

Impairment Verification Monitoring
Dissolved Oxygen and Bacteria
Segment 1803 A&B Sandies and Elm Creek
Volume 1
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Texas Engineering Experiment Station
Shoreline Environmental Research Facility

**Impairment Verification Monitoring—Volume 1: Physical, and
Chemical Components
Segment 1803 A&B Sandies and Elm Creek**

Prepared for
Total Maximum Daily Load Program
Texas Commission on Environmental Quality
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EXECUTIVE SUMMARY

This report describes water quality data collected on Sandies Creek (Segment 1803B) and Elm Creek (Segment 1803A) during the period from August 2002 through August 2004. It has been prepared for the Texas Commission on Environmental Quality (TCEQ) by the Shoreline Environmental Research Facility at Texas A&M University under an inter-agency contract between the TCEQ and the Texas Engineering Experiment Station. Sandies Creek is a 65-mile freshwater stream in the Guadalupe River Basin that extends from the confluence with the Guadalupe River west of Cuero in Dewitt County to the upstream perennial portion northwest of Smiley in Gonzales County. Elm Creek is a 24.3 mile freshwater stream in the Guadalupe River Basin that extends from the confluence of Sandies Creek east of Smiley in Gonzales County to the upstream perennial portion of the stream southwest of Smiley in Gonzales County. Sandies and Elm Creek were included on the 2000 State of Texas Clean Water Act 303(d) list (TNRCC 2000a) as non-supporting due to low concentration of dissolved oxygen that were below the criteria associated with a high aquatic life use, as well as being listed as non-supporting for contact recreation due to elevated levels of bacteria in the stream.

Volume 1 presents the water quality data, for 24-hr dissolved oxygen, bacteria, pH, water temperature, conductivity, and nutrients. Basic statistics are provided for each water quality constituent by station and sampling type. Data for dissolved oxygen and bacteria are compared to aquatic life and recreational criteria. Volume 2, prepared by project partner Ecological Communications Corporation (ECOMM 2005), describes the biological sampling and analyses conducted by ECOMM.

Water quality assessment has evolved since the 2000 305(b) Water Quality Inventory (TNRCC 2000a) with the introduction of new methodologies. These include the development of hydrologically unique Assessment Units, use of the binomial approach for analysis, the replacement of fecal coliform with *E. coli* as bacterial indicator, and the use of 24-hour dissolved oxygen measurements. Forty one of the 78 24-hour dissolved oxygen samples collected in the Sandies and Elm watershed an average value that fell below the TCEQ average of 5 mg/L, and 21 fell below the TCEQ minimum criteria of 3 mg/L associated with a “high aquatic life use” (TNRCC 2000b). A total of 14 of the 80 *e-coli* samples collected exceeded the single sample exceedance criteria (394 col/100mL) associated with contact recreation use, and six of the seven stations sampled yielded *e-coli* geometric means that exceeded the standard (126 col/100 mL) set by TCEQ for contact recreation. As a result of these findings, Sandies Creek and Elm Creek will remain on the 303(d) List of impaired waters due to non-support of aquatic life use resulting from depressed dissolved oxygen and non-support of contact recreation due to elevated levels of bacteria in the stream. A Total Maximum daily Load (TMDL) will be established for these watersheds to restore the impaired uses. The next phase of the project will involve storm event based monitoring for physical and chemical parameters of the stream as well as numerical water quality model selection and development.

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INTRODUCTION

Sandies Creek is a 65-mile freshwater stream in the Guadalupe River Basin that extends from the confluence with the Guadalupe River west of Cuero in Dewitt County to the upstream perennial portion northwest of Smiley in Gonzales County. Elm Creek is a 24.3 mile freshwater stream in the Guadalupe River Basin that extends from the confluence of Sandies Creek east of Smiley in Gonzales County to the upstream perennial portion of the stream southwest of Smiley in Gonzales County. Land use in the watershed is confined mostly to grassland and pasture. (Figure 2 and Table 1).

Sandies and Elm Creeks were identified as impaired based on exceedances of the criteria associated with high aquatic life and contact recreation use standards in the *2000 Water Quality Inventory* (TNRCC 2000a). The assessment found that some instantaneous dissolved oxygen samples collected in the stream exhibited concentrations lower than the criterion established to assure optimum conditions for aquatic life. Fecal coliform bacteria levels in the stream were also found to be in excess of the criterion set for contact recreation. The TCEQ determined that there was an insufficient number of 24-hour dissolved oxygen and bacteriological samples (*E. coli*) collected since 1999 to allow for a reassessment of standards attainment and in response, initiated a project to verify the impairment through the collection of additional physical, chemical, and biological data.

In 2001, TCEQ contracted the services of the South Texas Environmental Institute at Texas A&M University-Kingsville (TAMUK) to lead this effort, together with the Conrad Blucher Institute for Surveying and Science (CBI) at Texas A&M University-Corpus Christi and Ecological Communications Corporations (ECOMM). This team was tasked with the design and implementation of a monitoring plan to verify the impairment, make recommendations, and then take the necessary action to restore use where necessary. The TAMUK team conducted sampling at six stations on Sandies and Elm Creeks during August 2002 through August 2004 to provide the TCEQ with additional 24-hour dissolved oxygen, bacteria samples, physical and chemical analyses, as well as biological assessments. In September of 2003 CBI took over as the project lead under a contract between the TCEQ and the Texas Engineering Experiment Station (TEES).

The information provided in this report is included in two volumes. Volume 1 describes the physical/chemical sampling and data analyses for water quality on Sandies and Elm Creek. The 24-hour dissolved oxygen and bacteria sampling results are presented in tabular and graphical formats with statistical summaries. Other measured constituents include pH, water temperature, conductivity, and nutrient data, for which basic statistics are provided by station and sampling type. Volume 2, prepared by ECOMM (2004), describes the biological sampling and data analyses conducted by ECOMM on Sandies and Elm Creeks.

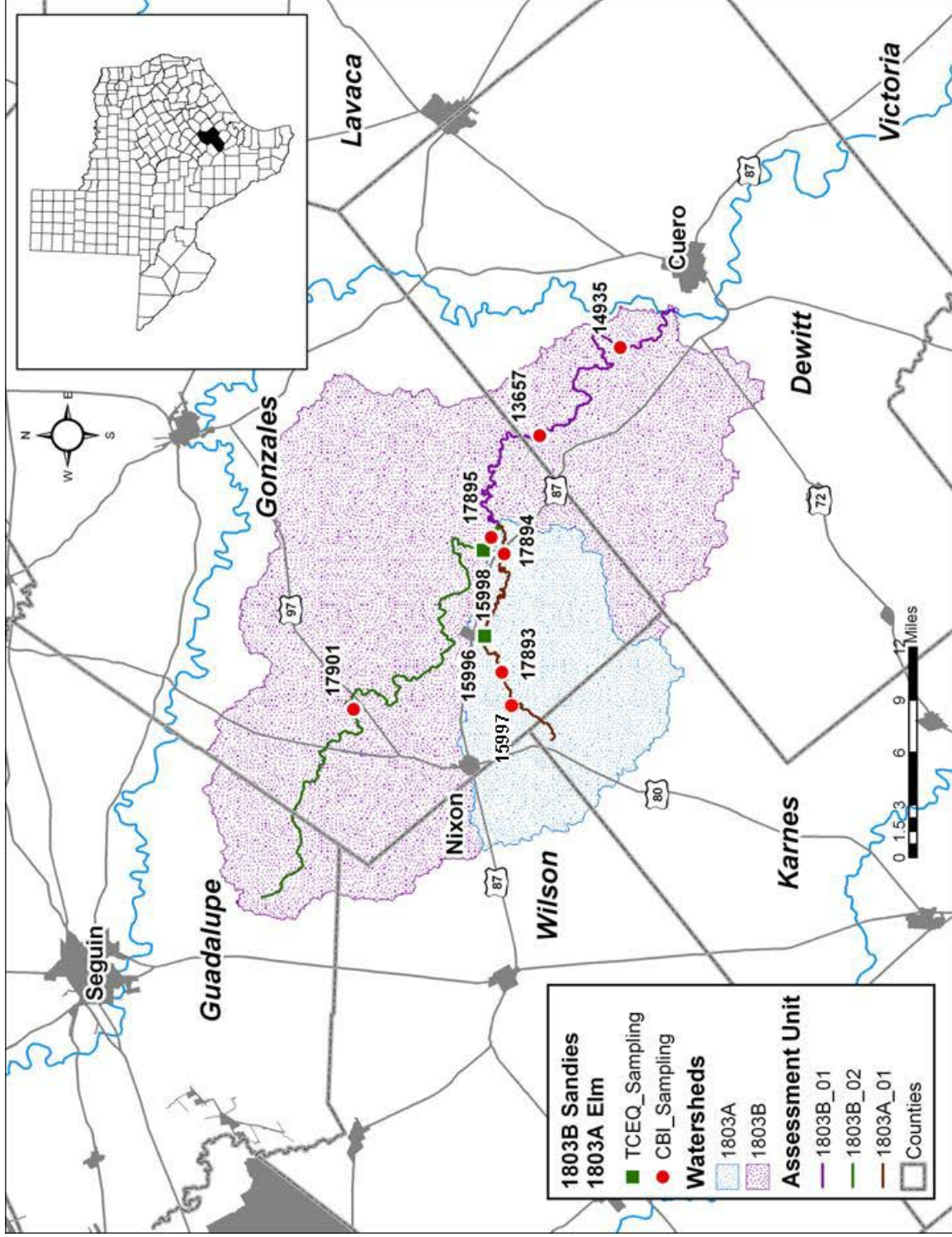


Figure 1. Map showing Sampling Station Locations on Sandies and Elm Creek.

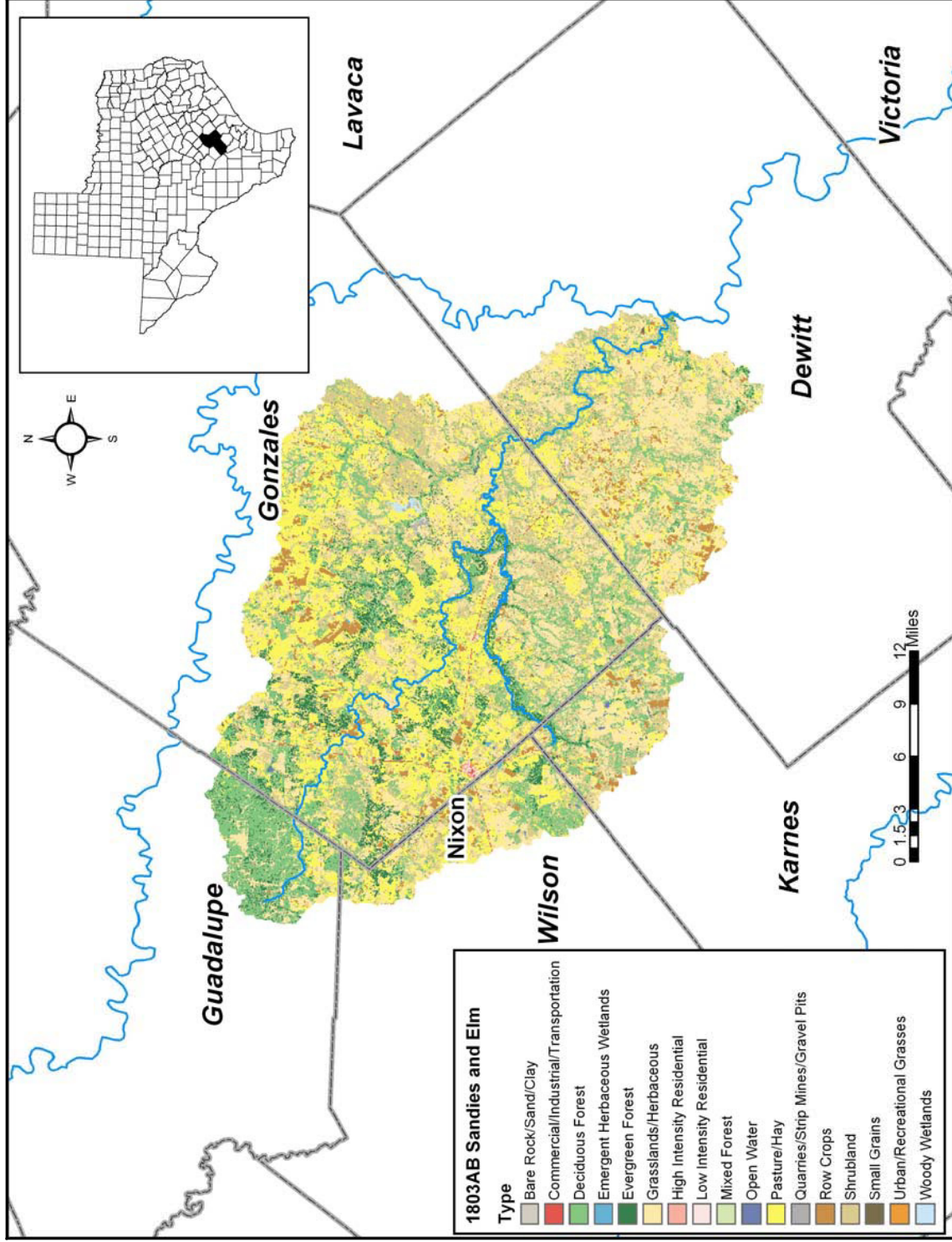


Figure 2. Land Use Map for Segments 1803A&B Sandies and Elm Creek

Table 1.1. Land use percentages for Sandies and Elm Creek

Percent	Type
25	Pasture/Hay
24	Grasslands/Herbaceous
21	Shrubland
20	Deciduous Forest
5	Evergreen Forest
3	Row Crops
<1	Open Water
<1	Small Grains
<1	Commercial/Industrial/Transportation
<1	Bare Rock/Sand/Clay
<1	Emergent Herbaceous Wetlands
<1	Woody Wetlands
<1	Low Intensity Residential
<1	Quarries/Strip Mines/Gravel Pits
<1	Urban/Recreational Grasses
<1	High Intensity Residential
<1	Mixed Forest

