

**Supplemental Biological Data Collection, Middle Trinity River Priority Instream Flow
Study**

Final Report

Prepared by:

Trinity River Authority of Texas and Texas Parks and Wildlife Department

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Draft Report

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Executive Summary

The 77th Texas Legislature passed Senate Bill 2 (SB 2) in 2001 which created the Texas Instream Flow Program (TIFP). This program is administered jointly by the Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife Department (TPWD), and Texas Water Development Board (TWDB). The Program's charge is to determine how much water rivers need to maintain a sound ecological environment. The middle Trinity River was identified by the TIFP as a priority subbasin in the Texas Instream Flow Studies: Programmatic Work Plan (TPWD, TCEQ & TWDB, 2002).

In late 2012, the TIFP and Trinity River Authority of Texas (TRA) began working on the reconnaissance and information evaluation phase of the project. A large biological data gap was identified and this Supplemental Biological Data Collection Study was initiated to obtain recent biological data for the study area. The TIFP and TRA sampled six sites twice in the middle Trinity River subbasin between August and November of 2012.

Standard TCEQ Surface Water Quality Monitoring (SWQM) biological field sampling methods were used although sampling events for each were segregated by identified mesohabitat types (i.e., riffle, run, pool, backwater). Results showed high species richness along the middle Trinity River study area with 36 species of fish, 58 taxa of benthic macroinvertebrates, and 15 species of mussels identified during the study. Additional data and spatial analysis is underway in order to provide information to the TIFP and basin stakeholders.

This study was funded under Texas Parks and Wildlife Department Interlocal Contract No. 1148321527 and Texas Water Development Board Research and Planning Funds (TWDB Contract No. 1248311360).

Introduction

In 2001, the Texas Legislature passed Senate Bill 2 (SB 2) which directed the Texas Parks and Wildlife Department (TPWD), the Texas Commission on Environmental Quality (TCEQ), and the Texas Water Development Board (TWDB), later referred to jointly as the Texas Instream Flow Program (TIFP), to work with area stakeholders to design and conduct studies to determine flow conditions needed in Texas' rivers to support a "*sound ecological environment.*" Because of potential water development projects, reuse projects, water rights permitting issues, and other factors, the middle Trinity River was identified as one of six priority subbasins (TWDB, 2008).

Lotic systems have a natural level of variability (Richter, Mathews, Harrison, and Wigington, 2003) and studies undertaken to understand and explain river ecosystems have an inherent level of uncertainty (TIFP, 2008). Instream flow studies attempt to integrate information regarding a system's hydrology and hydraulics, geomorphology, biology, and water quality on a mesohabitat scale in order to determine a range of flows that will promote a "*sound ecological environment*" (TIFP, 2008)

The TIFP identified eight steps for instream flow studies in Texas (Figure 1). The first step in the process is Reconnaissance and Information Evaluation. Reconnaissance level studies of systems are paramount first steps in understanding stream ecosystems (Maddock, 1999). TRA completed an extensive field reconnaissance survey in 2011 and installed a series of long term channel morphology monitoring sites along the middle Trinity River in 2012 (TRA & RPS Espey, 2011) (TRA & RPS Espey Consultants Inc., 2013). Previous environmental flow work in the Trinity River basin identified and assembled existing data during the Senate Bill 3 (SB 3) process in 2009 (EIH, 2009). Environmental flow standards applicable to the middle Trinity River were adopted by TCEQ in 2011 and are shown in Appendix A.

Benthic organisms are appropriate indicators of ecosystem health (Dewson, James, & Death, 2007) and benthic analysis at the mesohabitat scale is appropriate (Rabeni, Doisy, & Galat, 2002). Aquatic macroinvertebrates are good indicators of stream quality because they are affected by the "*physical, chemical, and biological conditions of the stream*" (Barbour, Gerritsen, Snyder, and Stribling, 1999).

The goal of this project was to conduct biological collections of fish and benthic organisms (invertebrates and mussels) in order to fill both spatial and temporal data gaps. This work was conducted cooperatively by TRA and TIFP agencies. The contract scope is shown in Appendix B.

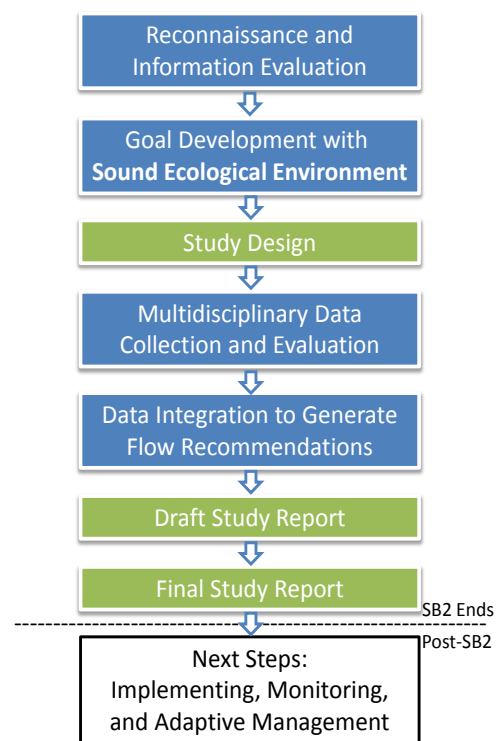


Figure 1. TIFP environmental flow study process.

Study Scope

Study Area Description

The middle Trinity River study area (Figure 2) was determined to be the 211 river miles stretching from the confluence of the East Fork Trinity River (river mile 432) downstream to the headwaters of Lake Livingston (river mile 221) located at the 131 ft (40 m) elevation contour. The middle Trinity River includes the lower 51 river miles within TCEQ Segment 0805 (Upper Trinity River) and all of Segment 0804 (Trinity River Above Lake Livingston). An additional sampling site was included further downstream within the 63 river mile riverine headwaters of Lake Livingston to determine if there was a need to extend the study area downstream.

The immediate middle Trinity River watershed covers 6,444 mi² (16,690 km²). Including the 7,840 mi² (20,305 km²) of watershed upstream, the total contributing watershed influencing the middle Trinity River is 14,284 mi² (36,995 km²). A watershed map is shown in Appendix B. The immediate watershed is mostly rural and the river is hard to access due to limited crossings, high, steep river banks, and private landownership. Within a 0.5 mile (0.8 km) buffer of the middle Trinity River mainstem, 30.4% of the land cover is wetland with only 1.2% classified as developed or barren (Figure 3). **Error! Reference source not found.** Much of the watershed upstream of the immediate middle Trinity River is highly urbanized and contains the Dallas/Fort Worth (DFW) area.

Due largely to population growth in the watershed upstream, base flows in the middle Trinity River have increased significantly since 1970. Using an average of the 0-50th percentile flows at the USGS gage at Oakwood, located near the middle of the study area, base flows have increased 112% between the periods 1942-1969 to 1970-2012 (Figure 4). There is limited groundwater interaction in the middle Trinity River and during periods of low flow, over 95% of the water in the middle Trinity River is treated effluent from the DFW area (TRA, 2012). During a 2011 longitudinal reconnaissance of this reach, the middle Trinity River became a losing river system (TRA & RPS Espey, 2011).

