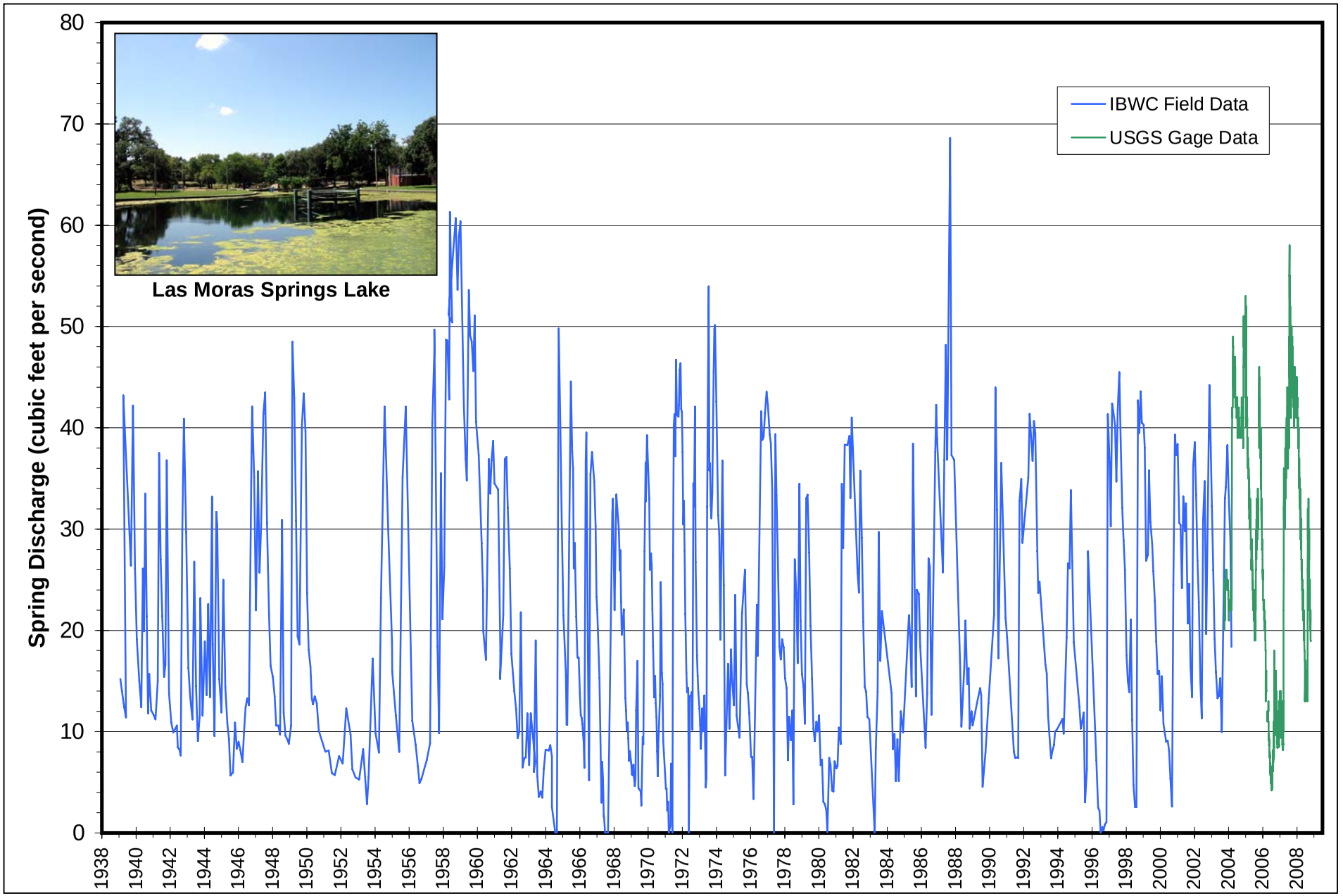


Figure 3.2 Las Moras Springs Discharge 1938 - 2008

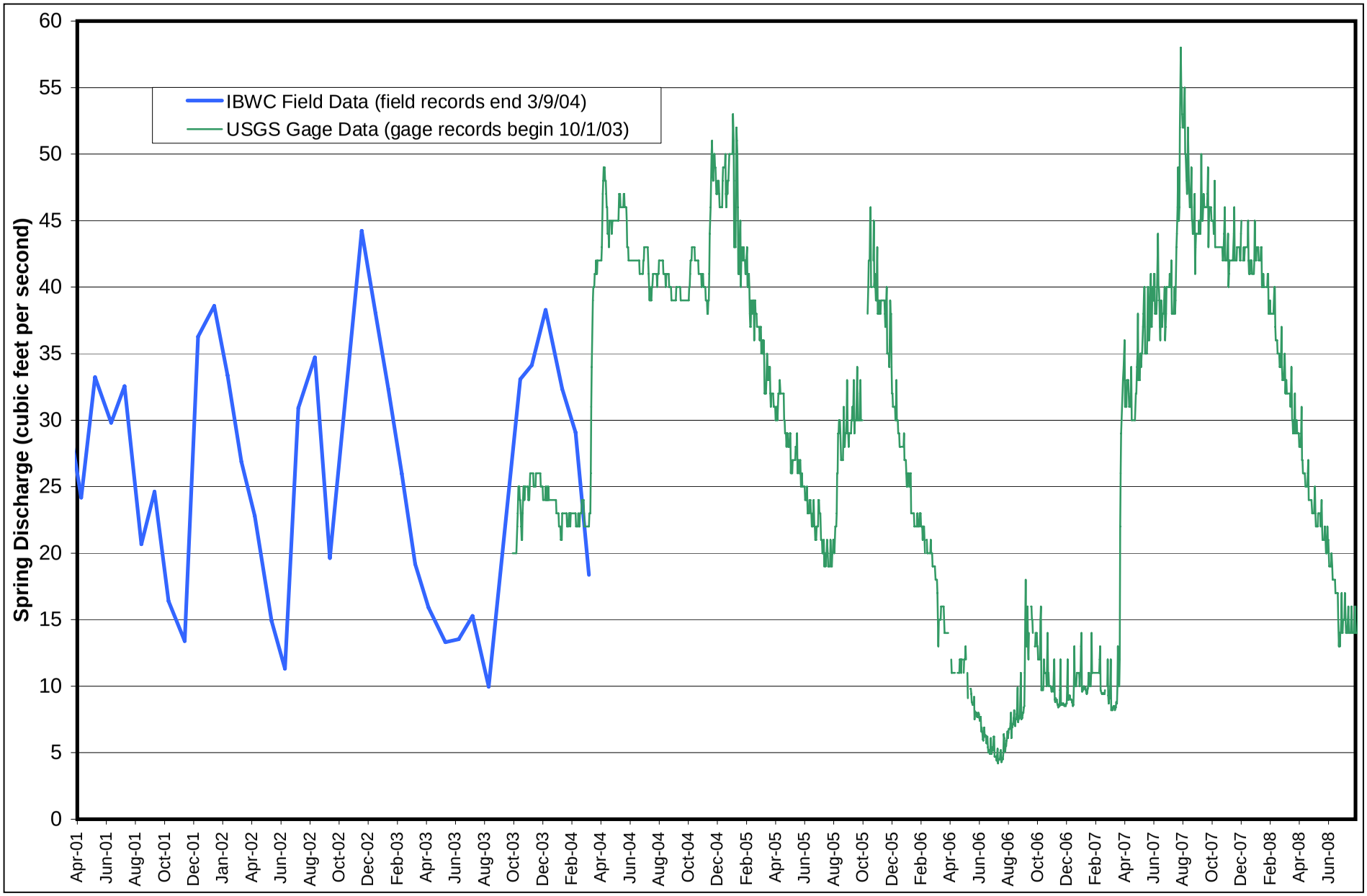


Figure 3.3 Las Moras Springs Discharge 2001-2008

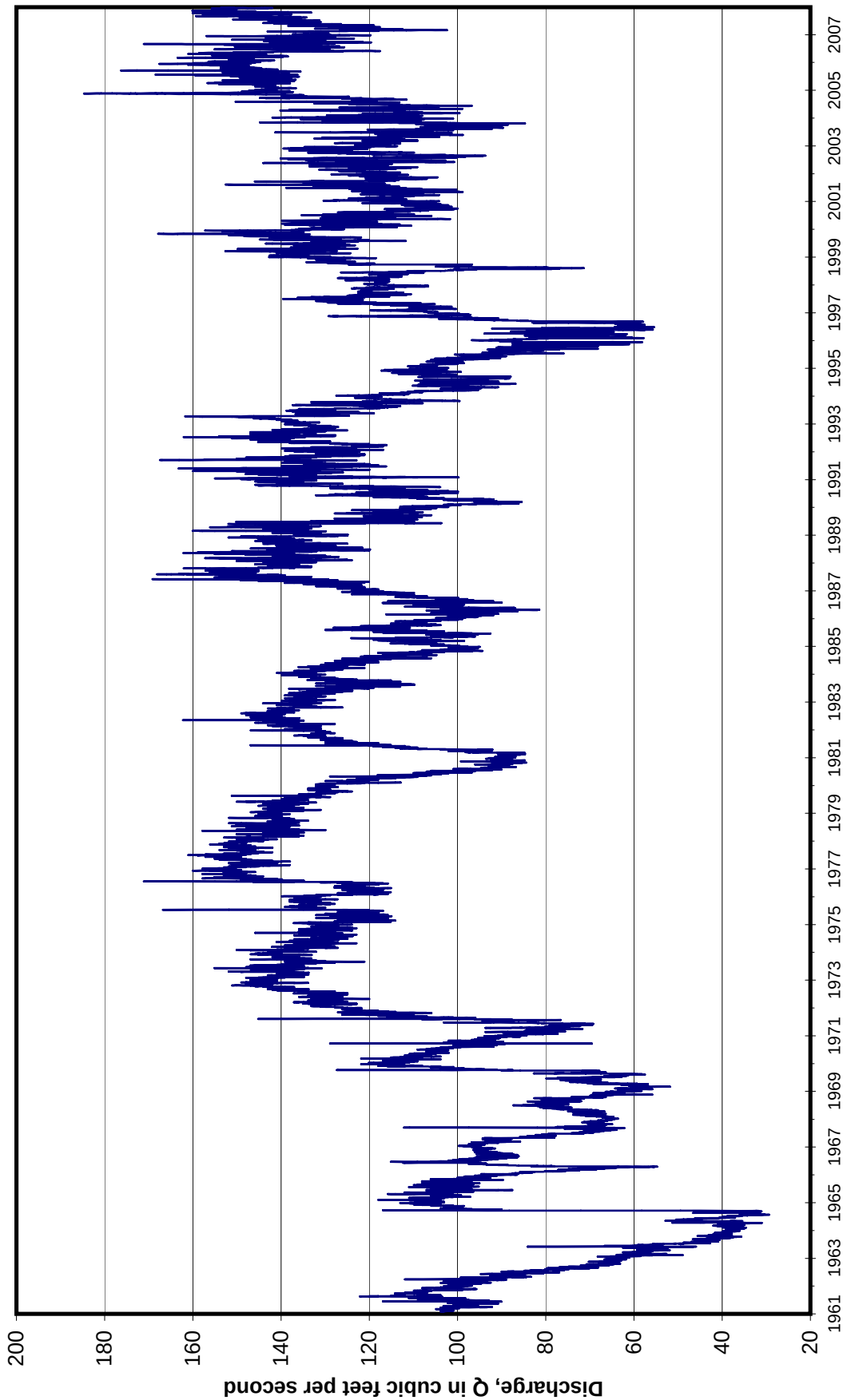
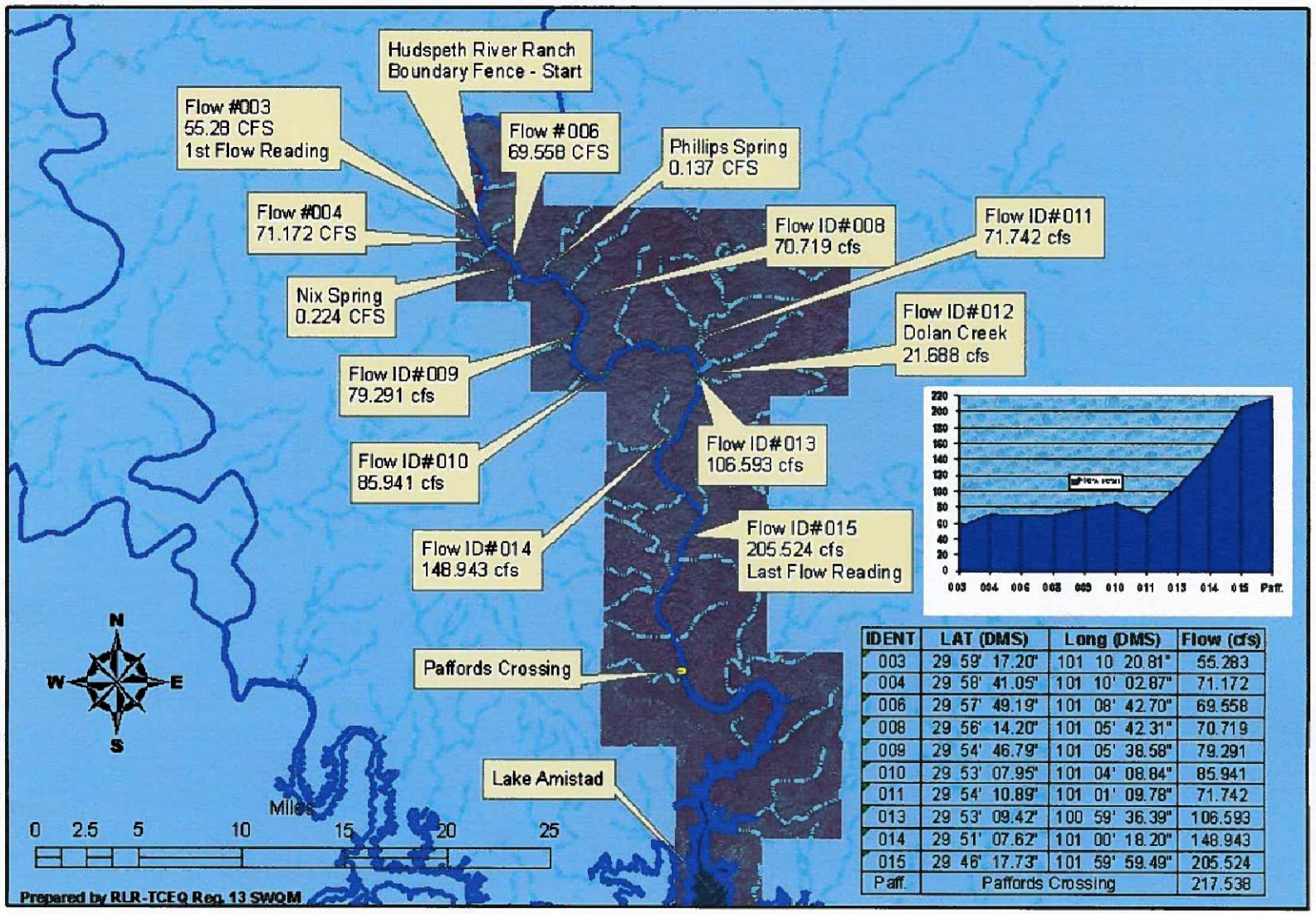


Figure 3.4 San Felipe Springs
Mean Daily Discharge (1961-2007)
Source: IBWC



IDENT	LAT (DMS)	Long (DMS)	Flow (cfs)
003	29 59' 17.20"	101 10 20.81"	55.283
004	29 58' 41.05"	101 10' 02.87"	71.172
006	29 57' 49.19"	101 08' 42.70"	69.558
008	29 56' 14.20"	101 05' 42.31"	70.719
009	29 54' 46.79"	101 05' 38.58"	79.291
010	29 53' 07.95"	101 04' 08.84"	85.941
011	29 54' 10.89"	101 01' 09.78"	71.742
013	29 53' 09.42"	100 59' 36.39"	106.593
014	29 51' 07.62"	101 00' 18.20"	148.943
015	29 46' 17.73"	101 59' 59.49"	205.524
Paff.	Paffords Crossing		217.538

Figure 3.5 Devils River Flow Measurements (September 2006)

Source: Texas Nature Conservancy

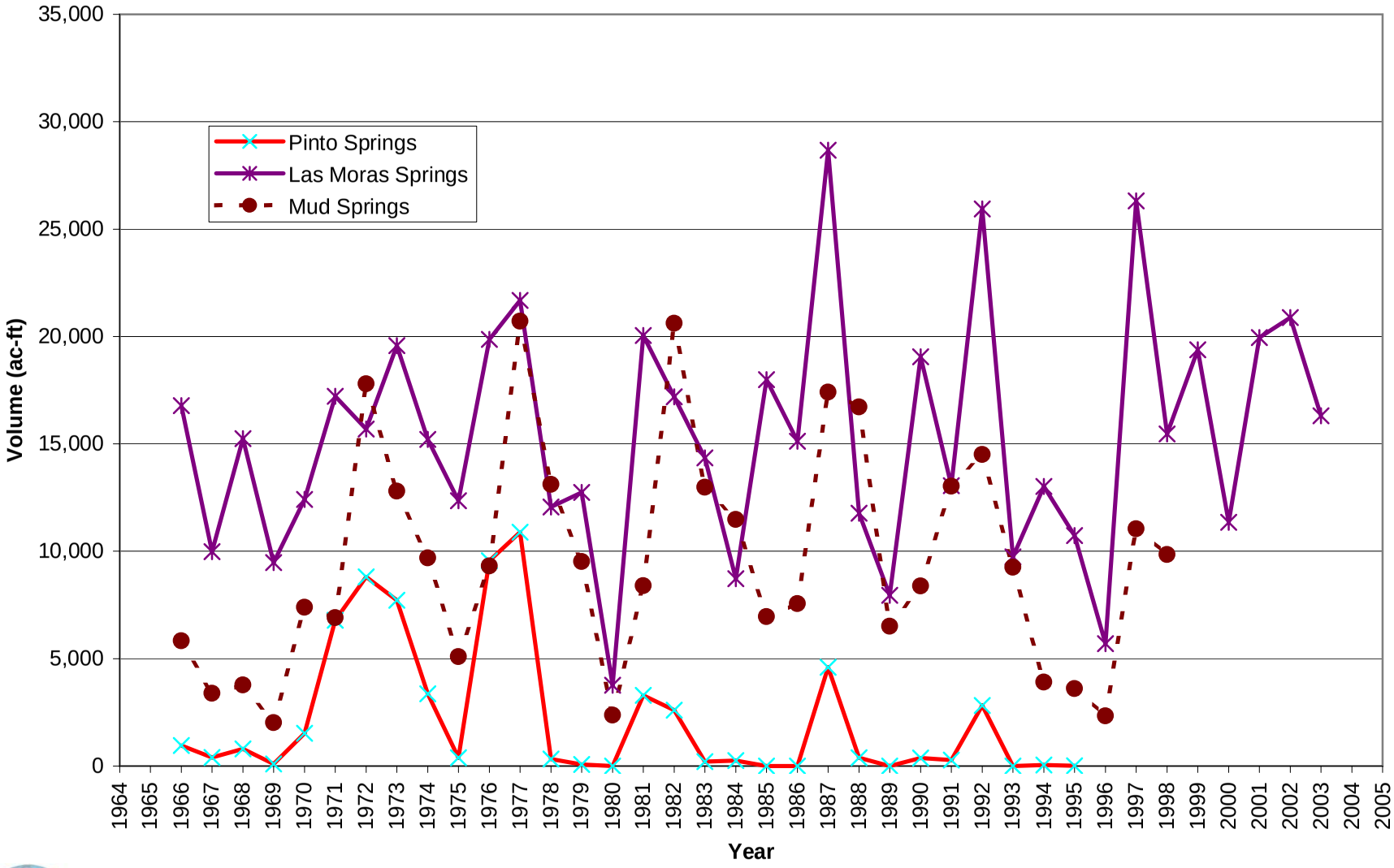


Figure 3.6 Annual Flow in Las Moras, Pinto and Mud Springs (1966-2003)

Table 3.2 Las Moras Springs Monthly Flow Measurements

Volume (cfs-days) per month

Month

Year	1	2	3	4	5	6	7	8	9	10	11	12	Total
1965		85	423	321	493	1019	1137	1016	828	738	536	534	
1966	413	339	308	300	1050	666	302	823	1158	1233	1029	841	8461
1967	662	469	349	170	154	53	0	0	374	889	948	963	5032
1968	792	1026	1058	925	858	644	487	606	385	380	258	262	7683
1969	215	172	172	303	534	169	30	88	269	629	1035	1160	4777
1970	1027	772	832	598	450	397	248	248	465	610	367	245	6259
1971	165	84	47	17	138	462	1235	1289	1262	1289	1369	1323	8681
1972	1090	870	632	449	438	410	420	627	1059	950	536	427	7910
1973	352	296	340	358	217	698	1467	1140	957	1146	1436	1459	9867
1974	1207	885	789	744	1035	631	236	353	445	385	507	452	7670
1975	456	571	375	311	371	643	725	848	708	480	402	338	6228
1976	243	190	143	271	603	746	1470	1354	1175	1227	1254	1337	10012
1977	1294	1109	1175	1042	1133	1152	1010	788	565	547	565	551	10931
1978	472	376	309	359	305	305	287	787	676	642	921	645	6084
1979	484	391	480	958	990	797	611	458	310	297	320	324	6420
1980	321	207	192	95	85	53	61	210	185	136	142	210	1896
1981	201	208	306	392	965	919	1184	1277	1159	1194	1066	1237	10107
1982	1119	864	1023	782	830	1013	867	617	447	416	346	346	8669
1983	322	280	292	266	297	480	800	580	729	1096	1040	1054	7236
1984	721	491	439	373	274	262	194	254	193	329	330	536	4396
1985	1159	922	861	661	575	605	1063	736	520	739	679	551	9069
1986	444	378	302	292	498	786	707	397	474	934	1216	1197	7626
1987	1152	1002	929	835	1174	1364	1193	1312	1816	1294	1288	1095	14454
1988	858	597	598	472	338	341	522	599	465	456	327	360	5933
1989	346	358	432	344	250	401	360	160	183	308	483	383	4008
1990	273	246	516	796	1245	891	692	1105	1093	1103	972	672	9605
1991	602	509	477	505	380	245	231	231	413	1007	1008	975	6583
1992	1193	1088	1243	1101	1277	1250	1178	1244	1121	903	728	757	13080
1993	708	564	552	498	458	378	372	243	246	277	300	315	4913
1994	309	241	215	317	353	499	643	812	827	981	754	611	6561
1995	591	434	517	370	328	338	305	128	278	792	708	620	5409
1996	492	277	249	187	90	52	7	15	12	27	277	1185	2871
1997	1112	924	1280	1237	1216	1103	1317	1358	1128	994	851	748	13268
1998	547	417	480	566	326	135	85	303	1143	1258	1278	1257	7796
1999	1234	986	852	868	1055	911	874	786	676	576	477	473	9769
2000	408	415	342	293	281	268	233	147	217	820	1128	1169	5719
2001	1136	879	905	801	993	917	926	693	677	501	534	1094	10055
2002	1161	910	820	637	463	480	961	985	683	984	1250	1192	10527
2003	986	703	583	461	419	418	432	386	661	982	1052	1139	8222
2004	996	776	179	0	0	0	0	0	0	0	0	0	
Average	699.1	557.8	550.5	506.9	573.5	572.4	621.8	625.0	649.6	738.8	742.9	751.0	

Table 3.3 Pinto Springs Monthly Flow Measurements

Volume (cfs-days) per month

Month

Year	1	2	3	4	5	6	7	8	9	10	11	12	Total
1965		301	177	81	136	229	112	8	57	179	200	199	
1966	97	7	0	0	0	0	0	0	87	93	47	152	483
1967	173	27	0	0	0	0	0	0	0	0	0	0	200
1968	2	50	128	116	100	6	0	0	0	0	0	0	401
1969	0	0	0	0	0	0	0	0	0	0	0	50	50
1970	228	160	284	88	9	0	0	0	0	0	0	0	769
1971	0	0	0	0	0	0	1	303	765	856	738	759	3423
1972	685	552	394	275	302	367	395	220	306	385	279	282	4443
1973	120	48	70	45	10	97	345	396	502	717	824	719	3893
1974	581	345	263	206	194	22	3	11	16	16	23	14	1694
1975	9	1	0	0	0	0	7	36	62	38	37	2	192
1976	0	0	0	0	0	84	389	699	854	845	969	979	4818
1977	944	759	662	645	744	315	333	260	252	229	194	154	5491
1978	112	37	4	0	0	0	0	0	0	0	2	9	163
1979	1	0	0	0	9	25	2	0	0	0	0	0	36
1980	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	0	0	0	0	0	65	226	79	241	273	400	373	1656
1982	309	224	187	128	122	127	118	61	36	0	0	0	1312
1983	0	0	0	0	0	0	0	0	0	5	46	53	104
1984	46	36	30	18	1	0	0	0	0	0	0	0	130
1985	0	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	19	190	453	375	366	344	241	190	136	2315
1988	99	61	31	2	0	0	0	0	0	0	0	0	194
1989	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	9	49	79	49	186
1991	11	4	4	2	1	0	0	0	7	34	42	37	143
1992	46	52	65	94	221	283	129	210	196	119	8	0	1424
1993	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	5	15	7	26
1995	4	3	1	0	0	0	0	0	0	0	0	0	8
1996	0	0	0	0	0	0	0	0	0				
Average	111.8	83.3	71.9	53.7	63.7	64.7	76.1	82.8	116.8	131.7	132.0	128.3	

Table 3.4 Mud Springs Monthly Flow Measurements

Volume (cfs-days) per month

Month

Year	1	2	3	4	5	6	7	8	9	10	11	12	Total
1965		436	482	426	361	377	421	354	356	380	361	303	
1966	262	159	135	106	215	248	244	230	273	328	361	381	2940
1967	366	303	303	244	197	115	74	27	6	8	26	37	1705
1968	47	89	121	136	191	254	247	215	207	174	127	96	1905
1969	73	35	12	10	24	31	27	5	34	119	278	370	1018
1970	415	394	443	399	352	320	305	254	237	248	198	164	3729
1971	126	89	62	29	7	24	173	383	531	675	664	717	3480
1972	741	722	817	777	791	734	658	728	743	775	744	742	8972
1973	722	642	653	572	553	493	588	445	414	443	449	483	6455
1974	528	497	523	485	476	469	426	377	299	283	265	257	4886
1975	227	204	187	170	164	130	147	277	272	286	268	237	2570
1976	194	131	94	88	102	80	67	661	738	792	863	888	4698
1977	888	880	1015	906	933	867	916	914	808	774	778	761	10441
1978	721	608	630	578	572	548	541	505	466	478	478	488	6614
1979	468	370	408	447	413	388	412	432	377	405	360	319	4797
1980	269	201	184	110	84	60	45	35	55	72	51	27	1194
1981	17	10	29	54	106	344	529	537	589	650	648	719	4231
1982	755	763	844	848	915	897	907	878	869	933	910	873	10391
1983	709	638	624	489	457	432	427	449	456	573	649	641	6546
1984	701	623	636	609	555	475	389	415	366	361	340	317	5787
1985	300	309	355	341	341	315	297	273	235	259	249	236	3510
1986	226	206	200	164	171	262	333	375	384	479	489	525	3813
1987	574	561	605	614	598	666	734	807	896	901	882	939	8779
1988	906	793	799	750	742	701	706	667	648	638	544	532	8427
1989	460	379	421	397	445	226	194	187	180	147	147	100	3284
1990	69	53	69	129	321	337	395	528	534	559	566	668	4228
1991	691	655	675	642	613	554	545	461	414	435	445	439	6569
1992	450	476	551	524	595	641	676	703	712	696	638	650	7312
1993	654	530	526	487	492	407	364	340	268	219	216	164	4667
1994	144	93	75	72	93	135	193	152	165	265	283	299	1969
1995	286	237	228	169	148	140	134	106	95	99	89	85	1816
1996	80	80	67	47	31	31	23	14	42	166	226	372	1180
1997	418	405	456	436	449	449	520	522	469	486	474	484	5568
1998	448	366	407	388	344	289	223	247	441	560	592	658	4964
1999	703	683	736	699	739	714	701	655	679	728	198		
Average	430.6	389.2	410.6	381.1	388.3	375.7	388.1	404.6	407.3	439.8	424.5	440.4	

3.3 Recently Drilled Wells

New wells drilled since 2004 in Edwards, Kinney and Val Verde Counties that are filed with the Texas Department of Licensing and Regulation (TDLR) and are available through the TWDB groundwater database are provided in Appendix A. Well location and surface elevation are included as reported by the driller and should be confirmed where needed. Well yield is reported by the driller generally as a short-term production test and does not necessarily represent the actual capacity of the aquifer at the specific well location.