HISTORICAL REVIEW

The segment specific uses and criteria for Sandies and Elm Creek, as identified in the 2002 305(b) Assessment (TNRCC 2002a), are as follows:

- High Aquatic Life Use
- Contact Recreation Use
- Fish Consumption Use

The 2000 303(d) List (TNRCC 2000a) included Sandies and Elm Creek as non-supporting for aquatic life use due to depressed dissolved oxygen and non-supporting for contact recreation use due to elevated levels of bacteria within the streams. The results of the assessment of samples for the 2000 and 2002 Water Quality Inventory are given in Tables 2 and 3 respectively. Table 4 lists all TCEQ Monitoring Stations on this segment and Figures 3 through 9 present photographs of the seven Monitoring Stations from which samples were collected during this project.

Table 2. Assessment Samples for Segment 1803A&B Sandies and Elm Creek for the 2000 Inventory

(Developed from water quality data collected between June 1, 1994 and May 31, 1999)

Segment ID	Year	Uses or Criteria	Level of Support	Method	Samples Taken	Exceeded	% Exceeded
1803A	1999	High Aquatic Life Use	Not Supported	DO grab	13	7	53.80
1803A	1999	Contact Recreation	Not Supported	Fecal Coliform	13	7	53.80
1803B	1999	High Aquatic Life Use	Not Supported	DO grab	32	14	43.75
1803B	1999	Contact Recreation	Not Supported	Fecal Coliform	18	4	22.22

Table 3. Assessment Samples for Segment 1803A&B Sandies and Elm Creek for the 2002 Inventory (Developed from water quality data collected between March 1, 1996 and February 28, 2001)

Segment ID	Assessment Unit	Year	Uses or Criteria	Level of Support	Method	Samples Taken	Exceeded	% Exceeded	Geometric Mean
1803A	1803A_01	2002	High Aquatic Life Use	Non Support	DO avg	15	9	60	
1803A	1803A_01	2002	High Aquatic Life Use	Non Support	DO min	15	3	20	
1803A	1803A_01	2002	Contact Recreation	Non Support	Fecal Coliform	15	8	53.33	
1803A	1803A_01	2002	Contact Recreation	Non Support	Fecal Geo Mean	15			353.83
1803B	1803B_02	2002	High Aquatic Life Use	Non Support	DO avg	26	10	38.46	
1803B	1803B_02	2002	High Aquatic Life Use	Non Support	DO min	26	1	3.85	
1803B	1803B_01	2002	High Aquatic Life Use	Non Support	DO avg	46	16	34.78	
1803B	1803B_01	2002	High Aquatic Life Use	Non Support	DO Min	46	16	34.78	
1803B	1803B_02	2002	Contact Recreation	Non Support	E.coli	18	3	16.67	
1803B	1803B_01	2002	Contact Recreation	Non Support	E.coli	25	5	20	
1803B	1803B_02	2002	Contact Recreation	Non Support	E.coli Geo Mean	18			131
1803B	1803B_01	2002	Contact Recreation	Non Support	E.coli Geo Mean	25			174
1803B	1803B_02	2002	Contact Recreation	Non Support	Fecal Coliform	25	10	40	
1803B	1803B_01	2002	Contact Recreation	Non Support	Fecal Coliform	25	7	28	
1803B	1803B_02	2002	Contact Recreation	Non Support	Fecal Geo Mean	25			336
1803B	1803B_01	2002	Contact Recreation	Non Support	Fecal Geo Mean	25			311

Table 4. All TCEQ Monitoring Stations on Segments 1803A&B. Green shading indicates Stations used in impairment verification monitoring. Photos for these 7 stations are indicated in the third column.

Station	Station Descriptions	Photograph
15996	Elm Creek at Gonzales CR 108 approximately 1.7 km south of Smiley, TX	
17894	Elm Creek on Lazy F Ranch 515 meters upstream of old US 87 bridge	Figure 3
17893	Elm Creek approximately 4.9 km upstream of FM 108 on Pattillo Ranch	Figure 4
15997	Elm Creek at Gonzales CR 534 approximately 6.7 km ESE of Nixon, TX	Figure 5
13657	Sandies Creek 100 ft downstream of county highway, 1.9 miles upstream from Birds Creek, 2.0 miles NE of Westhoff, TX	Figure 6
14935	Sandies Creek CR 953 in Dewitt County	Figure 7
17895	Sandies Creek on Lazy F Ranch 1.65 km downstream of FM 1116	Figure 8
17901	Sandies Creek 2.31 km downstream of CR 113	Figure 9
15998	Sandies Creek at FM 1116, 7.4 km east of Smiley, TX and approximately 3 km upstream of the confluence with Elm Creek	



Figure 3. Station 17894



Figure 4. Station 17893



Figure 5. Station 15997



Figure 6. Station 13657



Figure 7. Station 14935



Figure 8. Station 17895



Figure 9. Station 17901

PROBLEM DEFINITION

TAMUK and CBI led an effort for the TCEQ to assess the water quality in Sandies and Elm Creeks (Segments 1803A&B). These segments were included on the 2000 State of Texas Clean Water Act 303(d) (TNRCC 2000a) lists as non-supporting for aquatic life use due to depressed levels of dissolved oxygen and as non-supporting for contact recreation use due to elevated levels of bacteria. The initial phase of the project required that the impairment first be verified through the collection of additional physical, chemical, and biological data to fill in data and knowledge gaps as well as determining what course of action, if any, needed to be taken to address the impairment. The additional data would result in one of four outcomes: 1) removal from the 303(d) List, 2) an evaluation of applicable water quality standards (aquatic life use impairments only), 3) establishing TMDL for the given constituent and the impairment, or 4) collect additional data. Figure 10 outlines this decision making procedure for aquatic life impairments in graphical form.

ASSESSMENT METHODOLOGY

The 2002 305(b) Water Quality Inventory implemented several changes to the guidance for assessing surface waters (Sullivan et al. 2004) and these changes were incorporated into the assessment methodologies for this project as described in this section:

- **Dissolved oxygen monitoring.** The 2000 Water Quality Inventory determined that aquatic life uses on Segments 1803A&B were impaired primarily based on instantaneous grab samples. This type of sample presents only a small snapshot of the existing water quality conditions. The 2002 Assessment Guidance (TNRCC 2002b) specified that impairment determinations requiring restorative actions could only be made using 24-hour composite data, which gives a more accurate representation of the aquatic life uses for the stream. This requires the use of data logging equipment to obtain the specified type of data to make reliable use attainment determinations.
- **Indicator bacteria.** Revisions to the 2000 Water Quality Standards incorporated the use of *E. coli* bacteria, replacing fecal coliform, as the bacterial indicator for the determination of recreational use attainment.
- **Development of Assessment Units.** The 2002 Water Quality Inventory also included the use of hydrologically similar portions of entire segments to characterize better the extent of specific use impairment. This approach combines data from several nearby stations to increase the data quantity and, thus, the certainty with respect to the results (Table 5). Previous assessments considered data from the entire water body to be representative of ambient conditions.
- **Binomial Approach.** The 305(b) Water Quality Assessment has incorporated the binomial approach, a statistically-based method for the determination of impairment using varying exceedance percentages based upon the number of samples collected. The binomial approach results in a Type I statistical error that is significantly smaller than that of the previous approach of using a single percent exceedance.

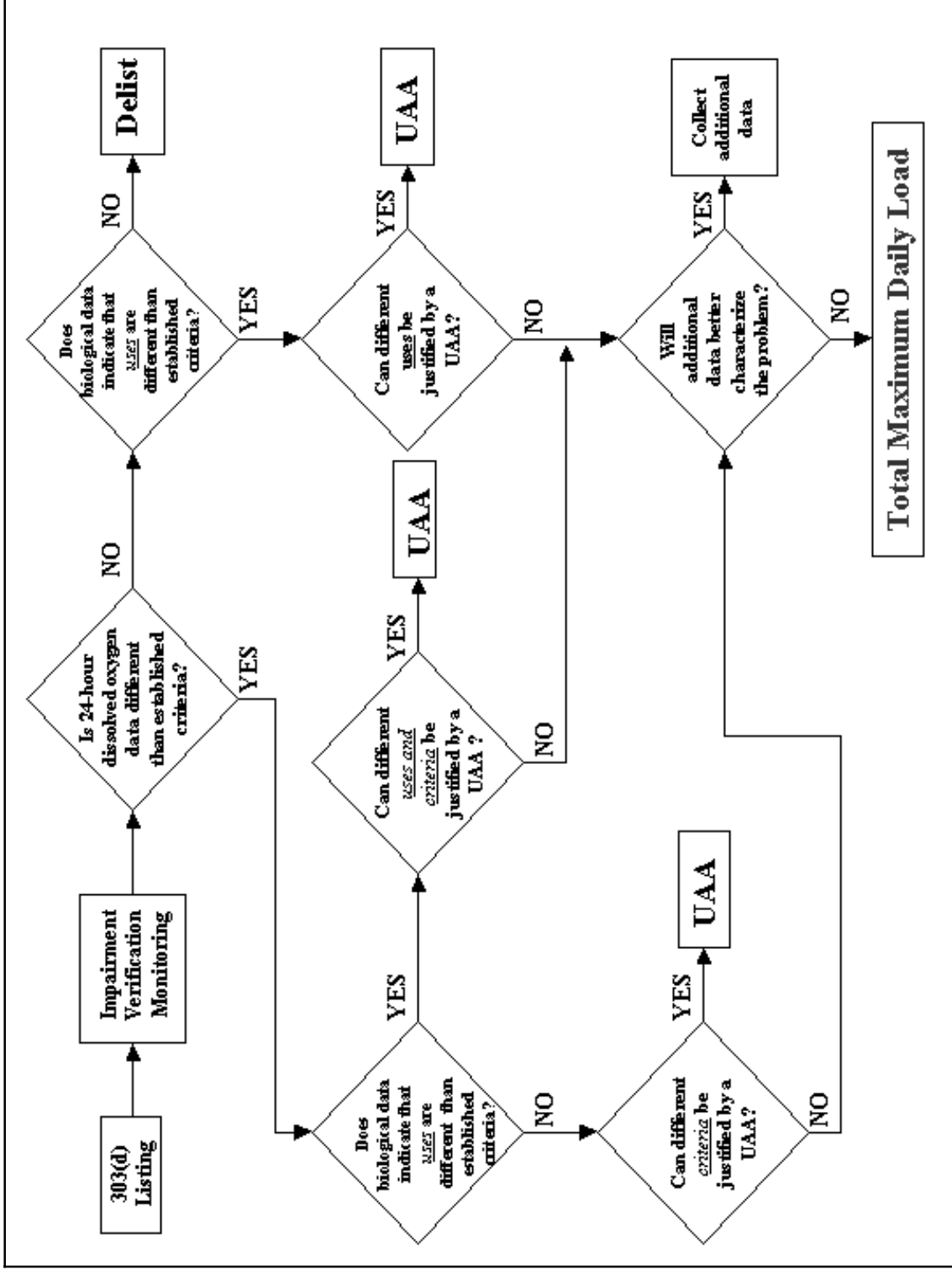


Figure 10 Conceptual Decision Framework

Table 5. Sandies and Elm Creek Aquatic Life Assessment Summary (NS=non-supporting, PS=partially supporting, FS=fully supporting)

Segment	Station ID	TMDL Station	TCEQ Station	Assessment Unit Number	Assessment Unit Description	Bacteria Support Status	Aquatic Life Support Status	24hr DO Avg Criteria	24hr DO Min Criteria
1803A	15996		X	1803A_01	Entire water body	NS	NS	5 mg/L	3 mg/L
1803A	17894	X	FS			FS	5 mg/L	3 mg/L	
1803A	17893	X	FS			FS	5 mg/L	3 mg/L	
1803A	15997	X	X			NS	NS	5 mg/L	3 mg/L
1803B	13657	X	X	1803B_01	From confluence with the Guadalupe River to the confluence with Elm Creek	NS	NS	5 mg/L	3 mg/L
1803B	14935	X	X			NS	NS	5 mg/L	3 mg/L
1803B	17895	X				FS	FS	5 mg/L	3 mg/L
1803B	17901	X		1803B_02	From confluence with Elm Creek to upper end of segment	FS	FS	5 mg/L	3 mg/L
1803B	15998		X			NS	NS	5 mg/L	3 mg/L

QAPP Development

In order to ensure that data collected under this project were scientifically valid and legally defensible, a Quality Assurance Project Plan (QAPP) was developed by TAMUK. This process ensured that all data submitted to the TCEQ have been collected and analyzed in a way that defines its reliability and, therefore, can be used in TMDL development, stream standards modifications, permit decisions, and water quality assessments.

