Interim Data Report for Tehuacana Creek Segment 1242N in the Brazos River Basin

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Table of Contents

List of Tables

List of Figures

List of Acronyms

Abbreviation	Definition
AFDM	ash free dry mass
ALU	aquatic life use
BIBI	Benthic Index of Biotic Integrity
BOD_5	biochemical oxygen demand (5 day)
BRA	Brazos River Authority
DI	deionized water
DO	dissolved oxygen
FM	Farm-to–Market road
ft	feet
gpm	gallons per minute
HQI	Habitat Quality Index
IBI	Index of Biotic Integrity
km	kilometers
m	meters
MGD	million gallons per day
mg/L	milligrams per liter
mL	milliliters
RWA	receiving water assessment
s	second
SH	State Highway
sp.	species
TCEQ	Texas Commission on Environmental Quality
TPWD	Texas Parks and Wildlife Department
TSS	total suspended solids
US	United States
USEPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
USGS	United States Geological Survey
V	volts

Executive Summary

Tehuacana Creek, located in Hill and McLennan counties, joins the Brazos River east of Waco, Texas. The stream is the main drainage for the eastern part of McLennan County. In 2006 Sanderson Farms, Inc., received an industrial wastewater permit from the Texas Commission on Environmental Quality (TCEQ) to discharge 1.7 million gallons per day (MGD) of treated poultry processing water into the mainstem of Tehuacana Creek. The Texas Parks and Wildlife Department (TPWD) recognized the importance of documenting the change in Tehuacana Creek from intermittent flow with perennial pools to perennial flow downstream of the discharge and planned a special study to evaluate potential effects of the wastewater discharge. The study design included one sampling event to establish a baseline before discharge commenced and one or more sampling events after the discharge is established. Three stations were selected on Tehuacana Creek and assigned TCEQ station identification numbers: one station located upstream of the outfall (Station 18870), and two downstream from the outfall (Stations 18871 and 11610 respectively). The baseline data were collected in September 2006 and are presented in this report. Data collected during the baseline effort included water chemistry, instantaneous physicochemical measurements, fish, benthic macroinvertebrates, habitat, and periphyton.

Sampling conditions were unusual due to a severe drought (TWDB 2006) in the area. The intermittent stream contained large perennial pools that were severely diminished. Water quality and biological communities of the remaining pools were sampled for this event. Dissolved oxygen in the pools ranged from 0.7 to 10.6 mg/L at the time of sampling.

Conditions in the stream made it necessary to modify standard TCEQ habitat assessment protocols, which were developed for flowing streams. An effort was made to include water at each habitat transect so instream habitat parameters could be measured and the data could be used in conjunction with fish and benthic aquatic life use indices. At station 18870, only one of the five habitat transects contained water even with protocol modification. The three stations were evaluated using the TCEQ's Habitat Quality Index (HQI) and ratings ranged from limited (13.5) at station 18870 to intermediate (15 and 16, respectively) at stations 18871 and 11610.

A total of 1,696 fish representing 34 species were collected from the three stations. Fish were collected solely by seine at station 18870 to avoid decimating the fish population in the remaining pool. The decision to omit the electrofishing component of the assessment is reflected in a lower Index of Biological Integrity (IBI) score for the station. IBI scores typically are calculated based on a combination of seining and electrofishing data. The IBI scores for stations 18870, 18871, and 11610 were limited (31), high (44), and exceptional (52) respectively. A receiving water assessment (RWA) conducted by the TCEQ in January 2006 designated the aquatic life use (ALU) as high. The difference between the RWA scores and the limited score from September 2006 can be explained by the stressed environment due to the severe drought, limited sampling methods (no electrofishing), and the approximately 0.3 mi. distance between the RWA station and station 18870. Stations 18871 and 11610 more closely resembled and supported the results found by TCEQ in the January 2006 sampling event based on comparable perennial pool size.

Benthic macroinvertebrates were collected at two of the three stations. Station 18870 lacked suitable habitat for sampling. The Rapid Bioassessment Protocol (RBP) was used to assess the benthic macroinvertebrate data. Benthic macroinvertebrates were collected from snags and aquatic vegetation found within the perennial pools. RBP scores for stations 18871 and 11610 were intermediate (24 and 28 respectively).

Periphyton was collected at each site for chlorophyll-*a* and ash free dry mass (AFDM) analysis. Results did not indicate excessive nutrient enrichment at any of the stations. These findings were consistent with field observations as well as measured dissolved nutrient concentrations.

Although Tehuacana Creek was experiencing dry conditions during September 2006 sampling, the diminished pools supported a robust fish community. IBI scores were high or exceptional at the two stations where both seining and electrofishing were performed. Benthic macroinvertebrate and habitat scores showed more correlation than benthic macroinvertebrates and fish, suggesting that the former components were more affected by dry conditions. When streams are reduced to isolated pools the quality of habitat and available food is also reduced and competition for these resources increases. This phenomenon may explain the lower aquatic life use scores for habitat and benthic invertebrates.

Introduction

In 2006, the Texas Commission on Environmental Quality (TCEQ) granted Sanderson Farms, Inc., a wastewater permit to discharge 1.7 MGD from a poultry processing facility into Tehuacana Creek, located in Hill and McLennan counties near Waco, Texas. The advent of a relatively large permitted discharge into an intermittent stream with perennial pools offered a unique opportunity to evaluate the potential effects on that type of system with a pre- and post-project, upstream and downstream assessment. TPWD's main concerns include nutrient and total suspended solids (TSS) loads which may result from the discharge and dissolved oxygen (DO) levels as they relate to ecosystem health.

A review of historical data from Tehuacana Creek turned up several studies but few publications (Bronson and Radloff 2008). The earliest data available for Tehuacana Creek are from 1958 when the United States Department of Agriculture (USDA) published a work plan for protecting the watershed from erosion during flood events (USDA 1958). Historic rain events in the mid-1950s spurred the 83rd Congress to pass Public Law 566, which provided funding for the USDA to straighten 10 miles of the stream and build flood control dams within the watershed. The Final Environmental Impact Statement published in 1977 provided additional information about the 27 flood control structures built on the tributaries and the mainstem of Tehuacana Creek (USDA 1977). In 1991, TCEQ conducted an intensive survey of Tehuacana Creek. In March and June 1991, seven stations were sampled for instantaneous physicochemical and routine water chemistry parameters along the mainstem and tributaries of Tehuacana Creek (Figure 1). The results of that study are summarized in the historical data review conducted by TPWD (Bronson and Radloff 2008). The most recent study was a TCEQ receiving water assessment (RWA) conducted in 2006 in response to the Sanderson Farms, Inc., industrial wastewater permit application (TCEQ 2006). The RWA classified the stream as having a high aquatic life use based on fish community data.

Currently Tehuacana Creek has one surface water quality monitoring station with long-term data available. Station 15771, at SH 6 four miles north of Riesel, has been monitored routinely under the Clean Rivers Program since 1997. The Brazos River Authority (BRA) currently collects data quarterly. Data from that station were also reviewed in Bronson and Radloff (2008).

Data were collected in 2006 before plant start-up to establish a baseline and update historical studies. Additional data will be collected after plant start-up when the discharge is well established. The baseline data will be compared to data collected after the permitted discharge begins. This interim report presents an overview of the special study project, discusses sampling protocols, and provides data from the baseline sampling effort conducted prior to initiation of the wastewater discharge.

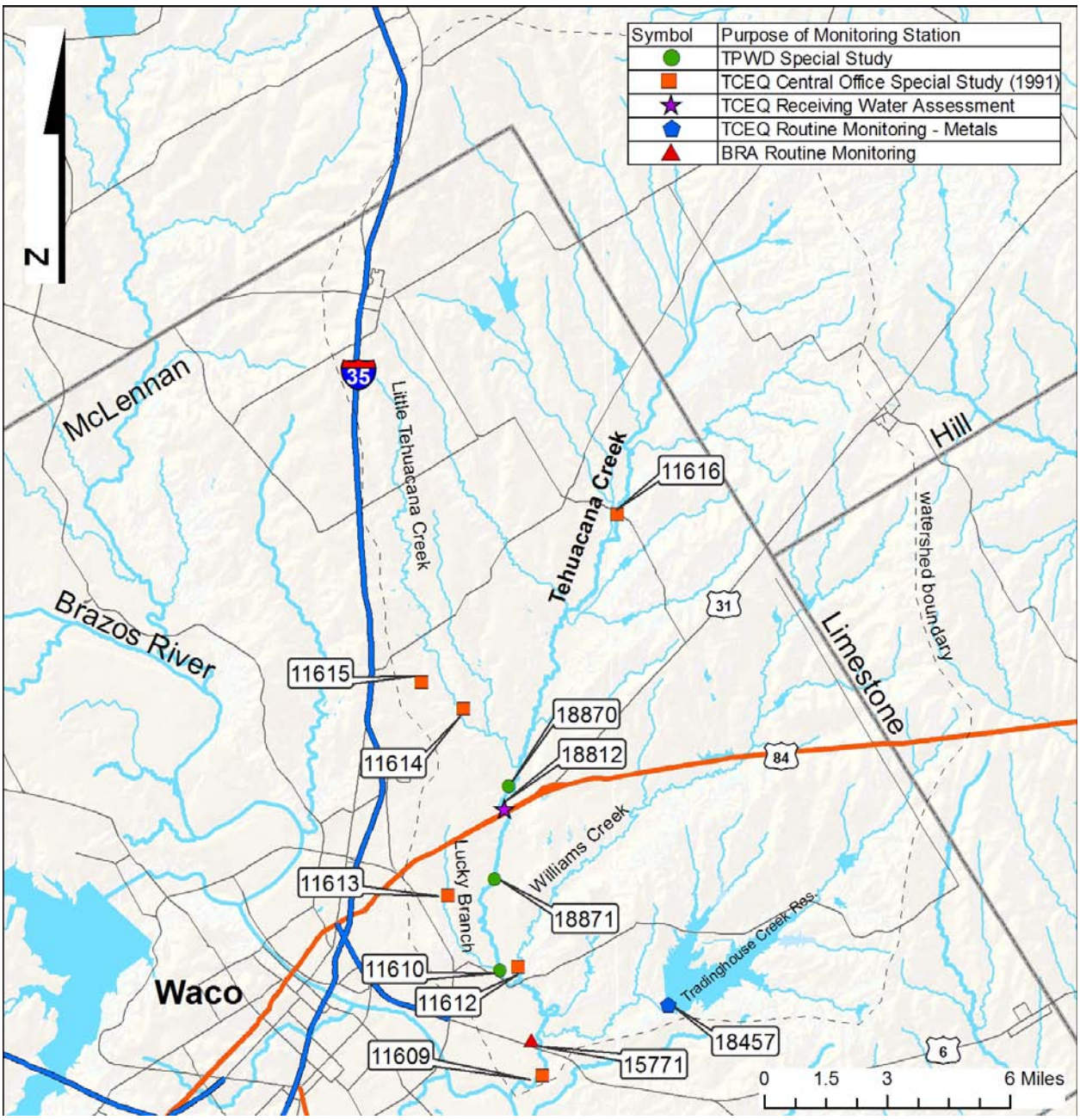

Figure 1. Map of station locations in the Tehuacana Creek watershed.

Project Area

Originating three miles south of Penelope in Hill County, Tehuacana Creek runs for 31 miles through McLennan County to its mouth at the Brazos River (Handbook of Texas 2006a). This intermittent, fourth-order stream (Strahler 1952) with perennial pools resides in Ecoregion 32, the Texas Blackland Prairies (Griffith et al. 2004). The flat-to-rolling terrain along Tehuacana Creek supports mesquite, cacti, water-tolerant hardwoods, conifers, and grasses (Handbook of Texas 2006a). The soils in the watershed consist of rich minerals weathered from limestone, shale, and marl (USDA 1992) and support corn, wheat, hay, grain sorghum, and cotton crops as well as provide rangeland for cattle and poultry (USDA 2002).

The TCEQ listed Tehuacana Creek on the 2002 though 2008 Texas 303(d) lists for nonattainment of the contact recreation use based on high bacteria densities (TCEQ 2005b). Tehuacana Creek receives wastewater discharges from six permitted entities and has three permitted industrial stormwater discharges and a varying number of permitted construction stormwater discharges; stormwater discharges are not shown on Figure 1 for the purpose of clarity. The wastewater discharges into Tehuacana Creek are reviewed in the Historical Review (Bronson and Radloff 2008). Of the six wastewater discharges, two are industrial and four are domestic discharges. Sanderson Farms, Inc. represents one of the two industrial wastewater dischargers and the only wastewater outfall that flows directly into Tehuacana Creek. The Sanderson Farms, Inc. poultry processing plant is located near the intersection of US 84 and Aviation Parkway in Waco. The outfall for the permitted discharge will be just downstream of the confluence of Kirkland Branch and Tehuacana Creek main stem.

In September 2006, Texas Parks and Wildlife Department Water Quality Program staff collected baseline data from three stations on Tehuacana Creek. To evaluate changes to the stream, a control station is located upstream from the permitted discharge (Station 18870), and two stations are located downstream from the discharge location (Station 18871, and Station 11610) (Table 1, Figure 2). At each station, five transects were established, with transect 1 being the most downstream transect.

Table 1. Sampling stations on Tehuacana Creek.

TCEQ Station Number	Nearest Road Crossing	Latitude	Longitude
18870	US 84	31.627246	-97.042440
18871	Old Mexia Road	31.598787	-97.049606
11610	FM 2491	31.564167	-97.048332

Figure 2. Map of Sampling Stations on Tehuacana Creek.

Station 18870, the most upstream station, is located 1.39 km upstream of US 84, 520 m upstream of Kirkland Branch, and approximately 5.1 km east of Lacy-Lakeview (Figure 2). Reach length is 394 m and encompasses five transects, four of which were dry during sampling in September 2006 with the only perennial pool (transect 1) being severely diminished (Figure 3). Determination of reach length and transect locations for all three stations is described in the methods section of this report.

Figure 3. TPWD and TCEQ personnel sampling transect 1 at station 18870 on Tehuacana Creek (September 2006).

Station 18871 is located at Old Mexia Road, 2.71 km downstream of US 84, and approximately 4.57 km east of Bellmead (Figure 4). The reach is 412 m, and each of the five transects encompassed a separate perennial pool. The perennial pool at Transect 3 was severely diminished with an average depth of 0.2 m.

Figure 4. Upstream view of transect 1 at station 18871 on Tehuacana Creek (September 2006).

The most downstream station is 11610 at FM 2491 southeast of Waco. All five transects within the 561 m reach included water. Transects one and two each incorporated a small pool and transects three, four, and five crossed the same large perennial pool (Figure 5).

Figure 5. Upstream view of transect 4 at station 11610 on Tehuacana Creek (September 2006).

Methods

The methods were selected to document the quality and conditions of the stream before and after the permitted discharge begins. Sample collections target general stream health indices, with particular focus on potential changes arising from nutrients and suspended solids loadings. To determine the general stream health, several types of data were collected, including, instantaneous physicochemical measurements, diel physicochemical measurements, water chemistry, flow, habitat, fish, benthic macroinvertebrates, and periphyton.

Staff conducted a reconnaissance trip in early September 2006 to become familiar with the existing habitat and accessibility at each station. During the reconnaissance trip, each station was assessed for the best placement of the stream reach, transects were marked, and latitude and longitude coordinates recorded. The location and length of the reach were based on the existing perennial pools making some reach lengths longer than standard practices. The final reach lengths were determined using field notes and mapping software. Sampling was conducted September 25 - 27, 2006. By the end of September many of the pools had decreased in size or had dried up completely due to drought conditions. The greatest changes were at station 18870 where two of the three perennial pools had evaporated.

Methods for sample collection follow the TCEQ Surface Water Quality Monitoring (SWQM) Procedures Manual, Volumes 1 and 2 (TCEQ 2003b; TCEQ 2005a) as specified in the project Quality Assurance Project Plan (TPWD 2006). Brief descriptions of the methods are given below.

Instantaneous and 24-hour Physicochemical Parameters

A YSI 600 XLM multi-parameter datasonde was used to measure dissolved oxygen, temperature, pH, and conductivity at all three stations on Tehuacana Creek. Physicochemical data were collected before other field work commenced to ensure measurements were not affected by sediment disturbance. Data recording, instrument calibration, and post-calibration procedures can be found in TCEQ (2003b).

During the RWA in 2006, the TCEQ Region 9 staff noted anomalous DO data. A large DO decline in their diel physicochemical measurements (TCEQ 2006) was attributed to the disturbance of sediment and release of gases in the pools when the datasondes were deployed. Based on this observation and pools which were even more severely diminished than at the time of the RWA, a decision was made not to collect 24-hour physicochemical data to avoid artificially depressing the DO level and biasing the collection of biological and water quality data.

Water Chemistry

On the first day of field work, TCEQ Region 9 staff collected water chemistry samples. The water chemistry samples were collected from the most downstream pool (transect 1) at each station. Secchi depth readings were recorded for each station.

Flow

Tehuacana Creek was not flowing during the 2006 baseline sample collection. Flow readings were not recorded and flow severity was noted as "No Flow." When flow occurs, it will be measured following TCEQ (2003b).

Habitat

Physical habitat data collection followed the protocol in TCEQ (2005a) as closely as possible. Due to drought conditions, reach designation and transect location followed the low-flow or dry condition guidelines (TCEQ 2005a). While SWQM protocols typically require wadeable stream reaches to be 40 times the wetted stream width, the evaluated stream reaches were longer than 40 times the average width to include perennial pools. SWQM Volume 2 protocol states that reach designation may be modified in order to incorporate the best available habitat, and perennial pools were considered to be the best available habitat. The low-flow or dry condition protocol was used to determine reach length because the perennial pools covered less then 50 percent of the reach length and were separated by exposed channel bed (TCEQ 2005a). Reach lengths and the distance between transects within the reach were based on the distance between perennial pools and included the largest existing pools. The transect placement depicted the best characterization of the pools and existing water.

Four of the five transects at station 18870 were dry. The reach was established during the reconnaissance trip in early September 2006 and originally incorporated three perennial pools. By the end of September, only one pool remained at transect 1. Information recorded at the dry transects included bank slope (based on the appearance of normal flow conditions), substrate type, riparian vegetation, canopy cover, bank erosion potential, buffer vegetation, and percent gravel or larger.