Three new wells in Kinney County of specific interest due to their high yield are:

- TDLR Tracking No. 71109 – 3,000 GPM with 200 ft drawdown after 7 hours.
- TDLR Tracking No. 110751 – 400 GPM with 100 ft drawdown after 6 hours.
- TDLR Tracking No. 116405 – 400-500 GPM with 200 ft drawdown after 2 hours.

3.4 Recent Aquifer Reports

Green and others (2006) recently conducted an aquifer evaluation in Kinney and Uvalde Counties for the Edwards Aquifer Authority in which updated assessments of hydrology, geochemistry, and structural geology were made. The report identifies separate "groundwater pools" in Kinney and Uvalde Counties, with the Kinney County pool extending from a groundwater divide between Mud and Pinto Creeks on the west to a zone of low permeability near the east county line. Study evaluations indicate an average annual recharge of 70,000 acre-feet from the West Nueces River basin.

Another aquifer evaluation of interest is provided in Khorzhad (2002 and 2003), in which a multi-well aquifer test was conducted and groundwater movement within the cone of influence was estimated. The test included six observation wells and one pumping well that was pumped for four days at an average rate of 4,588 gallons per minute with a maximum drawdown of 105.7 feet at the pumping well. Other recent reports of interest that contain useful aquifer data include Boghici (2004), Kier (1998), and Mace and Anaya (2004).

4.0 Dye Tracer Tests

The main objective of the dye-trace studies in Kinney and Val Verde Counties is to provide additional insight on groundwater flow paths and hydraulic characteristics of the aquifer in the Plateau Region (Region J) water planning area. This information will be utilized to improve the existing groundwater availability models (GAM) or if sufficient data is generated construction of a new computer model might be possible that will present a more useful groundwater supply management tool to be implemented in the region.

Dye tracer tests are commonly used in karst aquifers (Quinlan, 1986; Smart, 1988) such as the Edwards Aquifer. The tests entail introducing a non-toxic organic fluorescent dye at a specific location and monitoring the groundwater flow route and rate of travel of the dye in the aquifer by monitoring natural (springs) and man-made (water wells) discharge features. The test results provide additional information related to groundwater movement through the aquifer flowing to discharge points such as San Felipe Springs in Val Verde County or Las Moras Springs in Kinney County. This type of information is beneficial when assessing contamination issues, water supply availability, and other groundwater related evaluations.

The fluorescent dyes utilized are not harmful to humans or other animals, and have no effect on plants. The dye is diluted by groundwater as it moves through the aquifer and is usually in low enough concentrations to not be visibly detected. Samples of water or charcoal receptors are utilized to detect low concentrations of the dye found in wells or springs. Fluorescent dye detected at a well or spring indicates that a direct flow path exists from the injection point to that sampled well or spring. Conversely, the lack of a positive detection at any site does not negate the possibility of a direct connection between particular points. Other factors such as hydrology or dispersion and dilution may prevent detection of the dye. Even if a previous dye trace fails to identify a flow path, positive detection may occur with a new dye trace under different hydrogeologic conditions, such as a higher water table.

Because the dye is introduced into water wells, the Texas Commission on Environmental Quality (TCEQ) requires a Class V injection well permit. The authorization letters from the TCEQ for the dye test injections are included in Appendix B.

Prior to the initiation of field activities, procedural discussions pertaining to developing a consistent approach for all tracer studies were held with members of the Science Review Panel, City of Del Rio utility staff, and the manager and hydrologic consultant of the Kinney County Groundwater Conservation District. Most of the individuals continued to take an active part in the studies from start to finish. EAA staff also provided guidance recommendations and coordination in terms of their own tracer studies in the area.

Of particular importance to the *"Go – No Go"* strategy of the tracer studies was the cooperation and decision-making process of participating entities. In the Val Verde County test, City of Del Rio utility staff made the critical decision on the use of specific city wells for injection and monitoring. The Kinney County test relied on the Groundwater Conservation District to coordinate approval from private landowners and the Fort Clark MUD for use of injection and monitoring sites. All of the above mentioned individuals and entities were thus instrumental in making the final *"Go"* decision on the project.

Following completion of fieldwork involved in the dye-trace studies, a technical memorandum was prepared to describe the procedures and results. With minor editing, the technical memorandum was incorporated directly into this report as Sections 4.2, 4.3 and 4.4.

4.1 Acknowledgements

LBG-Guyton Associates would like to acknowledge the contributions of entities and personnel that assisted with the dye studies. Zara Environmental LLC was subcontracted by LBG-Guyton Associates to assist with performing the tracer study in Val Verde County and also subcontracted by both the Edwards Aquifer Authority (EAA) and LBG-Guyton Associates to assist with dye traces in Kinney County. The EAA

provided automated samplers and use of their fluorometer for analyses of samples for the Val Verde traces. In Kinney County, the EAA has been conducting a number of trace studies over the last few years. At our suggestion, the EAA worked cooperatively on the trace performed in Pinto Valley. We thank Mr. Geary Schindel and Mr. Steve Johnson of the EAA for their efforts.

In Val Verde County, the staff of the City of Del Rio assisted with equipment setup and the injection of the dye. We thank Mr. Robert Parker, PE, City Engineer and Mr. Mitch Lomas for arranging much of the assistance in Del Rio. In Kinney County, we appreciate the efforts of the Kinney County Groundwater Conservation District (GCD) especially Ms. Diana Ward, former general manager, and Dr. Joe Goebel. In addition, we appreciate the many landowners in Kinney County that provided permission to enter their property for sampling purposes during this study.

4.2 Tracer Test Protocol

The amount of dye obtained for each injection for the tracer tests were approximated by using the following equation (Worthington and Smart, 2001):

$$\mathbf{M = 19\ (LQC)^{0.95}}$$

Where:

M = mass of dye applied (grams)
L = distance between input and output (meters)
Q = discharge from the spring being traced to (cubic meters/second)
C = peak concentration of tracer at spring (gram/meter^3)

These dyes can become visible in water at concentrations of 0.03 g/m^3. During the tracer test, the peak value calculated at the springs is 0.01 g/m^3, which is below the visible concentrations. Liquid dyes from the supplier come pre-mixed at concentrations of 35 percent. So for calculation purposes, the liquid mass of dye is compensated. When chlorinated water is used to flush the dye into the aquifer, the chlorine can neutralize up to 50% of the dye. This doubles the amount of dye required in those circumstances. Some additional dye was added from the calculated mass to account for other potential variables.

Different individuals were utilized for the injection and sampling procedures during the study to minimize the potential for cross-contamination to the receptor locations from the injection sites. At the injection sites, plastic disposable tarps were placed on the ground around the well to minimize surface spills. Personnel performing the injection wore disposable coveralls, plastic gloves and shoe covers to minimize the spread of the dye. After the injection, the disposable clothing and plastic sheeting were carefully removed and placed in plastic garbage bags for proper disposal away from the site.

Prior to injection, samples were retrieved from the sites that were monitored to determine if any background fluorescence existed. Sampling for the dye trace detection was accomplished by three methods: 1) grab samples, 2) charcoal receptors and 3) automated samplers. Grab samples were taken directly into 13-milliliter screw top bottles and then placed in whirl packs that were labeled with location, date and time of sample.

The charcoal receptors, sometimes referred to as “Bugs”, are composed of activated coconut charcoal in a sealed nylon-mesh packet. These packets are strategically located in wells or streams and continually adsorb the dye when present in water, which produces an integrated sample over the duration that the packets are in place. Because of the continued sorption, the charcoal receptors can accumulate the dye from the water to levels that can be detected when eluted from the charcoal. Otherwise, if the concentrations are too low in a grab or automated water sample, the dye may be below the detection level of the analytical equipment. The charcoal is eluted in a mixture of isopropyl alcohol and sodium hydroxide for one hour prior to analyzing the decant with the spectrometer.

Samples were also taken at strategic locations by ISCO brand automated water samplers (Figure 4.1). The automated samplers are programmed to retrieve samples from streams or wells at pre-determined intervals. Initially after dye injection, the samples are retrieved more frequently, then after some time the interval was reduced to every 8-hours or more. The sampler utilizes a peristaltic pump that pulls in the samples and purges the sample line and places water in sequence into one of the 24-sample bottles within the

bottle case. The samples are later retrieved from the bottles in the sampler case and decanted into 13-milliliter glass screw top bottles, which are each marked with an identification number. For quality assurance/quality control procedures, duplicate samples are also taken at a rate of 2 for each set of 24 in the sampler bottle case. An additional blank is also included within that sample count. All of these samples are properly stored absent of ultraviolet radiation (sunlight), which breaks down fluorescent dye, prior to analyzing.

All samples for both tracer studies were analyzed using a Perkin Elmer Model LS50B luminescence spectrometer owned by the EAA. Personnel from Zara operated the spectrometer to obtain analyses for the Val Verde County traces. EAA staff analyzed most of the samples taken from Kinney County. Zara staff performed some analyses to assist with the total volume of samples taken in Kinney County. Scans using the spectrometer are made using a known wavelength of light exposed to the sample, which causes an emission if dye is present in the sample. Each type of dye fluoresces at a known wavelength. For quality control/quality assurance procedures, standards of known concentrations of dye as well as blanks are frequently run through the instrument to calibrate the spectrometer during the analyses.

Figure 4.1. ISCO Automated Sampler Utilized in Study

4.3 Val Verde County Dye Trace

Two wells were selected for introduction of dye into the aquifer. One well utilized was TWDB # 70-33-904, referred to as the Agarita Well, which is a City of Del Rio well that was drilled in the mid-1960s as a supply well for the City. The second injection site was a well referred to as the "Y" Well, located near the intersection of Highways 90 and 377 located on Val Verde County property.

4.3.1 Injection Site 1

The Agarita Well was originally drilled to a depth of 499 feet but was later plugged back to a depth of 445 feet. The well was acidized after construction to enhance the performance and yield of the well. The Agarita Well was utilized for many years to supplement the water supply for the City of Del Rio, which predominantly comes from

San Felipe Springs. In recent years, the Agarita Well has not been operated due to occasional bacteria detections from the produced water. The line-shaft turbine pump and motor is still in place in the well, which made for some difficulties in injecting the dye and flush water into the well.

On December 11, 2008 starting at 10:30 AM, fourteen pounds of eosine (FDA name D&C Red No.22) dye dissolved in about 5 gallons of water was injected through tubing set into the Agarita Well (Figure 4.2). For dye injection, about 100 feet of ½-inch diameter tubing was installed through a port in the base of the pump down past the water surface. The water level in the Agarita Well was measured at a depth of about 62 feet that morning. Because of limited access through the pump base, two garden hoses were installed on opposite sides of the pump and flush water was added through the two hoses from a tanker truck. The flush water was from a nearby hydrant and was de-chlorinated using phosphoric acid prior to injection. About 9,000 gallons of flush water was slowly added over a two-day period. An additional 1,500 gallons of flush water was slowly added on December 16, 2008.

Figure 4.2. Injection of Eosine Dye into Agarita Well on December 11, 2008

4.3.2 Injection Site 2

Hutto Drilling originally drilled the "Y" Well to a depth of 500 feet in 1990. In 2000, the well was deepened to 1,000 feet for an exploration study for the City of Del Rio and Plateau Region. After deepening, the well had the full section of Edwards limestone open hole in the well.

Fourteen pounds of uranine (sodium fluorescein) (FDA name D&C Yellow No. 8) dye dissolved in about 5 gallons of water was injected starting at 11:30 am on December 11, 2008 into the "Y" Well through ½-inch diameter tubing installed in the well to below the water surface. Because no pump was installed in the well at time of dye injection, flush water was added at a faster rate than at the Agarita Well. The water was de-chlorinated and hauled to the site via city trucks and gravity fed from the surface. About

4,000 gallons were added the afternoon of December 11, 2008 and about 6,000 gallons were added the next day for a total of about 10,000 gallons.

4.3.3 Monitoring Locations

Four automated samplers were installed in San Felipe Springs. Gunnar Brune's *Springs of Texas* (1981) indicates 10 spring orifices that compose San Felipe Springs. One sampler was installed at the upstream location of San Felipe Creek on the municipal golf course, which retrieves samples that are a composite of the flow from head springs (Springs 5 – 10, Brune, 1981). The water supply for the City of Del Rio issues from two springs referred to as East and West Spring (3 and 2, respectively in Brune, 1981). An automated sampler was installed in each of those springs near the pump intakes for the water supply. A fourth auto-sampler was installed in an additional spring found in the golf course, which is farthest southwest also previously referred to as Spring 1 (Brune, 1981).

Charcoal receptors were installed near all four locations. Charcoal was also placed in San Felipe Creek downstream near the intersection with Highway 277. Charcoal receptor and grab samples were also taken at Cantu Springs at Cantu Springs Road. Some samples were taken from a water-well located at a convenience store near the intersection of Highway 90 and Highway 377 near the "Y" Well injection.

4.3.4 Sample Detection Summary

Sample collection for the Val Verde County dye trace began prior to dye injection to confirm no pre-existing fluorescent substances were present at the monitoring sites. These samples, referred to as background samples, were all clear of fluorescent signatures in the wavelengths of the applied tracer dyes. A total of 943 samples were analyzed as part of the Val Verde dye trace study that spanned from early December 2008 through February 2009. A summary of samples is given in Table 4.1. All blanks were clear of detectible dye, and all instrument standard runs confirmed accuracy of the fluorometer.

Table 4.1. Summary of Dye Trace Samples from Val Verde County

SAMPLE TYPE	NUMBER OF SAMPLES
Environmental-Water	704
Environmental -Charcoal	64
Replicates	56
Field Blanks	29
Instrument Blanks	12
Instrument Standards	78
TOTAL	**943**

Dye was not detected in any water samples collected by auto samplers nor by hand except for one sample. This sample was the first bottle in the ISCO sampler deployed at San Felipe West Spring, collected on December 11, 2008 at 8:42 am, prior to either injection. The fluorescent wavelength measured was 492 nm, indicating uranine. Accidental cross-contamination likely occurred during sample handling for this particular sample, which resulted in the erroneous detection.

The charcoal receptors (bugs) analyzed for Val Verde County show clear communication from the "Y" Well to both San Felipe Springs and Cantu Springs (Figure 4.3). This indicates that the dye was in very low concentrations in the water, which resulted in non-detects in the raw water samples. Seventeen detections of uranine were identified at springs or streams from samples eluted from the charcoal; however, eosine, which was injected at the Agarita Well, was not observed in any of the samples retrieved between December 11, 2008 and February 27, 2009. Several possible issues could have contributed to not detecting the eosine dye from this trace, which include but are not limited to the following: 1) difficulties with adding flush water at the well; 2) mass of dye injected; 3) well being partially penetrating at a total depth of 445 feet; and 4) possible lack of direct flowpath connection leading to the springs.

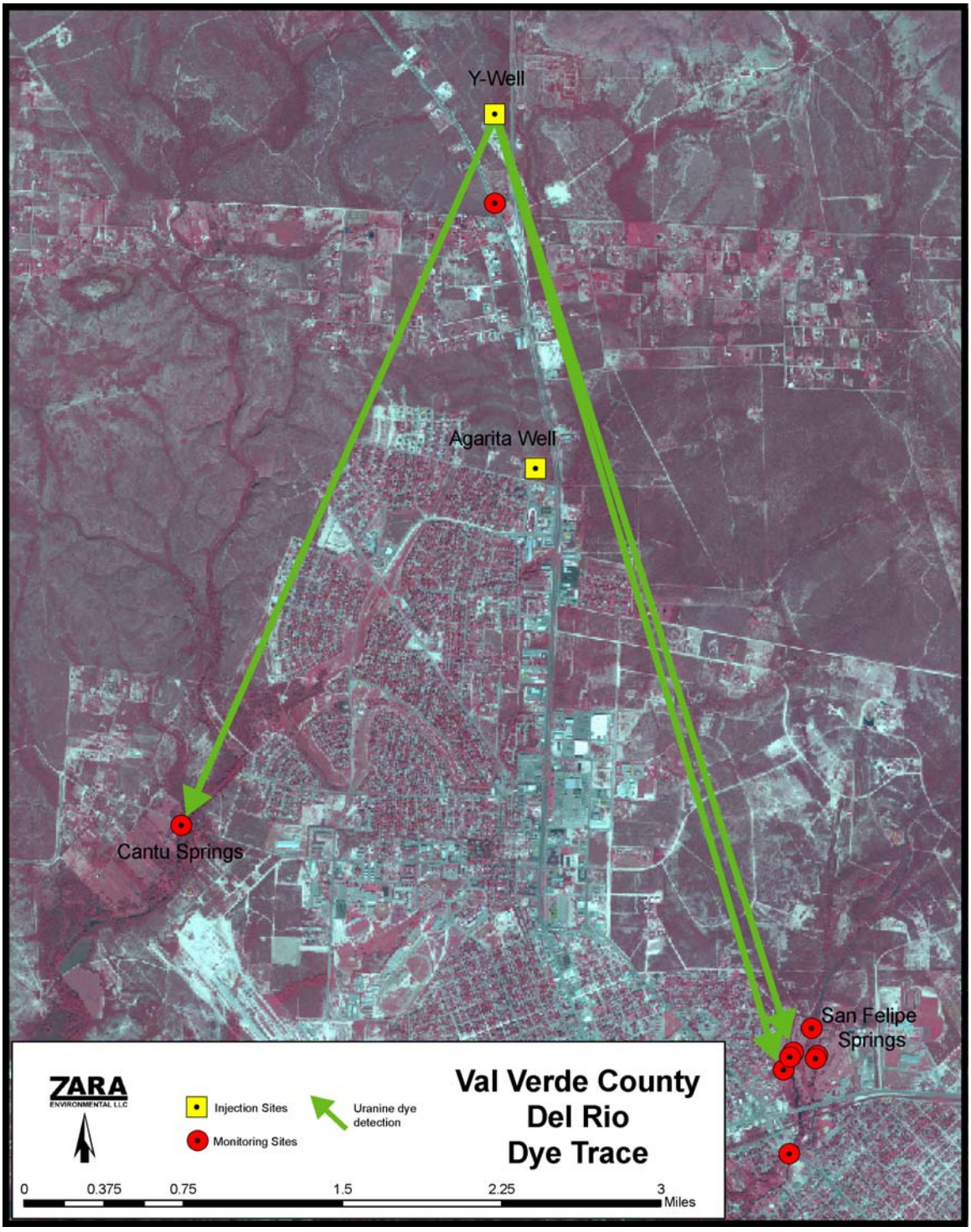


Figure 4.3. Satellite Imagery Map of the City of Del Rio showing injection sites and monitoring sites for dye tracing experiments in Val Verde County

The green arrows indicate generalized flowpaths of groundwater from the "Y" Well to Cantu Springs and two springs in the San Felipe Springs system.

Dye was detected at five sites in charcoal receptors. Figure 4.4 shows a graphical representation of the detection for Val Verde County. Charcoal receptors deployed on December 18 and recovered on December 23 show positive detections of the dye uranine at four monitoring locations: Cantu Springs, San Felipe Golf Course Spring (Spring 1, Brune, 1981), San Felipe West Spring (Spring 2, Brune, 1981), and the spring run below San Felipe West Spring. The charcoal receptor for the West Spring was placed in a bucket that was receiving pumped water from a monitoring system operated by the City of Del Rio. The flow was occasionally turned off to the bucket throughout the monitoring. An additional receptor in the spring run below the spring basin was in contact with similar water, and regularly adsorbed more dye than the one placed in the bucket in each of the periods represented in the bar graph in Figure 4.4. The site below Highway 90 catches flow from all San Felipe Springs discharge points and is not shown in the graphical representation on Figure 4.4. The sample site below San Felipe West Spring is indicative of dye emanating from that Spring.

Although specific breakthrough times are not apparent for this tracer test, minimum and maximum travel times can be observed from the "Y" Well to three discrete spring discharge points. Dye traveled 3.65 miles to Cantu Springs, arriving between 7 and 12 days, indicating minimum groundwater velocity of 0.30 miles/day and maximum groundwater velocity of 0.52 miles/day. Dye traveled 4.78 miles to San Felipe Springs, as detected at both the West Spring and the Golf Course Spring, in 7 to 12 days. This indicates minimum groundwater velocity of 0.40 miles/day and maximum groundwater velocity of 0.68 miles/day. Dye was persistent at all three springs (4 sites) for a period of approximately 2 months. No detections of dye occurred after February 12, 2009.

SiteID	DateSet	DateCollected	total # days	Analysis Wavelength	Analysis Amplitude	Amplitude / days
San Felipe West Spring (Brune #2)	18-Dec-08	23-Dec-08	5	499	42	8.4
San Felipe West Spring (Brune #2)	23-Dec-08	06-Jan-09	14	499	50	3.6
San Felipe West Spring (Brune #2)	06-Jan-09	14-Jan-09	8	500	11	1.4
San Felipe Golf Course Spring (Brune #1)	18-Dec-08	23-Dec-08	5	499	16	3.2
San Felipe Golf Course Spring (Brune #1)	23-Dec-08	06-Jan-09	14	499	21	1.5
San Felipe Golf Course Spring (Brune #1)	06-Jan-09	14-Jan-09	8	500	132	16.5
San Felipe Golf Course Spring (Brune #1)	14-Jan-09	12-Feb-09	29	500	13	0.4
Stream below S.F. West Spring	18-Dec-08	23-Dec-08	5	499	47	9.4
Stream below S.F. West Spring	23-Dec-08	06-Jan-09	14	499	80	5.7
Stream below S.F. West Spring	06-Jan-09	14-Jan-09	8	500	66	8.3
Stream below S.F. West Spring	14-Jan-09	12-Feb-09	29	500	11	0.4
Cantu Springs	18-Dec-08	23-Dec-08	5	499	26	5.2
Cantu Springs	23-Dec-08	31-Dec-08	8	499	40	5.0
Cantu Springs	31-Dec-08	06-Jan-09	6	499	15	2.5
Cantu Springs	06-Jan-09	14-Jan-09	8	500	51	6.4
Cantu Springs	14-Jan-09	12-Feb-09	29	500	16	0.6
San Felipe Creek below Hwy 90	23-Dec-08	06-Jan-09	14	499	11	0.8

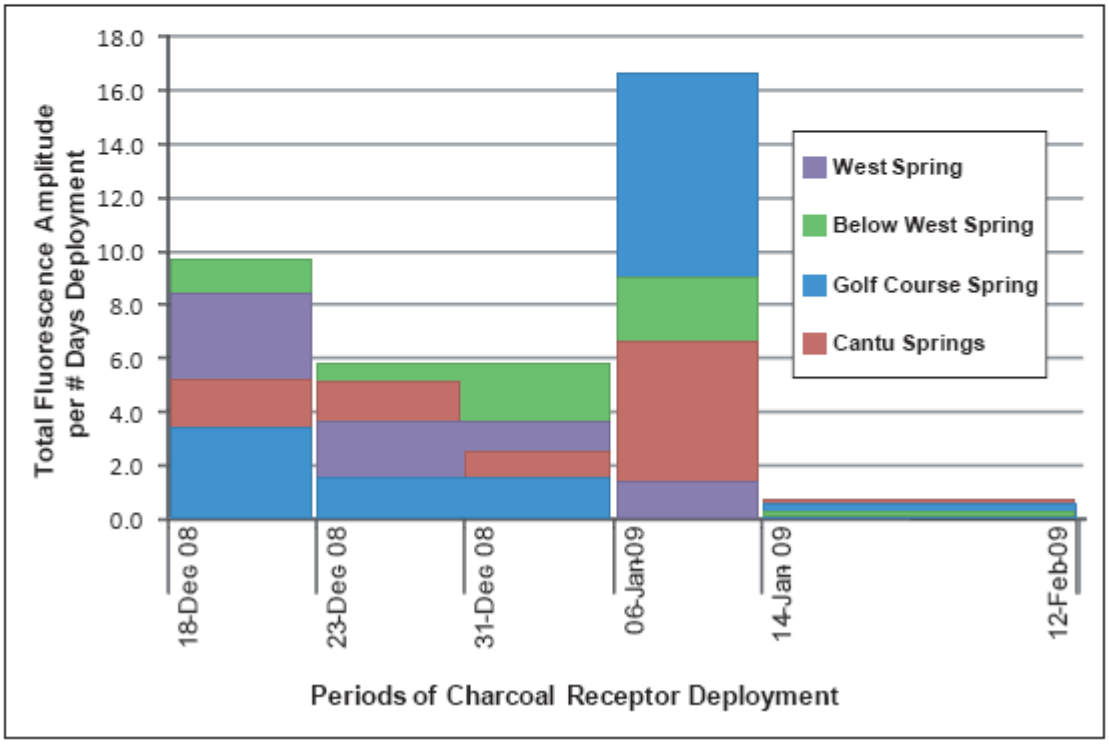


Figure 4.4. Summary Table and Graphical Representation of Fluorescent Dye Detections in Val Verde County near Del Rio and San Felipe Springs

The bottom graph shows time integrated intensity values at four sites. Intensity is directly relational to dye concentration of uranine, which has a fluorescent wavelength of 499-500 nm following extraction from charcoal.

4.3.5 Recommendations

These dye traces represent the first ever conducted in Val Verde County. With the number of large springs, caves, and heavily karstified limestone in the County, this investigative method has significant potential to expand the understanding of the groundwater system. Future dye tracing with higher masses of injected dye in the same two injection points could provide higher resolution data and precise break-through times if concentrations are detectible in water samples. Additionally, if the Agarita Well is utilized as an injection location again, issues with accessibility to the well head for flush water need to be resolved. Caves or other large karst features might be utilized in order to tap into existing karst flow pathways. Extending tracing experiments up-gradient in the groundwater system could identify additional direct flowpaths to springs and determine aquifer recharge characteristics north of Del Rio.

4.4 Kinney County Dye Trace

The Plateau Region projects were created to ascertain more information about the aquifer with emphasis on modeling. As a result, our interest was to learn more about the aquifer in the vicinity of the groundwater divide in Kinney County that separates the water in the aquifer that moves to the east toward San Antonio from the water that moves west toward Del Rio. Pinto Valley was selected because very little is known about flow directions in this segment of the Edwards aquifer. At LBG-Guyton Associates' suggestion, the dye test in Pinto Valley was performed in cooperation with the EAA and subcontracted with Zara Environmental.

Previous dye trace studies performed in the east and central part of Kinney County were conducted by the EAA in 2007 in cooperation with the Kinney County GCD. Traces were performed at two caves, HFF and Alamo Village, and an irrigation well on the Boerschig property. These tests are summarized in an EAA status report dated February 15, 2008 (Schindel, 2008).

A repeat dye trace was conducted by the EAA in the Boerschig Well contemporaneously with this Pinto Valley trace to utilize many of the same sample points for the two performed traces. The Boerschig injection was conducted on December 16, 2008, the day before the Pinto Valley injection.

4.4.1 Injection Site

The injection site for the dye trace in Kinney County was in a well located in Pinto Valley known as the Dooley Well (TWDB No. 70-37-808). This well is completed open hole from 375 to 1,010 feet through the entire section of Edwards limestone. Logging and spinner testing previously performed under the direction of URS, Inc. (Snyder, 2008) indicated porosity and velocity changes within the well at depths from about 510 to 760 feet below land surface. As a result, an injection tubing of ½-inch diameter was installed to a depth of about 700 feet in order to selectively inject the dye into the well at a porous, karstified interval.