Monitoring Plan Development

In accordance with the QAPP guidelines a monitoring plan was developed by TAMUK to provide the additional water quality data and information identified in the Historical Data Review as necessary to meet the project objectives. The data collected and assessed for this project included physical, chemical, biological, and hydrological parameters. The collection of these data was coordinated with the appropriate Clean River Partners and TCEQ Regional Offices. The monitoring plan was prepared in accordance with the guidelines established by TCEQ in the Surface Water Quality Monitoring Procedures Manual (TCEQ 2003). The monitoring plan identified the monitoring locations, the monitoring frequency, and the criteria for monitoring and data collection. The monitoring plan also identified the types of samples to be collected, the methods used to gather all data, and the parameters analyzed. Locations of the monitoring stations were determined using Global Positioning System (GPS) coordinates. The monitoring plan listed in detail the equipment and supplies necessary to carry out the monitoring effort.

Data Requirements

Data collected on Sandies and Elm Creek met requirements for several different outcomes: de-listing of the segment, standards adjustment, or establishing a TMDL. The primary goal in data

collection was to ensure that enough data were collected over the critical sampling period to adequately assess, and, if necessary, re-classify the uses for Sandies and Elm Creek.

Station Selection

Several factors were considered when sampling stations (Table 2) were selected for impairment verification:

- Accessibility
- Data history
- Water availability
- Repetitiveness
- Geographic location.

Physical/Chemical Sample Collection

Parameters measured at each sampling station are listed in Table 6. In-stream, multi-probe, data loggers measured dissolved oxygen, temperature, pH, and conductivity over a 24-hour period while flow and stream cross-sections were also measured to estimate loading of various chemical constituents. Samples were collected for laboratory analysis during each station visit. Analyses of these samples included routine TCEQ water monitoring constituents. All sampling procedures were included in the QAPP.

Biological Sample Collection

Biological data were collected on the segment during three separate events. Nekton, benthic, and habitat data were collected during each of these sampling events in accordance with the TCEQ Receiving Waters Assessment Procedures Manual (TNRCC 1999). These data were collected primarily to support a use reclassification, if necessary. Volume 2 presents all biological results and analyses.

Table 6. Parameters Measured.

PARAMETER	UNITS	METHOD TYPE	METHOD	STORET Code	AWRL	PRECISION of laboratory duplicates (RPD)	ACCURACY of matrix spikes % Recovery	AWRL Calibration Standard % Recovery	Laboratory Performing Analysis
<i>pH</i>	<i>pH units</i>	<i>Multi parameter probe</i>	<i>EPA 150.1and TCEQ SOP</i>	<i>00400</i>	<i>NA</i>	<i>10</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>DO</i>	<i>mg/L</i>	<i>Multi parameter probe</i>	<i>EPA 360.1and TCEQ SOP</i>	<i>00300</i>	<i>NA</i>	<i>10</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>DO 24-hr min.</i>	<i>mg/L</i>	<i>Multi parameter probe</i>	<i>EPA 360.1and TCEQ SOP</i>	<i>89855</i>	<i>NA</i>	<i>10</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>DO 24-hr max.</i>	<i>mg/L</i>	<i>Multi parameter probe</i>	<i>EPA 360.1and TCEQ SOP</i>	<i>89856</i>	<i>NA</i>	<i>10</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>DO 24-hr avg.</i>	<i>mg/L</i>	<i>Multi parameter probe</i>	<i>EPA 360.1and TCEQ SOP</i>	<i>89857</i>	<i>NA</i>	<i>10</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>DO number of meas.</i>	<i>mg/L</i>	<i>Multi parameter probe</i>	<i>EPA 360.1and TCEQ SOP</i>	<i>89858</i>	<i>NA</i>	<i>10</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>Conductivity</i>	<i>uS/cm</i>	<i>Multi parameter probe</i>	<i>EPA 120.1and TCEQ SOP</i>	<i>00094</i>	<i>NA</i>	<i>10</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>Temperature</i>	<i>°Celsius</i>	<i>Multi parameter probe</i>	<i>EPA 170.1and TCEQ SOP</i>	<i>00010</i>	<i>NA</i>	<i>10</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>Secchi Depth</i>	<i>meters</i>	<i>Secchi disc</i>	<i>TCEQ SOP</i>	<i>00078</i>	<i>NA</i>	<i>20</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>Days since last significant rainfall</i>	<i>days</i>		<i>TCEQ SOP</i>	<i>72053</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>Flow</i>	<i>cfs</i>		<i>TCEQ SOP and ADCP</i>	<i>00061</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>
<i>Flow Severity</i>	<i>1-no flow, 2-low,</i>		<i>TCEQ SOP</i>	<i>01351</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>Field</i>

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PARAMETER	UNITS	METHOD TYPE	METHOD	STORET Code	AWRL	PRECISION of laboratory duplicates (RPD)	ACCURACY of matrix spikes % Recovery	AWRL Calibration Standard % Recovery	Laboratory Performing Analysis
	3-normal, 4-flood, 5-high, 6-dry								
TSS	mg/L	gravimetric	EPA 160.2	00530	4.0	20	NA	NA	SATL
TOC	mg/L	combustion-infrared	SM 5310B	00680					SATL
Alkalinity	mg/L	titrimetric	EPA 310.1	00410	10	10	80-120	NA	SATL
Sulfate	mg/L	turbidimetric	EPA 375.4	00945	10	10	80-120	75-125	SATL
Chloride	mg/L	titrimetric	SM 4500	00940	10	10	80-120	75-125	SATL
Ammonia-N	mg/L	titrimetric	EPA 350.2	00610	0.06	10	80-120	75-125	SATL
O-phosphate-P	mg/L	colorimetric	EPA 365.2	00671	0.04	10	80-120	75-125	SATL
Nitrate/nitrite-N	mg/L	spectro-photometer	EPA 353.3	00631	0.04	10	80-120	75-125	SATL
Total Phosphorus	mg/L	colorimetric	EPA 365.2	00665	0.04	10	80-120	75-125	SATL
Total Kjeldahl Nitrogen	mg/L	ion selective electrode	EPA 351.3	00625	0.2	10	80-120	75-125	SATL
Chlorophyll-A	ug/L	colorimetric	SM 10200-H	32211	5.0	20	NA	75-125	SATL
Phaeophytin-A	ug/L	colorimetric	SM 10200-H	32218	3.0	20	NA	75-125	SATL
CBOD	mg/L	incubation	EPA 405.1	00307	2.0	10	NA	N/A	SATL
E-coli	Cfu/100 ml	IDEXX	MPN	31699	N/A	N/A	N/A	N/A	Field

SATL: San Antonio Testing Laboratory\

AWRL: Ambient Water Reporting Limit

RESULTS

Three Assessment Units (AU) were identified for impairment verification in this study, one of the units spans the entire water body for Elm Creek, and the other two are located on Sandies Creek. The 24-hour, dissolved-oxygen average values (Table 7) collected during this project for the three AUs were plotted against time with the TCEQ standard of 5 mg/L for high aquatic life use as benchmark (Figures 11, 12, and 13). Out of a total of 78 samples collected on Sandies and Elm Creek, 41 samples had dissolved oxygen values below the average criterion (5 mg/L). Similarly, 21 of the 78 samples (Table 8) were below the TCEQ minimum criteria of 3 mg/L (Figures 14, 15, and 16). E-coli values for the three assessment units (Table 9) were plotted against the TCEQ single sample exceedance of 394 cfu/100 mL (Figure 18, 19, and 20). Out of the 80 bacteriological samples taken at these stations, 14 exceeded the standard. The geometric mean for each assessment unit was calculated (Table 9) and plotted against the TCEQ standard of 126 (Figure 21, 22 and 23). Six out of the seven stations sampled exceeded the TCEQ standard. Statistics for the non-critical field and laboratory parameters are presented in Tables 10 and 11, respectively.

Table 7. Statistics for 24-hour DO average values.

Assessment Unit	Station Identification	Number of Samples	Mean Value	Standard Deviation	Maximum Value	Minimum Value
1803A_01	17894	15	4.49	1.74	7.78	1.98
1803A_01	17893	6	3.25	1.30	5.48	2.06
1803A_01	15997	3	3.19	2.17	5.42	1.09
1803B_01	13657	15	5.19	2.03	8.87	2.39
1803B_01	14935	13	6.17	1.71	9.48	4.20
1803B_02	17895	15	4.14	2.29	9.25	1.75
1803B_02	17901	11	5.99	1.49	8.26	3.08

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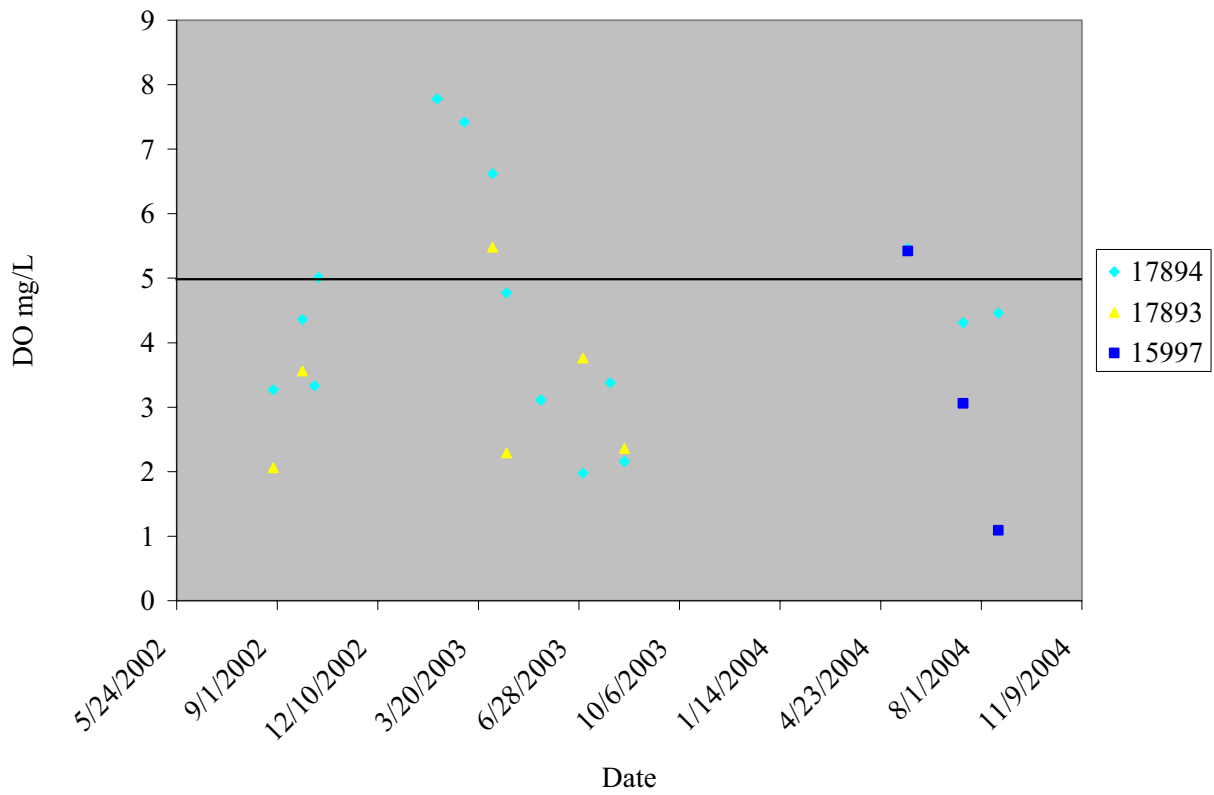


Figure 11. Plot of average 24-hour DO measurements at Elm Creek Assessment Unit 1