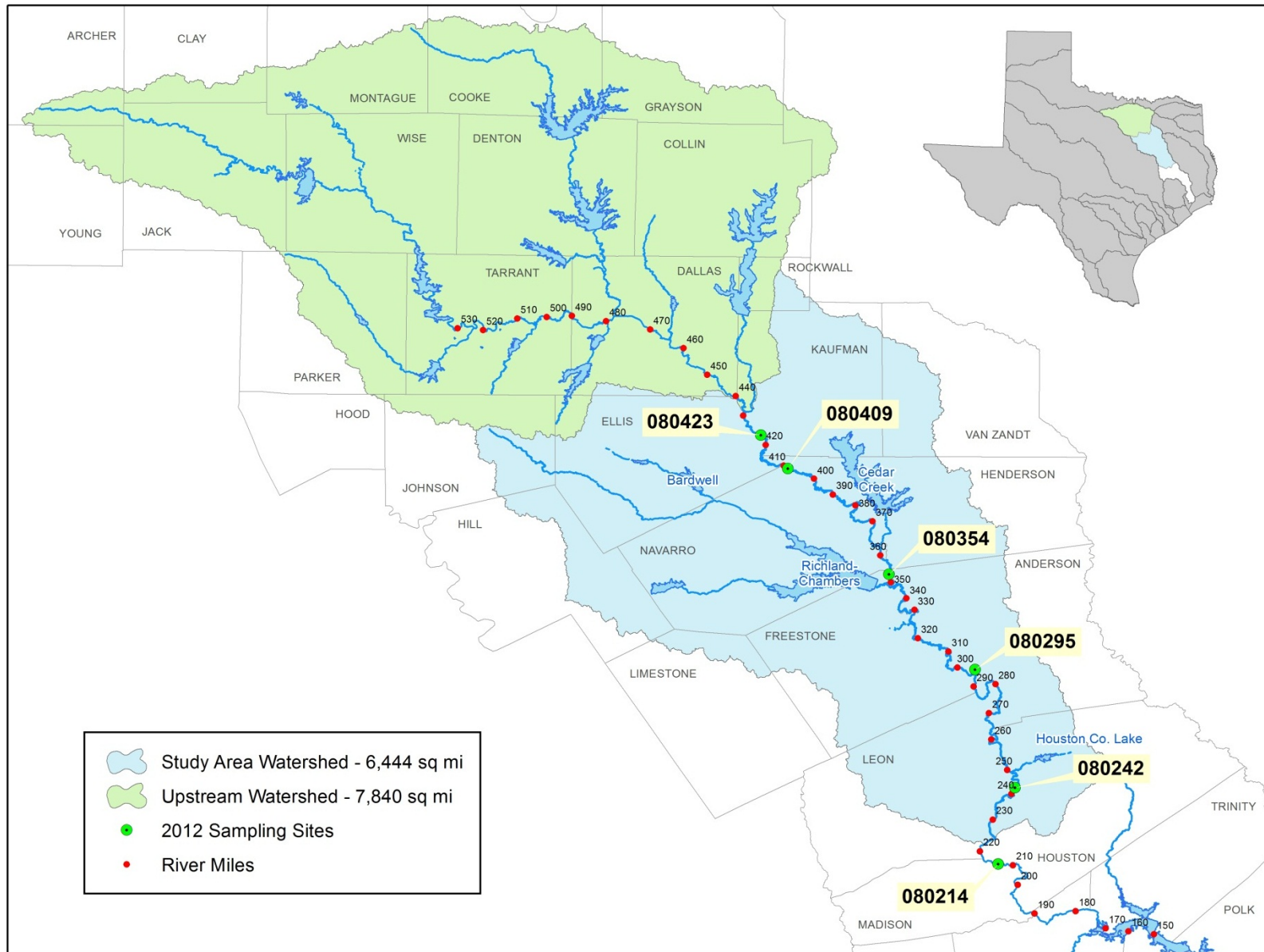


Figure 2. Middle Trinity River study area map.

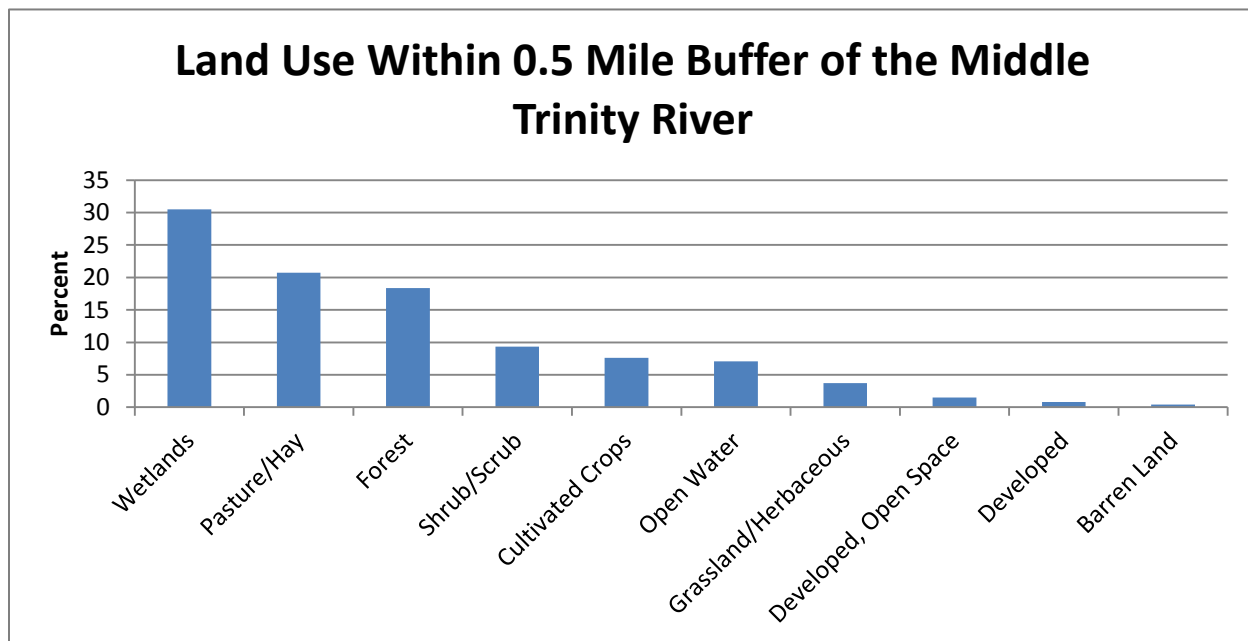


Figure 3. Land use from the National Land Cover Dataset 2006 within a 0.5 mile buffer of the middle Trinity River (USGS, 2011).

