POULTRY OPERATIONS STUDY
GUADALUPE RIVER BASIN

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POULTRY OPERATIONS STUDY
GUADALUPE RIVER BASIN

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Texas Clean Rivers Program

Prepared by:
Guadalupe-Blanco River Authority
with
PBS&J

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1.0 INTRODUCTION

Concentrating animal operations increases the potential for water quality effects. As with the rearing and marketing of other classes of livestock, the poultry industry has found it economically imperative to institute large scale, concentrated, animal feeding operations. Concentrating the poultry population introduces a waste management requirement that, if not properly met, can affect water quality.

The Texas Natural Resource Conservation Commission (TNRCC) was assigned the task of assessing the impact of the poultry industry on water quality by the 75th Session of the Texas Legislature. Texas is currently the sixth largest producer of broilers in the United States and the majority of poultry operations in Texas are found in nine Texas counties. Eight of these counties are situated in east Texas with the ninth (Gonzales County) located within the Guadalupe River Basin.

In 1997, under the Texas Clean Rivers Program, a project known as the "Poultry Operations Study - Guadalupe River Basin" was contracted from the TNRCC by the Guadalupe-Blanco River Authority (GBRA) who in turn sub-contracted part of the work with PBS&J (formerly known as Espey, Huston & Associates, Inc. (EH&A)). As part of the project, a quality assurance/quality control document was prepared and submitted to the TNRCC prior to project initiation.

1.1 OBJECTIVES

The objectives of this project were to develop and perform a special study, as mandated by the Texas Legislature, to determine if there has been an impact of poultry operations on water quality. The data collection efforts of the GBRA focused on providing information necessary to support the TNRCC in meeting its requirements. The monitoring focused on two watersheds in the lower Guadalupe River Basin where poultry operations exist and on two nearby watersheds without significant poultry operations (Figure 1). The streams selected were judged to be perennial. The project was designed to determine if there were water and sediment quality effects of poultry operations and to analyze collected data to develop trend information. Biological assessments of the sample streams were also conducted to evaluate the ecological health of each stream site.

1.2 INPUT FROM STAKEHOLDERS

In early October 1997, contact was made with the county extension agents in Gonzales and Dewitt counties, the Natural Resource Conservation Service (NRCS), the Gonzales Farm Service Agency

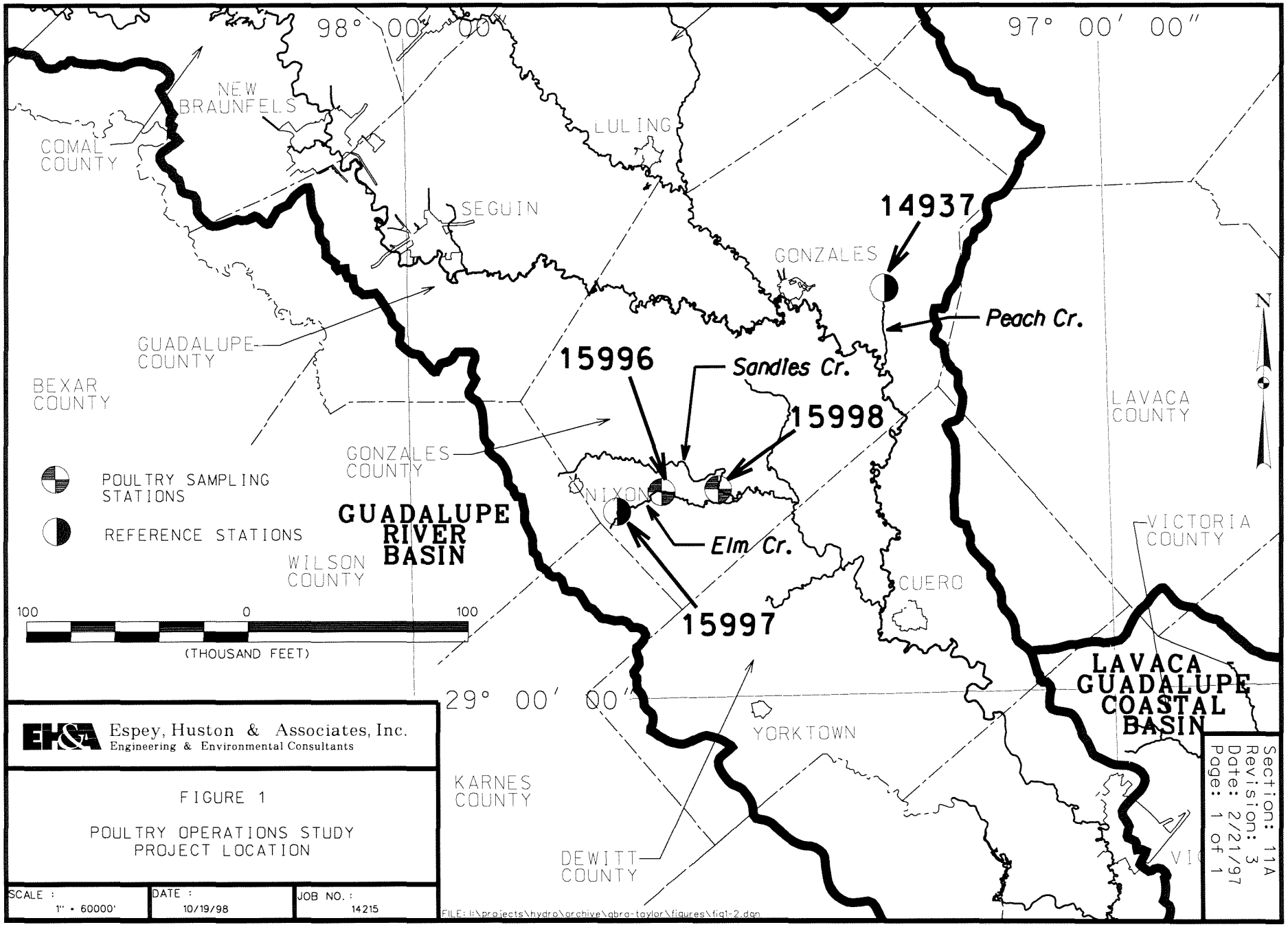

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FIGURE 1

POULTRY OPERATIONS STUDY
PROJECT LOCATION

SCALE :	DATE :	JOB NO. :
1" = 60000'	10/19/98	14215

FILE: I:\projects\hydro\archive\gbra-taylor\figures\fig1-2.dgn

Section: 11A
Revision: 3
Date: 2/21/97
Page: 1 of 1

office, and the local Texas Parks and Wildlife Department (TPWD) game warden to obtain input in relation to poultry operations within the Guadalupe River Basin. In addition, a public meeting was held 24 March 1998 in the city of Gonzales. Publicity releases were given to the local radio station and newspaper and fliers outlining the meeting agenda were distributed by personnel at Tyson Foods and Plantation Foods to their cooperators. Thirty-eight persons registered as attendees. Maps showing the sample locations and spreadsheets showing the water quality data collected at that time were distributed and discussed.

1.3 DESCRIPTION OF POULTRY OPERATIONS IN GONZALES COUNTY

The poultry business consists of several large companies that package and sell poultry products, each supported by a network of independent growers that supply land and poultry houses. Typically the company will provide young birds and feed to their growers, and receive mature birds at the end of a growing cycle.

There are two basic types of growing operation, wet and dry. The wet operations produce eggs. Cal-Maine near Waelder appears to be the major egg producer. According to the NRCS, about 95% of the poultry operations in Gonzales County are dry. The dry operations produce chicks, breeding, and grow-out for both chickens and turkeys. The major dry operations are Tyson for chickens and Plantation Farms for turkeys. With the dry operations, most of the litter is spread on fields near the sites, but some is sold as fertilizer or animal feed. The treated wastewater from the wet operations is also typically applied to nearby fields. During this study, many of the operators were in the process of preparing Pollution Prevention Plans, in conjunction with the NRCS, for litter application.

1.4 EXPERIMENTAL DESIGN AND LIMITATIONS

The project was designed to determine if there were detectable effects of poultry operations by comparing water quality sampling results of two paired watersheds. The two pairs of watersheds were selected to be generally similar in size and characteristics but differing primarily in the level of poultry activity as indicated by the number of rectangular poultry structures shown on aerial photographs.

While this paired study is a classical experimental design, its practical limitations must be recognized. First, the only way available to quantify the degree of poultry activity was the presence of specially-shaped buildings in maps and aerial photographs. Documenting the actual amount of poultry activity would require a more detailed field survey that was beyond the project resources. Perhaps more

importantly, there is no way of knowing where the poultry waste goes. From interviews with poultry operators, most of the poultry waste is applied to farm fields in close proximity to the point of generation, but quantitative information is not available. To develop that information would require more time and resources than were available to the project. A third limitation is that while the sites were selected to be on similar watersheds, differing primarily in the level of poultry activity, the possibility of other significant differences cannot be dismissed. In particular, differences in soils, shallow groundwater characteristics, and point sources of wastewater could affect significantly the sampling result. As a consequence, even if a significant difference in water quality were observed, one could not conclusively determine from this study alone that the cause of the difference was poultry activity. Conversely, it is also possible for an uncontrolled variable to mask a real difference caused by poultry activity. Controlling for differences of this type will always be a problem, which is why developing conclusive answers generally requires multiple studies. This study can contribute to an answer, but cannot be expected to resolve all the issues.

2.0 PROJECT LOCATION

2.1 SITE SELECTION

During the initial contact with the county extension agents in Gonzales and Dewitt counties, the NRCS, the Gonzales Farm Service Agency office, and the local TPWD game warden, potential sample site locations for the study were discussed. PBS&J reviewed the relevant USGS quad maps for watershed areas and then reviewed the most recent aerial photos to locate potential poultry operations. On 13 October 1997, a field investigation was made by PBS&J and Mr. Glen Sachleben (TPWD game warden - Gonzales County) to select the most appropriate stream sampling locations. Two sites (poultry sites) were selected on perennial streams based on a relatively high level of poultry activity and the other two sites (reference sites) were selected because of limited poultry activity on perennial streams that had similar watershed characteristics to the poultry sites. The sites (Figure 1), all within Gonzales County include:

POULTRY SITES

1) Elm Creek at FM 108, 1.7 km south of Smiley, Station ID - 15996;

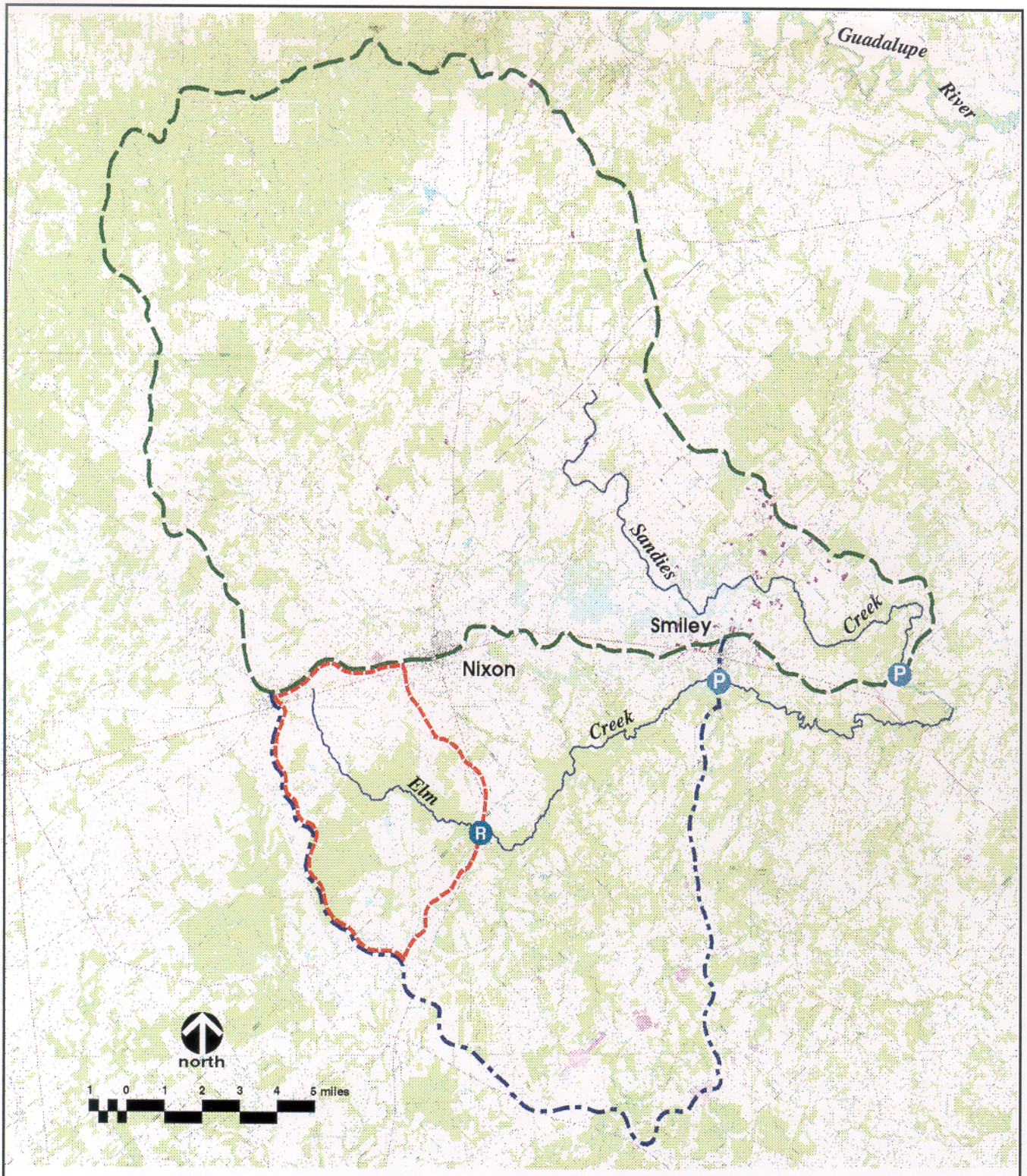
2) Sandies Creek at FM 1116, 7.4 km east of Smiley and approximately 3 km upstream of the confluence with Elm Creek, Station ID - 15998;

REFERENCE SITES

3) Peach Creek at CR 353, 11 km east of Gonzales, a short distance west of the community of Dilworth, Station ID - 14937; and

4) Elm Creek at CR 354, 6.7 km east southeast of Nixon, Station ID - 15997.

These stations are also depicted on figures 2 and 3. The two poultry sites described above (Elm Creek at FM 108 and Sandies Creek at FM 1116) were considered to have a relatively high level of poultry operations. The two reference sites (Peach Creek and Elm Creek at CR 354) had little apparent poultry use and were selected for comparison. The Peach Creek reference site had been monitored by the GBRA under the Clean Rivers Program since October, 1996, but the other three sites had not been monitored



P Poultry Site

R Reference Site

Potential Poultry Operations

Sandies Creek Watershed

Elm Creek Watershed

Elm Creek Reference Watershed

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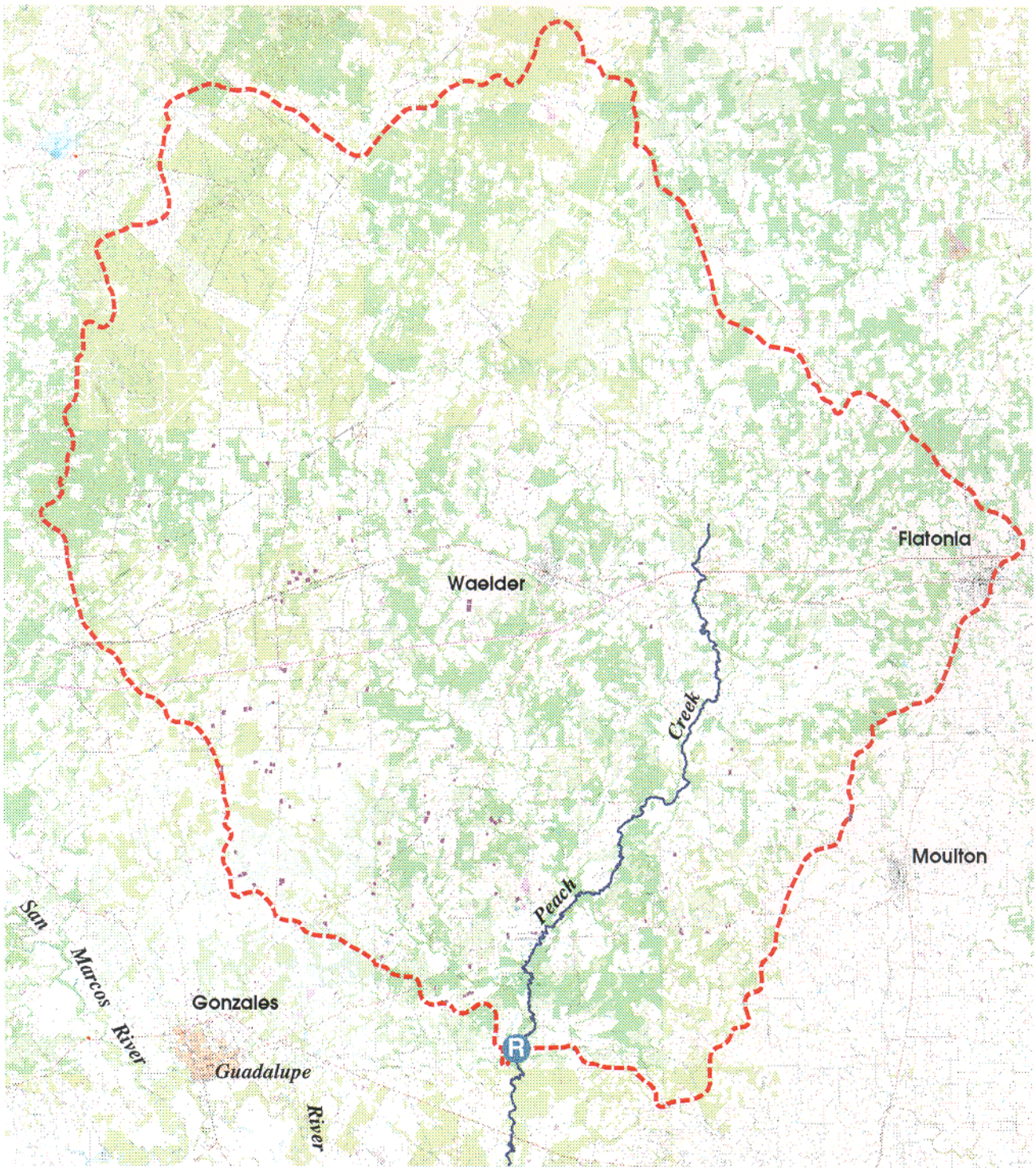
Figure 2

POULTRY OPERATIONS STUDY
SAMPLING LOCATIONS
SANDIES AND ELM CREEKS'
WATERSHEDS



R Reference Site

Potential Poultry Operation

Peach Creek Watershed

north

1 0 1 2 3 4 5 miles

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Figure 3

POULTRY OPERATIONS STUDY
SAMPLING LOCATION
PEACH CREEK WATERSHED

previously. All sites are on tributaries to the Guadalupe River below the San Marcos River confluence, segment 1803.

2.2 SITE DESCRIPTION

The four sampling sites were chosen along major tributaries of the Guadalupe River. These include approximately 445 square miles of the Peach Creek watershed above U.S. Highway Alt. 90 in Gonzales, Bastrop, Caldwell, Fayette, and Lavaca counties, approximately 218 square miles of the Sandies Creek watershed above U.S. Highway 87 in Gonzales, Guadalupe, and Wilson counties, and approximately 110 square miles divided into two sampling areas (Upper and Lower) on the Elm Creek watershed above State Highway 108 in Gonzales, Karnes, and Wilson counties (Bureau of Economic Geology (BEG), 1979; United States Geological Survey (USGS), 1975).

The four sampling sites are centered primarily in the Post Oak Belt Geographic Region of Texas; however, they are within a transitional area of three physiographic regions. These include the Blackland Prairie, the Post Oak Belt, and the Coastal Plain Physiographic Regions. The Post Oak Belt Region is bordered by the Black Prairie Region on the west and the Fayette Prairie and Goliad Woods regions of the Coastal Plains on the east. The Post Oak Belt of Texas is an area of flat to gently rolling prairies and low rolling hills. Post oak/savanna woodlands are found near drainages while mesquite and grasses dominate the prairies. The Blackland Prairie Region is characterized by having gently rolling to level terrain and black clay soils while the Coastal Plain Region is characterized by low topographic relief and sandy soils. In general, the region is characterized as having a humid subtropical climate dominated by post oaks, mesquites, and grasses with an undulating to slightly rolling landscape sloping to the east-southeast (BEG, 1977 and 1979; Chambers, 1948; Ferguson, 1986).

According to the Bureau of Economic Geology (BEG) Geologic Atlas of Texas; Seguin Sheet (1979), the surface geologic units within the sampling sites include; alluvium deposits of gravels, sands, silts, clays, and organic matter along drainages; sandstones from the Oakville, Catahoula, and Whitsett formations on ridges and side slopes; calcareous clays from the Manning, Caddell, and Yegua formations, and sands from the Sparta, Queen City, Reklaw, and Carrizo sands on upland divides.

Soil surveys of the counties encompassing the sampling sites were obtained from the Soil Conservation Service (SCS) (now the NRCS) and were used to describe the basic characteristics of the soil associations which comprise the sampling sites. The sampling site along Peach Creek is dominated by deep gently sloping sandy and sandy clay loam soils over clays. Pockets of clayey or loamy soils are

found on uplands throughout the sampling site. Along the Sandies Creek sampling site, the soils are deep gently sloping to sloping loamy to sandy soils with sandy soils on the uplands. The sampling sites along Elm Creek are dominated by sandy, loamy, and clayey soils that have clayey lower layers. In general, the sandy and loamy soils of the region are used primarily for cattle grazing and pasturage with limited cultivated agricultural activity in the loamy and clayey soils (SCS, 1977a, 1977b, 1978, 1979, 1983, and 1992).

3.0 METHODS AND MATERIALS

3.1 DATA COLLECTION EFFORTS

Drainage above each sampling site was identified and delineated by outlining the watershed on a United States Geological Survey (USGS) 1:250,000 scale map. The delineated boundary was transferred to twenty-six USGS 7.5 (1:24,000 scale) topographic quadrangle maps encompassing the sampling sites. The USGS maps ranged in dates from 1959 to 1965 with most having been revised and updated in the mid-1980s.

The USGS maps cultural features on the 7.5 minute quadrangle maps (quads) including agricultural, business, and residential structures. Using the quadrangle maps, PBS&J identified structures of the size and shape used for poultry operations. In addition, black and white aerial photographs, covering the major portions of the sample sites that are within Gonzales County, were provided by Executive Director Ronnie McDaniel of the Gonzales County Farm Services Administration. The aerial photographs were dated 1995 and were at a scale of one-inch to 650 feet (ft).

A procedure was followed where a count was made, within each sampling site watershed, of all structures identified on the USGS quads as potential poultry operations. Structures identified as potential poultry operations on the USGS quads were checked against the aerial photographs. Poultry operation structures identified on the USGS quads but that were not visible on the 1995 aerial photographs were not counted, and poultry operation structures identified on the aerial photographs that were not on the USGS quads were added to the total count. A limited reconnaissance prior to site selection was conducted to verify that structures identified on the maps and the aerial photographs were poultry operations. No effort was made to verify the level of activity on any of the structures identified as a poultry operation.

For the water quality evaluation, each of the four stations were monitored with a manual grab sample and flow observation once a month between November 1997 and June 1998. In addition, the Sandies Creek and Peach Creek stations, were added to GBRA's routine monitoring list and we sampled in July and early August, 1998. Finally, in an attempt to collect wet-weather samples, all four stations were sampled on 25 August, 1998. Water temperature, dissolved oxygen (D.O.), conductivity, and pH were taken at each site with a Hydrolab multiprobe. A single sediment sample was collected at each station during the June 1998 sampling and shipped to the TNRCC Houston Laboratory for metals analysis.

Rapid BioAssessments (RBA) were conducted at the Elm Creek reference site, Sandies Creek and Peach Creek. The depth of the Elm Creek poultry site made that site inappropriate for an RBA and thus no biological collections were conducted. Benthic macroinvertebrate RBA's were conducted at both the Elm Creek reference site and Sandies Creek, while a fish RBA was conducted at the Peach Creek reference site.

Benthic macroinvertebrates were evaluated using a systematic field collection and analysis of major benthic taxa (USEPA, 1989). The field collection consisted of sampling a riffle/run area with a kick net to collect from an approximately 1 m^2 area. Benthic macroinvertebrates were identified to the lowest practical taxonomic level (LPTL) using standard taxonomic references.

Fish sampling was conducted by electrofishing. Equipment included a variable voltage Smith-Root Model 15-B generator-powered backpack electrofisher. Each electrofish sample represented a total of 15 minutes of actual shock time per sample reach, sufficiently covering accessible areas of each reach. The main concentration of effort was near shore and cover (brush, snags, trash) with occasional sweeps through open water areas. Fish were identified and enumerated in the field. All fish were returned to the creek when eletrofishing at their respective stations/reaches were completed. All fish from each electrofish sample were visually examined for obvious diseases, parasites, and other abnormalities. Fish were identified to the lowest practical taxonomic level (LPTL) using standard taxonomic references.

3.2 LABORATORY ANALYSIS

Samples were analyzed for the routine GBRA conventional/nutrient parameters as described in tables 1-4. Analytical methods performed in the GBRA laboratory are approved by the TNRCC and United States Environmental Protection Agency (USEPA). The sediment samples collected in June 1998 were delivered to the TNRCC Houston Laboratory for metals analysis.

3.3 DATA ANALYSIS

Graphical depictions of the water and sediment quality data were used to visually examine for noticeable differences. Student's t-test was used to determine significant ($\alpha=0.05$) differences in means between sites for any water quality parameters that exhibited potential differences in the graphical depictions.

TABLE 1

WATER QUALITY - SANDIES CREEK POULTRY SITE

PARAMETER	TNRCC		Average[1]	CONCENTRATION ON SAMPLING DATES										
	WQ Standard	Screening Levels		11/20/97	12/9/97	1/14/98	2/12/98	3/23/98	4/14/98	5/27/98	6/9/98	7/14/98	8/11/98	8/25/98
Flow stream, instantaneous (cfs)			15.9	5.3	6.9	7.3	38.8	9.5	5.4	3.2	2.8	1.6	2.4	91.3
Specific conductance, field (µmhos/cm @ 25°C)			701	633	487	752	388	796	1,028	886	885	1,135	519	200
Residue, total filtrable (dried at 180°C) (mg/L) [TDS]	400		480	336	280	412	228	440	568	1,444	477	*	*	136
Chloride (mg/L)	100		105.1	72.2	53.4	94.1	38.2	52.5	152.0	96.5	121.0	200.0	62.9	213.0
Sulfate (mg/L)	50		63.9	76.0	18.1	94.0	16.7	126.0	111.0	68.6	62.2	53.3	68.3	8.4
Hardness, EDTA, total (mg/L)			157.8	*	*	*	116.0	223.0	208.0	*	82.0	170.0	148.0	*
Temperature, water (°C)	33.89		20.5	10.7	12.7	14.1	14.4	16.3	20.4	24.9	26.4	29.2	28.2	28.4
Oxygen, dissolved (mg/L)	5.0		5.6	7.5	7.7	7.6	7.9	8.3	5.3	3.6	3.0	3.1	3.2	4.4
pH (standard units)	6.5 - 9.0		7.4	7.5	7.4	7.2	7.7	7.5	7.5	7.3	7.1	7.0	7.4	7.5
Residue, total nonfiltrable (mg/L) [TSS]			61	21	47	26	62	31	35	29	20	*	*	276
Nitrogen ammonia (mg/L as N)		0.3	0.32	0.22	0.17	0.32	1.16	0.19	0.28	0.29	0.13	*	0.16	0.30
Nitrate nitrogen (mg/L as N)		3.1	0.70	0.89	0.65	0.68	1.12	0.96	0.55	0.54	0.36	0.23	1.20	0.54
Phosphate, ortho (mg/L as P)		1.4	0.19	0.14	0.19	0.15	0.23	0.12	0.09	0.11	0.21	*	*	0.48
Fecal coliform, membrane filter, M-FC broth (#/100 mL)	200	400	673	248	362	988	17,200	408	85	712	170	750	738	3,600
Chlorophyll a, spectrophotometric acid method		16.5	2.1	< 1.0	3.6	4.3	5.3	< 1.0	< 1.0	1.8	< 1.0	2.2	< 1.0	< 1.0

[1]Averages include "<" values at detection. FC average is geometric mean.