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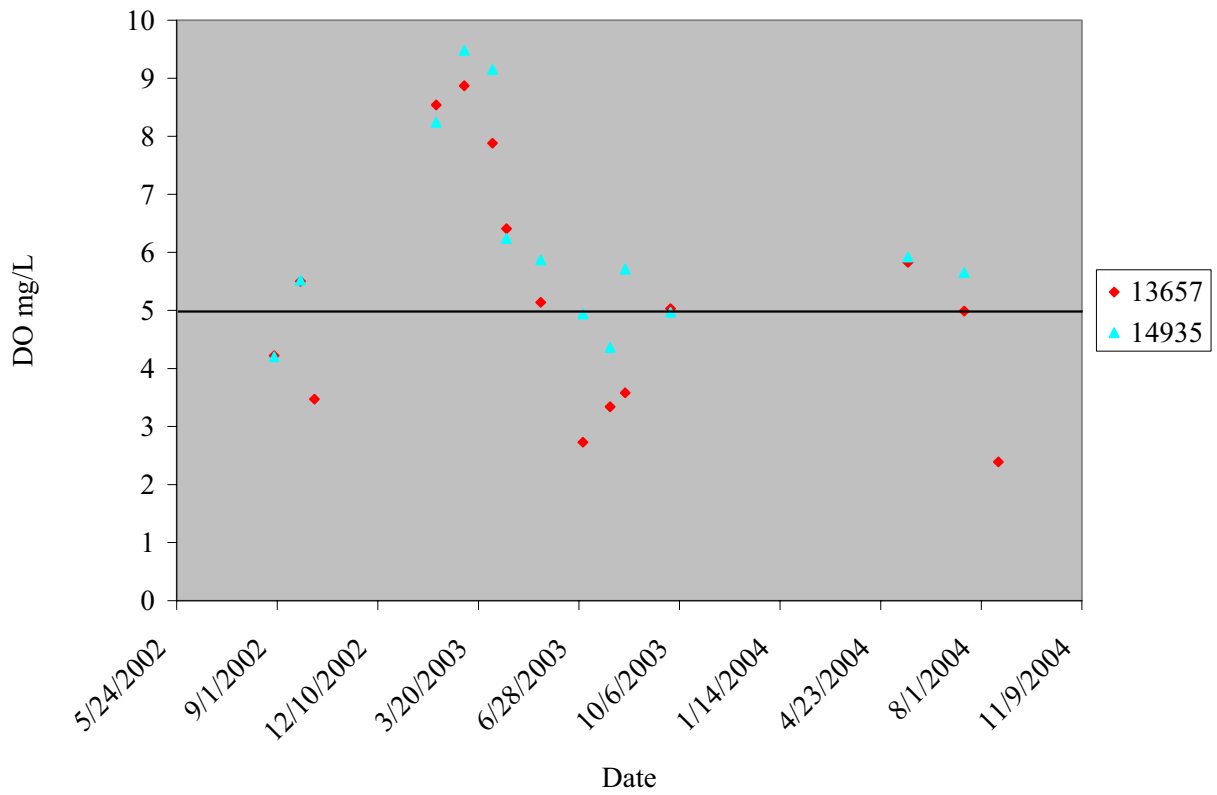


Figure 12. Plot of average 24-hour DO measurements at Sandies Creek Assessment Unit 1

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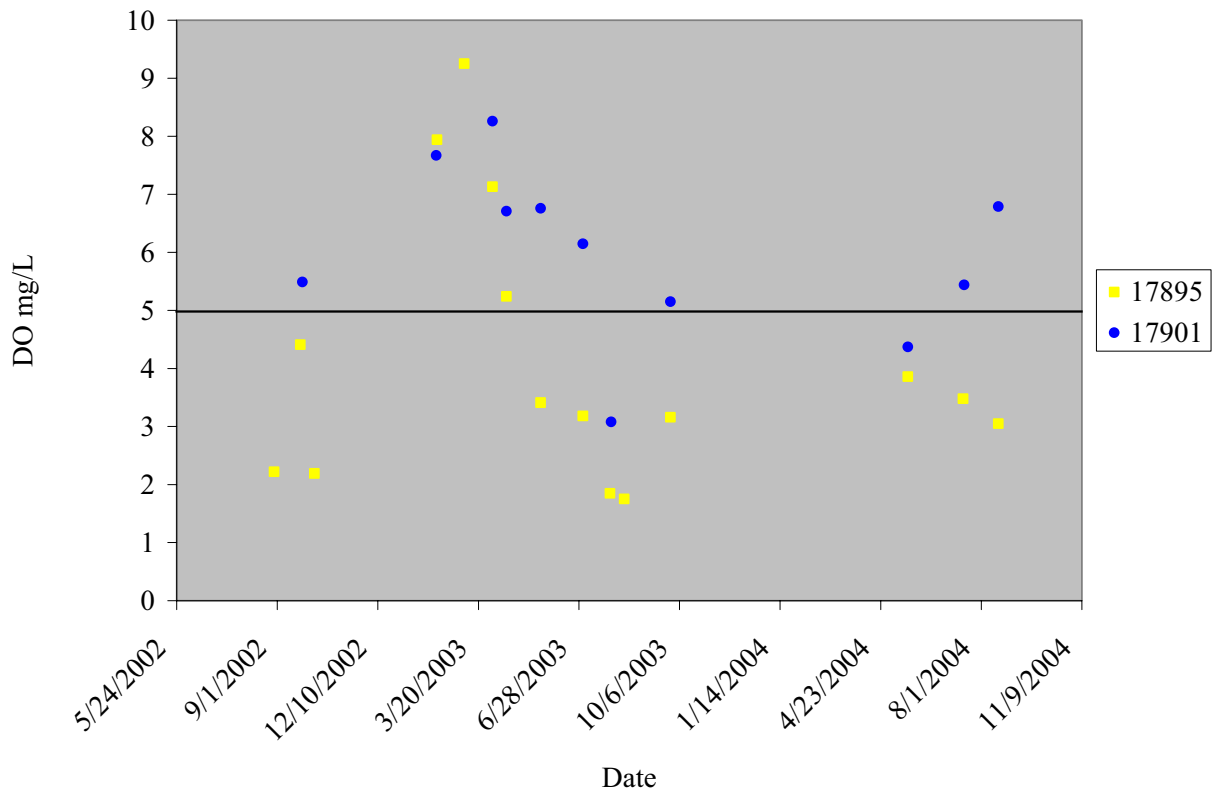


Figure 13. Plot of average 24-hour DO measurements at Sandies Creek Assessment Unit 2

Table 8. Statistics for 24-hour DO Minimum Values

Assessment Unit	Station Identification	Number of Samples	Mean Value	Standard Deviation	Maximum Value	Minimum Value
1803A_01	17894	15	3.86	1.83	7.42	1.38
1803A_01	17893	6	1.70	1.45	3.91	0.51
1803A_01	15997	3	2.73	2.46	5.17	0.26
1803B_01	13657	15	4.65	2.18	8.76	1.28
1803B_01	14935	13	5.66	1.66	9.39	3.47
1803B_02	17895	15	3.85	2.32	9.02	1.30
1803B_02	17901	11	3.92	1.56	6.97	1.47

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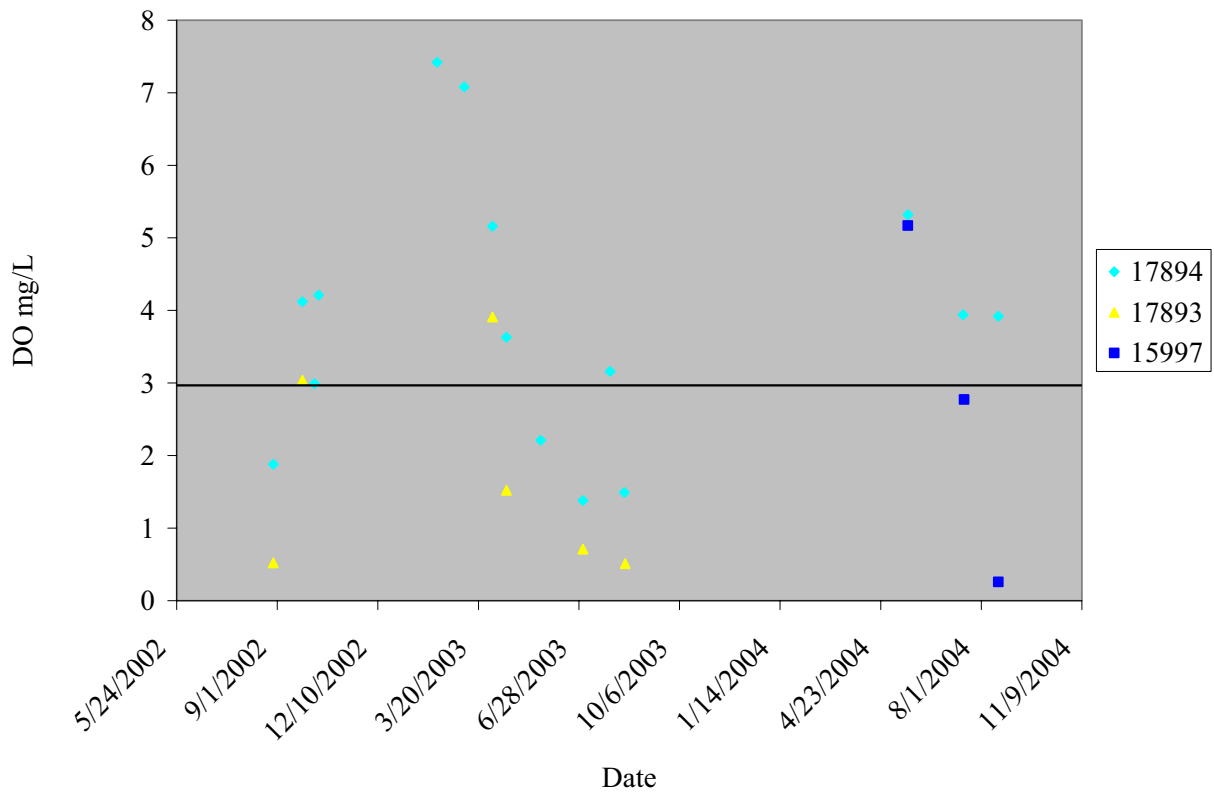


Figure 14. Plot of Minimum 24-hour DO values at Elm Creek Assessment Unit 1

Impairment Verification Monitoring—Volume 1: Physical, and Chemical Components
Segment 1803A&B Sandies and Elm Creek

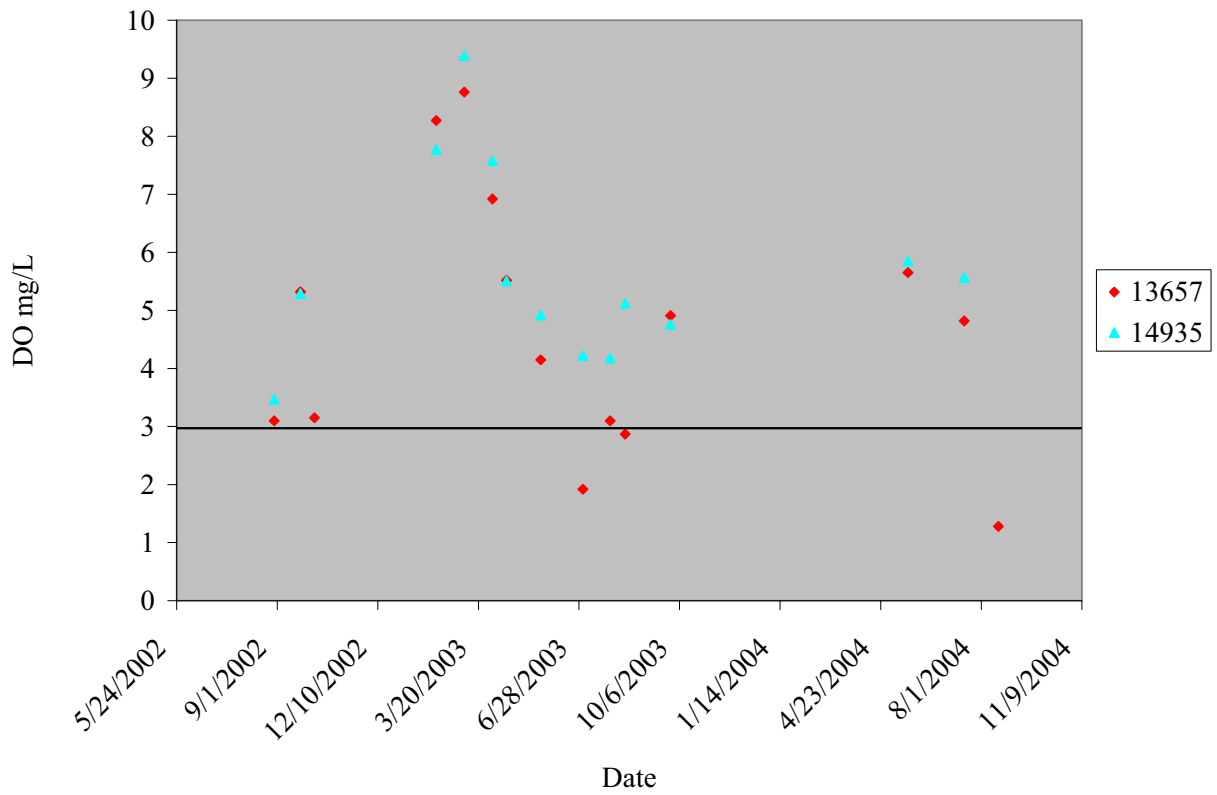


Figure 16. Plot of Minimum 24-hour DO values at Sandies Creek Assessment Unit 1

Impairment Verification Monitoring—Volume 1: Physical, and Chemical Components
Segment 1803A&B Sandies and Elm Creek

