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Texas Commission on Environmental Quality

Water-Quality, Stream-Habitat, and Biological Data for Highland and Marchand Bayous, Galveston County, Texas, 2006–07

Data Series 394

U.S. Department of the Interior
U.S. Geological Survey

Front cover: Highland Bayou near Hitchcock, Texas, July 10, 2006. Photograph by Patrick Keefe, U.S. Geological Survey.

Back cover: Highland Bayou near Hitchcock, Texas, July 11, 2006. Photograph by Patrick Keefe, U.S. Geological Survey.

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Horizontal coordinate information is referenced to North American Datum of 1983 (NAD 83).

Water-Quality, Stream-Habitat, and Biological Data for Highland and Marchand Bayous, Galveston County, Texas, 2006–07

By Dexter W. Brown, Jeffrey A. Mabe, and Michael J. Turco

Abstract

The U.S. Geological Survey, in cooperation with the Houston-Galveston Area Council and the Texas Commission on Environmental Quality, collected water-quality, stream-habitat, and biological data from five sites on Highland and Marchand Bayous in Galveston County, Texas, during 2006–07. Water-quality data-collection surveys consisted of synoptic 24-hour continuous measurements of water temperature, pH, specific conductance, and dissolved oxygen and periodically collected samples analyzed for several properties and constituents of interest. Bacteria samples were collected monthly at 10 sites on Highland and Marchand Bayous during the study. Stream-habitat data were collected at five sites three times during the study, July–August 2006, March 2007, and July–August 2007. At each site, a representative stream reach was selected. Within this reach, five evenly spaced stream transects were determined. At each transect, stream (wetted channel width, water depth, bottom material, instream cover) and riparian (bank slope and erosion potential, width of natural vegetation, type of vegetation, percentage tree canopy) attributes were measured.

Benthic macroinvertebrate and fish data were collected from the same five sites identified for habitat evaluation. Three assessments were done to account for seasonal differences in biotic distribution. Stream-habitat and aquatic biota (benthic macroinvertebrates and fish) were assessed at each site three times during the study to evaluate aquatic life use. A total of 5,126 macroinvertebrate individuals were identified at all sites. During the study, 34 species of fish representing 28 families were collected from all the sites.

Introduction

The Texas Commission on Environmental Quality (TCEQ) administers water-quality management programs with the goal of protecting, maintaining, and restoring water resources in Texas. One such program is the Texas Clean Rivers Program (CRP), which was established by the 1991 Texas Legislature (Texas Administrative Code, 2007). Under the CRP, water-quality monitoring and assessments are conducted in 23 river and coastal basins statewide through contracts with partner agencies. The Houston-Galveston Area Council (H-GAC) is the partner agency for a 13-county service area in southeastern Texas that includes the Houston metropolitan area. Every 2 years (biennium), CRP partners may perform systematic monitoring studies, whereby a variety of data are collected in water bodies that are not monitored routinely. Data from these special studies help to determine whether additional assessment is needed to evaluate human health concerns, the status of ecological conditions, or designated stream uses.

The coastal basins of Highland Bayou and Marchand Bayou in Galveston County were chosen for this monitoring study (fig. 1). Both bayous currently (2008) are listed on the 303(d) list of impaired waters in Texas for low dissolved oxygen (Texas Commission on Environmental Quality, 2008). Parts of Highland Bayou (segment 2424A) and all of Marchand Bayou (segment 2424C) also are listed as impaired because of high bacteria concentrations. To better understand the spatial and temporal variability of water quality in the two bayous, and to characterize the habitat of the streams and the status of their biological communities, the U.S. Geological Survey (USGS), in cooperation with H-GAC and TCEQ, collected data during 2006–07 to document water-quality, stream-habitat, and biological conditions in the bayous.