*Because of differences in sampling procedures and conditions, some parameters were not measured in all sampling events. See Addendum 1 for more details.

TABLE 2

WATER QUALITY - PEACH CREEK REFERENCE SITE

PARAMETER	TNRCC		Average[1]	CONCENTRATION ON SAMPLING DATES										
	WQ Standard	Screening Levels		11/20/97	12/8/97	1/14/98	2/12/98	3/23/98	4/14/98	5/21/98	6/9/98	7/14/98	8/11/98	8/25/98
Flow stream, instantaneous[2] (cfs)			9.8	H	H	H	H	H	9.3	2.6	8.1	0.8	19.2	19.2
Specific conductance, field (µmhos/cm @ 25°C)			539	299	337	378	168	226	1,262	1,018	430	788	738	289
Residue, total filtrable (dried at 180°C) (mg/L) [TDS]	400		318	*	*	*	*	260	*	590	228	*	*	194
Chloride (mg/L)	100		62.4	28.6	30.8	38.2	15.1	23.5	168.0	127.0	40.8	85.4	60.8	68.7
Sulfate (mg/L)	50		44.3	15.2	14.8	73.9	8.4	12.8	210.0	108.0	14.6	6.6	6.0	16.5
Hardness, EDTA, total (mg/L)			122.2	169.0	92.8	123.0	51.0	65.0	354.0	190.0	74.5	61.5	40.7	*
Temperature, water (°C)	33.89		20.9	10.7	13.4	13.3	14.7	17.7	21.9	25.9	28.4	28.1	27.5	28.5
Oxygen, dissolved (mg/L)	5.0		7.2	10.2	9.5	9.5	6.7	6.6	7.8	7.0	5.8	5.0	4.6	6.0
pH (standard units)	6.5 - 9.0		7.6	7.8	7.5	6.9	7.7	7.9	7.8	7.8	7.4	7.3	7.7	7.8
Residue, total nonfiltrable (mg/L) [TSS]			35	22	22	45	50	47	16	10	35	7	3	131
Nitrogen ammonia (mg/L as N)		0.3	0.99	*	0.15	*	0.38	0.16	0.24	0.19	6.30	*	0.12	0.37
Nitrate nitrogen (mg/L as N)		3.1	0.37	0.38	0.22	0.29	0.23	0.16	0.19	0.30	1.10	0.16	0.21	0.82
Phosphate, ortho (mg/L as P)		1.4	0.13	*	*	*	*	0.10	*	0.07	0.20	*	*	0.14
Fecal coliform, membrane filter, M-FC broth (#/100 mL)	200	400	790	217	312	1,162	8,800	1,400	260	675	1,650	750	375	944
Chlorophyll a, spectrophotometric acid method		16.5	5.1	6.7	< 1.0	2.7	5.3	8.0	4.8	1.6	5.1	< 1.0	19.2	< 1.0

[1]Averages include "<" values at detection. FC average is geometric mean.

[2]"H" indicates flow too high for safe measurement.

*Because of differences in sampling procedures and conditions, some parameters were not measured in all sampling events. See Addendum 1 for more details.

TABLE 3

WATER QUALITY - ELM CREEK POULTRY SITE

PARAMETER	TNRCC		Average[1]	CONCENTRATION ON SAMPLING DATES								
	WQ Standard	Screening Levels		11/20/97	12/8/97	1/14/98	2/12/98	3/23/98	4/14/98	5/27/98	6/9/98	8/25/98
Flow stream, instantaneous[2] (cfs)			0.1	L	L	L	L	L	L	< 0.1	< 0.1	< 0.1
Specific conductance, field (µmhos/cm @ 25°C)			422	466	310	304	410	402	480	574	620	231
Residue, total filtrable (dried at 180°C) (mg/L) [TDS]	400		239	244	130	216	240	288	250	320	316	148
Chloride (mg/L)	100		39.8	46.8	28.8	26.2	39.3	34.8	46.2	63.7	58.4	14.1
Sulfate (mg/L)	50		31.6	24.0	12.3	7.0	34.7	158.0	15.0	7.0	24.0	2.1
Hardness, EDTA, total (mg/L)			101.1	*	*	*	83.6	109.0	97.9	*	114.0	*
Temperature, water (°C)	33.89		19.5	11.6	12.8	13.3	14.4	18.1	22.2	26.3	28.6	28.5
Oxygen, dissolved (mg/L)	5.0		3.6	3.3	1.7	3.2	8.3	4.8	3.6	1.4	4.6	1.9
pH (standard units)	6.5 - 9.0		7.6	7.9	7.5	7.7	7.9	7.4	7.7	7.3	7.6	7.8
Residue, total nonfiltrable (mg/L) [TSS]			34	25	41	15	84	24	17	26	69	6
Nitrogen ammonia (mg/L as N)		0.3	0.33	0.24	0.30	0.38	0.39	0.32	0.42	0.38	0.34	0.23
Nitrate nitrogen (mg/L as N)		3.1	0.29	0.16	0.26	0.19	0.37	0.20	< 0.05	0.57	0.21	0.60
Phosphate, ortho (mg/L as P)		1.4	0.11	0.05	0.15	0.11	0.10	0.10	0.05	0.05	0.04	0.36
Fecal coliform, membrane filter, M-FC broth (#/100 mL)	200	400	335	128	488	500	11,000	720	20	300	240	150
Chlorophyll a, spectrophotometric acid method (mg/m^3)		16.5	17.5	13.4	5.3	1.3	< 1.0	8.0	26.1	7.1	74.1	21.6

[1]Averages include "<" values at detection. FC average is geometric mean.

[2]"L" indicates flow too low to measure.

*Because of differences in sampling procedures and conditions, some parameters were not measured in all sampling events. See Addendum 1 for more details.

TABLE 4

WATER QUALITY - ELM CREEK REFERENCE SITE

PARAMETER	TNRCC		Average[1]	CONCENTRATION ON SAMPLING DATES								
	WQ Standard	Screening Levels		11/20/97	12/8/97	1/14/98	2/12/98	3/23/98	4/14/98	5/27/98	6/9/98	8/25/98
Flow stream, instantaneous (cfs)			2.7	0.4	0.4	1.6	12.8	1.6	0.3	0.2	0.2	7.2
Specific conductance, field (µmhos/cm @ 25°C)			718	850	411	386	368	353	475	1,520	1,780	323
Residue, total filtrable (dried at 180°C) (mg/L) [TDS]	400		423	436	204	224	216	208	253	896	1,164	208
Chloride (mg/L)	100		42.2	57.2	32.9	32.7	29.4	28.8	36.6	127.0	14.2	21.2
Sulfate (mg/L)	50		18.2	19.2	11.2	63.5	10.0	22.6	19.8	9.2	4.8	3.5
Hardness, EDTA, total (mg/L)			100.2	*	*	*	72.7	96.0	118.0	*	114.0	*
Temperature, water (°C)	33.89		18.1	11.8	12.3	13.5	13.4	14.6	20.4	24.4	25.7	26.8
Oxygen, dissolved (mg/L)	5.0		5.0	5.3	9.3	4.8	8.3	7.7	3.2	< 1.0	0.1	4.9
pH (standard units)	6.5 - 9.0		7.7	8.0	7.5	7.4	7.7	7.5	7.7	7.7	7.9	8.0
Residue, total nonfiltrable (mg/L) [TSS]			34	25	42	36	68	28	17	10	14	64
Nitrogen ammonia (mg/L as N)		0.3	0.31	0.19	0.23	0.27	0.34	0.21	0.33	0.65	0.30	0.28
Nitrate nitrogen (mg/L as N)		3.1	0.23	0.34	0.22	0.17	0.29	0.27	0.13	0.32	0.11	0.26
Phosphate, ortho (mg/L as P)		1.4	0.13	0.13	0.10	0.15	0.17	0.04	0.04	0.04	0.35	0.13
Fecal coliform, membrane filter, M-FC broth (#/100 mL)	200	400	318	375	625	725	7,400	297	16	144	54	725
Chlorophyll a, spectrophotometric acid method (mg/m^3)		16.5	2.6	2.7	< 1.0	< 1.0	5.3	< 1.0	< 1.0	< 1.0	6.8	3.7

[1]Averages include "<" values at detection. FC average is geometric mean.

*Because of differences in sampling procedures and conditions, some parameters were not measured in all sampling events. See Addendum 1 for more details.

For the biological evaluation, the community trophic structure data along with the calculated parameters are being integrated through an index of biotic integrity (IBI) to provide an aquatic life use rating for the stream stations. The IBI is used to examine the fish community structure and to provide a baseline ecological rating for each site.

4.0 RESULTS

To examine potential nonpoint source influences from poultry operations in Gonzales County, the numbers of potential poultry operations present within each watershed and within the immediate sample site areas were counted and then updated using recent aerial photography. The results are presented in Section 4.1. Excessive growth of aquatic plant life in streams and rivers is a water quality concern sometimes associated with nonpoint source pollution. Excessive plant growth (Eutrophication) is most often stimulated by nitrogen and phosphorus (Daniel et al, 1994, Watson and Burnett, 1993). Nitrogen and phosphorus are constituents of poultry wastes (Young et al, 1996). Therefore, these nutrients along with other water and sediment quality parameters are examined in detail in sections 4.2 and 4.3. Finally, the ecological health of the systems is addressed by reviewing the macroinvertebrate and fish community data presented in Section 4.4.

4.1 POULTRY OPERATIONS DATABASE

The Sandies Creek poultry site watershed includes approximately 218 square miles located in Gonzales, Guadalupe, and Wilson counties. During the creation of the poultry operations database the following numbers of potential poultry operations were documented.

Numbers of potential poultry houses

56 - identified on USGS quad maps but not on aerial photography (gone)
249 - identified on USGS quad maps and confirmed with aerial photography
30 - identified only with aerial photography (newer)
279 - Total of potential poultry houses in the Sandies Creek watershed

The Sandies Creek poultry site has approximately 1.3 houses per square mile. Approximately 61% of the 279 poultry houses are within a six-mile radius of the sampling point.

The Peach Creek reference site watershed is larger, approximately 445 square miles, and is located in Bastrop, Caldwell, Fayette, and Gonzales counties. The numbers of potential poultry houses are as follows.

Numbers of potential poultry houses

32 - identified on USGS quad maps but not on aerial photography (gone)
149 - identified on USGS quad maps and confirmed with aerial photography
115 - identified only with aerial photography (newer)
264 - Total of potential poultry houses in the Peach Creek watershed

This is 0.6 houses per square mile, with approximately 23% of the 264 poultry houses within a six-mile radius of the sampling point. The Peach Creek reference site has about half the density of potential poultry houses and the density within the immediate area of the actual site is much lower.

The Elm Creek poultry site watershed consists of approximately 82 square miles and is situated in Gonzales, Karnes, and Wilson counties.

Numbers of potential poultry houses

3 - identified on USGS quad maps but not on aerial photography (gone)
34 - identified on USGS quad maps and confirmed with aerial photography
10 - identified only with aerial photography
44 - Total of potential poultry houses in the Elm Creek watershed

The density is 0.54 houses per square mile, with approximately 84% of the 44 potential poultry houses within a two-mile radius of the sampling point. While the overall density of this poultry site is lower than the Sandies Creek poultry site, the density near the sampling point is higher.

The Elm Creek reference site watershed is approximately 28 square miles upstream of the poultry site in Karnes and Wilson counties. There were no potential poultry houses identified within this watershed.

4.2 WATER QUALITY ANALYSIS

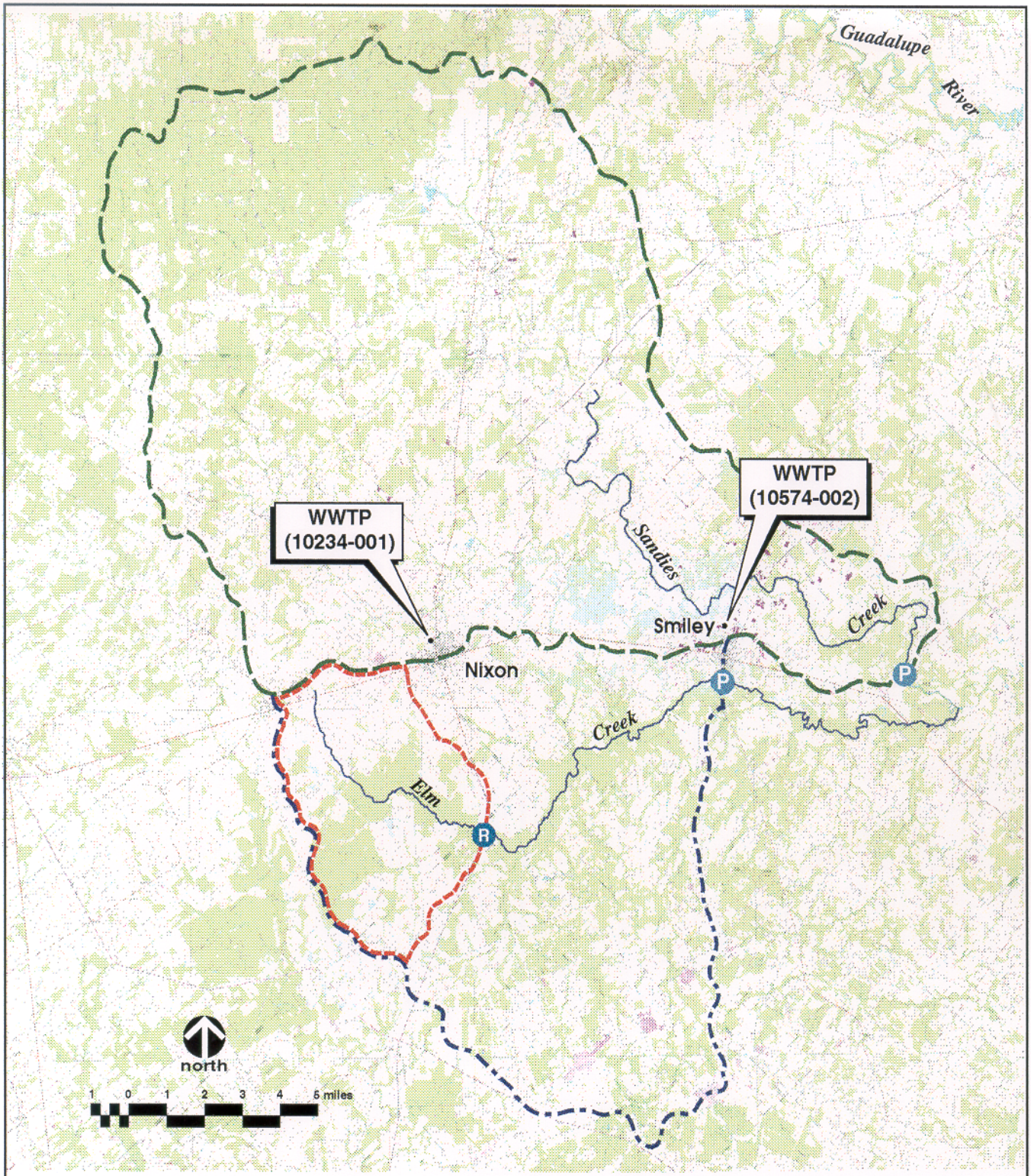
Tables 1-4 give the concentrations of the water quality parameters and stream flow data collected during the study period for each sample location.

Within the Sandies Creek watershed, the City of Nixon and City of Smiley both operate wastewater treatment plants (Figure 4). The City of Smiley (Permit number 10574-002) uses all their effluent for crop irrigation and does not discharge directly. The City of Nixon (Permit number 10234-001) outfall has a daily mean discharge of 0.204 million gallons per day (mgd) into the watershed. When compared to the mean flow in Sandies Creek (15.9 cfs) observed during the study period, the mean discharge of 0.31 cfs from the City of Nixon would account for approximately 2% of the total flow, assuming all flow entered Sandies Creek. The Peach Creek watershed has contributions from two wastewater treatment plants, one located in the City of Waelder and the other at the City of Flatonia (Figure 5). The City of Waelder (Permit number 10327-01) plant contributes a daily mean discharge of 0.056 mgd while the City of Flatonia (Permit number 10101-001) plant contributes a daily mean discharge of 0.093 mgd into the system. When combined and compared to the average flow observed in Peach Creek during the study period (9.8 cfs), the discharge from the two wastewater treatment plants would account for approximately 1.5% of the observed flow, again assuming all flow enters Peach Creek. There are no wastewater treatment plant influences within the Elm Creek poultry site or reference watersheds.

The rest of this section addresses each of the chemical parameters, considering poultry-reference site differences and comparison of absolute levels. For the absolute levels, tables 1-4 include the values from the Water Quality Standards for Segment 1803 (all sites are on tributaries to this segment) and TNRCC screening levels for freshwater streams used for Total Maximum Daily Load Analysis (TNRCC, 1998). With the screening levels, a "concern" is deemed to exist if more than 25% of the observations exceed the screening level, and a potential concern exists if between 11% and 25% exceed the level.

Ammonia – Nitrogen

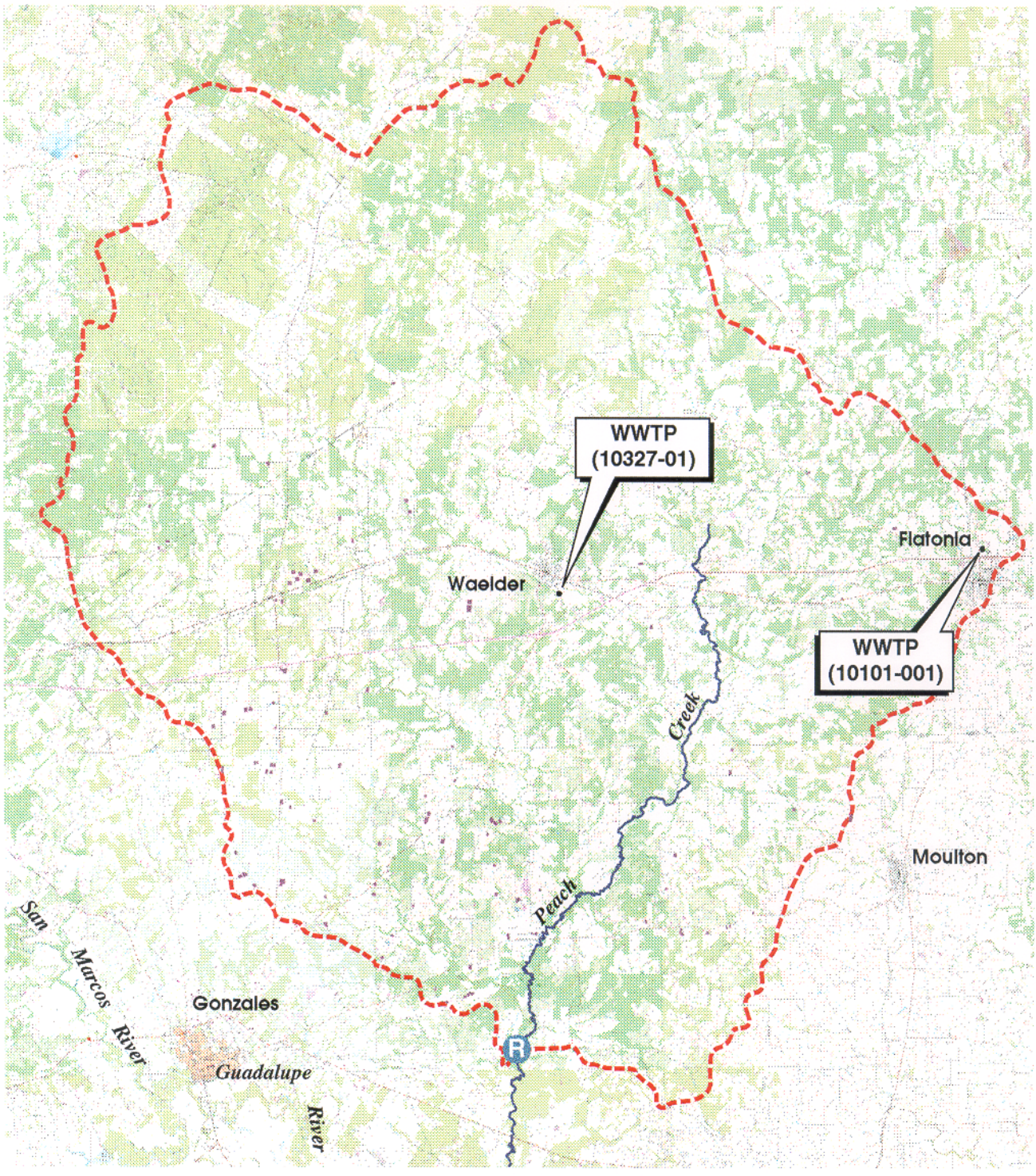
The concentrations of ammonia-N over the course of the study are shown in Figure 6. There were no notable differences between sample and reference sites. The Peach Creek reference site sample with a high ammonia-N concentration (6.3 mg/L) in June 1998 also had a relatively high nitrate concentration. This sample appears to be an anomaly, and no other parameters including flow appear to correlate with these values. The Peach Creek site had been sampled by the GBRA since October 1996, and the highest ammonia-N value observed was 0.38 mg/L. The slightly higher concentration of 1.16 mg/L from Sandies Creek poultry site in February 1998 occurred with the higher flows prevalent during that sampling. The only site that did not exceed 25% of the observations above



Espey, Huston & Associates, Inc.
Engineering & Environmental Consultants

Figure 4

POULTRY OPERATIONS STUDY
WASTEWATER PLANT SITES
SANDIES AND ELM CREEKS' WATERSHEDS

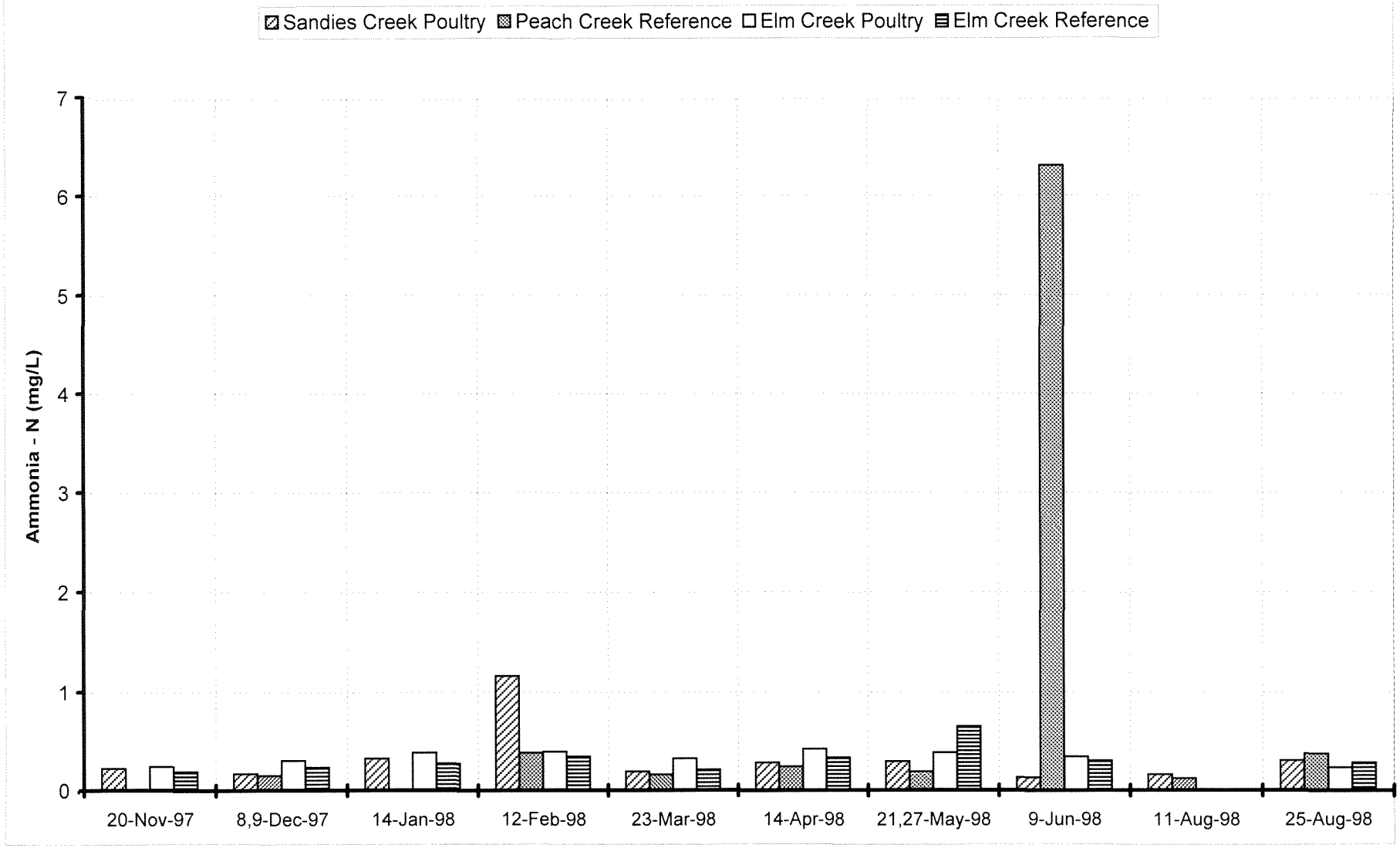


Espey, Huston & Associates, Inc.
Engineering & Environmental Consultants

Figure 5

POULTRY OPERATIONS STUDY
WASTEWATER PLANT SITES
PEACH CREEK WATERSHED

FIGURE 6
Ammonia - N Concentrations



the TNRCC screening criteria of 0.31 mg/L ammonia-N for freshwater streams was the Sandies Creek poultry site.

Nitrate - Nitrogen

The graphical depiction of the nitrate-N data is presented in Figure 7. The nitrate-N concentrations for all samples were below the USEPA and TNRCC standard of 10.0 mg/L for drinking water. The maximum concentration was 1.12 mg/L at the Sandies Creek poultry site in February 1998. The minimum concentration was 0.05 mg/L at the Elm Creek poultry site during April 1998. Student's t-tests confirm that the mean nitrate-N concentrations from Sandies Creek are significantly higher ($\alpha=0.05$) than for the Peach Creek reference site.