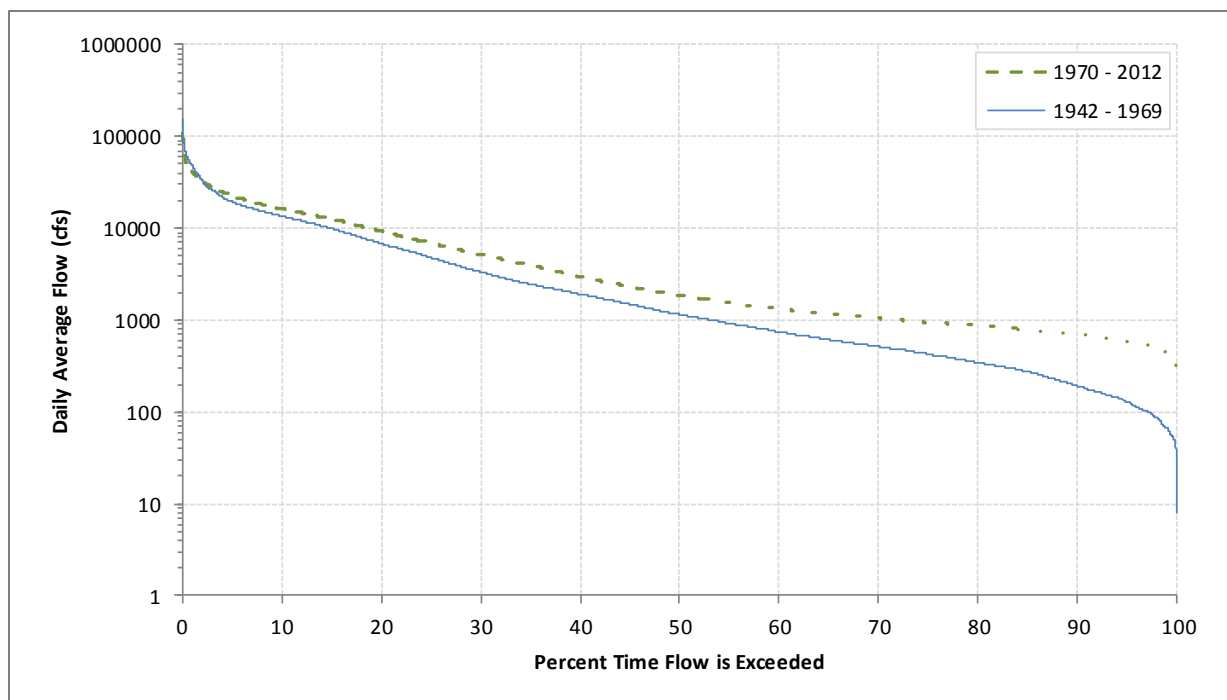


Figure 4. Flow exceedance curve for USGS gage 08065000, Trinity River near Oakwood, for periods 1942-1969 and 1970-2012.

Site Selection

Six sampling locations (Table 1) for supplemental biological sample collection were selected based upon:

1. Historical biological data collection sites
2. Reach segmentation
3. Availability of varied mesohabitat types
4. Instream structures and controls
5. Spatial distribution
6. Data gaps

In addition to TCEQ segmentation designations, reach segmentation also considered the 2011 Longitudinal Survey which took into account aerial photo analysis, field observations, and extensive empirical channel and mesohabitat data (TRA & RPS Espey, 2011). Minimal biological data has been collected since an extensive effort by TPWD in the late 1980s (Kleinsasser & Linam, 1990). A map of the 2012 sampling locations is shown in Figure 2.

Table 1. Sample site locations and dates.

Site No.	Location Description	Sample Date 1	Sample Date 2	County1	County2	Latitude	Longitude
080214	Trinity River upstream of SH 21	8/14/2012	10/17/2012	Madison	Houston	31.080009	95.719439
080242	Trinity River downstream of SH 7	8/15/2012	10/16/2012	Leon	Houston	31.319278	95.667159
080295	Trinity River upstream of US 79/84	8/16/2012	10/29/2012	Freestone	Anderson	31.689245	95.790823
080354	Trinity River upstream of US 287	9/11/2012	10/30/2012	Freestone	Anderson	31.988122	96.056724
080409	Trinity River upstream of FM 85	9/12/2012	10/31/2012	Navarro	Henderson	32.31943	96.369236
080423	Trinity River at SH 34	9/13/2012	11/1/2012	Ellis	Kaufman	32.423932	96.452315

Sampling Schedule

Because of the lack of existing, recent biological data within the middle Trinity River, each of the six sites were sampled twice in 2012. The intent was to sample each site twice in the TCEQ designated index period (March 15 – October 15), with one sample event at each site being within the critical period (July 1 – Sept 30). Weather conditions necessitated that sampling be pushed outside of these dates in order to ensure an adequate recovery period after high flow pulses. TRA and TIFP staff agreed that the conditions were still appropriate for supplemental biological data collection intended to fill data gaps and characterize the biology of the middle Trinity River.

Methodology

All available mesohabitat types were sampled for fish, benthic macroinvertebrates, and mussels. Multi-agency crews were present during each sampling event and were typically split into four general crews:

1. Seine, hoop net, gill net, and mussel
2. Benthic macroinvertebrates
3. Habitat
4. Boat electrofisher

When needed, resources and tasks were redistributed to ensure timely sample completion.

In general, fish and benthic macroinvertebrate sampling methods followed those outlined in the most recent version of *Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collection and Analyzing Biological Community Habitat Data* (TCEQ, 2007). Fish collections were primarily conducted by boat electrofishing with a Smith Root 7.5 GPP electrofisher and seining with 4.5 m long seines comprised of 3.1 mm mesh. Sampling was augmented with hoop nets and experimental gill nets to effectively sample all habitats. Protocols for benthic macroinvertebrate collection methods included kicknet sampling and/or sample collection from woody debris, rocks, or other structures. Mussel sampling was comprised of time searches along the shoreline and within the river channel.

Though sampling duration followed that outlined in the above references, collections of both fish and benthic macroinvertebrates were segregated by identified mesohabitat types (e.g., riffle, run, pool, backwater). Within each discrete mesohabitat sample, a global positioning system (GPS) receiver recorded a minimum of one location. A measurement of depth, dominant substrate, instream cover, and current velocity was taken at each point where a GPS coordinate was collected. A photograph was taken of each area sampled.

A minimum of one streamflow discharge measurement was completed at each site using a SonTek RiverSurveyor[®] M9 and standard USGS methods for boat mounted acoustic Doppler current profilers (Mueller & Wagner, 2009) or standard SWQM wadeable stream methods described in the TCEQ *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods* (2012). When available and appropriate, data from a USGS stream gage was recorded in lieu of field measurements.

Fishes and benthic macroinvertebrates collected in the field were identified following the requirements outlined in TCEQ (2007). TPWD provided quality assurance for identification of fish and mussel specimens and TCEQ identified benthic macroinvertebrates.

Results

Streamflow discharge measurements are reported in Table 2. Additionally, median flows from the middle Trinity River USGS gages are shown in Table 3.

Table 2. Flow results from 2012 supplemental biological data collection along the middle Trinity River.