Fourteen pounds of uranine (sodium fluorescein) (FDA name D&C Yellow No. 8) dye dissolved in about 5 gallons of water was injected starting at 9:45 am on December 17, 2008 into the Dooley Well through the ½-inch diameter tubing installed into the well (Figure 4.5). The tubing was then removed and placed in plastic garbage sacks and disposed offsite by personnel performing the injection. About 10,000 gallons of flush water was transported to the site via water trucks and quickly pumped into the well at the surface through 2-inch diameter piping.

Figure 4.5. Injection of Uranine Dye into Dooley Well on December 17, 2008

4.4.2 Monitoring Locations

Five automated samplers were installed for the dye trace in Kinney County to retrieve water samples on a pre-programmed interval. One auto-sampler was located on the bank of Las Moras Lake with a sampling tube installed to near the middle of the Lake where major spring discharge is observed through spring boils in the bottom of the Lake. The other four auto-samplers were installed at artesian flowing wells. One auto-sampler was installed utilizing hoses on the discharge of both Fort Clark MUD wells (TWDB Nos. 70-45-504 and 70-45-505) located about 0.1-mile to the northwest of Las Moras Springs. The three other auto-samplers are located in Pinto Valley on flowing wells known as the Davis Well (TWDB No. 70-45-105), the Jones Well (TWDB No. 70-45-107) and the Robinson Ag Well #2 (Figure 4.6). All are located to the southwest in Pinto Valley in a presumed down-gradient direction from the injection well. All the samplers

were initially programmed to retrieve samples on an 8-hour interval after the dye was injected.

Charcoal receptors were installed near all five automated sampler locations. Two additional sites were selected for sampling at the exit points of Las Moras Springs Lake, one location at the exit to the pool and one at the exit to Las Moras Creek. All sites that did not have auto-samplers were sampled with charcoal packets and grab samples. Another site was selected down stream on Las Moras Creek referred to as the Red Bridge.

Pinto Creek was sampled at four locations and 17 wells within Pinto Valley were sampled with charcoal receptors and grab samples (Figure 4.6). One City of Brackettville well (TWDB No. 70-45-601) and one School District well were monitored in Brackettville. Three additional extreme down-gradient wells (Jack Fields and Dorrell) south of Highway 90 were sampled. One Austin Chalk well (TWDB No. 70-45-405) down gradient and south of Highway 90 was monitored.

4.4.3 Sample Detection Summary

A summary of dye trace samples analyzed for Kinney County in 2008-2009 is given in Table 4.2. A total of 1,216 samples were analyzed, 919 of those were actual environmental samples and the remaining were quality control samples. Uranine dye injected into the Dooley Well was only detected in one water-well, the Robinson Ag Well #1, 3757 feet to the south, southwest of the injection well. Fluorescent dye at a wavelength of 500 nm was seen in a receptor set January 16, 2009 and collected February 27, 2009. Dye traveled the 0.7 miles in one to two months indicating relatively slow groundwater velocity in the aquifer for the winter of 2008-2009. Although dye was not detected in receptors placed in the vicinity of Las Moras Springs, this test using a relatively weak concentration of dye, does not preclude that such a path does not exist. A time-intensity graph similar to Figure 4.4 was not prepared for the Kinney County dye trace as only one detection at one site was recorded.

Table 4.2. Summary of Dye Trace Samples from Kinney County

SAMPLE TYPE	NUMBER OF SAMPLES
Environmental-Water	814
Environmental -Charcoal	105
Replicates	24
Field Blanks	25
Instrument Blanks	11
Instrument Standards	237
TOTAL	**1,216**

In April 2007, the EAA injected a series of dye injections northwest of Pinto Valley near Alamo Village (Schindel, 2008). Phloxine B injected into Alamo Village Cave was detected in wells directly southwest of the Cave in months immediately following the injection. Samples were not taken later in 2007 and for much of 2008. Monitoring in the fall of 2008 for the tracer work in Pinto Valley, detected significant peaks of Phloxine B in the charcoal receptors from two sites located much farther down gradient than previously sampled. Both detection sites were on the bank of Pinto Creek; one just downstream of Pinto Springs on the Ring Ranch (Mariposa Ranch), and the other from a small spring on the east bank further downstream on the Robinson Ranch. The spring is referred to as Robinson Spring in this report. Generalized groundwater flow routes are shown in Figure 4.6. As this work is considered preliminary, the EAA has not posted the raw data for this research. When dye trace analysis by EAA in Kinney County is finalized, the results will likely be posted on their website at www.edwardsaquifer.org/pages/reports.html.

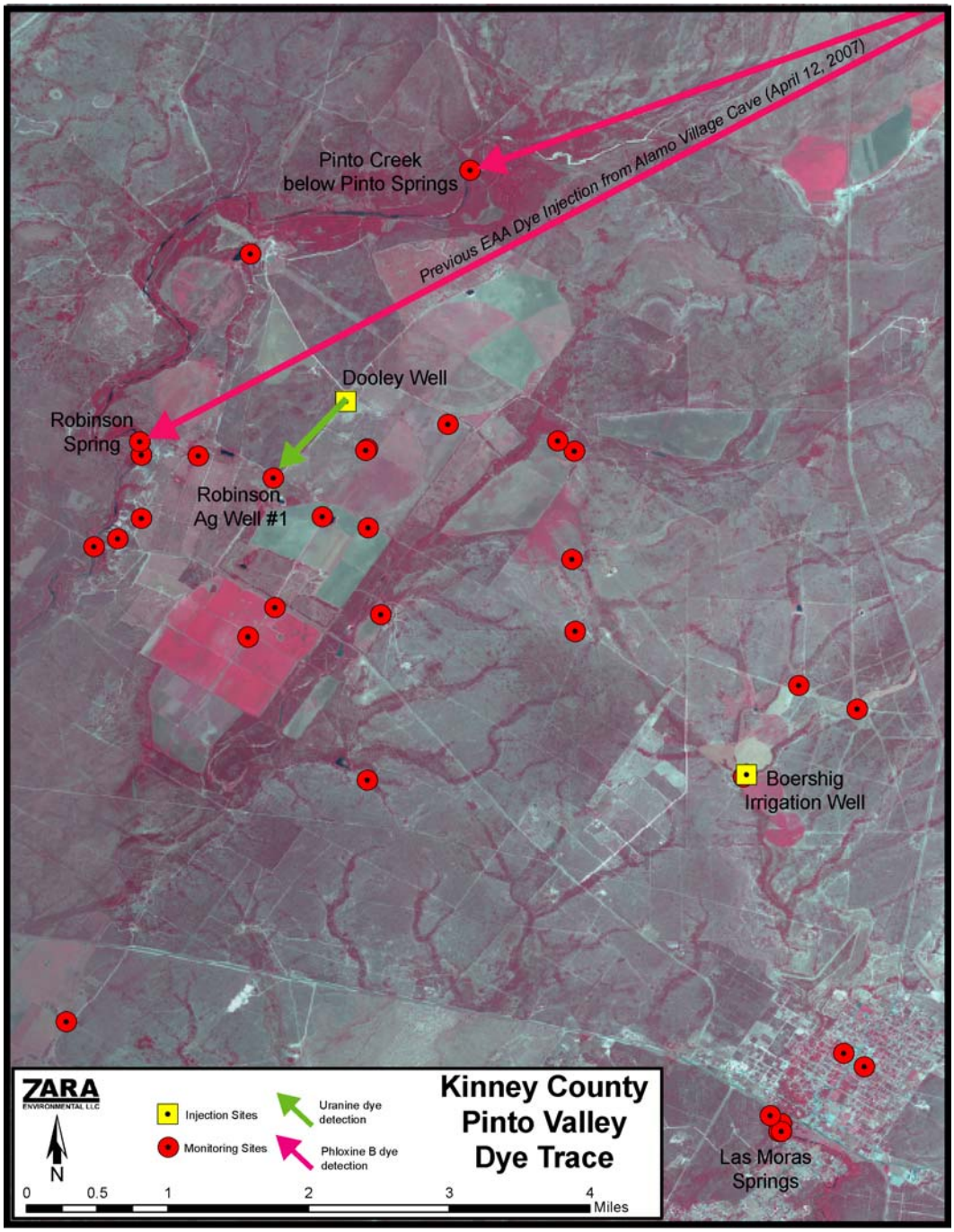


Figure 4.6. Map Showing Injection Sites and Most Monitoring Sites for Dye Tracer Tests in Pinto Valley, Kinney County

One detection of uranine injected on December 17, 2008 was found at the Robinson Ag Well #1 in a charcoal receptor recovered on February 27, 2009. Detections of Phloxine B dye injected by the EAA on April 12, 2007 were identified along Pinto Creek downstream of Pinto Springs and at Robinson Spring, a small tributary spring along the bank of Pinto Creek.

4.4.4 Recommendations

The dye trace studies conducted in Kinney County during the winter of 2008-2009 provide preliminary information on groundwater movement in the Pinto Valley area. As is common in performing these types of scientific investigations, replication of a trace is beneficial. Also in the case of the dye injection into the Dooley Well, a relatively low mass of dye was injected for this initial test to insure no public or private water supply wells were exposed to high concentrations of dye that would discolor the groundwater. It is common to "stage" dye injections in the same location with incrementally higher masses of dye. In the case of Pinto Valley, the Dooley Well is a logistically well-placed well for injection. Further fluorescent dye injections into this well with significantly higher masses is recommended to extend and expand the monitoring sites that potentially have direct hydrogeologic connection to the Dooley Well, thus identifying flow paths and travel times of groundwater. These higher mass injections also have much greater probability of emerging at Las Moras Springs if a direct flowpath exists from Pinto Valley to the Springs. Additional dye trace experiments are recommended in other areas of Kinney County to ascertain flow routes and travel times through the aquifer.

5.0 Water Level

Two synoptic water-level measurement events were conducted during this study in which depth to water was measured in selected wells. Synoptic water-level measurements are measurements in which water levels in wells are measured within a relatively short period and under specific hydrologic conditions, thus providing a "snapshot" of heads in an aquifer. The intent of this task was to observe the relative change in the aquifer water table elevation that occurs during an annual period. Wells selected for this project included wells that are annually measured by the TWDB and the Real-Edwards CRD. Additional wells were selected with the assistance of the Kinney County GCD and Real-Edwards CRD managers. TWDB staff also participated in the project by measuring water levels in wells on the Texas Nature Conservancy's Devils River Preserve and in other wells in Val Verde County.

The first coordinated measurement occurred in late February 2008 and was followed by the second measurement of the same wells in mid-September 2008. Figure 5.1 shows the measured well locations, and Figure 5.2 shows those wells in which both spring and fall measurements were made and the relative water level change in each well. Water-level contours based on the September measurements are illustrated in Figure 5.3. Table 5.1 provides the data for both measurement periods in tabular form. Following completion of fieldwork involved in the synoptic water-level measurements, a technical memorandum was prepared to describe the procedures and results. With minor editing, the technical memorandum was incorporated directly into this report as Section 5.0 and Figure 5.3, the required potentiometric map.

One continuous recording of water levels is available from an Edwards Aquifer Authority (EAA) monitoring well in eastern Kinney County (TWDB No. 70-38-902). Figure 5.4 displays a hydrograph of this well and contemporaneous flow measurements from Las Moras Springs. Green and others (2006) developed an Edwards aquifer water-level map based on January and February 2006 water-level measurements (Figure 5.5). For a wider perspective, Boghici (2004) provides a regional water-level map displaying the Edwards-Trinity (Plateau) aquifer potentiometric surface on both sides of the Rio Grande (Figure 5.6).

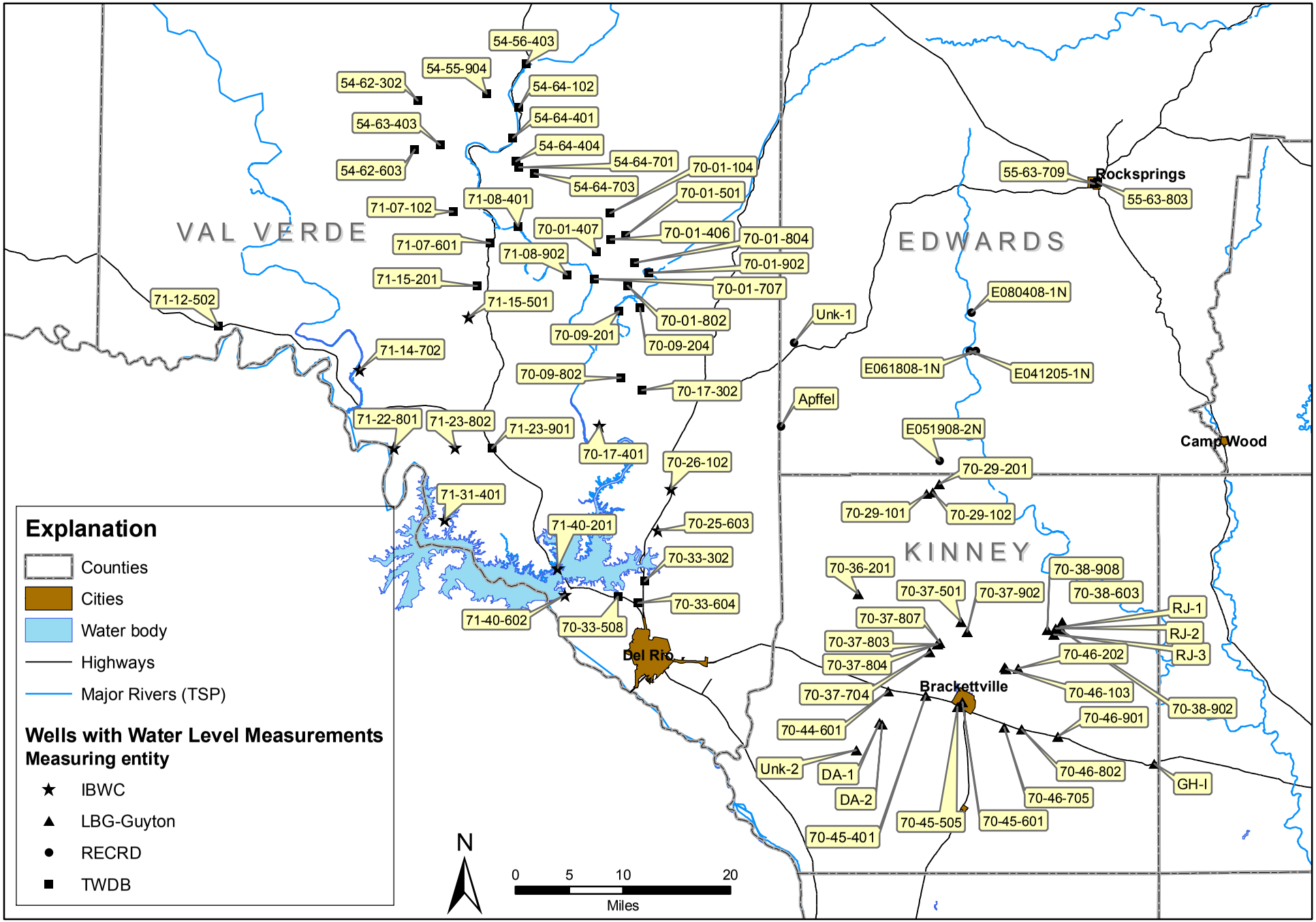
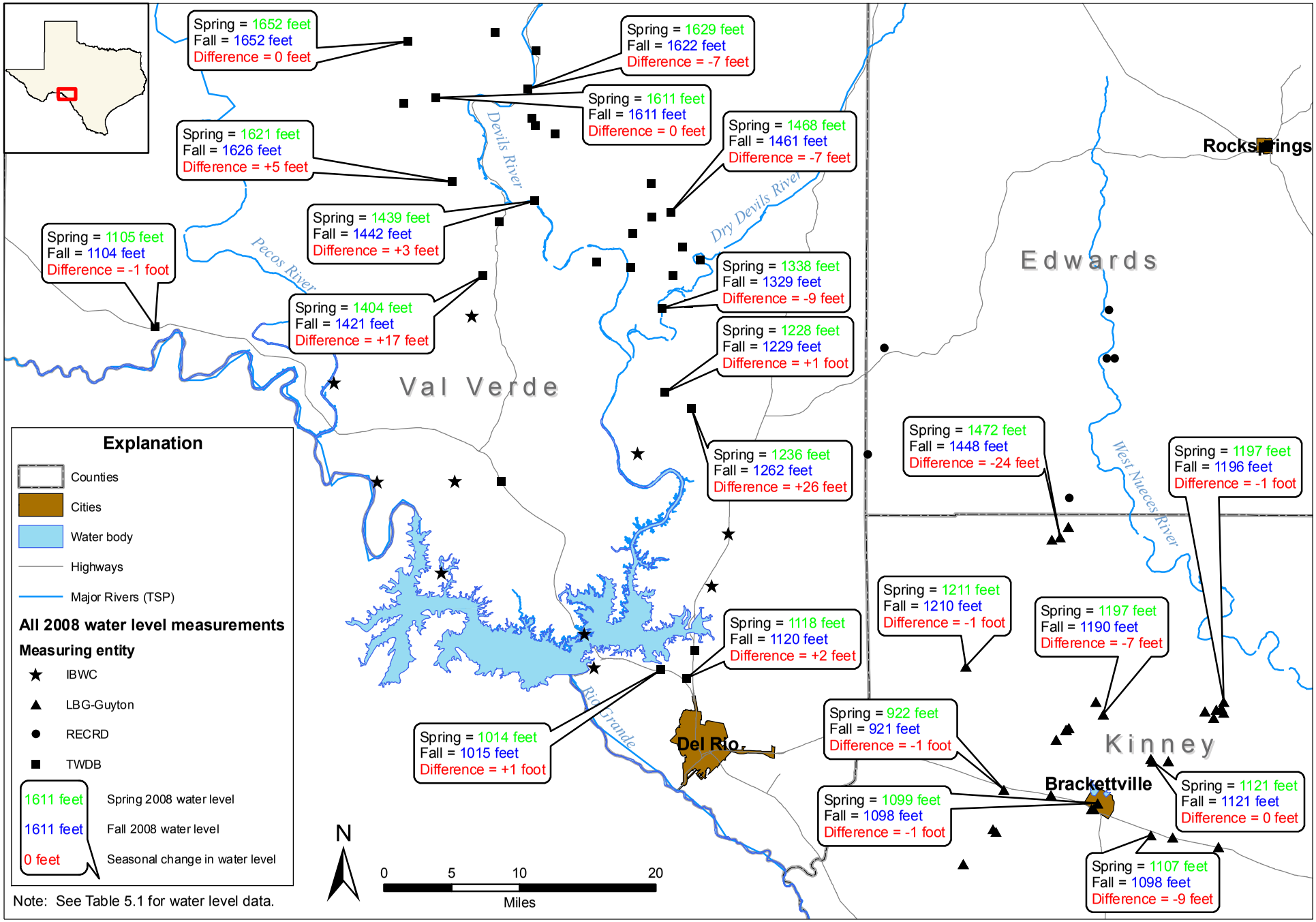


Figure 5.1 Location of Wells Used in 2008 Synoptic Water Level Measurements



Note: See Table 5.1 for water level data.

Figure 5.2 2008 Water Level Measurements in Val Verde, Edwards, and Kinney Counties

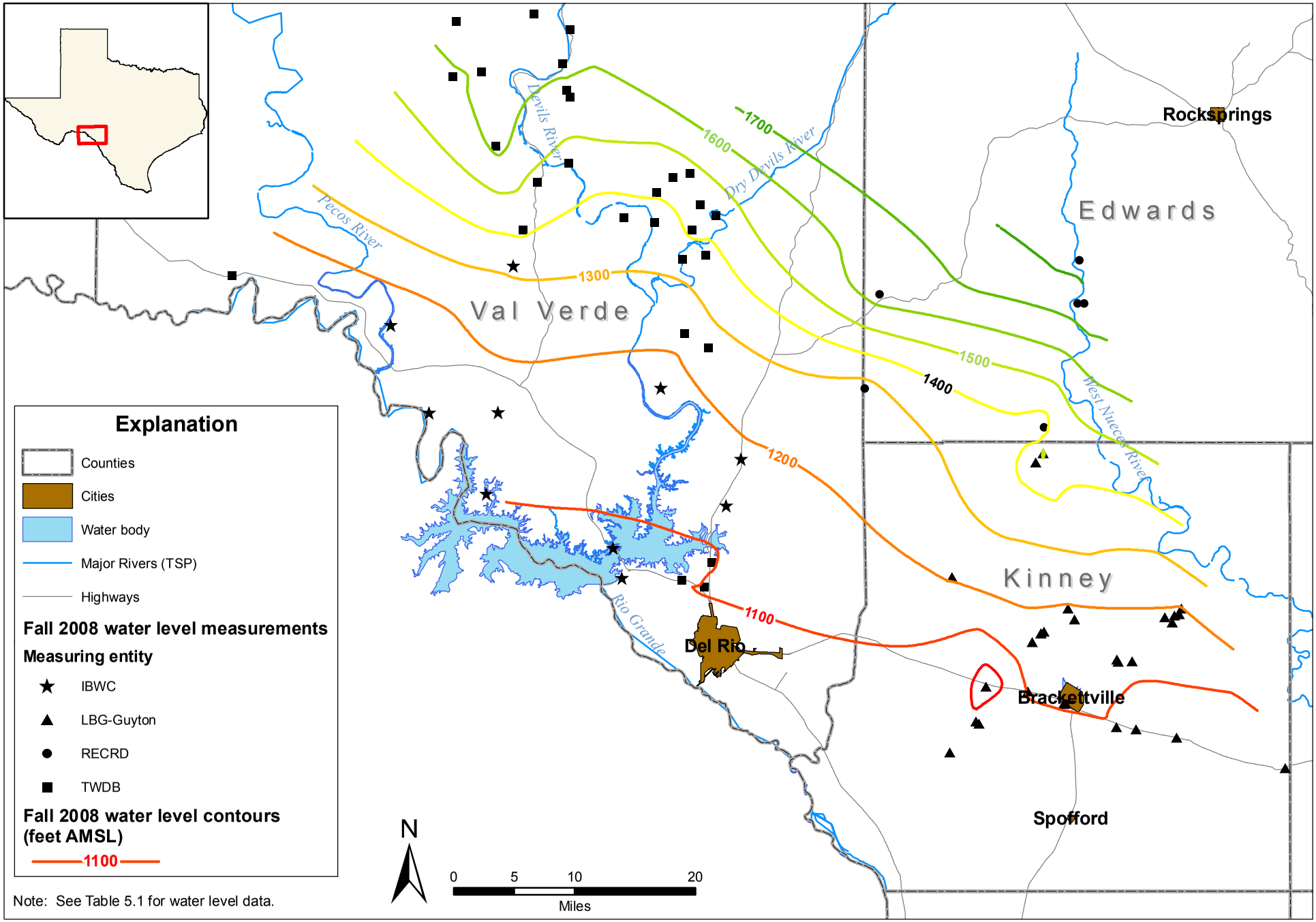


Figure 5.3 Fall 2008 Water Level Surface in Val Verde, Edwards, and Kinney Counties

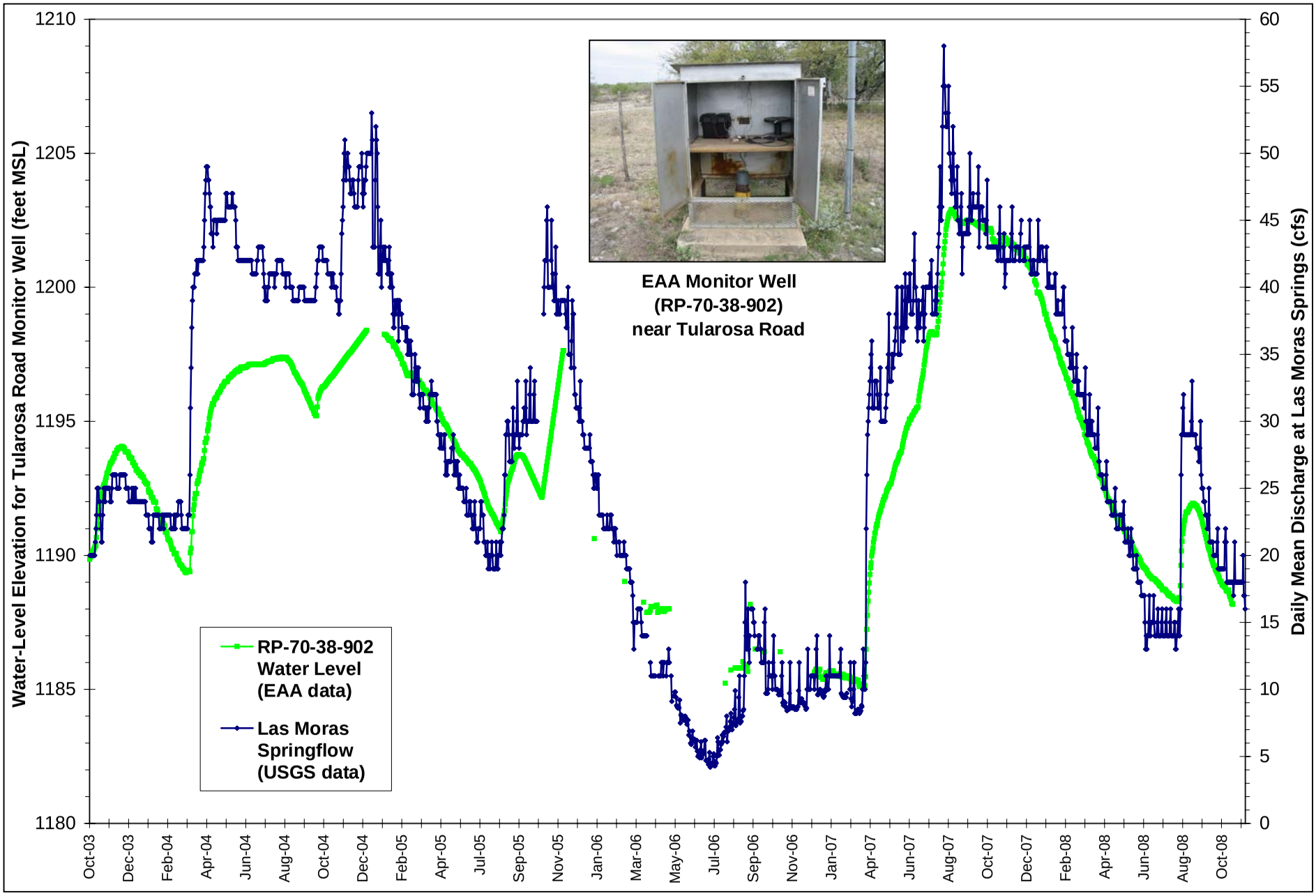


Figure 5.4 Discharge at Las Moras Springs Compared to Water Levels in Tularosa Road Monitor Well