None of the observations were close to the screening level of 3.1 mg/L. The critical level of nitrate for accelerated growth of aquatic plants in lake systems has been reported to be around 0.30 mg/L (Sawyer, 1947 and Vollenweider, 1968). The potential for eutrophication or accelerated/excessive plant growth can be higher when this level is exceeded. Most values reported from Sandies Creek poultry site exceeded this value.

While the nitrate-N concentrations at this station are higher than the other sites, it does not necessarily indicate a concern. For example, the spring waters from the Edwards Aquifer, the source of much of the flow in the Guadalupe River, typically have a higher nitrate-N concentration. To explore whether the nitrate-N levels are associated with the poultry operations concentrated in the lower part of the watershed, a longitudinal profile of Sandies Creek was performed on 10 September 1998. Results of this survey are shown in Table 5. The values do show a weak increase with distance downstream, but the difference is certainly not definitive.

Orthophosphate Phosphorus

The concentrations of ortho-P from the four sites over the course of the study period are shown in Figure 8. Values were reasonably consistent, except for the 25 August 1998 sample with higher flow, particularly in the Sandies Creek poultry site. There were no notable trends between sample and reference sites. None of the data came close to the screening level of 1.4 mg/L. Note that in the Sandies Creek longitudinal data in Table 5, there appears to be an increase in ortho-P concentrations at the lower end of the stream in the area where much of the poultry operations are located.

FIGURE 7
Nitrate-N Concentrations

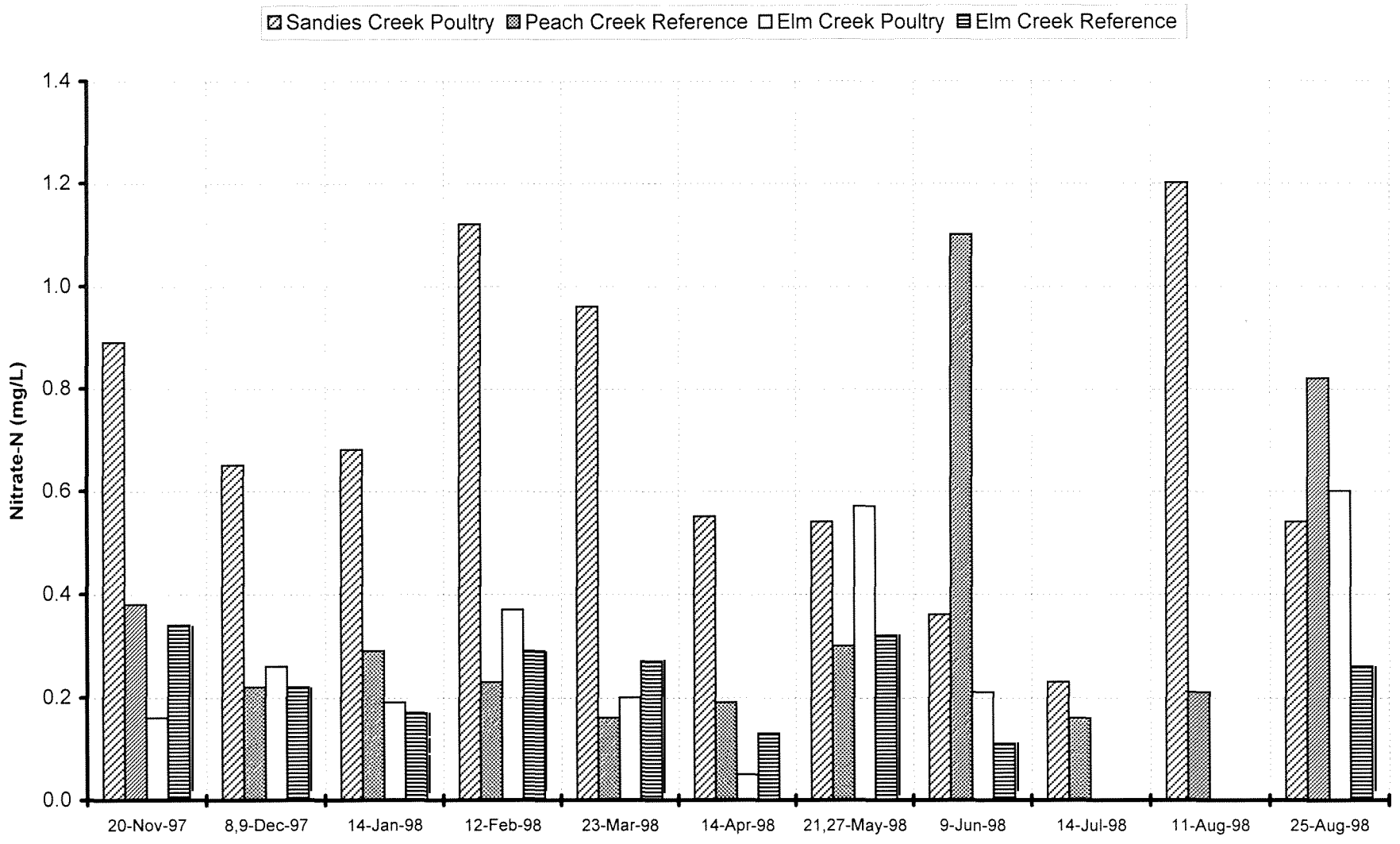
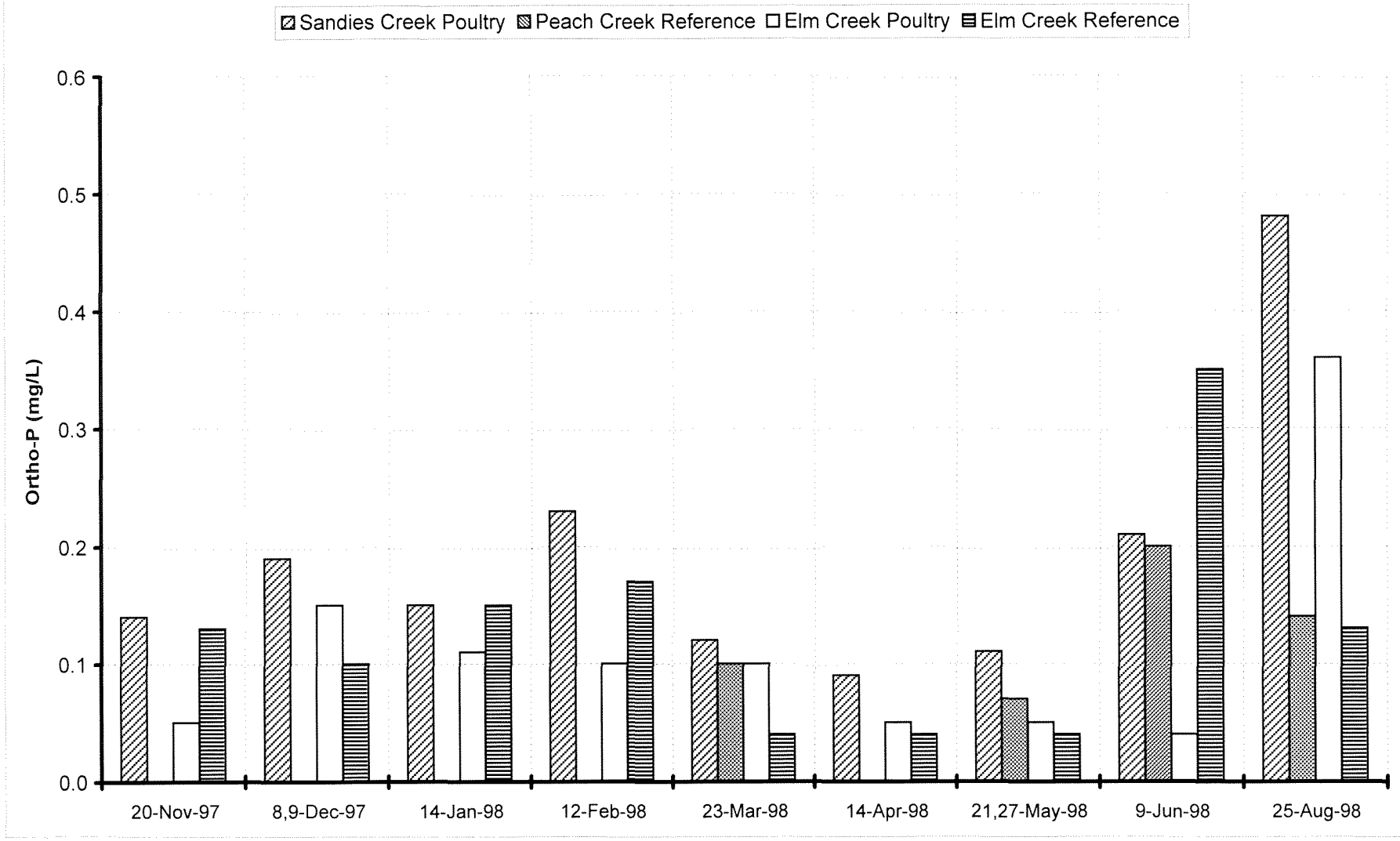


TABLE 5
WATER QUALITY DATA COLLECTED ON 9/10/98 ALONG SANDIES CREEK

Parameter	← Upstream of Poultry Site →				Poultry Site	Average[1]
	@ SH97	@ FM77	@ CR180	@ FM108	@ FM1116	
Flow stream, instantaneous (cfs)	< 0.1	2.3	< 0.1	3.6	3.7	2.0
Specific conductance, field (µmhos/cm @ 25°C)	813	553	689	696	694	689
Residue, total filtrable (dried at 180°C) (mg/L)	398	288	332	342	336	339
Chloride (mg/L)	112.0	58.0	84.2	89.3	81.5	85.0
Sulfate (mg/L)	70.8	48.6	65.0	68.6	70.8	64.8
Hardness, EDTA, total (mg/L)	177.0	131.0	177.0	122.0	168.0	155.0
Temperature, water (°C)	23.0	24.9	25.1	24.5	25.5	24.6
Oxygen, dissolved (mg/L)	2.4	6.8	4.4	3.9	4.5	4.4
pH (standard units)	7.6	7.7	7.7	7.7	7.6	7.7
Turbidity (NTU)	28.5	25.0	26.0	27.5	27.0	26.8
Residue, total nonfiltrable (mg/L)	10	11	21	30	27	20
Nitrogen ammonia (mg/L as N)	0.51	0.10	0.13	0.19	0.14	0.21
Nitrate nitrogen (mg/L as N)	0.16	0.24	0.20	0.22	0.32	0.23
Phosphate, ortho (mg/L as P)	< 0.01	< 0.01	0.04	0.03	0.06	0.03
Fecal coliform, membrane filter, M-FC broth (#/100 mL)	523	259	148	92	112	183
Chlorophyll a, spectrophotometric acid method (mg/m^3)	16.0	1.1	< 1.0	1.3	1.1	4.1

[1]Averages include "<" values at detection. FC average is geometric mean.

FIGURE 8
Ortho - P Concentrations



Sulfates

Figure 9 shows the concentration of sulfates over the course of the study period. The sulfate concentrations at the Sandies Creek poultry site were higher than that of the other three stations six of the eleven samples. However, the mean concentrations of sulfates were not significantly higher than the mean concentrations from the Peach Creek reference site. When compared to the 50 mg/L water quality standard for segment 1803, which is to be compared with the average of data, only the Sandies Creek poultry site exceeded the standard. The highest concentration of sulfates (158 mg/L) was detected at the Elm Creek poultry site.

Chlorides

The graphical depiction of chlorides concentrations (Figure 10) shows a somewhat different pattern from sulfates. The Sandies Creek poultry site had the highest observations, and the average concentration (105 mg/L) exceeded the standard for segment 1803. The high sulfate concentrations in March 1998 at the Elm Creek poultry site did not correspond with higher chloride concentrations at that site during the same time period. At the Sandies Creek poultry site, the highest chloride levels occurred late in the study, while the higher sulfate levels occurred earlier in the study.

Conventional parameters

The concentrations of dissolved oxygen and temperature were consistent with seasonal conditions in their respective streams (figures 11-12). The dissolved oxygen concentrations appear to track with seasonal temperatures, and to also exhibit marked differences. The Peach Creek reference site typically has the highest values, followed by the Sandies Creek poultry site and the two Elm Creek sites. The Elm Creek poultry site was consistently below the 5.0 mg/L standard (excepting the February sampling), while the concentrations at the Elm Creek reference site were below the standard only during the spring and summer. The Sandies Creek poultry site data were near or below the standard in late spring and early summer. The Peach Creek reference site had dissolved oxygen levels above the standard except for some of the summer observations.

TDS concentrations (Figure 13) exceeded the Guadalupe River segment standard of 400 mg/L at the Sandies Creek poultry site and the Elm Creek reference site. The flow data are depicted in Figure 14, highlighting the large amounts of rainfall and heavy flows on 12 February and 25 August 1998. The flow measurements for the Elm Creek poultry site were not possible because of the depth of