Site	Date	Q (cfs)	Source**
80214	8/14/2012	707	M9
80214	10/17/2012	975	M9
80242	8/15/2012	722	USGS Gage 08065350 - Provisional
80242	10/16/2012	1010	USGS Gage 08065350 - Provisional
80295	8/16/2012	653	USGS Gage 08065000 - Provisional
80295	10/29/2012	811	USGS Gage 08065000 - Provisional
80354	9/11/2012	616	M9
80354	10/30/2012	669	M9
80409	9/12/2012	634	M9
80409	10/31/2012	671	M9
80423	9/13/2012	618	USGS Gage 08062500 - Provisional
80423	11/1/2012	949	USGS Gage 08062500 - Provisional

**M9 data is instantaneous; USGS gage data was selected near the middle of the workday.

Table 3. Period of record USGS median flow (cfs) values for each biological data collection site.

Site	USGS Gage Number	USGS Gage Name	USGS Median ** Q (cfs)	Earliest Record
80214	na	na	na	na
80242	8065350	Trinity River near Crockett	2,270	1964
80295	8065000	Trinity River near Oakwood	1,520	1924
80354	na	na	na	na
80409	8062500	Trinity River near Rosser	1,000	1924a
80423	8062500	Trinity River near Rosser	1,000	1924a

** Median flows calculated for period from earliest record to 2012 except as noted.

a Ungaged from 1925 to 1938

Data for habitat (Table 4), fish (Table 5), mussels (Table 6), and benthic macroinvertebrates (Table 7) are reported in the following pages. Raw data (including all sampling methods) and georeferenced photographs are included in the accompanying electronic media.

Table 4. Summary of depth, velocity, and dominant substrate types by site, sample-collection method (BE=boat electrofishing; S=seine), and habitat.

Site_id	Method	Habitat	Number of samples	Depth (ft)			Velocity (ft/s)			Number of samples					
				Min	Mean	Max	Min	Mean	Max	Silt / Clay	Sand	Gravel	Rubble / Cobble	Boulder	Bedrock
80214	BE	backwater	2	2.9	3.0	3.1	0.22	0.28	0.34	2	0	0	0	0	0
80214	BE	pool	7	3.9	6.5	8.7	0.21	0.42	0.62	5	1	0	0	0	1
80214	BE	run	11	1.4	4.7	8.5	0.44	0.76	1.01	2	6	2	1	0	0
80214	S	backwater	4	0.3	0.9	1.6	0.00	0.05	0.13	2	2	0	0	0	0
80214	S	pool	5	1.4	2.0	2.5	0.00	0.06	0.13	4	1	0	0	0	0
80214	S	run	11	0.4	1.3	1.9	0.16	0.48	1.97	3	8	0	0	0	0
80242	BE	backwater	4	2.4	4.8	8.8	0.27	0.54	0.86	4	0	0	0	0	0
80242	BE	pool	1	--	5.3	--	--	0.34	--	1	0	0	0	0	0
80242	BE	run	17	1.7	4.4	7.4	0.72	1.46	2.23	1	8	6	2	0	0
80242	S	backwater	4	0.5	1.2	1.6	0.09	0.21	0.30	0	2	2	0	0	0
80242	S	pool	1	--	2.3	--	--	0.16	--	1	0	0	0	0	0
80242	S	riffle	5	0.2	0.8	1.4	0.59	1.65	2.10	0	1	4	0	0	0
80242	S	run	11	0.1	1.3	2.4	0.15	0.67	1.67	1	9	1	0	0	0
80295	BE	backwater	3	3.7	5.0	6.2	0.51	2.45	3.53	3	0	0	0	0	0
80295	BE	riffle	2	2.1	3.3	4.6	2.41	2.69	2.96	0	0	0	2	0	0
80295	BE	run	14	1.5	4.4	7.6	0.54	2.02	4.88	4	4	2	4	0	0
80295	S	backwater	5	0.9	1.4	1.9	0.04	0.11	0.26	2	1	1	1	0	0
80295	S	riffle	5	0.2	0.7	1.1	0.56	1.39	1.97	0	0	1	4	0	0
80295	S	run	14	0.9	1.6	2.3	0.02	0.86	2.26	1	6	2	5	0	0
80354	BE	backwater	4	3.3	5.5	7.9	0.24	0.31	0.34	4	0	0	0	0	0
80354	BE	run	23	1.7	5.5	11.8	0.75	1.38	2.23	12	7	3	1	0	0
80354	S	backwater	4	0.8	1.7	2.4	0.01	0.02	0.04	2	1	1	0	0	0
80354	S	pool	1	--	0.5	--	--	0.34	--	0	1	0	0	0	0
80354	S	riffle	1	1.3	1.3	1.3	--	1.79	--	0	0	1	0	0	0
80354	S	run	14	0.6	1.2	2.4	0.35	0.92	1.36	1	9	4	0	0	0
80409	BE	backwater	2	3.5	4.2	5.0	0.33	0.49	0.64	2	0	0	0	0	0

Continued on next page.

Table 4. Continued.

Site_id	Method	Habitat	Number of samples	Depth (ft)			Velocity (ft/s)			Number of samples					
				Min	Mean	Max	Min	Mean	Max	Silt / Clay	Sand	Gravel	Rubble / Cobble	Boulder	Bedrock
80409	BE	falls	1	--	4.1	--	--	1.18	--	0	1	0	0	0	0
80409	BE	plunge pool	1	--	4.3	--	--	1.22	--	0	0	0	0	1	0
80409	BE	pool	2	6.8	6.9	7.0	0.38	0.41	0.44	2	0	0	0	0	0
80409	BE	rapid	2	3.8	4.0	4.2	3.48	3.87	4.27	0	0	0	0	0	2
80409	BE	run	15	2.4	4.6	9.2	0.81	1.93	3.85	7	4	4	0	0	0
80409	S	backwater	5	1.0	1.7	3.6	0.06	0.14	0.26	3	0	1	1	0	0
80409	S	pool	2	1.3	1.9	2.4	0.07	0.16	0.24	2	0	0	0	0	0
80409	S	riffle	2	0.2	0.5	0.7	1.97	2.51	3.05	0	0	1	1	0	0
80409	S	run	14	0.5	1.6	2.7	0.07	0.98	2.43	7	2	2	3	0	0
80423	BE	backwater	3	4.2	5.7	8.4	0.08	0.35	0.49	3	0	0	0	0	0
80423	BE	falls	3	5.6	6.3	7.7	1.00	1.18	1.43	0	0	1	0	0	2
80423	BE	pool	3	5.6	7.6	11.6	0.27	0.38	0.50	3	0	0	0	0	0
80423	BE	riffle	1	--	1.5	--	--	1.65	--	0	0	0	1	0	0
80423	BE	run	9	1.9	5.2	9.0	0.19	1.41	2.34	3	3	0	1	1	1
80423	S	backwater	5	0.9	1.6	3.1	0.03	0.12	0.20	2	3	0	0	0	0
80423	S	pool	1	--	3.6	--	--	0.06	--	0	1	0	0	0	0
80423	S	riffle	3	0.4	0.6	0.8	0.46	2.11	3.93	1	0	0	2	0	0
80423	S	run	10	0.8	1.7	3.3	0.08	1.09	3.97	2	4	1	2	0	1

Table 5. Fish species collected in the middle Trinity River subbasin during 2012.