Fish

Fish collections were completed at all three stations following TCEQ (2005). Fish sampling gear types for station 18871 included a Smith-Root LR-24 backpack electrofisher and a 4.6 m seine with 5 mm delta-weave mesh. Level of effort at station 18871 included four seine hauls for a total of 80 m and electrofishing at 350 volts (V) for 966 seconds (s). Field gear for station 11610 required a 9.1 m seine with 6 mm delta-weave mesh and the same backpack electrofisher (Smith-Root LR-24). The larger seine ensured accurate sampling in the larger perennial pools. At station 11610 seven seine hauls were pulled for a total of 70 m and the electrofishing occurred for 950 s (amps and V were not recorded on the datasheet). At station 18870 only the 4.6 m seine was used. Based on the results of three seine hauls (combined length of 18 m and no new fish were observed on the third seine haul), an on-site decision was made not to electrofish the pool in order to preserve the fish population.

Fish assemblage data were recorded in the field. Common fishes were identified to the lowest taxonomic level and the first two fish of each species were preserved or photographed for a voucher collection. Small voucher specimens and unidentified fish were placed in clearly labeled jars with 10% formalin and identified in the laboratory. The larger fish were identified in the field and photo vouchers taken. For quality assurance, 10% of the voucher collection was reviewed by an experienced ichthyologist.

Benthic Macroinvertebrates

Benthic macroinvertebrate collection included sampling with kick-nets and collection from snag/woody debris. Level of effort was recorded in five minute intervals of kick-netting or snag/woody debris sampling. Sampling effort for stations 18871 and 11610 were 20 minutes of kick-net sampling and 20 minutes of snag/woody debris sampling from multiple pools at each station. Aquatic macrophytes were present and sampled in one of the pools at station 11610 (level of effort included with snag/woody debris). Station 18870 was not sampled for benthic macroinvertebrates based on TCEQ (2005a) procedures when there is only one perennial pool within the reach. Samples were processed in the field to ensure that enough benthic macroinvertebrates were collected at each station. The benthic macroinvertebrates were placed into labeled jars with 70% isopropyl alcohol. Preserved specimens were identified in the laboratory.

Periphyton

Periphyton (benthic algae) was sampled to identify a baseline of existing levels of attached algal density. Periphyton collection followed the United States Geological Survey (USGS) 2002 protocol. The ash free dry mass (AFDM) and chlorophyll-*a* protocols of Hauer and Lamberti (1996) were used. Preparation for sampling began by cleaning the 47 mm glass fiber filters with deionized water (DI) over a vacuum, and then drying them in a muffle furnace at 500ºC for one hour. Filters were cooled in a dessicator for at least five minutes and weighed. The filters were then placed into glassine envelopes with the appropriate weight and a unique label number for easy recognition and data recording in the field.

For periphyton sampling, five pieces of woody debris were collected from the perennial pool at station 18870, and from multiple pools within the reach at station 18871. Woody debris was the only available substrate to sample for periphyton at these stations. Using a tooth brush, the periphyton was brushed off the woody debris and rinsed into a pan with DI water. Once all five pieces of woody debris were brushed, the circumference and length of the area brushed was measured and recorded. At station 11610, periphyton was sampled from cobble found in one pool within the reach (transect 3). Twenty-five different pieces of cobble were collected and scraped into a small pan using DI to rinse the surface. The area scrapped on each piece of cobble was covered with foil and cut to size in order to record the area sampled.

At each station, periphyton samples were measured for volume and diluted with DI to the nearest 100 milliliters (mL). The samples were then homogenized using a hand mixer, and four - 5 mL samples were filtered at each station using a vacuum filter. Two filters for AFDM and two filters for chlorophyll-*a* were processed at each station (the second filter was a replicate to ensure consistency). The filters were individually wrapped in foil and placed on dry ice in the field. The chlorophyll-*a* filters were processed by the Brazos River Authority and the AFDM filters were processed by TPWD staff. Prior to lab processing, all chlorophyll-*a* filters were stored in a freezer. Once at the lab the chlorophyll-*a* filters were analyzed following EPA method 445.0. The AFDM filters were initially stored in a drying oven at 105°C in marked porcelain dishes, after which they were processed according to Hauer and Lamberti (1996).

Results

Instantaneous and 24-hour Physicochemical Data

Instantaneous physicochemical data were collected at each station simultaneously with water chemistry on September 25, 2006. Additional measurements were made at stations 18871 and 11610 on September 26 and 27, 2006 prior to conducting biological sampling at each station. These measurements provided real-time water quality information that may be used to help interpret the benthic, fish, and periphyton data. Instantaneous physicochemical measurements can be found in Table 2.

Table 2. Instantaneous physicochemical data for stations 18870, 18871, and 11610 (listed upstream to downstream) on Tehuacana Creek (September 2006).

Station	Date	Parameters					
		Water Temperature (°C)	Specific Conductance (µmhos/cm)	Dissolved Oxygen (mg/L)	pH (s.u.)	Secchi Disk (m)	Pool Depth (m)
18870	9/25/2006	19.9	700	0.7	7.4	0.20	0.80
18871	9/25/2006	20.1	1042	3.1	8.2	0.07	0.54
18871	9/26/2006	18.6	1077	3.3	8.2	0.05	0.68
11610	9/25/2006	21.7	911	10.6	7.8	>0.15	0.20
11610	9/27/2006	20.7	1236	-	7.6	-	1.80

Temperature ranged from 18.6 °C at station 18871 to 21.7 °C at station 11610. Specific conductance ranged from 700 to 1236 µmhos/cm and pH ranged from 7.4 to 8.2 standard units (s.u.). DO varied widely in the isolated pools, measuring as low as 0.7 mg/L in a small pool at the uppermost station, and as high as 10.6 mg/L in a pool at station 11610. Secchi disk readings ranged from 0.05 to 0.20 m.

Water Chemistry

The preliminary water chemistry data for stations 18870, 18871, and 11610 can be found in Table 3. Overall, the data are consistent with the water quality criteria for Segment 1242 (Table 4). Criteria for segment 1242 were used since site-specific criteria have not been established for Tehuacana Creek.

Table 3. Preliminary water chemistry data for stations 18870, 18871, and 11610 (listed upstream to downstream) on Tehuacana Creek (September 25, 2006). [b]

Routine Chemical Analysis[a]	18870	18871	11610	Unit	Method
Alkalinity, Total as CaCO3	244	350	142	mg/L	EPA 310.1
Ammonia as N	**1.49**	<0.05	**0.16**	mg/L	EPA 350.1
BOD, 5-Day	6	**12**	2	mg/L	EPA 405.1
Chloride	45	37	30	mg/L	EPA 300.0
Chlorophyll-a by Fluorometry	**82**	**194**	<3	ug/L	EPA 445.0
Fluoride	0.48	1.30	0.37	mg/L	EPA 300.0
Nitrate+Nitrite as N	<0.04	0.05	<0.04	mg/L	EPA 353.2
Orthophosphate as P, Fld Filtered	<0.04	<0.04	<0.04	mg/L	EPA 365.1
Phosphorus, Total	0.15	0.54	0.07	mg/L	EPA 365.1
Sulfate	43	124	**267**	mg/L	EPA 300.0
Total Dissolved Solids	418	840	626	mg/L	EPA 160.1
Total Kjeldahl Nitrogen	3.00	2.37	3.73	mg/L	EPA 351.2
Total Organic Carbon	9	8	13	mg/L	EPA 415.2
Total Suspended Solids	36	**235**	4	mg/L	EPA 160.2
Volatile Suspended Solids	8	**47**	<4	mg/L	EPA 160.4
Sample Depth	0.30	0.27	0.08	m	-

[a]Preliminary water chemistry data – data has not been verified by TCEQ.

[b]"<" indicates that some values are at or below the detection limit. When values were averaged to obtain the mean, the detection limit was used in the calculations.

Bold values indicate exceedance of criteria or screening levels.

Table 4 and Table 5 respectively present screening levels and Segment 1242 water quality criteria. The water quality criteria are not applicable when stream flows are less than the 7Q2 flow (TCEQ 2000). However comparisons can be helpful to provide insight to the data.

Some parameters were observed to have elevated values. The chlorophyll-*a* measurements for station 18870 and 18871 were 81.9 and 194 µg/L respectively. These values exceed the 2004 screening value for chlorophyll-*a* (11.6 µg/L). Sulfate data exceeded the segment criteria of 200 mg/L at station 11610 (267 mg/L). Station 18870 exceeded the 2004 screening level for ammonia (0.17 mg/L) with a measurement of 1.49 mg/L and station 11610 was close to the screening level with a measurement of 0.16 mg/L. At station 18871 the biochemical oxygen demand (BOD) was high with a measurement of 12 mg/L, the total suspended solids were 235 mg/L, and the volatile suspended solids were 47 mg/L.

Table 4. Water quality criteria for Segment 1242 (TCEQ 2000).

Parameter	Criteria
Chloride (mg/L)	350
Sulfate (mg/L)	200
Total Dissolved Solids (mg/L)	1000
Dissolved Oxygen (mg/L)	5
pH range (standard units)	6.5-9.0
Temperature (ºF)	95

Table 5. 2004 85th percentile values for freshwater streams (TCEQ 2003a).

Parameter	Screening Levels
Ammonia (mg/L)	0.17
Nitrate + Nitrite nitrogen (mg/L)	2.76
Orthophosphate-phosphorus (mg/L)	0.5
Total phosphorus (mg/L)	0.8
Chlorophyll-*a* (µg/L)	11.6

Habitat

At each station on Tehuacana Creek, physical habitat data were collected (Appendix C) and HQI scores were calculated (Appendix A). Use of the habitat index at the upstream station was complicated by the number of dry transects. Dry transects were entered as zero depth into the matrices.

The stream reach was 394 m long at the upstream station (18870) with one of the five transects containing a perennial pool (Table 6). The HQI for station 18870 was limited aquatic life use (13.5). Maximum depth at each transect and maximum stream width did not apply in this situation since only one transect had water. Left bank slope ranged from 25.0 to 51.5° and right bank slope from 41.6 to 55.0°. Observed percent erosion ranged from 20 to 80%.

Habitat data for station 18871 represented a stream reach of 461 m and a perennial pool at each of the five transects (Table 6). The HQI (Appendix A) score for station 18871 was 15 (intermediate aquatic life use). Width for the five transects ranged from 3.0 to 8.0 m. Maximum depth at each transect ranged from 0.21 to 0.86 m. Left bank slope ranged from 24 to 45° and right bank slope from 27 to 36°. Observed percent erosion ranged from 30 to 80%.

The downstream station 11610 stream reach was 561 m and encompassed three perennial pools over five transects. The HQI score was 16, placing it in the intermediate category (Appendix A). Widths of the five transects ranged from 2.9 to 15.5 m. Maximum depth ranged from 0.21 to 1.80 m. Left bank slope ranged from 9.8 to 34.4° and right bank slope from 29.1 to 44.5°. Observed percent erosion ranged from 20 to 80% for the left bank and 40 to 90% for the right bank (Table 6).

Table 6. Summary of physical characteristics for stations 18870, 18871, and 11610 (listed upstream to downstream) on Tehuacana Creek (August 2006).

Parameter	18870	18871	11610
Stream Bed Slope (m/m)	7.74	7.40	5.43
Drainage Area Above Downstream Transect (km²)	447	461	493
Length of Stream Evaluated (m)	394	412	561
Mean Stream Width (m)	1.2	5.3	8.1
Mean Stream Depth (m)	0.12	0.36	0.46
Maximum Width of Largest Pool (m)	5.8	8.0	15.5
Maximum Depth of Largest Pool (m)	0.90	0.86	1.80
Mean Bank Slope (degrees)	42.0	32.2	33.6
Mean % Bank Erosion	52	61	61
Mean % Tree Canopy	15.3	13.8	10.3
Mean % Substrate Gravel or Larger	18.8	2.0	6.0
Mean Width Riparian Buffer Vegetation (m)	26.0	26.3	20.5
Mean % Instream Cover	2.0	9.0	9.0
Number of Instream Cover Types	2	4	7
Dominant Substrate Type 1=clay,2=silt,3=sand, 4=gravel,5=cobble,6=boulder,7=bedrock,8=other	4	1	2
Riparian Vegetation: % Trees	32	26	25
Riparian Vegetation: % Shrubs	0	0	0
Riparian Vegetation: % Grasses, Forbs	34	37	54
Riparian Vegetation: % Cult. Fields	0	0	0
Riparian Vegetation: % Other [a]	34	37	21

[a] "Other" represents bare banks

Fish

Fish were collected at all three stations. Data are presented in Table 7. Overall, a total of 34 species and 1,696 individuals were collected from all three stations.

At station 18870 (upstream), 15 species and 101 individuals were collected from the only perennial pool. The most abundant species were bluegill (25 individuals), green sunfish (18 individuals), and gizzard shad (12 individuals). The IBI for Ecoregion 32 was calculated even though electrofishing did not occur (Appendix A). The metrics total without electrofishing data input equals 31 or limited aquatic life use.

The fish collection at station 18871 produced 565 individual fish from 23 species. The most abundant species were bluegill (150 individuals), warmouth (128 individuals), western mosquitofish (79 individuals), and green sunfish (66 individuals). The IBI for Ecoregion 32 scored as high aquatic life use (score of 44) (Appendix A).

Twenty-seven species comprising of 1,030 individuals were collected at station 11610. The most abundant species were longear sunfish (308 individuals), orangespotted sunfish (230 individuals), bullhead minnow (92 individuals), and bluegill (90 individuals). The Ecoregion 32 IBI reflected an exceptional aquatic life use (score of 52) (Appendix A).

Table 7. Fish species data for stations 18870, 18871, 11610 in September 2006 (listed upstream to downstream), and the RWA on Tehuacana Creek in January 2006 (TCEQ 2006).

Scientific Name[a]	Common Name	18870	18871	11610	RWA
Ameiurus natalis	Yellow bullhead	1	2	-	1
Aplodinotus grunniens	Freshwater drum	-	1	-	-
Campostoma anomalum	Central stoneroller	-	-	1	-
Carpiodes carpio	River carpsucker	2	2	2	-
Cyprinella lutrensis	Red shiner	2	-	25	-
Cyprinella venusta	Blacktail shiner	-	-	7	-
Cyprinus carpio	Common carp	5	6	-	-
Dorosoma cepedianum	Gizzard shad	12	37	35	-
Dorosoma petenense	Threadfin shad	-	-	48	-
Etheostoma chlorosomum	Bluntnose darter	-	-	4	1
Etheostoma gracile	Slough darter	-	1	6	1
Etheostoma spectabile	Orangethroat darter	-	-	2	-
Fundulus notatus	Blackstripe topminnow	-	2	14	-
Gambusia affinis	Western mosquitofish	9	79	33	75
Ictalurus punctatus	Channel catfish	-	3	1	-
Labidesthes sicculus	Brook silverside	-	-	44	-
Lepisosteus oculatus	Spotted gar	-	1	2	-
Lepisosteus osseus	Longnose gar	-	2	-	-
Lepomis auritus	Redbreast sunfish	-	-	-	2
Lepomis cyanellus	Green sunfish	18	66	30	8
Lepomis gulosus	Warmouth	6	128	14	7
Lepomis humilus	Orangespotted sunfish	1	-	230	-
Lepomis macrochirus	Bluegill	25	150	90	62
Lepomis megalotis	Longear sunfish	7	24	308	35
Lepomis microlophus	Redear sunfish	1	1	-	1
Lepomis sp. [a] (unknown)	Sunfish species	-	18	-	-
Micropterus punctulatus	Spotted bass	-	-	2	-
Micropterus salmoides	Largemouth bass	-	8	21	-
Moxostoma congestum	Gray redhorse	-	2	-	-
Notemigonus crysoleucas	Golden shiner	1	-	3	-
Noturus gyrinus	Tadpole madtom	-	1	5	-
Opsopoeodus emiliae	Pugnose minnow	-	2	1	-
Percina macrolepida	Bigscale logperch	-	-	2	-
Pimephales vigilax	Bullhead minnow	-	3	92	1
Pomoxis annularis	White crappie	7	26	8	1
Pomoxis nigromaculatus	Black crappie	4	-	-	-
	Green sunfish hybrid[b]	-	-	1	-
Total Fish Species Collected per Station		15	23	27	12
Total Individual Count		101	565	1030	195
Total Species Collected for Tehuacana Creek[c]		34			

[a]Fish names based on Nelson et al. 2004.
[b]*Lepomis sp.* and green sunfish hybrid are not included in the species counts
[c]RWA data are not included in this total

Benthic Macroinvertebrates

Benthic macroinvertebrates were collected at two of the three stations and the data are summarized in Table 8. A total of 353 individuals and 47 taxa were collected between the two stations. At station 18871, 163 individuals were collected comprising 33 taxa. The most abundant taxa collected were Chironomidae (54 individuals), *Perithemis* sp. (18 individuals), and *Trichocorixa* sp. (11 individuals). For station 11610, a total of 190 individuals made up of 34 taxa were collected. The most abundant organisms were *Caenis* sp. (67 individuals), *Hyalella* sp. (24 individuals), and Chironomidae (14 individuals). Benthic macroinvertebrates were not collected at station 18870 due to limited available habitat. A qualitative benthic IBI was used for 18871 and 11610. Both stations rated intermediate with station 18871 scoring 24 and station 11610 scoring 28 (Appendix A).

Table 8. Benthic macroinvertebrate species collected for stations 11871 and 11610 (listed upstream to downstream) on Tehuacana Creek (September 2006).