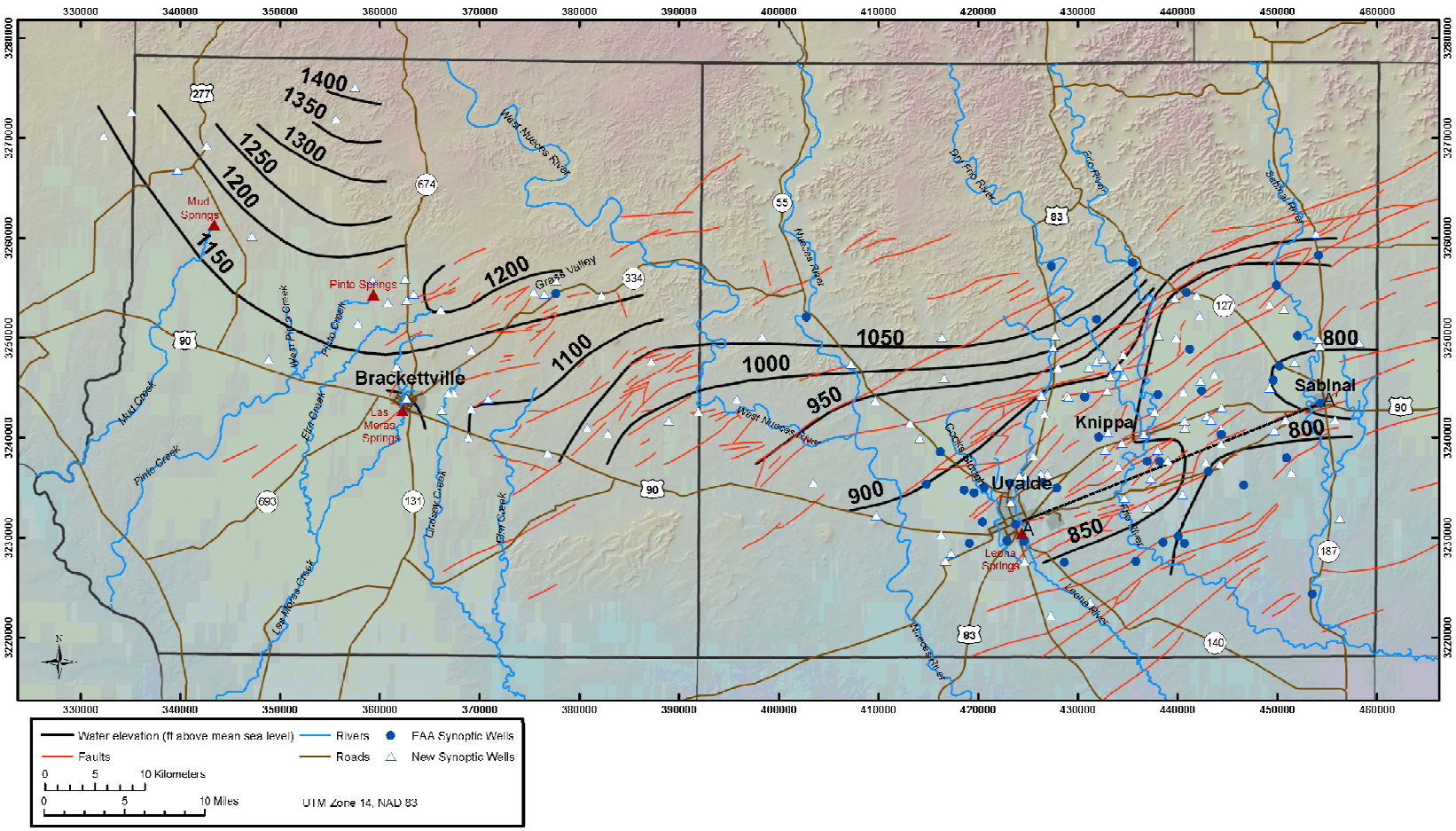


Figure 5.5 Groundwater Elevations of the Edwards Aquifer (January - February 2006)

Source: Green and others, 2006

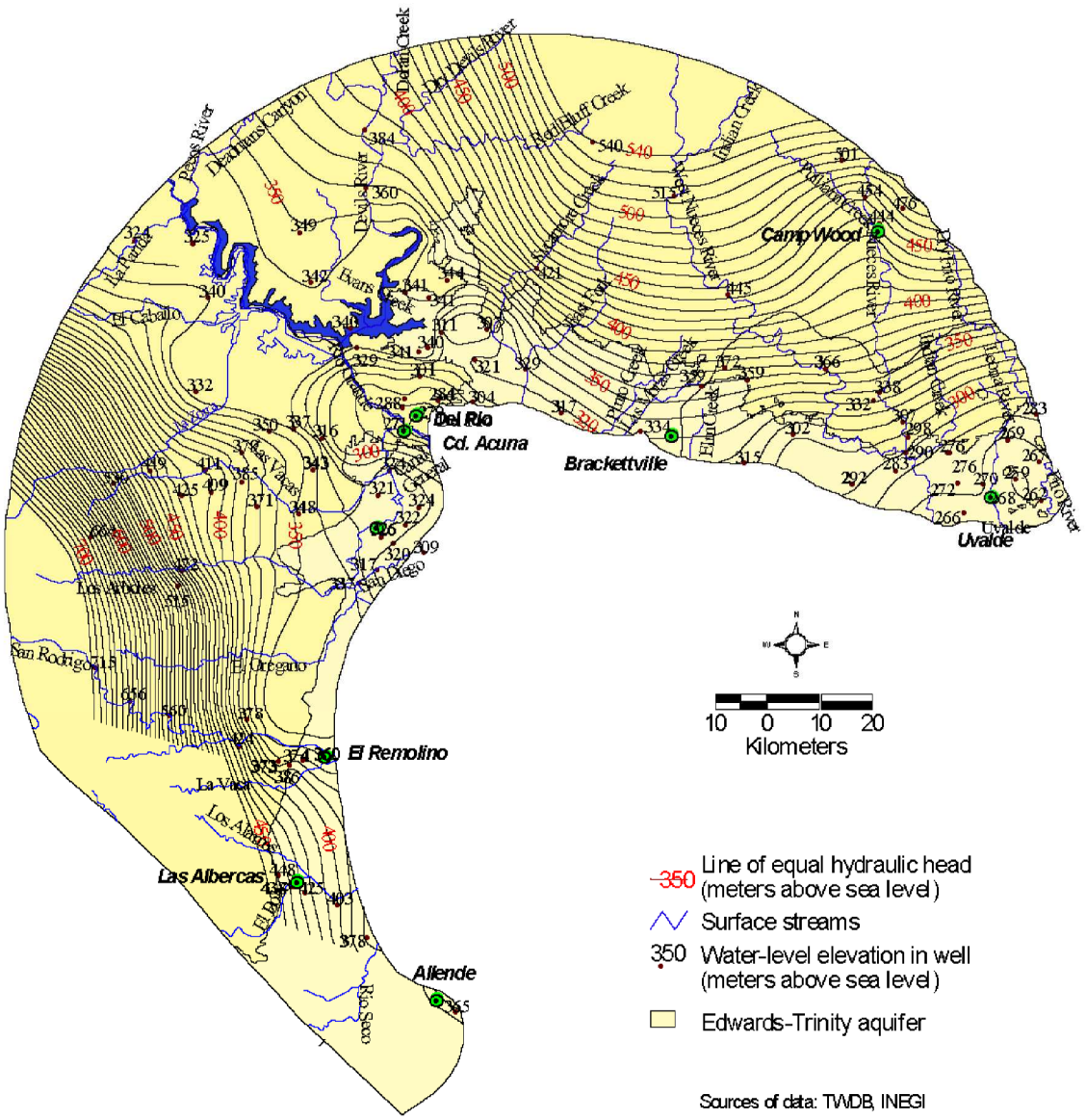


Figure 5.6 Regional Potentiometric Surface Map

Source: Boghici, 2004

6.0 Water Quality

The information discussed in this section consists of water quality data that was not available during the development of the Edwards-Trinity (Plateau) and Edwards BFZ GAM models. Both the Edwards-Trinity (Plateau) and the Edwards BFZ GAMs were published in 2004. Therefore, the general chemistry, trace metal and infrequent constituent data compiled by the TWDB is limited to water quality samples collected from January 2004 through August 2007.

General Chemistry, Trace Metals and Infrequent Constituents

Chemical analyses of water samples collected between January 2004 and August 2007 are available on the TWDB groundwater database. A map detailing well locations that were sampled within this timeframe and their corresponding total dissolved solids concentrations (TDS) are included as Figure 6.1.

Isotopes

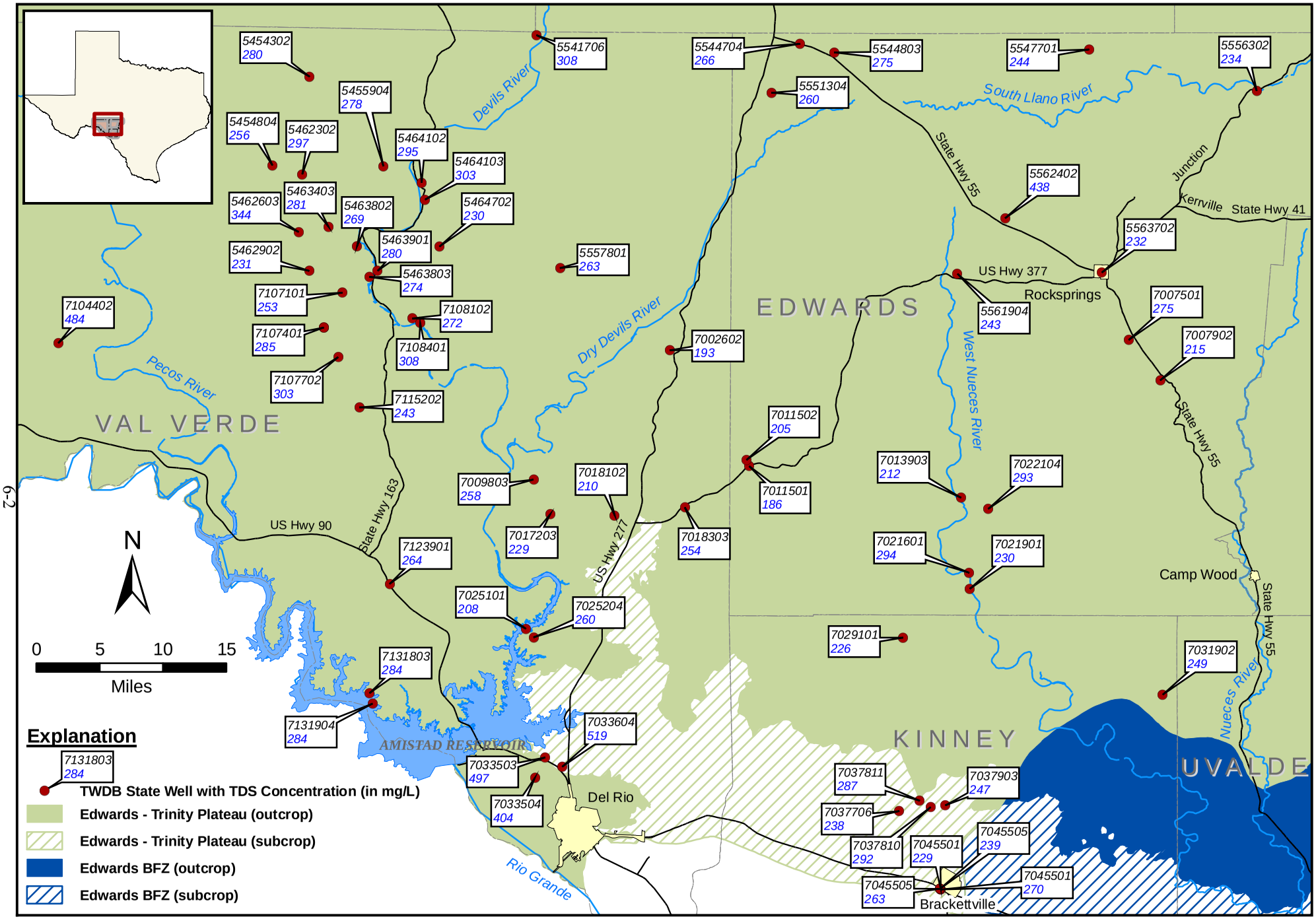
Isotope data, which is relatively scarce in the project area, incorporates samples collected since 1990. These data sources are as follows:

Boghici, R., 2004 - Six groundwater samples collected in 2002 from wells and springs in Edwards, Kinney and Val Verde Counties which were analyzed for stable and radiogenic isotopes. His data are as follows:

Table 6.1 Isotope components in Edwards-Trinity groundwater samples from Val Verde, Edwards, and Kinney Counties

State Well Number	δ^2H (‰) SMOW	$\delta^{18}O$ (‰) SMOW	Apparent ^{14}C Age[1]	pmC[2]	$\delta^{13}C$ (‰)	Tritium (TU)[3]
55-44-801	-33.5	-5.10	2870±40	0.6990	-10.6	1.14
70-41-301	-33.5	-5.30	2400±40	0.7410	-11.8	1.85
71-15-401	-37.5	-5.95	8130±40	0.3630	-9.6	0.79
70-45-505	-32.5	-4.90	4030±40	0.6050	-10.3	2.01
55-63-702	-36.0	-5.30	5960±40	0.4760	-8.4	0.98
70-29-101	-33.5	-5.10	2650±40	0.7190	-11.1	2.64

1) Reported as radiocarbon years before present ("present" = 1950 A.D.).
2) Percent modern carbon.
3) Tritium Units.



6-2

LBG-Guyton Associates

Figure 6.1 Total Dissolved Solids Concentrations in State Wells with Water Quality Sample Data Collected between 2004 and 2007 Edwards, Kinney and Val Verde Counties

Oetting, G.C., 1996 - A compilation of forty-seven water samples were collected from wells, springs and streams between 1990 and 1995 over the entire Edwards BFZ aquifer. Data were collected by Oetting (1995), Land and McPherson (1992), Senger (1990) and Groshen (1990). Samples were analyzed for major and trace element constituents as well as isotopes. The data were then categorized into six Edwards BFZ hydrochemical facies as previously defined by Maclay (1980) in an effort to determine regional controls on the evolution of saline waters in the Edwards aquifer. The area designated with Facies A groundwater is the segment of the Edwards aquifer located west of the Kinney-Uvalde County line. Facies A data are as follows:

Table 6.2 Geochemical and Isotopic Analyses of Edwards Aquifer

Sample ID	Na (mg/L)	K (mg/L)	Mg (mg/L)	Ca (mg/L)	Sr (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 (mg/L)	$^{87}Sr/^{86}Sr$[1]	$\delta^{18}O$ (‰)	δD (‰)
A-1	29	1.3	57	732	14.3	10	1566	225	0.707569±13	-5.2	-34
A-2	90.2	-	141	685	15.5	18.4	1878	355	0.707532±12		
A-2 Rep.	90.3	-	140	684	-	-	-	-	0.707572±12		
A-3	28.2	0.6	52	689	12.9	13.3	1560	212	0.707560±13		

1) Sr isotope data for filtered (less than 0.22 um) samples.
2) 'Rep', complete sample replicate.

Uliana, M.M., 2006 – Twenty-seven samples were collected from the upper reaches of Pinto Creek and nearby wells between May 2005 and January 2006. All of the samples were analyzed for field parameters as well as major anions and cations. Twenty-three of the samples were analyzed for isotopes (3 spring samples, 4 stream samples and 16 well samples). Inorganic and strontium data were presented at the National Ground Water Association 2006 Groundwater Summit; however, the stable isotope data has not yet been published. All Pinto Creek data presented in this report are provided in Tables 6.3 through 6.5 with permission of Dr. Uliana.

S. Nance also collected samples primarily north of the study area during the summer months of 2006 and 2007. Data include major ions, C^{14}, tritium, Sr-isotopes, O and D isotopes. Samples were collected from Crockett (15 locations), Sutton (6 locations) and northeastern-most Edwards (1 location) counties. This data is not included in this report.

Table 6.3
Pinto Creek Field Data
Kinney County, Texas

DATE	LOCATION	LONGITUDE	LATITUDE	pH (S.U.)	TEMP (^{o}C)	SPECIFIC CONDUCTANCE (mS/cm)	DISSOLVED OXYGEN (% SAT)	ESTIMATED DEPTH (FEET)	DESCRIPTION
WELLS									
8/10/2005	FLOW WELL	-100.48	29.41	6.48	25.6			300	artesian well; depth unknown; taken directly from stream pouring out of stand pipe
1/21/2006	ALAMO VILLIAGE	-100.41	29.41	6.87	23.5	473		690	about 690 ft deep with 200 ft casing; TWDB well 70-37-902
1/21/2006	ALAMO HQ	-100.40	29.42	6.84	22.6	503		160	160 ft deep with 80 ft casing
1/21/2006	SOUTH PINTO WELL	-100.42	29.41					680	about 680 ft deep with 200 ft casing
1/21/2006	SOUTH PINTO WINDMILL	-100.43	29.40	6.83	23.0	580		200	probably about 200 ft deep
1/21/2006	SHAHAN HOUSE WELL	-100.42	29.42	6.99	23.6	405		200	windmill well; depth unknown
1/21/2006	NELSON CABIN WELL	-100.51	29.36	6.86	21.6	536		28	28 feet deep
1/21/2006	NELSON TAP	-100.42	29.31	7.17	19.6	428		1000	from municiple water supply; sourced from artesian Edwards wells; TWDB well 70-45-503
1/21/2006	ROB HOUSE WELL 2	-100.49	29.37	7.96	17.2	368		200	about 200 ft deep; sulfur smell
5/27/2005	R HSEWELL	-100.49	29.37	6.71	26.4	790	29.3	300	shallow (~300-350 ft deep) well behind house on Robinson property (also called ROB HOUSE WELL 1)
9/27/2005	ROB HOUSE WELL 1			6.69	23.6	796		300	shallow (~300-350 ft deep) well behind house on Robinson property (also called R HSEWELL)
1/21/2006	ROB HOUSE WELL 1	-100.49	29.37	7.06	22.7	601		300	shallow (~300-350 ft deep) well behind house on Robinson property (also called R HSEWELL)
8/10/2005	R DEEP WELL	-100.47	29.38	6.73	26.1			800	taken from water discharging from beneath cap (also called RobArtWel1)
1/21/2006	ROB ARTESIAN WELL 2	-100.48	29.38	7.12	26.5	500		800	deep artesian well; depth unknown
1/21/2006	MARCOURT HOUSE WELL	-100.49	29.37	7.13	26.1	463		500	~500 ft deep
1/21/2006	MARCOURT IRRIGATION WELL	-100.48	29.37	7.24	18.3	443		800	~800 ft deep
1/22/2006	RING ARTESIAN WELL	-100.48	29.40	7.08	27.5	423		1000	warm artesian water; depth unknown; TWDB well 70-37-706
SPRINGS									
5/26/2005	LAS MORAS	-100.42	29.31	6.87	21.8	509	71.1	0	at outfall from main pool (not swimming pool) of Las Moras; just up from USGS gage station
8/10/2005	LAS MORAS	-100.42	29.31	6.63	22.8			0	at outfall from main pool (not swimming pool) of Las Moras; just up from USGS gage station
5/26/2005	PINTO MAIN	-100.45	29.41	6.66	23.0	575	48.0	0	at confluence of main spring tributary and main stem of creek
8/10/2005	PINTO MAIN	-100.45	29.41	6.40	23.3			0	in side tributary about 1.5 m downstream of orifice
5/27/2005	SPRING ROB	-100.49	29.38	6.65	22.1	668	64.2	0	discrete spring on left bank of creek on Robinson property
8/10/2005	SPRING ROB	-100.49	29.38	6.40	21.9			0	discrete spring on left bank of creek on Robinson property
PINTO CREEK									
1/21/2006	PINTO RAILROAD CROSSING	-100.60	29.30	7.71	15.3	491		0	Pinto Creek at RR crossing downstream of Rt 90
1/22/2006	PINTO AT RT 90	-100.53	29.34	7.64	15.3	490		0	Pinto Creek at Rt 90
1/22/2006	PINTO AT 2804	-100.49	29.37	7.68	16.5	429		0	Pinto Creek at 2804
1/22/2006	PINTO AT G-04A	-100.49	29.39	7.70	17.6	456		0	Pinto Creek just upstream of gage 04A; at ranch property boundary fence

NOTES:

1) All samples collected by M. Uliana; field parameters measured by M. Uliana.

2) Sampling and analysis were funded by the Coypu Foundation throught Texas State University-San Marcos.

Table 6.4
Pinto Creek Ion Chemistry Data
Kinney County, Texas

DATE	LOCATION	ESTIMATED DEPTH (FEET)	ALKALINITY				ION CHEMISTRY															
			meq/L	mg/L HCO_3	mg/L $CaCO_3$		TDS (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	Sr (mg/L)	Cl (mg/L)	SO4 (mg/L)	F (mg/L)	Br (mg/L)	Si (mg/L)	Fe (mg/L)	Al (mg/L)	NO3 (mg/L)	P (mg/L)	ANION/CATION BALANCE (%)
						MDL-->	*<10*	*<0.5*	*<0.5*	*<0.5*	*<0.5*	*<0.007*	*<1*	*<1*	*<0.1*	*<0.05*	*<0.5*	-	-	*<0.1*	*<0.05*	
WELLS																						
8/10/2005	FLOW WELL	300	3.84	234.3	192.2		221	63.5	4.2	0.5	4	0.98	12	10	0.4	0.06	9.8			1.7	<0.05	-8.2%
1/21/2006	ALAMO VILLIAGE	690	4.45	271.5	222.7		284	98.5	4.5	7	10	0.519	11	7	0.2	0.06	11.2	0.3	0.053			9.3%
1/21/2006	ALAMO HQ	160	4.63	282.7	231.8		284	103.5	5	17	11	0.215	11	7	0.1	0.06	12.2	0.3	0.058			12.1%
1/21/2006	SOUTH PINTO WELL	680	4.24	259.0	212.4		242	93.5	5	9	10.5	0.51	11	6	0.2	0.059	11.6	0.2	<0.051			10.5%
1/21/2006	SOUTH PINTO WINDMILL	200	4.64	283.3	232.3		365	106	6.5	16.5	19.5	0.687	28	20	0.3	0.1	15.5	0.3	<0.051			9.7%
1/21/2006	SHAHAN HOUSE WELL	200	4.02	245.6	201.4		280	91	3.6	7	10	0.307	11	6	0.2	0.06	12.3	0.3	<0.051			10.1%
1/21/2006	NELSON CABIN WELL	28	4.93	300.8	246.7		311	99	5	7.5	28	0.484	17	8	0.3	0.08	19.1	3.1	0.092			9.7%
1/21/2006	NELSON TAP	1000	4.00	244.0	200.1		278	84	5	6.5	10	2.13	13	14	0.3	<0.05	9.9	0.2	<0.051			6.0%
1/21/2006	ROB HOUSE WELL 2	200	3.28	200.3	164.3		203	42	13.5	9.2	21.5	3.51	15	1	2.1	0.09	6.5	1.7	<0.051			8.9%
5/27/2005	R HSEWELL	300	5.34	326.1	267.4		*SAMPLE BOTTLE BROKE; WILL RESAMPLE IN FUTURE*															
9/27/2005	ROB HOUSE WELL 1	300	5.47	333.5	273.6																	
1/21/2006	ROB HOUSE WELL 1	300	5.17	315.2	258.5		353	77	6	7.6	55.5	0.452	28	29	0.7	0.13	24.2	0.3	<0.051			2.9%
8/10/2005	R DEEP WELL	800	4.40	268.3	220.1		261	79.5	3	0.6	4.6	0.37	10	10	0.1	0.06	11.7			2.2	<0.05	-4.8%
1/21/2006	ROB ARTESIAN WELL 2	800	4.45	271.2	222.5		275	97.5	5.5	8.4	10	0.569	11	7	0.3	0.06	12.2	0.2	<0.051			9.9%
1/21/2006	MARCOURT HOUSE WELL	500	4.09	249.9	204.9		243	69.5	10.5	9.3	11	1.5	11	17	0.9	0.05	13	0.3	<0.051			3.3%
1/21/2006	MARCOURT IRRIGATION WELL	800	3.97	242.0	198.5		254	77.5	6	16.5	10	0.461	11	9	0.3	0.04	13.6	2.2	<0.051			7.9%
1/22/2006	RING ARTESIAN WELL	900	3.67	224.1	183.8		229	71.2	7.1	6.2	9	2.93	11	13	0.7	0.05	10.9	0.3	<0.051			5.6%
SPRINGS																						
5/26/2005	LAS MORAS	0	3.94	240.4	197.2		260	53	5.6	0.6	11.2	**	<10	<10	0.1	0.06	10.9			2.2	<0.05	-4.4%
8/10/2005	LAS MORAS	0	4.05	247.2	202.7		200	60.5	5.6	0.5	4.1	0.16	11	18	<0.1	0.07	12.3			1.3	<0.05	-12.6%
5/26/2005	PINTO MAIN	0	4.44	270.7	222.0		267	66.4	3.1	0.8	13.8	**	<10	<10	0.1	0.06	15.1			2	<0.05	-2.9%
8/10/2005	PINTO MAIN	0	4.48	273.2	224.0		264	80	2.3	0.6	5.1	0.26	10	6.7	0.1	0.06	13.8			2.1	<0.05	-5.1%
5/27/2005	SPRING ROB	0	4.91	299.9	245.9		289	59.6	2.9	0.8	31.8	**	<10	15.0	0.3	0.08	19.3			2.1	<0.05	-6.2%
8/10/2005	SPRING ROB	0	4.99	304.7	249.9		303	76	5.1	0.6	4.8	0.38	12	16	0.3	0.08	19.2			2.4	<0.05	-12.1%
PINTO CREEK																						
1/21/2006	PINTO RAILROAD CROSSING	0	4.02	245.0	200.9		274	80.5	5	6.8	20	0.412	20	14	0.2	0.08	13	0.3	<0.051			5.9%
1/22/2006	PINTO AT RT 90	0	4.18	255.0	209.1		257	83	4.5	7.7	16	0.394	17	10	0.2	0.06	13.9	0.3	<0.051			5.3%
1/22/2006	PINTO AT 2804	0	3.96	241.8	198.3		243	66	4.5	6.6	13.5	0.391	13	8	0.2	0.06	13.3	0.3	<0.051			-0.7%
1/22/2006	PINTO AT G-04A	0	3.95	240.7	197.5		256	90.5	4	7.3	11.5	0.391	12	7	0.2	0.06	12.9	0.3	<0.051			11.1%

NOTES:

1) All samples collected by M. Uliana; field parameters measured by M. Uliana.
2) Ion concentrations analyzed at the Edwards Aquifer Research and Data Center in San Marcos, TX.
3) MDL: Minimum Detection Limit.
4) **Inadvertently not analyzed by lab.