FIGURE 9
Sulfate Concentrations

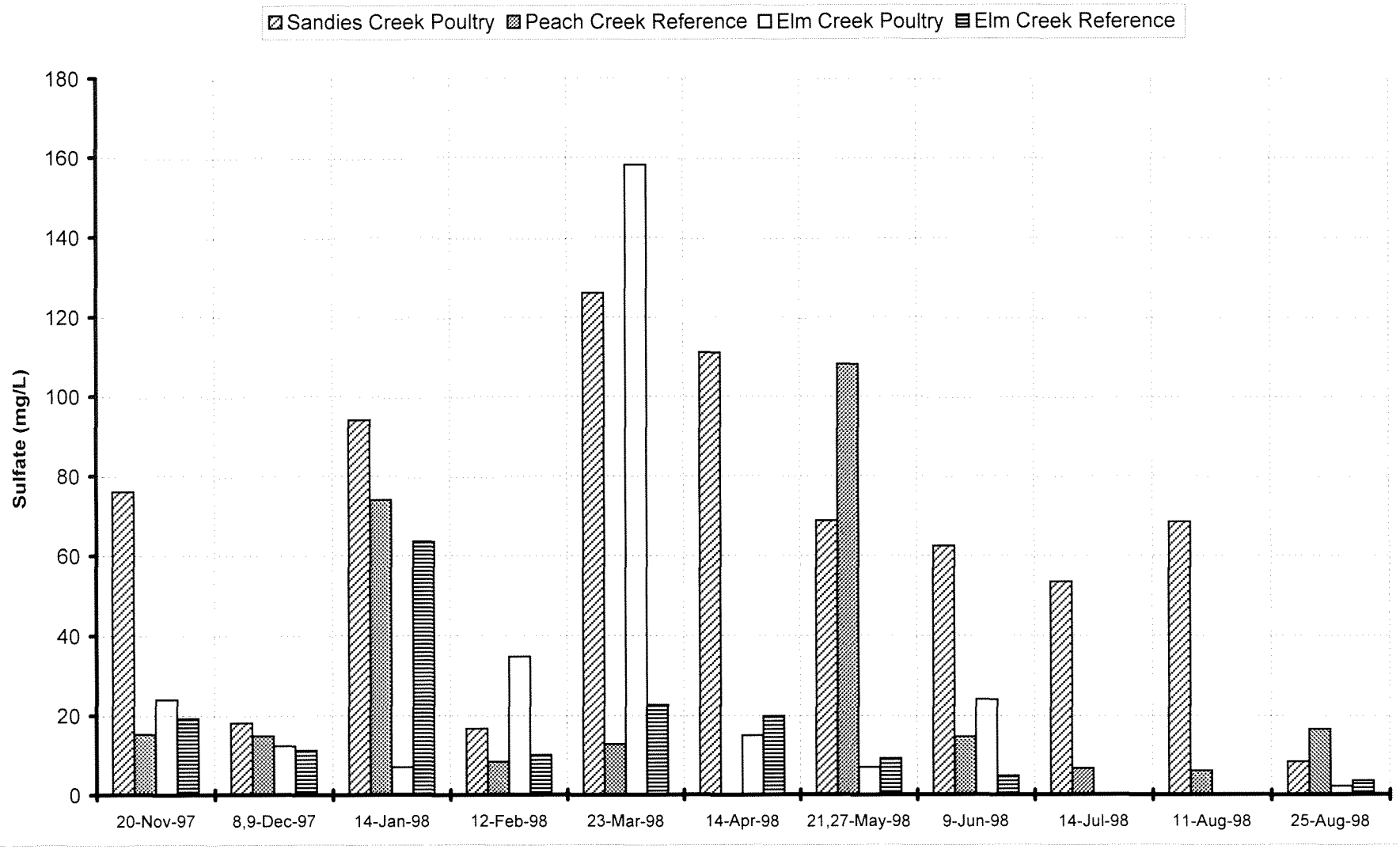


FIGURE 10
Chloride Concentrations

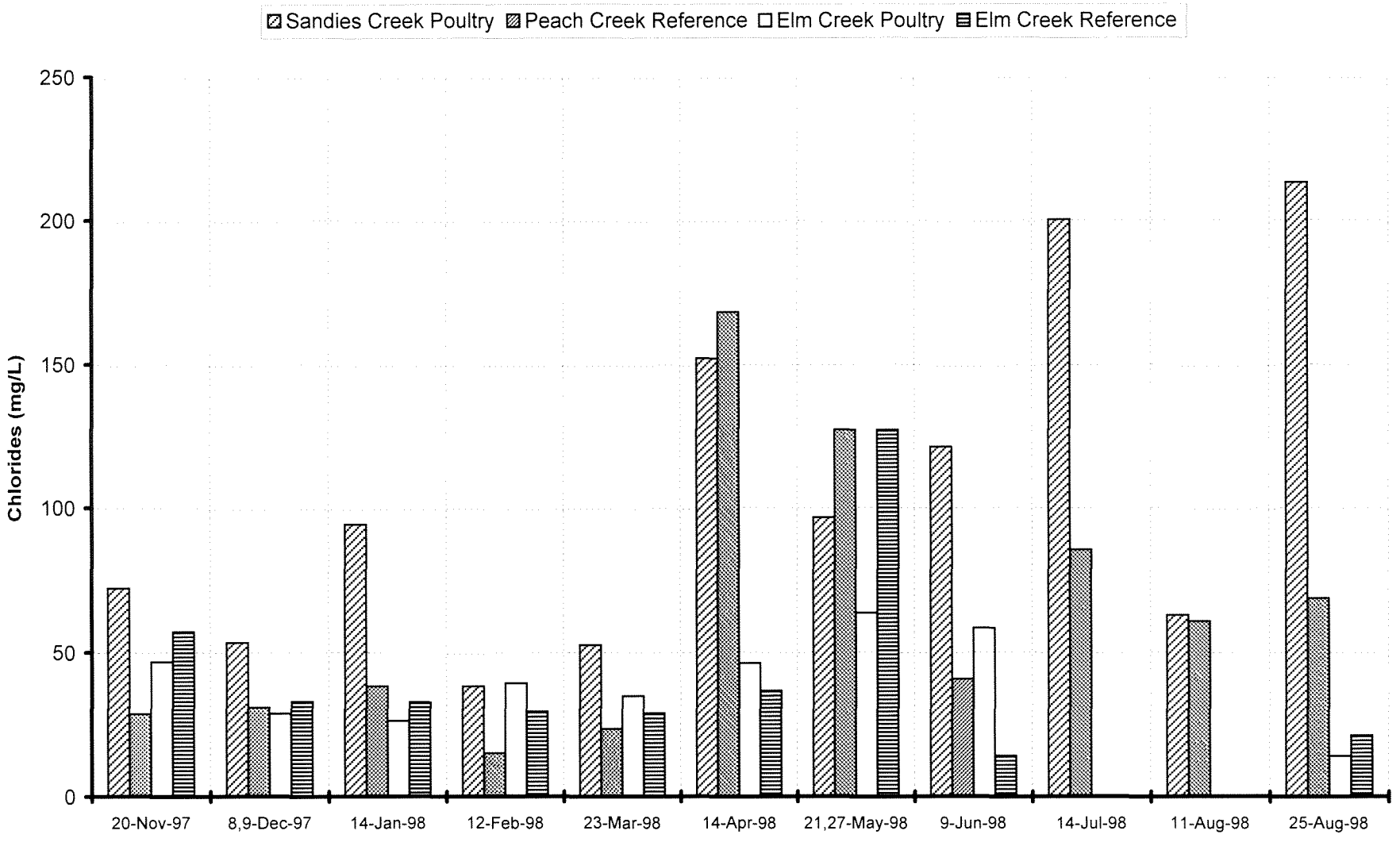


FIGURE 11
Water Temperature

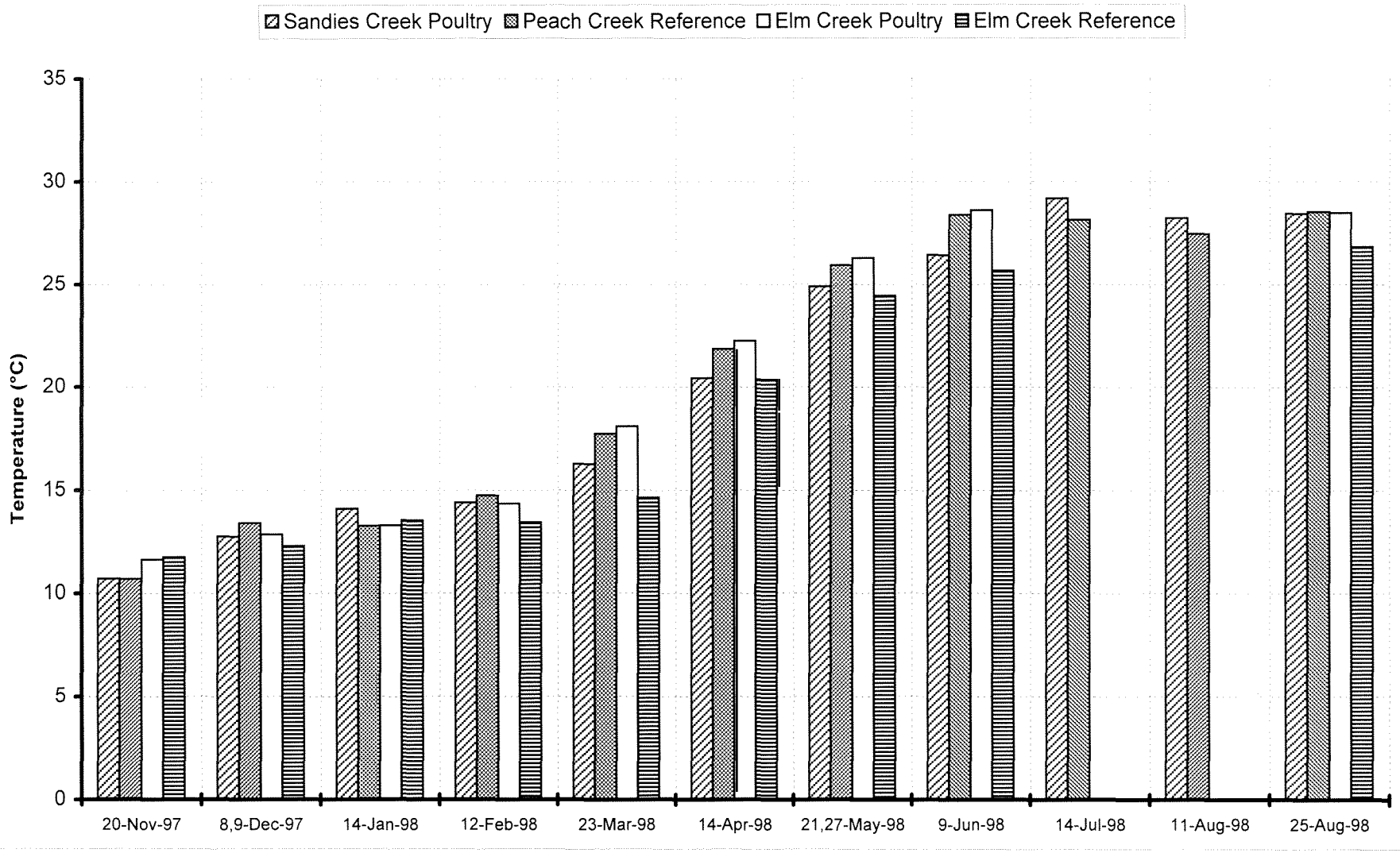


FIGURE 12
Dissolved Oxygen Concentrations

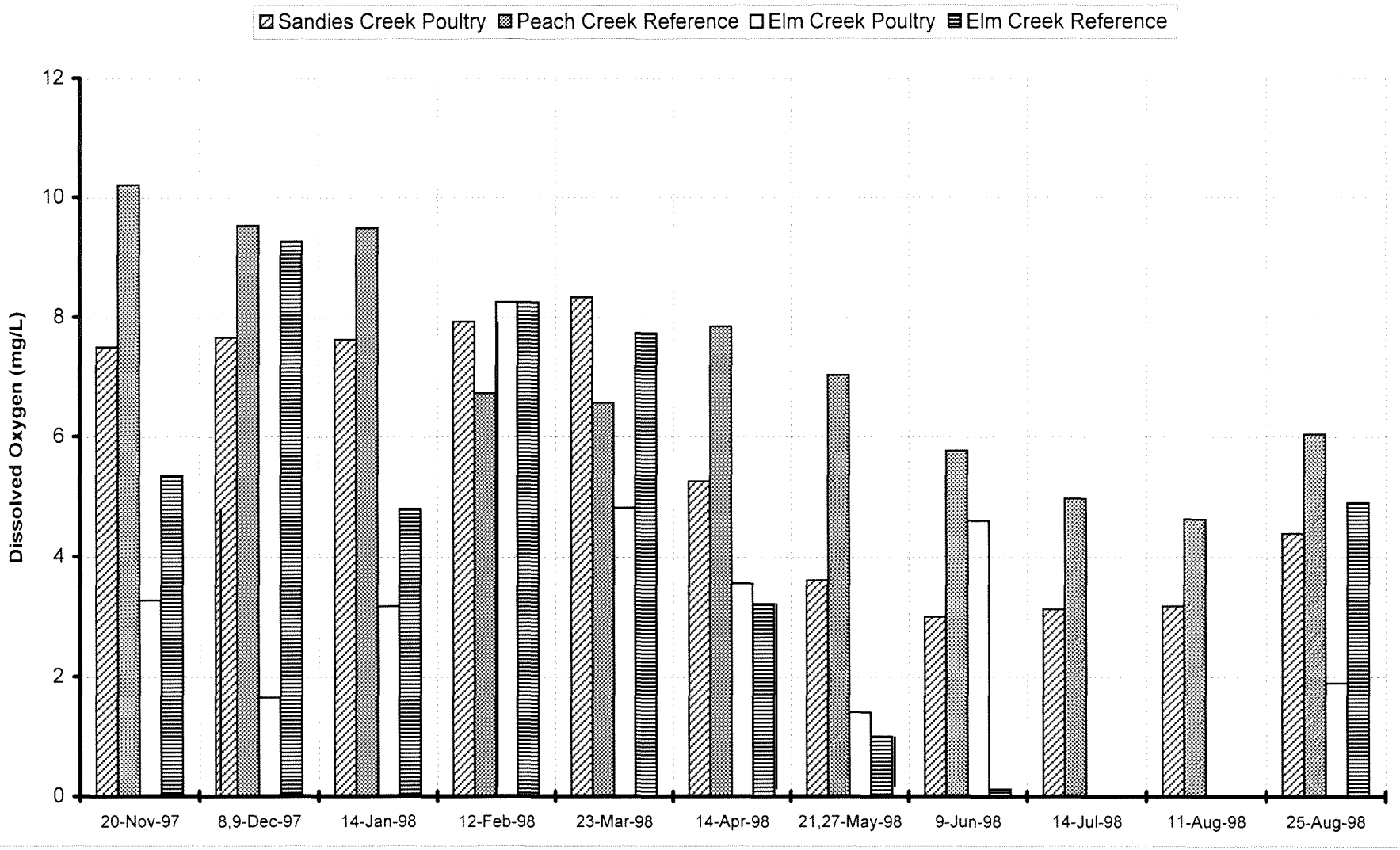


FIGURE 13
TDS Concentrations

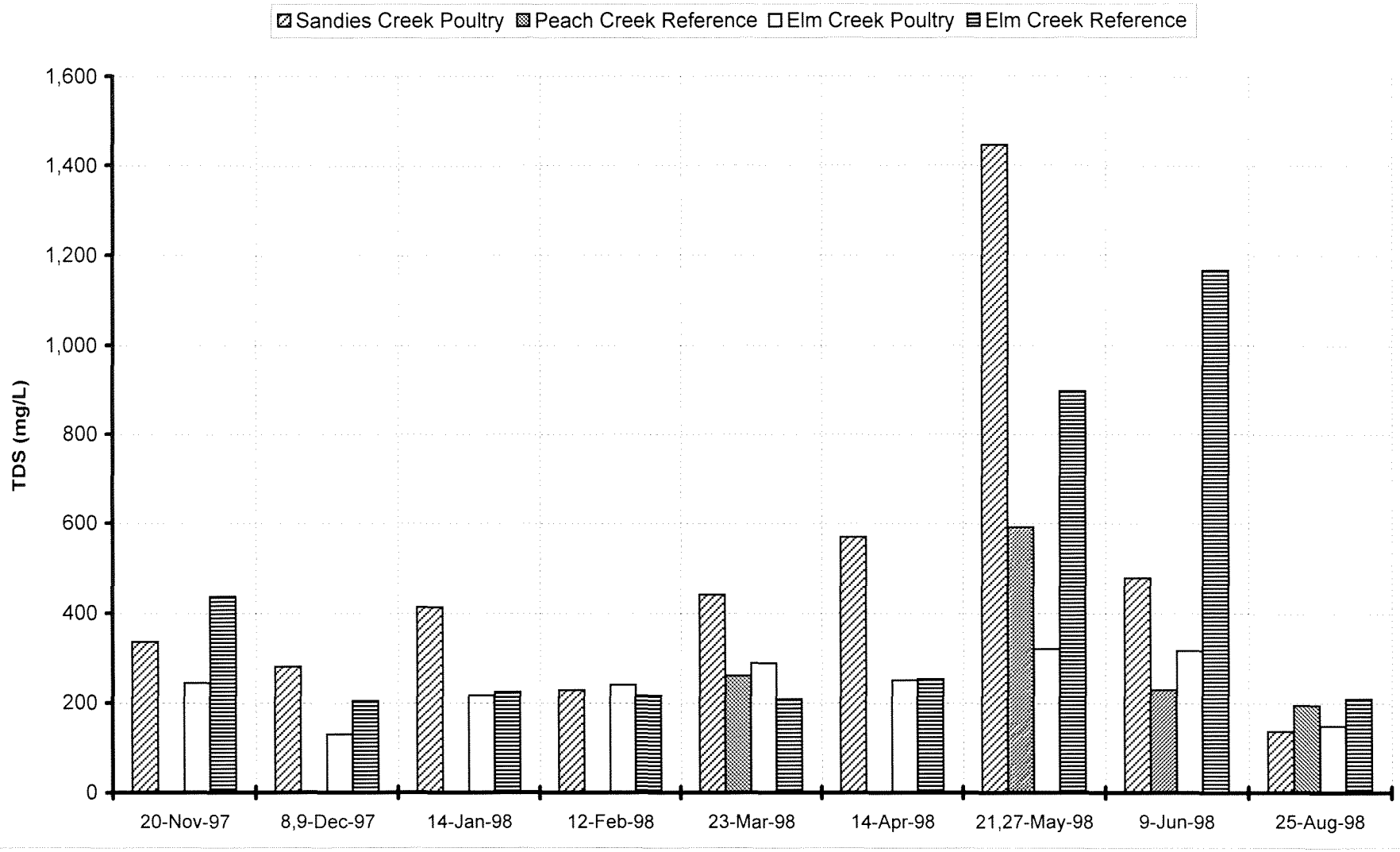
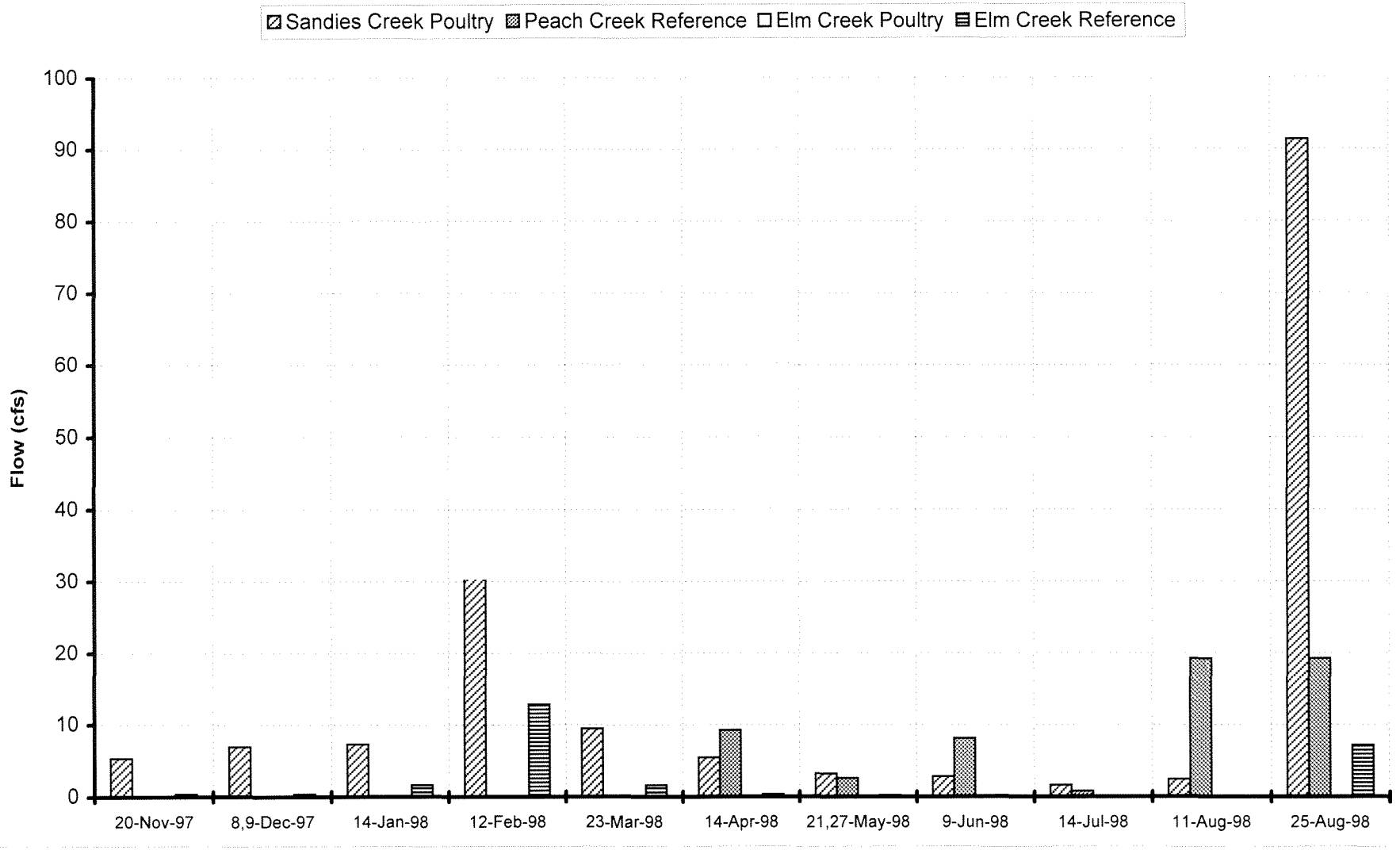


FIGURE 14
Flow Data



the water. However, inasmuch as it is downstream from the Elm Creek reference site, the flow should be similar. The flows for Peach Creek were too high to be safely measured from November 1997 through March 1998.

Chlorophyll a

The chlorophyll a concentrations ranged from 1 $\mu g/m^3$ at several stations to 74.1 $\mu g/m^3$ at the Elm Creek poultry site in June 1998 (Figure 15). The Elm Creek poultry site had the highest chlorophyll a concentrations. The greater depth and slow movement of water at this location may have led to the higher values. Only the Elm Creek poultry site had 25% of the observations greater than the 16.5 $\mu g/L$ screening level.

Fecal Coliform

The FC results presented in Figure 16 demonstrate that moderate to low levels were recorded for all trips with the exception of the high flow period documented in February and the 25 August 1998 observations. During the February 1998 high flow period, both the Sandies Creek and Elm Creek poultry sites had higher levels of FC than the two reference stations. However, there was no significant difference between the poultry and reference stations overall. As is typical for small, coastal plain streams, all four stations exceeded the stream standard and had more than 25% of FC observations greater than the 400 col/100mL screening level.

4.3 SEDIMENT QUALITY ANALYSIS

As previously mentioned, sediment samples were collected from each station during the June 1998 sampling and submitted to the TNRCC Houston Laboratory for metals analysis. As of this writing, the TNRCC has not submitted the results to GBRA.

4.4 BIOLOGICAL ASSESSMENT

A biological assessment following the guidelines of the TNRCC *Use Attainability Protocol for Unclassified Perennial Streams* was performed for each sample site. A habitat quality index (HQI) was prepared for each site, and biological characterizations were performed where site conditions were suitable. The HQI involves the ranking of nine physical characteristics for each site. These characteristics and associated descriptive range of scoring are as follows:

FIGURE 15
Chlorophyll a Concentrations

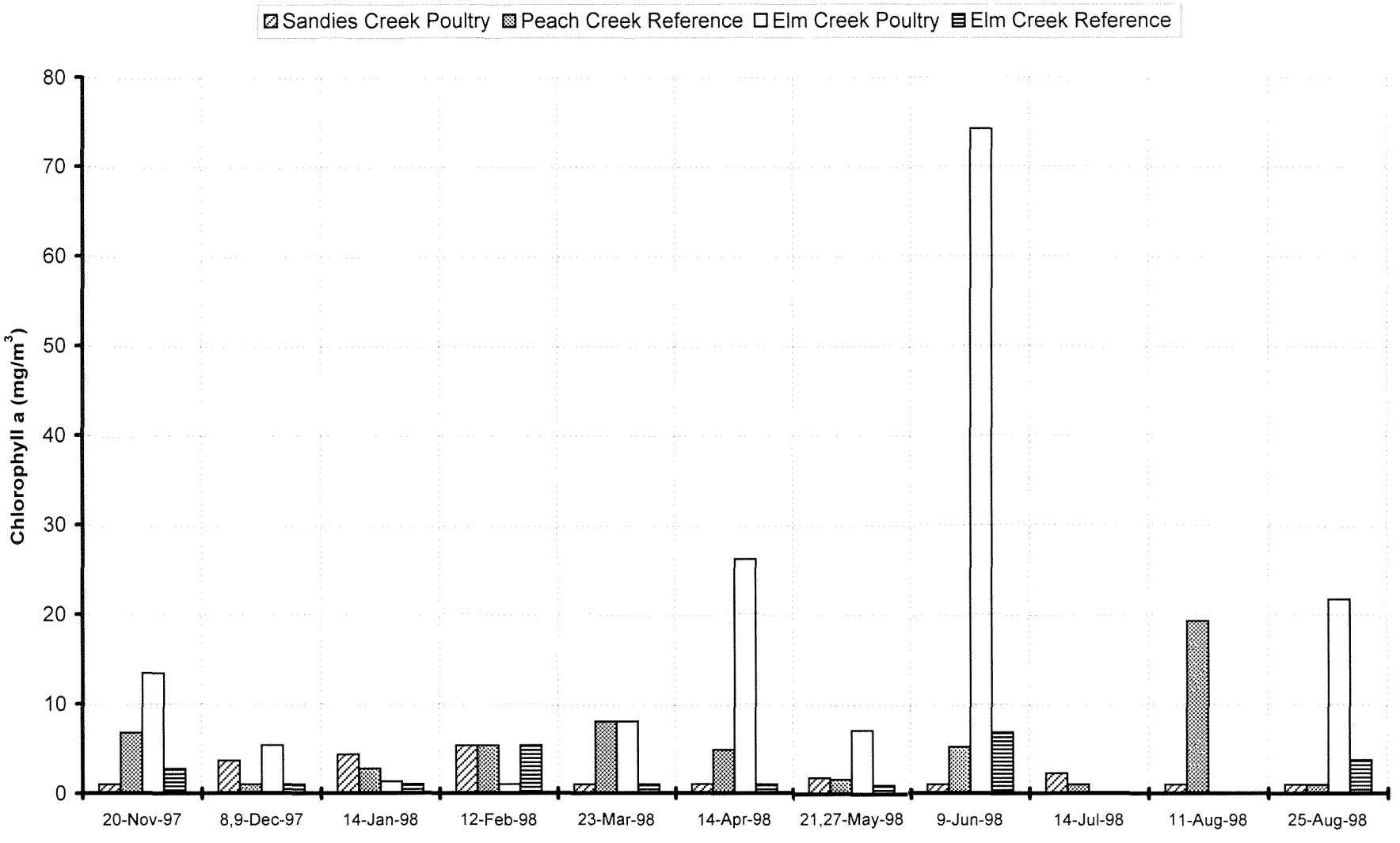
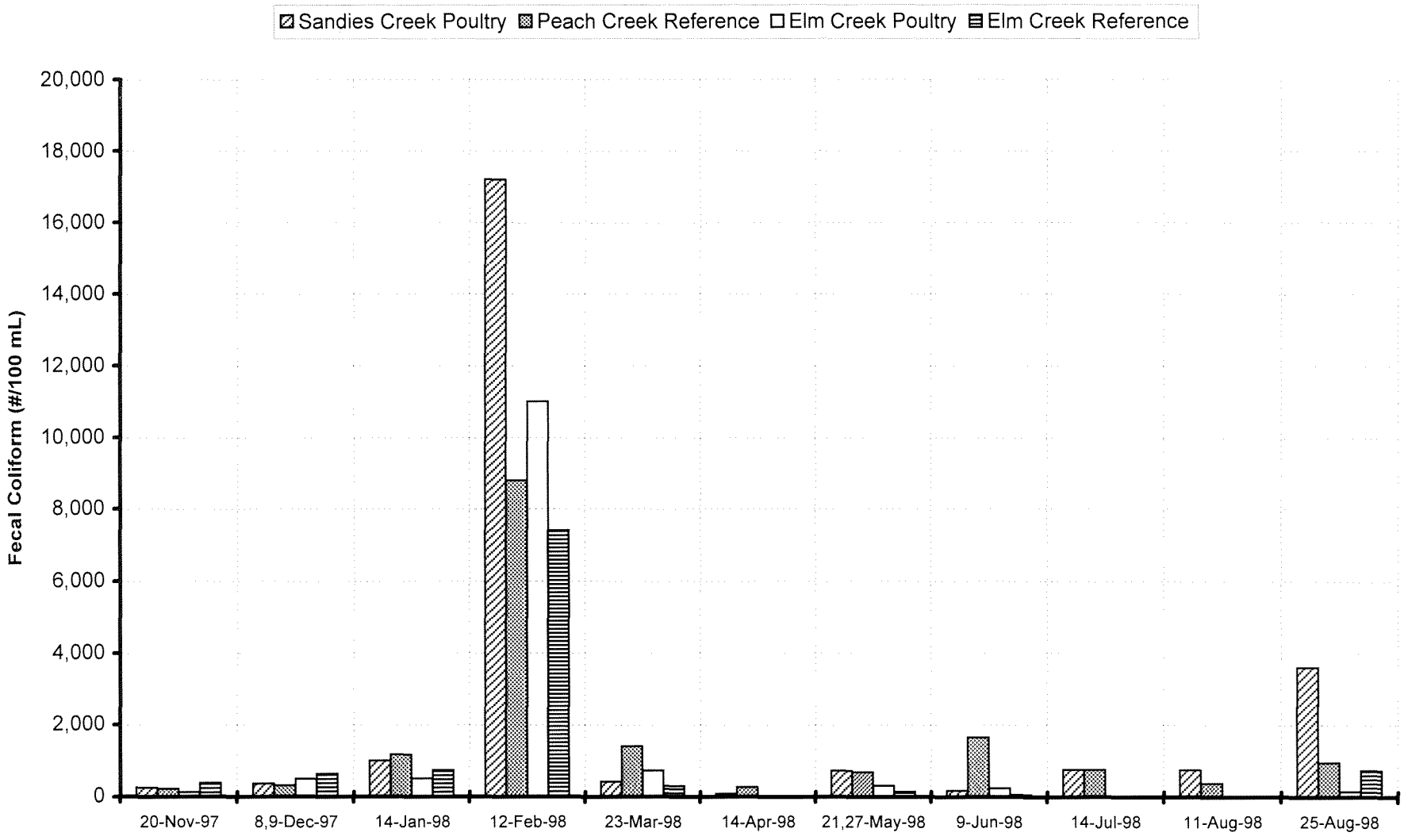


FIGURE 16
Fecal Coliform Concentrations



Instream cover	abundant to absent
Riffle/Runs	Common to none
Pool depth	>4 feet to none
Bank stability	no erosion to frequent raw banks
Riparian buffer	>or= 350 feet to <15 feet
Flow fluctuations	stable flows to severe intermittent stream
Channel sinuosity	frequent bends to straight channel (channelized)
Bottom substrate	stable with big rocks to unstable
Aesthetics	Wilderness with clear water to developed with discolored water

The physical characteristics described above were scored using a scale of 0 to 4 with four representing the best conditions and zero representing the worst habitat conditions. The total scores represented by each site are as follows:

Sandies Creek Poultry site = 19

Peach Creek Reference site = 16

Elm Creek Poultry site = 13

Elm Creek Reference site = 18

Attachment A provides the detailed information for each station. The TNRCC criteria describe a total score of 15-20 to be "Intermediate" habitat while a score less than 15 is characterized as "Limited" habitat. Therefore, using the HQI, the Elm Creek Poultry site would be classified as "Limited" aquatic habitat and the remainder of the sites would be classified as "Intermediate" aquatic habitat.

Tables 6 and 7 present the benthic characterization of biological condition for the Sandies Creek Poultry site and the Elm Creek reference site. As presented in Table 6, the benthic data collected from the Sandies Creek Poultry site indicate the site was not impaired and maintained a balanced benthic trophic structure. The Elm Creek Reference site was classified as moderately impaired with fewer species present (Table 7). Table 8 presents the Index of Biotic Integrity and aquatic life use classification calculated for the Peach Creek Reference site. The fish sampling results indicate that the Peach Creek Reference site supports an intermediate aquatic life use classification.

The physical habitat characterization and biological assessment performed in conjunction with this study provides solid baseline information upon which further investigations can be compared.

TABLE 6
SANDIES CREEK @ FM 1116 - GBRA Routine Monitoring Station
CRITERIA FOR CHARACTERIZATION OF BIOLOGICAL CONDITION
MAY 22,1998
Benthic Sampling

CATEGORY	METRIC	SANDIES CREEK Value	SANDIES CREEK Score
Species Richness and Composition	1. Taxa richness, Number of families	83	**6**
	2. Biotic index, Number in Family * tolerance value	94	**6**
	3. Ratio of EPT and Chironomid Abundances	20	**0**
	4. % Dominant Family	33%	**3**
	5. EPT Index, Number of Families	50	**0**
	6. Community Loss Index	0.5	**3**
	Total Metric Score		**18**
	Total Reference Score		***22***

Biological Condition Category	Attributes	% Composition to Reference	
Non-impaired	Comparable to the best situation to be expected within an ecoregion. Balanced trophic structure. Optimum community structure (composition and dominance) for stream size and habitat quality	>79%	**81.80%**
Moderately impaired	Fewer species due to loss of most intolerant forms. Reduction in EPT index.	29-72%	
Severely impaired	Few species present. If high densities of organisms, then dominated by on or two taxa. Only tolerant organisms present.	<21%	

TABLE 7
ELM CREEK @ C.R. 354 - GBRA Poultry Study
CRITERIA FOR CHARACTERIZATION OF BIOLOGICAL CONDITION
MAY 22,1998
Benthic Sampling

CATEGORY	METRIC	ELM CR. @ C.R. 354 Value	Score
Species Richness and Composition	1. Taxa richness, Number of families	72	**3**
	2. Biotic index, Number in Family * tolerance value	64	**3**
	3. Ratio of EPT and Chironomid Abundances	25	**0**
	4. % Dominant Family	40%	**3**
	5. EPT Index, Number of Families	66	**0**
	6. Community Loss Index	3.3	**3**
	Total Metric Score		**12**
	Total Reference Score		***22***

Biological Condition Category	Attributes	% Composition to Reference	
Non-impaired	Comparable to the best situation to be expected within an ecoregion. Balanced trophic structure. Optimum community structure (composition and dominance) for stream size and habitat quality	>79%	
Moderately impaired	Fewer species due to loss of most intolerant forms. Reduction in EPT index.	29-72%	**54.50%**
Severely impaired	Few species present. If high densities of organisms, then dominated by on or two taxa. Only tolerant organisms present.	<21%	

TABLE 8
PEACH CREEK - GBRA Routine Monitoring Station
INDEX OF BIOTIC INTEGRITY SCORING AND EVALUATION CRITERIA
21-May-98
Electrofishing

CATAGORY	METRIC	Peach Creek Value	Peach Creek Score
Species Richness and Composition	1. Total number of fish species	11	3
	2. Total number of darter species	0	1
	3. Total number of sunfish species	4	5
	4. Total number of sucker species	0	1
	5. Total number of intolerant species	4	5
	6. Proportion of individuals as tolerants	34.90%	1
Trophic Composition	7. Proportion of individuals as omnivores	6.35%	5
	8. Proportion of individuals as insectivores	81.95%	5
	9. Proportion of individuals as piscivores	12.70%	5
Fish Abundance and Condition	10. Number of individuals in sample	63	3
	11. Proportion of individuals as hybrids	0	5
	12. Proportion of individuals with disease or other anomaly	0.00%	5
	Total IBI Score		**44**

Aquatic Life Use Subcatagory	IBI Score
Exceptional	58-60
High	48-52
Intermediate	40-44
Limited	34-0

TABLE 8 (Concluded)
GBRA ROUTINE MONITORING - FISH SAMPLING
Electrofishing selected sample reaches
21-May-98

Species		Trophic	Tolerance	Peach
Scientific Name	Common Name	Level	Level	Creek
Cyprinella lutrensis	red shiner	Insectivore	Tolerant	5
Cyprinella venusta	blacktail shiner	Insectivore	Intolerant	13
Gambusia affinis	western mosquitofish	Insectivore	Tolerant	3
Ictalurus punctatus	channel catfish	Omnivore	Tolerant	3
Lepisosteus spatula	alligator gar	Piscivore	Tolerant	6
Lepomis gulosus	warmouth	Piscivore	Tolerant	2
Lepomis macrochirus	bluegill	Insectivore	Tolerant	2
Lepomis megalotis	longear sunfish	Insectivore	Intolerant	25
Lepomis microlophus	redear sunfish	Insectivore	Intolerant	2
Ictalurus natalis	yellow bullhead	Omnivore	Intolerant	1
Dorosoma cepedianum	gizzard shad	Omnivore	Tolerant	1
Total Species				11
Total Individuals				63

Overall, the biological information collected appears to be consistent with small perennial streams in central Texas, and does not suggest a significant water quality concern. However, the biological sampling design utilized does not allow for direct comparisons between sample and reference sites.

5.0 DISCUSSION

The similar watershed characteristics along with more limited poultry activity in the immediate vicinity of the actual site in the Peach Creek watershed made the Peach Creek site a reasonable reference for comparison with the Sandies Creek poultry site. The concentration of potential poultry operations within a short distance from the sample site and relative abundance of operations within the watershed made the Sandies Creek poultry site a reasonably appropriate site to examine for potential water quality effects. Both the Sandies and Peach Creek watersheds have wastewater discharge influences but as noted above they account for approximately the same amount of flow with respect to the observed total flow in both systems. The Elm Creek reference watershed contained no recorded poultry operations and thus served as a solid reference for the Elm Creek poultry watershed. The Elm Creek poultry watershed exhibited considerable activity within a short distance from the actual sample site and moderate activity within the watershed.

A poultry operations database was digitally created using spliced USGS quad maps as a base map. The base maps were then updated using 1995 aerial photography from the Gonzales Farm Services Agency. Mr. Glen Sachleben (TPWD game warden in Gonzales County for 28 plus years) endorsed the site selections, however, no field verification effort was conducted to confirm the current usage of the facilities.

The water quality data suggests the possibility of effects of poultry operations, but is certainly not definitive in this regard. Table 9 presents a summary of a statistical evaluation of the means of the paired data. With the exception of the nitrate-N levels at the Sandies Creek poultry site relative to the Peach Creek reference site, there were no statistically significant differences in the data means. The higher level of nitrate-N and to a lesser extent other dissolved solids (sulfates, chlorides and TDS) at the Sandies Creek location may relate to the higher level of poultry operations in that area. However, differences in baseline groundwater concentrations of nitrates and the possibility of spring fed influences may also explain the differences. A check was made with TWDB Report 4 (Groundwater-Resources of Gonzales County, Texas) but the only wells in the immediate vicinity of Sandies Creek were deep and not representative of surface conditions.

The longitudinal survey of Sandies Creek conducted at the end of the effort indicated that nitrate-N levels were not markedly lower upstream of the poultry operations. However, ortho-P concentrations were higher at sample stations closer to the poultry sites. While there was a possibility of

TABLE 9
TESTS OF SIGNIFICANT DIFFERENCE IN MEANS

Parameter	t-test on Means	
	Sandies Creek Poultry vs. Peach Creek Reference	Elm Creek Poultry vs. Elm Creek Reference
Flow stream, instantaneous (cfs)	Insignificant[2]	Insignificant[1]
Specific conductance, field (µmhos/cm @ 25°C)	Insignificant[2]	Insignificant[1]
Residue, total filtrable (dried at 180°C) (mg/L) [TDS]	Insignificant[1]	Insignificant[1]
Chloride (mg/L)	Insignificant[1]	Insignificant[1]
Sulfate (mg/L)	Insignificant[2]	Insignificant[2]
Hardness, EDTA, total (mg/L)	Insignificant[2]	Insignificant[2]
Temperature, water (°C)	Insignificant[1]	Insignificant[1]
Oxygen, dissolved (mg/L)	Insignificant[1]	Insignificant[2]
pH (standard units)	Insignificant[2]	Insignificant[2]
Residue, total nonfiltrable (mg/L) [TSS]	Insignificant[2]	Insignificant[1]
Nitrogen ammonia (mg/L as N)	Insignificant[1]	Insignificant[1]
Nitrate nitrogen (mg/L as N)	**Significant[1]**	Insignificant[2]
Phosphate, ortho (mg/L as P)	Insignificant[1]	Insignificant[1]
Fecal coliform, membrane filter, M-FC broth (#/100 mL)	Insignificant[2]	Insignificant[1]
Chlorophyll a, spectrophotometric acid method (mg/m^3)	Insignificant[1]	Insignificant[2]

[1]Based on results of F-tests on variances, the t-tests on means were done by assuming equal variances.
[2]Based on results of F-tests on variances, the t-tests on means were done by assuming unequal variances.

differences between the Sandies-Peach poultry-reference sites, there was no indication of significant differences between the Elm Creek poultry and reference sites.