Purpose and Scope

The purpose of this report is to document the water-quality, stream-habitat, and biological data collected from 10 sites (reaches) on Highland and Marchand Bayous during 2006–07. Data-collection methods are described, and data are presented to compare water-quality changes at and among

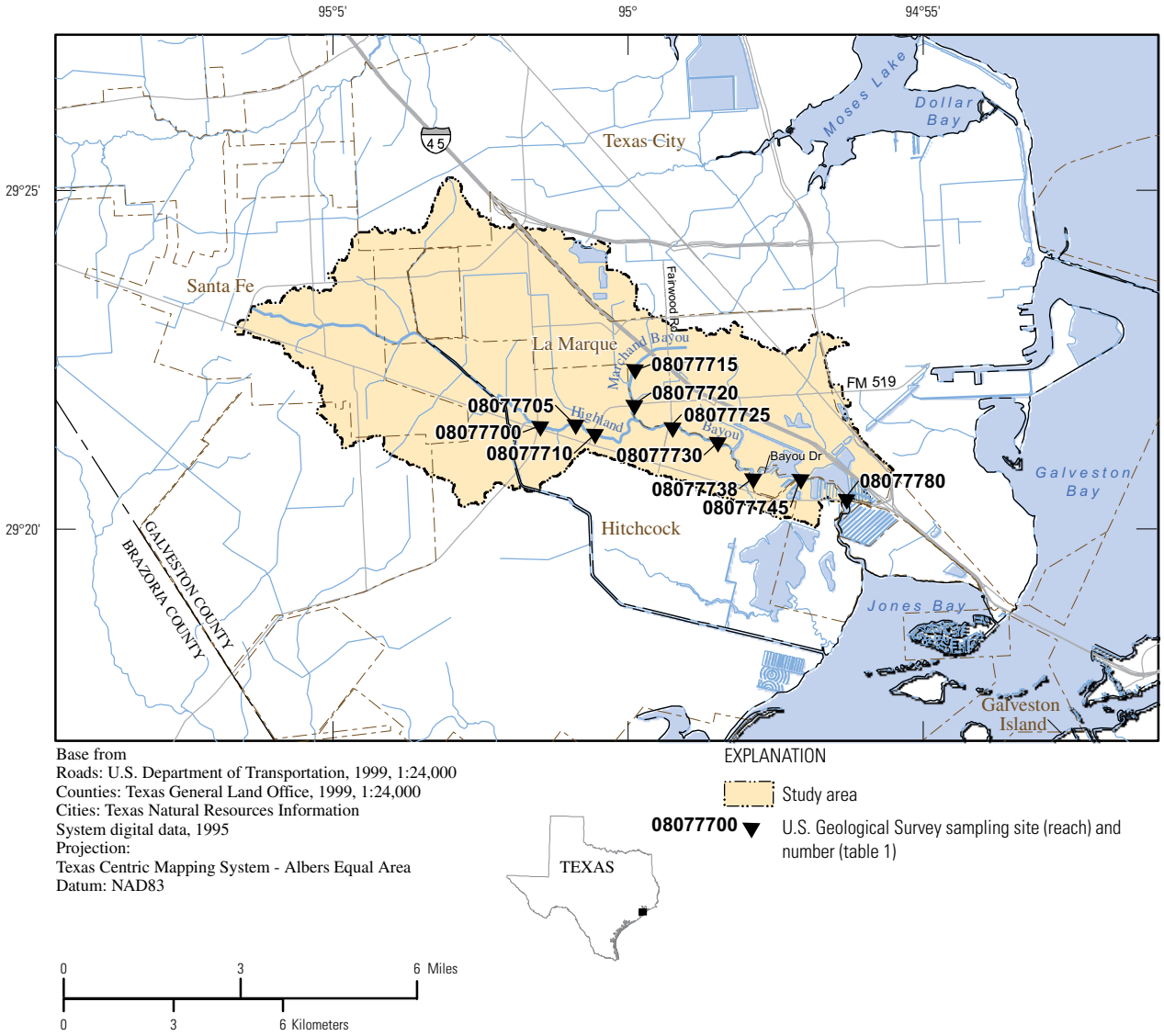

Figure 1. Highland and Marchand Bayous watershed and locations of Highland and Marchand Bayous sampling sites (reaches), Galveston County, Texas, 2006–07.

sites during the study period. In addition, water-quality data were compared to State screening thresholds for selected water-quality constituents. Metrics computed from stream-habitat and biological data were compared to State indexes for aquatic life use (Texas Commission on Environmental Quality, 2007).