Scientific Name	Common Name	080214	080242	080295	080354	080409	080423
<i>Ameiurus natalis</i>	yellow bullhead	X					
<i>Aplodinotus grunniens</i>	freshwater drum	X	X	X	X	X	X
<i>Atractosteus spatula</i>	alligator gar		X		X	X	X
<i>Carpionodes carpio</i>	river carpsucker		X	X			X
<i>Cyprinella lutrensis</i>	red shiner	X	X	X	X	X	X
<i>Cyprinella venusta</i>	blacktail shiner		X	X	X		
<i>Cyprinus carpio</i>	common carp	X		X	X		
<i>Dorosoma cepedianum</i>	gizzard shad	X	X	X	X		X
<i>Dorosoma petenense</i>	threadfin shad	X	X	X	X		X
<i>Etheostoma chlorosoma</i>	bluntnose darter				X	X	
<i>Etheostoma gracile</i>	slough darter	X			X	X	
<i>Fundulus notatus</i>	blackstripe topminnow						X
<i>Gambusia affinis</i>	western mosquitofish	X	X	X	X	X	X
<i>Ictalurus furcatus</i>	blue catfish	X	X	X	X	X	X
<i>Ictalurus punctatus</i>	channel catfish	X	X	X	X	X	X
<i>Ictiobus bubalus</i>	smallmouth buffalo	X	X	X	X	X	X
<i>Lepisosteus oculatus</i>	spotted gar	X	X	X	X	X	X
<i>Lepisosteus osseus</i>	longnose gar	X	X	X	X	X	X
<i>Lepomis cyanellus</i>	green sunfish	X	X	X			X
<i>Lepomis gulosus</i>	warmouth	X					
<i>Lepomis humilis</i>	orangespotted sunfish	X	X	X		X	X
<i>Lepomis macrochirus</i>	bluegill	X		X	X		X
<i>Lepomis megalotis</i>	longear sunfish	X	X	X	X	X	X
<i>Menidia beryllina</i>	inland silverside	X	X	X		X	
<i>Micropterus punctulatus</i>	spotted bass	X	X	X		X	X
<i>Micropterus salmoides</i>	largemouth bass	X	X			X	X
<i>Morone chrysops</i>	white bass	X	X	X			
<i>Notropis buchanani</i>	ghost shiner	X	X	X	X	X	X
<i>Notropis shumardi</i>	silverband shiner	X	X				
<i>Notropis texanus</i>	weed shiner		X	X			
<i>Noturus nocturnus</i>	freckled madtom	X	X	X	X	X	X
<i>Percina macrolepida</i>	bigscale logperch			X		X	X
<i>Percina sciera</i>	dusky darter		X	X		X	
<i>Pimephales vigilax</i>	bullhead minnow	X	X	X	X	X	X
<i>Pomoxis annularis</i>	white crappie	X	X	X	X		X
<i>Pylodictis olivaris</i>	flathead catfish	X	X	X	X	X	X

Table 6. Mussel species found in the Trinity River subbasin in 2012.

Species	Common name	Status
<i>Truncilla donaciformis</i>	fawnsfoot	TCAP
<i>Pyganodon grandis</i>	giant floater	
<i>Leptodea fragilis</i>	fragile papershell	
<i>Potamilus amphichaenus</i>	Texas heelsplitter	1,3 (TWAP-SC)
<i>Fusconaia askewi</i>	Texas pigtoe	1,2,3 (TWAP-SC)
<i>Obliquaria reflexa</i>	threehorn wartyback	
<i>Quadrula mortoni</i>	western pimpleback	
<i>Quadrula nobilis</i>	Gulf mapleleaf	
<i>Amblema plicata</i>	threeridge	
<i>Arcidens confragosus</i>	rock pocketbook	(TWAP-SC)
<i>Megaloniaias nervosa</i>	washboard	
<i>Plectomerus dombevanus</i>	bankclimber	
<i>Tritogonia verrucosa</i>	pistolgrip	
<i>Potamilus purpuratus</i>	bleufer	
<i>Lampsilis teres</i>	yellow sandshell	

TWAP-SGCN = Texas Conservation Action Plan-Species of Greatest Conservation Need (TPWD, 2010)

1 = State Rank (S1) – Critically imperiled, extremely rare, very vulnerable to extirpation, 5 or fewer occurrences

2 = State Rank (S2) – Imperiled in state, very rare, vulnerable to extirpation, 6 to 20 occurrences

3 = State Threatened

Table 7. Benthic macroinvertebrates collected in the middle Trinity River subbasin in 2012.

Taxon	80214	80242	80295	80354	80409	80423
<i>Baetis</i> sp.	X	X	X	X	X	X
<i>Camelobaetidius</i> sp.		X	X	X	X	X
<i>Fallceon</i> sp.	X	X			X	X
<i>Paracloeodes</i> sp.	X					
<i>Pseudocloeon</i> sp.		X	X	X	X	X
<i>Campsurus</i> sp.				X		
<i>Pentagenia vittegera</i>	X					
<i>Caenis</i> sp.	X	X	X	X	X	X
<i>Isonychia</i> sp.	X	X	X	X	X	X
<i>Maccaffertium</i> sp.	X	X	X	X	X	X
<i>Stenonema</i> sp.			X	X	X	
<i>Asioplax</i> sp.	X	X	X	X	X	X
<i>Tricorythodes</i> sp.	X	X	X	X	X	X
<i>Traverella</i> sp.		X	X	X	X	
<i>Choroerpes</i> sp.			X			
<i>Neoperla</i> sp.		X	X	X		
<i>Cheumatopsyche</i> sp.	X	X	X	X	X	X
<i>Hydropsyche</i> sp.	X	X	X	X	X	X
<i>Potamyia flava</i>	X		X			
<i>Hydroptila</i> sp.					X	X
<i>Mayatrichia</i> sp.			X			
<i>Neotrichia</i>		X	X			X
<i>Nectopsyche</i> sp.		X	X	X	X	X
<i>Neureclipsis</i> sp.	X					X
<i>Cynellus</i> sp.	X	X				
<i>Corydalus cornutus</i>		X	X	X		
<i>Chauliodes</i> sp.			X			
<i>Petrophila</i> sp.		X		X	X	X
<i>Dubiraphia</i> sp.			X	X		
<i>Heterelmis</i> sp.	X	X	X	X	X	
<i>Stenelmis</i> sp.	X	X	X	X	X	X
<i>Helichus</i> sp.			X	X		
<i>Dineutus</i> sp.				X		
<i>Berosus</i> sp. (larva)			X			
<i>Desmopachria</i> sp.				X		
<i>Argia</i> sp.	X		X		X	X
<i>Enallagma</i> sp.						X
<i>Hetaerina</i> sp.						X
<i>Dromogomphus</i> sp.			X			
<i>Erpetogomphus</i> sp.	X					
<i>Stylurus</i> sp.					X	
<i>Rhagovelia</i> sp.						X
Chironomidae	X	X	X	X	X	X
<i>Atrichopogon</i> sp.	X					
<i>Bezzia</i> sp.	X		X			

Continued on next page.