The FC concentrations remaining essentially the same for all stations throughout much of the study period, excluding the high flow event in February 1998, and do not suggest a difference due to land use. However, during the high flow event in February 1998, the FC values were the highest at the two poultry sites. In addition, the Sandies Creek poultry site was the only station to exhibit a higher ammonia concentration during the high flow event. The high concentrations of nitrate-N and ammonia-N observed in the June 1998 sampling at the Peach Creek reference site is unexplained. The remaining water quality parameters exhibit no evident trends.

The biological data do not indicate a problem but are not definitive in this regard because differences in site characteristics precluded collection of directly comparable information. The sediment quality data have not been received and discussions of results will take place in a subsequent draft of this report.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The poultry operations study was designed and conducted to support the requirements placed on the TNRCC by the Texas Legislature. The task was to assess the impact of high-intensity poultry activity on water quality. The assessment is based on monitoring water quality parameters on two pairs of streams, with each pair having sites that drain watersheds selected to be as similar as possible, differing primarily in the level of poultry activity. An impact would be indicated if the data from the poultry site was significantly different in some adverse fashion from its reference site. Based on the data collected during the ten month study, the following conclusions can be drawn.

1. Water quality data from all sites appears to be in the normal range for small rural streams with no indication of significant environmental concerns.

2. Of the two paired locations monitored, one (the Elm Creek pair) indicated no detectable difference between poultry and reference sites, and the other (the Sandies-Peach pair) indicated the possibility of a difference related to poultry operations, at least with some parameters.

3. Of the two watershed pairs, the Elm Creek sites would appear to provide more accurate comparison information. The Sandies-Peach pairing are two entirely separate watersheds, and thus have a higher number of uncontrolled variables than the Elm Creek sites, which are to a substantial degree in the same watershed. Also, there is a strong difference in the level of poultry activity between the two Elm Creek sites (no poultry activity versus moderate activity), while the Sandies-Peach pairing differs only in degree of poultry activity.

4. This study does not provide sufficient data to reach a definitive conclusion on the impact assessment question. However, if there is an adverse effect of poultry operations on water quality, the data suggests that the effect is not large. If that is the case, a more intensive effort would be required to identify and quantify an effect.

The overall conclusion drawn from this poultry operations study is that a short term monitoring effort will provide solid baseline information for future comparison but may not provide

concrete evidence as to long-term poultry operations influences into adjacent water bodies. Items that are outside of the scope of this project but would provide valuable information include:

1. A field verification of active poultry operations within Gonzales County to add to the poultry operations database created during this study and to get information on how and where the poultry litter is used,

2. Additional longitudinal surveys should be performed at a range of flow conditions in the Sandies Creek Watershed collecting samples at all available road crossings.

3. Future analyses should be focused on the poultry litter application practices and runoff from fields where poultry litter is applied. This work could be performed in conjunction with the NRCS who are preparing Pollution Prevention Plans for Area operators.

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ATTACHMENT A

HABITAT QUALITY INDICES

ATTACHMENT A
HABITAT QUALITY INDICES
ELM CREEK @ C.R. 108 - Poultry Site
22-May-98

RATING PARAMETER	ATTRIBUTES (Rating Scores)			
Instream Cover	Abundant (> or = 50%) (4)	Common (30-49.9%) (3)	Rare (10-29.9%) (2)	Absent (<10%) (0)
Riffle/Runs	Common (>5 Discrete Riffles) (4)	Occasional (2-4 Discrete Riffles) (3)	Rare (1 Discrete Riffle) (2)	None (0)
Pool Depth	Typically Large and Deep Max. Pool Depth >4 ft. (4)	Typically Moderate Max. Pool Depth 2-4 ft. (3)	Typically Small Max. Pool Depth <2 ft. (2)	None No existing pools Only shallow auxiliary pockets (1)
Bank Stability	Stable Little evidence (<10%) of eroded banks Side slopes generally <30 degrees (3)	Moderately Stable Some evidence (10-29.9%) of eroded bands; small areas of erosion mostly healed over Side slopes average 30-39.9 degrees (2)	Moderately Unstable Moderate frequency (30-49.9%) and size of eroded areas. Side slopes average 40-59.9 degrees (1)	Unstable Large and frequent (> or =50%) eroded areas. Raw areas frequent along steep banks. Side slopes > or =60 degrees (0)
Riparian Buffer	Extensive Width of Natural Buffer > or =350 ft. (3)	Wide Width of Natural Buffer 150-349 ft. (2)	Moderate Width of Natural Buffer 15-149 ft. (1)	Narrow Width of Natural Buffer <15 ft. (0)
Flow Fluctuations	Minor Little or none from base flow. (3)	Moderate Evidence of debris along middle portion of banks (2)	Severe Evidence of debris high on banks (0)	Severe Intermittent Stream (0)

ATTACHMENT A
HABITAT QUALITY INDICES
ELM CREEK @ C.R. 108 - Poultry Site (Concluded)
22-May-98

RATING PARAMETER	ATTRIBUTES (Rating Scores)			
Channel Sinuosity	High > or = 2 well defined bends with deep outside areas and shallow inside areas (3)	Moderate 1 well-developed bend or > or =3 moderately-defined bends (2)	Low < 3 moderately-defined bends or only poorly-defined bends present (1)	None Straight channel: maybe channelized (0)
Bottom Substrate	Stable > or =50% cobbles, rubble, or gravel (3)	Moderately Stable 30-49.9% gravel or larger substrate (2)	Moderately Unstable 10-29.9% gravel or larger substrate (1)	Unstable <10% gravel or larger bottom uniform sand, clay, silt, or bedrock (0)
Aesthetics	Wilderness Outstanding natural beauty; usually wooded or unpastured area; water clarity exceptional (3)	Natural Area Trees and/or native vegetation common; some development evident (from fields, pastures, dwellings); water clarity discolored (2)	Common Setting Not offensive, developed but uncluttered; water may be colored or turbid (1)	Offensive Stream does not enhance aesthetics; cluttered, highly developed, dumping area; water discolored (0)

Total Score for all Subcategories to Determine Habitat Quality Index

Total Habitat Score = 13 - LIMITED

26-30	Exceptional
21-25	High
15-20	Intermediate
<or=14	Limited

ATTACHMENT A
HABITAT QUALITY INDICES
ELM CREEK @ C.R. 354 - Reference Site
22-May-98

RATING PARAMETER	ATTRIBUTES (Rating Scores)			
Instream Cover	Abundant (> or = 50%) (4)	Common (30-49.9%) (3)	Rare (10-29.9%) (2)	Absent (<10%) (0)
Riffle/Runs	Common (>5 Discrete Riffles) (4)	Occasional (2-4 Discrete Riffles) (3)	Rare (1 Discrete Riffle) (2)	None (0)
Pool Depth	Typically Large and Deep Max. Pool Depth >4 ft. (4)	Typically Moderate Max. Pool Depth 2-4 ft. (3)	Typically Small Max. Pool Depth <2 ft. (2)	None No existing pools Only shallow auxiliary pockets (1)
Bank Stability	Stable Little evidence (<10%) of eroded banks Side slopes generally <30 degrees (3)	Moderately Stable Some evidence (10-29.9%) of eroded bands; small areas of erosion mostly healed over Side slopes average 30-39.9 degrees (2)	Moderately Unstable Moderate frequency (30-49.9%) and size of eroded areas. Side slopes average 40-59.9 degrees (1)	Unstable Large and frequent (> or =50%) eroded areas. Raw areas frequent along steep banks. Side slopes > or =60 degrees (0)
Riparian Buffer	Extensive Width of Natural Buffer > or =350 ft. (3)	Wide Width of Natural Buffer 150-349 ft. (2)	Moderate Width of Natural Buffer 15-149 ft. (1)	Narrow Width of Natural Buffer <15 ft. (0)
Flow Fluctuations	Minor Little or none from base flow. (3)	Moderate Evidence of debris along middle portion of banks (2)	Severe Evidence of debris high on banks (0)	Severe Intermittent Stream (0)

ATTACHMENT A
HABITAT QUALITY INDICES
ELM CREEK @ C.R. 354 - Reference Site (Concluded)
22-May-98

RATING PARAMETER	ATTRIBUTES (Rating Scores)			
Channel Sinuosity	High > or = 2 well defined bends with deep outside areas and shallow inside areas (3)	Moderate 1 well-developed bend or > or =3 moderately-defined bends (2)	Low < 3 moderately-defined bends or only poorly-defined bends present (1)	None Straight channel: maybe channelized (0)
Bottom Substrate	Stable > or =50% cobbles, rubble, or gravel (3)	Moderately Stable 30-49.9% gravel or larger substrate (2)	Moderately Unstable 10-29.9% gravel or larger substrate (1)	Unstable <10% gravel or larger bottom uniform sand, clay, silt, or bedrock (0)
Aesthetics	Wilderness Outstanding natural beauty; usually wooded or unpastured area; water clarity exceptional (3)	Natural Area Trees and/or native vegetation common; some development evident (from fields, pastures, dwellings); water clarity discolored (2)	Common Setting Not offensive, developed but uncluttered; water may be colored or turbid (1)	Offensive Stream does not enhance aesthetics; cluttered, highly developed, dumping area; water discolored (0)

Total Score for all Subcategories to Determine Habitat Quality Index

Total Habitat Score = 18 - Intermediate

26-30	Exceptional
21-25	High
15-20	Intermediate
<or=14	Limited

ATTACHMENT A
HABITAT QUALITY INDICES
SANDIES CREEK - Poultry Site
MAY 22, 1998

RATING PARAMETER	ATTRIBUTES (Rating Scores)			
Instream Cover	Abundant (> or = 50%) (4)	Common (30-49.9%) (3)	Rare (10-29.9%) (2)	Absent (<10%) (0)
Riffle/Runs	Common (>5 Discrete Riffles) (4)	Occasional (2-4 Discrete Riffles) (3)	Rare (1 Discrete Riffle) (2)	None (0)
Pool Depth	Typically Large and Deep Max. Pool Depth >4 ft. (4)	Typically Moderate Max. Pool Depth 2-4 ft. (3)	Typically Small Max. Pool Depth <2 ft. (2)	None No existing pools Only shallow auxiliary pockets (1)
Bank Stability	Stable Little evidence (<10%) of eroded banks Side slopes generally <30 degrees (3)	Moderately Stable Some evidence (10-29.9%) of eroded bands; small areas of erosion mostly healed over Side slopes average 30-39.9 degrees (2)	Moderately Unstable Moderate frequency (30-49.9%) and size of eroded areas. Side slopes average 40-59.9 degrees (1)	Unstable Large and frequent (> or =50%) eroded areas. Raw areas frequent along steep banks. Side slopes > or =60 degrees (0)
Riparian Buffer	Extensive Width of Natural Buffer > or =350 ft. (3)	Wide Width of Natural Buffer 150-349 ft. (2)	Moderate Width of Natural Buffer 15-149 ft. (1)	Narrow Width of Natural Buffer <15 ft. (0)
Flow Fluctuations	Minor Little or none from base flow. (3)	Moderate Evidence of debris along middle portion of banks (2)	Severe Evidence of debris high on banks (1)	Severe Intermittent Stream (0)

ATTACHMENT A
HABITAT QUALITY INDICES
SANDIES CREEK - Poultry Site (Concluded)
MAY 22, 1998

RATING PARAMETER	ATTRIBUTES (Rating Scores)			
Channel Sinuosity	High > or = 2 well defined bends with deep outside areas and shallow inside areas (3)	Moderate 1 well-developed bend or > or =3 moderately-defined bends (2)	Low < 3 moderately-defined bends or only poorly-defined bends present (1)	None Straight channel: maybe channelized (0)
Bottom Substrate	Stable > or =50% cobbles, rubble, or gravel (3)	Moderately Stable 30-49.9% gravel or larger substrate (2)	Moderately Unstable 10-29.9% gravel or larger substrate (1)	Unstable <10% gravel or larger bottom uniform sand, clay, silt, or bedrock (0)
Aesthetics	Wilderness Outstanding natural beauty; usually wooded or unpastured area; water clarity exceptional (3)	Natural Area Trees and/or native vegetation common; some development evident (from fields, pastures, dwellings); water clarity discolored (2)	Common Setting Not offensive, developed but uncluttered; water may be colored or turbid (1)	Offensive Stream does not enhance aesthetics; cluttered, highly developed, dumping area; water discolored (0)

Total Score for all Subcategories to Determine Habitat Quality Index

Total Habitat Score = 19 - Intermediate

26-30	Exceptional
21-25	High
15-20	Intermediate
<or=14	Limited

ATTACHMENT A
HABITAT QUALITY INDICES
PEACH CREEK - Reference Site
MAY 21, 1998

RATING PARAMETER	ATTRIBUTES (Rating Scores)			
Instream Cover	Abundant (> or = 50%) (4)	Common (30-49.9%) (3)	Rare (10-29.9%) (2)	Absent (<10%) (0)
Riffle/Runs	Common (>5 Discrete Riffles) (4)	Occasional (2-4 Discrete Riffles) (3)	Rare (1 Discrete Riffle) (2)	None (0)
Pool Depth	Typically Large and Deep Max. Pool Depth >4 ft. (4)	Typically Moderate Max. Pool Depth 2-4 ft. (3)	Typically Small Max. Pool Depth <2 ft. (2)	None No existing pools Only shallow auxiliary pockets (1)
Bank Stability	Stable Little evidence (<10%) of eroded banks Side slopes generally <30 degrees (3)	Moderately Stable Some evidence (10-29.9%) of eroded bands; small areas of erosion mostly healed over Side slopes average 30-39.9 degrees (2)	Moderately Unstable Moderate frequency (30-49.9%) and size of eroded areas. Side slopes average 40-59.9 degrees (1)	Unstable Large and frequent (> or =50%) eroded areas. Raw areas frequent along steep banks. Side slopes > or =60 degrees (0.5)
Riparian Buffer	Extensive Width of Natural Buffer > or =350 ft. (3)	Wide Width of Natural Buffer 150-349 ft. (2)	Moderate Width of Natural Buffer 15-149 ft. (1)	Narrow Width of Natural Buffer <15 ft. (0)
Flow Fluctuations	Minor Little or none from base flow. (3)	Moderate Evidence of debris along middle portion of banks (2)	Severe Evidence of debris high on banks (0)	Severe Intermittent Stream (0)

ATTACHMENT A
HABITAT QUALITY INDICES
PEACH CREEK - Reference Site (Concluded)
MAY 21, 1998

RATING PARAMETER	ATTRIBUTES (Rating Scores)			
Channel Sinuosity	High > or = 2 well defined bends with deep outside areas and shallow inside areas (3)	Moderate 1 well-developed bend or > or =3 moderately-defined bends (2)	Low < 3 moderately-defined bends or only poorly-defined bends present (1)	None Straight channel: maybe channelized (0)
Bottom Substrate	Stable > or =50% cobbles, rubble, or gravel (3)	Moderately Stable 30-49.9% gravel or larger substrate (2)	Moderately Unstable 10-29.9% gravel or larger substrate (1)	Unstable <10% gravel or larger bottom uniform sand, clay, silt, or bedrock (0)
Aesthetics	Wilderness Outstanding natural beauty; usually wooded or unpastured area; water clarity exceptional (3)	Natural Area Trees and/or native vegetation common; some development evident (from fields, pastures, dwellings); water clarity discolored (2.5)	Common Setting Not offensive, developed but uncluttered; water may be colored or turbid (1)	Offensive Stream does not enhance aesthetics; cluttered, highly developed, dumping area; water discolored (0)

Total Score for all Subcategories to Determine Habitat Quality Index

Total Habitat Score = 16 - Intermediate

26-30	Exceptional
21-25	High
15-20	Intermediate
<or=14	Limited

ADDENDUM 1
POULTRY OPERATIONS STUDY
GUADALUPE RIVER BASIN

In August of 1998 a draft report on the GBRA's Poultry Study was submitted to the TNRCC. In September 1998 24 comments were received. In preparing the final report, all of the comments were considered and substantial efforts made to respond to each. In several areas the effort expended was well beyond that originally specified and budgeted. With four of the comments it was not possible to respond completely. This addendum addresses those comments.

Comment 2, Rainfall data. The comment requested monthly average rain amounts through the course of the study, and a discussion of related conditions. Collecting rain data was not part of the scope of work. In response to the comment, GBRA and contractor personnel made a number of inquiries, but no data were located during that time. The only information we were able to locate in Gonzales County was the twice/week recordings at two stations on the Guadalupe River, run by the GBRA staff. It was not clear how these observations would be useful in interpreting the monitoring results, as they were well removed from the study watersheds. Based on this, and the fact that flow was measured directly where possible, no effort was put into including rain data remote from the sites. As this addendum was being assembled GBRA staff did locate data from a National Weather Service gage in Nixon, and data from November through August 1998 is attached. Note that there was little rain in the general area during the months of April through July, 1998.

Comment 14, Blanks in data tables. There were two primary reasons for the blanks in the data tables. The first is that, because two of the four stations were incorporated into the routine CRP sampling network, their routine list of parameters was slightly different than specified for the special poultry study. This sometimes led to some confusion as to which parameters to run. On the July 14, and August 11, samplings, only the regular CRP stations were included, as it was believed the Poultry Study was finished. The addition of another month of data following a rain (the August 25 samples), along with including the July 14 and August 11 samples produced tabular gaps. Another problem was parameters like hardness, which were not on the specified list, but were analyzed on some occasions. We elected to include the results of all analyses and leave the blanks when not tested, rather than simply delete all the routine and hardness observations. Finally, there were a few cases where intended sample results were lost due to error, either in specifying parameters or in the analytical process.

Comment 9, difficulty in seeing poultry houses on maps when color version photocopied. The purpose of the figures was to show the entire watershed and

include the overall locations of the poultry operations within each watershed. In order to easily view each poultry house at its original size, zooming in would be required which would lead to several figures per watershed. The three solutions are 1) to present the actual information to be used as an overall view of poultry activity within each watershed, 2) break each watershed down into segments and include several figures per watershed, or 3) represent the poultry houses in some expanded format and explain that the size of the poultry houses is not representative of actual sizes. We don't believe that any one solution is ideal, but we opted for the first solution to use the actual sizes within the framework of the entire watershed.

List parameters actually measured and the frequency at which they were sampled for all sites. Tables 1-4 in the report show the parameters sampled and the frequency of sampling. It would seem repetitive to add a table of parameters and schedule of sampling.

RAINFALL RECORD FOR NOVEMBER 1997 THROUGH AUGUST 1998 - NATIONAL WEATHER SERVICE - NIXON STATION

Day	Nov Rainfall inches	Day	Dec Rainfall inches	Day	Jan Rainfall inches	Day	Feb Rainfall inches	Day	Mar Rainfall inches	Day	Apr Rainfall inches	Day	May Rainfall inches	Day	Jun Rainfall inches	Day	Jul Rainfall inches	Day	Aug Rainfall inches
1	0.00	1	0.00	1	0.00	1	0.90	1	0.00	1	0.00	1	0.00	1	0.00	1	0.00	1	0.00
2	0.00	2	0.00	2	0.00	2	0.00	2	0.00	2	0.00	2	0.00	2	0.00	2	0.00	2	0.00
3	0.00	3	0.90	3	0.00	3	0.00	3	0.00	3	0.00	3	0.00	3	0.00	3	0.00	3	0.00
4	0.00	4	0.00	4	0.00	4	0.00	4	0.00	4	0.00	4	0.00	4	0.00	4	2.14	4	0.00
5	0.00	5	0.00	5	0.19	5	0.13	5	0.00	5	0.00	5	0.00	5	0.00	5	0.00	5	0.00
6	0.00	6	0.00	6	0.00	6	0.09	6	0.00	6	0.00	6	0.00	6	0.12	6	0.00	6	1.29
7	0.00	7	0.00	7	1.21	7	0.00	7	0.00	7	0.00	7	0.00	7	0.00	7	0.00	7	3.01
8	0.00	8	0.11	8	0.00	8	0.00	8	0.20	8	0.05	8	0.00	8	0.00	8	0.00	8	0.69
9	0.00	9	0.00	9	0.00	9	0.00	9	0.00	9	0.00	9	0.00	9	0.00	9	0.00	9	0.00
10	0.60	10	0.00	10	0.00	10	0.00	10	0.00	10	0.00	10	0.00	10	0.00	10	0.00	10	0.00
11	0.00	11	0.00	11	0.00	11	1.14	11	0.00	11	0.00	11	0.00	11	0.00	11	0.00	11	0.00
12	2.00	12	0.00	12	0.00	12	0.00	12	0.00	12	0.00	12	0.00	12	0.17	12	0.00	12	0.00
13	0.17	13	0.00	13	0.00	13	0.00	13	0.00	13	0.00	13	0.00	13	0.00	13	0.00	13	0.00
14	0.00	14	0.00	14	0.00	14	0.00	14	0.45	14	0.00	14	0.00	14	0.00	14	0.00	14	0.00
15	0.00	15	0.00	15	0.00	15	0.57	15	0.00	15	0.00	15	0.00	15	0.00	15	0.46	15	0.73
16	0.26	16	0.00	16	0.00	16	0.47	16	0.71	16	0.00	16	Trace	16	0.00	16	0.00	16	0.00
17	0.00	17	0.00	17	0.00	17	0.00	17	0.00	17	0.00	17	0.00	17	0.00	17	0.00	17	1.46
18	0.04	18	0.00	18	0.05	18	0.00	18	0.00	18	0.54	18	0.00	18	0.00	18	0.00	18	0.07
19	0.00	19	0.00	19	0.00	19	0.82	19	0.00	19	0.20	19	0.00	19	0.00	19	0.00	19	0.00
20	0.00	20	0.00	20	0.00	20	0.00	20	0.00	20	0.00	20	0.00	20	0.00	20	0.00	20	0.00
21	0.00	21	0.75	21	0.00	21	0.00	21	0.00	21	0.00	21	0.00	21	0.00	21	0.00	21	0.23
22	0.00	22	0.00	22	0.00	22	0.85	22	0.00	22	0.00	22	0.00	22	0.00	22	0.00	22	1.00
23	0.00	23	0.05	23	0.07	23	0.00	23	0.00	23	0.00	23	0.00	23	0.00	23	0.00	23	2.41
24	0.00	24	0.33	24	0.00	24	0.00	24	0.00	24	0.00	24	0.00	24	0.00	24	0.00	24	0.00
25	0.00	25	0.00	25	0.00	25	0.00	25	0.00	25	0.00	25	0.00	25	0.00	25	0.00	25	0.00
26	0.00	26	0.00	26	0.00	26	0.35	26	0.00	26	0.00	26	0.00	26	0.00	26	0.00	26	1.48
27	0.00	27	0.00	27	0.00	27	0.00	27	0.00	27	0.00	27	0.34	27	0.00	27	0.00	27	0.00
28	0.00	28	0.00	28	0.00	28	0.00	28	0.00	28	0.00	28	0.00	28	0.00	28	0.00	28	0.00
29	0.15	29	0.00	29	0.00			29	0.00	29	0.00	29	0.00	29	0.12	29	0.00	29	0.00
30	0.00	30	0.00	30	0.00			30	0.00	30	0.00	30	0.00	30	0.00	30	0.00	30	0.00
		31	0.00	31	0.05			31	0.00			31	0.00			31	0.00	31	0.00
Totals:	3.22		2.14		1.57		5.32		1.36		0.79		0.34		0.41		2.60		12.37