Phylum	Class	Order	Family	Genus	18871	11610
Annelida	Hirudinea				4	3
	Oligochaeta				6	3
Arthropoda	Hydracarina				--	2
	Crustacea	Amphipoda	Taltridae	*Hyalella*	4	24
		Copepoda			1	--
		Decapoda	Cambaridae		3	3
			Palaemonidae	*Palaemontes*	--	2
	Insecta	Coleoptera	Dytiscidae	*Acilius*	--	1
			Elmidae	*Dubiraphia*	1	--
				Stenelmis	1	--
			Gyrinidae	*Dineutus*	6	5
			Haliplidae	*Peltodytes*	1	4
			Hydraenidae	*Ochthebius*	6	3
			Hydrochidae	*Hydrochus*	6	--
			Hydrophilidae	*Berosus*	2	5
				Enochrus	--	1
				Helochares	3	1
				Tropisternus	4	--
			Scirtidae	*Scirtes*	3	--
		Diptera	Ceratopogonidae	*Bezzia*	1	1
				Palpomyia	--	1
				Probezzia	--	1
				Stilobezzia	3	1
			Chaoboridae	*Chaoborus*	1	--
			Chironomidae		54	14
			Culicidae	*Anopheles*	--	5
			Stratiomyidae	*Stratiomys (Stratiomyia)*	2	1
			Tabanidae	*Tabanus*	1	--
		Ephemeroptera	Baetidae	*Callibaetis*	2	7
			Caenidae	*Caenis*	4	67
			Ephemeridae	*Hexagenia*	--	1
		Hemiptera	Belostomatidae	*Belostoma*	2	--
			Corixidae	*Trichocorixa*	11	3
			Naucoridae	*Pelocoris*	2	--
			Nepidae	*Ranatra*	3	2
		Megaloptera	Sialidae	*Sialis*	1	--
		Odonata	Coenagrionidae	*Enallagma*	--	3
			Corduliidae	*Epitheca*	--	1
			Gomphidae	*Arigomphus*	1	--
			Libellulidae	*Erythemis*	--	7
				Miathyria	--	3
				Perithemis	18	7
			Macromiidae	*Didymops*	2	1
		Trichoptera	Polycentropodidae	*Polycentropus*	--	1
Mollusca	Gastropoda	Limnophila	Physidae	*Physella*	2	4
	Pelecypoda	Heterodonta	Corbiculidae	*Corbicula*	--	2
			Sphaeriidae	*Sphaerium*	2	--
Total Species per Station					**33**	**34**
Total Individual Count					**163**	**190**
Total Species for Tehuacana Creek					**47**	**--**

Periphyton

Periphyton data can be found in Table 9. Once the water samples were collected, the reach at each station was visually assessed for substrate suitable for periphyton sampling. Cobble or rocks were the preferred substrate, but if cobble was not present within the reach then woody debris was randomly selected from multiple pools. Two filters (field splits) for AFDM and for chlorophyll-*a* were processed to provide extra data for quality control measures. The relative percent differences (RPDs) for AFDM and chlorophyll-*a* were calculated for the replicate samples taken at each station and to verify that field techniques were consistent (TPWD 2006). The equation for the RPD is

$$RPD = (X1-X2)/\{(X1+X2)/2\}*100$$

where X1 and X2 are the reported values for duplicate samples. The largest RPD for chlorophyll-*a* was station 18870 at 20.1% and the largest RPD for AFDM was station 11610 at 7.4%. The calculated RPDs all fall below 30%, which supports consistent collection and analysis techniques. RPD data can be found in Appendix B.

Both chlorophyll-*a* and AFDM were present in small amounts for the area sampled (Table 9). Nuisance levels of algal biomass have been correlated with chlorophyll-*a* values greater than 10 µg/cm² and AFDM values greater than 5 mg/cm² (Biggs 1996). The data collected from the three stations on Tehuacana Creek did not exceed the nuisance levels.

Table 9. Ash free dry mass and chlorophyll-*a* data for stations 18870, 18871, and 11610 (listed upstream to downstream) on Tehuacana Creek (September 2006).

Station	Date	Substrate Type	Substrate Area Sampled (cm²)	Total Chlorophyll-*a* per Sample Area (µg/cm²)	Dry Mass per Sample Area (mg/cm²)	AFDM per Sample Area (mg/cm²)
18870	25-Sep-06	woody debris	610.7	0.50	3.64	0.75
	25-Sep-06	woody debris	610.7	0.61	3.86	0.74
18871	26-Sep-06	woody debris	262.2	1.11	14.0	3.0
	26-Sep-06	woody debris	262.2	1.07	14.0	2.8
11610	27-Sep-06	cobble	946.5	1.00	7.15	0.82
	27-Sep-06	cobble	946.5	1.14	7.05	0.89

Discussion

Although the three stations shared many characteristics, including the existence of perennial pools and no flow, they exhibited some differences in physical habitat characteristics, biological populations, and water quality.

Most water chemistry parameters were within TCEQ screening levels and Segment 1242 water quality criteria, though exceedances were observed. Physicochemical data varied widely, and DO and specific conductance had the most variability. Anomalous values can be attributed to the size of the pools as well as varying demands for oxygen within each pool. Oxygen demand can vary based on fish population, nutrient levels, macrophytes, algal blooms, etc. Station 18870 had the lowest DO level of the three stations and high values for chlorophyll-*a* and ammonia. Under stressed conditions these values are not unexpected. The dissolved oxygen levels fluctuate with algal photosynthesis and respiration, along with uptake of oxygen for organic matter decomposition. Ammonia sources include animal waste and decomposition of organic matter. As noted previously, this reach had only one pool, which had a large fish population that displayed signs of stress. Chlorophyll-*a*, $BOD_{5,}$ total suspended solids, and volatile suspended solids at station 18871, and the ammonia values at station 11610 can be explained by similar arguments.

Specific conductance ranged from 700 to 1236 µmhos/cm at the three stations. Station 18870 had the lowest specific conductance. Since salts are not lost when water evaporates, one might expect this station to have higher values based on the condition of the perennial pool.

Habitat data collection was complicated at station 18870 because four of the five transects were dry. With only one severely diminished perennial pool, it was impossible to collect all the data needed to calculate fish, benthics, and habitat quality indices. Despite the dry transects, as much data as possible was recorded. Although the stream was not flowing, each station had more available water within the perennial pools as one moved downstream.

Typical stream progression is noted within the data, for example, mean stream width and depth increased from the upstream station to the downstream station (18870, 18871, and 11610 respectively). As the stream got wider and deeper, mean percent tree canopy decreased, and there was an increase of grasses and forbs along the banks (station 11610). Aquatic macrophytes were present at both 18871 and 11610 but were denser at station 11610. This can be attributed to the decrease in tree canopy cover, and the mean width of the riparian buffer vegetation. Finally, large log jams were observed at stations 18870 and 18871, but not at 11610.

There was a change in substrate type between the uppermost and downstream stations. At station 18870 the dominant substrate type was gravel, but stations 18871 and 11610 had, respectively, predominately clay and silt substrates. The clay and silt substrates are what would be expected for a stream in the Texas Blackland Prairies, however the presence of gravel at station 18870 was unexpected. While this observation was unexpected, it was noted that there was sand and gravel in the area. Approximately 10 m downstream of station 18870, Kirkland Branch flows into Tehuacana Creek. Kirkland Branch was dry during sampling and field staff

observed sand and gravel in the stream bed. The observation of gravel at station 18870 is consistent with the presence of sand and gravel in Kirkland Branch.

While the dominant substrate at station 11610 was silt, large cobble was found at the edge of a pool. The pool, located at transect 3, incorporates a 90° bend to the east. The bend causes water to slow allowing the cobble to settle out. While gravel was observed at 18870, no cobble was noted.

Habitat quality indices for each station were relatively similar (Appendix A). Station 18870 HQI was calculated using zeros for the depth measurements at dry transects for a final score of limited (13.5). Both stations 18871 and 11610 scored intermediate with scores of 15 and 16, respectively. The three scores are quite close to the criteria split at 14, which separates limited and intermediate.

Fish collections for the study totaled 1,696 individuals consisting of 34 species. Bluegill was numerically dominant at station 18870 and 18871, and the fourth most abundant fish at 11610. Green sunfish was the next most numerous fish at two of the three stations (18870 and 18871). Longear sunfish dominated at station 11610. Overall, most of the fish collected were from the *Lepomis* genus in the study as well as in the RWA study in January 2006. The fish metric scores varied among the three stations. Station 18871 scored high (total of 44) ALU and station 11610 scored exceptional ALU (total of 52). As previously noted, an IBI was calculated for station 18870 despite the lack of electrofishing data. Not surprisingly, the score was lower than that of the other stations, both of which were consistent with the RWA score from January 2006 and supporting the designated use of high.

The variability of fish collections within an Ecoregion has been explored by TPWD staff. There tends to be more variability in streams that score in lower ALU categories, and more stability in streams with higher ALU scores (Linam 2007). For Ecoregion 32, the coefficient of variation for a limited ALU was observed to be 12.82%. When this value is applied to the score for station 18870 it places the ALU in the intermediate category. The natural variability between biological collections may account for part of the difference between the two collections (RWA in January 2006 and the September 2006 collection). As noted above, environmental stress could be another component to the difference between the two scores. It could also be argued that the use of different sampling methods influenced the variability between the two collections.

The qualitative benthic IBI (BIBI) for stations 18871 and 11610 scored intermediate despite the large number of individuals and species collected. Although the total number of species collected for each station was high, the individual composition and ratio of species collected resulted in reduced BIBI scores. The scoring for the two stations was not identical, but they scored similarly in several categories. Station 18871 scored high in taxa richness, number of non-insect taxa, and the percentage of Elmidae found. The lower scoring metrics for station 18871 were a high percentage of Chironomids, predators as the dominant functional feeding group, the percentage of tolerant to intolerant species, and the percentage of Trichoptera as Hydropsychidae. Station 11610 scores were highest for taxa richness, number of non-insect taxa, and the percentage of total Trichoptera as Hydropsychidae. The lower scoring metrics included EPT index, ratio of tolerant to intolerant taxa, percentage of collector-gatherers, and

percent of total number as Elmidae. The limited habitat provides an explanation for the unbalanced benthic populations which is represented in the metric scores.

For periphyton, the chlorophyll-*a* values ranged from 0.50 -1.1 μg/cm², and the AFDM values ranged from 0.74 to 3.0 mg/cm^2. The chlorophyll-*a* values are much less than the 10 μg/cm² nuisance levels reported by Biggs (1996), and below the 7 μg/cm² chlorophyll-*a* value which Dodds defines as the mesotrophic-eutrophic boundary (Dodds 1998). The AFDM values are less than 4 mg/cm^2, which Biggs suggested is the maximum biomass that protects a contact recreation use (Biggs 1996). Low values for periphyton can be explained by increased grazing pressure from biological communities within the diminished perennial pools, and the lack of available instream habitat for attachment. Relatively low concentrations of total nitrogen and total phosphorus may also have limited algal growth. Although station 18871 had the highest level of total phosphorus (0.54 mg/L) it was still below the 85th percentile screening value for nutrients in streams (0.8 mg/L). Excessive algal growth was noted only at one pool located at the uppermost transect (transect 5) at station 11610. This transect spanned a shallow pool with partial canopy cover and had more than 50% algal and macrophyte coverage. This transect was not sampled for periphyton because the algae was growing on sediment which is not appropriate substrate as defined by sampling protocols.

Aquatic macrophytes were present in limited areas. They were noted in areas with increased light penetration due to decreased canopy cover. Macrophytes did not occur within the designated transects, but were noted in one pool of the reach at station 18871 and in two pools within the reach at station 11610.

Comparison of available water chemistry data from the three stations along Tehuacana Creek showed a majority of the parameters were highest at station 18871 when compared to the other stations. Station 18871 had the largest value for AFDM, chlorophyll-*a*, total phosphorus, total nitrogen, conductivity, total dissolved solids, pH, and alkalinity. We note that there are two municipal landfills within the watershed of station 18871, located south of US 84 and 300 m west of Tehuacana Creek. The older landfill, located further away from the stream, is inactive and the second landfill is currently used by the City of Lacy-Lakeview.

Station 18870 had the highest ammonia values and lowest instantaneous DO level (0.7 mg/L). The diminished state of the pool and lack of recent rains as well as the large number of fish (101 individuals) in the pool may have contributed to these conditions. Although the pool was diminished and supported an extensive fish population, none of the other parameters exceeded Segment 1242 criteria or 85th percentile screening values for freshwater streams.

Interpretation of the biological index scores was complicated by dry conditions observed during sampling. Benthic macroinvertebrates scored intermediate at 18871 and 11610, and both stations also scored intermediate for habitat. During a wetter year, a more diverse set of habitats would be available for benthic invertebrates, such as larger perennial pools, riffles, and runs. Fish scored limited, high, and exceptional (upstream to downstream respectively) within the three reaches sampled. The evaluation of limited ALU for station 18870 has already been discussed, and is almost certainly not representative of Tehuacana Creek, as demonstrated by the high ALU obtained by TCEQ in the 2006 sampling event during wetter conditions (Figure 1). This station

also ranked limited using the Habitat Quality Index, reflecting the effects of the dry transects within the reach due to the extended drought. The high and exceptional ALU found for fish at 18871 and 11610 appear to more appropriately represent Tehuacana Creek.

Conclusion

The data collected in September 2006 provide a baseline to compare to future sampling data. The measurements made for the baseline study will be repeated after the wastewater discharge is fully established. Efforts will be made during future sampling trips to use all gear types as well as collect diel physicochemical data. Future sampling will occur at least several months after the discharge is initiated, when flow and water quality conditions in the stream are fully established and equilibrated. Once the data are collected further analysis will be conducted.

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Appendix A - Biological Data Summary: Metric Sets

Table 10. Indices of Biotic Integrity for habitat, nekton, and benthic macroinvertebrates for stations 18870, 18871, and 11610 (listed upstream to downstream) on Tehuacana Creek (September 2006).

IBI Description	18870	18871	11610
Habitat			
Total Score	13.5	15	16
Aquatic Life Use[a]	Limited	Intermediate	Intermediate
Fish			
Total Score	31[d]	44	52
Aquatic Life Use[b]	Limited	High	Exceptional
Benthic Macroinvertebrates	[e]		
Total Score	-	24	28
Aquatic Life Use[c]	-	Intermediate	Intermediate

[a]Habitat Aquatic Life Use Point Score Ranges:

Exceptional:	26 - 31
High:	20 - 25
Intermediate:	14 - 19
Limited:	< 14

[b]Fish Aquatic Life Use Point Score Ranges:

Exceptional:	≥ 49
High:	41 - 48
Intermediate:	35 - 40
Limited:	< 35

[c]Benthic Macroinvertebrates Aquatic Life Use Point Score Ranges:

Exceptional:	> 36
High:	29 - 36
Intermediate:	22 - 28
Limited:	< 22

[d]Nekton score for station 18870 was calculated without electrofishing data.

[e]No data collected

Table 11. Habitat quality index for stations 18870, 18871, and 11610 on Tehuacana Creek (September 2006).

Habitat Quality Index						
Date	9/25/2006		9/26/2006		9/27/2006	
Site	Upstream of Kirkland Branch		Old Mexia Rd.		FM 2491	
TCEQ ID	18870		18871		11610	
Metric	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
Mean % Instream Cover	2.0	1	9.0	1	9.0	1
Number of Riffles	0	1	0	1	0	1
Maximum Depth of Largest Pool (m)	0.9	3	0.9	3	1.8	4
Bank Stability	-	0.5	-	1.0	-	1.0
Mean Bank Slope (degrees)	42.0	1.0	32.2	2.0	33.6	2.0
Mean % Bank Erosion	52.0	0.0	61.0	0.0	61.0	0.0
Mean Width Riparian Buffer Vegetation (m)	26.0	3	26.3	3	20.5	3
Channel Flow Status	no flow	0	no flow	0	no flow	0
Channel Sinuosity	low	1	high	3	high	3
Bottom Substrate Stability (% Substrate Gravel or Larger)	18.8	2	2.0	1	6.0	1
Aesthetics	natural	2	natural	2	natural	2
AQUATIC LIFE USE SCORE	13.5		15.0		16	
AQUATIC LIFE USE RATING	Limited		Intermediate		Intermediate	
Scoring Criteria						
Exceptional						26 - 31
High						20 - 25
Intermediate						14 - 19
Limited						< 14

Table 12. Fish Ecoregion 32 index of biotic integrity (IBI) for station 18870 on Tehuacana Creek (September 2006).

Fish Ecoregions 27,29,32 Index of Biotic Integrity						
Date	9/25/2006		9/26/2006		9/27/2006	
Site	Upstream of Kirkland Branch		Old Mexia Rd.		FM 2491	
TCEQ ID	18870		18871		11610	
Metric	**Raw Value**	**IBI Score**	**Raw Value**	**IBI Score**	**Raw Value**	**IBI Score**
Total Number of Fish Species	15	5	22	5	28	5
Number of Native Cyprinid Species	2	3	2	3	6	5
Number of Benthic Invertivore Species	0	1	3	5	5	5
Number of Sunfish Species	8	5	6	5	6	5
% of Individuals as Tolerant Species[a]	70.3	1	70.1	1	19.6	5
% of Individuals as Omnivores	19.8	1	8.8	3	8.3	5
% of Individuals as Invertivores	45.5	3	50.3	3	84.0	5
% of Individuals as Piscivores	34.7	5	40.9	5	7.5	3
Number of Individuals in Sample	-	-	-	4	-	4
Number of Individuals/seine haul	33.7	1	45.0	3	86.0	3
Number of Individuals/min electrofishing	[b]	-	23.9	5	27.2	5
% of Individuals as Non-native Species	5.0	1	1.1	5	0.0	5
% of Individuals With Disease/Anomaly	0.0	5	0.0	5	0.0	5
Index of Biotic Integrity Numeric Score:	31[c]		44		52	
Aquatic Life Use:	Limited		High		Exceptional	

[a]Excluding western mosquitofish
[b]No electrofishing data available for calculations. Number of individuals in sample was not calculated.
[c]IBI score does not include electrofishing data. Any use of this data should take that into consideration.

Table 13. Qualitative benthic index of biotic integrity (IBI) for station 18871 on Tehuacana Creek (September 2006).

Qualitative Benthic IBI				
Date	9/26/2006		9/27/2006	
Site	Old Mexia Rd.		FM 2491	
TCEQ ID	18871		11610	
Metric	**Value**	**Score**	**Value**	**Score**
Taxa Richness	33	4	34	4
EPT Index	2	1	4	2
HBI	6.2	1	6.8	1
% Chironomidae	33.1	1	7.4	3
% Dominant Taxon	33.1	2	35.3	2
% Dominant FFG	46.0	2	43.5	3
% Predators	46.0	1	26.9	2
Intolerant : Tolerant	0.4	1	0.2	1
% Total Trichoptera as Hydropsychidae	No Trich	1	0.0	4
Number of Non-Insect Taxa	7	4	8	4
% CG	34.1	2	43.5	1
% n as Elmidae	1.2	4	0.0	1
AQUATIC LIFE USE SCORE	24		28	
AQUATIC LIFE USE RATING	Intermediate		Intermediate	
Kicknet (Qualitative) Scoring Criteria				
Exceptional				>36
High				29 - 36
Intermediate				22 - 28
Limited				<22

Appendix B – Biological Data Summary: Relative Percent Difference for Periphyton Data

Table 14. Relative percent difference (RPD) for the periphyton chlorophyll-*a* field splits and for the periphyton ash free dry mass (AFDM) for stations 18870, 18871, and 11610 (listed upstream to downstream) on Tehuacana Creek (September 2006).