Table 7. Continued

Taxon	80214	80242	80295	80354	80409	80423
<i>Sphaeromias</i> sp.	X					
<i>Simulium</i> sp.		X	X	X	X	X
<i>Limnophora</i> sp.						X
<i>Hyallela azteca</i>	X					X
Collembola						X
Ostracoda	X					
<i>Corbicula fluminea</i>		X	X	X	X	X
<i>Sphaerium</i> sp.			X			
<i>Physella</i> sp.			X			X
<i>Ferrisia</i> sp.			X			
<i>Hydracarina</i> sp.						X
Oligochaeta	X	X	X		X	X
<i>Dugesia</i> sp.						X

Discussion

Habitat, fish, and benthic invertebrate data are summarized and discussed below. Additional data analysis is underway by the TIFP and TRA in order to create the middle Trinity River Study Design in collaboration with the stakeholder workgroup. Habitat and fish assemblage data from this study will be used to determine appropriate indicator species for the middle Trinity River instream flow study and develop stratified random sampling designs for collection of habitat utilization data.

Habitat

Sampling events took place during a range of base flow conditions and were below the period of record median flow. Even at these lower end flows, sampling crews had difficulty in some locations due to water depth (too deep) and high velocities. In some instances, substrate notation was complicated by the type of substrate. For example, some substrate samples were 100% compacted, spherical clay balls. These were recorded as clay due to type, though their structure and size fit into the large sand to gravel category.

Large woody debris is prevalent in many locations along the middle Trinity River and serves as instream cover and as a nutrient source.

Fisheries

Collection methods included boat electrofishing and seining in as many habitat types as possible. Additionally, hoop and gill nets were utilized to supplement collections. A total of 36 species comprising more than 58,000 individuals was collected. Several lotic-adapted species that were distributionally limited (e.g., dusky darter), uncommon (e.g., freckled madtom), or

absent (e.g., bigscale logperch) in the 1970s and 1980s were observed more broadly. Table 8 shows a comparison of fishery data between historical collections and 2012 (Perkin & Bonner, in review) (Kleinsasser & Linam, 1990) (TPWD, 1974). Eighteen species from the historic assemblage were not collected in 2012. This may be due to several factors including limited effort compared to historic (two seasons in 2012 versus more than thirty years of collections) and 2012 sampling was conducted only in mainstem habitats.

Previous studies had suggested longitudinal zonation of fish assemblages, likely related to water quality issues. Preliminary analysis of the baseline fish data demonstrated fewer longitudinal trends, with the upper four sites grouping together and the lower two clustering.

Benthic Macroinvertebrates

In the six study reaches sampled in the summer and fall of 2012, approximately 54 taxa were identified (Chironomidae at family level) based on the analysis of over 5,000 individuals. Two primary sampling techniques were used. Snags, in form of woody debris and submerged tree limbs, were sampled in areas exposed to current. Kicknet samples were collected in shallow riffles and runs.

Several sensitive benthic macroinvertebrate taxa were collected that were not noted in Dickson, et al. (1989). In general, sensitive benthic macroinvertebrate taxa were distributed across all six study reaches. Table 9 shows a comparison of benthic macroinvertebrate data between historical collections and 2012 (Dickson et al., 1989) (Davis, 1989).

The sample reach located around State Highway 21 (Site ID 80214) is different from upstream reaches. This is primarily related to the predominance of sandy substrates and lack of cobble/gravel riffles that were present in each of the other reaches.

Mussels

Timed searches were used at all six collection sites during baseline sampling in 2012. In that effort, 15 species (live) were collected (Table 6), including two state threatened species, Texas heelsplitter and Texas pigtoe (Texas Mussel Watch, 2008). Catch per unit effort (total mussels/hour) ranged from 4.5 to 29.2, which are relatively high values. No apparent longitudinal trend in mussel abundance was observed. The highest diversity and abundance of mussels was in a reach with large riffles. Table 10 shows a comparison of mussel data between historical collections and 2012. Invasive zebra mussels (*Dreissena polymorpha*) have been found upstream of the study area, but were not observed during this extensive sampling effort.

Table 8. Fish species collected in the middle Trinity River from 1970s to 2000s (Perkin & Bonner, in review) and during baseline TIFP sampling in 2012.

Species	Common name	Historic	2012 Baseline
<i>Ameiurus melas</i>	black bullhead	X	
<i>Ameiurus natalis</i>	yellow bullhead	X	X
<i>Amia calva</i>	bowfin	X	
<i>Aplodinotus grunniens</i>	freshwater drum	X	X
<i>Atractosteus spatula</i>	alligator gar	X	X
<i>Campostoma anomalum</i>	central stoneroller	X	
<i>Carpiodes carpio</i>	river carpsucker	X	X
<i>Ctenopharyngodon idella</i>	grass carp	X	
<i>Cyprinella lutrensis</i>	red shiner	X	X
<i>Cyprinella venusta</i>	blacktail shiner	X	X
<i>Cyprinus carpio</i>	common carp	X	X
<i>Dorosoma cepedianum</i>	gizzard shad	X	X
<i>Dorosoma petenense</i>	threadfin shad	X	X
<i>Etheostoma chlorosoma</i>	bluntnose darter	X	X
<i>Etheostoma gracile</i>	slough darter	X	X
<i>Etheostoma proeliare</i>	cypress darter	X	
<i>Fundulus notatus</i>	blackstripe topminnow	X	X
<i>Gambusia affinis</i>	western mosquitofish	X	X
<i>Ictalurus furcatus</i>	blue catfish	X	X
<i>Ictalurus punctatus</i>	channel catfish	X	X
<i>Ictiobus bubalus</i>	smallmouth buffalo	X	X
<i>Labidesthes sicculus</i>	brook silverside	X	
<i>Lepisosteus oculatus</i>	spotted gar	X	X
<i>Lepisosteus osseus</i>	longnose gar	X	X
<i>Lepomis auritus</i>	redbreast sunfish	X	
<i>Lepomis cyanellus</i>	green sunfish	X	X
<i>Lepomis gulosus</i>	warmouth	X	X
<i>Lepomis humilis</i>	orangespotted sunfish	X	X
<i>Lepomis macrochirus</i>	bluegill	X	X
<i>Lepomis marginatus</i>	dollar sunfish	X	
<i>Lepomis megalotis</i>	longear sunfish	X	X
<i>Lepomis microlophus</i>	reardear sunfish	X	
<i>Lepomis miniatus</i>	redspotted sunfish	X	
<i>Lythrurus fumeus</i>	ribbon shiner	X	
<i>Lythrurus umbratilis</i>	redfin shiner	X	
<i>Menidia beryllina</i>	inland silverside	X	X
<i>Micropterus punctulatus</i>	spotted bass	X	X
<i>Micropterus salmoides</i>	largemouth bass	X	X
<i>Minytrema melanops</i>	spotted sucker	X	
<i>Morone chrysops</i>	white bass	X	X
<i>Morone mississippiensis</i>	yellow bass	X	
<i>Morone saxatilis</i>	striped bass	X	