Table 6.5
Pinto Creek Isotope Data
Kinney County, Texas

DATE	LOCATION	ESTIMATED DEPTH (FEET)	ISOTOPES								
			$^{87}Sr/^{86}Sr$	[1]Internal precision (2 x Std. Err. of mean)	$^{88}Sr/^{84}Sr$	$\delta^{18}O$			δD		
						MIN	MAX	AVG	MIN	MAX	AVG
WELLS											
8/10/2005	FLOW WELL	300	0.707861	8	148.27	-5.2	-5.5	-5.4	-36	-34	-35
1/21/2006	ALAMO VILLIAGE	690	0.707990	8	148.21	-5.2	-5.2	-5.2	-36	-35	-36
1/21/2006	ALAMO HQ	160	0.708180	7	148.25	-5.2		-5.2	-35		-35
1/21/2006	SOUTH PINTO WELL	680	0.707946	7	148.26	-5.3	-5.4	-5.4	-36	-36	-36
1/21/2006	SOUTH PINTO WINDMILL	200	0.707957	7	148.25	-5.2		-5.2	-33	-34	-34
1/21/2006	SHAHAN HOUSE WELL	200	0.708086	6	148.24	-5.3		-5.3	-34		-34
1/21/2006	NELSON CABIN WELL	28	0.708029	7	148.26	-5.2		-5.2	-34	-34	-34
1/21/2006	NELSON TAP	1000	0.707716	7	148.26	-5	-4.9	-5.0	-31	-32	-32
1/21/2006	ROB HOUSE WELL 2	200	0.707709*	9	148.25	-5.4		-5.4	-37	-37	-37
5/27/2005	R HSEWELL	300									
9/27/2005	ROB HOUSE WELL 1	300	0.708084	8	148.24	-5.0	-5.1		-34	-33	
1/21/2006	ROB HOUSE WELL 1	300	0.708035	7	148.24	-5.2	-5.2	-5.2	-34	-35	-35
8/10/2005	R DEEP WELL	800	0.708021	9	148.26	-5.4		-5.4	-34	-33	-34
1/21/2006	ROB ARTESIAN WELL 2	800	0.707901	8	148.21	-5.5		-5.5	-36	-35	-36
1/21/2006	MARCOURT HOUSE WELL	500	0.707750	7	148.26	-5.5	-5.6	-5.6	-35	-36	-36
1/21/2006	MARCOURT IRRIGATION WELL	800	0.707888	10	148.21	-5.3		-5.3	-36	-36	-36
1/22/2006	RING ARTESIAN WELL	900	0.707897	7	148.24	-5.4	-5.4	-5.4	-36	-35	-36
SPRINGS											
5/26/2005	LAS MORAS	0									
8/10/2005	LAS MORAS	0	0.708082	7	148.24	-4.9	-4.7	-4.8	-30	-32	-31
5/26/2005	PINTO MAIN	0									
8/10/2005	PINTO MAIN	0	0.708129	8	148.23	-5.3		-5.3	-33	-33	-33
5/27/2005	SPRING ROB	0									
8/10/2005	SPRING ROB	0	0.708089	8	148.20	-5.3		-5.3	-34	-34	-34
PINTO CREEK											
1/21/2006	PINTO RAILROAD CROSSING	0	0.708044	6	148.25	-4.7	-4.7	-4.7	-34	-35	-35
1/22/2006	PINTO AT RT 90	0	0.708040	8	148.22	-4.9		-4.9	-34	-35	-35
1/22/2006	PINTO AT 2804	0	0.708034	7	148.23	-4.9		-4.9	-34	-33	-34
1/22/2006	PINTO AT G-04A	0	0.708028	7	148.24	-4.9		-4.9	-35	-33	-34

NOTES:
1) All samples collected by M. Uliana; field parameters measured by M. Uliana.
2) Total analytical uncertainty for Sr isotopes:+/-0.000015 (2-sigma uncertainty based on replicate analyses of SRM 987 standard).
3) *From isotope lab: Extremely fractionated sample. Possibly too much Sr on filament. Lab tech indicated that it is still a reportable value.
4) **Inadvertently not analyzed by lab.
5) Stable isotopes analyzed at Coastal Laboratories, Inc. in Austin, TX

7.0 Recommendations

While this project has culminated in a significant amount of new hydrologic data, there still remains additional work that would benefit the further characterization of the Edwards-Trinity (Plateau) Aquifer in Edwards, Kinney and Val Verde Counties. The two synoptic water-level measurements performed in February and September of 2008 provide a look at seasonal water-level differences under the existing set of meteorological conditions. Another round of measurements documenting water-level elevations at more extreme wet or dry conditions would continue to demonstrate the aquifer's response to significant recharge or the lack of recharge. At the present time, only one continuous water-level recorder is in operation in this area. With the assistance of the groundwater conservation districts and the TWDB, additional strategically positioned recorders should be operated.

Dye trace studies performed under this project provided interesting first-step results. Additional tests should be continued with greater concentrations of dye and in different locations. Probably the most urgent question to be addressed by dye-trace studies is the delineation of the critical flow paths that contribute to the major springs in the area. These studies will be very useful in terms of documenting time of travel in the aquifer, which impacts critical habitat and recovery plans of the federally listed Devils River Minnow.

A hydrogeologic structural issue of interest is the proper positioning of the water table divide in Kinney County. Both logistically focused water-level measurements and dye trace studies will greatly enhance this evaluation. The proper placement of this divide is an important component of simulated groundwater flow direction in a groundwater model.

A final note of importance is the determination of the vertical zone of greatest yield within the thickness of the designated aquifer (Edwards-Trinity). Recent pumping tests and geophysical log analyses suggest that most groundwater flow may be in the McKnight Formation, with lesser amounts in the overlying Salmon Peak Formation of the Edwards. The Trinity Aquifer is found at such depths and may be brackish that this

zone is not considered to be of economic interest at this time. Analysis should continue on delineating the depth and yield potential from these productive zones.

Hydrologic data developed through this project is available for incorporation into future revisions of the Edwards-Trinity (Plateau) GAM. The two synoptic water-level measurement events reveal the aquifer's recharge response to the existing meteorological conditions. The tracer test results provided the first opportunity to evaluate groundwater flow paths at a more localized level. The listing of new wells drilled since the completion of the GAM (2004) provides a better understanding of the density and distribution of pumping centers. And finally as discussed above, this project has identified additional research that will continue to improve the GAM's ability to simulate the hydraulic actions of the aquifer.

8.0 References

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Appendix A

Table A.1
Driller's Reports for Wells Completed Since January 2004
Edwards County, Texas

WELL TRACKING NUMBER	STATE GRID NUMBER	LATITUDE	LONGITUDE	DATE COMPLETED	SURFACE ELEVATION (FT MSL)[1]	WELL DEPTH (FT)	STATIC LEVEL (FT BGL)	WELL YIELD (GPM)	DRILLER	USE[2,3]
31350	55538	30.14667	-100.43389	1/7/2004		440	358	4	THORP WATERWELL DRILLING SERVICE	D
31355	70137	29.75278	-100.48194	1/10/2004		340	235	6	THORP WATERWELL DRILLING SERVICE	D
31359	70051	29.98361	-100.46583	1/9/2004		360	320	4	THORP WATERWELL DRILLING SERVICE	D
34859	55646	30.06611	-100.01805	2/21/2004		440	375	10+	BLUEBONNET DRILLING	D
35846	56508	30.14611	-99.80222	4/7/2004	1937	400	315	6+	McGuire Well Service	D
35847	55641	30.08972	-100.10111	4/9/2004	2351	400	330	6+	McGuire Well Service	D
35848	56506	30.17861	-99.76306	3/26/2004	1914	360	306	5	McGuire Well Service	D
35850	56497	30.15722	-99.98694	4/5/2004	2031	300	215	6+	McGuire Well Service	D
37923	55617	30.02000	-100.49056	4/2/2004	2362	494	240	6	THORP WATERWELL DRILLING AND SERVICE	D
37946	70141	29.84861	-100.36722	5/9/2004			470	4	THORP WATERWELL AND DRILLNG SERVICES	D
37949	55516	30.17250	-100.63139	4/21/2004	2065	315	200	3	THORP WATERWELL AND DRILLING SERVICES	D
37952	55527	30.16139	-100.61083	5/10/2004	2105	315	180	4	THORP WATERWELL AND DRILLING SERVICES	D
37955	55524	30.18556	-100.60444	5/12/2004	2062	330			THORP WATERWELL AND DRILLING SERVICE	D
38231	56587	30.03889	-99.86917	4/9/2004		400	298	5+	McGuire Well Service	D
38836	55608	30.02139	-100.54611	6/4/2004	2063	400	230	1	THORP WATERWELL DRILLING SERVICE	D
38837	70077	29.89111	-100.23694	6/7/2004	2277	580	455	2	THORP WATERWELL DRILLING SERVICE	D
39923	70148	29.76194	-100.29500	6/27/2004		460	315	2	THORP WATERWELL DRILLING SERVICE	D
40344	70067	29.89500	-100.34056	6/28/2004	2307	580	460	2	THORP WATERWELL DRILLING SERVICES	D
40346	70068	29.87528	-100.31139	6/30/2004	2207	580	450	2	THORP WATERWELL DRILLING SERVICES	D
40350	70142	29.87333	-100.33194	7/5/2004		380	260	5	THORP WATERWELL DRILLING SERVICES	D
40543	70064	29.92250	-100.37417	7/7/2004	2153	350	290	5	THORP WATERWELL DRILLING SERVICES	D
41011	56502	30.23000	-99.82167	7/14/2004		340	250	6	THORP WATERWELL DRILLING SERVICE	D
42534	55639	30.00222	-100.15528	4/9/2004		480	390	10	LANGE DRILLING CO., INC	D
42535	55639	30.01805	-100.13472	4/13/2004		230	165	20	LANGE DRILLING CO., INC	D
42538	70072	29.98028	-100.19000	4/15/2004		480	418	10-15	LANGE DRILLING CO., INC	D
42541	70072	29.96389	-100.17889	4/18/2004		420	355	15	LANGE DRILLING CO., INC	D
42543	70075	29.94583	-100.19972	4/20/2004		580	400	3	LANGE DRILLING CO., INC	D
42600	70081	29.96028	-100.10028	4/27/2004		380	325	20	LANGE DRILLING	D
42607	70084	29.93778	-100.11278	4/28/2004		390	362	10-15	LANGE DRILLING	D
42610	55567	30.16278	-100.12028	5/5/2004		220	140	15	LANGE DRILLING	D
42615	55553	30.23944	-100.13833	5/6/2004		250	185	15	LANGE DRILLING	D
42827	55449	30.26611	-100.50722	8/1/2004	2250	380	280	4	THORP WATERWELL DRILLING SERVICES	D
42831	55449	30.27055	-100.50972	8/2/2004	2238	380	295	4	THORP WATERWELL DRILLING SERVICES	D
42834	55449	30.27250	-100.51805	8/4/2004	2242	420	330	4	THORP WATERWELL DRILLING SERVICES	D
44798	55604	30.05583	-100.59528	8/18/2004	2005	260			THORP WATERWELL DRILLING SERVICES	D
44861	55604	30.08278	-100.59889	9/4/2004	2005	300	200	1	THORP WATERWELL DRILLING SERVICES	D
44866	55604	30.07389	-100.61139	8/28/2004	2206	380	260	1	THORP WATERWELL DRILLING SERVICES	D
44876	55604	30.06972	-100.59500	8/27/2004	2011	320			THORP WATERWELL DRILLING SERVICES	D
45975	56506	30.18944	-99.75750	9/2/2004	2220	340	261	6	McGuire Well Service	D
45976	56509	30.16444	-99.78694	9/2/2004	2218	260	182	6	McGuire Well Service	D
45977	56505	30.17555	-99.80667	9/3/2004	2218	380	191	6	McGuire Well Service	D
47450	55608	30.01861	-100.54472	9/16/2004	2105	500			THORP WATERWELL DRILLING SERVICES	D
47457	70087	29.87722	-100.08667	10/13/2004	2025	500			THORP WATERWELL DRILLING SERVICES	D
47460	70087	29.87972	-100.08417	10/15/2004	1932	150			THORP WATERWELL DRILLING SERVICES	D
47461	70065	29.94000	-100.32389	10/27/2004		300	240	5	THORP WATERWELL DRILLING SERVICES	D
47507	70243	29.71944	-100.04000	10/14/2004		106	23	10	THORP WATERWELL DRILLING SERVICES	D
47514	55625	30.06500	-100.31333	10/18/2004	2285	460	385	4	THORP WATERWELL DRILLING SERVICES	D
47518	55625	30.05667	-100.29917	10/20/2004		460	375	5	THORP WATERWELL DRILLING SERVICES	D
49187	55614	30.04417	-100.49056	11/26/2004		420	395	3	THORP WATER WELL DRILLING SERVICE	D
49511	70054	29.92528	-100.45972	11/4/2004		500		0	Lange Drilling Co.	D

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49513	70055	29.92278	-100.45667	11/8/2004		400		0	Lange Drilling Co.	D
49514	70055	29.92389	-100.45583	11/9/2004		400		0	Lange Drilling Co.	D
49606	56581	30.11833	-99.86861	12/3/2004		250	150	5/10	CYPRESS CREEK DRILLING	D
50237	55607	30.03639	-100.60500	11/30/2004		380	355	2	THORP WATER WELL DRILLING SERVICES	D
50239	70212	29.72444	-100.42472	12/5/2004		540	460	1	THORP WATER WELL DRILLING SERVICES	D
50240	70215	29.70222	-100.42833	12/9/2004		420	290	1/2	THORP WATERWELL DRILLING SERVICE	D
50870	56492	30.23667	-99.94306	1/3/2005	2158	340	250	4	McGuire Well Service	D
51483	70149	29.78444	-100.28083	12/18/2004	2151	400	320	2	THORP WATER WELL DRILLING SERVICE	D
52631	55636	30.08000	-100.12944	1/13/2005		470	324		T Bar Drilling	D
52783	70051	29.96444	-100.46972	12/15/2004	2160	400	290	2	THORP WATERWELL DRILLING SERVICES	D
53356	70243	29.72639	-100.03083	2/28/2004		60		20	Cruz Drilling	D
56001	55606	30.05028	-100.53305	3/18/2005	2131	340	170	.50	THORP WATER WELL DRILLING SERVICES	D
56003	55605	30.06722	-100.58083	3/21/2005	1970				THORP WATER WELL DRILLING SERVICES	D
56923	55605	30.06639	-100.57889	4/4/2005		420			THORP WATER WELL DRILLING SERVICES	D
56926	70074	29.92278	-100.21639	4/10/2005	2271	450	360	10	THORP WATER WELL DRILLING SERVICES	D
57267	70149	29.75889	-100.28583	4/16/2005	2282	480	433	6	THORP WATER WELL DRILLING SERVICES	D
57269	55605	30.05250	-100.57278	4/19/2005		420			THORP WATER WELL DRILLING SERVICES	D
57271	55605	30.06722	-100.57722	4/23/2005		240	213	1	THORP WATER WELL DRILLING SERVICES	D
57511	70202	29.73833	-100.57722	4/25/2005	1769	300	190	10	SPURGEON DRILLING CO.	S
59000	56506	30.19889	-99.75750	5/9/2005	2231	340	255	7	McGuire Well Service	D
59934	55478	30.28250	-100.17639	5/30/2005	2031	280	196	8	McGuire Well Service	D
61419	70081	29.98639	-100.09500	6/22/2005		340	250	1	THORP WATER WELL DRILLING SERVICES	D
62378	55558	30.14361	-100.20361	6/30/2005	2336	420	360	9	THORP WATER WELL DRILLING SERVICES	D
64601	55646	30.04194	-100.01000	7/15/2005	2153	380	342	3	McGuire Well Service	D
64606	56504	30.18556	-99.84500	7/16/2005	2033	260	186	8	McGuire Well Service	D
67642	55569	30.15500	-100.01222	9/24/2005		420	350	3	THORP WATER WELL DRILLING SERVICES	D
67650	70074	29.93806	-100.21167	9/21/2005	2278	480	435	3	THORP WATER WELL DRILLING SERVICES	D
67952	70125	29.82583	-100.56556	9/22/2005		690	505		T Bar Drilling	D
68328	70119	29.78917	-100.63722	9/27/2005	1927	480	440	5	THORP WATER WELL DRILLING SERVICES	D
68330	70119	29.78000	-100.63278	10/4/2005	2300	540	490	5	THORP WATER WELL DRILLING SERVICES	D
70648	56503	30.21611	-99.75833	9/30/2005		405	326	5	Pickens Drilling Co	D
70759	55602	30.08472	-100.56722	10/6/2005	2099	320			THORP WATER WELL DRILLING SERVICES	D
73591	56507	30.15667	-99.86000	12/16/2005	2192	240	160	10	THORP WATER WELL DRILLING SERVICES	D
73593	55618	30.02472	-100.43111	12/13/2005	1934	520	430	10	THORP WATER WELL DRILLING SERVICES	D
74823	70215	29.68889	-100.43305	12/10/2005	1880	420			SPURGEON DRILLING CO.	S
75011	55643	30.10722	-100.02972	12/23/2005		360	260	10	Pickens Drilling Co.	S
75012	55646	30.07694	-100.02778	12/29/2005		350	262	12	Pickens Drilling Co.	S
75013	55643	30.10000	-100.01639	1/13/2006		350	290	7	Pickens Drilling Co.	S
76328	55531	30.22278	-100.46805	1/14/2006		420		15	Lange Drilling Co.	S
77482	70113	29.83917	-100.65500	1/10/2006		680	580		T-BAR Drilling	S
77633	55646	30.06472	-100.02250	2/1/2006		420	360	3	THORP WATER WELL DRILLING SERVICES	D
77636	55649	30.00278	-100.01722	2/23/2006		610		40	T-BAR Drilling	
77638	70089	29.91361	-100.02583	2/6/2006	2117	180	80	5	THORP WATER WELL DRILLING SERVICES	D
79244	55632	30.08389	-100.16750	1/20/2006		410	360	8	PICKENS DRILLING COMPANY	S
79245	55646	30.07944	-100.01444	1/30/2006		425	368	10	PICKENS DRILLING COMPANY	S
79862	70059	29.89833	-100.40056	3/23/2006	1966	260	260	5	THORP WATER WELL DRILLING SERVICES	D
79864	55527	30.12528	-100.61000	3/12/2006	2142	300	240	10	THORP WATER WELL DRILLING SERVICES	D
79867	55527	30.12528	-100.61139	3/31/2006	2142	300	240	5	THORP WATER WELL DRILLING SERVICES	D
80616	70246	29.66917	-100.02500	3/26/2006		797			Utopia Sales & Service	T
82124	70215	29.69361	-100.43472	4/12/2006		400	60	.5	SPURGEON DRILLING CO.	S

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82769	55633	30.09889	-100.14444	4/24/2006		152	276	4+	McGuire Well Service	D
84561	70149	29.78611	-100.28722	4/11/2006		400	350	5	THORP WATER WELL DRILLING SERVICE	D
85085	70248	29.66278	-100.05028	6/9/2006		248	89	120	Utopia Sales & Service	T
87918	70245	29.69056	-100.05667	6/21/2006	1650	200	120	20	THORP WATER WELL DRILLING AND SERVICE	D
88426	70245	29.69083	-100.05667	6/16/2006	1650	160	0	0	THORP WATER WELL DRILLING AND SERVICE	D
88440	56574	30.07000	-99.98806	6/29/2006	2362	420	370	10	THORP WATER WELL DRILLING AND SERVICE	D
88485	70081	29.99556	-100.11694	7/10/2006	2285	180	150	1.5	THORP WATER WELL DRILLING AND SERVICE	D
88493	70081	29.99500	-100.11639	7/15/2006	2285	340	280	5	THORP WATER WELL DRILLING AND SERVICE	D
88807	55646	30.07889	-100.02805	7/25/2006	2171	400	350	3	THORP WATER WELL DRILLING AND SERVICE	D
89779	55556	30.18667	-100.13139	8/2/2006	2088	280	200	5	THORP WATER WELL DRILLING AND SERVICE	D
89945	70129	29.75667	-100.53305	5/2/2006		421	334	10	Bruce Drilling and Services	D
90084	70056	29.94778	-100.37833	7/31/2006	2163	380	330	4	THORP WATER WELL DRILLING AND SERVICE	D
90087	70056	29.94778	-100.37833	7/31/2006	2163	380	330	4	THORP WATER WELL DRILLING AND SERVICE	D
90088	70056	29.94778	-100.37833	7/31/2006	2163	380	330	4	THORP WATER WELL DRILLING AND SERVICE	D
90089	70056	29.94778	-100.37833	7/31/2006	2163	380	330	4	THORP WATER WELL DRILLING AND SERVICE	D
90361	70063	29.99139	-100.26583	8/5/2006	2190	420	370	12	THORP WATER WELL DRILLING AND SERVICE	D
90782	56507	30.12889	-99.87083	8/15/2006	1941	320	278	7	McGuire Well Service	D
90783	56575	30.04889	-99.93778	8/18/2006	1978	320	248	8	McGuire Well Service	D
92735	70248	29.63139	-100.06306	7/26/2006		660	310	30	Davenport Drilling	D
92736	69093	29.87361	-99.89167	7/28/2006		180	110	12	Davenport Drilling	D
93235	70068	29.89000	-100.31889	8/16/2006	2309	540	480	5	THORP WATER WELL DRILLING SERVICES	D
93239	55549	30.16333	-100.26139	9/2/2006	2281	460	390	3	THORP WATER WELL DRILLING SERVICES	D
93251	55626	30.05111	-100.26667	9/12/2006	2322	420	375	3	THORP WATER WELL DRILLING SERVICES	D
93265	56506	30.20472	-99.78139	8/21/2006	2049	300	245	7	McGuire Well Service	D
93275	70077	29.90500	-100.21361	8/22/2006		420	370	3	THORP WATER WELL DRILLING SERVICES	D
93285	55566	30.18278	-100.01250	9/19/2006	2134	300	228	6	McGuire Well Service	D
94231	70074	29.93667	-100.22250	7/19/2006		645	500		T-Bar Drilling Inc.	D
96131	70127	29.75028	-100.59111	10/3/2006		480	400		T-Bar Drilling Inc.	D
96132	70127	29.76222	-100.59056	10/3/2006		455	320		T-Bar Drilling Inc.	D
96134	70087	29.87889	-100.10028	7/29/2006		500	480		T-Bar Drilling Inc.	D
96538	70144	29.80389	-100.35083	9/24/2006	1899	220	170	10	THORP WATER WELL DRILLING SERVICES	D
96596	70144	29.80556	-100.34833	9/20/2006	1827	200	160	10	THORP WATER WELL DRILLING SERVICES	D
96600	70167	29.75333	-100.10000	10/11/2006	1581	17	11	5	THORP WATER WELL DRILLING AND SERVICES	D
96603	70167	29.75194	-100.10250	10/12/2006	1581	28	18	8	THORP WATER WELL DRILLING AND SERVICES	D
96607	70167	29.75194	-100.10250	10/12/2006	1581	28	18	8	THORP WATER WELL DRILLING AND SERVICES	D
96610	70167	29.75194	-100.10250	10/12/2006	1581	28	18	8	THORP WATER WELL DRILLING AND SERVICES	D
96613	70167	29.75194	-100.10250	10/12/2006	1581	28	18	8	THORP WATER WELL DRILLING AND SERVICES	D
96707	70245	29.69444	-100.04778	10/13/2006	1424	23	13	10	THORP WATER WELL DRILLING AND SERVICES	D
96711	70245	29.69028	-100.05833	10/14/2006	1472	200	12	50	THORP WATER WELL DRILLING AND SERVICES	D
96983	70245	29.69056	-100.04222	10/15/2006	1422	18	12	29	THORP WATER WELL DRILLING AND SERVICES	D
96984	70167	29.75333	-100.11000	10/16/2006	1626	150	110	10	THORP WATER WELL DRILLING AND SERVICES	D
96985	70167	29.75528	-100.10361	10/17/2006	1567	35	18	20	THORP WATER WELL DRILLING AND SERVICES	D
96986	70167	29.75556	-100.10528	10/17/2006	1578	100	60	40	THORP WATER WELL DRILLING AND SERVICES	D
97000	70052	29.96917	-100.43806	10/21/2006	2168	320	250	1	THORP WATER WELL DRILLING SERVICES	D
97189	56496	30.19111	-99.89694	10/10/2006	2259	240	183	6	McGuire Well Service	D
97208	70168	29.76389	-100.08000	11/2/2006		107	49	80	Utopia Sales & Service	D
98380	69091	29.83833	-99.98917	11/6/2006		57	22	100	Utopia Sales & Service	D
98397	55643	30.09472	-100.01694	6/3/2006		405	315	15	Pickens Drilling Co.	S
98438	55566	30.18694	-100.02889	11/7/2006		405	305	13	PICKENS DRILLING CO	S
98447	55554	30.19250	-100.21444	9/13/2006		405	295	12	PICKENS DRILLING CO	S

Table A.1
Driller's Reports for Wells Completed Since January 2004
Edwards County, Texas

WELL TRACKING NUMBER	STATE GRID NUMBER	LATITUDE	LONGITUDE	DATE COMPLETED	SURFACE ELEVATION (FT MSL)[1]	WELL DEPTH (FT)	STATIC LEVEL (FT BGL)	WELL YIELD (GPM)	DRILLER	USE[2,3]
101346	70144	29.81944	-100.35833	11/15/2006	2040	400	290	10	Wilson Drilling Co.	D
101369	55555	30.17639	-100.20722	11/29/2006	2296	384	312	8	Wilson Drilling Cop	D
101370	55555	30.17000	-100.19778	11/25/2006	2263	384	290	8	Wilson Drilling Cop	D
103698	70087	29.87833	-100.10472	7/27/2006		405	270		T- Bar Drilling, Inc.	D
104153	70042	29.99194	-100.55528	1/9/2007		755	610		T-Bar Drilling Inc.	D
104287	55637	30.01583	-100.21167	1/15/2007		631	420	520	Utopia Sales & Service	P
104360	55609	30.00056	-100.53111	2/12/2007		380	300	2	THORP WATER WELL DRILLING AND SERVICE	D
105377	70244	29.68222	-100.10639	9/18/2003		20	2.5	30	Bluebonnet Drlg. and Pump Svc.	D
105395	70168	29.77111	-100.07250	10/31/2002		900	690	8	Bluebonnet Drlg. and Pump Svc.	D
108547	70067	29.88417	-100.34306	10/11/2006	2296	500			Wilson Drilling Co.	T
108548	70068	29.88444	-100.32611	10/14/2006	2291	500			Wilson Drilling Co.	T
110804	55073	30.98694	-100.12611	4/4/2007	2333	400	350	10	THORP WATER WELL DRILLING AND SERVICES	D
110808	55615	30.04861	-100.43944	2/20/2007	2038	325	260	1	THORP WATER WELL AND DRILLING SERVICE	D
110818	55604	30.05222	-100.60889	3/6/2007	2400	360	300	2	THORP WATER WELL AND DRILLING SERVICE	D
110825	55604	30.04833	-100.61056	3/2/2007	1998	360	320	2	THORP WATER WELL AND DRILLING SERVICE	D
110831	70087	29.89139	-100.11889	4/15/2007	2273	440	330	4	THORP WATER WELL AND DRILLING SERVICE	D
111464	70067	29.88472	-100.34222	4/21/2007	2229	545	470	2	Wilson Drilling Co.	D
111612	56497	30.14667	-99.99139	3/22/2007	2130	360	275	10	McGuire Well Service	D
111813	76122	28.83667	-100.54444	3/14/2007		605	327		T-Bar Drilling Inc.	D
112637	70062	29.96444	-100.32778	4/30/2007		460	380	5	THORP WATER WELL DRILLING AND SERVICE	S
112641	70062	29.98000	-100.31972	5/2/2007	2162	400	330	2	THORP WATER WELL AND DRILLING SERVICE	S
112647	70058	29.91222	-100.43722	5/20/2007	2109	280	230	5	THORP WATER WELL AND DRILLING SERVICE	D
112815	55601	30.09556	-100.60389	5/23/2005		330	270	.5	Jerry Kenneth Edmonds	D
113291	56509	30.15389	-99.78472	4/11/2007	2002	320	261	7	McGuire Well Service	D
113639	55609	30.00944	-100.52389	12/20/2006		472	287	1.5	Bruce Drilling and Services	D
114181	55555	30.16861	-100.20694	4/18/2007	2285	410	318	12	PICKENS DRILLING CO.	S
114187	55555	30.18167	-100.20389	4/23/2007	2287	410	312	10+	PICKENS DRILLING CO.	S
114196	55558	30.16417	-100.18528	4/25/2007	2300	405	330	12	PICKENS DRILLING CO.	S
114412	70141	29.83694	-100.35583	5/23/2007		400	70	2	THORP WATER WELL DRILLING AND SERVICE	S
114519	70221	29.74694	-100.35611	5/31/2007	2039	320	70	2	THORP WATER WELL DRILLING AND SERVICE	S
115583	70217	29.64611	-100.45917	6/22/2007		530	400	8	T- Bar Drilling, Inc.	D
115927	55558	30.16639	-100.17333	5/8/2007	2299	410	314	14	Pickens Drilling Co.	S
116108	55643	30.12194	-100.02805	1/22/2005		420	315	12	Will Pickens	S
116109	55643	30.12083	-100.02722	2/1/2005		408	290	15+	Will Pickens	S
116401	70218	29.65472	-100.43250	7/7/2007	1820	375	250	10-12	SPURGEON DRILLING CO.	D
116789	55555	30.18139	-100.17833	5/15/2007	2223	390	231	8	Pickens Drilling Co.	S
116796	55643	30.10944	-100.00472	5/20/2007	2379	425	358	15	Pickens Drilling Co.	S
116801	55643	30.12389	-100.00278	5/22/2007	2360	430	249	12	Pickens Drilling Co.	S
117975	55641	30.08917	-100.11556	7/13/2007		430	305	25	T- Bar Drilling, Inc.	D
117977	55569	30.15528	-100.00806	7/14/2007		455	284	10	T-BAR Drilling	D
119519	70057	29.89278	-100.46028	8/6/2007		270	180	5	THORP WATER WELL DRILLING AND SERVICE	S
119618	55646	30.06417	-100.01083	8/10/2007		400	350	20	THORP WATER WELL DRILLING AND SERVICE	D
120363	70145	29.80917	-100.32889	7/13/2007		430	300	1/2	cypress creek drilling	D
121395	55638	30.02917	-100.16861	8/18/2007		400	355	4	THORP WATER WELL DRILLING AND SERVICE	D
121396	70136	29.80444	-100.38250	8/23/2007		200	110	100	THORP WATER WELL DRILLING AND SERVICE	D
121397	70141	29.83417	-100.36222	8/29/2007		360	310	3	THORP WATER WELL DRILLING AND SERVICE	D
121647	55569	30.15500	-100.04000	8/30/2007		430	165		T- Bar Drilling, Inc.	D
121794	55538	30.15028	-100.42194	9/7/2007	2328	420	375	10	THORP WATER WELL DRILLING AND SERVICE	S
122529	70225	29.68833	-100.32000	7/14/2005		400	270	1	Cruz Drilling	D
122535	70087	29.88722	-100.11556	7/10/2005		400	310	4	Cruz Drilling	D