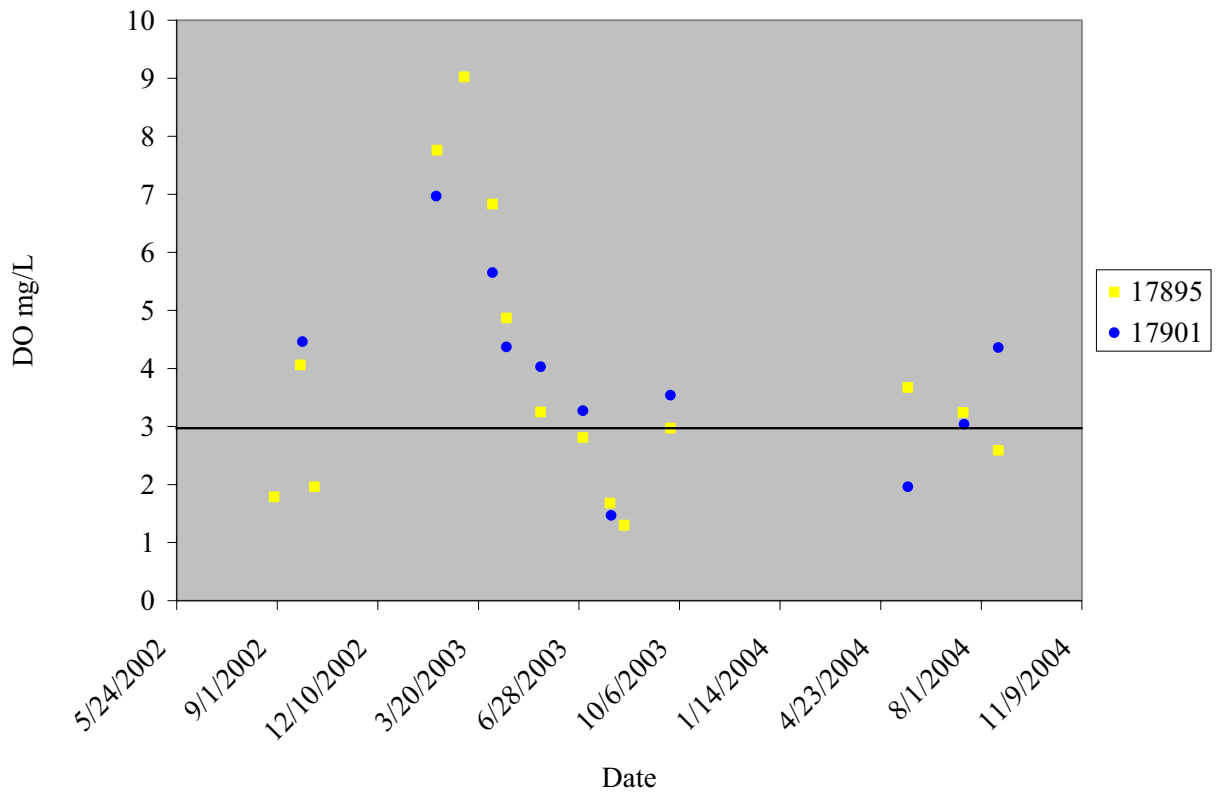


Figure 17. Plot of Minimum 24-hour DO values at Sandies Creek Assessment Unit 2

Table 9. Statistics for E-coli values.

Assessment Unit	Station Identification	Number of Samples	Mean Value	Standard Deviation	Maximum Value	Minimum Value	Geometric Mean
1803A_01	17894	15	304.95	635.23	>2419.2	5.20	70.95
1803A_01	17893	8	306.63	179.73	686.70	95.90	265.10
1803A_01	15997	3	254.67	162.00	440.00	140.00	224.63
1803B_01	13657	14	450.84	155.35	>2419.20	17.30	155.35
1803B_01	14935	14	348.47	608.58	>2419.20	66.00	193.58
1803B_02	17895	14	312.81	622.20	>2419.20	46.00	138.68
1803B_02	17901	12	271.43	286.73	1046.20	5.20	135.85

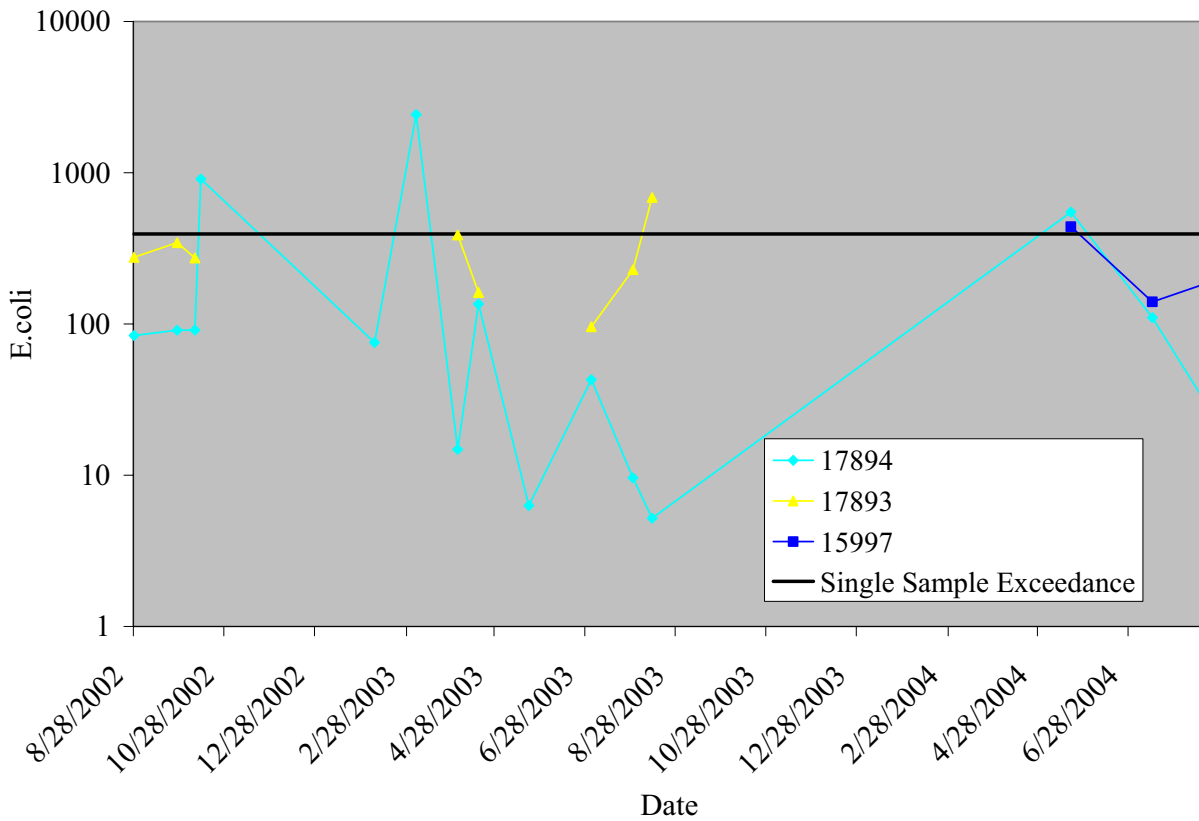


Figure 18. Plot of single sample exceedance of E-coli values for Elm Creek Assessment Unit 1

Impairment Verification Monitoring—Volume 1: Physical, and Chemical Components
Segment 1803A&B Sandies and Elm Creek

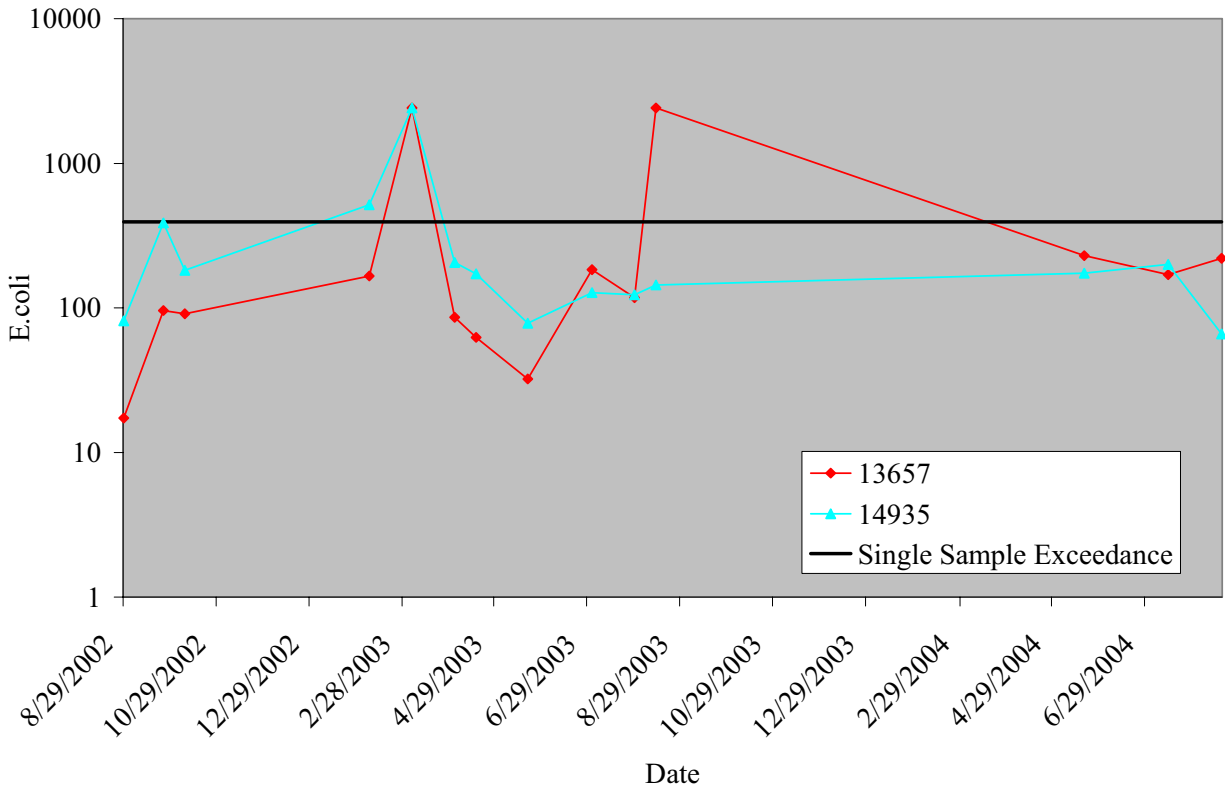


Figure 19. Plot of single sample exceedance of E-coli values for Sandies Creek Assessment Unit 1

Impairment Verification Monitoring—Volume 1: Physical, and Chemical Components
Segment 1803A&B Sandies and Elm Creek