Table 8. Continued

Species	Common name	Historic	2012 Baseline
<i>Notemigonus crysoleucas</i>	golden shiner	X	
<i>Notropis buchanani</i>	ghost shiner	X	X
<i>Notropis shumardi</i>	silverband shiner	X	X
<i>Notropis texanus</i>	weed shiner	X	X
<i>Notropis volucellus</i>	mimic shiner	X	X
<i>Noturus gyrinus</i>	tadpole madtom	X	
<i>Noturus nocturnus</i>	freckled madtom	X	X
<i>Opsopoeodus emiliae</i>	pugnose minnow	X	X
<i>Percina macrolepida</i>	bigscale logperch	X	X
<i>Percina sciera</i>	dusky darter	X	X
<i>Pimephales vigilax</i>	bullhead minnow	X	X
<i>Pomoxis annularis</i>	white crappie	X	X
<i>Pomoxis nigromaculatus</i>	black crappie	X	
<i>Pylodictis olivaris</i>	flathead catfish	X	X

Table 9. Benthic macroinvertebrate taxa collected in historic sampling as well as baseline TIFP sampling in 2012.

Taxon	Historic	2012 Baseline
<i>Baetis</i> sp.	X	X
<i>Camelobaetidium</i> sp.		X
<i>Fallceon</i> sp.		X
<i>Paracloeodes</i> sp.	X	X
<i>Pseudocloeon</i> sp.		X
<i>Campsurus</i> sp.		X
<i>Hexagenia</i> sp.	X	
<i>Pentagenia vittegera</i>		X
<i>Tortopus</i> sp.	X	
<i>Caenis</i> sp.	X	X
<i>Isonychia</i> sp.		X
<i>Maccaffertium</i> sp.		X
<i>Stenacron</i> sp.	X	
<i>Stenonema</i> sp.	X	X
<i>Asioplax</i> sp.		X
<i>Tricorythodes</i> sp.	X	X
<i>Traverella</i> sp.		X
<i>Perlesta</i> sp.		X
<i>Cheumatopsyche</i> sp.		X
<i>Hydropsyche</i> sp.		X
<i>Potamyia</i> sp.	X	X
<i>Hydroptila</i> sp.		X
<i>Neotrichia</i>		X
<i>Nectopsyche</i> sp.		X
<i>Neureclipsis</i> sp.		X
<i>Cyrnellus</i> sp.	X	X
<i>Corydalus cornutus</i>		X
<i>Petrophila</i> sp.		X
<i>Dubiraphia</i> sp.		X
<i>Heterelmis</i> sp.		X
<i>Microcyloopus</i> sp.		X
<i>Stenelmis</i> sp.		X
<i>Helichus</i> sp.		X
<i>Helophorus</i> sp.	X	
<i>Dineutus</i> sp.		X
<i>Gyretes</i> sp.	X	
<i>Berosus</i> sp. (larva)		X
<i>Desmopachria</i> sp.		X
<i>Hydrochus</i> sp.	X	
<i>Tropisternus</i> sp.	X	
<i>Peltodytes</i> sp.	X	
<i>Dytiscus</i> sp.	X	
<i>Argia</i> sp.		X

Taxon	Historic	2012 Baseline
<i>Enallagma</i> sp.		X
<i>Hetaerina</i> sp.		X
<i>Lestes</i> sp.	X	
<i>Dromogomphus</i> sp.		X
<i>Erpetogomphus</i> sp.		X
<i>Stylurus</i> sp.		X
<i>Metrobates</i> sp.	X	
<i>Rhagovelia</i> sp.		X
<i>Rheumatobates</i> sp.	X	
<i>Trichocorixa</i> sp.	X	
<i>Hebrus</i> sp.	X	
Chironomidae	X	X
<i>Atrichopogon</i> sp.		X
<i>Bezzia</i> sp.		X
<i>Sphaeromias</i> sp.		X
<i>Simulium</i> sp.		X
<i>Limnophora</i> sp.		X
<i>Dicranota</i> sp.	X	
<i>Erioptera</i> sp.	X	
<i>Syrphidae</i> sp.	X	
<i>Hyalolela azteca</i>		X
Collembola		X
<i>Palaemonetes</i> sp.	X	
Ostracoda	X	X
<i>Sphaerium</i> sp.	x	
<i>Corbicula fluminea</i>	X	X
<i>Ferrisia rivularis</i>	X	
<i>Physella</i> sp.	X	X
<i>Gyraulus</i> sp.	X	
<i>Hydracarina</i> sp.	X	X
<i>Oligochaeta</i>	X	X
Nematoda	X	
<i>Dugesia</i> sp.	X	X

Table 10. Historic unionid mussel occurrences in the Trinity River basin with recent collections during 2012 baseline sampling and current status.

Species	Common name	2012 Baseline	Status
<i>Toxolasma parvus</i>	lilliput		
<i>Toxolasma texasiensis</i>	Texas lilliput		
<i>Truncilla donaciformis</i>	fawnsfoot	X	(TWAP-SC)
<i>Truncilla macrodon</i>	Texas fawnsfoot		3,4 (TWAP-SC)
<i>Unio merus declivis</i>	tapered pondhorn		
<i>Unio merus tetralasmus</i>	pondhorn		
<i>Villosa lienosa</i>	little spectaclecase		
<i>Pyganodon grandis</i>	giant floater	X	
<i>Utterbackia imbecillis</i>	paper pondshell		
<i>Lasmigona complanata</i>	white heelsplitter		
<i>Leptodea fragilis</i>	fragile papershell	X	
<i>Potamilus amphichaenus</i>	Texas heelsplitter	X	1,3 (TWAP-SC)
<i>Potamilus ohiensis</i>	pink papershell		
<i>Fusconaia askewi</i>	Texas pigtoe	X	1,2,3 (TWAP-SC)
<i>Fusconaia flava</i>	Wabash pigtoe		
<i>Fusconaia lananensis</i>	triangle pigtoe		1,3
<i>Obovaria jacksoniana</i>	southern hickorynut		3 (TWAP-SC)
<i>Obliquaria reflexa</i>	threehorn wartyback	X	
<i>Pleurobema riddellii</i>	Louisiana pigtoe		1,3 (TWAP-SC)
<i>Quadrula apiculata</i>	southern mapleleaf		
<i>Quadrula mortoni</i>	western pimpleback	X	
<i>Quadrula nobilis</i>	gulf mapleleaf	X	
<i>Truncilla truncate</i>	deertoe		
<i>Amblema plicata</i>	threeridge	X	
<i>Arcidens confragosus</i>	rock pocketbook	X	(TWAP-SC)
<i>Megaloniais nervosa</i>	washboard	X	
<i>Plectomerus dombevanus</i>	bankclimber	X	
<i>Tritogonia verrucosa</i>	pistolgrip	X	
<i>Glebula rotundata</i>	round pearlyshell		
<i>Lampsilis satura</i>	sandbank pocketbook		1,3 (TWAP-SC)
<i>Potamilus purpuratus</i>	bleufer	X	
<i>Lampsilis hydiana</i>	Louisiana fatmucket		
<i>Lampsilis teres</i>	yellow sandshell	X	
<i>Ligumia subrostrata</i>	pond mussel		