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Edwards County, Texas

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122906	70129	29.76611	-100.54111	8/31/2007		490	200	8	T- Bar Drilling, Inc.	D
122952	70054	29.94361	-100.46333	9/5/2007		320	218	22	Jolander Well Drilling Co	D
122953	70054	29.94194	-100.46694	9/10/2007		320	216	8	Jolander Well Drilling Co	D
123226	55555	30.17278	-100.18528	9/24/2007	2033	400	335	6+	McGuire Well Service	D
123227	55555	30.18417	-100.18583	9/26/2007	2092	340	262	6+	McGuire Well Service	D
123585	70125	29.80694	-100.55056	9/20/2007		435	340	18	T- Bar Drilling, Inc.	D
124588	55643	30.10639	-100.03305	9/28/2007		360	300	12	Wilson Well Service	D
124634	56506	30.17222	-99.78583	8/29/2007	2207	320	242	15	Pickens Drilling Co.	S
125856	56496	30.19917	-99.89139	10/24/2007	2143	280	221.5	6	McGuire Well Service	D
125857	56496	30.18194	-99.88139	10/25/2007	2157	360	282	6	McGuire Well Service	D
125858	56504	30.18417	-99.87333	10/26/2007	2178	320	258	6	McGuire Well Service	D
125859	56504	30.18556	-99.86861	10/29/2007	2217	320	263	6	McGuire Well Service	D
125996	55604	30.05583	-100.59278	9/25/2007		265	NO DATA		THORP WATER WELL AND DRILLING SERVICE	S
126003	55609	30.00639	-100.53472	10/6/2007		380	335	4	THORP WATER WELL DRILLING AND SERVICE	S
126005	70055	29.92111	-100.43111	10/19/2007		280	235	4	THORP WATER WELL DRILLING AND SERVICE	S
126008	55638	30.00750	-100.20722	10/12/2007		500	340	40	THORP WATER WELL DRILLING AND SERVICE	
126009	70244	29.68167	-100.10722	10/26/2007		60	18	30	THORP WATER WELL DRILLING AND SERVICE	S
126011	70244	29.67305	-100.10750	10/26/2007		80	20	3	THORP WATER WELL DRILLING AND SERVICE	D
127963	56496	30.18667	-99.90944	11/9/2007		280	230	20	THORP WATER WELL DRILLING AND SERVICE	D
127974	55547	30.14861	-100.33556	11/18/2007		320	270	10	THORP WATER WELL DRILLING AND SERVICE	D
129890	70065	29.93917	-100.30694	12/17/2007	2248	380	330	5-10	THORPS WATER WELL DRILLING AND SERVICE	S
130691	55555	30.17639	-100.19444	11/5/2007	2284	400	210	12	Pickens Drilling Co.	D
130693	55558	30.16444	-100.19222	11/6/2007	2260	400	309	11	Pickens Drilling Co.	S
130694	56504	30.18806	-99.83528	11/26/2007	2130	270	158	10	Pickens Drilling Co.	D
131734	55569	30.13917	-100.00250	12/7/2007		580	330		T-Bar Drilling Inc.	D
135287	70074	29.93806	-100.24278	12/31/2007		455	340	1	THORP WATER WELL DRILLING AND SERVICE	D
135290	70075	29.92861	-100.20667	1/6/2008		420	330	10	THORP WATER WELL DRILLING AND SERVICE	D
135480	55552	30.22361	-100.18833	2/21/2008		300	220	7	McGuire Well Service	D
135485	55556	30.18750	-100.15833	2/22/2008		200	136	25	McGuire Well Service	D
135487	55559	30.16361	-100.15194	2/25/2008		320	273	3	McGuire Well Service	D
135489	55555	30.20583	-100.17750	2/25/2008		340	295	5	McGuire Well Service	D
135497	56506	30.17917	-99.78250	2/26/2008		220	163	5	McGuire Well Service	D
137319	70131	29.85861	-100.46583	2/19/2008		480	200		T- Bar Drilling, Inc.	D
137322	55535	30.17639	-100.45056	2/6/2008		380	295		T- Bar Drilling, Inc.	D
139373	56417	30.25361	-99.95889	3/23/2008		185	116	.25	PICKENS DRILLING CO.	D
140889	55594	30.06611	-100.72528	3/27/2008		705	380		T- Bar Drilling, Inc.	D
141223	70222	29.71306	-100.30889	4/19/2008	2180	440	360	3	THORPS WATER WELL DRILLING AND SERVICE	S
141242	70221	29.73611	-100.34444	4/29/2008	1989	600	500	.25	THORPS WATER WELL DRILLING AND COMPANY	S
141713	55605	30.07028	-100.57639	3/29/2008		785			T- Bar Drilling, Inc.	D
142073	70217	29.64889	-100.46333	9/3/2007		440	324	17	Bruce Drilling and Services	D
142077	70217	29.65028	-100.46500	10/3/2007		440	311	6	Bruce Drilling and Services	D
143531	55534	30.17528	-100.46444	5/1/2008		430	320	8	T- Bar Drilling, Inc.	D
144128	70068	29.91361	-100.31556	6/9/2008		460	395	3	THORP WATER WELL DRILLING AND SERVICE	D
144129	70139	29.79028	-100.39583	5/30/2008		240	140	15	THORP WATER WELL DRILLING AND SERVICE	D
144130	70222	29.72111	-100.31778	5/12/2008		440	0	0	THORP WATER WELL DRILLING AND SERVICE	D
144131	70221	29.73833	-100.35833	5/15/2008		400	0	0	THORP WATER WELL DRILLING AND SERVICE	D
144613	56508	30.15639	-99.82139	3/22/2007		380	220	12	Edmonds Dirlling	D
144949	70116	29.83278	-100.62528	3/22/2008		640	520	7	Bollinger Drilling	D
144954	70145	29.79528	-100.30889	10/28/2007		540	300	30	Bollinger Drilling	D
145091	70205	29.69556	-100.57222	11/29/2007		420	220	6	Bollinger Drilling	D

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Driller's Reports for Wells Completed Since January 2004
Edwards County, Texas

WELL TRACKING NUMBER	STATE GRID NUMBER	LATITUDE	LONGITUDE	DATE COMPLETED	SURFACE ELEVATION (FT MSL)[1]	WELL DEPTH (FT)	STATIC LEVEL (FT BGL)	WELL YIELD (GPM)	DRILLER	USE[2,3]
145093	70074	29.93167	-100.21639	10/8/2007		516	360		Bollinger Drilling	D
145097	70148	29.78972	-100.31417	10/13/2007		420	180		Bollinger Drilling	D
145100	70129	29.76250	-100.51917	11/10/2006		490	420	8	Bollinger Drilling Co.	D
145105	55646	30.07778	-100.02778	12/5/2006		460	220	10	Bollinger Drilling	D
145129	56599	30.01805	-99.63528	11/7/2006		500	420	8-10	Bollinger Drilling	D
146274	70078	29.89528	-100.20222	6/13/2008		400	260	10	THORP WATER WELL DRILLING SERVICE	D
146280	55631	30.08889	-100.21500	6/18/2008		390	330	10	THORP WATER WELL DRILLING SERVICE	D
146629	70065	29.94750	-100.29528	4/4/2008		430		12	Apex Drilling, Inc	D
146630	70065	29.95000	-100.29806	4/12/2008		430		25	Apex Drilling, Inc	D
147726	70133	29.84333	-100.40361	6/30/2008		160	35	100	Wilson Well Service	D
148144	70066	29.93417	-100.27111	4/10/2008		440		37	Apex Drilling, Inc.	D
148147	70066	29.93389	-100.28167	4/16/2008		390		37	Apex Drilling, Inc.	D
148458	70169	29.77889	-100.03528	12/23/2005		100	45		Cruz Drilling	D
151464	56506	30.19639	-99.75694	7/4/2008		320	246	6	McGuire Well Service	D
151465	56508	30.14833	-99.80500	7/5/2008		360	285	6	McGuire Well Service	D
151466	56508	30.14306	-99.80833	7/5/2008		360	294	6	McGuire Well Service	D
151471	56505	30.17389	-99.82972	8/22/2008		260	172	6+	McGuire Well Service	D
151472	55644	30.07222	-100.08389	8/23/2008		360	322	6	McGuire Well Service	D
151547	70245	29.68361	-100.07194	4/27/2005		240	160	4	Cruz Drilling	D
151548	70245	29.67361	-100.05528	4/28/2005		80	30	18	Cruz Drilling	D

1) Surface elevations from driller's records where noted.
2) Well Use Codes:
D - Domestic
Ir - Irrigation
P - Public Supply
S - Stock
T - Test
3) Monitoring and environmental wells are not included in this table.

Table A.2
Driller's Reports for Wells Completed Since January 2004
Kinney County, Texas

WELL TRACKING NUMBER	STATE GRID NUMBER	LATITUDE	LONGITUDE	DATE COMPLETED	SURFACE ELEVATION (FT MSL)[1]	WELL DEPTH (FT)	STATIC LEVEL (FT BGL)	WELL YIELD (GPM)	DRILLER	USE[2,3]
33200	70484	29.30833	-100.11333	2/27/2004		300	200	25	SPURGEON DRILLING COMPANY	S
36298	70456	29.31917	-100.39222	4/15/2004	1185	340	115	75	SPURGEON DRILLING CO.	D
36776	70373	29.45917	-100.40639	4/20/2004	1332	260	95	15	Spurgeon Drilling Company	S
36777	70373	29.48833	-100.39361	4/23/2004	1442	300	180	15-20	Spurgeon Drilling Company	S
36778	70373	29.47778	-100.38389	4/24/2004	1420	260	168	20-25	Spurgeon Drilling Company	S
36779	70373	29.46250	-100.38194	4/27/2004	1400	275	145	25-30	Spurgeon Drilling Company	S
36780	70373	29.48694	-100.38694	4/29/2004	1445	280	170	15-20	Spurgeon Drilling Company	S
37678	70293	29.58528	-100.39778	5/6/2004	1770	400	270	8-10	SPURGEON DRILLING CO.	S
38705	70447	29.29056	-100.60278	4/26/2004		1407			T Bar Drilling	D
38708	70448	29.26167	-100.58139	5/14/2004		600			T Bar Drilling	D
38710	70447	29.25611	-100.58528	5/25/2004		500			T Bar Drilling	D
40570	70447	29.29083	-100.60278	6/15/2004		407	80		T Bar Drilling	D
40574	71403	29.46306	-101.01500	6/8/2004		500	15		T Bar Drilling	D
42063	70379	29.39750	-100.38000	7/28/2004		300	60	30	SPURGEON DRILLING CO.	S
42387	70251	29.60278	-100.96556	7/14/2004		217	90		T Bar Drilling	D
43919	70381	29.49444	-100.35778	8/24/2004	1615	400	295	1.5	SPURGEON DRILLING CO.	D
44034	70297	29.53250	-100.48750	8/5/2004	1482	295	110	15-20	SPURGEON DRILLING CO.	S
44035	70294	29.56917	-100.49917	8/5/2004	1525	300	152	30	SPURGEON DRILLING CO.	S
44036	70294	29.56889	-100.49083	8/12/2004	1535	300	160	30	SPURGEON DRILLING CO.	S
44037	70294	29.56972	-100.46250	8/18/2004	1608	600	205	2-3	SPURGEON DRILLING CO.	S
52969	70442	29.35083	-100.55694	2/8/2005	1122	740		40	SPURGEON DRILLING CO.	S
55541	70469	29.26944	-100.26805	3/18/2005	1116	500	70	3-5	SPURGEON DRILLING CO.	D
58539	70275	29.55667	-100.68444	5/7/2005	1465	475	290	30	SPURGEON DRILLING CO.	S
58858	70367	29.37583	-100.61389	5/14/2005	1130	362	40	4-6	SPURGEON DRILLING CO.	S
61012	70442	29.34167	-100.56805	6/15/2005	1090	460	50	5-6	SPURGEON DRILLING CO.	S
61594	70434	29.29444	-100.72750	6/28/2005	978	42	23	15-20	SPURGEON DRILLING CO.	S
63882	70556	29.20500	-100.12778	7/27/2005		100			SPURGEON DRILLING CO	E
63884	70556	29.20028	-100.13028	7/27/2005		100			SPURGEON DRILLING CO	E
63887	70556	29.19417	-100.13305	7/27/2005		100			SPURGEON DRILLING CO	E
63888	70556	29.18861	-100.13750	7/27/2005		100			SPURGEON DRILLING CO	E
63889	70556	29.18139	-100.13778	7/27/2005		100			SPURGEON DRILLING CO	E
63890	70556	29.18139	-100.13778	7/27/2005		100			SPURGEON DRILLING CO	E
63895	70564	29.18194	-100.11194	7/29/2005		100		0	SPURGEON DRILLING CO	E
63896	70564	29.17861	-100.11278	7/29/2005		100		0	SPURGEON DRILLING CO	E
63898	70564	29.18361	-100.11611	7/29/2005		100		0	SPURGEON DRILLING CO	E
63904	70564	29.17361	-100.11333	7/30/2005		100			SPURGEON DRILLING CO	E
63905	70567	29.16528	-100.11417	7/30/2005		100	40	3-4	SPURGEON DRILLING CO	E
63907	70564	29.17805	-100.11694	7/30/2005		100			SPURGEON DRILLING CO	E
65691	70448	29.25139	-100.58139	8/23/2005	1040	1465	neg 1	3000	Wilson Drilling Co.	Ir
67220	70487	29.25139	-100.12444	9/10/2005	1040	154	75	12-15	SPURGEON DRILLING CO.	S
67224	70286	29.56556	-100.51472	9/14/2005	1540	280	165	25	SPURGEON DRILLING CO.	S
67227	70294	29.56750	-100.49694	9/16/2005	1523	275	132	25	SPURGEON DRILLING CO.	D
68020	70401	29.49611	-100.12111	9/30/2005	1360	200	45	10-12	SPURGEON DRILLING CO.	D
70157	70464	29.30750	-100.36972	10/27/2005	1160	600	60	8-10	SPURGEON DRILLING CO.	S
70158	70456	29.29972	-100.38139	10/29/2005	1170	240	70	8-10	SPURGEON DRILLING CO.	D

Table A.2
Driller's Reports for Wells Completed Since January 2004
Kinney County, Texas

WELL TRACKING NUMBER	STATE GRID NUMBER	LATITUDE	LONGITUDE	DATE COMPLETED	SURFACE ELEVATION (FT MSL)[1]	WELL DEPTH (FT)	STATIC LEVEL (FT BGL)	WELL YIELD (GPM)	DRILLER	USE[2,3]
71109	70448	29.25139	-100.58139	8/23/2005	1040	1465	neg 1	3000	WILSON DRILLING COMPANY	Ir
71582	70478	29.27972	-100.18611	10/21/2005	1475	300	135	100+	SPURGEON DRILLING CO.	D
76743	70397	29.40833	-100.20972	2/10/2006		330	250	5	Davenport Drilling	D
80227	70387	29.38750	-100.35167	3/29/2006	1410	360	225	8-10	SPURGEON DRILLING CO.	S
80229	70387	29.38861	-100.36583	3/31/2006	1285	300	137	10-15	SPURGEON DRILLING CO.	S
80231	70456	29.30500	-100.39833	4/5/2006		410	81	2	SPURGEON DRILLING CO.	S
80233	70456	29.30556	-100.39833	4/3/2006		200			SPURGEON DRILLING CO.	S
80235	70464	29.30917	-100.36306	4/7/2006		600	90	12-15	SPURGEON DRILLING CO.	S
87983	70303	29.61056	-100.27361	6/14/2006	1632	415	112	55	Wilson Drilling Co.	D
88853	70296	29.55278	-100.40278	7/20/2006		500	150	2-3	SPURGEON DRILLING CO.	D
88854	70296	29.54833	-100.38944	7/22/2006		340	170	1	SPURGEON DRILLING CO.	S
88855	70296	29.55250	-100.40139	7/25/2006		300			SPURGEON DRILLING CO.	D
88856	70296	29.55806	-100.38083	7/27/2006		220	140	12-15	SPURGEON DRILLING CO.	S
90200	70401	29.49639	-100.12028	8/3/2006		200	53	8-10	SPURGEON DRILLING CO.	D
90201	70398	29.40528	-100.17361	8/5/2006		340	240	10-12	SPURGEON DRILLING CO.	S
91402	76303	28.60889	-100.27639	8/17/2006	1648	200	85	85	Wilson Drilling Co.	D
91403	70303	29.60583	-100.27778	8/23/2006	1621	240	78	70	Wilson Drilling Co.	D
93371	70478	29.26444	-100.16694	9/16/2006	1105	140	75	15-17	SPURGEON DRILLING CO.	S
93373	70478	29.26306	-100.18472	9/21/2006	1115	260	95	12-15	SPURGEON DRILLING CO.	S
96138	70463	29.36667	-100.27139	10/21/2006		360	165	15-17	SPURGEON DRILLING CO.	S
96248	70477	29.28000	-100.23944	10/23/2006		360	92	8-10	SPURGEON DRILLING CO.	S
100930	70441	29.36000	-100.58722	12/22/2006	1095	600	10	30-40	SPURGEON DRILLING CO.	S
103963	70393	29.49278	-100.16250	2/8/2007	1540	440	135	3-4	SPURGEON DRILLING CO.	S
104475	70386	29.42805	-100.27667	2/10/2007	1375	420	160	25-30	SPURGEON DRILLING CO.	D
104476	70386	29.43639	-100.26306	2/15/2007	1375	405	160	25-30	SPURGEON DRILLING CO.	S
105152	70462	29.36944	-100.31472	2/24/2007	1350	650	215	150	SPURGEON DRILLING CO.	S
109382	70259	29.53028	-100.90778	2/27/2007		605	32	6	T- Bar Drilling, Inc.	D
110749	70462	29.37250	-100.31417	2/21/2007	1350	650	170	100	SPURGEON DRILLING CO.	S
110750	70388	29.39500	-100.29389	4/8/2007	1450	600	272	40-50	SPURGEON DRILLING CO.	D
110751	70461	29.35111	-100.36278	3/8/2007		700	115	400	SPURGEON DRILLING CO.	Ir
110752	70389	29.40528	-100.26444	3/10/2007	1380	580	200	20-25	SPURGEON DRILLING CO.	D
110753	70397	29.38667	-100.23778	3/17/2007	1420	340	267	10-15	SPURGEON DRILLING CO.	S
110754	70397	29.37778	-100.21250	3/19/2007	1425	400	270	40-50	SPURGEON DRILLING CO.	S
110755	70462	29.36639	-100.30194	4/14/2007	1350	480	160	6-8	SPURGEON DRILLING CO.	S
110892	70391	29.48389	-100.22139	3/16/2007		600			Wilson Well Service	D
111403	70593	29.10639	-100.64583	5/3/2007	933	350			Wilson Drilling Co.	S
113793	70593	29.10639	-100.64528	5/30/2007	933	350			Wilson Drilling Co.	T
113800	70517	29.13500	-100.70833	5/14/2007	833	63	20	20	Wilson Drilling Co.	D
115723	70514	29.18278	-100.71056	6/1/2007	938	540			Wilson Drilling Co.	T
115724	70516	29.18278	-100.64389	6/6/2007	938	540			Wilson Drilling Co.	T
116402	70462	29.36361	-100.32389	6/21/2007		700	180	50	SPURGEON DRILLING CO.	S
116405	70453	29.34000	-100.39083	6/7/2007		800	132	400-500	SPURGEON DRILLING CO.	Ir
117962	70382	29.45861	-100.32167	6/28/2007		460	300		T- Bar Drilling, Inc.	D
118028	70377	29.39278	-100.46083	5/28/2007		801	+ 3	1000	Bruce Drilling and Services	M
120472	70201	29.71667	-100.58333	8/16/2007		385	280	8	T- Bar Drilling, Inc.	D

Table A.2
Driller's Reports for Wells Completed Since January 2004
Kinney County, Texas

WELL TRACKING NUMBER	STATE GRID NUMBER	LATITUDE	LONGITUDE	DATE COMPLETED	SURFACE ELEVATION (FT MSL)[1]	WELL DEPTH (FT)	STATIC LEVEL (FT BGL)	WELL YIELD (GPM)	DRILLER	USE[2,3]
120475	70276	29.54306	-100.62750	8/17/2007		330	45	25	T- Bar Drilling, Inc.	D
122949	70155	29.81139	-100.20722	9/13/2007		140	48	20-25	SPURGEON DRILLING CO.	D
123322	70471	29.35250	-100.24028	9/21/2007	1283	440	175	50+	SPURGEON DRILLING CO.	S
123323	70389	29.38972	-100.26611	9/19/2007	1400	440	220	50+	SPURGEON DRILLING CO.	D
123324	70463	29.36778	-100.26222	9/26/2007	1327	440	185	50+	SPURGEON DRILLING CO.	D
123832	70386	29.43361	-100.28944	10/6/2007	1405	330	138	25-30	SPURGEON DRILLING CO.	S
131423	70367	29.38750	-100.59583	12/6/2007	1110	410	10	30	SPURGEON DRILLING CO.	D
133370	70395	29.45306	-100.17805	2/1/2008		200	80	2-3	SPURGEON DRILLING CO.	S
133606	70391	29.47778	-100.21306	2/5/2008	1350	195	110	12-15	SPURGEON DRILLING CO.	S
134265	70388	29.38667	-100.30611	2/9/2008	1435	655	260	100+	SPURGEON DRILLING CO.	S
134771	70465	29.32472	-100.32778	2/15/2008	1210	500	85	3-4	SPURGEON DRILLING CO.	S
134776	70443	29.33444	-100.53194	2/13/2008	1095	160	35	15-20	SPURGEON DRILLING CO.	D
141288	70218	29.65611	-100.45167	4/9/2008		505	240		T- Bar Drilling, Inc.	D
142753	58598	30.00472	-97.67639	3/11/2007		25			Hinojosa Services, LLC	M
142756	58598	30.00472	-97.67639	3/11/2007		25			Hinojosa Services, LLC	M
145034	70279	29.51167	-100.63111	5/11/2008		410	55	75	Bollinger Drilling	D
147723	70535	29.17972	-100.42361	6/20/2008		60	20	2	Wilson Well Service	D
147724	70535	29.16944	-100.43111	6/23/2008		360			Wilson Well Service	D
147725	70477	29.25639	-100.22333	6/25/2008		300			Wilson Well Service	D
149855	70456	29.31250	-100.41222	10/2/2005		252	21	15	Bruce Drilling and Services	Ir
150124	70456	29.32611	-100.38694	12/5/2004		220	78	30	Bruce Drilling & Services	D
151068	70462	29.37444	-100.30806	8/19/2008	1365	720	237	20-25	SPURGEON DRILLING CO.	D
151069	70462	29.34417	-100.31583	8/22/2008	1260	360	132	25-30	SPURGEON DRILLING CO.	S

1) Surface elevations from driller's records where noted.
2) Well Use Codes:
- D - Domestic
- Ir - Irrigation
- P - Public Supply
- S - Stock
- T - Test

3) Monitoring and environmental wells are not included in this table.