Station	Date	Chlorophyll-*a* (ug/L)	RPD (%)	AFDM (mg)	RPD (%)
18870	25-Sep-06 25-Sep-06	1020 1248	20.1	7.6E-06 7.5E-06	1.3
18871	26-Sep-06 26-Sep-06	4900 4675	4.7	1.3E-05 1.2E-05	5.5
11610	27-Sep-06 27-Sep-06	3146 3588	13.1	1.3E-05 1.4E-05	7.4

Appendix C – Biological Data Summary: Habitat

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Surface Water Quality Monitoring Program

Habitat Assessment Worksheet B Part I of III

Worksheet #	**Part I - Stream Physical Characteristics Worksheet**		
Observers: A. Whisenant, C. Contreras, J, Bronson		Date:9/25/06	Time:10:45
Weather conditions: Sunny			
Stream: Tehuacana Creek, Station # 18870		Stream Segment no. 1242 N	
Location of site: Upstream of Kirkland Branch		Length of reach: 394 M	
Observed stream uses: Wildlife, Fishing			
Stream type (circle one):	**perennial**	or	**intermittent w/ perennial pools**
Stream bends: 2	No. well defined None	No. moderately defined 2	No. poorly defined None
Aesthetics (circle one):	**(1) wilderness**	**(2) natural**	**(3) common** **(4) offensive**
Channel obstructions or modifications: log Jams			No. of riffles None
Channel flow status (circle one):	**high**	**moderate**	**low** **no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	20	44
Shrubs	0	0
Grasses or forbs	51	17
Cultivated fields	0	0
Other	29	39

Site map:

Notes

During recon trip the reach had three perennial pools. During sampling, it was observed that two of the pools had dried up due to the ongoing drought.

TCEQ 20156-A (Rev. 4-14-2005)

Station # 18870 **Part I – TCEQ Stream Physical Characteristics Worksheet**

Location of transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.90											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
90 m. upstream of Kirkland Branch Lat - 31° 37.498' Long – 97° 02.715' 1	5.8 m	28	60	.44	.85	.90	.80	.70	.63	.58	.62	.50	.27	.15	48.1	70	Total	17
	Habitat type (circle one) **Riffle** **Run** **Glide** **[Pool]**		Dominant substrate type Mud and Silt												Dominant types riparian vegetation: Left bank: small trees, small forbs and vines Right bank: Trees and vines		% Gravel or larger 0	CL CR	17 16
	Macrophytes (circle one) **Abundant** **Common** **Rare** **[Absent]**	Algae (circle one) **Abundant** **Common** **[Rare]** **Absent**	Width of natural buffer vegetation (m) LB: 30 RB: 30												Instream cover types: Snags, moderately undercut bank		% Instream cover 10	LB RB	17 16
Location of transect 78 m upstream of Transect 1 Lat – 31° 37.515' Long – 97° 02.699' 2	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: Dry											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
	NA	38	40												41.6	60	Total	16
	Habitat type (Circle One) **Riffle** **Run** **Glide** **Pool** **[Dry]**		Dominant substrate type Gravel												Dominant types riparian vegetation: Left bank: Trees, vines, forbes Right bank: Trees, Small trees, forbs		% Gravel or larger 70	CL CR	16 16
	Macrophytes (circle one) **Abundant** **Common** **Rare** **[Absent]**	Algae (circle one) **Abundant** **Common** **Rare** **[Absent]**	Width of natural buffer vegetation (m) LB: 50 RB: 20												Instream cover types: NA		% Instream cover NA	LB RB	16 17
Location of Transect 78 m upstream of Transect 2 Lat – 31° 37.573' Long – 97° 02.697' 3	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: Dry											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
	NA	36	30												52.2	40	Total	12
	Habitat type (circle one) **Riffle** **Run** **Glide** **Pool** **[Dry]**		Dominant substrate type Sand												Dominant types riparian vegetation: Left bank: Trees, vines forbs Right bank: trees, vines, forbs		% Gravel or larger 5	CL CR	3 13
	Macrophytes (circle one) **Abundant** **Common** **Rare** **[Absent]**	Algae (circle one) **Abundant** **Common** **Rare** **[Absent]**	Width of natural buffer vegetation (m) LB: 20 RB: 20												Instream cover types: NA		% Instream cover NA	LB RB	16 16

Station # 18870

Part I – TCEQ Stream Physical Characteristics Worksheet (continued)

Location of transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: Dry	Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
119 m upstream of Transect 3 Lat - 31° 37.615' Long – 97° 02.619' 4	NA	25	20		45	60	Total	16
	Habitat type (circle one) **Riffle Run** **Glide Pool** **Dry**	Dominant substrate type Gravel	Dominant types riparian vegetation: Left bank: Trees, forbs Right bank: Trees, forbs			% Gravel or larger:	CL	17
							CR	15
Macrophytes (circle one) **Abundant Common** **Rare Absent**	Algae (circle one) **Abundant Common** **Rare Absent**	Width of natural buffer vegetation (m) LB: 30	RB: 20	Instream cover types: NA		% Instream cover NA	LB	15
							RB	17

Location of transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: Dry	Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
119 m upstream of Transect 4 Lat – 31° 37.637' Long – 97° 02.549' 5	NA	52	60		55	80	Total	16
	Habitat type (Circle One) **Riffle Run** **Glide Pool** **Dry**	Dominant substrate type Sand	Dominant types riparian vegetation: Left bank: Forbs, Trees Right bank: Trees, bank			% Gravel or larger: 0	CL	16
							CR	15
Macrophytes (circle one) **Abundant Common** **Rare Absent**	Algae (circle one) **Abundant Common** **Rare Absent**	Width of natural buffer vegetation (m) LB: 20	RB: 20	Instream cover types: NA, Dry		% Instream cover: NA	LB	16
							RB	16

Location of transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth:	Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
							Total	
	Habitat type (circle one) **Riffle Run** **Glide Pool**	Dominant substrate type	Dominant types riparian vegetation: Left bank: Right bank:			% Gravel or larger	CL	
							CR	
Macrophytes (circle one) **Abundant Common** **Rare Absent**	Algae (circle one) **Abundant Common** **Rare Absent**	Width of natural buffer vegetation(m) LB:	RB:	Instream cover types:		% Instream cover	LB	
							RB	

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:			
Stream Name	Tehuacana Creek, Station # 18870 at US84	**Date**	9/25/06
Physical Characteristics		**Value**	
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)		7.74 m/km	
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)		447 sq. km.	
Stream order		4	
Length of stream evaluated (in meters or kilometers)		394 m	
Number of lateral transects made		5	
Average stream width (in meters)		5.8	
Average stream depth (in meters)		0.9	
Instantaneous stream flow (in ft^3/sec)		0	
Indicate flow measurement method		NA	
Channel flow status (high, moderate, low, or no flow)		No Flow	
Maximum pool width (in meters)		5.8	
Maximum pool depth (in meters)		0.9	
Total number of stream bends		2	
Number of well defined bends		0	
Number of moderately defined bends		2	
Number of poorly defined bends		0	
Total number of riffles		0	
Dominant substrate type		4= Gravel	
Average percent of substrate gravel sized or larger		19	
Average percent instream cover		2	
Number of stream cover types	Moderate undercut bank, woody debris	2	
Average percent stream bank erosion potential		52	
Average stream bank slope (in degrees)		42	
Average width of natural buffer vegetation (in meters)		26	
Average riparian vegetation percent composition by: (total to equal 100%)			
Trees		32	
Shrubs		0	
Grasses and Forbes		34	
Cultivated fields		0 (Outside of buffer trees)	
Other		34	
Average percent tree canopy coverage		19	
Overall aesthetic appraisal of the stream		Natural	

Habitat Assessment Worksheet B Part III of III

Part III - Habitat Quality Index

Habitat Parameter	Scoring Category			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	**Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score_____1___	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	**Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score_____2___	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** $\geq$ 5 riffles	**Common** 2-4 riffles	**Rare** 1 riffle	**Absent** No riffles
Score_____1___	4	3	2	1
Dimensions of Largest Pool	**Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score_____3____	4	3	2	1
Channel Flow Status	**High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score_____0____	3	2	1	0

Part III - Habitat Quality Index (continued)

Habitat Parameter	Scoring Category			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score_____0.5____	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score_____1____	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score_____3____	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score_____2____	3	2	1	0

Total Score____13.5 _____

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
20 - 25 **High**
14 - 19 **Intermediate**
≤ 13 **Limited**

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Habitat Assessment Worksheet B Part I of III

Worksheet #	**Part I - Stream Physical Characteristics Worksheet**		
Observers: A. Whisenant, C. Contreras, J, Bronson		Date:9/26/06	Time:10:30
Weather conditions: Calm, Sunny, Cool			
Stream: Tehuacana Creek, Station # 18871		Stream Segment no. 1242 N	
Location of site: at Old Mexia Rd, 2.71 km downstream of US 84		Length of reach: 412 M	
Observed stream uses: Wildlife, Fishing			
Stream type (circle one):	**perennial**	or	**intermittent w/ perennial pools**
Stream bends: 3	No. well defined 2	No. moderately defined 1	No. poorly defined None
Aesthetics (circle one):	**(1) wilderness**	**(2) natural**	**(3) common** **(4) offensive**
Channel obstructions or modifications: log Jams			No. of riffles None
Channel flow status (circle one):	**high**	**moderate**	**low** **no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	27	24
Shrubs	0	0
Grasses or forbs	32	42
Cultivated fields	0	0
Other	41	34

Site map:

Notes

This study was conducted under drought conditions. Pools were diminished but still provided habitat.

Station # 18871 **Part I – TCEQ Stream Physical Characteristics Worksheet**

Location of transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.68										Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
1st 60 m upstream of Old Mexia Rd. bridge Lat - 31° 35.957' Long - 097° 02.967'	6.2	26	50	.01	.36	.59	.68	.67	.66	.62	.50	.44	.37	.25	27	30	Total	14
	Habitat type (circle one) **Riffle** **Run** **Glide** **Pool**		Dominant substrate type Clay												Dominant types riparian vegetation: Left bank: Trees, forbs Right bank: Trees, forbs		% Gravel or larger 5	CL CR	11 16
Macrophytes (circle one) **Abundant** **Common** **Rare** **Absent**	Algae (circle one) **Abundant** **Common** **Rare** **Absent**		Width of natural buffer vegetation (m) LB: 5	RB: 30											Instream cover types: Overhanging veg. woody debris moderately undercut banks		% Instream cover 15	LB RB	13 17
Location of transect 108 m upstream of Transect 1 Lat - 31° 35.993'' Long - 097°02.993'' 2	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.52											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
	3.0	45	80	.06	.13	.18	.24	.36	.45	.52	.54	.37	.12	.25	33	80	Total	15
	Habitat type (Circle One) **Riffle** **Run** **Glide** **Pool**		Dominant substrate type Clay												Dominant types riparian vegetation: Left bank: Trees, vines, forbs Right bank: Trees, forbs		% Gravel or larger 0	CL CR	17 14
Macrophytes (circle one) **Abundant** **Common** **Rare** **Absent**	Algae (circle one) **Abundant** **Common** **Rare** **Absent**		Width of natural buffer vegetation (m) LB: 40	RB: 60											Instream cover types: root wads, undercut banks, woody debris		% Instream cover 50	LB RB	16 14
Location of Transect 80 m upstream of Transect 2 Lat - 31° 36.023'' Long - 097° 02.995' 3	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.21											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
	4.2	29	30	.08	.15	.19	.19	.20	.18	.17	.19	.17	.21	.06	36	70	Total	14
	Habitat type (circle one) **Riffle** **Run** **Glide** **Pool**		Dominant substrate type Clay/Silt												Dominant types riparian vegetation: Left bank: Trees, forbs Right bank: vines, forbs		% Gravel or larger: 0	CL CR	16 12
Macrophytes (circle one) **Abundant** **Common** **Rare** **Absent**	Algae (circle one) **Abundant** **Common** **Rare** **Absent**		Width of natural buffer vegetation (m) LB: 30	RB: 200											Instream cover types: woody debris		% Instream cover: 5	LB RB	16 12

Station # 18871

Part I – TCEQ Stream Physical Characteristics Worksheet (continued)

Location of transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.86											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
120 m upstream of Transect 3 Lat - 31° 36.070' Long - 097° 02.956' 4	8.0	24	50	.04	.27	.61	.73	.76	.8	.86	.83	.82	.74	.17	35	70	Total	12
	Habitat type (circle one) **Riffle Run** **Glide [Pool]**		Dominant substrate type Silt												Dominant types riparian vegetation: Left bank: Forbs, trees Right bank: Forbs, small trees		% Gravel or larger: 0	CL	13
																		CR	15
Macrophytes (circle one) **Abundant Common** **Rare [Absent]**	Algae (circle one) **Abundant Common** **[Rare] Absent**		Width of natural buffer vegetation (m) LB: 25	RB: >200	Instream cover types: Root wads, woody debris												% Instream cover: 5	LB	15
																		RB	16
Location of transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.50											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
104 m upstream of Transect 4 Lat - 31° 36.104' Long - 097° 02.902' 5	5.0	34	80	.06	.18	.33	.50	.49	.41	.41	.29	.27	.17	.08	33	70	Total	13
	Habitat type (Circle One) **Riffle Run** **Glide [Pool]**		Dominant substrate type Silt												Dominant types riparian vegetation: Left bank: Forbs Right bank: Trees, forbs		% Gravel or larger: 0	CL	12
																		CR	16
Macrophytes (circle one) **Abundant Common** **Rare [Absent]**	Algae (circle one) **Abundant Common** **[Rare] Absent**		Width of natural buffer vegetation (m) LB: 0	RB: 20	Instream cover types: Woody Debris												% Instream cover: 5	LB	7
																		RB	17
Location of transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth:											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
																	Total	
	Habitat type (circle one) **Riffle Run** **Glide Pool**		Dominant substrate type												Dominant types riparian vegetation: Left bank: Right bank:		% Gravel or larger	CL	
																		CR	
Macrophytes (circle one) **Abundant Common** **Rare Absent**	Algae (circle one) **Abundant Common** **Rare Absent**		Width of natural buffer vegetation (m) LB:	RB:	Instream cover types:												% Instream cover	LB	
																		RB	

Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:

Stream Name	Tehuacana Creek, Station # 18871 at Old Mexia Rd	**Date**	09/26/06

Physical Characteristics	**Value**
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)	7.40m/km
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)	461sq. km
Stream order	4
Length of stream evaluated (in meters or kilometers)	412
Number of lateral transects made	5
Average stream width (in meters)	5.3
Average stream depth (in meters)	0.4
Instantaneous stream flow (in ft^3/sec)	0
Indicate flow measurement method	NA
Channel flow status (high, moderate, low, or no flow)	No Flow
Maximum pool width (in meters)	8.0
Maximum pool depth (in meters)	0.9
Total number of stream bends	3
Number of well defined bends	2
Number of moderately defined bends	1
Number of poorly defined bends	0
Total number of riffles	0
Dominant substrate type	Clay
Average percent of substrate gravel sized or larger	2.0
Average percent instream cover	9.0
Number of stream cover types Undercut banks, woody, root wads, overhang veg.	4
Average percent stream bank erosion potential	61
Average stream bank slope (in degrees)	32
Average width of natural buffer vegetation (in meters)	26
Average riparian vegetation percent composition by: (total to equal 100%)	
Trees	26
Shrubs	0
Grasses and Forbes	37
Cultivated fields	0 (outside of buffer of trees)
Other	37
Average percent tree canopy coverage	14
Overall aesthetic appraisal of the stream	Natural

Habitat Assessment Worksheet B Part III of III

Part III - Habitat Quality Index

Habitat Parameter	Scoring Category			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	**Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score_____1__	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	**Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score_____1___	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** $\geq$ 5 riffles	**Common** 2-4 riffles	**Rare** 1 riffle	**Absent** No riffles
Score_____1___	4	3	2	1
Dimensions of Largest Pool	**Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score_____3___	4	3	2	1
Channel Flow Status	**High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score_____0__	3	2	1	0

Part III - Habitat Quality Index (continued)

Habitat Parameter	Scoring Category			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score_____1__	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score_____3___	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score_____3___	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score_____2___	3	2	1	0

Total Score_____15_____

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
20 - 25 **High**
14 - 19 **Intermediate**
≤ 13 **Limited**

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Habitat Assessment Worksheet B Part I of III

Worksheet #	**Part I - Stream Physical Characteristics Worksheet**		
Observers: A. Whisenant, C. Contreras, J, Bronson		Date: 9/27/06	Time: 10:30
Weather conditions: Partly cloudy, warm			
Stream: Tehuacana Creek, Station # 11610		Stream Segment no. 1242 N	
Location of site: upstream of FM 2491		Length of reach: 561	
Observed stream uses: Wildlife			
Stream type (circle one):	**perennial**	or	**intermittent w/ perennial pools**
Stream bends: 8	No. well defined 2	No. moderately defined 2	No. poorly defined 4
Aesthetics (circle one):	**(1) wilderness**	**(2) natural**	**(3) common** **(4) offensive**
Channel obstructions or modifications: None			No. of riffles None
Channel flow status (circle one):	**high**	**moderate**	**low** **no flow**

Riparian vegetation (%):	**Left Bank**	**Right Bank**
Trees	25	26
Shrubs	0	0
Grasses or forbs	64	44
Cultivated fields	0	0
Other	11	30

Site map:

Notes

Pools were severely diminished due to drought conditions.