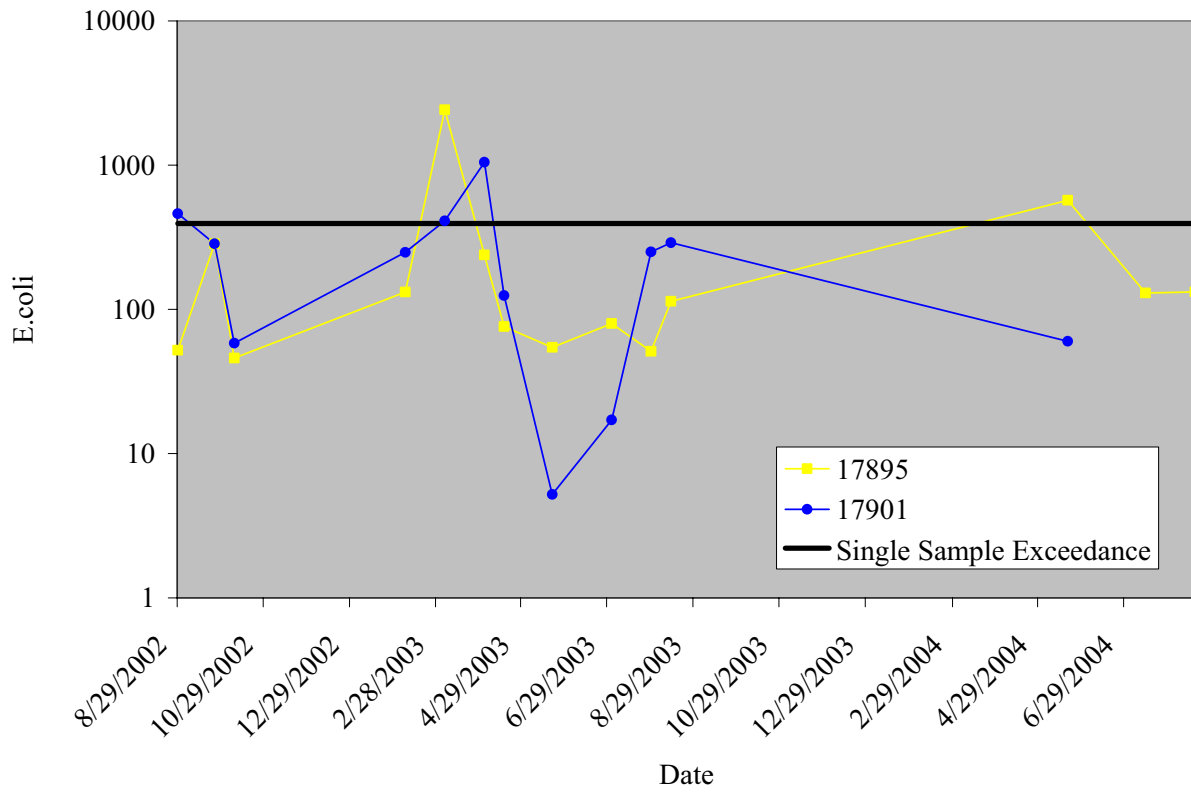


Figure 20. Plot of single sample exceedance of E-coli values for Sandies Creek Assessment Unit 2

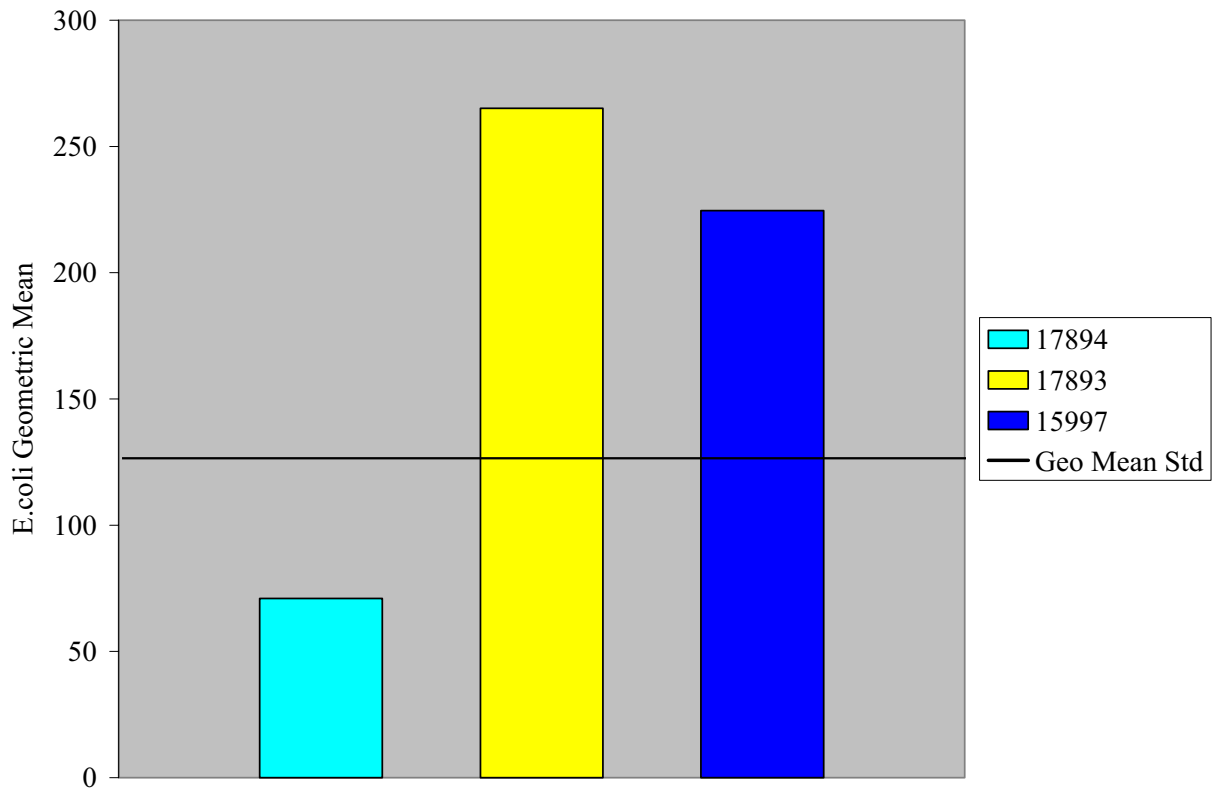


Figure 21. Plot of geometric mean exceedance of E-coli values for Elm Creek Assessment Unit 1

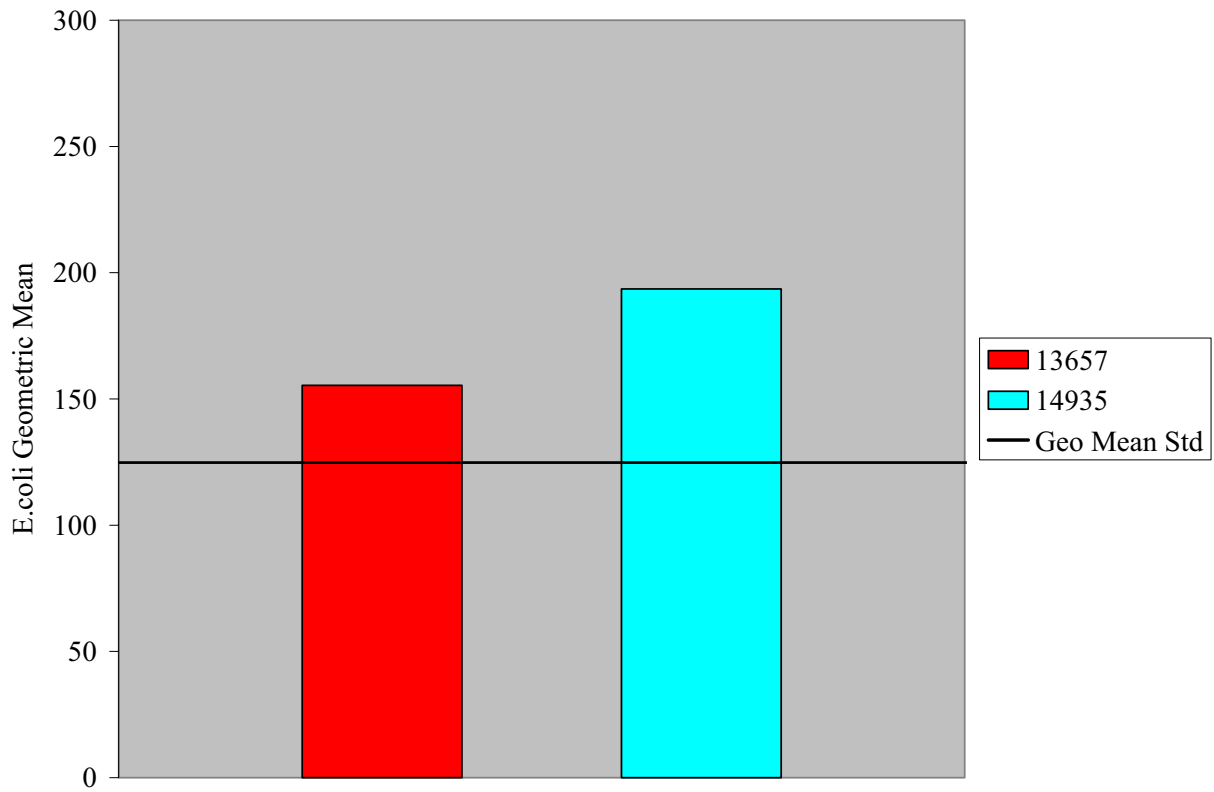


Figure 22. Plot of geometric mean exceedance of E-coli values for Sandies Creek Assessment Unit 1

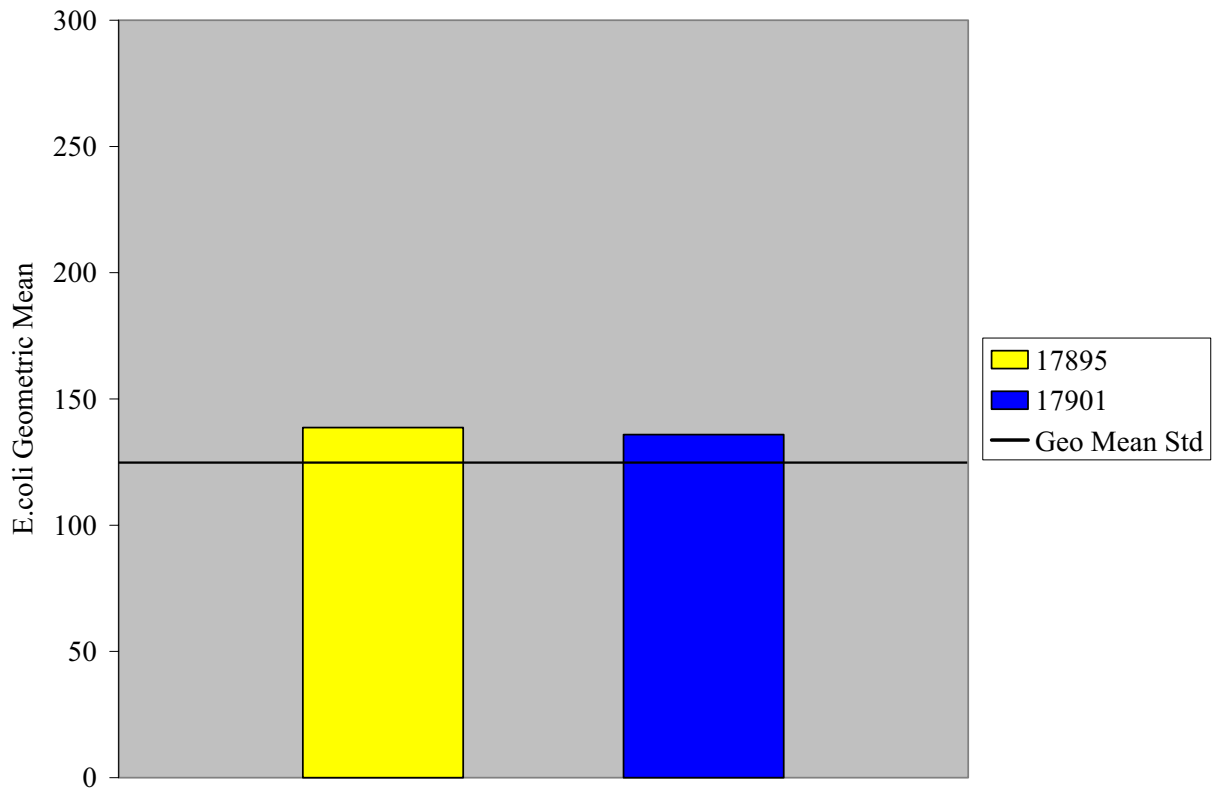


Figure 23. Plot of geometric mean exceedance of E-coli values for Sandies Creek Assessment Unit 2

Impairment Verification Monitoring—Volume 1: Physical, and Chemical Components
Segment 1803A&B Sandies and Elm Creek