Data from 1931-93 Texas Almanac

County and Station	Temperature					Average Freeze Dates				Growing Season	Normal Total Precipitation													
	Length of Record	Mean Max. July	Mean Min. January	Record Highest	Record Lowest	Last in Spring		First in Fall			Length of Record	January	February	March	April	May	June	July	August	September	October	November	December	Annual
	Yr.	F.	F.	F.	F.	Mo.	Day	Mo.	Day	Days	Yr.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Fisher, Rotan	28	96	30	116	3	Apr.	2	Nov.	6	218	N	0.7	1.1	1.1	1.9	3.8	2.7	2.1	2.6	3.8	2.4	1.2	1.0	24.3
Floyd, Floydada	N	92	22	111	—9	Apr.	7	Nov.	6	213	N	0.4	0.7	1.0	1.2	2.8	3.6	2.2	2.6	3.0	1.7	0.9	0.5	20.5
Foard, Crowell*	N	97	24	114	—7	Apr.	2	Nov.	7	219	N	0.9	1.1	1.3	2.0	4.1	2.5	2.4	1.8	3.1	2.7	1.2	0.8	23.9
Fort Bend, Sugar Land	N	93	41	106	6	Feb.	14	Dec.	7	296	N	3.3	2.8	2.7	2.8	4.6	4.9	3.7	4.1	5.6	3.5	4.0	3.3	45.3
Franklin, Mount Vernon*	18	93	33	105	—1	Mar.	23	Nov.	12	234	18	2.8	3.3	4.3	4.4	4.7	4.1	3.4	2.5	4.9	3.9	3.7	4.8	46.8
Freestone, Fairfield	29	95	36	109	—2	Mar.	11	Nov.	29	263	N	2.5	3.1	3.2	3.7	4.9	3.5	2.0	2.3	4.0	4.1	3.6	3.0	39.8
Frio, Pearsall	N	97	38	111	9	Feb.	23	Dec.	2	291	N	1.2	1.3	1.0	2.2	3.6	3.3	1.6	2.5	3.0	3.1	1.5	1.1	25.4
Gaines, Seminole	N	94	25	114	—9	Apr.	8	Nov.	4	210	N	0.5	0.7	0.7	0.9	2.0	2.6	2.5	2.3	2.5	1.4	0.8	0.6	17.5
Galveston, Galveston	N	87	47	101	8	Jan.	24	Dec.	25	335	N	3.3	2.3	2.2	2.4	3.6	4.4	4.0	4.5	5.9	2.8	3.4	3.5	42.3
Garza, Post	28	94	27	115	—1	Apr.	5	Nov.	7	216	N	0.6	0.8	0.9	1.2	2.7	3.1	2.1	2.8	2.9	2.0	0.9	0.7	20.9
Gillespie, Fredericksburg	N	93	35	109	—5	Apr.	1	Nov.	6	219	N	1.3	1.8	1.4	2.5	4.2	3.6	2.2	2.7	3.6	3.6	1.9	1.3	30.0
Glasscock, Garden City	26	94	25	114	0	Apr.	2	Nov.	10	222	N	0.6	0.7	0.7	1.2	2.2	2.0	2.0	2.0	3.3	1.8	0.8	0.6	18.0
Goliad, Goliad	N	95	43	112	7	Feb.	24	Dec.	6	285	N	2.1	2.1	1.4	2.8	4.1	4.5	3.2	3.4	5.0	3.6	2.3	2.0	36.5
Gonzales, Nixon	N	95	40	113	3	Feb.	28	Dec.	1	276	N	2.2	2.1	1.6	2.9	4.0	3.5	1.9	2.3	4.6	3.2	2.4	1.7	32.4
Gray, Pampa	N	92	21	111	—12	Apr.	15	Oct.	27	195	N	0.5	0.9	1.4	1.3	2.9	3.6	2.4	2.6	2.4	1.5	1.0	0.5	21.0
Grayson, Sherman	N	95	30	110	—2	Mar.	27	Nov.	9	227	N	1.9	2.7	3.4	3.9	5.8	4.2	1.9	2.1	5.1	4.2	3.1	2.0	40.4
Gregg, Longview	N	93	33	110	—7	Mar.	16	Nov.	15	247	N	3.5	3.6	4.1	4.5	5.1	4.4	2.9	2.8	3.9	3.7	4.3	4.3	47.0
Grimes, Anderson*	9	96	40	108	4	Mar.	1	Dec.	4	278	N	3.1	3.3	2.8	4.3	4.3	3.4	2.4	2.8	4.1	3.1	3.4	3.4	40.4
Guadalupe, Seguin*	N	96	40	110	0	Mar.	6	Nov.	28	267	N	1.8	2.5	1.8	3.3	3.4	2.9	1.8	2.1	4.1	3.4	2.1	1.7	31.4
Hale, Plainview	N	92	24	111	—7	Apr.	10	Nov.	6	211	N	0.5	0.7	0.8	1.1	3.0	3.5	2.4	2.3	2.5	1.7	0.8	0.6	19.8
Hall, Memphis	N	96	24	117	—7	Apr.	4.	Nov.	4	213	N	0.5	0.8	1.3	1.7	3.5	3.1	1.7	2.5	2.4	1.6	0.9	0.6	20.5
Hamilton, Hico	N	96	32	111	—11	Mar.	27	Nov.	21	239	N	1.9	2.0	2.4	3.0	4.6	3.2	2.1	2.2	3.4	3.3	2.2	1.5	31.8
Hansford, Spearman	N	95	21	109	—22	Apr.	22	Oct.	25	186	N	0.4	0.7	1.3	1.1	2.9	3.0	2.9	2.4	2.1	1.2	1.0	0.5	19.4
Hardeman, Quanah	N	97	23	119	—15	Mar.	31	Nov.	7	221	N	0.8	1.0	1.5	1.7	3.5	3.2	2.4	2.5	3.6	2.4	1.2	0.9	24.5
Hardin, Evadale	22	93	37	102	12	Mar.	31	Nov.	14	246	N	4.8	3.9	4.0	3.8	5.4	5.8	4.7	4.0	5.3	4.0	4.9	5.1	55.7
Harris, Houston	N	92	43	107	7	Feb.	14	Dec.	11	300	N	3.3	3.0	2.9	3.2	5.2	5.0	3.6	3.5	4.9	4.3	3.8	3.5	46.1
Harrison, Marshall	N	93	32	110	2	Mar.	16	Nov.	17	245	N	3.8	4.0	4.0	4.4	4.9	4.4	3.0	2.5	3.8	3.9	4.3	4.5	47.7
Hartley, Channing*	13	92	21	108	—9	Apr.	22	Oct.	19	180	13	0.4	0.5	0.7	1.2	2.2	1.9	2.4	2.8	1.9	1.2	0.7	0.2	16.1
Haskell, Haskell	N	96	27	115	—6	Mar.	28	Nov.	16	232	N	0.9	1.4	1.4	2.2	3.6	3.0	2.1	2.9	3.7	2.6	1.3	1.1	26.1
Hays, San Marcos	N	95	36	110	—2	Mar.	14	Nov.	23	254	N	2.0	2.3	1.8	2.8	5.0	4.2	2.1	2.3	3.7	3.1	3.1	2.1	34.6
Hemphill, Canadian	N	96	22	112	—14	Apr.	9	Oct.	30	204	N	0.3	0.8	1.3	1.4	3.4	3.1	1.9	2.6	2.6	1.4	0.9	0.5	20.1
Henderson, Athens	N	95	35	110	—2	Mar.	11	Nov.	26	260	N	2.5	3.1	3.6	3.7	5.2	3.6	1.5	1.8	3.8	4.0	3.7	3.3	39.7
Hidalgo, McAllen	N	96	49	106	17	Feb.	7	Dec.	8	327	39	1.4	1.3	0.6	1.3	2.8	2.7	1.7	2.4	4.4	2.6	1.0	1.1	23.4
Hill, Hillsboro	N	95	34	113	—1	Mar.	13	Nov.	18	250	N	1.9	2.6	3.0	3.0	4.8	3.9	2.2	1.9	3.4	3.7	2.5	2.3	35.1
Hockley, Levelland	N	92	22	115	—16	Apr.	15	Oct.	28	196	N	0.4	0.7	0.6	0.9	2.0	2.6	2.5	3.1	3.3	1.7	0.7	0.6	19.3
Hood, Granbury*	28	97	33	110	—6	Mar.	26	Nov.	13	232	28	1.9	2.0	1.7	3.9	4.9	3.4	1.8	1.8	2.9	3.2	2.1	1.5	30.9
Hopkins, Sulphur Springs	N	94	30	110	—4	Mar.	23	Nov.	16	238	N	2.5	3.3	4.1	4.7	5.5	4.1	3.0	2.3	4.4	4.6	4.0	3.5	46.0
Houston, Crockett	N	93	34	110	0	Mar.	6	Nov.	26	265	N	3.5	2.9	3.2	4.1	4.4	3.7	3.0	2.2	4.4	3.9	3.8	3.5	42.4
Howard, Big Spring	N	94	28	114	21	Apr.	4	Nov.	7	217	N	0.6	0.8	0.8	1.3	2.8	2.3	1.7	2.0	3.9	1.6	0.8	0.6	19.2
Hudspeth, Cornudas Ser.	N	95	25	111	—13	Mar.	27	Nov.	11	231	N	0.4	0.3	0.2	0.2	0.5	1.1	1.5	2.2	1.9	0.9	0.4	0.4	10.0
Hunt, Greenville	N	94	29	108	—3	Mar.	21	Nov.	13	237	N	2.2	3.0	3.8	3.9	5.7	3.7	2.7	2.2	4.5	4.1	3.3	2.6	41.6
Hutchinson, Borger	N	93	23	107	—12	Apr.	20	Oct.	24	187	N	0.5	0.9	1.3	1.3	2.8	3.4	2.7	2.9	2.0	1.3	0.8	0.5	20.3

County and Station	Temperature					Average Freeze Dates				Growing Season	Normal Total Precipitation													
	Length of Record	Mean Max. July	Mean Min. January	Record Highest	Record Lowest	Last in Spring		First in Fall			Length of Record	January	February	March	April	May	June	July	August	September	October	November	December	Annual
	Yr.	F.	F.	F.	F.	Mo.	Day	Mo.	Day	Days	Yr.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Irion, Mertzon	27	95	32	108	4	Mar.	27	Nov.	14	232	N	0.7	1.3	1.0	1.6	3.1	2.3	1.5	2.5	3.1	2.0	1.2	0.9	21.1
Jack, Jacksboro	N	95	29	113	—7	Apr.	1	Nov.	5	218	N	1.3	1.6	2.1	2.8	4.7	2.9	2.5	2.2	3.8	3.2	2.0	1.5	30.7
Jackson, Edna*	8	94	42	105	17	Feb.	19	Dec.	6	290	26	2.2	2.8	1.7	2.8	5.1	4.6	2.2	3.4	5.7	3.9	2.8	2.5	40.9
Jasper, Jasper	22	93	36	106	7	Mar.	18	Nov.	13	230	N	4.4	4.4	4.4	3.7	5.6	5.3	3.8	3.6	4.1	3.6	4.6	5.3	52.7
Jeff Davis, Mount Locke	N	82	30	104	—10	—	—	—	—	—	N	0.5	0.5	0.4	0.5	1.5	2.6	3.9	4.3	3.5	1.7	0.7	0.6	20.8
Jefferson, Port Arthur	N	92	42	107	12	Mar.	11	Nov.	16	250	N	4.8	3.4	3.2	3.5	5.7	5.6	5.4	5.3	6.3	4.3	4.9	4.8	57.2
Jim Hogg, Hebbronville	N	97	42	109	12	Feb.	15	Dec.	15	303	N	1.1	1.3	0.7	1.7	3.4	2.9	1.5	2.0	4.1	1.9	1.2	0.9	22.7
Jim Wells, Alice	N	96	43	111	12	Feb.	18	Dec.	4	289	N	1.3	1.6	0.8	1.6	3.2	3.5	2.5	2.7	5.1	2.7	1.6	1.1	27.8
Johnson, Cleburne	N	97	33	114	—5	Mar.	25	Nov.	14	233	N	1.9	2.2	2.9	3.6	5.4	3.5	2.0	2.1	3.3	3.3	2.1	1.8	34.0
Jones, Anson	N	96	31	114	—12	Mar.	31	Nov.	9.	223	22	1.0	1.4	1.3	2.2	3.4	2.9	2.0	2.6	4.3	2.4	1.3	1.1	25.8
Karnes, Kenedy*	18	97	41	112	7	Feb.	24	Dec.	2	281	18	2.3	2.4	1.1	2.2	4.0	4.2	1.2	3.0	5.3	3.6	2.0	1.8	33.2
Kaufman, Kaufman	N	95	32	112	—3	Mar.	18	Nov.	21	248	N	2.4	3.0	3.2	3.8	5.0	3.1	2.6	1.8	3.8	3.9	3.3	3.0	38.9
Kendall, Boerne	N	93	33	107	—4	Mar.	25	Nov.	11	236	N	1.7	2.1	2.1	3.1	4.1	3.8	2.2	2.9	4.2	3.6	2.7	1.8	34.2
Kenedy, Armstrong*	14	95	45	110	14	Feb.	2	Dec.	18	319	14	1.2	1.7	0.5	1.3	4.4	3.4	2.1	3.2	6.4	2.9	1.3	1.3	29.7
Kent, Jayton	18	96	25	116	—5	Apr.	4	Nov.	6	216	18	0.7	1.0	1.1	1.6	3.0	2.9	1.8	2.7	3.2	2.1	0.9	0.8	21.8
Kerr, Kerrville*	N	94	32	110	—7	Apr.	6	Nov.	6	216	N	1.6	2.2	2.0	3.1	3.8	2.6	1.7	2.1	4.0	3.6	1.6	1.6	29.8
Kimble, Junction	N	96	31	110	—11	Apr.	3	Nov.	3	213	N	1.0	1.6	1.2	2.1	3.6	2.8	1.7	2.5	2.8	2.4	1.2	1.1	23.8
King, Guthrie	27	98	24	119	—10	Apr.	3	Nov.	8	219	N	0.9	1.1	1.1	1.6	3.5	3.1	1.9	2.7	3.7	2.4	1.1	0.7	23.8
Kinney, Brackettville	23	95	36	109	4	Mar.	1	Nov.	26	270	45	0.8	1.3	0.9	2.3	2.6	3.1	1.6	2.0	2.6	2.4	1.2	0.8	21.7
Kleberg, Kingsville	N	95	45	108	10	Feb.	5	Dec.	16	314	N	1.5	1.8	0.9	1.6	3.4	4.0	2.2	2.9	4.3	2.7	1.4	1.0	27.6
Knox, Munday	N	98	28	117	—9	Apr.	3	Nov.	6	217	N	0.9	1.4	1.6	2.1	3.7	3.0	2.0	2.6	3.9	2.8	1.3	1.0	26.2
La Salle, Fowlerton	N	99	38	111	7	Feb.	20	Dec.	6	288	N	1.1	1.1	0.8	1.8	3.2	2.2	1.5	2.4	3.3	3.0	1.2	1.0	22.5
Lamar, Paris	N	94	30	111	—1	Mar.	25	Nov.	14	235	N	2.2	3.2	4.2	4.0	5.9	3.9	3.6	2.7	4.8	4.6	3.9	3.3	46.1
Lamb, Littlefield	N	91	22	112	—14	Apr.	16	Oct.	27	194	N	0.4	0.6	0.6	1.0	2.3	3.3	2.4	2.8	2.5	1.6	0.7	0.5	18.7
Lampasas, Lampasas	N	95	30	111	—12	Apr.	1	Nov.	10	223	N	1.5	2.0	2.1	2.7	4.1	2.9	1.8	2.5	3.1	3.3	2.0	1.7	29.6
Lavaca, Hallettsville	N	95	41	111	5	Mar.	1	Dec.	6	280	N	2.8	2.4	2.2	3.0	5.3	4.4	2.5	2.7	5.1	3.2	3.3	2.4	39.1
Lee, Lexington	28	94	36	104	11	Mar.	1	Nov.	29	273	28	2.2	2.5	2.4	2.9	4.8	3.8	1.7	2.0	4.2	3.8	3.0	2.3	35.6
Leon, Centerville	N	95	34	111	—3	Mar.	6	Dec.	1	270	N	3.1	3.1	3.1	3.9	4.4	3.5	2.5	2.4	4.0	4.1	3.2	3.1	40.5
Liberty, Liberty	N	93	39	107	7	Mar.	3	Nov.	19	261	N	3.8	3.6	3.2	3.5	5.4	6.1	4.5	4.0	5.7	4.5	5.2	4.8	54.1
Limestone, Mexia	N	95	33	110	—5	Mar.	15	Nov.	26	255	N	2.5	3.1	3.4	3.6	4.9	3.5	1.9	2.3	4.7	4.1	3.4	3.2	40.3
Lipscomb, Follett	N	93	20	110	—12	Apr.	10	Oct.	29	202	N	0.5	1.0	1.9	1.7	3.5	3.4	2.3	3.1	2.1	1.4	1.2	0.7	22.8
Live Oak, George West*	N	95	41	109	12	Feb.	20	Dec.	6	289	N	1.7	1.6	0.8	1.9	3.3	2.8	1.5	2.9	4.7	3.1	1.9	1.4	27.6
Llano, Llano	N	96	31	113	—6	Mar.	29	Nov.	13	229	N	1.2	1.8	1.6	2.5	3.8	2.8	1.8	2.4	3.0	2.7	1.8	1.2	26.4
Loving, Mentone*	N	96	28	114	—14	Apr.	3	Nov.	8	222	N	0.3	0.3	0.3	0.2	1.1	0.9	1.8	1.4	1.2	1.0	0.3	0.3	9.1
Lubbock, Lubbock	N	92	25	114	—16	Apr.	9	Nov.	3	208	N	0.4	0.7	0.9	1.0	2.4	2.8	2.4	2.5	2.6	1.9	0.8	0.5	18.7
Lynn, Tahoka	N	92	24	111	—5	Apr.	5	Nov.	6	217	N	0.5	0.8	0.9	1.4	2.7	3.0	2.5	2.2	2.6	1.8	0.8	0.7	19.7
Madison, Madisonville	N	96	38	110	—2	Mar.	5	Dec.	2	272	N	3.0	2.8	3.2	3.5	5.0	3.9	2.3	2.6	4.5	4.1	3.7	3.0	41.6
Marion, Jefferson*	N	94	32	109	—5	Mar.	18	Nov.	9	236	N	3.9	3.5	3.9	5.3	4.6	3.4	3.1	2.5	3.6	2.0	3.8	4.1	44.7
Martin, Lenorah*	N	94	30	109	—8	Apr.	5	Nov.	6	215	N	0.6	0.8	0.8	1.2	2.3	1.6	2.4	1.7	2.7	1.6	0.8	0.6	17.2
Mason, Mason	N	95	31	109	5	Apr.	3	Nov.	6	217	N	1.1	1.6	1.5	2.1	3.7	3.3	1.9	2.6	3.2	3.1	1.6	1.1	26.8
Matagorda, Matagorda	N	91	45	102	9	Feb.	17	Dec.	10	296	N	3.6	2.6	1.9	2.6	4.5	4.8	4.0	3.3	6.9	3.9	3.9	2.7	44.7
Maverick, Eagle Pass	N	98	38	115	10	Feb.	21	Dec.	3	285	N	0.7	0.9	0.7	1.9	3.4	3.0	1.8	2.2	2.8	2.4	1.0	0.8	21.5

Texas Temperature, Freeze, Growing Season and Precipitation Records by Counties

Data in the table below are from the office of the **State Climatologist for Texas**, College Station. Because of the small change in averages, data are revised only at intervals of 10 years. Data below are the latest compilations, as of Jan. 1, 1993. Table shows temperature, freeze, growing season and precipitation for each county in Texas. Data for counties where a National Weather Service Station has not been maintained long enough to establish a reliable mean are interpolated from isoline charts prepared from mean values from stations with long-established records. **Mean maximum temperature for July** is computed from the sum of the daily maxima. **Mean minimum January** is computed from the sum of the daily minima. For stations where precipitation "Length of Record" are designated with an "N," data are based on the 30-year normal period 1961-90. Stations which have a specified precipitation "Length of Record" are based on data mainly from the period 1931-1993.

County and Station	Temperature					Average Freeze Dates				Growing Season	Normal Total Precipitation													
	Length of Record	Mean Max. July	Mean Min. January	Record Highest	Record Lowest	Last in Spring		First in Fall			Length of Record	January	February	March	April	May	June	July	August	September	October	November	December	Annual
	Yr.	F.	F.	F.	F.	Mo.	Day	Mo.	Day	Days	Yr.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Anderson, Palestine	N	94	36	114	—6	Mar.	8	Nov.	27	264	N	3.1	3.2	3.9	3.9	4.8	4.5	2.3	2.3	3.6	4.4	3.9	3.6	43.3
Andrews, Andrews	29	94	29	113	0	Apr.	6	Nov.	5	213	29	0.4	0.5	0.6	0.9	1.6	2.0	2.5	1.9	2.5	1.5	0.6	0.4	15.4
Angelina, Lufkin	N	93	37	108	—2	Mar.	14	Nov.	13	244	N	3.7	2.8	3.2	3.3	4.9	4.2	2.6	2.4	4.0	3.5	3.1	2.3	38.9
Aransas, Rockport	N	91	44	103	9	Feb.	7	Dec.	16	312	N	2.7	2.4	1.4	2.1	4.2	4.7	3.2	3.1	6.2	4.0	2.1	2.7	36.9
Archer, Archer	27	98	29	114	—10	Mar.	31	Nov.	6	220	N	1.0	1.7	2.0	2.6	4.3	3.0	1.7	2.5	4.3	2.9	1.8	1.3	29.3
Armstrong, Claude	28	92	20	108	—7	Apr.	6	Nov.	5	213	N	0.4	0.6	1.1	1.1	3.0	3.7	2.9	3.1	2.4	1.7	0.8	0.4	21.2
Atascosa, Poteet	N	96	38	110	—1	Feb.	25	Dec.	2	282	N	1.4	1.7	1.2	2.5	4.0	3.2	1.8	2.6	3.6	2.9	1.8	1.4	28.0
Austin, Sealy	N	94	39	110	0	Feb.	27	Dec.	5	282	N	3.0	2.9	2.2	2.7	4.8	4.4	2.3	3.2	4.6	3.9	3.6	3.0	40.4
Bailey, Muleshoe	N	92	19	112	—21	Apr.	22	Oct.	20	181	N	0.4	0.5	0.6	0.9	1.9	2.6	2.3	2.9	2.2	1.4	0.8	0.5	16.8
Bandera, Medina*	15	94	31	109	5	Mar.	26	Nov.	16	235	15	1.7	1.8	1.7	3.3	4.5	2.9	2.8	4.7	4.5	3.7	2.3	1.2	35.1
Bastrop, Smithville	N	95	35	111	6	Mar.	7	Nov.	30	268	N	2.6	2.5	2.2	2.9	5.1	3.9	2.2	2.3	4.7	4.0	3.2	2.6	38.3
Baylor, Seymour	N	97	26	116	—14	Apr.	3	Nov.	3	214	N	0.9	1.5	1.6	2.2	4.0	3.4	2.1	2.4	4.1	2.7	1.3	1.2	27.3
Bee, Beeville	N	94	41	109	9	Feb.	22	Dec.	4	285	N	2.0	1.9	1.2	2.3	3.6	3.8	2.8	2.9	4.8	3.1	2.0	1.6	32.1
Bell, Temple	N	95	35	112	—4	Mar.	9	Nov.	24	260	N	1.9	2.7	2.5	2.9	4.6	3.6	2.0	2.3	3.8	3.3	2.9	2.3	34.9
Bexar, San Antonio	N	95	38	108	0	Mar.	6	Nov.	26	265	N	1.7	1.8	1.5	2.5	4.2	3.8	2.2	2.5	3.4	3.2	1.5	1.4	31.0
Blanco, Blanco	N	94	33	109	—6	Mar.	26	Nov.	15	234	N	1.9	2.4	2.2	2.8	4.5	3.8	2.3	2.3	3.9	3.8	2.3	2.0	34.2
Borden, Gail	27	94	31	113	—1	Apr.	6	Nov.	6	214	N	0.5	0.5	0.4	0.5	1.2	2.2	2.7	3.0	3.3	1.5	0.6	0.5	16.9
Bosque, Lake Whitney*	18	97	33	111	—3	Mar.	23	Nov.	21	243	18	1.9	2.4	1.5	4.1	4.4	3.5	1.6	1.5	3.2	2.7	2.8	2.0	31.6
Bowie, Texarkana*	N	93	35	101	—6	Mar.	21	Nov.	11	235	N	3.6	3.3	4.2	5.1	4.4	3.9	3.5	3.2	3.6	2.8	3.9	3.9	45.3
Brazoria, Angleton	N	92	41	105	10	Mar.	5	Nov.	28	268	N	4.5	3.5	3.3	3.2	5.2	6.3	5.2	5.1	7.3	4.0	4.7	4.1	56.4
Brazos, College Station	N	94	39	110	—3	Mar.	1	Nov.	30	274	N	2.7	2.6	2.6	3.4	4.8	3.7	2.3	2.4	4.9	3.8	3.2	2.8	39.1
Brewster, Alpine	N	89	30	106	—2	Apr.	1	Nov.	8	223	N	0.5	0.5	0.4	0.5	1.2	2.2	2.7	2.6	3.3	1.5	0.6	0.5	16.9
Brewster, Chisos Basin	N	85	35	103	—3	Mar.	31	Nov.	9	223	N	0.6	0.6	0.4	0.6	1.6	2.3	3.1	3.6	3.3	1.9	0.6	0.6	19.2
Briscoe, Silverton	29	91	20	109	—9	Apr.	7	Nov.	5	214	N	0.4	0.7	1.1	1.3	2.8	4.2	2.2	3.0	2.7	1.6	0.9	0.5	21.4
Brooks, Falfurrias	N	97	43	110	9	Feb.	10	Dec.	10	303	N	1.3	1.6	0.7	1.3	3.2	3.2	2.2	2.5	4.9	2.7	1.2	1.1	25.9
Brown, Brownwood	N	97	33	111	—6	Mar.	22	Nov.	19	242	N	1.3	1.7	1.9	2.6	3.6	3.4	1.7	2.1	3.2	2.9	1.6	1.4	27.3
Burleson, Somerville*	16	94	37	105	3	Mar.	1	Dec.	1	275	16	2.7	2.5	2.4	3.9	5.1	3.6	2.2	2.4	4.9	3.4	3.1	2.8	39.1
Burnet, Burnet	N	93	32	108	—4	Mar.	29	Nov.	14	230	N	1.7	2.0	2.1	2.7	4.8	3.5	1.9	2.0	3.5	3.5	2.1	1.5	31.2
Caldwell, Luling	N	96	36	110	—3	Feb.	27	Nov.	29	275	N	2.2	2.2	1.9	3.0	4.8	4.4	1.7	2.2	4.4	3.5	3.1	1.9	35.3
Calhoun, Port O'Connor	N	90	46	107	11	Feb.	19	Dec.	16	300	N	3.1	2.7	1.6	1.7	4.0	3.7	3.7	3.3	6.1	4.5	2.7	2.4	39.4
Callahan, Putnam	27	96	32	110	—8	Mar.	28	Nov.	11	228	N	1.4	1.4	1.7	2.0	3.0	3.0	1.8	2.1	3.1	2.9	1.7	1.1	25.2
Cameron, Brownsville	N	93	50	106	16	Feb.	4	Dec.	12	341	N	1.6	1.1	0.5	1.6	2.9	2.7	1.9	2.8	6.0	2.8	1.5	1.3	26.6
Camp, Pittsburg*	N	94	32	109	—3	Mar.	21	Nov.	14	238	N	2.9	3.3	3.8	5.4	4.8	3.4	2.7	2.2	4.0	3.2	4.0	3.5	43.3
Carson, Panhandle	29	93	22	109	—10	Apr.	17	Oct.	25	191	N	0.5	0.8	1.1	1.3	2.6	3.7	2.3	3.1	2.3	1.7	0.9	0.5	20.8
Cass, Linden	22	93	31	103	8	Mar.	19	Nov.	11	237	N	3.3	3.9	4.9	5.0	4.5	4.8	2.9	2.8	3.2	3.6	4.9	4.5	48.3
Castro, Dimmitt	29	91	19	107	—8	Apr.	17	Oct.	25	193	22	0.4	0.6	0.8	0.8	2.3	3.0	2.3	2.8	2.4	1.5	0.7	0.5	18.0