TCEQ 20156-A (Rev. 4-14-2005)

Station # 11610 **Part I – TCEQ Stream Physical Characteristics Worksheet**

Location of Transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.21										Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
235 m upstream from Old Mexia Rd. Lat - 31° 33.974' Long - 097° 02.930' 1	2.9	32.3	40	.04	.13	.21	.18	.20	.19	.20	.19	.14	.08	.04	43	60	Total	13
	Habitat type (circle one) **Riffle Run** **Glide [Pool]**		Dominant substrate type Silt/Clay	Dominant types riparian vegetation: Left bank: Forbs, Trees Right bank: Forbs, Trees											% Gravel or larger: 0		CL	9
																	CR	16
Macrophytes (circle one) **Abundant Common** **Rare [Absent]**	Algae (circle one) **Abundant Common** **[Rare] Absent**		Width of natural buffer vegetation (m) LB: 20	RB: 20	Instream cover types: Undercut banks, root wads, woody debris, overhanging veg.											% Instream cover: 10		LB	10
																	RB	17
Location of Transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 4.2										Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
221 m upstream of Transect 1 Lat - 31° 34.082' Long - 097° 02.944' 2	8.3	34	70	.14	.31	.53	.69	.78	.84	.74	.65	.57	.36	.12	29	40	Total	11.
	Habitat type (Circle One) **Riffle Run** **Glide [Pool]**		Dominant substrate type Silt/Clay	Dominant types riparian vegetation: Left bank: Forbs, Grasses, Trees Right bank: Forbs, Grasses, Trees											% Gravel or larger: 0		CL	10
																	CR	7
Macrophytes (circle one) **Abundant [Common]** **Rare Absent**	Algae (circle one) **Abundant [Common]** **Rare Absent**		Width of natural buffer vegetation (m) LB: 20	RB: 2	Instream cover types: Macrophytes, algal beds, woody debris											% Instream cover: 5		LB	15
																	RB	13
Location of Transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 3.5										Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
95 m upstream of Transect 2 Lat - 31° 34.118' Long - 097° 02.961' 3	15.5	10	20	.29	.63	.88	1.03	1.20	1.80	1.80	.87	.91	.52	.21	45	90	Total	0
	Habitat type (circle one) **Riffle Run** **Glide [Pool]**		Dominant substrate type Silt/Clay	Dominant types riparian vegetation: Left bank: Trees, Forbs, Grasses Right bank: None, but a few grasses											% Gravel or larger: 20		CL	0
																	CR	0
Macrophytes (circle one) **Abundant [Common]** **Rare Absent**	Algae (circle one) **Abundant [Common]** **Rare Absent**		Width of natural buffer vegetation (m) LB :20	RB: 0	Instream cover types: Woody debris, macrophytes, cobble											% Instream cover: 5		LB	0
																	RB	0

Station # 11610

Part I – TCEQ Stream Physical Characteristics Worksheet (continued)

Location of Transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream Depths (m) at Points Across Transect Thalweg Depth: 0.88											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
120 m upstream of Transect 3	8.2	27	80	.32	.46	.58	.72	.87	.88	.70	.63	.49	.40	.24	41	70	Total	16
Lat - 31° 34.150’ Long - 097° 02.978’ 4	Habitat type (circle one) **Riffle Run** **Glide** **Pool**		Dominant substrate type Silt/ Clay												Dominant types riparian vegetation: Left bank: Forbs, Trees, Vines Right bank: Forbs, Trees, Vines		% Gravel or larger: 10	CL	14
																		CR	16
Macrophytes (circle one) **Abundant Common** **Rare** **Absent**	Algae (circle one) **Abundant Common** **Rare** **Absent**		Width of natural buffer vegetation (m) LB :10	RB: 10	Instream cover types: Undercut Banks, Woody Debris												% Instream cover: 5	LB	16
																		RB	16

Location of Transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth: 0.22											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
125 m upstream of Transect 4	5.6	32	80	.07	.16	.18	.21	.22	.15	.17	.16	.14	.06	.03	44	60	Total	11.5
Lat - 31° 34.199’ Long - 097° 02.984’ 5	Habitat type (Circle One) **Riffle Run** **Glide** **Pool**		Dominant substrate type Silt. Clay												Dominant types riparian vegetation: Left bank: Trees, Forbs Right bank: Trees, Forbs		% Gravel or larger: 0	CL	16
																		CR	7
Macrophytes (circle one) **Abundant** **Common** **Rare Absent**	Algae (circle one) **Abundant** **Common** **Rare Absent**		Width of natural buffer vegetation (m) LB: 100	RB: 3	Instream cover types: Macrophyte and algal beds, woody debris												% Instream cover: 20	LB	16
																		RB	7

Location of transect	Stream width (m)	Left bank slope (E)	Left bank erosion potential (%)	Stream depths (m) at points across transect Thalweg depth:											Right bank slope (E)	Right bank erosion potential (%)	Tree canopy (%)	
																	Total	
	Habitat type (circle one) **Riffle Run** **Glide Pool**		Dominant substrate type												Dominant types riparian vegetation: Left bank: Right bank:		% Gravel or larger	CL	
																		CR	
Macrophytes (circle one) **Abundant Common** **Rare Absent**	Algae (circle one) **Abundant Common** **Rare Absent**		Width of natural buffer vegetation (m) LB:	RB:	Instream cover types:												% Instream cover	LB	
																		RB	

Habitat Assessment Worksheet B Part II of III

Part II - Summary of Physical Characteristics of Water Body

Using information from all of the transects and measurements in Part I and other sources, report the following general characteristics or averages for the entire reach:

Stream Name	Tehuacana Creek, Station # 11610 at FM 2491	**Date**	9/27/06

Physical Characteristics	**Value**
Stream bed slope over evaluated reach (from USGS map; elevation change in meters/reach length in meters)	5.43 m/km
Approximate drainage area above the transect furthest downstream (from USGS or county highway map in km^2)	493 sq. km
Stream order	4
Length of stream evaluated (in meters or kilometers)	561 m
Number of lateral transects made	5
Average stream width (in meters)	8.1
Average stream depth (in meters)	0.5
Instantaneous stream flow (in ft^3/sec)	0
Indicate flow measurement method	NA
Channel flow status (high, moderate, low, or no flow)	No Flow
Maximum pool width (in meters)	15.5
Maximum pool depth (in meters)	1.8
Total number of stream bends	8
Number of well defined bends	2
Number of moderately defined bends	2
Number of poorly defined bends	4
Total number of riffles	0
Dominant substrate type	Silt
Average percent of substrate gravel sized or larger	6
Average percent instream cover	9
Number of stream cover types: Undercut banks, root wads, overhang veg. woody debris, macrophyte beds, algal beds, cobble	7
Average percent stream bank erosion potential	61
Average stream bank slope (in degrees)	34
Average width of natural buffer vegetation (in meters)	21
Average riparian vegetation percent composition by: (total to equal 100%)	
Trees	25
Shrubs	0
Grasses and Forbes	54
Cultivated fields	0 (Outside of buffer of trees)
Other	21
Average percent tree canopy coverage	10
Overall aesthetic appraisal of the stream	Natural

Habitat Assessment Worksheet B Part III of III

Part III - Habitat Quality Index

Habitat Parameter	Scoring Category			
Available Instream Cover	**Abundant** >50% of substrate favorable for colonization and fish cover; good mix of several stable (not new fall or transient) cover types such as snags, cobble, undercut banks, macrophytes	**Common** 30-50% of substrate supports stable habitat; adequate habitat for maintenance of populations; may be limited in the number of different habitat types	**Rare** 10-29.9% of substrate supports stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed	**Absent** <10% of substrate supports stable habitat; lack of habitat is obvious; substrate unstable or lacking
Score_____1___	4	3	2	1
Bottom Substrate Stability	**Stable** >50% gravel or larger substrate; gravel, cobble, boulders; dominant substrate type is gravel or larger	**Moderately Stable** 30-50% gravel or larger substrate; dominant substrate type is mix of gravel with some finer sediments	**Moderately Unstable** 10-29.9% gravel or larger substrate; dominant substrate type is finer than gravel, but may still be a mix of sizes	**Unstable** <10% gravel or larger substrate; substrate is uniform sand, silt, clay or bedrock
Score_____1___	4	3	2	1
Number of Riffles To be counted, riffles must extend >50% the width of the channel and be at least as long as the channel width	**Abundant** $\geq$ 5 riffles	**Common** 2-4 riffles	**Rare** 1 riffle	**Absent** No riffles
Score_____1___	4	3	2	1
Dimensions of Largest Pool	**Large** Pool covers more than 50% of the channel width; maximum depth is >1 meter	**Moderate** Pool covers approximately 50% or slightly less of the channel width; maximum depth is 0.5-1 meter	**Small** Pool covers approximately 25% of the channel width; maximum depth is <0.5 meter	**Absent** No existing pools; only shallow auxiliary pockets
Score_____4___	4	3	2	1
Channel Flow Status	**High** Water reaches the base of both lower banks; < 5% of channel substrate is exposed	**Moderate** Water fills >75% of the channel; or <25% of channel substrate is exposed	**Low** Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	**No Flow** Very little water in the channel and mostly present in standing pools; or stream is dry
Score_____0___	3	2	1	0

Part III - Habitat Quality Index (continued)

Habitat Parameter	Scoring Category			
Bank Stability	**Stable** Little evidence (<10%) of erosion or bank failure; bank angles average <30°	**Moderately Stable** Some evidence (10-29.9%) of erosion or bank failure; small areas of erosion mostly healed over; bank angles average 30-39.9°	**Moderately Unstable** Evidence of erosion or bank failure is common (30-50%); high potential of erosion during flooding; bank angles average 40-60°	**Unstable** Large and frequent evidence (>50%) of erosion or bank failure; raw areas frequent along steep banks; bank angles average >60°
Score_____1___	3	2	1	0
Channel Sinuosity	**High** ≥ 2 well-defined bends with deep outside areas (cut banks) and shallow inside areas (point bars) present	**Moderate** 1 well-defined bend or ≥ 3 moderately-defined bends present	**Low** <3 moderately-defined bends or only poorly-defined bends present	**None** Straight channel; may be channelized
Score_____3___	3	2	1	0
Riparian Buffer Vegetation	**Extensive** Width of natural buffer is >20 meters	**Wide** Width of natural buffer is 10.1-20 meters	**Moderate** Width of natural buffer is 5-10 meters	**Narrow** Width of natural buffer is <5 meters
Score_____3___	3	2	1	0
Aesthetics of Reach	**Wilderness** Outstanding natural beauty; usually wooded or unpastured area; water clarity is usually exceptional	**Natural Area** Trees and/or native vegetation are common; some development evident (from fields, pastures, dwellings); water clarity may be slightly turbid	**Common Setting** Not offensive; area is developed, but uncluttered such as in an urban park; water clarity may be turbid or discolored	**Offensive** Stream does not enhance the aesthetics of the area; cluttered; highly developed; may be a dumping area; water clarity is usually turbid or discolored
Score_____2___	3	2	1	0

Total Score___16___

HABITAT QUALITY INDEX

26 - 31 **Exceptional**
20 - 25 **High**
14 - 19 **Intermediate**
≤ 13 **Limited**

Appendix D – Biological Data Summary: Biological Assessment

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Habitat Data Reporting Form

RTAG#	REGION	EMAIL-ID:	COLLECTOR

STATION ID	SEGMENT	SEQUENCE	DATA SOURCE
18870	1242N		

Station Description _____Tehuacana Creek upstream of the confluence with Kirkland Branch and US 84_____

Composite - habitat events will be Both

COMPOSITE SAMPLE

B COMPOSITE CATEGORY: T=Time S=Space B=Both

START DATE (MMDDYYYY)	START TIME (HHMM)	START DEPTH (SHALLOWEST)	M = meters F = feet
09252006	1045	Y	

END DATE (MMDDYYYY)	END TIME (HHMM)	END DEPTH (DEEPEST)	M = meters F = feet
09252006		Y	

HABITAT DESCRIPTORS

NOTE: All measurements reported in metric units

72052	7.74	Streambed slope over evaluated reach (from USGS map; elevation change in meters/reach length in kilometers multiplied by 1000)	89844	4	Dominant substrate type (1=clay, 2-silt, 3=sand, 4=gravel, 5=cobble, 6=boulder, 7=bedrock, 8=other)
89859	447	Approximate drainage area above the most downstream transect from USGS map (km^2)	89845	19	Average percent of substrate gravel size (> 2mm) or larger (%)
89860	0.394	Length of stream evaluated (km)	84159	2	Average percent instream cover (%)
89832	5	Number of lateral transects that were made	89929	2	Number of Stream Cover Types
89861	5.8	Average stream width (m)	89846	52.0	Average percent stream bank erosion potential (%)
89862	0.9	Average stream depth (m)	89847	42.0	Average stream bank angle (degrees)
00061	0	Instantaneous stream flow (ft^3/sec)	89866	26	Average width of natural riparian vegetation (m)
89835	NA	Indicate flow measurement method 1=Flow Gage Station, 2= Electronic, 3=Mechanical, 4=Weir/Flume, 5=Doppler	89849	32	Average percent trees as riparian vegetation, over reach (%)
			89850	0	Average percent shrubs as riparian vegetation, over reach (%)
89848	1	Channel Flow Status 1=no flow, 2=low, 3=moderate, 4=high	89851	34	Average percent grasses and forbes as riparian vegetation, over reach (%)
89864	5.8	Maximum pool width at time of study (m)	89852	0	Average percent cultivated fields as riparian vegetation, over reach (%)
89865	0.9	Maximum pool depth in study area (m)	89853	34	Average percent other as riparian vegetation, over reach (%)
89839	2	Total number of stream bends	89854	19	Average percent tree canopy coverage (%)
89840	0	Number of well defined stream bends	89867	2	Aesthetics (1=wilderness, 2=natural, 3=common, 4=offensive)
89841	2	Number of moderately defined stream bends	84161	4	Stream Order
89842	0	Number of poorly defined stream bends	89961	32	Ecoregion (Texas Ecoregion Code)
89843	0	Total number of riffles	89962	3	Land Development Impact (1=unimpacted, 2=low, 3=moderate, 4=high)

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Benthic Macroinvertebrate Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID: 1 8 8 7 0

SEGMENT: 1 2 4 2N

SEQUENCE | DATA SOURCE

Station Description_____Tehuacana Creek upstream of the confluence with Kirkland Branch and US 84_____

Composite - Most biological samples will be type Both

COMPOSITE SAMPLE

COMPOSITE CATEGORY: B (T=Time S=Space B=Both)

START DATE (MMDDYYYY): 0 9 2 5 2 0 0 6

START TIME (HHMM): 1 0 4 5

START DEPTH (SHALLOWEST): X

M = meters F = feet

END DATE (MMDDYYYY):

END TIME (HHMM):

END DEPTH (DEEPEST): X

M = meters F = feet

PARAMETRIC DATA

Enter the codes and values appropriate for this sample. Code (<) if less than value, and (>) if greater than value, other wise leave this column blank. Continue if necessary, on additional worksheets. Codes to describe the benthic sampling effort are listed on the back. Benthic data must be submitted with a Habitat Assessment.

CODE	(<) or (>)	Value	Description
			No benthics collected due to habitat conditions (diminished pool)

Benthic Macroinvertebrate Parameter Codes

NOTE: Measurements reported in metric units
**** Indicates Parameter Measured at Sample Point (e.g. riffle from which benthic sample is collected)**

Quantitative Benthic Sample Descriptors					
89899		Biological Data Reporting Units (Values: 1= number of individuals from sub-sample; 2 = number of individuals/ft^2; 3 = number of individuals/m^2; 4 = total number in kicknet)	**89946**		Mesh size, any net or sieve (diagonal measurements) for benthic collection (cm)
89901		Surber Sampler Effort, area sampled (m^2)	**89961**		Ecoregion (Texas Ecoregion Code)
89935		Ekman Sampler Effort, area sampled (m^2)	**84161**		Stream Order
89934		Petersen Sampler Effort, area sampled (m^2)	**90005**		Benthos Sampled--No Organisms Present
89933		Hester-Dendy Duration (days)	**90055**		Total Taxa (Taxa Richness), Benthos # Taxa
89950		Benthic Sampler (1=Surber, 2=Ekman, 3=kicknet, 4=Petersen, 5=Hester-Dendy)	**90056**		Total # of Diptera Taxa
89975		Area of snag surface sampled (m^2)	**90057**		Total # of Ephemeroptera Taxa
****89921**		Percent undercut bank at sample point (%)	**90058**		Total # of Intolerant Taxa
****89922**		Percent overhanging brush at sample point (%)	**90060**		EPT Taxa (% of communtiy)
****89923**		Percent gravel substrate at sample point (%)	**90062**		Chironomidae (% of community)
****89924**		Percent sand substrate at sample point (%)	**90066**		Tolerant Taxa (% of community), Benthos
****89925**		Percent soft bottom at sample point (%)	**90020**		Benthic Grazers (% of community)
****89926**		Percent macrophyte bed at sample point (%)	**90025**		Benthic Gatherers (% of community)
****89927**		Percent snags and brush at sample point (%)	**90030**		Benthic Filterers (% of community)
****89928**		Percent bedrock at sample point (%)	**90067**		Dominance (3 Taxa) (% of community)
RBAP Benthic Sample Descriptors					
89899		Biological Data Reporting Units (Values: 1= number of individuals from sub-sample; 2 = number of individuals/ft^2; 3 = number of individuals/m^2; 4 = total number in kicknet)	89946		Mesh size, sieve (diagonal measurements) (cm)
89950		Benthic Sampler (1=Surber, 2=Ekman, 3=kicknet, 4=Petersen, 5=Hester-Dendy)	**89961**		Ecoregion (Texas Ecoregion Code)
89902		Dip Net Effort, area swept (m^2)	**84161**		Stream Order
89903		Kicknet Effort, area kicked (m^2)	**90005**		Benthos Sampled--No Organisms Present
89904		Kicknet Effort, minutes kicked (min.)	**90055**		Total Taxa (Taxa Richness), Benthos, # Taxa
89905		Snags and Shoreline Sampling Effort, minutes picked	**90008**		EPT Taxa Abundance (# Taxa)
89906		Number of individuals in benthic RBA sub-sample ($\forall$ 100)	**90007**		Biotic Index (HBI)
89950		Benthic Sampler (1=Surber, 2=Ekman, 3=kicknet, 4=Petersen, 5=Hester-Dendy)	**90062**		Chironomidae (% of community)
****89921**		Percent undercut bank at sample point (%)	**90042**		Dominant Taxon, Benthos (% of community)
****89922**		Percent overhanging brush at sample point (%)	**90010**		Dominant Functional Feeding Group (% of community)
****89923**		Percent gravel substrate at sample point (%)	**90036**		Benthic Predators (% of community)
****89924**		Percent sand substrate at sample point (%)	**90050**		Ratio of Intolerant: Tolerant Taxa
****89925**		Percent soft bottom at sample point (%)	**90069**		% of Total Trichoptera as Hydropsychidae
****89926**		Percent macrophyte bed at sample point (%)	**90052**		Total # Non-insect Taxa
****89927**		Percent snags and brush at sample point (%)	**90025**		Benthic Collector-Gatherers (% of community)
****89928**		Percent bedrock at sample point (%)	**90054**		% of Total # as Elmidae (% of community)

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Nekton Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

1	8	8	7	0	1	2	4	2 N										
STATION ID					SEGMENT				SEQUENCE						DATA SOURCE			

Station Description___Tehuacana Creek upstream of confluence with Kirkland Branch and US 84_____

Composite - Most biological samples will be: Both

COMPOSITE SAMPLE

B	COMPOSITE CATEGORY:	T=Time	S=Space	B=Both

0	9	2	7	2	0	0	6	1	7	3	0			X		
M	M	D	D	Y	Y	Y	Y	H	H	M	M	START DEPTH (SHALLOWEST)				M = meters F = feet
START DATE								START TIME								

0	9	2	7	2	0	0	6	1	8	3	0			X		
M	M	D	D	Y	Y	Y	Y	H	H	M	M	END DEPTH (DEEPEST)				M = meters F = feet
END DATE								END TIME								

PARAMETRIC DATA

Enter the codes and values appropriate for this sample. Code (<) if less than value, and (>) if greater than value, other wise leave this column blank. Continue if necessary, on additional worksheets. Codes to describe the nekton sampling effort are listed on the back. Nekton data must be submitted with a Habitat Assessment.