Description of Study Area

Highland Bayou is a tidally influenced stream draining an approximately 39-square-mile area in Galveston County on the Texas Gulf Coast (fig. 1). The water course rises near the town of Santa Fe and runs east-southeastward about 12.6 miles to Jones Bay. Marchand Bayou is a smaller, shallower tributary that joins Highland Bayou near its mid-point. The Highland and Marchand Bayous watershed (study area) contains a mix of developed and undeveloped land (fig. 2). The upper reaches of the watershed are characterized by relatively narrow channels, steeply sloping channel sides, and low banks. Bank vegetation primarily consists of grasses, trees, and shrubs or maintained lawns. The lower reaches are characterized by relatively broad channels, a sinuate shoreline, and gently sloping channel sides that grade into shallow banks. Channel margins in the lower reaches are less developed and generally are lined with cordgrass.

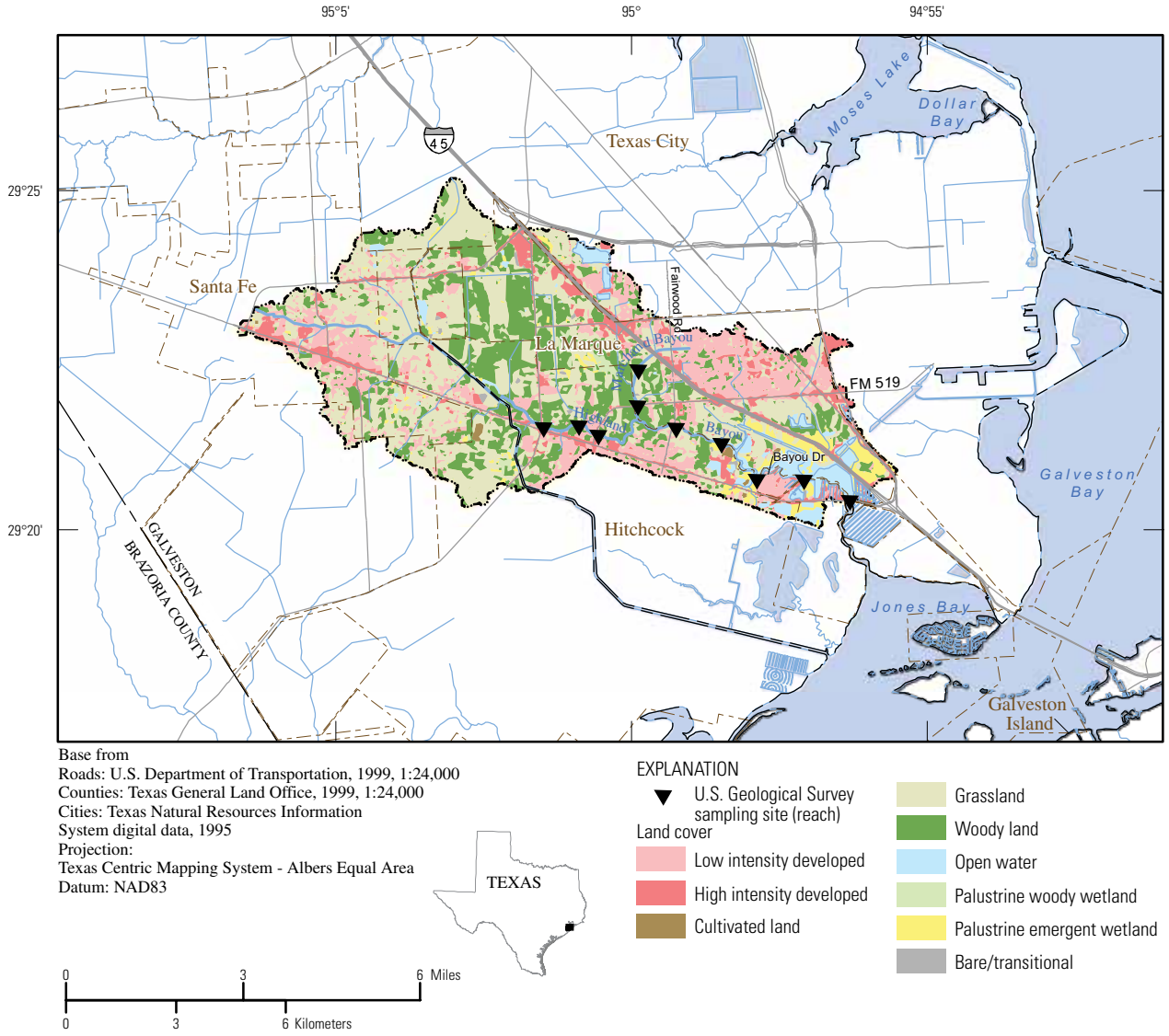

Figure 2. Land-cover distribution in Highland and Marchand Bayous watershed, Galveston County, Texas (Houston-Galveston Area Council digital data, 2002).

Climatic conditions in the study area are classified as humid subtropical (Larkin and Bomar, 1983) and characterized by cool temperate winters, long hot summers, and high relative humidity. Data from a National Weather Service station on Galveston Island about 10 miles south of Hitchcock (Jamaica Beach, COOP ID 414531) indicate weather conditions during the study period, July 2006–September 2007 (National Climatic Data Center, 2008). During the study period, mean temperatures ranged from about 55 degrees Fahrenheit (°F) in winter (December–February) to about 83 °F in summer (June–August), with maximum temperatures frequently higher than 90 °F. Total rainfall at Jamaica Beach during the 15-month study period was 96.24 inches; the maximum monthly total was 14.89 inches in October 2006, and the minimum monthly total was 0.16 inch in February 2007 (fig. 3).

Data Collection and Analysis

Data for this report were collected from 10 sites (reaches) in the Highland and Marchand Bayous watershed (fig. 1; table 1). Hereinafter, reaches are referred to by their short names as listed in table 1. Water-quality data for this report are categorized by the way they were collected: (1) continuously monitored data—water-quality properties measured with a multiprobe instrument at each site; and (2) periodically