Table 10. Statistics for non-critical field parameters

Station Identification	Parameters	Number of Samples	Mean Value	Standard Deviation	Maximum Value	Minimum Value
17894	Temp (Celsius)	15	22.51	4.76	27.29	11.52
17893	Temp (Celsius)	8	23.88	2.62	27.28	19.25
15997	Temp (Celsius)	3	24.76	1.78	26.51	22.95
13657	Temp (Celsius)	14	22.73	4.76	27.73	12.55
14935	Temp (Celsius)	13	22.63	4.78	27.16	12.50
17895	Temp (Celsius)	15	22.68	4.62	27.68	12.49
17901	Temp (Celsius)	12	24.71	5.30	32.00	13.21
17894	pH	14	7.57	0.29	8.02	6.96
17893	pH	8	7.65	0.20	8.02	7.39
15997	pH	3	7.25	0.17	7.43	7.09
13657	pH	14	7.68	0.49	8.91	7.07
14935	pH	10	7.73	0.26	7.99	7.07
17895	pH	15	7.51	0.26	8.03	6.93
17901	pH	11	7.61	0.35	8.12	6.92
17894	Spot DO (mg/L)	15	4.06	1.71	7.59	1.86
17893	Spot DO (mg/L)	7	2.62	1.33	4.75	1.02
15997	Spot DO (mg/L)	3	3.23	2.49	5.39	0.51
13657	Spot DO (mg/L)	14	5.05	2.10	8.86	2.12
14935	Spot DO (mg/L)	13	5.80	1.66	9.46	3.53
17895	Spot DO (mg/L)	15	3.99	2.29	9.18	1.52
17901	Spot DO (mg/L)	11	5.85	2.04	8.88	2.22
17894	Specific Conductivity (microsiemens/cm)	11	1012.00	595.48	1980.00	288.00
17893	Specific Conductivity (microsiemens/cm)	8	795.50	216.52	1111.00	378.00
15997	Specific Conductivity (microsiemens/cm)	3	398.00	132.32	544.00	286.00
13657	Specific Conductivity (microsiemens/cm)	14	1154.86	620.68	2071.00	350.00
14935	Specific Conductivity (microsiemens/cm)	9	912.22	342.97	1491.00	434.00
17895	Specific Conductivity (microsiemens/cm)	11	1069.64	279.11	1507.00	672.00
17901	Specific Conductivity (microsiemens/cm)	10	1019.00	363.21	1621.00	526.00
17894	24hr DO Max (mg/L)	15	5.52	1.75	8.65	2.87
17893	24hr DO Max (mg/L)	6	5.30	2.24	9.25	3.72
15997	24hr DO Max (mg/L)	3	3.80	1.85	5.64	1.95
13657	24hr DO Max (mg/L)	15	6.00	2.04	9.37	3.33
14935	24hr DO Max (mg/L)	13	6.94	1.79	10.81	4.65
17895	24hr DO Max (mg/L)	15	4.55	2.20	9.61	2.63
17901	24hr DO Max (mg/L)	11	8.69	1.88	11.88	5.49
17894	Flow (cfs)	11	2.39	3.13	11.03	0.17
17893	Flow (cfs)	6	0.55	0.34	1.03	0.15
15997	Flow (cfs)	1	5.62	0.00	5.62	5.62
13657	Flow (cfs)	15	46.73	114.80	456.00	2.84
14935	Flow (cfs)	3	13.28	10.63	22.93	2.67
17895	Flow (cfs)	13	4.15	2.34	10.84	1.16
17901	Flow (cfs)	8	0.60	0.73	1.78	0.042

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Table 11. Statistics for laboratory parameters

Station Identification	Parameter	Number of Samples	Mean Value	Standard Deviation	Maximum Value	Minimum Value
17894	Alkalinity (mg/L)	15	202.69	134.26	460.00	40.79
17893	Alkalinity (mg/L)	8	262.97	139.64	481.48	51.18
15997	Alkalinity (mg/L)	3	118.00	36.17	156.00	84.00
13657	Alkalinity (mg/L)	14	151.24	91.18	298.70	24.36
14935	Alkalinity (mg/L)	14	216.93	105.03	480.00	66.70
17895	Alkalinity (mg/L)	14	156.53	67.45	232.73	2.30
17901	Alkalinity (mg/L)	12	161.82	40.54	247.05	110.97
17894	Chloride (mg/L)	15	119.38	94.48	301.62	10.60
17893	Chloride (mg/L)	8	75.26	22.12	102.97	38.41
15997	Chloride (mg/L)	3	46.67	21.55	71.00	30.00
13657	Chloride (mg/L)	14	178.54	86.24	306.05	57.00
14935	Chloride (mg/L)	14	132.01	63.22	264.70	44.28
17895	Chloride (mg/L)	14	143.58	55.39	259.62	71.18
17901	Chloride (mg/L)	12	165.44	67.63	255.84	71.00
17894	Sulfate (mg/L)	15	52.64	53.72	179.00	7.20
17893	Sulfate (mg/L)	8	60.43	99.62	296.00	5.20
15997	Sulfate (mg/L)	3	29.73	4.35	34.00	25.30
13657	Sulfate (mg/L)	14	112.99	114.44	429.00	7.20
14935	Sulfate (mg/L)	14	74.52	72.39	275.00	7.20
17895	Sulfate (mg/L)	14	118.40	57.47	233.59	62.00
17901	Sulfate (mg/L)	12	161.67	55.18	229.19	56.80
17894	TSS (mg/L)	3	92.00	65.96	162.00	31.00
17893	TSS (mg/L)	N/A	N/A	N/A	N/A	N/A
15997	TSS (mg/L)	3	37.67	18.90	59.00	23.00
13657	TSS (mg/L)	4	61.50	27.60	96.00	33.00
14935	TSS (mg/L)	4	60.25	18.59	84.00	44.00
17895	TSS (mg/L)	4	43.75	10.50	56.00	31.00
17901	TSS (mg/L)	4	50.00	28.54	83.00	15.00
17894	Ammonia (mg/L)	15	0.47	0.46	<1.00	<0.03
17893	Ammonia (mg/L)	8	1.12	1.42	4.46	0.086
15997	Ammonia (mg/L)	3	0.00	<0.03	<0.03	<0.03
13657	Ammonia (mg/L)	14	0.56	0.47	<1.00	<0.03
14935	Ammonia (mg/L)	14	0.56	0.47	<1.00	<0.03
17895	Ammonia (mg/L)	14	0.57	0.46	<1.00	<0.03
17901	Ammonia (mg/L)	12	0.58	0.45	<1.00	<0.03
17894	Phosphate (mg/L)	14	47.83	178.21	667.00	<0.01
17893	Phosphate (mg/L)	8	84.27	237.88	673.00	0.051
15997	Phosphate (mg/L)	3	0.086	0.041	0.128	0.047
13657	Phosphate (mg/L)	13	30.28	108.08	390.00	<0.01
14935	Phosphate (mg/L)	13	28.64	101.96	368.00	<0.01
17895	Phosphate (mg/L)	13	14.58	51.81	187.00	<0.01
17901	Phosphate (mg/L)	11	5.55	17.73	59.00	<0.01
17894	Orthophosphate (mg/L)	15	0.14	0.11	0.45	0.02
17893	Orthophosphate (mg/L)	3	0.086	0.032	0.130	0.042
15997	Orthophosphate (mg/L)	3	0.050	0.022	0.075	0.035
13657	Orthophosphate (mg/L)	14	0.23	0.10	0.39	0.088
14935	Orthophosphate (mg/L)	14	0.18	0.09	0.31	0.03
17895	Orthophosphate (mg/L)	14	0.13	0.08	0.28	<0.01
17901	Orthophosphate (mg/L)	12	0.04	0.03	0.11	<0.01

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17894	TKN (mg/L)	14	0.67	0.43	<1.00	<0.05
17893	TKN (mg/L)	8	0.87	0.24	<1.00	0.373
15997	TKN (mg/L)	3	<0.05	0.00	<0.05	<0.05
13657	TKN (mg/L)	13	0.69	0.43	<1.00	<0.05
14935	TKN (mg/L)	13	0.62	0.45	<1.00	<0.05
17895	TKN (mg/L)	13	0.69	0.43	<1.00	<0.05
17901	TKN (mg/L)	11	0.72	0.44	<1.00	<0.05
17894	TOC (mg/L)	15	23.08	37.52	158.00	8.10
17893	TOC (mg/L)	8	9.55	6.45	23.10	<1.00
15997	TOC (mg/L)	3	54.53	72.29	138.00	12.30
13657	TOC (mg/L)	15	19.83	35.48	147.00	5.50
14935	TOC (mg/L)	15	16.92	31.67	130.00	<1.00
17895	TOC (mg/L)	15	15.68	30.13	124.00	4.34
17901	TOC (mg/L)	13	20.27	40.07	153.00	4.59
17894	Chlorophyll A (ug/L)	15	3.15	4.01	10.10	<0.25
17893	Chlorophyll A (ug/L)	8	3.14	6.21	18.20	<0.25
15997	Chlorophyll A (ug/L)	3	10.30	12.11	24.00	<1.00
13657	Chlorophyll A (ug/L)	15	2.25	3.67	<10.00	<0.25
14935	Chlorophyll A (ug/L)	15	2.18	3.39	<10.00	<0.25
17895	Chlorophyll A (ug/L)	15	1.97	3.41	<10.00	<0.25
17901	Chlorophyll A (ug/L)	13	3.23	4.67	13.90	<0.25
17894	Phenophytin A (ug/L)	15	2.35	2.47	6.00	<0.25
17893	Phenophytin A (ug/L)	8	2.20	3.67	9.30	<0.25
15997	Phenophytin A (ug/L)	3	4.30	1.83	5.90	2.30
13657	Phenophytin A (ug/L)	15	1.31	1.72	<5.00	<0.25
14935	Phenophytin A (ug/L)	14	1.23	1.71	<5.00	<0.25
17895	Phenophytin A (ug/L)	15	1.83	2.31	6.9	<0.20
17901	Phenophytin A (ug/L)	13	2.64	3.85	12.80	<0.25
17894	Nitrate/Nitrite (mg/L)	15	0.37	0.53	<2.00	<0.02
17893	Nitrate/Nitrite (mg/L)	8	0.60	0.64	<2.00	0.05
15997	Nitrate/Nitrite (mg/L)	3	<0.05	0.00	<0.05	0.05
13657	Nitrate/Nitrite (mg/L)	14	0.37	0.51	<2.00	<0.02
14935	Nitrate/Nitrite (mg/L)	14	0.44	0.49	<2.00	0.04
17895	Nitrate/Nitrite (mg/L)	14	0.37	0.52	<2.00	<0.02
17901	Nitrate/Nitrite (mg/L)	12	1.87	6.09	21.20	<0.01

DISCUSSION

Water quality assessment has improved dramatically with introduction of new analytical techniques and methodologies. These include the development of Assessment Units, the use of the binomial approach for data analysis, the transition from fecal coliform to e-coli as a bacterial indicator, and the use of 24-hour dissolved oxygen measurements. The most significant improvements directly related to data collected on Segments 1803A&B is the use of 24-hour dissolved-oxygen averages in place of the (historical) instantaneous measurements, and the use of E.coli as a bacterial indicator. The 24-hour average dissolved oxygen measurements provide a more accurate representation of the true health of the stream in relation to dissolved oxygen levels. In addition, the use of this parameter allows for a more realistic comparison to the 24-hour criteria. The results from the physical, chemical, and bacterial data collected by the TAMUK/CBI team on Sandies and Elm Creek indicate impairment due to depressed levels of dissolved oxygen and increased levels of bacteria in the water. Of the 78 24-hour dissolved oxygen samples taken, 41 had an average value that exceeded the TCEQ average criteria, and 21 exceeded the TCEQ minimum criteria associated with a “high aquatic life use”. A total of 14 of the 80 e-coli samples collected exceeded the single sample exceedance criteria associated with contact recreation use, and six of the seven stations sampled yielded e-coli geometric means that exceeded the standard set by TCEQ for contact recreation. As a result of these findings, Sandies and Elm will continue to be designated as impaired due to non-support of aquatic life use resulting from depressed dissolved oxygen and non-support of contact recreation due to elevated levels of bacteria in the streams.

ESTABLISHING A TMDL FOR SANDIES AND ELM CREEK

Currently, Texas Engineering Experiment Station (TEES) and the TCEQ are in the process of establishing a TMDL for Sandies and Elm Creek. A TMDL determines the maximum amount of a pollutant a water body can receive and still maintain its uses. The allowable amount of the specific pollutant is determined as a load and is allocated across the sources within the watershed. Impaired water bodies are included in Category 5a of the 303(d) list. These waterbodies are categorized by the fact that a TMDL is underway, scheduled or will be scheduled in the future.

Main Elements of a TMDL

- Problem Definition
- Endpoint Identification
- Source Analysis
- Linkage between sources and receiving waters
- Margin of Safety
- Pollutant load allocation (point, non-point, and natural)

In the case of Sandies and Elm, the project team is currently in the development stages for a TMDL for dissolved oxygen and bacteria. This process includes the collection of event based monitoring data for the streams, establishing a stakeholder steering committee for the watershed, and the development of water quality and watershed models for simulating pollutant loading scenarios. The end result of this process will be the development of the TMDL which will

provide a plan to restore impaired uses. Following the approval of the TMDL an Implementation Plan (IP) or Watershed Restoration Plan (WRP) is then developed. IPs are remedial actions for impaired waters and are based on TMDLs while WRPs may be either remedial or preventative and use other measurable goals for water quality. Both have the same goal of improving water quality within the stream and involve both regulatory and voluntary actions for success.

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ACKNOWLEDGEMENTS

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Appendix A
Fact Sheets

Elm Creek (unclassified water body)

Segment: 1803A Guadalupe River Basin

Basin number:	18
Basin group:	E
Water body description:	From the confluence of Sandies Creek east of Smiley in Gonzales County to the upstream perennial portion of the stream southwest of Smiley in Gonzales County
Water body classification:	Unclassified
Water body type:	Freshwater Stream
Water body length / area:	24.3 Miles
Water body uses:	Aquatic Life Use, Contact Recreation Use, Fish Consumption Use

Standards Not Met and Concerns in Previous Years:				
Assessment Area	Use	Support Status or Concern	Parameter	Category
Entire water body	Aquatic Life Use	Not Supporting	depressed dissolved oxygen	5b
Entire water body	Contact Recreation Use	Not Supporting	bacteria	5c

Additional Information: The fish consumption use was not assessed.