County and Station	Temperature					Average Freeze Dates				Growing Season	Normal Total Precipitation													
	Length of Record	Mean Max. July	Mean Min. January	Record Highest	Record Lowest	Last in Spring		First in Fall			Length of Record	January	February	March	April	May	June	July	August	September	October	November	December	Annual
	Yr.	F.	F.	F.	F.	Mo.	Day	Mo.	Day	Days	Yr.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Chambers, Anahuac	N	92	41	110	8	Mar.	6	Nov.	20	261	N	4.0	2.9	3.0	3.6	4.8	5.8	4.5	4.5	6.2	3.8	4.4	4.2	51.7
Cherokee, Rusk	N	93	35	107	1	Mar.	8	Nov.	21	258	N	3.7	3.5	3.6	4.1	4.0	5.1	4.0	2.9	2.2	4.2	4.2	4.2	46.1
Childress, Childress	N	96	26	117	—7	Apr.	3	Nov.	6	217	N	0.5	0.9	1.2	1.5	3.0	3.0	1.9	2.1	2.8	2.0	1.0	0.7	20.7
Clay, Henrietta	N	97	26	116	—8	Mar.	27	Nov.	14	232	N	1.3	2.0	2.5	3.0	4.3	3.9	1.8	2.6	4.2	3.1	1.7	1.6	31.9
Cochran, Morton	27	91	22	110	—12	Apr.	18	Oct.	24	189	N	0.4	0.6	0.6	0.9	1.8	2.7	2.4	3.3	3.0	1.7	0.7	0.5	18.6
Coke, Robert Lee	28	96	28	111	—2	Mar.	31	Nov.	12	226	N	0.8	1.2	1.1	1.8	3.3	2.8	1.6	2.0	3.7	2.8	1.2	0.9	23.2
Coleman, Coleman	N	96	32	114	—4	Mar.	26	Nov.	16	235	N	1.2	1.5	1.6	2.4	4.1	3.3	2.0	2.5	3.8	2.8	1.6	1.2	28.0
Collin, McKinney	N	95	32	118	—7	Mar.	26	Nov.	11	230	N	2.0	2.8	3.5	3.9	5.8	4.0	2.4	2.4	4.6	3.4	3.1	2.3	40.0
Collingsworth, Wellington	N	97	26	113	—6	Apr.	5	Nov.	3	212	N	0.5	0.8	1.3	1.7	3.4	3.2	2.0	2.1	3.0	2.0	1.0	0.6	21.5
Colorado, Columbus	28	95	37	108	4	Mar.	1	Dec.	6	280	N	3.3	2.8	2.5	3.2	5.5	4.1	2.9	2.9	5.0	3.2	3.6	2.9	41.8
Comal, New Braunfels	N	95	37	110	2	Mar.	12	Nov.	25	261	N	1.9	2.2	1.8	2.6	5.0	4.1	2.0	2.5	4.1	3.5	2.8	2.0	34.3
Comanche, Proctor Reservoir	27	95	30	108	—8	Mar.	27	Nov.	20	238	27	1.6	1.9	2.1	3.1	4.6	3.4	1.7	1.9	3.9	3.0	2.0	1.3	30.4
Concho, Paint Rock	N	98	31	111	—1	Mar.	29	Nov.	12	228	N	1.0	1.3	1.4	1.9	3.4	2.9	1.9	2.1	4.0	2.6	1.3	1.1	24.8
Cooke, Gainesville	N	95	27	112	—7	Mar.	27	Nov.	8	226	N	1.7	2.3	3.3	3.2	4.7	3.5	2.0	2.4	4.5	4.0	2.4	1.8	35.8
Coryell, Gatesville	N	96	33	112	—6	Mar.	25	Nov.	21	241	N	1.8	2.3	2.4	3.1	4.3	3.9	2.1	2.2	3.7	3.1	2.3	1.8	32.9
Cottle, Paducah	N	96	25	118	—7	Apr.	2	Nov.	7	219	N	0.7	1.0	1.2	1.5	3.2	3.4	1.8	2.5	3.1	2.1	1.0	0.8	22.3
Crane, Crane	28	97	31	115	3	Mar.	31	Nov.	11	225	28	0.4	0.6	0.4	0.9	1.7	1.7	1.5	1.9	3.0	1.6	0.7	0.5	14.8
Crockett, Ozona	N	94	30	109	4	Mar.	26	Nov.	14	233	N	0.7	0.9	0.9	1.5	2.3	2.0	1.6	2.1	3.3	2.2	1.0	0.6	19.2
Crosby, Crosbyton	N	93	23	113	—6	Apr.	10	Nov.	2	206	N	0.5	0.9	1.2	1.3	2.9	3.0	2.3	3.1	3.6	2.1	1.0	0.7	22.6
Culberson, Van Horn	N	94	28	112	—7	Apr.	2	Nov.	10	224	N	0.5	0.3	0.2	0.3	0.6	1.4	2.1	2.5	2.7	1.3	0.7	0.6	13.1
Dallam, Dalhart	N	92	19	107	—21	Apr.	23	Oct.	18	178	N	0.4	0.5	0.8	1.1	2.6	2.4	3.1	3.1	1.9	1.0	0.7	0.4	17.9
Dallas, Dallas	N	96	35	113	1	Mar.	23	Nov.	13	235	N	1.8	2.3	3.2	3.9	5.0	3.5	2.4	2.3	3.6	3.9	2.4	1.9	36.1
Dawson, Lamesa	N	95	25	114	—12	Apr.	8	Nov.	6	210	N	0.5	0.6	0.8	1.0	2.3	2.8	2.2	1.9	3.5	1.8	0.7	0.5	16.2
De Witt, Yoakum	N	95	39	110	12	Mar.	3	Nov.	29	270	N	2.4	2.3	2.0	3.3	4.3	4.5	2.9	3.0	4.1	3.2	3.0	2.0	37.0
Deaf Smith, Hereford	N	90	20	108	—17	Apr.	16	Oct.	28	195	N	0.4	0.6	0.8	0.8	1.9	3.0	1.9	3.1	2.1	1.4	0.8	0.4	17.2
Delta, Cooper*	N	94	30	110	—1	Mar.	25	Nov.	13	233	N	2.7	2.9	3.6	4.8	5.0	3.9	2.8	2.2	4.5	3.6	3.3	3.4	42.7
Denton, Denton	N	94	30	113	—3	Mar.	27	Nov.	8	226	N	1.8	2.4	3.0	3.7	5.3	3.3	2.2	2.2	4.8	4.0	2.4	2.1	37.3
Dickens, Dickens*	15	95	26	110	0	Apr.	4	Nov.	7	217	15	0.4	0.6	1.1	1.2	3.3	2.6	2.0	3.3	3.3	1.8	0.7	0.4	20.7
Dimmit, Carrizo Springs	N	99	41	114	10	Feb.	19	Dec.	6	290	N	0.9	1.2	0.8	1.8	3.2	2.6	1.3	2.5	2.9	2.6	1.12	0.9	21.7
Donley, Clarendon	N	94	21	112	—11	Apr.	9	Nov.	1	206	N	0.5	0.8	1.2	1.5	3.1	3.7	2.1	3.3	2.7	1.7	1.0	0.6	22.0
Duval, Freer	28	96	41	109	12	Feb.	16	Dec.	11	298	N	1.3	1.3	1.0	1.7	3.5	3.1	1.6	2.3	4.1	2.8	1.4	0.9	24.8
Eastland, Rising Star	N	94	29	109	—8	Mar.	27	Nov.	11	299	N	1.5	1.7	2.1	2.7	4.2	3.8	2.1	2.1	3.5	3.1	1.7	1.3	29.7
Ector, Penwell	27	95	28	110	0	Apr.	3	Nov.	6	217	27	0.3	0.6	0.5	0.8	1.9	1.6	1.3	1.3	2.5	1.2	0.7	0.5	13.1
Edwards, Carta Valley	27	95	34	109	9	Mar.	16	Nov.	21	250	27	0.7	1.2	0.9	2.0	2.9	2.5	2.5	2.1	3.0	2.4	1.1	0.7	22.0
El Paso, El Paso	N	96	29	114	—8	Mar.	9	Nov.	12	248	N	0.4	0.4	0.3	0.2	0.3	0.7	1.5	1.6	1.7	0.8	0.4	0.6	8.8
Ellis, Waxahachie	N	96	34	114	—4	Mar.	20	Nov.	21	246	N	1.9	2.8	3.1	3.8	5.1	3.1	12.0	2.0	3.9	3.8	2.7	2.4	36.8
Erath, Dublin	N	94	31	110	—7	Mar.	27	Nov.	18	238	N	1.7	2.1	2.3	3.2	4.7	3.4	2.2	2.8	3.6	3.3	2.1	1.6	32.9
Falls, Marlin	N	96	36	112	—7	Mar.	13	Nov.	25	257	N	2.1	2.4	3.0	3.3	5.2	3.5	2.0	2.1	3.6	3.8	3.2	2.5	36.8
Fannin, Bonham	N	94	29	114	—4	Mar.	27	Nov.	10	228	N	2.1	3.1	3.9	3.8	6.1	4.5	3.1	2.3	4.9	4.1	3.4	2.7	44.0
Fayette, Flatonia	N	95	40	110	3	Mar.	2	Nov.	4	277	N	2.5	2.5	2.0	3.0	4.8	4.3	1.9	2.5	5.0	3.2	2.9	2.3	37.1

ADDENDUM 2

GONZALES COUNTY POULTRY STUDY

TRACE METAL RESULTS ANALYSIS

As part of the poultry study, water and sediment samples were collected by GBRA personnel from the four stations: Elm Creek @ CR 534 and CR 108, Sandies Creek @ FM 1116 and Peach Creek @ CR 353. The samples were sent to the TNRCC Laboratory in Houston for trace metal analysis. This note presents the sampling procedures, analyses and results. Briefly, the sampling does not indicate any concern over trace metals associated with poultry operations.

1. SUMMARY OF SAMPLE COLLECTION

The first set of water samples was collected on 3/23/98. These along with other samples were accumulated and shipped to the TNRCC Lab on 8/17/98. The water samples were collected using TNRCC recommended clean techniques. The samples were field filtered using a peristaltic pump (acid washed Tygon tubing for each station, that had been sealed in a plain (no color) ziploc bag). Each sample was filtered through a new Gelman #12179 0.45-micron filter, and placed in new Eagle-Picher #02796 1-liter bottles. These bottles are approved by EPA for clean metal work and were factory sealed with the required nitric acid preservative. All collection work was done wearing surgical gloves. Samples included an equipment blank, a field blank, and one field duplicate.

The second set of water samples was collected with similar methods on 6/9/98. Like the earlier set it was held at the GBRA lab until 8/17/98.

The third set was sediment samples collected on 7/14/98. These were collected in shallow, quiescent areas of each stream, using a pre-cleaned plastic beaker. The sediment was placed on a cleaned plastic dish and large objects removed. The remaining material was transferred to a wide-mouthed E-P container, and placed on ice prior to shipment. One field duplicate was collected.

All of the water and sediment samples were collected under dry weather conditions. Because the TNRCC had expressed criticism of GBRA on this point, and even though not required in the scope, when rains came in August the GBRA voluntarily collected additional water and sediment samples. This final set of both water and sediment samples was collected on 8/25/98 and received at the TNRCC lab on 8/27/98. The flow at each station was much higher in this sampling run, and difficulties (along with some danger) were encountered with sediment sample collection. Despite this, samples were collected successfully.

2. LABORATORY ANALYSES

The first three sample sets were received in one batch at the TNRCC lab on 8/17/98. For the water samples the analyses performed were primarily icp (method 200.7) with some graphite furnace (arsenic, lead, selenium, and silver). For sediment, the parameters analyzed were a slightly shorter list of icp total metals. The method given is 3050A/6010A in most cases. Graphite furnace was used for arsenic, cadmium, and selenium. Because of the sample shipping procedure, all samples (except those collected on 8/25/98) exceeded the 30-day holding time limit for mercury analysis. Performing analyses for hexavalent chromium, with a 24-hour time limit, was never practical.

3. SCREENING OF RESULTS

To assess the results the values reported by the TNRCC laboratory are compared to available screening levels. The attached Table 1 summarizes the screening for dissolved metals. It contains the acute and chronic aquatic life concentration (Table 1 in the Standards) values and the public health (Table 3) values for the water samples. Even though individual sample hardness values are reported, for simplicity the aquatic life values were computed using a basin default hardness value of 190 mg/L. Also included on the table are the apparent reporting levels used by the TNRCC laboratory.

With the water samples, all observations exceeded the cadmium screening level of 1.9 µg/L, simply because the minimum reporting level was 5 µg/L. In addition, two mercury samples slightly exceeded the human health level derived from fish consumption calculations of 0.0122 µg/L. Both were on the 8/25/98 collection. The value at Elm Creek at CR 108 was 0.017 µg/L and Sandies Creek at FM 1116 was 0.014 µg/L. Both stations are poultry as opposed to reference sites.

Table 2 contains the current screening levels (June 26, 1998) used by TNRCC for sediment metals in freshwater streams, and the results of the sediment sample screening. The Sandies Creek site on the 7/14/98 sampling had two metals that were slightly higher than the TNRCC freshwater stream screening levels. These were arsenic and chromium. It should be stressed that the sediment screening levels are empirical (85^{th} percentile of values in TNRCC database) and are not related to sediment grain size, which plays a major role in sediment results.

4. DISCUSSION

The only water parameters that exceeded any comparison level was the two mercury samples that slightly exceeded the human health value of 0.0122 µg/L (Table 3 of Standards) and the analytical reporting level. While there is always the possibility of a concern, several points should be noted. First, the TNRCC

has recognized the possibility of problems with its mercury analyses in the Houston area and is conducting additional sampling in cooperation with TAMU. Second, there are technical concerns with the human health standard itself. It is a calculated value designed to keep fish tissue levels below target concentrations for some species in east Texas lakes. More recent testing in other waters has indicated low levels of fish tissue mercury despite occasional TNRCC detections of mercury in water above the 0.0122 µg/L level. Efforts are underway at the agency to obtain better information on an appropriate standard for fish tissue protection. Even if there were a mercury concern in fish tissue, it is questionable whether there is enough of a fishery in these small streams to be considered for human consumption. Finally, while both detections were on poultry sites, there is no obvious relation between poultry activity and mercury.

With the sediment sample exceeding the 85^{th} percentile value for two parameters (arsenic and chromium), it should be noted that sediment metals are a strong function of the amount of fine particles in the sediment. To correct for differences in sediment grain size it is common to use metals such as aluminum or iron to normalize results. While iron was not measured, the aluminum concentration of the sample with the higher values was roughly twice as high as the other samples. This suggests that the particular sample had a relatively high percentage of fines.

TABLE 1
SCREENING OF DISSOLVED METAL DATA COLLECTED DURING POULTRY STUDY

Parameter	Acute Criteria		Chronic Criteria		Hardness (mg/L)	Aquatic Life Criteria (µg/L)		Human Health Criteria (µg/L)	Reporting Level (µg/L)	Exceedances
	Exponent	Constant	Exponent	Constant		Acute	Chronic			
Aluminum						991.00			15.00	
Arsenic						360.00	190.00		0.50	
Barium								2,000	1.00	
Cadmium	1.1280	1.6774	0.7852	3.4900	190	69.49	1.88		5.00	All
Chromium+3	0.8190	3.6680	0.8190	1.5610	190	2,879.33	350.13	100	5.00	
Chromium+6						16.00	11.00			
Copper	0.9422	1.3844	0.8545	1.3860	190	35.14	22.14		3.00	
Lead	1.2730	1.4600	1.2730	4.7050	190	184.83	7.20	5	1.00	
Magnesium									10.00	
Manganese									2.50	
Molybdenum									4.00	
Mercury						2.40	1.30	0.0122	0.01	Elm & Sandies, 8/25/98
Nickel	0.8460	3.3612	0.8460	1.1645	190	2,441.05	271.37		10.00	
Selenium						20.00	5.00	50	3.00	
Silver (free ion)						0.92			0.25	
Zinc	0.8473	0.8604	0.8473	0.7614	190	201.58	182.58		5.00	

TABLE 2
SCREENING OF SEDIMENT METAL DATA COLLECTED DURING POULTRY STUDY

Parameter	Screening Level (mg/kg)	Exceedance from 7/14/98 Sampling		Exceedance from 8/25/98 Sampling	
		(mg/kg)	Location	(mg/kg)	Location
Aluminum					
Arsenic	6.9	8.68	Sandies		
Barium	189				
Cadmium	1.024				
Chromium+3	20	22.20	Sandies		
Chromium+6					
Copper	19.2				
Lead	40				
Manganese	490				
Mercury	0.115				
Nickel	15				
Selenium	1.3				
Silver	1.6				
Zinc	83				

GUADALUPE-BLANCO RIVER AUTHORITY

933 East Court Street
Seguin, Texas 78155
830/379-5822 Fax: 830/379-9718

FACSIMILE TRANSMITTAL SHEET

Date: 11/10/98

To: Allison

From: Dawn Mag

We are transmitting a total of 37 pages including this sheet.

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11/12/98
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JBA

Guadalupe-Blanco River Authority - Regional Laboratory

GBRA
GUADALUPE-BLANCO RIVER AUTHORITY

930 933 E. Court, Seguin, Texas 78155
210-379-5822 Fax 210-379-9718

Chain of Custody

Customer Name GBRA

Sampled By Mike McCall (Printed Name) Mike McCall (Signature)

Date Collected	Time Collected	Sample Name or Description	TNRCC Id. No. (CRP only)	Grab/ Comp	Pres.	Analyses Requested	GBRA lab Sample Id. LIQUID
3-23-98	1107	Field Blank		G	ICE HNO_3	Al, Cd, Cr, Cu, Pb, Ni, Se, Ag, Zn, Ca, Mg, Hard(Calc), Ba, Fe, Mn, Mo, Hg	9804244
3-23-98	1124	Equipment Blank		G	"	"	9804245
3-23	1126	Elm Creek @ CR 534	15997	G	"	"	9804246
3-23	1209	Elm Creek @ CR 108	15996	G	"	"	9804247
3-23	1220	Elm Creek @ CR 108 DUP	15996	G	"	"	9804248
3-23	1312	Sandies Cr	15998	G	"	"	9804249
3-23	1511	Peach Cr	14937	G	"	"	9804250

@SCOM-I @SCOM-G

Special Notes: Cr Hex on all if Possible Hg & Cr_6 Exceeded Holdtime Not Analyzed

GBRA Lab

Delivered By: _____ Date: _____ Time: _____ Received By: _____ Date: _____ Time: _____

Method of Delivery: _____ Condition of Container: _____ Ice: _____

Second Lab

Delivered By: UPS Ground Date: 05/11/98 Time: 10:45 Received By: [illegible] Date: 05/11/98 Time: 10:45

Method of Delivery: UPS Ground Condition of Container: _____ Ice: No

TNRCC Laboratory

Report of Analysis

9/9/98 9:26

TNRCC Sample #: 9804244 Group#: 19981526 Chain of Custody #: GBRA Region: 0

Program Code: GBRA Sample Matrix: LIQUID Sample Depth: Station ID:

Sample Collected: 3/23/98 12:07 pm Sample Recieved: 8/17/98 Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Field Blank

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	47.0	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	<0.5	ug/L	206.2
01005	Barium, Dissolved, icp	1.00	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	0.0221	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	< 0.08	mg/L	200.7
01046	Iron, Dissolved, icp	15.0	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	0.0100	mg/L	200.7
01056	Manganese, Dissolved, icp	2.50	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804244

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:26

TNRCC Sample #: 9804245 Group#: 19981526 Chain of Custody #: GBRA Region: 0

Program Code: GBRA Sample Matrix: LIQUID Sample Depth: Station ID:

Sample Collected: 3/23/98 12:24 pm Sample Recieved: 8/17/98 Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Equipment Blank

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	32.9	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	0.56	ug/L	206.2
01005	Barium, Dissolved, icp	1.00	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	0.0311	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	< 1.0	mg/L	200.7
01046	Iron, Dissolved, icp	15.0	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	0.0100	mg/L	200.7
01056	Manganese, Dissolved, icp	1.00	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804245

Comments:

Laboratory Approval: MC E Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC

TNRCC Laboratory

Report of Analysis

9/9/98 9:26

TNRCC Sample #: 9804246 Group#: 19981526 Chain of Custody #: GBRA Region: 0

Program Code: GBRA Sample Matrix: LIQUID Sample Depth: Station ID: 15997

Sample Collected: 3/23/98 12:26 pm Sample Recieved: 8/17/98 Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Elm Creek @ CR 534

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	815.	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	3.01	ug/L	206.2
01005	Barium, Dissolved, icp	85.2	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	21.7	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	81.7	mg/L	200.7
01046	Iron, Dissolved, icp	477.	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	6.71	mg/L	200.7
01056	Manganese, Dissolved, icp	34.3	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804246

Comments:

Laboratory Approval: MC

Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:26

TNRCC Sample #: 9804247 | Group#: 19981526 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID: 15996

Sample Collected: 3/23/98 01:09 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Elm Creek @ CR 108

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	875.	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	4.47	ug/L	206.2
01005	Barium, Dissolved, icp	81.3	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	24.1	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	77.8	mg/L	200.7
01046	Iron, Dissolved, icp	580.	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	4.28	mg/L	200.7
01056	Manganese, Dissolved, icp	139.	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804247

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804248 | Group#: 19981526 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID: 15996

Sample Collected: 3/23/98 01:20 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Elm Creek @ CR 108 - dup

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	1.02e+03	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	4.38	ug/L	206.2
01005	Barium, Dissolved, icp	84.6	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	24.5	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	79.1	mg/L	200.7
01046	Iron, Dissolved, icp	642.	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	4.36	mg/L	200.7
01056	Manganese, Dissolved, icp	148.	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.50	ug/L	200.7

End of Data for TNRCC Sample# : 9804248

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804249 | Group#: 19981526 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID: 15998

Sample Collected: 3/23/98 02:12 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Sandies Creek

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	80.9	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	2.16	ug/L	206.2
01005	Barium, Dissolved, icp	84.5	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	53.4	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	182	mg/L	200.7
01046	Iron, Dissolved, icp	100.	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	11.8	mg/L	200.7
01056	Manganese, Dissolved, icp	62.6	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804249

Comments:

Laboratory Approval: MC

Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804250 | Group#: 19981526 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID: 14937

Sample Collected: 3/23/98 04:11 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Peach Creek

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	201.	ug/L	200.7
01005	Barium, Dissolved, icp	120.	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	59.3	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	199	mg/L	200.7
01046	Iron, Dissolved, icp	487.	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	12.3	mg/L	200.7
01056	Manganese, Dissolved, icp	79.3	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804250

Comments:

Laboratory Approval: MC

Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

1527

Guadalupe-Blanco River Authority - Regional Laboratory

933 E. Court, Seguin, Texas 78155

830-379-5822 Fax 210-379-9718

Chain of Custody

GBRA

GUADALUPE-BLANCO RIVER AUTHORITY

Customer Name GBRA

Sampled By Mike McCall (Printed Name) Mike McCall (Signature)

Date Collected	Time Collected	Sample Name or Description	TNRCC Id. No. (CRP only)	Grab/ Comp	Pres.	Analyses Requested	GBRA lab Sample Id. L1LQUD
6-9-98	1004	Equipment Blank		G	ICE HNO_3	Al, Cd, Cr, Cu, Pb, Ni, Se, Ag, Zn, Ca, Mg, Hard(Calc), Ba, Fe, Mn, Mo, Hg	9804251
6-9-98	1008	Field Blank		G	"	"	9804252
6-9	1015	Elm Cr @ CR 534	15997	G	"	"	9804253
6-9	1022	Elm Cr @ CR 534 Dup	15997	G	"	"	9804254
6-9	1130	Elm Cr @ CR 108	15996	G	"	"	9804255
6-9	1204	Sandies Creek	15998	G	"	"	~~98~~04256
6-9	1435	Peach Creek	14937	G	"	"	9804257

@SUOM-L @SUOM-G

Special Notes: Cr Hex on all if possible Hg & Cr_{16} Exceeded Holdtime Not Analyzed

GBRA Lab

Delivered By: _____ Date: _____ Time: _____ Received By: _____ Date: _____ Time: _____

Method of Delivery: _____ Condition of Container: _____ Ice: _____

Second Lab

Delivered By: UPS Ground Date: 05/11/98 Time: 10:45 Received By: A Clarke Date: 05/11/98 Time: 10.45

Method of Delivery: UPS Ground Condition of Container: _____ Ice: No

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804251 | Group#: 19981527 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID:

Sample Collected: 6/9/98 12:04 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Equipment Blank

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	34.0	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	0.61	ug/L	206.2
01005	Barium, Dissolved, icp	1.00	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	0.0351	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	< 1.0	mg/L	200.7
01046	Iron, Dissolved, icp	15.6	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	0.0100	mg/L	200.7
01056	Manganese, Dissolved, icp	2.50	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804251

Comments:

Laboratory Approval: MC

Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804252 | Group#: 19981527 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID:

Sample Collected: 6/9/98 12:08 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Field Blank

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	51.8	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	<0.5	ug/L	206.2
01005	Barium, Dissolved, icp	1.00	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	0.0200	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	< 1.0	mg/L	200.7
01046	Iron, Dissolved, icp	15.0	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	0.0100	mg/L	200.7
01056	Manganese, Dissolved, icp	2.50	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804252

Comments:

Laboratory Approval: MLC

Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804253 Group#: 19981527 Chain of Custody #: GBRA Region: 0

Program Code: GBRA Sample Matrix: LIQUID Sample Depth: Station ID: 15997

Sample Collected: 6/9/98 12:15 pm Sample Recieved: 8/17/98 Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Elm Creek @ CR 534

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	1.65e+03	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	23.5	ug/L	206.2
01005	Barium, Dissolved, icp	95.1	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	28.4	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	96.0	mg/L	200.7
01046	Iron, Dissolved, icp	1.27e+03	ug/L	200.7
01049	Lead, Dissolved, gfaa	1.23	ug/L	239.2
00925	Magnesium, Dissolved, icp	6.06	mg/L	200.7
01056	Manganese, Dissolved, icp	113.	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804253

Comments:

Laboratory Approval: MC Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804254 | Group#: 19981527 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID: 15997

Sample Collected: 6/9/98 12:22 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Elm Creek @ CR 534 - Dup

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	2.08e+03	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	23.3	ug/L	206.2
01005	Barium, Dissolved, icp	96.6	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	28.6	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	96.4	mg/L	200.7
01046	Iron, Dissolved, icp	1.66e+03	ug/L	200.7
01049	Lead, Dissolved, gfaa	1.12	ug/L	239.2
00925	Magnesium, Dissolved, icp	6.04	mg/L	200.7
01056	Manganese, Dissolved, icp	121.	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.40	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	6.90	ug/L	200.7

End of Data for TNRCC Sample# : 9804254

Comments:

Laboratory Approval: MCJ

Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804255 | Group#: 19981527 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID: 15996

Sample Collected: 6/9/98 01:30 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Elm Creek @ CR 108

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	101.	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	9.68	ug/L	206.2
01005	Barium, Dissolved, icp	102.	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	34.0	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	116	mg/L	200.7
01046	Iron, Dissolved, icp	145.	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	7.48	mg/L	200.7
01056	Manganese, Dissolved, icp	252.	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	6.40	ug/L	200.7

End of Data for TNRCC Sample# : 9804255

Comments:

Laboratory Approval: MCU

Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804256 | Group#: 19981527 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID: 15998

Sample Collected: 6/9/98 02:04 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Sandies Creek

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	49.5	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	6.33	ug/L	206.2
01005	Barium, Dissolved, icp	76.4	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	49.2	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	161	mg/L	200.7
01046	Iron, Dissolved, icp	55.1	ug/L	200.7
01049	Lead, Dissolved, gfaa	2	ug/L	239.2
00925	Magnesium, Dissolved, icp	9.16	mg/L	200.7
01056	Manganese, Dissolved, icp	78.4	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804256

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804257 | Group#: 19981527 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID: 14937

Sample Collected: 6/9/98 04:35 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Peach Creek

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	665.	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	5.86	ug/L	206.2
01005	Barium, Dissolved, icp	68.2	ug/L	200.7
01025	Cadmium, Dissolved, icp	5.00	ug/L	200.7
00915	Calcium, Dissolved, icp	24.3	mg/L	200.7
01030	Chromium, Dissolved, icp	5.00	ug/L	200.7
01040	Copper, Dissolved, icp	3.00	ug/L	200.7
46570	Hardness, Dissolved, Calc.	81.7	mg/L	200.7
01046	Iron, Dissolved, icp	556.	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	5.12	mg/L	200.7
01056	Manganese, Dissolved, icp	61.6	ug/L	200.7
01060	Molybdenum, Dissolved, icp	4.00	ug/L	200.7
01065	Nickel, Dissolved, icp	10.0	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5.00	ug/L	200.7

End of Data for TNRCC Sample# : 9804257

Comments:

Laboratory Approval: MC

Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

Guadalupe-Blanco River Authority - Regional Laboratory

GBRA
GUADALUPE-BLANCO RIVER AUTHORITY

830 933 E. Court, Seguin, Texas 78155
210-379-5822 Fax 210-379-9718

Chain of Custody

Customer Name Guadalupe Blanco River Authority

Sampled By Mike McCall (Printed Name) Mike McCall (Signature)

Date Collected	Time Collected	Sample Name or Description	TNRCC Id. No. (CRP only)	Grab/ Comp	Pres.	Analyses Requested	GBRA lab Sample Id. (Sediment)
7/14·98	1109	Peach Cr @ C.R. 353	14937	G	ICE HNO_3	Al, Cd, Cr, Cu, Pb, Ni, Se, Ag, Zn, Ca, Mg, Hard (Calc), Ba, Fe, Mn, Mo, Hg	9804258
"	1337	Sandies Cr @ F.M 1116	15998	G	"	"	9804259
"	1351	Elm Cr @ CR 108	15996	G	"	"	9804260
"	1412	Elm Cr @ CR 534	15997	G	"	"	9804261
"	1414	Elm Cr @ CR 534 DUP	15997	G	"	"	9804262

Special Notes: Cr Hex. if possible on all @SEO-I @SEO-GF Hg & Cr_6 Exceeded Hold time Not Analyzed