Table A.3
Driller's Reports for Wells Completed Since January 2004
Val Verde County, Texas

WELL TRACKING NUMBER	STATE GRID NUMBER	LATITUDE	LONGITUDE	DATE COMPLETED	SURFACE ELEVATION (FT MSL)[1]	WELL DEPTH (FT)	STATIC LEVEL (FT BGL)	WELL YIELD (GPM)	DRILLER	USE[2,3]
31483	71164	29.79222	-101.11917	1/6/2004		905	493		T Bar Drilling	D
31485	71164	29.79194	-101.11944	1/12/2004		471	150		T Bar Drilling	D
31492	71403	29.46167	-101.00750	1/15/2004		447	250		T Bar Drilling	D
31842	70182	29.72472	-100.81139	1/29/2004	1797	780	605	7.5	THORP WATERWELL DRILLING SERVICE	D
32502	70334	29.43639	-100.97055	1/23/2004		435	80		T Bar Drilling	D
32508	71243	29.74111	-101.01444	2/1/2004		120	60		T Bar Drilling	D
32511	71243	29.74111	-101.01444	2/4/2004		140	60		T Bar Drilling	D
32594	70252	29.60778	-100.95222	2/12/2004		409	280		T Bar Drilling	D
34124	71406	29.45611	-101.01028	2/26/2004		450	325		T Bar Drilling	D
34289	70347	29.39556	-100.83750	3/10/2004		200	110		T Bar Drilling	D
35553	70351	29.47667	-100.74167	3/10/2004		600	77		T Bar Drilling	Ir
35569	70183	29.74583	-100.75889	3/19/2004		872	390		T Bar Drilling	D
35655	71403	29.46111	-101.01639	3/23/2004		457	60		T Bar Drilling	D
35864	70354	29.45722	-100.74306	3/24/2004		220	100		T Bar Drilling	D
36375	70254	29.58111	-100.97250	3/26/2004	1201	381	241	40	THORP WATERWELL DRILLING SERVICE	D
36378	70252	29.59500	-100.95583	3/27/2004	1230	340	200	6	THORP WATERWELL DRILLING SERVICE	D
37134	71406	29.44806	-101.00611	3/30/2004		407	115		T Bar Drilling	D
37137	70331	29.47000	-100.98972	3/26/2004		420	105		T Bar Drilling	D
37140	70331	29.47083	-100.97694	3/30/2004		440	115		T Bar Drilling	D
37142	71406	29.45278	-101.00972	4/2/2004		450	120		T Bar Drilling	D
37200	71406	29.45194	-101.00889	4/13/2004		407	95		T Bar Drilling	D
37223	71406	29.45528	-101.01583	4/21/2004		450	110		T Bar Drilling	D
37227	70334	29.43305	-100.96361	4/26/2004		407	100		T Bar Drilling	D
37229	71401	29.48806	-101.09583	5/3/2004		450	75		T Bar Drilling	D
37374	71318	29.53000	-101.16944	5/6/2004		367	75		T Bar Drilling	D
37715	70099	29.76778	-100.90833	5/13/2004		450	280		T Bar Drilling	D
37740	70099	29.76778	-100.90833	5/13/2004		450	280		T Bar Drilling	D
37748	70099	29.76778	-100.90833	5/13/2004		450	280		T Bar Drilling	D
38332	71321	29.58861	-101.11444	5/20/2004		450	320		T Bar Drilling	D
38935	71403	29.48583	-101.00806	5/28/2004		420	250		T Bar Drilling	D
38951	71403	29.46389	-101.01389	6/3/2004		440	200		T Bar Drilling	D
40126	71403	29.46583	-101.01361	6/14/2004		440	250		T Bar Drilling	D
40129	70339	29.39778	-100.89278	6/17/2004		227	67		T Bar Drilling	D
40357	70254	29.57805	-100.97222	5/27/2004		310	230	6	THORP WATERWELL DRILLING SERVICES	D
40559	70333	29.47833	-100.90417	6/29/2004		453	80		T Bar Drilling	D
42388	70442	29.34194	-100.56805	7/16/2004		407	370		T Bar Drilling	D
42619	55491	30.23389	-100.96417	5/6/2004		140	80	20	LANGE DRILLING	D
44981	70251	29.60528	-100.96556	7/18/2004		407	120		T Bar Driling	D
44984	70134	29.82583	-100.49472	8/9/2004		507	300		T Bar Drilling	D
44987	70347	29.40222	-100.86833	8/19/2004		67	13		T Bar Drilling	D
44990	71403	29.46250	-101.01306	8/27/2004		450	200		T Bar Drilling	D
45488	70275	29.57305	-100.70278	9/5/2004	1400	500	240	150	SPURGEON DRILLING CO.	T
45773	54528	30.12944	-101.58250	9/7/2004		127	68		T Bar Drilling	D
46054	70335	29.45333	-100.93778	9/17/2004		460	120		T Bar Drilling	D
46319	70339	29.39806	-100.89611	9/17/2004		127	98		T Bar Drilling	D
46320	71406	29.43778	-101.03194	9/22/2004		440	5		T Bar Drilling	D
46933	70339	29.39806	-100.89611	9/17/2004		127	98		T Bar Drilling	D
49508	70182	29.73444	-100.82361	11/2/2004		760		6-7	Lange Drilling Co.	D
50241	54458	30.25778	-101.43222	12/12/2004	2211	600	480	8	THORP WATERWELL DRILLING SERVICE	D
51482	70421	29.36944	-100.84861	12/16/2004		450	120		T Bar Drilling	D
51523	71403	29.45944	-101.01722	12/18/2004		440	130		T Bar Drilling	D
51862	71403	29.46167	-101.00972	1/8/2005		469	75		T Bar Drilling	D
52603	71403	29.45944	-101.01694	12/23/2004		450	140		T Bar Drilling	D
52623	71222	29.74389	-101.33028	1/3/2005		624	289		T Bar Drilling	D
52627	71403	29.45944	-101.00667	1/6/2005		445	75		T Bar Drilling	D
53063	70421	29.36861	-100.83722	1/17/2005		200	50		T Bar Drilling	D
53115	70421	29.36861	-100.83722	1/23/2005		200	50		T Bar Drilling	D
53260	70336	29.42667	-100.88806	1/31/2005		200	95		T Bar Drilling	D

Table A.3
Driller's Reports for Wells Completed Since January 2004
Val Verde County, Texas

WELL TRACKING NUMBER	STATE GRID NUMBER	LATITUDE	LONGITUDE	DATE COMPLETED	SURFACE ELEVATION (FT MSL)[1]	WELL DEPTH (FT)	STATIC LEVEL (FT BGL)	WELL YIELD (GPM)	DRILLER	USE[2,3]
53264	70336	29.42667	-100.88806	1/31/2005		200	95		T Bar Drilling	D
53412	70346	29.41750	-100.75556	2/15/2005	1126	500	75	150-200	SPURGEON DRILLING CO.	Ir
55214	70331	29.46611	-100.98694	2/22/2005		400	90		T Bar Drilling	D
55665	71406	29.45111	-101.00361	3/1/2005		385	80		T Bar Drilling	D
55778	70252	29.61389	-100.94139	3/18/2005		365	60		T Bar Drilling	D
55985	54634	30.05806	-101.22305	3/28/2005	1752	275	220	15	THORP WATERWELL DRILLING SERVICES	D
55988	55416	30.29417	-100.91167	2/10/2005	2002	320	280	7	THORP WATER WELL DRILLING SERVICES	D
55994	54573	30.08361	-101.90333	2/17/2005	1940	500	300	8	THORP WATERWELL DRILLING SERVICES	D
55996	54576	30.04444	-101.89694	2/21/2005	1790	500	450	2	THORP WATER WELL DRILLING SERVICES	D
55998	54573	30.11778	-101.89139	2/27/2005	1985	560	500	3	THORP WATER WELL DRILLING SERVICES	D
58424	70336	29.43833	-100.91417	3/25/2005		400	80		T Bar Drilling	D
58428	71319	29.51889	-101.16333	3/29/2005		407	70		T Bar Drilling	D
58434	70335	29.45639	-100.94250	4/1/2005		440	80		T Bar Drilling	D
58506	71403	29.46167	-101.00000	4/12/2005		440	100		T Bar Drilling	D
58507	70339	29.39667	-100.89139	4/15/2005		145	100		T Bar Drilling	D
58540	70271	29.60194	-100.71833	5/10/2005	1430	400	235	12-15	SPURGEON DRILLING CO.	S
58547	70331	29.46805	-100.97750	4/19/2005		427	100		T Bar Drilling	D
58908	70336	29.42278	-100.90028	4/22/2005		200	65		T Bar Drilling	D
59589	70274	29.55083	-100.73083	4/15/2005	1326	480	180	530	SPURGEON DRILLING CO.	Ir
60350	55587	30.03806	-100.87028	5/21/2005	1947	480	350	10	THORP WATER WELL DRILLING SERVICE	D
60552	71318	29.52639	-101.17167	5/27/2005	1163	440	85	20+	THORP WATER WELL DRILLING SERVICES	D
60555	71318	29.52778	-101.17111	5/31/2005	1185	460	100	30+	THORP WATER WELL DRILLING SERVICES	D
60592	71318	29.53000	-101.16750	6/7/2005	1176	460	95	40+	THORP WATER WELL SERVICE	D
60600	71403	29.45889	-101.02167	5/19/2005		430	200		T Bar Drilling	D
60858	70268	29.50833	-100.80917	4/21/2005		600	250		T Bar Drilling	Ir
60993	71403	29.46111	-101.02611	5/26/2005		430	80		T Bar Drilling	D
61001	70335	29.44722	-100.95583	6/14/2005		450	200		T Bar Drilling	D
61031	71403	29.46056	-101.01889	6/17/2005	1138	420	187	12	THORP WATER WELL DRILLING SERVICES	D
61086	70268	29.50389	-100.81389	5/9/2005		610	210		T Bar Drilling	D
61090	70412	29.37278	-100.95528	6/3/2005		400	80		T Bar Drilling	D
62376	71318	29.52833	-101.16722	6/9/2005	1174	460	77	12	THORP WATER WELL DRILLING SERVICES	D
63050	71403	29.46194	-101.01778	6/30/2005		410	160		T Bar Drilling	D
63052	71406	29.45556	-101.03000	6/25/2005		410	85		T Bar Drilling	D
64579	70251	29.59222	-100.96528	7/11/2005		320	70		T Bar Drilling	D
64619	70331	29.46583	-100.97639	7/15/2005		425	70		T Bar Drilling	D
64620	70335	29.44750	-100.95611	7/13/2005		415	95		T Bar Drilling	D
64624	70334	29.44111	-100.96222	7/16/2005		465	75		T Bar Drilling	D
64692	70335	29.44917	-100.95667	7/19/2005		445	85		T Bar Drilling	D
64695	70334	29.45056	-100.96194	7/20/2005		380	100		T Bar Drilling	D
66286	54495	30.19417	-101.93639	8/29/2005		610	550		T Bar Drilling	D
66306	71041	29.98250	-101.59944	7/26/2005		727	527		T Bar Drilling	D
66314	71048	29.88250	-101.56694	8/3/2005		600	400		T Bar Drilling	D
66328	70331	29.47305	-100.97694	8/15/2005		450	200		T Bar Drilling	D
66336	70334	29.44861	-100.98305	8/17/2005		450	200		T Bar Drilling	D
66830	70334	29.44472	-100.98083	8/16/2005		450	425		T Bar Drilling	D
66848	70331	29.47278	-100.97722	8/19/2005		430	200		T Bar Drilling	D
66853	54634	30.08222	-101.23167	8/23/2005		710	400		T Bar Drilling	D
67000	70351	29.47139	-100.72139	8/18/2005		600	200		T Bar Drilling	Ir
67572	70334	29.44861	-100.98389	8/25/2005		450	200		T Bar Drilling	D
67580	70354	29.44861	-100.73778	8/26/2005		435	85		T Bar Drilling	D
67687	70335	29.44306	-100.95056	8/29/2005		410	97		T Bar Drilling	D
67789	70331	29.47111	-100.97500	9/7/2005		430	200		T Bar Drilling	D
67880	70431	29.37194	-100.74806	9/10/2005		210	80		T Bar Drilling	D
67889	70144	29.80944	-100.36306	9/14/2005		230	60		T Bar Drilling	D
69203	70331	29.45833	-100.96639	9/27/2005		408	90		T - Bar Drilling	D
69227	70331	29.45861	-100.96805	9/29/2005		448	50		T Bar Drilling	D
69229	70331	29.46667	-100.97222	9/30/2005		448	60		T Bar Drilling	D

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Driller's Reports for Wells Completed Since January 2004
Val Verde County, Texas

WELL TRACKING NUMBER	STATE GRID NUMBER	LATITUDE	LONGITUDE	DATE COMPLETED	SURFACE ELEVATION (FT MSL)[1]	WELL DEPTH (FT)	STATIC LEVEL (FT BGL)	WELL YIELD (GPM)	DRILLER	USE[2,3]
70054	70374	29.45000	-100.47472	9/29/2005		408	110		T Bar Drilling	D
70276	70331	29.46861	-100.97917	10/24/2005		427	90		T Bar Drilling	D
70278	70334	29.44111	-100.97889	10/25/2005		427	110		T Bar Drilling	D
70281	70337	29.40944	-100.97667	10/26/2005		440	70		T Bar Drilling	D
70521	70335	29.45194	-100.95250	10/27/2005		420	110		T Bar Drilling	D
70523	70331	29.46861	-100.97917	10/31/2005		427	60		T Bar Drilling	D
71201	55428	30.28639	-100.79194	10/22/2005	2053	380	280	3	THORP WATER WELL DRILLING SERVICES	D
71203	55502	30.24750	-100.82417	10/29/2005	1972	380	340	2	THORP WATER WELL DRILLING SERVICES	D
71292	71403	29.46639	-101.00694	10/31/2005		427	100		T Bar Drilling	D
71438	70112	29.83889	-100.69333	10/4/2005		720	400		T Bar Drilling	D
71769	70334	29.44417	-100.97917	11/2/2005		427	120		T Bar Drilling	D
72687	71149	29.76306	-101.28250	11/8/2005		970	350		T Bar Drilling	D
72700	70331	29.46972	-100.98222	11/10/2005		440	60		T Bar Drilling	D
72706	70252	29.61500	-100.93694	11/17/2005		410	100		T Bar Drilling	D
73972	71236	29.66667	-101.13333	11/30/2005		900	396		T-BAR Drilling	D
73975	70331	29.47333	-100.97667	12/1/2005		447	80		T-BAR Drilling	D
73976	70331	29.47333	-100.97667	12/1/2005		447	80		T-BAR Drilling	D
73979	70252	29.61111	-100.94306	12/8/2005		340	45		T-BAR Drilling	D
73982	70335	29.45500	-100.95500	12/15/2005		425	100		T-BAR Drilling	D
73983	70336	29.42805	-100.88194	12/16/2005		220	60		T-BAR Drilling	D
73984	70335	29.44167	-100.95750	12/6/2005		465	80		T-BAR Drilling	D
77483	70334	29.43583	-100.98639	1/30/2006		410	100		T-BAR Drilling	D
77488	70334	29.43583	-100.98639	2/2/2006		210	50		T-BAR Drilling	Ir
77491	70334	29.44833	-100.99222	2/13/2006		410	100		T-BAR Drilling	D
77495	70334	29.44833	-100.99222	2/2/2006		450	100		T-BAR Drilling	D
77500	70264	29.54222	-100.83556	2/13/2006		110	50		T-BAR Drilling	D
77634	71328	29.51028	-101.05167	2/21/2006		430	100		T-BAR Drilling	D
80283	70347	29.39778	-100.86389	1/25/2006		68	31	18	J Randel Dissler	S
85004	70334	29.44694	-100.96306	4/24/2006		445	120		T-BAR Drilling	D
85006	70334	29.44556	-100.98000	3/2/2006		447	120		T-BAR Drilling	D
85007	71401	29.49806	-101.09278	3/8/2006		350	100		T-BAR Drilling	D
85009	70366	29.43917	-100.52278	4/20/2006		310	30		T-BAR Drilling	Ir
85011	70331	29.47333	-100.97555	3/7/2006		430	80		T-BAR Drilling	D
85013	70345	29.44222	-100.79833	4/22/2006		425	100		T-BAR Drilling	D
85018	70336	29.44139	-100.91417	4/27/2006		420	100		T-BAR Drilling	D
85020	70341	29.48750	-100.85278	5/5/2006		425	100		T-BAR Drilling	D
85031	70341	29.48750	-100.85500	2/24/2006		425	160		T-BAR Drilling	D
85034	70334	29.44667	-100.98417	3/1/2006		420	120		T-BAR Drilling	D
85035	71406	29.44500	-101.00861	5/10/2006		350	40		T-BAR Drilling	D
85169	70331	29.47194	-100.97750	4/5/2006		420	70		T-Bar Drilling Inc.	D
85171	70339	29.41250	-100.90694	4/13/2006		410	70		T-Bar Drilling Inc.	D
85172	71327	29.50139	-101.09000	3/29/2006		610	400		T-Bar Drilling Inc.	D
85173	54595	30.04639	-101.69250	4/8/2006		800	500		T-Bar Drilling Inc.	D
85174	70339	29.41167	-100.90722	4/10/2006		450	80		T-Bar Drilling Inc.	D
85447	54621	30.09944	-101.33861	6/2/2006		660		20-30	Lange Drilling Co.	D
87888	54624	30.06889	-101.37417	6/13/2006	1982	460	340	3	THORP WATER WELL DRILLING AND SERVICE	D
89086	70254	29.58167	-100.97139	3/15/2006		420	110		T-Bar Drilling Inc.	D
89892	70347	29.39750	-100.83750	1/10/2006		180	78	5	Bruce Drilling and Services	S
89898	70338	29.39611	-100.94056	1/24/2006		230	none	none	Bruce Drilling and Services	Ir
89902	71403	29.46556	-101.01861	2/22/2006		430	97	100	Bruce Drilling and Services	Ir
89904	70413	29.34722	-100.89694	3/5/2006		51	18	15	Bruce Drilling and Services	Ir
89906	70413	29.34778	-100.89778	3/16/2006		36	17	60	Bruce Drilling and Services	Ir
89951	70347	29.39750	-100.83750	5/29/2006		120	36	50	Bruce Drilling and Services	D
91159	70347	29.39583	-100.87167	7/29/2006		75	14	75	J Randel Dissler	S
93906	70332	29.46111	-100.95611	6/22/2006		425	100		T-Bar Drilling Inc.	D
93907	70332	29.46111	-100.95611	6/22/2006		365	90		T-Bar Drilling Inc.	D
93909	70331	29.46028	-100.96000	6/23/2006		440	130		T-Bar Drilling Inc.	D

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Driller's Reports for Wells Completed Since January 2004
Val Verde County, Texas

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93910	70345	29.44306	-100.79944	6/27/2006		310	150		T-Bar Drilling Inc.	D
94276	70332	29.46000	-100.95778	8/18/2006		425	140		T-Bar Drilling Inc.	D
94279	70331	29.46000	-100.95889	8/19/2006		425	150		T-Bar Drilling Inc.	D
94280	70382	29.45861	-100.32278	8/21/2006		425	120		T-Bar Drilling Inc.	D
94282	70331	29.46000	-100.95972	8/21/2006		425	110		T-Bar Drilling Inc.	D
94283	70331	29.45972	-100.96000	8/22/2006		425	120		T-Bar Drilling Inc.	D
94285	70335	29.45611	-100.94250	8/22/2006		425	140		T-Bar Drilling Inc.	D
94287	70332	29.46028	-100.95639	8/23/2006		425	90		T-Bar Drilling Inc.	D
94288	70334	29.44639	-100.96389	8/23/2006		450	110		T-Bar Drilling Inc.	D
94290	70334	29.44639	-100.96556	8/24/2006		450	110		T-Bar Drilling Inc.	D
94291	70335	29.45333	-100.93944	8/26/2006		455	160		T-Bar Drilling Inc.	D
94294	70357	29.39167	-100.74444	8/26/2006		180			T-Bar Drilling Inc.	D
94296	70357	29.39722	-100.74694	8/26/2006		130			T-Bar Drilling Inc.	D
94299	70357	29.39722	-100.74833	8/26/2006		305	60		T-Bar Drilling Inc.	D
95055	71483	29.36917	-101.00917	9/6/2006		42	10		T-Bar Drilling Inc.	D
95060	71483	29.37167	-101.00833	9/5/2006		42	10		T-Bar Drilling Inc.	D
99038	70339	29.39750	-100.88111	7/25/2006		480	200		T-Bar Drilling Inc.	D
99975	70335	29.44361	-100.91750	12/11/2006		520	165		T-Bar Drilling Inc.	P
100080	71328	29.51028	-101.05167	12/1/2006		420	200		T-Bar Drilling Inc.	D
100361	70252	29.61028	-100.91750	11/29/2006		430	130		T- Bar Drilling, Inc.	D
100364	70334	29.44444	-100.98305	11/10/2006		455	120		T- Bar Drilling, Inc.	D
100437	54624	30.05278	-101.36972	11/3/2006		605	490		T- Bar Drilling, Inc.	D
100492	70339	29.37667	-100.88528	11/6/2006		80	20		T- Bar Drilling, Inc.	D
100495	70339	29.37889	-100.88167	11/9/2006		55	12		T-Bar Drilling Inc.	D
100496	70342	29.49778	-100.83305	11/15/2006		605	207		T- Bar Drilling, Inc.	D
100498	70341	29.48055	-100.83806	11/16/2006		613	200		T- Bar Drilling, Inc.	D
100499	70341	29.48055	-100.83806	11/16/2006		613	200		T- Bar Drilling, Inc.	D
100501	70335	29.45639	-100.95083	11/30/2006		405	90		T- Bar Drilling, Inc.	D
100502	70331	29.46056	-100.99889	12/4/2006		430	140		T- Bar Drilling, Inc.	D
100518	70251	29.58583	-100.98000	12/1/2006		430	80		T- Bar Drilling, Inc.	D
104125	71169	29.77194	-101.00139	12/22/2006		555	190	20	T- Bar Drilling, Inc.	D
104128	70334	29.44667	-100.96139	1/4/2007		430	40	20	T-Bar Drilling Inc.	D
104132	70413	29.34472	-100.90361	1/8/2007		430	140	35	T- Bar Drilling, Inc.	D
104133	70432	29.35889	-100.68944	1/19/2007		235	20	20	T- Bar Drilling, Inc.	D
104134	71403	29.46250	-101.02417	1/12/2007		405	100	20	T- Bar Drilling, Inc.	D
104135	71403	29.46028	-101.01083	1/12/2007		405	100	20	T- Bar Drilling, Inc.	D
104136	71403	29.46028	-101.01083	1/12/2007		405	100	20	T- Bar Drilling, Inc.	D
104137	70335	29.42472	-100.92083	1/12/2007		205	60	35	T- Bar Drilling, Inc.	D
104138	70336	29.43361	-100.91000	1/15/2007		405	140		T- Bar Drilling, Inc.	D
104139	70338	29.37611	-100.95583	1/18/2007		235	50	20	T- Bar Drilling, Inc.	D
104145	70336	29.42278	-100.90028	1/23/2007		235	50	20	T- Bar Drilling, Inc.	D
104147	70252	29.60806	-100.95167	2/2/2007		405	120	35	T- Bar Drilling, Inc.	D
104593	70338	29.38861	-100.95250	2/1/2007		405	45	20	T-Bar Drilling Inc.	D
104597	70339	29.41417	-100.90806	1/31/2007		485	40	35	T- Bar Drilling, Inc.	D
105298	71401	29.49750	-101.09417	2/21/2007		480	82	20	T- Bar Drilling, Inc.	D
105305	70413	29.34472	-100.90028	2/12/2007		55	15	8	T-Bar Drilling Inc.	D
105582	71023	29.98917	-101.77778	2/27/2007		900	497.5		Geoprojects International, Inc	D
106256	71403	29.46917	-101.01500	2/8/2007		530	75	150	T- Bar Drilling, Inc.	P
106257	71403	29.46917	-101.01500	2/21/2007		455	50	20	T- Bar Drilling, Inc.	D
107277	71031	29.98417	-101.73500	3/20/2007		940			Geoprojects International, Inc.	S
111814	70332	29.46028	-100.95694	3/15/2007		430	80	20	T- Bar Drilling, Inc.	D
111820	70342	29.48472	-100.81667	3/19/2007		605	240	20	T- Bar Drilling, Inc.	D
111821	71223	29.71028	-101.25250	4/18/2007		505	375		T-Bar Drilling Inc.	D
111823	70117	29.78528	-100.73028	4/19/2007		505	345		T- Bar Drilling, Inc.	D
111840	70177	29.63194	-100.99694	3/23/2007		710	295		T-Bar Drilling Inc.	D
111851	70334	29.45750	-100.97444	3/16/2007		455	140	20	T- Bar Drilling, Inc.	D
112515	70331	29.46944	-100.98889	5/8/2007		405	110	20	T- Bar Drilling, Inc.	D

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Driller's Reports for Wells Completed Since January 2004
Val Verde County, Texas

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113635	70334	29.45611	-100.98806	7/17/2006		420	69	100	Bruce Drilling and Services	D
113636	70347	29.40278	-100.83472	9/14/2006		100	71	75	Bruce Drilling and Services	D
113637	70331	29.46556	-100.99861	9/10/2006		410	106	100	Bruce Drilling and Services	D
113638	71328	29.51167	-101.05194	10/7/2006		440	53	100	Bruce Drilling and Services	D
113640	70334	29.43444	-100.96611	2/17/2007		342	78	50	Bruce Drilling and Services	D
114454	70251	29.59111	-100.97889	5/15/2007		405	105	25	T- Bar Drilling, Inc.	D
114457	70335	29.45722	-100.95444	6/1/2007		430	85	25	T-Bar Drilling Inc.	D
114460	71401	29.49694	-101.09583	6/4/2007		425	95	20	T- Bar Drilling, Inc.	D
114461	71329	29.53806	-101.03806	6/5/2007		305	110	25	T- Bar Drilling, Inc.	D
114462	70098	29.77333	-100.91750	6/7/2007		505	290		T- Bar Drilling, Inc.	D
114464	70178	29.62500	-100.92805	6/11/2007		410	80	25	T- Bar Drilling, Inc.	D
114983	70335	29.42417	-100.92250	6/19/2007		230	60	25	T-Bar Drilling Inc.	D
115179	70339	29.38139	-100.87861	6/20/2007		130	35	25	T- Bar Drilling, Inc.	D
115182	70339	29.38055	-100.87889	6/20/2007		130	30		T- Bar Drilling, Inc.	D
116332	70347	29.40056	-100.86583	5/29/2007		40	12	42	Randel Dissler	S
116510	70334	29.44056	-100.96361	7/3/2007		430	180	25	T- Bar Drilling, Inc.	D
117964	70413	29.34944	-100.90778	7/11/2007		55	8	12	T- Bar Drilling, Inc.	D
117967	70335	29.45694	-100.95389	7/12/2007		430	120	25	T- Bar Drilling, Inc.	D
117968	71401	29.49028	-101.09861	7/20/2007		430	140	25	T-BAR Drilling	D
117978	70328	29.51000	-100.05333	7/23/2007		430	120	25	T- Bar Drilling, Inc.	D
119463	70331	29.46306	-100.99361	8/8/2007		430	125	8	T- Bar Drilling, Inc.	D
119465	70268	29.50389	-100.81889	8/8/2007		480	140	25	T- Bar Drilling, Inc.	D
121649	54449	30.28361	-101.50333	7/23/2007		505	390	10	T- Bar Drilling, Inc.	D
123583	70251	29.59917	-100.95861	9/24/2007		420	120	20	T- Bar Drilling, Inc.	D
125129	70335	29.45694	-100.95361	10/10/2007		430	95	25	T-BAR Drilling	D
125131	70331	29.46500	-100.97528	10/9/2007		430	105	25	T- Bar Drilling, Inc.	D
125822	70412	29.36028	-100.94250	10/18/2007		435	365	5	T- Bar Drilling, Inc.	D
125824	70336	29.41917	-100.91500	10/19/2007		455	105	25	T- Bar Drilling, Inc.	D
127943	70331	29.46639	-100.98861	11/20/2007		430	95	20	T- Bar Drilling, Inc.	D
131732	71328	29.51000	-101.04889	1/8/2008		430	90	200	T- Bar Drilling, Inc.	D
131737	70334	29.44500	-100.96250	12/21/2007		455	120	25	T- Bar Drilling, Inc.	D
131742	70347	29.39944	-100.86805	12/12/2007		130	20	25	T- Bar Drilling, Inc.	D
134433	70336	29.42417	-100.89917	1/14/2008		220	60		T-Bar Drilling Inc.	D
137107	54633	30.09778	-101.15750	3/2/2005		420	320	15	Lange Drilling Co., Inc.	D
137113	55427	30.28667	-100.86417	3/9/2005		380	305	5-8	Lange Drilling Co., Inc.	D
137121	54528	30.12917	-101.56861	3/11/2005			40	100	Lange Drilling Co., Inc.	D
137314	70335	29.45667	-100.95667	1/31/2008		430	115		T-Bar Drilling Inc.	D
137317	70411	29.37194	-100.96556	2/15/2008		205	55		T- Bar Drilling, Inc.	D
137323	70331	29.46722	-100.97861	2/29/2008		430	110		T- Bar Drilling, Inc.	D
137901	71068	29.87833	-101.30417	1/17/2008		1005	355		T- Bar Drilling, Inc.	D
140816	70251	29.59194	-100.96583	1/29/2008		430	100		T- Bar Drilling, Inc.	D
141142	70335	29.45778	-100.95556	10/1/2007		400	110		T-Bar Drilling Inc.	D
142880	70335	29.42444	-100.92278	4/3/2008		185	40	12	T- Bar Drilling, Inc.	D
143029	71326	29.54389	-101.03917	4/22/2008		355	85	40	T- Bar Drilling, Inc.	D
143043	71327	29.50139	-101.09333	4/24/2008		430	110	30	T- Bar Drilling, Inc.	D
143053	71328	29.50611	-101.05361	4/30/2008		405	140	30	T- Bar Drilling, Inc.	D
143061	70335	29.45806	-100.95472	4/28/2008		430	150	35	T- Bar Drilling, Inc.	D
143067	70332	29.45833	-100.95333	4/29/2008		405	150	35	T- Bar Drilling, Inc.	D
143072	70335	29.45778	-100.95361	5/8/2008		405	130	35	T- Bar Drilling, Inc.	D
143534	70334	29.45556	-100.96583	5/6/2008		430	140	35	T- Bar Drilling, Inc.	D
143535	70335	29.45778	-100.95500	5/7/2008		405	150	35	T-Bar Drilling Inc.	D
143682	70258	29.53250	-100.94861	5/2/2008		405	140		T-Bar Drilling Inc.	D
143691	70332	29.45889	-100.95667	5/5/2008		430	120		T- Bar Drilling, Inc.	D
143693	70112	29.86056	-100.69417	5/15/2008		755	556	8	T- Bar Drilling, Inc.	D
144906	70339	29.39500	-100.88305	9/11/2007		460	171	12	Bollinger Drilling	D
144914	70331	29.46722	-100.97611	4/22/2008		420	160	30	Bollinger Drilling	D
144917	70181	29.73583	-100.83667	4/20/2008		730	530	8	Bollinger Drilling	D

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Driller's Reports for Wells Completed Since January 2004
Val Verde County, Texas

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144996	70331	29.47444	-100.98861	7/1/2007		430	160	12	Bollinger Drilling	D
145002	71328	29.52055	-101.06278	8/5/2007		450	120	12	Bollinger Drilling	D
145003	71328	29.52055	-101.06278	11/23/2007		400	110	12	Bollinger Drilling	D
145009	70331	29.47083	-100.99889	7/3/2007		440	165	12	Bollinger Drilling	D
145015	71318	29.53167	-101.16750	6/16/2007		420	140	12	Bollinger Drilling	D
145017	70347	29.37528	-100.84278	4/28/2008		450	140	10	Bollinger Drilling	D
145023	70357	29.38500	-100.73917	8/21/2007		75	45	20	Bollinger Drilling	D
145027	70347	29.40556	-100.86361	7/15/2007		55	30	90	Bollinger Drilling	Ir
145030	70412	29.34333	-100.92305	5/25/2008		30	6	30	Bollinger Drilling	S
145187	71243	29.74361	-101.03694	12/17/2006		180	110	30	Bollinger Drilling	D
145196	70413	29.34944	-100.87805	2/28/2008		450		25	Bollinger Drillilng	D
145204	70183	29.73055	-100.77278	8/29/2007		530	330		Bollinger Drilling	D
145209	71403	29.47222	-101.02917	2/13/2007		440	310	50	Bollinger Drilling	D
145210	71182	29.74361	-101.79778	4/28/2007		670	455	8	Bollinger Drilling	D
145212	70334	29.42750	-100.98778	7/14/2007		450	165	12	Bollinger Drilling	D
145214	70021	29.98000	-100.86944	11/24/2007		500	305	7	Bollinger Drilling	D
145216	70337	29.39000	-100.99611	7/16/2007		430	170	12	Bollinger Drilling	D
145218	71243	29.73639	-101.04028	11/26/2006		300	110	30	Bollinger Drilling	D
145490	70112	29.86056	-100.69417	5/15/2008		755	556	8	T-Bar Drilling	D
147612	70335	29.42417	-100.92222	6/6/2008		255	35		T-Bar Drilling	D
148114	54551	30.22500	-101.24861	6/9/2008		305	160		T-Bar Drilling	D
148274	70334	29.42861	-100.97111	12/17/2007		450	160	12	Bollinger Drilling	D
148277	70334	29.43000	-100.96472	8/27/2007		450	160	12	Bollinger Drilling	D
148381	54613	30.10972	-101.40028	3/10/2008		840	480	7	Bollinger Drilling	D
148655	54543	30.24139	-101.26611	6/11/2008		305	215		T-Bar Drilling	D
148658	70332	29.45833	-100.95333	6/12/2008		405	110	20	T-Bar Drilling	D
149853	70347	29.38389	-100.84889	6/26/2005		80	35	80	Bruce Drilling and Services	D
149854	71406	29.45778	-101.02861	7/10/2005		420	97	100	Bruce Drilling and Services	D
149856	70334	29.44833	-100.97389	8/5/2005		375	107	75	Bruce Drilling and Services	D
150130	70094	29.79694	-100.98861	11/3/2004		220	118	16	Bruce Drilling & Services	D
150140	70097	29.78861	-100.98806	9/20/2004		100	74	40	Bruce Drilling & Services	D
150146	54624	30.06944	-101.34167	6/7/2004		570	421	12	Bruce Drilling & Services	D
150154	70347	29.38389	-100.84889	5/24/2005		110	40	60	Bruce Drilling & Services	D
150162	70335	29.42944	-100.94111	4/29/2005		310	92	16	Bruce Drilling & Services	D
150216	71401	29.48722	-101.09722	3/31/2005		440	68	100+	Bruce Drilling and Services	D
150231	70339	29.41111	-100.91056	2/25/2005		180	97	25	Bruce Drilling and Services	D
151941	71318	29.51917	-101.17000	6/24/2008		405	85	25	T-Bar Drilling	D
151943	70024	29.95389	-100.86389	7/9/2008		505	196	10	T-Bar Drilling	D
151945	54624	30.05333	-101.36444	7/18/2008		630	450	25	T-Bar Drilling	D

1) Surface elevations from driller's records where noted.
2) Well Use Codes:
D - Domestic
Ir - Irrigation
P - Public Supply
S - Stock
T - Test
3) Monitoring and environmental wells are not included in this table.