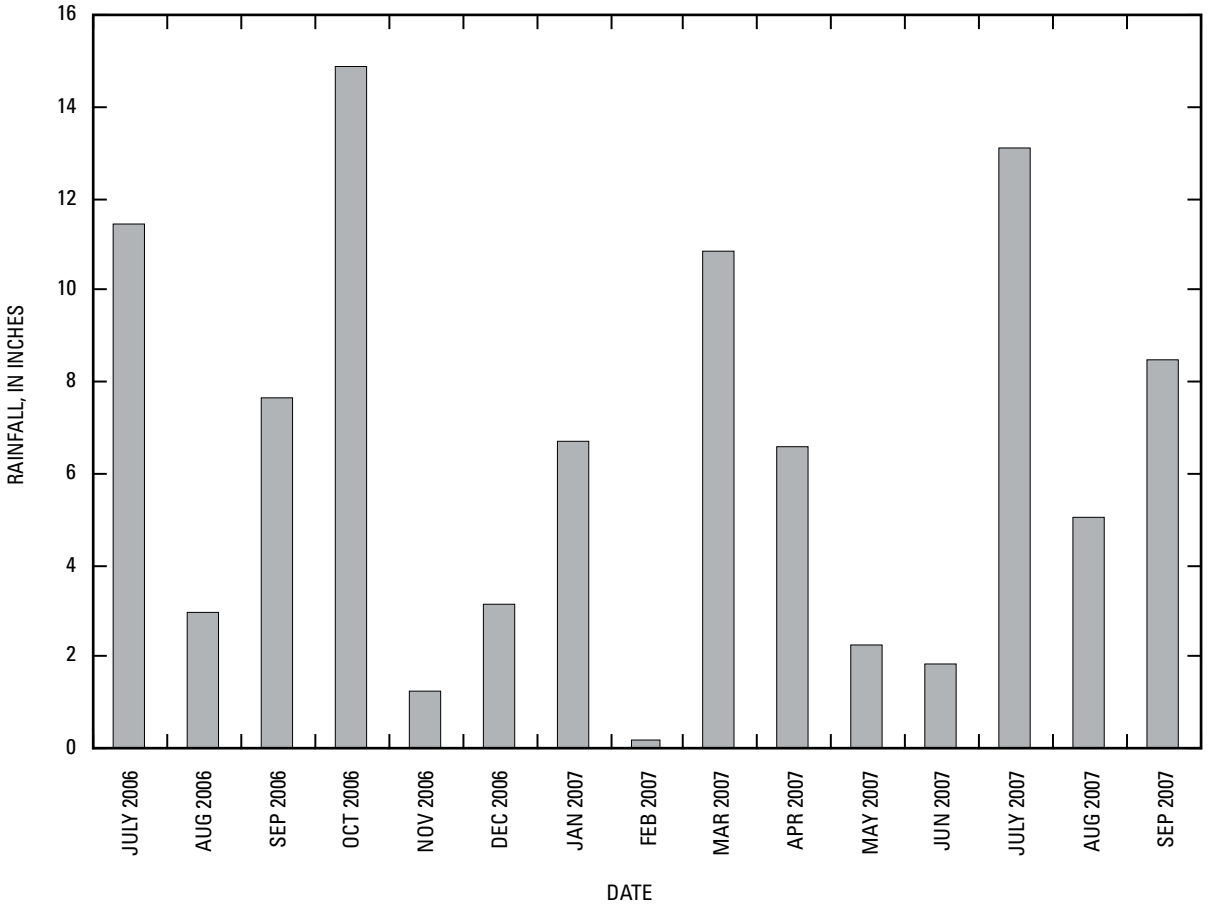

Figure 3. Rainfall at National Weather Service station Jamaica Beach (COOP ID 414531), Galveston Island, Galveston County, Texas, July 2006–September 2007.

collected data—water-quality properties and constituent concentrations obtained from analysis of discrete samples collected periodically at the sites.

Four properties (water temperature, pH, specific conductance, and dissolved oxygen) were monitored continuously at five sites (table 1) for periods ranging from 24 hours to several days during July–October 2006, and March, May, July, and August 2007. At each site, monitors were located where depth and flow conditions were typical of the reach used for biological data collection. Properties were measured and logged by the monitors at 15-minute intervals.

The same four properties plus transparency and turbidity were measured, and the constituents listed below were sampled periodically (one to five times per month during the 2006–07 study period) at five sites (table 1):

1. Chloride and sulfate
2. Residue on evaporation and total residue
3. Nutrients (ammonia plus organic nitrogen, ammonia nitrogen, nitrate plus nitrite nitrogen, nitrate nitrogen, nitrite nitrogen, organic nitrogen, total nitrogen, orthophosphate phosphorus, total phosphorus)
4. Total organic carbon
5. Biochemical oxygen demand (BOD) and carbonaceous biochemical oxygen demand (CBOD)
6. Phytoplankton (chlorophyll-*a*, pheophytin-*a*)
7. Suspended sediment

Water temperature, pH, specific conductance, dissolved oxygen, transparency, and turbidity were measured, and the fecal indicator bacteria *Enterococci, Escherichia (E.) coli,* and total coliform were sampled periodically at all 10 sites.