GBRA Lab	Delivered By:		Date:		Time:	Received By:		Date:	Time:
	Method of Delivery:		Condition of Container:				Ice:		
Second Lab	Delivered By:	UPS Ground	Date:	05/17/98	Time: 10:45	Received By:	[illegible]	Date: 05/17/98	Time: 10:45
	Method of Delivery:	UPS Ground	Condition of Container:				Ice:	No	

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804258 | Group#: 19981528 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: SOLID | Sample Depth: | Station ID: 14937

Sample Collected: 7/14/98 01:09 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Peach Cr @ C.R. 353

Storet Code	Parameter Name	Result	Unit	Method
01108	Aluminum, Total, icp	940.	mg/Kg	3050A/6010A
01003	Arsenic, Total, gfaa	0.82	mg/Kg	206.2
01008	Barium, Total, icp	11.4	mg/Kg	3050A/6010A
01028	Cadmium, Total, gfaa	0.02	mg/Kg	3050A/7131
01029	Chromium, Total, icp	1.42	mg/Kg	3050A/6010A
01043	Copper, Total, icp	0.413	mg/Kg	3050A/6010A
01052	Lead, Total, icp	4.58	mg/Kg	3050A/6010A
01053	Manganese, Total, icp	35.0	mg/Kg	3050A/6010A
01068	Nickel, Total, icp	0.960	mg/Kg	3050A/6010A
01148	Selenium, Total, gfaa	<0.32	mg/Kg	3050A/7740
01078	Silver, Total, icp	0.288	mg/Kg	3050A/200.7
01093	Zinc, Total, icp	3.82	mg/Kg	3050/6010

End of Data for TNRCC Sample# : 9804258

Comments:

Laboratory Approval: MC

Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804259 Group#: 19981528 Chain of Custody #: GBRA Region: 0

Program Code: GBRA Sample Matrix: SOLID Sample Depth: Station ID: 15998

Sample Collected: 7/14/98 03:37 pm Sample Recieved: 8/17/98 Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Sandies Cr @ F.M. 1116

Storet Code	Parameter Name	Result	Unit	Method
01108	Aluminum, Total, icp	3.04e+04	mg/Kg	3050A/6010A
01003	Arsenic, Total, gfaa	8.68	mg/Kg	206.2
01008	Barium, Total, icp	167.	mg/Kg	3050A/6010A
01028	Cadmium, Total, gfaa	0.13	mg/Kg	3050A/7131
01029	Chromium, Total, icp	22.2	mg/Kg	3050A/6010A
01043	Copper, Total, icp	9.21	mg/Kg	3050A/6010A
01052	Lead, Total, icp	17.6	mg/Kg	3050A/6010A
01053	Manganese, Total, icp	290.	mg/Kg	3050A/6010A
01068	Nickel, Total, icp	14.6	mg/Kg	3050A/6010A
01148	Selenium, Total, gfaa	<0.71	mg/Kg	3050A/7740
01078	Silver, Total, icp	0.569	mg/Kg	3050A/200.7
01093	Zinc, Total, icp	72.4	mg/Kg	3050/6010

End of Data for TNRCC Sample# : 9804259

Comments:

Laboratory Approval: MC Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804260 | Group#: 19981528 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: SOLID | Sample Depth: | Station ID: 15996

Sample Collected: 7/14/98 03:51 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Elm Cr @ CR 108

Storet Code	Parameter Name	Result	Unit	Method
01108	Aluminum, Total, icp	1.39e+04	mg/Kg	3050A/6010A
01003	Arsenic, Total, gfaa	3.46	mg/Kg	206.2
01008	Barium, Total, icp	130.	mg/Kg	3050A/6010A
01028	Cadmium, Total, gfaa	0.09	mg/Kg	3050A/7131
01029	Chromium, Total, icp	8.89	mg/Kg	3050A/6010A
01043	Copper, Total, icp	4.02	mg/Kg	3050A/6010A
01052	Lead, Total, icp	11.1	mg/Kg	3050A/6010A
01053	Manganese, Total, icp	123.	mg/Kg	3050A/6010A
01068	Nickel, Total, icp	6.49	mg/Kg	3050A/6010A
01148	Selenium, Total, gfaa	<0.40	mg/Kg	3050A/7740
01078	Silver, Total, icp	0.347	mg/Kg	3050A/200.7
01093	Zinc, Total, icp	30.1	mg/Kg	3050/6010

End of Data for TNRCC Sample# : 9804260

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804261 | Group#: 19981528 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: SOLID | Sample Depth: | Station ID: 15997

Sample Collected: 7/14/98 04:12 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Elm Cr @ CR 534

Storet Code	Parameter Name	Result	Unit	Method
01108	Aluminum, Total, icp	1.35e+04	mg/Kg	3050A/6010A
01003	Arsenic, Total, gfaa	4.88	mg/Kg	206.2
01008	Barium, Total, icp	137.	mg/Kg	3050A/6010A
01028	Cadmium, Total, gfaa	0.03	mg/Kg	3050A/7131
01029	Chromium, Total, icp	9.18	mg/Kg	3050A/6010A
01043	Copper, Total, icp	2.65	mg/Kg	3050A/6010A
01052	Lead, Total, icp	9.69	mg/Kg	3050A/6010A
01053	Manganese, Total, icp	205.	mg/Kg	3050A/6010A
01068	Nickel, Total, icp	6.79	mg/Kg	3050A/6010A
01148	Selenium, Total, gfaa	<0.36	mg/Kg	3050A/7740
01078	Silver, Total, icp	0.330	mg/Kg	3050A/200.7
01093	Zinc, Total, icp	22.7	mg/Kg	3050/6010

End of Data for TNRCC Sample# : 9804261

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804262 | Group#: 19981528 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: SOLID | Sample Depth: | Station ID: 15997

Sample Collected: 7/14/98 04:14 pm | Sample Recieved: 8/17/98 | Sample Collector: McCall,M

Collection Site: Guadalupe-Blanco River Authority--Elm Cr @ CR 534 - dup

Storet Code	Parameter Name	Result	Unit	Method
01108	Aluminum, Total, icp	1.42e+04	mg/Kg	3050A/6010A
01003	Arsenic, Total, gfaa	4.57	mg/Kg	206.2
01008	Barium, Total, icp	100.	mg/Kg	3050A/6010A
01028	Cadmium, Total, gfaa	0.03	mg/Kg	3050A/7131
01029	Chromium, Total, icp	9.56	mg/Kg	3050A/6010A
01043	Copper, Total, icp	2.59	mg/Kg	3050A/6010A
01052	Lead, Total, icp	9.31	mg/Kg	3050A/6010A
01053	Manganese, Total, icp	188.	mg/Kg	3050A/6010A
01068	Nickel, Total, icp	6.27	mg/Kg	3050A/6010A
01148	Selenium, Total, gfaa	<0.35	mg/Kg	3050A/7740
01078	Silver, Total, icp	0.308	mg/Kg	3050A/200.7
01093	Zinc, Total, icp	22.9	mg/Kg	3050/6010

End of Data for TNRCC Sample# : 9804262

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

Guadalupe-Blanco River Authority - Regional Laboratory

933 E. Court, Seguin, Texas 78155

210-379-5822 Fax 210-379-9718

GBRA

GUADALUPE-BLANCO RIVER AUTHORITY

Chain of Custody

Customer Name GBRA Chicken Study

Sampled By Mike McCall (Printed Name) Mike McCall (Signature)

Date Collected	Time Collected	Sample Name or Description	TNRCC Id. No. (CRP only)	Grab/ Comp	Pres.	Analyses Requested	GBRA lab Sample Id.
8-25 98	1050	Field Blank			HNO_3 ICE	@SWDM-1 @SWDM-6 Hg-1	9804353
8-25 98	1055	Equipment Blank			"	" "	9804354
8-25-98	1100	Elm Creek @ C.R. 534		G	"	" "	9804355
8-25-98	1150	Elm Creek @ C.R. 108		G	"	" "	9804356
8-25-98	1239	Sandies Creek@ FM 1116		G	"	" "	9804357
8-25-98	1250	Sandies Creek@ FM 1116 Dup		G	"	" "	9804358
8-25-98	1535	Peach Creek @ C.R. ~~77~~ 353		G	"	" "	9804359

Special Notes: _____

GBRA Lab

Delivered By: Mike McCall Date: 8-25-98 Time: 1640 Received By: C McCall Date: 8/25 Time: 1645

Method of Delivery: GBRA Condition of Container: Good Ice: Yes

Second Lab

Delivered By: UPS Ground Date: 08/27/98 Time: 13:29 Received By: A Crocker Date: 08/27/98 Time: 13:29

Method of Delivery: UPS Ground Condition of Container: Good Ice: Yes

TNRCC

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804353 | Group#: 19981563 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID:

Sample Collected: 8/25/98 12:50 pm | Sample Recieved: 8/27/98 | Sample Collector: McCall,M

Collection Site: GBRA - Chicken Study - Field Blank

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	21	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	0.50	ug/L	206.2
01005	Barium, Dissolved, icp	< 1	ug/L	200.7
01025	Cadmium, Dissolved, icp	< 5	ug/L	200.7
00915	Calcium, Dissolved, icp	< 0.02	mg/L	200.7
01030	Chromium, Dissolved, icp	< 5	ug/L	200.7
01040	Copper, Dissolved, icp	< 3	ug/L	200.7
46570	Hardness, Dissolved, Calc.	0.101	mg/L	200.7
01046	Iron, Dissolved, icp	< 15	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	0.013	mg/L	200.7
01056	Manganese, Dissolved, icp	< 1	ug/L	200.7
71890	Mercury, Dissolved, cvaa	<0.010	ug/L	245.1
01060	Molybdenum, Dissolved, icp	< 4	ug/L	200.7
01065	Nickel, Dissolved, icp	< 10	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	< 5	ug/L	200.7

End of Data for TNRCC Sample# : 9804353

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804354 | Group#: 19981563 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID:

Sample Collected: 8/25/98 12:55 pm | Sample Recieved: 8/27/98 | Sample Collector: McCall,M

Collection Site: GBRA - Chicken Study - Equipment Blank

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	< 15	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	0.63	ug/L	206.2
01005	Barium, Dissolved, icp	< 1	ug/L	200.7
01025	Cadmium, Dissolved, icp	< 5	ug/L	200.7
00915	Calcium, Dissolved, icp	0.030	mg/L	200.7
01030	Chromium, Dissolved, icp	< 5	ug/L	200.7
01040	Copper, Dissolved, icp	< 3	ug/L	200.7
46570	Hardness, Dissolved, Calc.	0.101	mg/L	200.7
01046	Iron, Dissolved, icp	< 15	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	< 0.01	mg/L	200.7
01056	Manganese, Dissolved, icp	< 1	ug/L	200.7
71890	Mercury, Dissolved, cvaa	<0.010	ug/L	245.1
01060	Molybdenum, Dissolved, icp	< 4	ug/L	200.7
01065	Nickel, Dissolved, icp	< 10	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	< 5	ug/L	200.7

End of Data for TNRCC Sample# : 9804354

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804355 | Group#: 19981563 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID:

Sample Collected: 8/25/98 01:00 pm | Sample Recieved: 8/27/98 | Sample Collector: McCall,M

Collection Site: GBRA - Chicken Study - Elm Creek @ C.R. 534

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	856	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	4.49	ug/L	206.2
01005	Barium, Dissolved, icp	73	ug/L	200.7
01025	Cadmium, Dissolved, icp	< 5	ug/L	200.7
00915	Calcium, Dissolved, icp	19.0	mg/L	200.7
01030	Chromium, Dissolved, icp	< 5	ug/L	200.7
01040	Copper, Dissolved, icp	< 3	ug/L	200.7
46570	Hardness, Dissolved, Calc.	65.2	mg/L	200.7
01046	Iron, Dissolved, icp	735	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	4.33	mg/L	200.7
01056	Manganese, Dissolved, icp	15	ug/L	200.7
71890	Mercury, Dissolved, cvaa	<0.010	ug/L	245.1
01060	Molybdenum, Dissolved, icp	< 4	ug/L	200.7
01065	Nickel, Dissolved, icp	< 10	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5	ug/L	200.7

End of Data for TNRCC Sample# : 9804355

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804356 | Group#: 19981563 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID:

Sample Collected: 8/25/98 01:50 pm | Sample Recieved: 8/27/98 | Sample Collector: McCall,M

Collection Site: GBRA - Chicken Study - Elm Creek @ C.R. 108

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	1410	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	7.55	ug/L	206.2
01005	Barium, Dissolved, icp	71	ug/L	200.7
01025	Cadmium, Dissolved, icp	< 5	ug/L	200.7
00915	Calcium, Dissolved, icp	13.6	mg/L	200.7
01030	Chromium, Dissolved, icp	< 5	ug/L	200.7
01040	Copper, Dissolved, icp	< 3	ug/L	200.7
46570	Hardness, Dissolved, Calc.	45.3	mg/L	200.7
01046	Iron, Dissolved, icp	1290	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	2.75	mg/L	200.7
01056	Manganese, Dissolved, icp	170	ug/L	200.7
71890	Mercury, Dissolved, cvaa	0.017	ug/L	245.1
01060	Molybdenum, Dissolved, icp	< 4	ug/L	200.7
01065	Nickel, Dissolved, icp	< 10	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	12	ug/L	200.7

End of Data for TNRCC Sample# : 9804356

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804357	Group#: 19981563	Chain of Custody #: GBRA	Region: 0
Program Code: GBRA	Sample Matrix: LIQUID	Sample Depth:	Station ID:
Sample Collected: 8/25/98 02:39 pm	Sample Recieved: 8/27/98	Sample Collector: McCall,M	
Collection Site: GBRA - Chicken Study - Sandies Creek @ FM 1116			

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	743	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	4.77	ug/L	206.2
01005	Barium, Dissolved, icp	44	ug/L	200.7
01025	Cadmium, Dissolved, icp	< 5	ug/L	200.7
00915	Calcium, Dissolved, icp	16.9	mg/L	200.7
01030	Chromium, Dissolved, icp	< 5	ug/L	200.7
01040	Copper, Dissolved, icp	< 3	ug/L	200.7
46570	Hardness, Dissolved, Calc.	55.1	mg/L	200.7
01046	Iron, Dissolved, icp	749	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	3.15	mg/L	200.7
01056	Manganese, Dissolved, icp	19	ug/L	200.7
71890	Mercury, Dissolved, cvaa	0.014	ug/L	245.1
01060	Molybdenum, Dissolved, icp	< 4	ug/L	200.7
01065	Nickel, Dissolved, icp	< 10	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	5	ug/L	200.7

End of Data for TNRCC Sample# : 9804357

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804358 | Group#: 19981563 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID:

Sample Collected: 8/25/98 02:50 pm | Sample Recieved: 8/27/98 | Sample Collector: McCall,M

Collection Site: GBRA - Chicken Study - Sandies Creek @ FM 1116 - Dup.

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	647	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	4.69	ug/L	206.2
01005	Barium, Dissolved, icp	44	ug/L	200.7
01025	Cadmium, Dissolved, icp	< 5	ug/L	200.7
00915	Calcium, Dissolved, icp	16.9	mg/L	200.7
01030	Chromium, Dissolved, icp	< 5	ug/L	200.7
01040	Copper, Dissolved, icp	< 3	ug/L	200.7
46570	Hardness, Dissolved, Calc.	55.3	mg/L	200.7
01046	Iron, Dissolved, icp	724	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	3.17	mg/L	200.7
01056	Manganese, Dissolved, icp	17	ug/L	200.7
71890	Mercury, Dissolved, cvaa	<0.010	ug/L	245.1
01060	Molybdenum, Dissolved, icp	< 4	ug/L	200.7
01065	Nickel, Dissolved, icp	< 10	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	< 5	ug/L	200.7

End of Data for TNRCC Sample# : 9804358

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

9/9/98 9:27

TNRCC Sample #: 9804359 | Group#: 19981563 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: LIQUID | Sample Depth: | Station ID:

Sample Collected: 8/25/98 05:35 pm | Sample Recieved: 8/27/98 | Sample Collector: McCall,M

Collection Site: GBRA - Chicken Study - Peach Creek @ C.R. 353

Storet Code	Parameter Name	Result	Unit	Method
01106	Aluminum, Dissolved, icp	827	ug/L	200.7
01000	Arsenic, Dissolved, gfaa	4.44	ug/L	206.2
01005	Barium, Dissolved, icp	65	ug/L	200.7
01025	Cadmium, Dissolved, icp	< 5	ug/L	200.7
00915	Calcium, Dissolved, icp	17.7	mg/L	200.7
01030	Chromium, Dissolved, icp	< 5	ug/L	200.7
01040	Copper, Dissolved, icp	< 3	ug/L	200.7
46570	Hardness, Dissolved, Calc.	57.7	mg/L	200.7
01046	Iron, Dissolved, icp	702	ug/L	200.7
01049	Lead, Dissolved, gfaa	<1	ug/L	239.2
00925	Magnesium, Dissolved, icp	3.26	mg/L	200.7
01056	Manganese, Dissolved, icp	19	ug/L	200.7
71890	Mercury, Dissolved, cvaa	<0.010	ug/L	245.1
01060	Molybdenum, Dissolved, icp	< 4	ug/L	200.7
01065	Nickel, Dissolved, icp	< 10	ug/L	200.7
01145	Selenium, Dissolved, gfaa	<3	ug/L	270.2
01075	Silver, Dissolved, gfaa	<0.25	ug/L	272.2
01090	Zinc, Dissolved, icp	< 5	ug/L	200.7

End of Data for TNRCC Sample# : 9804359

Comments:

Laboratory Approval: _____ Approval Date: 9-Sep-1998

RP15FYNL 4 Feb 1998

1565

Guadalupe-Blanco River Authority - Regional Laboratory
933 E. Court, Seguin, Texas 78155
210-379-5822 Fax 210-379-9718

GBRA
GUADALUPE-BLANCO RIVER AUTHORITY

Chain of Custody

RECEIVED
SEP 24 1998
GBRA-SEGUIN OFFICE

4965-69

Customer Name GBRA Chicken Study

Sampled By Mike McCall (Printed Name) Mike McCall (Signature)

Date Collected	Time Collected	Sample Name or Description * SEDIMENTS *	TNRCC Id. No. (CRP only)	Grab/ Comp	Pres.	Analyses Requested	GBRA lab Sample Id.
8-25-98	1045	Elm Creek @ C.R. 534		G	ICE	@SED-1 @SED-GF Hg-4	9804365
8-25-98	1136	Elm Creek @ C.R. 108		G	ICE	" "	9804366
8-25-98	1230	Sandies Creek @ FM 1116		G	ICE	" "	9804367
8-25-98	1235	Sandies Creek @ FM 1116 Dup		G	TCE	" "	9804368
8-25-98	1523	Peach Creek @ C.R. 353		G	TCE	" "	9804369

Special Notes:

GBRA Lab
Delivered By: Mike McCall Date: 8-25-98 Time: 1640 Received By: C Nickel Date: 8/25 Time: 1645
Method of Delivery: GBRA Condition of Container: Good Ice: Yes

Second Lab
Delivered By: UPS Ground Date: 08/27/98 Time: 13:29 Received By: A Cuellar Date: 8/27/98 Time: 13:29
Method of Delivery: UPS Ground Condition of Container: Good Ice: Yes

TNRCC Laboratory

Report of Analysis

TNRCC Sample #: 9804365 | Group#: 19981565 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: SOLID | Sample Depth: | Station ID:

Sample Collected: 8/25/98 10:45 am | Sample Recieved: 8/27/98 | Sample Collector: McCall,M

Collection Site: GBRA - Chicken Study - Elm Creek @ C.R. 534

Storet Code	Parameter Name	Result	Unit	Prepared	Analyzed	Method	Data Qualifiers
01078	Silver, Total, icp	< 0.4	mg/Kg	8/31/98	9/2 11am	3050A/200.7	
01108	Aluminum, Total, icp	11000	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01003	Arsenic, Total, gfaa	6.49	mg/Kg	9/4/98	9/9 2pm	206.2	
01008	Barium, Total, icp	88.8	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01028	Cadmium, Total, gfaa	0.06	mg/Kg	9/4/98	9/9 2pm	3050A/7131	
01029	Chromium, Total, icp	9.17	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01043	Copper, Total, icp	3.55	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
71921	Mercury, Total, cvaa	0.017	mg/Kg	N/A	9/3 5pm	7470A	
01053	Manganese, Total, icp	94.6	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01068	Nickel, Total, icp	7.63	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01052	Lead, Total, icp	10.6	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01148	Selenium, Total, gfaa	0.24	mg/Kg	9/4/98	9/9 2pm	3050A/7740	
01093	Zinc, Total, icp	29.7	mg/Kg	8/31/98	9/2 11am	3050/6010	

End of Data for TNRCC Sample# : 9804365

Comments:

Laboratory Approval: MC

Approval Date: 22-Sep-1998

TNRCC Laboratory

Report of Analysis

TNRCC Sample #: 9804366 Group#: 19981565 Chain of Custody #: GBRA Region: 0
Program Code: GBRA Sample Matrix: SOLID Sample Depth: Station ID:
Sample Collected: 8/25/98 11:36 am Sample Recieved: 8/27/98 Sample Collector: McCall,M
Collection Site: GBRA - Chicken Study - Elm Creek @ C.R. 108

Storet Code	Parameter Name	Result	Unit	Prepared	Analyzed	Method	Data Qualifiers
01078	Silver, Total, icp	< 0.5	mg/Kg	8/31/98	9/2 11am	3050A/200.7	
01108	Aluminum, Total, icp	9450	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01003	Arsenic, Total, gfaa	5.63	mg/Kg	9/4/98	9/9 2pm	206.2	
01008	Barium, Total, icp	78	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01028	Cadmium, Total, gfaa	0.06	mg/Kg	9/4/98	9/9 2pm	3050A/7131	
01029	Chromium, Total, icp	6.14	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01043	Copper, Total, icp	2.81	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
71921	Mercury, Total, cvaa	0.012	mg/Kg	N/A	9/3 5pm	7470A	
01053	Manganese, Total, icp	168	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01068	Nickel, Total, icp	4.74	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01052	Lead, Total, icp	7.38	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01148	Selenium, Total, gfaa	<0.14	mg/Kg	9/4/98	9/9 2pm	3050A/7740	
01093	Zinc, Total, icp	19.5	mg/Kg	8/31/98	9/2 11am	3050/6010	

End of Data for TNRCC Sample# : 9804366

Comments:

Laboratory Approval: MC Approval Date: 22-Sep-1998

TNRCC Laboratory

Report of Analysis

TNRCC Sample #: 9804367 | Group#: 19981565 | Chain of Custody #: GBRA | Region: 0

Program Code: GBRA | Sample Matrix: SOLID | Sample Depth: | Station ID:

Sample Collected: 8/25/98 12:30 pm | Sample Recieved: 8/27/98 | Sample Collector: McCall,M

Collection Site: GBRA - Chicken Study - Sandies Creek @ FM 1116

Storet Code	Parameter Name	Result	Unit	Prepared	Analyzed	Method	Data Qualifiers
01078	Silver, Total, icp	< 0.5	mg/Kg	8/31/98	9/2 11am	3050A/200.7	
01108	Aluminum, Total, icp	7820	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01003	Arsenic, Total, gfaa	4.17	mg/Kg	9/4/98	9/9 2pm	206.2	
01008	Barium, Total, icp	63.9	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01028	Cadmium, Total, gfaa	0.06	mg/Kg	9/4/98	9/9 2pm	3050A/7131	
01029	Chromium, Total, icp	6.55	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01043	Copper, Total, icp	2.9	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
71921	Mercury, Total, cvaa	0.013	mg/Kg	N/A	9/3 5pm	7470A	
01053	Manganese, Total, icp	99.1	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01068	Nickel, Total, icp	5.26	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01052	Lead, Total, icp	9.09	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01148	Selenium, Total, gfaa	0.12	mg/Kg	9/4/98	9/9 2pm	3050A/7740	
01093	Zinc, Total, icp	26.1	mg/Kg	8/31/98	9/2 11am	3050/6010	

End of Data for TNRCC Sample# : 9804367

Comments:

Laboratory Approval: MC

Approval Date: 22-Sep-1998

RP15FYNL 4 Feb 1998

TNRCC Laboratory

Report of Analysis

TNRCC Sample #: 9804368 Group#: 19981565 Chain of Custody #: GBRA Region: 0

Program Code: GBRA Sample Matrix: SOLID Sample Depth: Station ID:

Sample Collected: 8/25/98 12:35 pm Sample Recieved: 8/27/98 Sample Collector: McCall,M

Collection Site: GBRA - Chicken Study - Sandies Creek @ FM 1116 - Dup

Storet Code	Parameter Name	Result	Unit	Prepared	Analyzed	Method	Data Qualifiers
01078	Silver, Total, icp	< 0.6	mg/Kg	8/31/98	9/2 11am	3050A/200.7	
01108	Aluminum, Total, icp	7280	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01003	Arsenic, Total, gfaa	3.83	mg/Kg	9/4/98	9/9 2pm	206.2	
01008	Barium, Total, icp	58	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01028	Cadmium, Total, gfaa	0.05	mg/Kg	9/4/98	9/9 2pm	3050A/7131	
01029	Chromium, Total, icp	5.93	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01043	Copper, Total, icp	2.57	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
71921	Mercury, Total, cvaa	0.011	mg/Kg	N/A	9/3 5pm	7470A	
01053	Manganese, Total, icp	77.1	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01068	Nickel, Total, icp	4.77	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01052	Lead, Total, icp	7.47	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01148	Selenium, Total, gfaa	0.10	mg/Kg	9/4/98	9/9 2pm	3050A/7740	
01093	Zinc, Total, icp	24.1	mg/Kg	8/31/98	9/2 11am	3050/6010	

End of Data for TNRCC Sample# : 9804368

Comments:

Laboratory Approval: MC Approval Date: 22-Sep-1998

TNRCC Laboratory

Report of Analysis

TNRCC Sample #: 9804369 Group#: 19981565 Chain of Custody #: GBRA Region: 0

Program Code: GBRA Sample Matrix: SOLID Sample Depth: Station ID:

Sample Collected: 8/25/98 03:23 pm Sample Recieved: 8/27/98 Sample Collector: McCall,M

Collection Site: GBRA - Chicken Study - Peach Creek @ C.R. 353

Storet Code	Parameter Name	Result	Unit	Prepared	Analyzed	Method	Data Qualifiers
01078	Silver, Total, icp	< 0.19	mg/Kg	8/31/98	9/2 11am	3050A/200.7	
01108	Aluminum, Total, icp	2000	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01003	Arsenic, Total, gfaa	1.75	mg/Kg	9/4/98	9/9 2pm	206.2	
01008	Barium, Total, icp	24.1	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01028	Cadmium, Total, gfaa	0.03	mg/Kg	9/4/98	9/9 2pm	3050A/7131	
01029	Chromium, Total, icp	2.06	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01043	Copper, Total, icp	3.68	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
71921	Mercury, Total, cvaa	0.004	mg/Kg	N/A	9/3 5pm	7470A	
01053	Manganese, Total, icp	41.8	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01068	Nickel, Total, icp	1.46	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01052	Lead, Total, icp	3.95	mg/Kg	8/31/98	9/2 11am	3050A/6010A	
01148	Selenium, Total, gfaa	<0.09	mg/Kg	9/4/98	9/9 2pm	3050A/7740	
01093	Zinc, Total, icp	7.46	mg/Kg	8/31/98	9/2 11am	3050/6010	

End of Data for TNRCC Sample# : 9804369

Comments:

Laboratory Approval: _____ Approval Date: 22-Sep-1998

RP15FYNL 4 Feb 1998