Appendix B

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

December 11, 2008

Mr. Mitchell Lomas
City of Del Rio, Water Treatment Plant
264 San Felipe Springs Road
Del Rio, TX 78840

Re: Authorization and Registration of Class V Tracer Dye Study Injection Wells
TCEQ Authorization No. 5X2500114/ARTS12545052
CN600756290/RN102289949
Y-Well, City of Del Rio
US Hwy 277
Del Rio, TX

Dear Mr. Lomas:

The Underground Injection Control (UIC) staff has completed review of the inventory/authorization form dated November 19, 2008 requesting approval of injection of a dye tracer with potable water via an existing well for a groundwater tracer dye study at the above site. Based on our review, approval is hereby given for construction and operation of the injection wells according to the submitted plans and specifications.

This authorization relates only to the pilot test. In order to maintain authorization by rule for the injection operations, the project must meet all requirements set by the UIC rules provided by 30 TAC, Chapter 331. Requirements for the injection include:

1. All injection wells are to be constructed to meet the standards provided in 30 TAC §331.132;

2. Closure reports including injection well monitoring data (injection volumes, pressures, and results) shall be submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 within 60 days of project completion;

3. Operational and status changes shall be reported to and approved by the UIC Permits Team;

4. Additional injection activities relating to the tracer study shall be submitted to the UIC Permits Team, Industrial and Hazardous Waste Permits Section, at mail code MC-130 prior to injection.

If you have any questions regarding this matter, please contact me at (512) 239-6075. If you will be corresponding by mail, please use mail code MC-130.

Sincerely,

Bryan Smith, Project Manager
Industrial and Hazardous Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

BS/ff

cc: Mr. Marcus Gary, Zara Environmental, LLC, Buda, TX

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

December 12, 2008

Mr. Mitchell Lomas
City of Del Rio, Water Treatment Plant
264 San Felipe Springs Road
Del Rio, TX 78840

Re: Authorization and Registration of Class V Tracer Dye Study Injection Wells
TCEQ Authorization No. 5X2500115/ARTS 12545063
CN600756290/RN102289949
Agarita, City of Del Rio
US Hwy 277
Del Rio, TX

Dear Mr. Lomas:

The Underground Injection Control (UIC) staff has completed review of the inventory/authorization form dated December 8, 2008 requesting approval of injection of a dye tracer with potable water via an existing well for a groundwater tracer dye study at the above site. Based on our review, approval is hereby given for construction and operation of the injection wells according to the submitted plans and specifications.

This authorization relates only to the pilot test. In order to maintain authorization by rule for the injection operations, the project must meet all requirements set by the UIC rules provided by 30 TAC, Chapter 331. Requirements for the injection include:

1. All injection wells are to be constructed to meet the standards provided in 30 TAC §331.132;

2. Closure reports including injection well monitoring data (injection volumes, pressures, and results) shall be submitted to the UIC Permits Team, Industrial & Hazardous Waste Permits Section, at mail code MC-130 within 60 days of project completion;

3. Operational and status changes shall be reported to and approved by the UIC Permits Team;

4. Additional injection activities relating to the tracer study shall be submitted to the UIC Permits Team, Industrial & Hazardous Waste Permits Section, at mail code MC-130 prior to injection.

If you have any questions regarding this matter, please contact me at (512) 239-6075. If you will be corresponding by mail, please use mail code MC-130.

Sincerely,

Ben Knape, for

Bryan Smith, Project Manager
Industrial & Hazardous Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

BS/fp

cc: Mr. Marcus Gary, Zara Environmental, LLC, Buda

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

December 16, 2008

Mr. C. J. Bitters
Dooley Estates
P. O. Box 6
Brackettville, TX 78832

Re: Authorization and Registration of Class V Tracer Dye Study Injection Wells
TCEQ Authorization No. 5X2500116/ARTS 12551208
CN603431818/RN105662555
Dooley Well
FM 2804
Brackettville, TX

Dear Mr. Bitters:

The Underground Injection Control (UIC) staff has completed review of the inventory/authorization form dated December 8, 2008 requesting approval of injection of a dye tracer with potable water via an existing well for a groundwater tracer dye study at the above site. Based on our review, approval is hereby given for construction and operation of the injection wells according to the submitted plans and specifications.

This authorization relates only to the pilot test. In order to maintain authorization by rule for the injection operations, the project must meet all requirements set by the UIC rules provided by 30 TAC, Chapter 331. Requirements for the injection include:

1. All injection wells are to be constructed to meet the standards provided in 30 TAC §331.132;

2. Closure reports including injection well monitoring data (injection volumes, pressures, and results) shall be submitted to the UIC Permits Team, Industrial & Hazardous Waste Permits Section, at mail code MC-130 within 60 days of project completion;

3. Operational and status changes shall be reported to and approved by the UIC Permits Team;

4. Additional injection activities relating to the tracer study shall be submitted to the UIC Permits Team, Industrial & Hazardous Waste Permits Section, at mail code MC-130 prior to injection.

If you have any questions regarding this matter, please contact me at (512) 239-6075. If you will be corresponding by mail, please use mail code MC-130.

Sincerely,

Bryan Smith, Project Manager
Industrial & Hazardous Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

BS/ff

cc: Mr. Marcus Gary, Zara Environmental, LLC, Buda, TX

Appendix C

Table C1 Water Level Measurements

State Well Number or Other Well ID	Well Name	Owner	Date of Water Level Measurement	Elevation of Land Surface Datum (feet AMSL)	Depth to Water (feet) below LS	Water Level Elevation (feet AMSL)	Measuring Entity*
54-55-904	Mayfield HQ	Mayfield Ranch	2/28/2008	1744	80.8	1663	TWDB
			9/10/2008	1744	85.5	1659	TWDB
54-56-403		Byron Hodge	2/20/2008	1710	29.2	1681	TWDB
54-62-302	Ricardo Well	Blue Hills Ranch	2/27/2008	1960	308.3	1652	TWDB
			9/10/2008	1960	308.5	1652	TWDB
54-62-603	Pompa Sur	Blue Hills Ranch	9/10/2008	1990	402.8	1587	TWDB
54-63-403	Dos Pilas Well	Blue Hills Ranch	2/27/2008	1820	209.4	1611	TWDB
			9/10/2008	1820	208.9	1611	TWDB
54-64-102	HiWay Well	Cauthorn Ranch	2/28/2008	1670	26.2	1644	TWDB
			9/10/2008	1670	26.2	1644	TWDB
54-64-401	Paulins Well	Cauthorn Ranch	2/28/2008	1690	61.5	1629	TWDB
			9/10/2008	1690	68.5	1622	TWDB
54-64-404	Oilfield #1 Well	Cauthorn Ranch	2/28/2008	1728	148.9	1579	TWDB
			9/10/2008	1728	145.9	1582	TWDB
54-64-701	Corral Well	Baker/Ward	2/28/2008	1780	203.8	1576	TWDB
			9/10/2008	1780	202.6	1578	TWDB
54-64-703	Pila Grande Well	Baker/Ward	2/28/2008	2027	438.3	1589	TWDB
55-63-709		City of Rocksprings	2/20/2008	2402	413.4	1989	TWDB
55-63-803		City of Rocksprings	2/21/2008	2403	414.3	1989	TWDB
70-01-104	Hell's Gap Mill	Devil's River SNA	2/26/2008	1640	172.3	1468	TWDB
70-01-406	Home Well	Devil's River SNA	2/25/2008	1520	62.2	1458	TWDB
			9/9/2008	1520	66.6	1453	TWDB
70-01-407	Newton Place Mill	Devil's River SNA	2/25/2008	1463	41.9	1421	TWDB
			9/9/2008	1463	46.3	1417	TWDB
70-01-501	East Canyon Mill	Devil's River SNA	2/26/2008	1618	150.2	1468	TWDB
			9/9/2008	1618	157.1	1461	TWDB
70-01-707	Leon Spring Canyon Mouth Well	Dolan Falls Preserve	2/26/2008	1380	55.2	1325	TWDB
			9/9/2008	1380	55.1	1325	TWDB
70-01-802	Rio Vista #5	Rio Vista Ranch	2/26/2008	1580	138.8	1441	TWDB
			9/9/2008	1580	151.7	1428	TWDB
70-01-804	Nolan Mott Mill	Devil's River SNA	2/26/2008	1890	428.7	1461	TWDB
			9/9/2008	1890	452	1438	TWDB
70-01-902	Rio Vista #3	Rio Vista Ranch	2/26/2008	1581	107.8	1473	TWDB
			9/9/2008	1581	122	1459	TWDB
70-09-201	Rio Vista #8	Rio Vista Ranch	2/26/2008	1410	72.5	1338	TWDB
			9/9/2008	1410	80.9	1329	TWDB
70-09-204	Rio Vista #2	Rio Vista Ranch	2/26/2008	1550	173.5	1377	TWDB
			9/9/2008	1550	190.1	1360	TWDB
70-09-802	DRR-E1, Solar Panel Well	Devil's River Ranch	2/25/2008	1738	510.5	1228	TWDB
			9/8/2008	1738	508.8	1229	TWDB
70-17-302	DRR-1A	Devil's River Ranch	2/25/2008	1590	354.2	1236	TWDB
			9/8/2008	1590	328.5	1262	TWDB
70-17-401			7/7/2008	1464	321.6	1143	IBWC
70-25-603			7/25/2008	1219	73.5	1146	IBWC
70-26-102			7/25/2008	1351	166	1186	IBWC
70-29-101		Texas Parks & Wildlife -	3/26/2008	1634	187.8	1446	LBG-Guyton
70-29-102		Texas Parks & Wildlife - Kickapoo	3/26/2008	1718	246	1472	LBG-Guyton
			9/10/2008	1718	270.3	1448	LBG-Guyton
70-29-201		Texas Parks & Wildlife - Kickapoo	3/26/2008	1725	258.5	1466	LBG-Guyton
			9/10/2008	1725	203.4	1522	LBG-Guyton
70-33-302			9/10/2008	1214	128.2	1086	TWDB
70-33-508		Trail West	2/20/2008	1130	115.6	1015	TWDB
			9/10/2008	1170	114.5	1056	TWDB
70-33-604		Charles Kelley	2/20/2008	1259	140.7	1118	TWDB
			9/10/2008	1160	139.3	1021	TWDB
70-36-201		David Winters	4/2/2008	1247	36.4	1211	LBG-Guyton
			9/9/2008	1247	36.7	1210	LBG-Guyton
70-37-501	WM behind house	Shahan	4/3/2008	1256	56.9	1199	LBG-Guyton
			9/10/2008	1257	63.5	1194	LBG-Guyton

State Well Number or Other Well ID	Well Name	Owner	Date of Water Level Measurement	Elevation of Land Surface Datum (feet AMSL)	Depth to Water (feet) below LS	Water Level Elevation (feet AMSL)	Measuring Entity*
70-37-704		Dooley Ranch	3/27/2008	1197	+7.0 above LS	1204	LBG-Guyton
			9/9/2008	1193	+4.4 above LS	1197	LBG-Guyton
70-37-803		Coates Property (Haby)	3/27/2008	1196	14.4	1182	LBG-Guyton
			9/10/2008	1195	16.1	1181	LBG-Guyton
70-37-804		Coates Property (Haby)	3/27/2008	1197	15	1182	LBG-Guyton
			9/10/2008	1197	16.7	1180	LBG-Guyton
70-37-805		Coates Property (Haby)	3/27/2008	1197	14.7	1182	LBG-Guyton
			9/10/2008	1197	16.3	1181	LBG-Guyton
70-37-807		Coates Property (Haby)	3/27/2008	1201	6.5	1195	LBG-Guyton
			9/10/2008	1201	9.5	1192	LBG-Guyton
70-37-902	Irrigation Well	Shahan - Alamo Village	4/3/2008	1236	39.3	1197	LBG-Guyton
			9/10/2008	1237	46.4	1191	LBG-Guyton
70-38-603	MW-4	Ray Smith	3/19/2008	1355	156.5	1199	LBG-Guyton
			9/8/2008	1355	157.7	1197	LBG-Guyton
70-38-902	Monitor	Edwards Aquifer Authority	3/26/2008	1375	181	1194	LBG-Guyton
70-38-908	MW-5	Ray Smith	3/19/2008	1367	179.3	1188	LBG-Guyton
			9/8/2008	1367	180.5	1187	LBG-Guyton
70-44-601		Tom "Doc" Dorrell	4/3/2008	1075	153.3	922	LBG-Guyton
			9/9/2008	1077	154	923	LBG-Guyton
70-45-401		Hotel West Brackettville on 90	3/25/2008	1130	24	1106	LBG-Guyton
			9/9/2008	1130	23.9	1106	LBG-Guyton
70-45-503	Well #2	City of Brackettville	3/25/2008	1112	1.6	1110	LBG-Guyton
			9/5/2008	1116	1.3	1115	City Staff
70-45-505	East Well	Fort Clark MUD	3/25/2008	1107	1.8	1105	LBG-Guyton
			9/9/2008	1110	1.2	1106	LBG-Guyton
70-45-601	Well #1	City of Brackettville	3/25/2008	1113	14.4	1099	LBG-Guyton
			9/5/2008	1114	15	1099	City Staff
70-46-103	PVC Monitor	John Boersching	4/3/2008	1278	157	1121	LBG-Guyton
			9/10/2008	1279	157	1122	LBG-Guyton
70-46-202		Cecil Smith	3/26/2008	1320	195.6	1124	LBG-Guyton
			9/8/2008	1321	204.8	1116	LBG-Guyton
70-46-705		Don Hood	4/2/2008	1131	24.3	1107	LBG-Guyton
			9/9/2008	1131	33.5	1098	LBG-Guyton
70-46-706		Don Hood	4/2/2008	1132	60.5	1100	LBG-Guyton
			9/9/2008	1132	66.4	1100	LBG-Guyton
70-46-802	Well 2West Well	TXDOT Roadside Park Well - I90 and Elm Creek	3/27/2008	1085	17.1	1068	LBG-Guyton
			9/10/2008	1087	21.6	1065	LBG-Guyton
70-46-901		Sulfur WM - WM @ 90 (Donna Schuster)	4/2/2008	1118	73.2	1045	LBG-Guyton
			9/10/2008	1119	88.7	1029	LBG-Guyton
71-07-102	Grace Well	Prosser Ranch	2/27/2008	1810	188.9	1621	TWDB
			9/10/2008	1810	184.1	1626	TWDB
71-07-601	Camino Well	Rose Ranch	2/27/2008	1578	121.8	1456	TWDB
			9/10/2008	1578	113.8	1464	TWDB
71-08-401	Cabina Well	A.O. Baker Ranch	2/28/2008	1475	35.8	1439	TWDB
			9/10/2008	1475	33.1	1442	TWDB
71-08-902	West Pasture Well	Dolan Falls Preserve	2/26/2008	1763	413.9	1349	TWDB
			9/9/2008	1763	410.3	1353	TWDB
71-12-502		Langtry WSC	2/20/2008	1399	294	1105	TWDB
			9/11/2008	1400	296	1104	TWDB
71-14-702			7/7/2008	1400	287	1113	IBWC
71-15-201	Casa Well	Rose Ranch	2/27/2008	1718	313.7	1404	TWDB
			9/10/2008	1718	296.9	1421	TWDB
71-15-501			7/10/2008	1699	380.9	1318	IBWC
71-22-801			7/21/2008	1305	192.9	1112	IBWC
71-23-802			7/23/2008	1421	270.4	1150	IBWC
71-23-901		F. H. Whitehead	2/20/2008	1470	326.8	1143	TWDB
71-31-401			7/23/2008	1189	85.6	1103	IBWC
71-40-201			7/16/2008	1161	76	1085	IBWC
71-40-602			7/30/2008	1138	73.4	1065	IBWC

State Well Number or Other Well ID	Well Name	Owner	Date of Water Level Measurement	Elevation of Land Surface Datum (feet AMSL)	Depth to Water (feet) below LS	Water Level Elevation (feet AMSL)	Measuring Entity*
Latitude/ Longitude							
29.79014/ -100.40539	E041205-1N	Keith Hale	10/8/2008	1862	118.2	1744	RECRD
29.64158/ -10045089	E051908-2N	Boyd Nutt	10/8/2008	1892	538.2	1354	RECRD
29.79019/ -100.39583	E061808-1N	Harold Black	10/8/2008	1890	119.4	1771	RECRD
29.84183/ -100.40272	E080408-1N	Gary Flores	10/8/2008	1934	99.2	1834	RECRD
29.418306/ -100.264028	MW-1	Ray Smith	3/19/2008	1347	149.3	1198	LBG-Guyton
			9/8/2008	1347	148.9	1198	LBG-Guyton
29.416667/ -100.270583	MW-2	Ray Smith	9/8/2008	1350	157.1	1193	LBG-Guyton
29.408278/ -100.273389	MW-3	Ray Smith	3/19/2008	1398	215.8	1182	LBG-Guyton
			9/8/2008	1398	218.8	1179	LBG-Guyton
29.15054/ -100.34410		Jack Fields	3/25/2008	1042	24.3	1018	LBG-Guyton
			9/9/2008	1042	16	1024	LBG-Guyton
29.288722/ -100.542139	Irrigation 1	Dos Angeles - Condry Farm - Jack Fields	9/9/2008	1072	2.4	1069	LBG-Guyton
29.286167/ -100.538444	Irrigation 2	Dos Angeles - Condry Farm - Jack Fields	9/9/2008	1073	3	1070	LBG-Guyton
29.233556/ -100.118056	Irrigation Well	Gun Hill (Paul Mazak)	9/10/2008	1075	58.2	1017	LBG-Guyton
29.364056/ -100.349722	Near Center Pivot	John Boersching	4/3/2008	1281	161.2	1120	LBG-Guyton
			9/10/2008	1281	161.8	1119	LBG-Guyton
29.68681/ -100.69744		Darrell Apffel	10/8/2008	1673	410.2	1263	RECRD
29.80011/ -100.67808	Unknown Old Well		10/8/2008	1897	252.4	1645	RECRD

* TWDB Texas Water Development Board
IBWC International Boundary and Water Commission
RECRD Real-Edwards Conservation and Reclamation District

Appendix D

1st Response to TWDB Comments on Draft Final Report
for Plateau Region-Specific Study #1
(TWDB Contract No. 0704830695)

Acquisition of GW Data for Model Development in
Edwards, Kinney, and Val Verde Counties

1. Please submit all data and maps in electronic format along with the final reports as stated in the contract between TWDB and Region J. The appropriate format is specified on TWDB web site http://www.twdb.state.tx.us/GwRD/HEMON/gwdatasub.asp. The updated User's Manual on the web site will have the correct codes.

   Response: Data, maps and reports are provided in electronic format.

2. The contract Scope of Work (SOW) Task 1 states that an *interim deliverable will be the credentials for peer-review committee members*. Please provide information listing the qualifications of these members in the final report.

   Response: The position and affiliation of the committee members is listed. The Planning Group felt that each of these members had the most personal knowledge of hydrologic conditions in their specific location. Each of the committee members also assisted in soliciting landowner cooperation during field data acquisition activities.

3. The contract SOW Task 2 states *extract data of importance to aquifer characterization* from recent studies. Please consider including maps in the final report that will illustrate and define the narrative statements made in Sections 3.1 and 3.4 regarding this data.

   Response: The IBWC reports do not contain maps that define the narrative that is provided in this report. We also did not attempt to gain permission to reproduce maps from authors of other listed reports other than TWDB reports.

4. The contract SOW Task 3.B. states that there will be *coordination with the Science Review Panel (SRP) and other entities (TWDB; groundwater conservation districts–GCDs; Edwards Aquifer Authority –EAA; U.S. Geological Survey–USGS) to develop a consistent approach for all tracer studies.* Please include a discussion of this coordination in the final report.

   Response: Statement added in last paragraph of Section 4.0.

5. The contract SOW Task 3.C. states that *a "Go-No Go" strategy will be built to allow TWDB assurance that participating entities are in agreement with the plan and methods*. Please include discussion on the "Go-No Go" strategy in the final report.

   Response: Statement added in last paragraph of Section 4.0.

6. The contract SOW Task 3.G. states that an *Interim deliverable will be a memorandum describing the results and findings of each tracer test preformed*. Please include this memorandum in the final report.

   Response: The memorandum report was converted directly into the original draft report for review by the SRP and Planning Group. Including this memorandum report will add confusing duplication to the final report. We will be glad to provide the Zara consulting memorandum report upon request.

7. The contract SOW Task 4.G. states that an *Interim deliverable will be a memorandum illustrating wells measured and the resulting potentiometric map*. Please include this memorandum and the potentiometric map developed for the specific wells measured in this study in the final report.

   Response: As stated in Comment 6 above, well locations, measurement data, and evaluation results were incorporated directly into the original draft report for review by the SRP and Planning Group. Figure 5.3 is the potentiometric map developed from the project data.

8. Pages 1-1 and 2-1: Please specify when the Edwards-Trinity Plateau GAM was developed and provide clear delineations for data "not available during the development" of the GAM (as was done for Section 6.0). Also, throughout the report, please delineate data that already exists in the TWDB's databases.

   Response: September 2004 is added to both sections. Further delineation of data origin is provided throughout the report where possible.

9. Figure 4.6 shows an injection site at Boershig Irrigation Well. In the final report, please include this injection site in the Chapter 4 discussion.

   Response: The Boershig well was a contemporaneous EAA injection site as discussed in paragraph 3 of Section 4.4.

10. Section 7.0, Recommendations: In the final report, please specify how the data obtained from this study can directly integrate into and improve the existing Edwards-Trinity Plateau GAM, as was stated as the project's goal on page 1-1, sentence 2.

    Response: The requested statement is provided in the last paragraph of Section 7.0.

2nd Response to TWDB Comments on
Final Report for Plateau Region-Specific Study #1
(TWDB Contract No. 0704830695)

Acquisition of GW Data for Model Development in
Edwards, Kinney, and Val Verde Counties

General:

1. Please provide hard copies of revised final report for Study 1.

Response: Nine hard copies of the revised report are provided.

2. Please provide a new CD with all final & revised final digital reports and associated data for this contract. (2 copies please)

Response: Two new CDs are provided.

Study #1: Acquisition of GW Data for Model Development in Edwards, Kinney, & Val Verde Counties

1. Regarding the 'TWDB General Comment' – Digital data was missing from the CD: missing data files were received separately from consultant 9-9-09; please include this digital data on the new CD to be submitted. Please note that the CD should contain all digital deliverables for the contract, not just Study #1 digital files.

Response: New CDs contain all required digital deliverables.

2. Regarding Comment #6: Please reference in the final report text that the entire technical memorandum from Zara (required interim deliverable) was incorporated into this report. Also please correct the title of Table 4.2 – should be for Kinney Co. And specifically for Kinney Co tracer detection results, please provide brief explanation of why there is not an equivalent time-intensity graph to Figure 4.4 that was produced for Val Verde County.

Response: The Zara technical memorandum is discussed in the last paragraph of Section 4.0. Title of Table 4.2 is changed to Kinney County. An explanation of why a

time-intensity graph was not produced for Kinney County data is provided in the last sentence of the first paragraph in Section 4.4.3.

3. Regarding Comment #7: Please reference in the final report text that the entire technical memorandum from LBG-Guyton (required interim deliverable) was incorporated into this report; and please note in the report text that Figure 5.3 is the required potentiometric map. Please provide a definition/context of the term "synoptic water level measurement".

Response: The LBG-Guyton technical memorandum and the note pertaining to Figure 5.3 are discussed in the last sentence of the second paragraph of Section 5.0. A definition of "synoptic water level measurement" is provided in the second sentence of the first paragraph of Section 5.0.

4. Regarding Comment #9: Please provide explanation in the final report text [Section 4.4 paragraphs 2 and 3; and report text on page 4-17] why there is no Task 2 data analysis provided for dye tracer studies involving the Boerschig irrigation well that were performed by the EAA (February 15, 2008 report and repeat dye trace conducted on 12-16-08). Please also provide EAA webpage link in the text where readers will be able to find this info once the EAA finalizes their studies/reports.

Response: An explanation of the availability of EAA tracer data and results and a link to the EAA website is provided in the last two sentences of the second paragraph in section 4.4.3.