CODE	Gear Type	Value	Common Name	Common Name
98437	Seine	5	*Cyprinus carpio*	Common carp
99108	Seine	7	*Pomoxis annularis*	White crappie
99109	Seine	4	*Pomoxis nigromaculatus*	Black crappie
99097	Seine	25	*Lepomis macrochirus*	Bluegill
99094	Seine	18	*Lepomis cyanellus*	Green sunfish
99095	Seine	6	*Lepomis gulosus*	Warmouth
98564	Seine	1	*Ameiurus natalis*	Yellow bullhead
98441	Seine	1	*Notemigonus crysoleucas*	Golden shiner
98430	Seine	12	*Dorosoma cepedianum*	Gizzard shad
99100	Seine	1	*Lepomis microlophus*	Redear sunfish
99099	Seine	7	*Lepomis megalotis*	Longear sunfish
99096	Seine	1	*Lepomis humilis*	Orangespotted sunfish
98713	Seine	9	*Gambusia affinis*	Western mosquitofish
98511	Seine	2	*Carpiodes carpio*	River carpsucker
98474	Seine	2	*Cyprinella lutrensis*	Red shiner

Nekton Parameter Codes

NEKTON SAMPLES					
98005		Nekton, None Captured	98003	15	Total # Fish Species (Richness)
89944		Electrofishing Effort, Duration of Shocking (sec.)	98004	0	Total # of Darter Species
89947	3	Seining Effort (# of Seine Hauls)	98008	8	Total # of Sunfish Species (except bass)
89948	18.3	Combined Length of Seine Hauls (meters)	98009	1	Total # of Sucker Species
89949		Seining Effort, Duration (min.)	98010	0	Total # of Intolerant Fish Species
89930	0.476	Minimum Seine Mesh Size, net average bar (inches)	98016	70.3	Tolerant Individuals, Fish (% of community)
89931	0.476	Maximum Seine Mesh Size, net average bar (inches)	98017	19.8	Omnivore Individuals (% of community)
89941	4.57	Net Length (meters)	98021	45.5	Insectivore/Invertivore Individuals (% of community)
89943		Electrofishing Method (1= boat, 2=backpack, 3=tote barge)	98022	34.7	Piscivore Individuals (% of community)
89976	83.6	Area Seined (m^2)	98023	101	Total # of Individuals
84161	4	Stream Order	98024	0.0	Hybrid individuals (% of community)
89961	32	Ecoregion (Texas Ecoregion Code)	98030	0.0	Individuals with disease / anomalies (% of community)
Additional Parameters					
89942		Net or Hook & Line Effort, Duration in Water (hrs)	89951		Cooling Water Intake Screen (1=revolving, 2=static)
89945		Castnetting Effort (# of casts)	89940		Intake Screen Collection, Duration (min.)
89907		Trawl, Otter, Duration (min.)	89953		Trawl, Otter, Width (meters)

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Habitat Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID: 1 8 8 7 1 | SEGMENT: 1 2 4 2N | SEQUENCE | DATA SOURCE

Station Description _____Tehuacana Creek at Old Mexia Rd._____

Composite - habitat events will be Both

COMPOSITE SAMPLE

B COMPOSITE CATEGORY: T=Time S=Space B=Both

	START DATE (MMDDYYYY)	START TIME (HHMM)	START DEPTH (SHALLOWEST)	
	09262006	1030	Y	M = meters F = feet
	END DATE (MMDDYYYY)	END TIME (HHMM)	END DEPTH (DEEPEST)	
	09262006		Y	M = meters F = feet

HABITAT DESCRIPTORS					
NOTE: All measurements reported in metric units					
72052	7.40	Streambed slope over evaluated reach (from USGS map; elevation change in meters/reach length in kilometers multiplied by 1000)	89844	1	Dominant substrate type (1=clay, 2-silt, 3=sand, 4=gravel, 5=cobble, 6=boulder, 7=bedrock, 8=other)
89859	461	Approximate drainage area above the most downstream transect from USGS map (km^2)	89845	2.0	Average percent of substrate gravel size (> 2mm) or larger (%)
89860	0.412	Length of stream evaluated (km)	84159	9.0	Average percent instream cover (%)
89832	5	Number of lateral transects that were made	89929	4	Number of Stream Cover Types
89861	5.3	Average stream width (m)	89846	61	Average percent stream bank erosion potential (%)
89862	0.4	Average stream depth (m)	89847	32	Average stream bank angle (degrees)
00061	0	Instantaneous stream flow (ft^3/sec)	89866	26	Average width of natural riparian vegetation (m)
89835	NA	Indicate flow measurement method 1=Flow Gage Station, 2= Electronic, 3=Mechanical, 4=Weir/Flume, 5=Doppler	89849	26	Average percent trees as riparian vegetation, over reach (%)
			89850	0	Average percent shrubs as riparian vegetation, over reach (%)
89848	1	Channel Flow Status 1=no flow, 2=low, 3=moderate, 4=high	89851	37	Average percent grasses and forbes as riparian vegetation, over reach (%)
89864	8.0	Maximum pool width at time of study (m)	89852	0	Average percent cultivated fields as riparian vegetation, over reach (%)
89865	0.9	Maximum pool depth in study area (m)	89853	37	Average percent other as riparian vegetation, over reach (%)
89839	3	Total number of stream bends	89854	14	Average percent tree canopy coverage (%)
89840	2	Number of well defined stream bends	89867	2	Aesthetics (1=wilderness, 2=natural, 3=common, 4=offensive)
89841	1	Number of moderately defined stream bends	84161	4	Stream Order
89842	0	Number of poorly defined stream bends	89961	32	Ecoregion (Texas Ecoregion Code)
89843	0	Total number of riffles	89962	3	Land Development Impact (1=unimpacted, 2=low, 3=moderate, 4=high)

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Benthic Macroinvertebrate Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID: 1 8 8 7 1 | SEGMENT: 1 2 4 2N | SEQUENCE | DATA SOURCE

Station Description_____Tehuacana Creek at Old Mexia Rd._____

Composite - Most biological samples will be type Both

COMPOSITE SAMPLE

COMPOSITE CATEGORY: B (T=Time S=Space B=Both)

START DATE (MMDDYYYY)	START TIME (HHMM)	START DEPTH (SHALLOWEST)	M = meters F = feet
09262006	1030	X	

END DATE (MMDDYYYY)	END TIME (HHMM)	END DEPTH (DEEPEST)	M = meters F = feet
09262006		X	

PARAMETRIC DATA

Enter the codes and values appropriate for this sample. Code (<) if less than value, and (>) if greater than value, other wise leave this column blank. Continue if necessary, on additional worksheets. Codes to describe the benthic sampling effort are listed on the back. Benthic data must be submitted with a Habitat Assessment.

CODE	(<) or (>)	Value	Description
90913		4	Hirudinea
90382		6	Oligochaeta
91241		4	*Hyalella*
91409		3	Cambaridae
91119		1	Copepoda
92874		2	*Physella*
93032		2	*Sphaerium*
92230		1	*Dubiraphia*
92253		1	*Stenelmis*
92090		6	*Dineutus*
92100		1	*Peltodytes*
92177		6	*Ochthebius*
92165		6	*Hydrochus*
92154		2	*Berosus*
92166		3	*Helochares*
92180		4	*Tropisternus*

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Benthic Macroinvertebrate Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID: 1 8 8 7 1

SEGMENT: 1 2 4 2N

SEQUENCE | DATA SOURCE

Station Description_____Tehuacana Creek at Old Mexia Rd._____

Composite - Most biological samples will be type Both

COMPOSITE SAMPLE

COMPOSITE CATEGORY: B (T=Time S=Space B=Both)

START DATE (MMDDYYYY)	START TIME (HHMM)	START DEPTH (SHALLOWEST)	M = meters F = feet
09262006	1030	X	

END DATE (MMDDYYYY)	END TIME (HHMM)	END DEPTH (DEEPEST)	M = meters F = feet
09262006		X	

PARAMETRIC DATA

Enter the codes and values appropriate for this sample. Code (<) if less than value, and (>) if greater than value, other wise leave this column blank. Continue if necessary, on additional worksheets. Codes to describe the benthic sampling effort are listed on the back. Benthic data must be submitted with a Habitat Assessment.

CODE	(<) or (>)	Value	Description
92206		3	*Scirtes*
92478		1	*Bezzia*
92488		3	*Stilobezzia*
92447		1	*Chaoborus*
92491		54	Chironomidae
92715		2	*Stratiomys (Stratiomyia)*
92622		1	*Tabanus*
91650		2	*Callibaetis*
91600		4	*Caenis*
91988		2	*Belostoma*
92044		11	*Trichocorixa*
92059		2	*Pelocoris*
92002		3	*Ranatra*
92069		1	*Sialis*
91668		1	*Arigomphus*
91827		18	*Perithemis*
		2	*Didymops*

Benthic Macroinvertebrate Parameter Codes

NOTE: Measurements reported in metric units
**** Indicates Parameter Measured at Sample Point (e.g. riffle from which benthic sample is collected)**

Quantitative Benthic Sample Descriptors					
89899	4	Biological Data Reporting Units (Values: 1= number of individuals from sub-sample; 2 = number of individuals/ft^2; 3 = number of individuals/m^2; 4 = total number in kicknet)	**89946**	0.05	Mesh size, any net or sieve (diagonal measurements) for benthic collection (cm)
89901		Surber Sampler Effort, area sampled (m^2)	**89961**	32	Ecoregion (Texas Ecoregion Code)
89935		Ekman Sampler Effort, area sampled (m^2)	**84161**	4	Stream Order
89934		Petersen Sampler Effort, area sampled (m^2)	**90005**		Benthos Sampled--No Organisms Present
89933		Hester-Dendy Duration (days)	**90055**	33	Total Taxa (Taxa Richness), Benthos # Taxa
89950	3	Benthic Sampler (1=Surber, 2=Ekman, 3=kicknet, 4=Petersen, 5=Hester-Dendy)	**90056**	6	Total # of Diptera Taxa
89975	0.3	Area of snag surface sampled (m^2)	**90057**	2	Total # of Ephemeroptera Taxa
****89921**		Percent undercut bank at sample point (%)	**90058**	41	Total # of Intolerant Taxa
****89922**		Percent overhanging brush at sample point (%)	**90060**	7.7	EPT Taxa (% of communtiy)
****89923**		Percent gravel substrate at sample point (%)	**90062**	33.1	Chironomidae (% of community)
****89924**		Percent sand substrate at sample point (%)	**90066**	70.1	Tolerant Taxa (% of community), Benthos
****89925**		Percent soft bottom at sample point (%)	**90020**	5.5	Benthic Grazers (% of community)
****89926**		Percent macrophyte bed at sample point (%)	**90025**	34.1	Benthic Gatherers (% of community)
****89927**		Percent snags and brush at sample point (%)	**90030**	12.9	Benthic Filterers (% of community)
****89928**	0	Percent bedrock at sample point (%)	**90067**	33.1	Dominance (3 Taxa) (% of community)
RBAP Benthic Sample Descriptors					
89899	4	Biological Data Reporting Units (Values: 1= number of individuals from sub-sample; 2 = number of individuals/ft^2; 3 = number of individuals/m^2; 4 = total number in kicknet)	**89946**	0.05	Mesh size, sieve (diagonal measurements) (cm)
89950	3	Benthic Sampler (1=Surber, 2=Ekman, 3=kicknet, 4=Petersen, 5=Hester-Dendy)	**89961**	32	Ecoregion (Texas Ecoregion Code)
89902	0.3	Dip Net Effort, area swept (m^2)	**84161**	4	Stream Order
89903	2	Kicknet Effort, area kicked (m^2)	**90005**		Benthos Sampled--No Organisms Present
89904	20	Kicknet Effort, minutes kicked (min.)	**90055**	33	Total Taxa (Taxa Richness), Benthos, # Taxa
89905	20	Snags and Shoreline Sampling Effort, minutes picked	**90008**	2	EPT Taxa Abundance (# Taxa)
89906		Number of individuals in benthic RBA sub-sample ($\forall$ 100)	**90007**	6.2	Biotic Index (HBI)
89950	3	Benthic Sampler (1=Surber, 2=Ekman, 3=kicknet, 4=Petersen, 5=Hester-Dendy)	**90062**	33.1	Chironomidae (% of community)
****89921**		Percent undercut bank at sample point (%)	**90042**	33.1	Dominant Taxon, Benthos (% of community)
****89922**		Percent overhanging brush at sample point (%)	**90010**	46.0	Dominant Functional Feeding Group (% of community)
****89923**		Percent gravel substrate at sample point (%)	**90036**	46.0	Benthic Predators (% of community)
****89924**		Percent sand substrate at sample point (%)	**90050**	0.43	Ratio of Intolerant: Tolerant Taxa
****89925**		Percent soft bottom at sample point (%)	**90069**	0	% of Total Trichoptera as Hydropsychidae
****89926**		Percent macrophyte bed at sample point (%)	**90052**	7	Total # Non-insect Taxa
****89927**		Percent snags and brush at sample point (%)	**90025**	34.1	Benthic Collector-Gatherers (% of community)
****89928**	0	Percent bedrock at sample point (%)	**90054**	1.2	% of Total # as Elmidae (% of community)

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Nekton Data Reporting Form

RTAG#							REGION		EMAIL-ID:								COLLECTOR					
1	**8**	**8**	**7**	**1**																		
STATION ID							SEGMENT				SEQUENCE						DATA SOURCE					
					1	2	4	2 N														

Station Description_____Tehuacana Creek at Old Mexia Rd. _____

Composite - Most biological samples will be: Both

COMPOSITE SAMPLE

B	COMPOSITE CATEGORY:	T=Time	S=Space	B=Both

0	9	2	6	2	0	0	6	1	0	3	0			Y		
M	M	D	D	Y	Y	Y	Y	H	H	M	M	START DEPTH (SHALLOWEST)				M = meters F = feet
START DATE								START TIME								

0	9	2	6	2	0	0	6	1	1	2	0			Y		
M	M	D	D	Y	Y	Y	Y	H	H	M	M	END DEPTH (DEEPEST)				M = meters F = feet
END DATE								END TIME								

PARAMETRIC DATA

Enter the codes and values appropriate for this sample. Code (<) if less than value, and (>) if greater than value, other wise leave this column blank. Continue if necessary, on additional worksheets. Codes to describe the nekton sampling effort are listed on the back. Nekton data must be submitted with a Habitat Assessment.

CODE	Gear Type	Value	Genus species	Common Name
98958	Electro	1	*Aplodiontus grunniens*	Freshwater drum
98437	Electro	5	*Cyprinus carpio*	Common carp
98430	Electro	8	*Dorosoma cepedianum*	Gizzard shad
98713	Electro	42	*Gambusia affinis*	Western mosquitofish
98561	Electro	1	*Ictalurus punctatus*	Channel catfish
98340	Electro	1	*Lepisosteus oculatus*	Spotted gar
98341	Electro	2	*Lepisosteus osseus*	Longnose gar
99094	Electro	56	*Lepomis cyanellus*	Green sunfish
99095	Electro	89	*Lepomis gulosus*	Warmouth
99097	Electro	118	*Lepomis macrochirus*	Bluegill
99099	Electro	23	*Lepomis megalotis*	Longear sunfish
99100	Electro	1	*Lepomis microlophus*	Redear sunfish
	Electro	18	*Lepomis sp.* (unknown)	Sunfish species
99090	Electro	6	*Micropterus salmoides*	Largemouth bass
98513	Electro	2	*Moxostoma congestum*	Gray redhorse
98452	Electro	2	*Opsopoeodus emiliae*	Pugnose minnow
98498	Electro	2	*Pimephales vigilax*	Bullhead minnow
99108	Electro	8	*Pomoxis annularis*	White crappie

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Nekton Data Reporting Form

RTAG#							REGION		EMAIL-ID:								COLLECTOR		
1	**8**	**8**	**7**	**1**		1	2	4	2 N										
STATION ID						SEGMENT				SEQUENCE							DATA SOURCE		

Station Description_____Tehuacana Creek at Old Mexia Rd. _____

Composite - Most biological samples will be: Both

COMPOSITE SAMPLE

B	COMPOSITE CATEGORY:	T=Time	S=Space	B=Both

M	M	D	D	Y	Y	Y	Y	H	H	M	M	START DEPTH (SHALLOWEST)	M = meters F = feet
0	9	2	6	2	0	0	6	1	1	3	0	Y	
START DATE								START TIME					
M	M	D	D	Y	Y	Y	Y	H	H	M	M	END DEPTH (DEEPEST)	M = meters F = feet
0	9	2	6	2	0	0	6	1	3	0	0	Y	
END DATE								END TIME					

PARAMETRIC DATA

Enter the codes and values appropriate for this sample. Code (<) if less than value, and (>) if greater than value, other wise leave this column blank. Continue if necessary, on additional worksheets. Codes to describe the nekton sampling effort are listed on the back. Nekton data must be submitted with a Habitat Assessment.