Before sample collection, properties were measured at three sections in the stream to determine uniformity of physical conditions across the channel. Water (grab) samples were collected at the center of the stream using methods described by the Texas Natural Resource Conservation Commission (1999). All samples were maintained at less than 4 degrees Celsius (°C) until analysis. Analyses for most constituents were done at the USGS National Water Quality Laboratory (NWQL) in Denver, Colo., using methods described in Wershaw and others (1987), Fishman and Friedman (1989), Patton and Truitt (1992, 2000), Fishman (1993), and U.S.

Table 1. Data-collection sites (reaches) and types of data collected at each, Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[USGS, U.S. Geological Survey; TCEQ, Texas Commission on Environmental Quality; WWTP, wastewater treatment plant]

USGS site (reach) number (fig. 1)	TCEQ site (reach) number	USGS site (reach) name	Site (reach) short name	Latitude (decimal degrees)	Longitude (decimal degrees)	Drainage area (square miles)	Altitude (feet above NAVD 88)	Data collected					
								Continuous properties[1]	Periodic properties and constituents[2]	Bacteria	Stream habitat	Benthic macroinvertebrates	Fish
08077700	16491	Highland Bayou at Hitchcock, Tex.	Hitchcock	29.354	95.030	12.0	8.0	•	•	•	•	•	•
08077705	20008	Highland Bayou at Delaney Rd., Hitchcock, Tex.	Delaney	29.354	95.020	13.9	5.0			•			
08077710	15941	Highland Bayou at FM 519, Hitchcock, Tex.	Highland 519	29.351	95.015	19.7	5.0			•			
08077715	20007	Marchand Bayou at North Carbide Park, La Marque, Tex.	Marchand NCP	29.367	95.003	.629	10			•			
08077720	16490	Marchand Bayou at FM 519, Hitchcock, Tex.	Marchand 519	29.358	95.004	2.74	6.0	•	•	•	•	•	•
08077725	11415	Highland Bayou at Fairwood Rd., La Marque, Tex.	Fairwood	29.352	94.993	23.9	2.0	•	•	•	•	•	•
08077730	20004	Highland Bayou downstream of WWTP 10410, La Marque, Tex.	WWTP	29.348	94.981	24.5	3.0			•			
08077738	20005	Highland Bayou at Bayou Dr. near La Marque, Tex.	Bayou Dr	29.338	94.971	28.4	2.0	•	•	•	•	•	•
08077745	20006	Highland Bayou upstream of railroad bridge, near La Marque, Tex.	RRB	29.338	94.958	29.3	1.0			•			
08077780	16488	Highland Bayou near Texas City, Tex.	Texas City	29.332	94.945	32.8	1.0	•	•	•	•	•	•

[1] Water temperature, pH, specific conductance, and dissolved oxygen.

[2] Water temperature, pH, specific conductance, dissolved oxygen, transparency, turbidity, chloride, sulfate, residue, nutrients, organic carbon, biochemical oxygen demand, phytoplankton, and suspended sediment.

Environmental Protection Agency (1993). Analyses for BOD, CBOD (Delzer and McKenzie, 2003), and fecal indicator bacteria (Myers and others, 2007) were done at the USGS Texas Water Science Center Gulf Coast Program office. Suspended sediment concentrations were analyzed at the USGS Louisiana Water Science Center Sediment Laboratory (Guy, 1969).

Stream-habitat data were collected at five sites (table 1) three times during the study, July–August 2006, March 2007, and July–August 2007. At each site, a representative stream reach was selected (Texas Natural Resource Conservation Commission, 1999). Within each reach, five evenly spaced transects were identified. At each transect, stream attributes (wetted channel width, water depth, bottom material, instream cover) and riparian attributes (bank slope and erosion potential, width of natural vegetation, type of vegetation, percentage tree canopy) were categorized or measured. The number of stream bends and riffles and the overall aesthetic condition were determined. The dominant substrates were noted at all sites. A habitat quality index was calculated for stream-habitat data at each site to indicate aquatic-life-use scores described by the Texas Commission on Environmental Quality (2007).