This water body was identified on the 2000 303(d) List as not supporting the contact recreation use due to bacteria. Because there were insufficient data available in 2002 to evaluate changes in water quality, this water body will be identified as not meeting the standard for bacteria until sufficient data are available to demonstrate use support. There were insufficient data for 2004.

This water body was also identified on the 2000 303(d) List as not supporting the aquatic life use due to depressed dissolved oxygen. Because an insufficient number of 24-hour dissolved oxygen values were available to determine if the criterion is supported, this water body will be identified as not meeting the standard for dissolved oxygen until sufficient 24-hour measurements are available to demonstrate support of the criterion. There were insufficient 24-hour data for 2004.

2004 Concerns:			
Assessment Area	Use or Concern	Concern Status	Description of Concern
Entire water body	Narrative Criteria Concern	Concern	depressed dissolved oxygen

Monitoring sites used:		
Assessment Area	Station ID	Station Description
Entire water body	15996	ELM CREEK AT GONZALES CR108, APPROX. 1.7KM SOUTH OF
Entire water body	15997	ELM CREEK AT GONZALES CR534, APPROX. 6.7KM ESE OF NIXON

Segment ID: 1803A Water body name: Elm Creek (unclassified water body)

Freshwater Stream Total size: 24.3 Miles

Guadalupe River Basin

Assessment Year	Assessment Method	Status of Use Support or Concern	Location	Location size	# of samples	# of exceedances	Mean
Aquatic Life Use							
2002	Dissolved Oxygen grab average	Not Assess-Not Represent	Entire water body	24.3	15	9	
2002	Dissolved Oxygen grab minimum	Not Assess-Not Represent	Entire water body	24.3	15	3	
2002	Dissolved Oxygen 24hr average	Not Assessed	Entire water body	24.3	0		
2002	Dissolved Oxygen 24hr minimum	Not Assessed	Entire water body	24.3	0		
2002	Overall Aquatic Life Use	Not Assessed	Entire water body	24.3			

Contact Recreation Use

2002	E. coli single sample	Not Assessed	Entire water body	24.3	0		
2002	E. coli geometric mean	Not Assessed	Entire water body	24.3	0		
2002	Fecal coliform single sample	Not Assess-Not Represent	Entire water body	24.3	4	1	
2002	Fecal coliform geometric mean	Not Assess-Not Represent	Entire water body	24.3	4		91
2002	Overall Recreation Use	Not Assessed	Entire water body	24.3			

Fish Consumption Use

2002	Overall Fish Consumption Use	Not Assessed	Entire water body	24.3			
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Overall Use Support

2002		Not Assessed	Entire water body	24.3			
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Segment ID: 1803A Water body name: Elm Creek (unclassified water body)

Freshwater Stream Guadalupe River Basin

Total size: 24.3 Miles

Assessment Year	Assessment Method	Status of Use Support or Concern	Location	Location size	# of samples	# of exceedances	Mean
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Nutrient Enrichment Concern

2002	Ammonia Nitrogen	Not Assess-Not Represent	Entire water body	24.3	18	18	
2002	Nitrite + Nitrate Nitrogen	Not Assess-Not Represent	Entire water body	24.3	18	0	
2002	Orthophosphorus	Not Assessed	Entire water body	24.3	0		
2002	Total Phosphorus	Not Assessed	Entire water body	24.3	0		
2002	Overall Nutrient Enrichment Concerns	Not Assessed	Entire water body	24.3			

Algal Growth Concern

2002	Chlorophyll a	Not Assess-Not Represent	Entire water body	24.3	18	4	
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Sediment Contaminants Concern

2002	Overall Sediment Contaminant Concerns	Not Assessed	Entire water body	24.3			
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Fish Tissue Contaminants Concern

2002	Overall Fish Tissue Contaminant Concerns	Not Assessed	Entire water body	24.3			
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Narrative Criteria Concern

2002	Dissolved Oxygen grab average	Concern	Entire water body	24.3			
2002	Dissolved Oxygen grab minimum	Concern	Entire water body	24.3			
2002	Overall Narrative Criteria Concerns	Concern	Entire water body	24.3			

Segment ID: 1803A Water body name: Elm Creek (unclassified water body)

Freshwater Stream Guadalupe River Basin

Total size: 24.3 Miles

Assessment Year	Assessment Method	Status of Use Support or Concern	Location	Location size	# of samples	# of exceedances	Mean
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Overall Secondary Concern

2002		Concern	Entire water body	24.3			
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Sandies Creek (unclassified water body)

Segment: 1803B Guadalupe River Basin

Basin number: 18
Basin group: E
Water body description: From the confluence of the Guadalupe River west of Cuero in DeWitt County to the upstream perennial portion of the stream northwest of Smiley in Gonzales County
Water body classification: Unclassified
Water body type: Freshwater Stream
Water body length / area: 65 Miles
Water body uses: Aquatic Life Use, Contact Recreation Use, Fish Consumption Use

Standards Not Met in 2004 Assessment Area	Use	Support Status	Parameter	Category
From the confluence with Elm Creek to upper end of water body	Aquatic Life Use	Not Supporting	depressed dissolved oxygen	5a
From the confluence with Elm Creek to upper end of water body	Contact Recreation Use	Not Supporting	bacteria	5a
From the confluence with the Guadalupe River to the confluence with Elm Ck.	Contact Recreation Use	Not Supporting	bacteria	5a

Standards Not Met and Concerns in Previous Years Assessment Area	Use	Support Status or Concern	Parameter	Category
From the confluence with the Guadalupe River to the confluence with Elm Ck.	Aquatic Life Use	Not Supporting	depressed dissolved oxygen	5a

Additional Information: The fish consumption and general uses were not assessed.

2004 Concerns: Assessment Area	Use or Concern	Concern Status	Description of Concern
From the confluence with Elm Creek to upper end of water body	Aquatic Life Use	Use Concern	depressed dissolved oxygen
From the confluence with Elm Creek to upper end of water body	Nutrient Enrichment Concern	Concern	ammonia
From the confluence with the Guadalupe River to the confluence with Elm Ck.	Aquatic Life Use	Use Concern	depressed dissolved oxygen

(based on data from 03/01/1998 to 02/28/2003)

2004 Concerns:			
Assessment Area	Use or Concern	Concern Status	Description of Concern
From the confluence with the Guadalupe River to the confluence with Elm Ck.	Contact Recreation Use	Use Concern	bacteria
From the confluence with the Guadalupe River to the confluence with Elm Ck.	Nutrient Enrichment Concern	Concern	ammonia

Monitoring sites used:		
Assessment Area	Station ID	Station Description
From the confluence with Elm Creek to upper end of water body	15998	SANDIES CREEK AT FM1116, 7.4KM EAST OF SMILEY AND APPROX. 3KM UPSTREAM OF CONFL. WITH ELM CREEK
From the confluence with the Guadalupe River to the confluence with Elm Ck.	13657	SANDIES CREEK 100 FT. DOWNSTREAM OF COUNTY HIGHWAY, 1.9 MI. UPSTREAM FROM BIRDS CREEK, 2.0 MI. NE OF WESTHOFF
From the confluence with the Guadalupe River to the confluence with Elm Ck.	14935	SANDIES CREEK AT CR 953 OM DEWITT COUNTY

Segment ID: 1803B Water body name: Sandies Creek (unclassified water body)

Freshwater Stream **Guadalupe River Basin**

Total size: **65 Miles**

Assessment Year	Assessment Method	Status of Use Support or Concern	Location	Location size	# of samples	# of exceedances	Mean
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Aquatic Life Use

2002	Dissolved Oxygen grab average	Use Concern	From the confluence with Elm Creek to upper end of water body	32	26	10	
2002	Dissolved Oxygen grab average	Use Concern	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	46	16	
2002	Dissolved Oxygen grab minimum	Fully Supporting	From the confluence with Elm Creek to upper end of water body	32	26	1	
2002	Dissolved Oxygen grab minimum	Fully Supporting	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	46	3	
2004	Dissolved Oxygen 24hr average	Not Supporting	From the confluence with Elm Creek to upper end of water body	32	7	5	
2004	Dissolved Oxygen 24hr average	Not Assessed	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	0		
2004	Dissolved Oxygen 24hr minimum	Partially Supporting	From the confluence with Elm Creek to upper end of water body	32	7	4	
2004	Dissolved Oxygen 24hr minimum	Not Assessed	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	0		
2004	Overall Aquatic Life Use	Not Supporting	From the confluence with Elm Creek to upper end of water body	32			
2004	Overall Aquatic Life Use	Fully Supporting	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33			

Contact Recreation Use

2002	E. coli single sample	Fully Supporting	From the confluence with Elm Creek to upper end of water body	32	18	3	
2002	E. coli single sample	Fully Supporting	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	25	5	
2002	E. coli geometric mean	Not Supporting	From the confluence with Elm Creek to upper end of water body	32	18		131

Segment ID: 1803B Water body name: Sandies Creek (unclassified water body)

Freshwater Stream **Guadalupe River Basin** Total size: **65** Miles

Assessment Year	Assessment Method	Status of Use Support or Concern	Location	Location size	# of samples	# of exceedances	Mean
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Contact Recreation Use (continued)

2002	E. coli geometric mean	Not Supporting	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	25		174
2002	Fecal coliform single sample	Not Supporting	From the confluence with Elm Creek to upper end of water body	32	25	10	
2002	Fecal coliform single sample	Use Concern	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	25	7	
2002	Fecal coliform geometric mean	Not Supporting	From the confluence with Elm Creek to upper end of water body	32	25		336
2002	Fecal coliform geometric mean	Not Supporting	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	25		311
2002	Overall Recreation Use	Not Supporting	From the confluence with Elm Creek to upper end of water body	32			
2002	Overall Recreation Use	Not Supporting	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33			

Fish Consumption Use

2002	Overall Fish Consumption Use	Not Assessed	From the confluence with Elm Creek to upper end of water body	32			
2002	Overall Fish Consumption Use	Not Assessed	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33			

Overall Use Support

2004		Not Supporting	From the confluence with Elm Creek to upper end of water body	32			
2004		Not Supporting	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33			

Segment ID: 1803B Water body name: Sandies Creek (unclassified water body)

Freshwater Stream **Guadalupe River Basin**

Total size: **65 Miles**

Assessment Year	Assessment Method	Status of Use Support or Concern	Location	Location size	# of samples	# of exceedances	Mean
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Nutrient Enrichment Concern

2002	Ammonia Nitrogen	Concern	From the confluence with Elm Creek to upper end of water body	32	19	12	
2002	Ammonia Nitrogen	Concern	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	13	5	
2002	Nitrite + Nitrate Nitrogen	No Concern	From the confluence with Elm Creek to upper end of water body	32	27	0	
2002	Nitrite + Nitrate Nitrogen	No Concern	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	25	0	
2002	Orthophosphorus	Not Assessed	From the confluence with Elm Creek to upper end of water body	32	0		
2002	Orthophosphorus	Not Assessed	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	0		
2002	Total Phosphorus	No Concern	From the confluence with Elm Creek to upper end of water body	32	19	1	
2002	Total Phosphorus	No Concern	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	25	3	
2002	Overall Nutrient Enrichment Concerns	Concern	From the confluence with Elm Creek to upper end of water body	32			
2002	Overall Nutrient Enrichment Concerns	Concern	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33			

Algal Growth Concern

2002	Chlorophyll a	No Concern	From the confluence with Elm Creek to upper end of water body	32	27	1	
2002	Chlorophyll a	No Concern	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33	25	2	

Segment ID: 1803B Water body name: Sandies Creek (unclassified water body)

Freshwater Stream **Guadalupe River Basin**

Total size: **65 Miles**

Assessment Year	Assessment Method	Status of Use Support or Concern	Location	Location size	# of samples	# of exceedances	Mean
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Sediment Contaminants Concern

2002	Overall Sediment Contaminant Concerns	Not Assessed	From the confluence with Elm Creek to upper end of water body	32			
2002	Overall Sediment Contaminant Concerns	Not Assessed	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33			

Fish Tissue Contaminants Concern

2002	Overall Fish Tissue Contaminant Concerns	Not Assessed	From the confluence with Elm Creek to upper end of water body	32			
2002	Overall Fish Tissue Contaminant Concerns	Not Assessed	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33			

Narrative Criteria Concern

2002	Overall Narrative Criteria Concerns	No Concern	From the confluence with Elm Creek to upper end of water body	32			
2002	Overall Narrative Criteria Concerns	No Concern	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33			

Overall Secondary Concern

2002		Concern	From the confluence with Elm Creek to upper end of water body	32			
2002		Concern	From the confluence with the Guadalupe River to the confluence with Elm Ck.	33			

Appendix B
Raw Data