CODE	Gear Type	Value	Genus species	Common Name
98564	Seine	2	*Ameiurus natalis*	Yellow bullhead
98511	Seine	2	*Carpiodes carpio*	River carpsucker
98437	Seine	1	*Cyprinus carpio*	Common carp
98430	Seine	29	*Dorosoma cepedianum*	Gizzard shad
99078	Seine	1	*Etheostoma gracile*	Slough darter
98677	Seine	2	*Fundulus notatus*	Blackstripe topminnow
98713	Seine	37	*Gambusia affinis*	Western mosquitofish
98561	Seine	2	*Ictalurus punctatus*	Channel catfish
99094	Seine	10	*Lepomis cyanellus*	Green sunfish
99095	Seine	39	*Lepomis gulosus*	Warmouth
99097	Seine	32	*Lepomis macrochirus*	Bluegill
99099	Seine	1	*Lepomis megalotis*	Longear sunfish
99090	Seine	2	*Micropterus salmoides*	Largemouth bass
98574	Seine	1	*Noturus gyrinus*	Tadpole madtom
98498	Seine	1	*Pimephales vigilax*	Bullhead minnow
99108	Seine	18	*Pomoxis annularis*	White crappie

Nekton Parameter Codes

NEKTON SAMPLES					
98005		Nekton, None Captured	98003	21	Total # Fish Species (Richness)
89944	966	Electrofishing Effort, Duration of Shocking (sec.)	98004	1	Total # of Darter Species
89947	4	Seining Effort (# of Seine Hauls)	98008	6	Total # of Sunfish Species (except bass)
89948	80	Combined Length of Seine Hauls (meters)	98009	2	Total # of Sucker Species
89949	90	Seining Effort, Duration (min.)	98010	1	Total # of Intolerant Fish Species
89930	0.467	Minimum Seine Mesh Size, net average bar (inches)	98016	87.0	Tolerant Individuals, Fish (% of community)
89931	0.467	Maximum Seine Mesh Size, net average bar (inches)	98017	9.0	Omnivore Individuals (% of community)
89941	4.57	Net Length (meters)	98021	49.0	Insectivore/Invertivore Individuals (% of community)
89943	2	Electrofishing Method (1= boat, 2=backpack, 3=tote barge)	98022	42.0	Piscivore Individuals (% of community)
89976	365.6	Area Seined (m^2)	98023	565	Total # of Individuals
84161	4	Stream Order	98024	0.0	Hybrid individuals (% of community)
89961	32	Ecoregion (Texas Ecoregion Code)	98030	0.0	Individuals with disease / anomalies (% of community)
Additional Parameters					
89942		Net or Hook & Line Effort, Duration in Water (hrs)	89951		Cooling Water Intake Screen (1=revolving, 2=static)
89945		Castnetting Effort (# of casts)	89940		Intake Screen Collection, Duration (min.)
89907		Trawl, Otter, Duration (min.)	89953		Trawl, Otter, Width (meters)

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Habitat Data Reporting Form

RTAG#	REGION	EMAIL-ID: COLLECTOR

STATION ID	SEGMENT	SEQUENCE	DATA SOURCE
1 1 6 1 0	1 2 4 2N		

Station Description _____Tehuacana Creek at FM 2491_______________

Composite - habitat events will be Both

COMPOSITE SAMPLE

B COMPOSITE CATEGORY: T=Time S=Space B=Both

	MM	DD	YYYY	HHMM	Depth	
START DATE / START TIME / START DEPTH (SHALLOWEST)	0 9	2 7	2 0 0 6	1 0 3 0	Y	M = meters F = feet
END DATE / END TIME / END DEPTH (DEEPEST)	0 9	2 7	2 0 0 6		Y	M = meters F = feet

HABITAT DESCRIPTORS

NOTE: All measurements reported in metric units

72052	5.43	Streambed slope over evaluated reach (from USGS map; elevation change in meters/reach length in kilometers multiplied by 1000)	89844	2	Dominant substrate type (1=clay, 2-silt, 3=sand, 4=gravel, 5=cobble, 6=boulder, 7=bedrock, 8=other)
89859	493	Approximate drainage area above the most downstream transect from USGS map (km^2)	89845	6.0	Average percent of substrate gravel size (> 2mm) or larger (%)
89860	0.561	Length of stream evaluated (km)	84159	9.0	Average percent instream cover (%)
89832	5	Number of lateral transects that were made	89929	7	Number of Stream Cover Types
89861	8.1	Average stream width (m)	89846	61	Average percent stream bank erosion potential (%)
89862	0.5	Average stream depth (m)	89847	34	Average stream bank angle (degrees)
00061	0	Instantaneous stream flow (ft^3/sec)	89866	21	Average width of natural riparian vegetation (m)
89835	NA	Indicate flow measurement method 1=Flow Gage Station, 2= Electronic, 3=Mechanical, 4=Weir/Flume, 5=Doppler	89849	25	Average percent trees as riparian vegetation, over reach (%)
			89850	0	Average percent shrubs as riparian vegetation, over reach (%)
89848	1	Channel Flow Status 1=no flow, 2=low, 3=moderate, 4=high	89851	54	Average percent grasses and forbes as riparian vegetation, over reach (%)
89864	15.5	Maximum pool width at time of study (m)	89852	0	Average percent cultivated fields as riparian vegetation, over reach (%)
89865	1.8	Maximum pool depth in study area (m)	89853	21	Average percent other as riparian vegetation, over reach (%)
89839	8	Total number of stream bends	89854	10	Average percent tree canopy coverage (%)
89840	2	Number of well defined stream bends	89867	2	Aesthetics (1=wilderness, 2=natural, 3=common, 4=offensive)
89841	2	Number of moderately defined stream bends	84161	4	Stream Order
89842	4	Number of poorly defined stream bends	89961	32	Ecoregion (Texas Ecoregion Code)
89843	0	Total number of riffles	89962	3	Land Development Impact (1=unimpacted, 2=low, 3=moderate, 4=high)

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Benthic Macroinvertebrate Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID: 1 1 6 1 0 | SEGMENT: 1 2 4 2N | SEQUENCE | DATA SOURCE

Station Description_____Tehuacana Creek at FM 2491_____

Composite - Most biological samples will be type Both

COMPOSITE SAMPLE

COMPOSITE CATEGORY: B (T=Time, S=Space, B=Both)

START DATE (MMDDYYYY)	START TIME (HHMM)	START DEPTH (SHALLOWEST)	M = meters F = feet
09272006	1030	X	

END DATE (MMDDYYYY)	END TIME (HHMM)	END DEPTH (DEEPEST)	M = meters F = feet
09272006		X	

PARAMETRIC DATA

Enter the codes and values appropriate for this sample. Code (<) if less than value, and (>) if greater than value, other wise leave this column blank. Continue if necessary, on additional worksheets. Codes to describe the benthic sampling effort are listed on the back. Benthic data must be submitted with a Habitat Assessment.

CODE	(<) or (>)	Value	Description
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90382		3	Oligochaeta
91525		2	Hydracarina
91241		24	*Hyalella*
91409		3	Cambaridaae
91397		2	*Palaemontes*
92874		4	*Physella*
93036		2	*Corbicula*
92106		1	*Acilius*
92090		5	*Dineutus*
92100		4	*Peltodytes*
92177		3	*Ochthebius*
92154		5	*Berosus*
92161		1	*Enochrus*
92166		1	*Helochares*
92478		1	*Bezzia*

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Benthic Macroinvertebrate Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID: 1 1 6 1 0 | SEGMENT: 1 2 4 2N | SEQUENCE | DATA SOURCE

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Composite - Most biological samples will be type Both

COMPOSITE SAMPLE

COMPOSITE CATEGORY: B (T=Time, S=Space, B=Both)

	MM	DD	YYYY	HHMM		
START	09	27	2006	1030	X	M = meters, F = feet
END	09	27	2006		X	M = meters, F = feet

START DATE / START TIME / START DEPTH (SHALLOWEST)

END DATE / END TIME / END DEPTH (DEEPEST)

PARAMETRIC DATA

Enter the codes and values appropriate for this sample. Code (<) if less than value, and (>) if greater than value, other wise leave this column blank. Continue if necessary, on additional worksheets. Codes to describe the benthic sampling effort are listed on the back. Benthic data must be submitted with a Habitat Assessment.

CODE	(<) or (>)	Value	Description
92483		1	*Palpomyia*
92486		1	*Probezzia*
92488		1	*Stilobezzia*
92491		14	Chironomidae
92445		5	*Anopheles*
92715		1	*Stratiomys (Stratiomyia)*
91650		7	*Callibaetis*
91600		67	*Caenis*
91570		1	*Hexagenia*
92044		3	*Trichocorixa*
92002		2	*Ranatra*
91687		3	*Enallagma*
91791		1	*Epitheca*
91792		7	*Erythemis*
91813		3	*Miathyria*
91827		7	*Perithemis*
		1	*Didymops*
92281		1	*Polycentropus*

Benthic Macroinvertebrate Parameter Codes

NOTE: Measurements reported in metric units
**** Indicates Parameter Measured at Sample Point (e.g. riffle from which benthic sample is collected)**

Quantitative Benthic Sample Descriptors					
89899	4	Biological Data Reporting Units (Values: 1= number of individuals from sub-sample; 2 = number of individuals/ft^2; 3 = number of individuals/m^2; 4 = total number in kicknet)	**89946**	0.05	Mesh size, any net or sieve (diagonal measurements) for benthic collection (cm)
89901		Surber Sampler Effort, area sampled (m^2)	**89961**	32	Ecoregion (Texas Ecoregion Code)
89935		Ekman Sampler Effort, area sampled (m^2)	**84161**	4	Stream Order
89934		Petersen Sampler Effort, area sampled (m^2)	**90005**		Benthos Sampled--No Organisms Present
89933		Hester-Dendy Duration (days)	**90055**	34	Total Taxa (Taxa Richness), Benthos # Taxa
89950	3	Benthic Sampler (1=Surber, 2=Ekman, 3=kicknet, 4=Petersen, 5=Hester-Dendy)	**90056**	7	Total # of Diptera Taxa
89975	0.3	Area of snag surface sampled (m^2)	**90057**	3	Total # of Ephemeroptera Taxa
****89921**		Percent undercut bank at sample point (%)	**90058**	33	Total # of Intolerant Taxa
****89922**		Percent overhanging brush at sample point (%)	**90060**	0.4	EPT Taxa (% of communtiy)
****89923**		Percent gravel substrate at sample point (%)	**90062**	7.4	Chironomidae (% of community)
****89924**		Percent sand substrate at sample point (%)	**90066**	75.3	Tolerant Taxa (% of community), Benthos
****89925**		Percent soft bottom at sample point (%)	**90020**	20.5	Benthic Grazers (% of community)
****89926**		Percent macrophyte bed at sample point (%)	**90025**	43.5	Benthic Gatherers (% of community)
****89927**		Percent snags and brush at sample point (%)	**90030**	6.7	Benthic Filterers (% of community)
****89928**	0	Percent bedrock at sample point (%)	**90067**	55.3	Dominance (3 Taxa) (% of community)
RBAP Benthic Sample Descriptors					
89899	4	Biological Data Reporting Units (Values: 1= number of individuals from sub-sample; 2 = number of individuals/ft^2; 3 = number of individuals/m^2; 4 = total number in kicknet)	**89946**	0.05	Mesh size, sieve (diagonal measurements) (cm)
89950	3	Benthic Sampler (1=Surber, 2=Ekman, 3=kicknet, 4=Petersen, 5=Hester-Dendy)	**89961**	32	Ecoregion (Texas Ecoregion Code)
89902		Dip Net Effort, area swept (m^2)	**84161**	4	Stream Order
89903	2	Kicknet Effort, area kicked (m^2)	**90005**		Benthos Sampled--No Organisms Present
89904	20	Kicknet Effort, minutes kicked (min.)	**90055**	34	Total Taxa (Taxa Richness), Benthos, # Taxa
89905	0.3	Snags and Shoreline Sampling Effort, minutes picked	**90008**	4	EPT Taxa Abundance (# Taxa)
89906	20	Number of individuals in benthic RBA sub-sample ($\forall$ 100)	**90007**	6.8	Biotic Index (HBI)
89950	3	Benthic Sampler (1=Surber, 2=Ekman, 3=kicknet, 4=Petersen, 5=Hester-Dendy)	**90062**	7.4	Chironomidae (% of community)
****89921**		Percent undercut bank at sample point (%)	**90042**	35.3	Dominant Taxon, Benthos (% of community)
****89922**		Percent overhanging brush at sample point (%)	**90010**	43.5	Dominant Functional Feeding Group (% of community)
****89923**		Percent gravel substrate at sample point (%)	**90036**	26.9	Benthic Predators (% of community)
****89924**		Percent sand substrate at sample point (%)	**90050**	0.2	Ratio of Intolerant: Tolerant Taxa
****89925**		Percent soft bottom at sample point (%)	**90069**	0.0	% of Total Trichoptera as Hydropsychidae
****89926**		Percent macrophyte bed at sample point (%)	**90052**	8	Total # Non-insect Taxa
****89927**		Percent snags and brush at sample point (%)	**90025**	43.5	Benthic Collector-Gatherers (% of community)
****89928**		Percent bedrock at sample point (%)	**90054**	0.0	% of Total # as Elmidae (% of community)

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Nekton Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID: 1 1 6 1 0 | SEGMENT: 1 2 4 2 N | SEQUENCE | DATA SOURCE

Station Description_____Tehuacana Creek at FM 2491_____

Composite - Most biological samples will be: Both

COMPOSITE SAMPLE

COMPOSITE CATEGORY: **B** (T=Time S=Space B=Both)

START DATE (MMDDYYYY)	START TIME (HHMM)	START DEPTH (SHALLOWEST)	M = meters F = feet
09272006	0900	Y	

END DATE (MMDDYYYY)	END TIME (HHMM)	END DEPTH (DEEPEST)	M = meters F = feet
09272006	1146	Y	

PARAMETRIC DATA

Enter the codes and values appropriate for this sample. Code (<) if less than value, and (>) if greater than value, other wise leave this column blank. Continue if necessary, on additional worksheets. Codes to describe the nekton sampling effort are listed on the back. Nekton data must be submitted with a Habitat Assessment.

CODE	Gear Type	Value	*Genus species*	Common Name
98502	Electro	1	*Campostoma anomalum*	Central Stoneroller
98474	Electro	3	*Cyprinella lutrensis*	Red shiner
98487	Electro	6	*Cyprinella venusta*	Blacktail shiner
98430	Electro	5	*Dorosoma cepedianum*	Gizzard shad
98677	Electro	9	*Fundulus notatus*	Blackstripe topminnow
98713	Electro	19	*Gambusia affinis*	Western mosquitofish
98734	Electro	4	*Labidesthes sicculus*	Brook silverside
98340	Electro	1	*Lepisosteus oculatus*	Spotted gar
99094	Electro	28	*Lepomis cyanellus*	Green sunfish
99095	Electro	9	*Lepomis gulosus*	Warmouth
99096	Electro	21	*Lepomis humilus*	Orangespotted sunfish
99097	Electro	66	*Lepomis macrochirus*	Bluegill
99099	Electro	215	*Lepomis megalotis*	Longear sunfish
99092	Electro	1	*Lepomis sp.*	Green sunfish hybrid
99090	Electro	1	*Micropterus salmoides*	Largemouth bass
98498	Electro	33	*Pimephales vigilax*	Bullhead minnow

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Nekton Data Reporting Form

RTAG#	REGION	EMAIL-ID:	COLLECTOR

STATION ID	SEGMENT	SEQUENCE	DATA SOURCE
11610	1242N		

Station Description_____Tehuacana Creek at FM 2491_____

Composite - Most biological samples will be: Both

COMPOSITE SAMPLE

COMPOSITE CATEGORY:	T=Time	S=Space	B=Both
B			

START DATE (MMDDYYYY)	START TIME (HHMM)	START DEPTH (SHALLOWEST)	M = meters F = feet
09272006	1345	Y	

END DATE (MMDDYYYY)	END TIME (HHMM)	END DEPTH (DEEPEST)	M = meters F = feet
09272006	1550	Y	

PARAMETRIC DATA

Enter the codes and values appropriate for this sample. Code (<) if less than value, and (>) if greater than value, other wise leave this column blank. Continue if necessary, on additional worksheets. Codes to describe the nekton sampling effort are listed on the back. Nekton data must be submitted with a Habitat Assessment.