TWAP-SC = Texas Wildlife Action Plan-Species of Concern (TPWD, 2005)
1 = State Rank (S1) – Critically imperiled, extremely rare, very vulnerable to extirpation, 5 or fewer occurrences
2 = State Rank (S2) – Imperiled in state, very rare, vulnerable to extirpation, 6 to 20 occurrences
3 = State Threatened
4 = Candidate Species under Federal Endangered Species Act

Recommendations for Additional Work

Instream flow reconnaissance and supplemental studies are, by nature, designed to be the basis for additional studies. As the instream flow study for the middle Trinity River subbasin moves forward, opportunities exist to expand the scientific knowledge base. The following additional studies are recommended:

- Substrate plays an important role in instream flow studies. Particle size studied in conjunction with other physical and hydraulic variables have been able to predict distribution and, in some cases, the density of macroinvertebrates (Gore, Layzer, & Mead, 2001) (Statner, Merigoux, & Leichtfried, 2005). Additional research should be done to determine the habitat function of the spherical clay balls identified during this study.
- Large woody debris is common throughout some portions of the middle Trinity River study area. The role, amount, and movement of large woody debris throughout this system needs to be better understood.
- The SWQM guidelines for stream sampling were designed for small, wadeable streams. Additional methods for biological and sediment sampling on large river systems should be continually tested and developed to ensure that mesohabitat specific sampling is representative.

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Appendix A. SB 3 flow standards within the middle Trinity River

Location	Season	Subsistence Flow (cfs)	Base Flow (cfs)	Pulse Flow
USGS Gage: 08049500	Winter	19	45	Trigger: 300 cfs
				Volume: 3,500 af
				Duration: 4 days
	Spring	25	45	Trigger: 1,200 cfs
				Volume: 8,000 af
				Duration: 8 days
West Fork Trinity River near Grand Prairie	Summer	23	35	Trigger: 300 cfs
				Volume: 1,800 af
				Duration: 3 days
	Fall	21	35	Trigger: 300 cfs
				Volume: 1,800 af
				Duration: 3 days
USGS Gage: 08057000	Winter	26	50	Trigger: 700 cfs
				Volume: 3,500 af
				Duration: 3 days
	Spring	37	70	Trigger: 4,000 cfs
				Volume: 40,000 af
				Duration: 9 days
Trinity River at Dallas	Summer	22	40	Trigger: 1,000 cfs
				Volume: 8,500 af
				Duration: 5 days
	Fall	15	50	Trigger: 1,000 cfs
				Volume: 8,500 af
				Duration: 5 days
USGS Gage: 08065000	Winter	120	340	Trigger: 3,000 cfs
				Volume: 18,000 af
				Duration: 5 days
	Spring	160	450	Trigger: 7,000 cfs
				Volume: 130,000 af
				Duration: 11 days
Trinity River near Oakwood	Summer	250	250	Trigger: 2,500 cfs
				Volume: 23,000 af
				Duration: 5 days
	Fall	100	260	Trigger: 2,500 cfs
				Volume: 23,000 af
				Duration: 5 days

Adapted from (Tex. Admin. Code tit. 30 § 298.225)

Appendix B. Scope of Work

Supplement Existing Biological data in the middle Trinity River Study Area

Background: A preliminary evaluation of existing biological data in the middle Trinity River indicates temporal and spatial gaps in historical collections that should be supplemented to allow a more thorough understanding of the system and its biology. The goal of the project is to conduct new biological collections that would facilitate a better understanding of biological assemblages and aid in scoping an instream flow study.

Task 1: Identify sampling locations, conduct reconnaissance, and secure access.

Through coordination between the Trinity River Authority (Authority), Texas Parks and Wildlife Department (TPWD), Texas Water Development Board (TWDB), and Texas Commission on Environmental Quality (TCEQ), a minimum of five appropriate sampling locations will be developed to fill baseline biological data needs within the middle Trinity River study area. Among the considerations for selection of sample sites are:

- Geographic gaps in the historic data;
- Representativeness of the reach;
- A lack of recent collections (e.g., post 1995); and
- Overall geographic coverage, especially as it relates to areas where instream flow study sites may be located.

The Authority will identify adjacent landowners through appraisal district records or other means and initiate contacts if access to their property is required, securing it through written permission.

Task 2: Collect biological assemblages and associated data

In general, sampling methods for biological assemblages will follow those outlined in the most recent version of *Surface Water Quality Monitoring Procedures, Vol 2: Methods for Collection and Analyzing Biological Community Habitat Data*. Fish collections will include boat and backpack electrofishing as well as seining and may be augmented by other methods to effectively sample all habitats. See *Appendix A: Fish Sampling Guidelines*. Protocols for benthic macroinvertebrate collection methods will include kicknet sampling and/or sample collection from woody debris, rocks, or other structures as available and may be augmented by other methods to effectively sample all habitats. See *Appendix B: Benthic Sampling Guidelines*.

Though sampling duration will follow that outlined in the above reference, collections of both fish and benthic macroinvertebrates will be segregated by identified mesohabitat types (e.g., riffle, run, pool, backwater). Within each discrete mesohabitat sample, a global positioning system (GPS) receiver will be used to record a minimum of one location (datum-WGS84; units=decimal degrees; reception-3D). A measurement will be made of habitat depth, dominant substrate, and current velocity at each point where a GPS coordinate is collected. A photograph will be taken depicting the area sampled.

A minimum of one flow measurement will be completed at each site using standard USGS methods for boat mounted acoustic Doppler current profilers (Mueller and Wagner, 2009) or standard SWQM wadeable stream methods described in the TCEQ *Surface Water Quality Monitoring Procedures, Vol 1: Physical and Chemical Monitoring Methods*. When available and

appropriate, data from a USGS stream gage data may be recorded in lieu of field measurements.

The intent is to sample each site twice during the index period (e.g., TCEQ), with one of those during the critical period.

Sampling will be conducted in consultation and collaboration with the Authority, TPWD, TWDB, TCEQ Resource Protection Team, and TCEQ Surface Water Quality Monitoring Team and a representative from each agency will be notified in advance of field sampling events to allow for participation. TPWD will provide technical assistance and gear associated with field sampling.

Task 3: Identify fishes and benthic macroinvertebrates, prepare species lists, and report data

Fishes and benthic macroinvertebrates collected in the field will be identified following the requirements outlined in TCEQ (2005). TPWD will provide quality assurance for identification of fish specimens. TCEQ SWQM will provide assistance in identification of benthic macroinvertebrates. Fish and benthic macroinvertebrate assemblage enumeration, location, and habitat information will be reported in Microsoft Excel format. Photographs will be submitted in a suitable electronic format and georeferenced.

Deliverables:

A report containing all the details of work for the above mentioned tasks and the methodologies used will be delivered to TPWD. The report will also contain results, conclusions and recommendations for further work.