CODE	Gear Type	Value	*Genus species*	Common Name
98511	Seine	2	*Carpiodes carpio*	River carpsucker
98474	Seine	22	*Cyrinella lutrensis*	Red shiner
98487	Seine	6	*Cyprinella venusta*	Blacktail shiner
98430	Seine	30	*Dorosoma cepedianum*	Gizzard shad
98429	Seine	48	*Dorosoma petenense*	Threadfin shad
99075	Seine	4	*Etheostoma chlorosomum*	Bluntnose darter
99078	Seine	6	*Etheostoma gracile*	Slough darter
99085	Seine	2	*Etheostoma spectabile*	Orangethroat darter
98677	Seine	5	*Fundulus notatus*	Blackstripe topminnow
98713	Seine	14	*Gambusia affinis*	Western mosquitofish
98561	Seine	1	*Ictalurus punctatus*	Channel catfish
98734	Seine	40	*Labidesthes sicculus*	Brook silverside
98340	Seine	1	*Lepisosteus oculatus*	Spotted gar
99094	Seine	2	*Lepomis cyanellus*	Green sunfish
99095	Seine	5	*Lepomis gulosus*	Warmouth
99096	Seine	209	*Lepomis humilus*	Orangespotted sunfish

Parametric Data Continued

CODE	Gear Type	Value	*Genus species*	Common Name
90097	Seine	24	*Lepomis macrochirus*	Bluegill
99099	Seine	93	*Lepomis megalotis*	Longear sunfish
99089	Seine	2	*Micropterus punctulatus*	Spotted bass
99090	Seine	8	*Micropterus salmoides*	Largemouth bass
98441	Seine	3	*Notemigonus crysoleucas*	Golden shiner
98574	Seine	5	*Noturus gyrinus*	Tadpole madtom
98452	Seine	1	*Opsopoeodus emiliae*	Pugnose minnow
99069	Seine	2	*Percina macrolepida*	Bigscale logperch
98498	Seine	59	*Pimephales vigilax*	Bullhead minnow
99108	Seine	8	*Pomoxis annularis*	White crappie

Nekton Parameter Codes

NEKTON SAMPLES					
98005		Nekton, None Captured	98003	28	Total # Fish Species (Richness)
89944	914	Electrofishing Effort, Duration of Shocking (sec.)	98004	4	Total # of Darter Species
89947	7	Seining Effort (# of Seine Hauls)	98008	7	Total # of Sunfish Species (except bass)
89948	70	Combined Length of Seine Hauls (meters)	98009	1	Total # of Sucker Species
89949	125	Seining Effort, Duration (min.)	98010	3	Total # of Intolerant Fish Species
89930	0.635	Minimum Seine Mesh Size, net average bar (inches)	98016	19.6	Tolerant Individuals, Fish (% of community)
89931	0.635	Maximum Seine Mesh Size, net average bar (inches)	98017	8.3	Omnivore Individuals (% of community)
89941	9.14	Net Length (meters)	98021	84.0	Insectivore/Invertivore Individuals (% of community)
89943	2	Electrofishing Method (1= boat, 2=backpack, 3=tote barge)	98022	7.5	Piscivore Individuals (% of community)
89976	319.9	Area Seined (m^2)	98023	1131	Total # of Individuals
84161	4	Stream Order	98024	0.0	Hybrid individuals (% of community)
89961	32	Ecoregion (Texas Ecoregion Code)	98030	0.0	Individuals with disease / anomalies (% of community)
Additional Parameters					
89942		Net or Hook & Line Effort, Duration in Water (hrs)	89951		Cooling Water Intake Screen (1=revolving, 2=static)
89945		Castnetting Effort (# of casts)	89940		Intake Screen Collection, Duration (min.)
89907		Trawl, Otter, Duration (min.)	89953		Trawl, Otter, Width (meters)

Appendix E – Biological Data Summary: Field Data

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Field Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID: 1 8 8 7 0 | SEGMENT: 1 2 4 2N | SEQUENCE | DATA SOURCE

Station Description _____Tehuacana Creek, Upstream of Kirkland Branch and US 84_____

GRAB SAMPLE

DATE (MMDDYYYY)	TIME (HHMM)	DEPTH	
09252006	1045	0.3	m

M = meters, F = feet

COMPOSITE SAMPLE

COMPOSITE CATEGORY : T = TIME, S = SPACE (i.e. Depth), B = BOTH, F = FLOW WEIGHT

START DATE (MMDDYYYY)	START TIME (HHMM)	START DEPTH (SURFACE)	M = Meters, F = Feet
		•	

END DATE (MMDDYYYY)	END TIME (HHMM)	END DEPTH (DEEPEST)	M = Meters, F = Feet
		•	

COMPOSITE TYPE : ## = Number of Grabs in Composite, CN = Continuous

00010	19.9	WATER TEMP (°C only)	72053	>7	DAYS SINCE LAST SIGNIFICANT PRECIPITATION
00400	7.4	pH (s.u)	01351	1	FLOW SEVERITY: 1-no flow, 2-low, 3-normal, 5-high, 4-flood, 6-dry
00300	0.7	D.O. (mg/L)			
00094	700	SPECIFIC COND (µmhos/cm)	00061	0	INSTANTANEOUS STREAM FLOW (ft^3/sec)
00480		SALINITY (ppt, marine only)	89835		FLOW MEASUREMENT METHOD: 1- Flow Gage Station, 2- Electric, 3- Mechanical, 4- Weir/Flume
50060		CHLORINE RESIDUAL (mg/L)			
00078	0.20	SECCHI DISK (meters)	74069		FLOW ESTIMATE (ft^3/sec)
82078		TURBIDITY-FIELD (NTU)	82903		TOTAL WATER DEPTH (meters)
31616		FECAL COLIFORM (#/100 ml)	00055		WATER VELOCITY (maximum)(ft/sec)
31699		E. coli (#/100 ml) (Colilert Method)	89864	5.8	MAXIMUM POOL WIDTH (meters) *
31701		Enterococci (#/100 ml) (Enterolert Method)	89869	10.5	POOL LENGTH (meters) *
			89865	0.9	MAXIMUM POOL DEPTH (meters) *
			89870	2.5	% POOL COVERAGE IN 500 M REACH *

*Parameters related to data collection in perennial pools; i.e., Flow Severity of 1 and Flow of zero reported.

Measurement Comments and Field Observations:

Used TCEQ (Wilson Snyder) datasonde reading (SN#02E0845), only one pool in reach others dried up

Reach length was 394 m. The percent pool coverage is calculated using 394 m instead of 500 m.

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Stream Flow (Discharge) Measurement Form

Stream:_____Tehuacana Creek_____ Date:_____9/25/06

Station:_____18870_____

Description:_____Upstream of Kirkland Branch and US 84_____

Time Begin:_____ Time End:_____ Meter Type:_____

Observers:_____ Stream Width*:_____ Section Width (W):_____

Observations:_____No Flow_____

Section Midpoint (ft) (m)	Section Depth (ft) (m) (cm) (D)	Observational Depth** (ft)(m)	Velocity (V)		Flow (Q) (m^3/s) (ft^3/s) Q = (W)(D)(V)
			At Point (ft/s)(m/s)	Average (ft/s)(m/s)	

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Field Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID: 1 8 8 7 1 | SEGMENT: 1 2 4 2N | SEQUENCE | DATA SOURCE

Station Description _____Tehuacana Creek at Old Mexia Rd 2.71 km downstream of US 84_____

GRAB SAMPLE

DATE (MMDDYYYY)	TIME (HHMM)	DEPTH	
09262006	1030	0.3	m

M = meters, F = feet

COMPOSITE SAMPLE

COMPOSITE CATEGORY : T = TIME, S = SPACE (i.e. Depth), B = BOTH, F = FLOW WEIGHT

	START DATE (MMDDYYYY)	START TIME (HHMM)	START DEPTH (SURFACE)	M = Meters, F = Feet

	END DATE (MMDDYYYY)	END TIME (HHMM)	END DEPTH (DEEPEST)	M = Meters, F = Feet

COMPOSITE TYPE : ## = Number of Grabs in Composite, CN = Continuous

00010	18.6	WATER TEMP (°C only)	72053	>7	DAYS SINCE LAST SIGNIFICANT PRECIPITATION		
00400	8.2	pH (s.u)	01351	1	FLOW SEVERITY	1-no flow	2-low
00300	3.3	D.O. (mg/L)			3-normal / 5-high	4-flood	6-dry
00094	1077	SPECIFIC COND (µmhos/cm)	00061		INSTANTANEOUS STREAM FLOW (ft^3/sec)		
00480		SALINITY (ppt, marine only)	89835		FLOW MEASUREMENT METHOD: 1- Flow Gage Station, 2- Electric, 3- Mechanical, 4- Weir/Flume		
50060		CHLORINE RESIDUAL (mg/L)					
00078	0.05	SECCHI DISK (meters)	74069		FLOW ESTIMATE (ft^3/sec)		
82078		TURBIDITY-FIELD (NTU)	82903		TOTAL WATER DEPTH (meters)		
31616		FECAL COLIFORM (#/100 ml)	00055		WATER VELOCITY (maximum)(ft/sec)		
31699		E. coli (#/100 ml) (Colilert Method)	89864	8.0	MAXIMUM POOL WIDTH (meters) *		
31701		Enterococci (#/100 ml) (Enterolert Method)	89869		POOL LENGTH (meters) *		
			89865	0.9	MAXIMUM POOL DEPTH (meters) *		
			89870		% POOL COVERAGE IN 500 M REACH *		

*Parameters related to data collection in perennial pools; i.e., Flow Severity of 1 and Flow of zero reported.

Measurement Comments and Field Observations:

01M0700 Sonde used for instantaneous physicochemical parameters. Water appearance: Grey brown, no flow. Individual pool lengths were not measured. Total reach length was 412 m.

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Stream Flow (Discharge) Measurement Form

Stream:_____Tehuacana Creek_____ Date:_____9/26/06

Station:_____18871_____

Description:_____Tehuacana Creek at Old Mexia Rd. 2.71 km downstream of US84

Road_____

Time Begin:_____ Time End:_____ Meter Type:_____

Observers:_____ Stream Width*:_____ Section Width (W):_____

Observations:_____No Flow_____

Section Midpoint (ft) (m)	Section Depth (ft) (m) (cm) (D)	Observational Depth** (ft)(m)	Velocity (V)		Flow (Q) (m^3/s) (ft^3/s) Q = (W)(D)(V)
			At Point (ft/s)(m/s)	Average (ft/s)(m/s)	

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Field Data Reporting Form

RTAG# | REGION | EMAIL-ID: | COLLECTOR

STATION ID: 1 1 6 1 0 | SEGMENT: 1 2 4 2N | SEQUENCE | DATA SOURCE

Station Description _____Tehuacan a Creek at FM 2491 SE of Waco_____

GRAB SAMPLE

DATE (MMDDYYYY)	TIME (HHMM)	DEPTH	
09272006		0.3	m

M = meters
F = feet

COMPOSITE SAMPLE

COMPOSITE CATEGORY : T = TIME | S = SPACE (i.e. Depth) | B = BOTH | F = FLOW WEIGHT

	START DATE (MMDDYYYY)	START TIME (HHMM)	START DEPTH (SURFACE)	
				M = Meters / F = Feet

	END DATE (MMDDYYYY)	END TIME (HHMM)	END DEPTH (DEEPEST)	
				M = Meters / F = Feet

COMPOSITE TYPE : ## = Number of Grabs in Composite | CN = Continuous

00010	20.7	WATER TEMP (°C only)	72053	>7	DAYS SINCE LAST SIGNIFICANT PRECIPITATION
00400	7.6	pH (s.u)	01351	1	FLOW SEVERITY: 1-no flow; 2-low; 3-normal; 5-high; 4-flood; 6-dry
00300	5.9	D.O. (mg/L)			
00094	1236	SPECIFIC COND (µmhos/cm)	00061		INSTANTANEOUS STREAM FLOW (ft^3/sec)
00480		SALINITY (ppt, marine only)	89835		FLOW MEASUREMENT METHOD: 1- Flow Gage Station; 2- Electric; 3- Mechanical; 4- Weir/Flume
50060		CHLORINE RESIDUAL (mg/L)			
00078		SECCHI DISK (meters)	74069		FLOW ESTIMATE (ft^3/sec)
82078		TURBIDITY-FIELD (NTU)	82903		TOTAL WATER DEPTH (meters)
31616		FECAL COLIFORM (#/100 ml)	00055		WATER VELOCITY (maximum)(ft/sec)
31699		E. coli (#/100 ml) (Colilert Method)	89864	15.5	MAXIMUM POOL WIDTH (meters) *
31701		Enterococci (#/100 ml) (Enterolert Method)	89869		POOL LENGTH (meters) *
			89865	1.8	MAXIMUM POOL DEPTH (meters) *
			89870		% POOL COVERAGE IN 500 M REACH *

*Parameters related to data collection in perennial pools; i.e., Flow Severity of 1 and Flow of zero reported.

Measurement Comments and Field Observations:

No Flow, Isolated Pools. Individual pool lengths were not measured. The total reach length was 561 m.

01M0700 Sonde used to measure instantaneous physicochemical parameters.

Texas Commission on Environmental Quality
Surface Water Quality Monitoring Program

Stream Flow (Discharge) Measurement Form

Stream:_____Tehuacana Creek_____ Date:____9/27/06

Station:_____11610_____

Description:_____Tehuacana Creek at FM2491 SE of Waco_____

Time Begin:_____ Time End:_____ Meter Type:_____

Observers:_____ Stream Width*:_____ Section Width (W):_____

Observations:_____No Flow _____

Section Midpoint (ft) (m)	Section Depth (ft) (m) (cm) (D)	Observational Depth** (ft)(m)	Velocity (V)		Flow (Q) (m^3/s) (ft^3/s) Q = (W)(D)(V)
			At Point (ft/s)(m/s)	Average (ft/s)(m/s)	

Appendix F – Biological Data Summary: Photographs

Photographs taken by Jennifer Bronson, Cindy Contreras, and Adam Whisenant of TPWD, September 2006.

Figure 6. Upstream view from Transect 1 on Tehuacana Creek at US 84 (Station 18870), 25 September 2006.

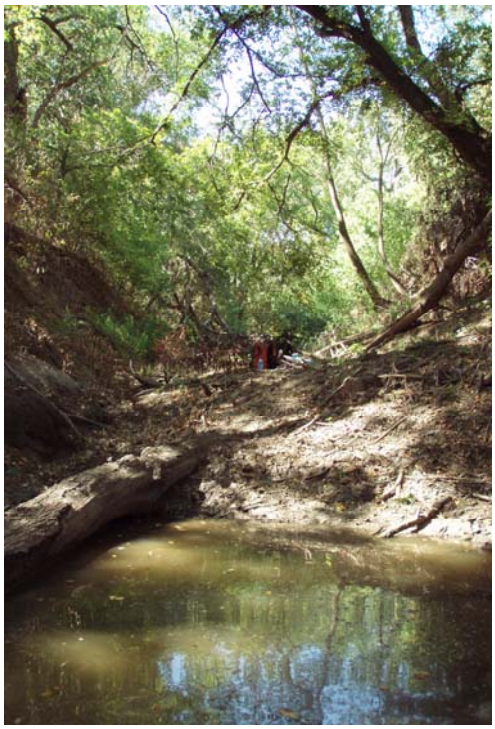

Figure 7. Downstream view from Transect 1 on Tehuacana Creek at US 84 (Station 18870), 25 September 2006.

Figure 8. Upstream view of Transect 2 on Tehuacana Creek at US 84 (Station 18870), 25 September 2006.

Figure 9. Downstream view of Transect 2 on Tehuacana Creek at US 84 (Station 18870), 25 September 2006.

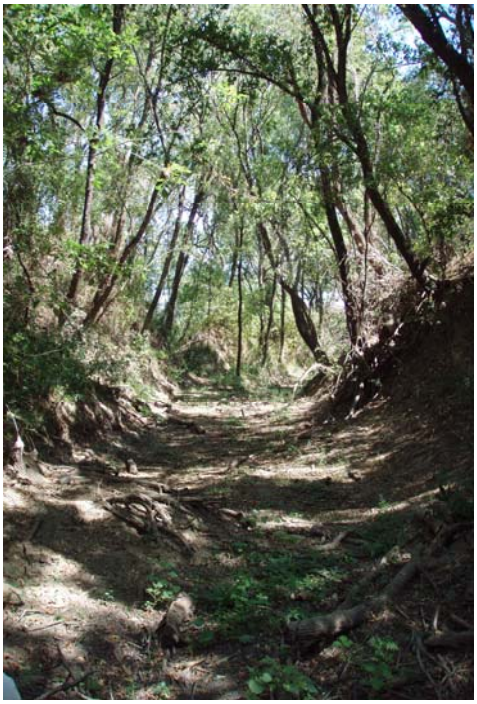

Figure 10. Upstream view of Transect 3 on Tehuacana Creek at US 84 (Station 18870), 25 September 2006.

Figure 11. Downstream view of Transect 3 on Tehuacana Creek at US 84 (Station 18870), 25 September 2006.

Figure 12. Upstream view of Transect 4 on Tehuacana Creek at US 84 (Station 18870), 25 September 2006.

Figure 13. Downstream view of Transect 4 on Tehuacana Creek at US 84 (Station 18870), 25 September 2006.

Figure 14. Upstream view of Transect 5 on Tehuacana Creek at US 84 (Station 18870), 25 September 2006.

Figure 15. Downstream view of Transect 5 on Tehuacana Creek at US 84 (Station 18870), 25 August 2006.

Figure 16. Upstream view of Transect 1 on Tehuacana Creek at Old Mexia Rd. (Station 18871), 26 September 2006.

Figure 17. Downstream view of Transect 1 on Tehuacana Creek at Old Mexia Rd. (Station 18871), 26 September 2006.

Figure 18. Upstream view of Transect 2 on Tehuacana Creek at Old Mexia Rd. (Station 18871), 26 September 2006.

Figure 19. Downstream view of Transect 2 on Tehuacana Creek at Old Mexia Rd. (Station 18871), 26 September 2006.

Figure 20. Upstream view of Transect 3 on Tehuacana Creek at Old Mexia Rd. (Station 18871), 26 September 2006.

Figure 21. Downstream view of Transect 3 on Tehuacana Creek at Old Mexia Rd. (Station 18871), 26 September 2006.

Figure 22. Upstream view of Transect 4 on Tehuacana Creek at Old Mexia Rd. (Station 18871), 26 September 2006.

Figure 23. Downstream view of Transect 4 on Tehuacana Creek at Old Mexia Rd. (Station 18871), 26 September 2006.

Figure 24. Upstream view of Transect 5 on Tehuacana Creek at Old Mexia Rd. (Station 18871), 26 September 2006.

Figure 25. Downstream view of Transect 5 on Tehuacana Creek at Old Mexia Rd. (Station 18871), 26 September 2006.

Figure 26. Upstream view of Transect 1 on Tehuacana Creek at FM 2491, (Station 11610), 27 September 2006.

Figure 27. Downstream view of Transect 1 on Tehuacana Creek at FM 2491, (Station 11610), 27 September 2006.

Figure 28. Upstream view of Transect 2 on Tehuacana Creek at FM 2491, (Station 11610), 27 September 2006.

Figure 29. Downstream view of Transect 2 on Tehuacana Creek at FM 2491, (Station 11610), 27 September 2006.

Figure 30. Upstream view of Transect 3 on Tehuacana Creek at FM 2491, (Station 11610), 27 September 2006.

Figure 31. Downstream view of Transect 3 on Tehuacana Creek at FM 2491, (Station 11610), 27 September 2006.

Figure 32. Upstream view of Transect 4 on Tehuacana Creek at FM 2491, (Station 11610), 27 September 2006.

Figure 33. Downstream view of Transect 4 on Tehuacana Creek at FM 2491, (Station 11610), 27 September 2006.

Figure 34. Upstream view of Transect 5 on Tehuacana Creek at FM 2491, (Station 11610), 27 September 2006.

Figure 35. Downstream view of Transect 5 on Tehuacana Creek at FM 2491, (Stations 11610), 27 September 2006.