Benthic macroinvertebrates were sampled at a representative reach of the same five sites (table 1) where habitat data were collected. A 9- by 9-inch Ekman dredge on a pole was used to collect samples from four separate dredge hauls from undisturbed soft sediment near mid-channel. Sediment collected by the dredge was first washed through a 0.25-inch (0.64-centimeter) sieve to separate the benthic macroinvertebrates from any large organic debris in the sample. All large organic debris retained by the 0.25-inch sieve was discarded after it was thoroughly washed and inspected for any remaining benthic macroinvertebrates. Samples were then processed through a 0.02-inch (0.05-centimeter) mesh sieve to separate the benthic macroinvertebrates from the remaining sediment. Processed benthic macroinvertebrate samples were preserved in 80-percent ethanol and submitted to EcoAnalysts, Inc., in Moscow, Idaho, for taxonomic identification and enumeration. Each dredge sample underwent complete sorting and enumeration, and all benthic macroinvertebrates collected were identified to the lowest taxonomic level possible. A reference collection, with at least one specimen of each taxon identified was provided to the USGS by EcoAnalysts, Inc.

A tolerance value and functional feeding group designation were assigned to each benthic macroinvertebrate taxa as defined by TCEQ classification guidance (Texas Natural Resource Conservation Commission, 1999). Each macroinvertebrate community was assessed on the basis of metrics described in "Surface Water Quality Monitoring Procedures, Volume 2" (Texas Commission on Environmental Quality, 2007).

As part of the initial biological sampling (July 2006), the benthic macroinvertebrate sample from one site was split to create a primary sample and a replicate sample. This was done by dividing the sample into subsections and identifying and enumerating all individuals in each subsection until a minimum of 100 individuals in each subsection was obtained (Texas Natural Resource Conservation Commission, 1999).

Fish sampling (surveys) were done at a representative reach of the same five sites (table 1) where habitat data were collected. Fish were collected using a combination of seining and electrofishing (Texas Natural Resource Conservation Commission, 1999). Seining, or seine netting, involves manually pulling a large, mesh net through relatively shallow water nearshore. Seining was done with a 4.6-meter flat-panel seine with a 0.64-centimeter mesh. Electrofishing involves the application of electrical current to the water to stun fish. Electrofishing was done with a Smith-Root 5.0 Generator Powered Pulsator electrofishing system with a maximum power output of 5,000 watts. Description of seining and electrofishing to sample fish in the reaches of Highland and Marchand Bayous is in Mabe and Moring (2008).

Seining was used where relatively high salinity precluded electrofishing. Salinity was too high for electrofishing in the two most downstream reaches that were sampled for fish (Bayou Dr and Texas City), so these reaches were sampled by seining only. In the more upstream reaches where salinity was lower (Marchand 519 and Fairwood), a combination of electrofishing and seining was used. In the uppermost reach of Highland Bayou (Hitchcock), seining was not practical because of steep banks and abundant woody debris that disrupted effective net hauling; therefore only electrofishing was used for fish sampling in this reach. After collection and identification at the stream, fish were released. Fish collected by seining were kept separate from fish collected by electrofishing for identification and enumeration so that the effectiveness of each method could be assessed.

Unidentified fish were analyzed by Dr. Dean Hendrickson, ichthyologist, at the Texas Memorial Museum at The University of Texas, Austin, for final identification and storage. A tolerance rating and trophic group were assigned to each species (Linam and Kleinsasser, 1998). An index of biotic integrity was calculated for the combined catch for each site using scoring indexes developed to assess stream fish assemblages in the Western Gulf Coastal Plain (ecoregion 34) (Linam and others, 2002).

Water-Quality Data

Continuously Monitored Water-Quality Properties

Measured water temperatures (table 2) ranged from a minimum of 22.1 °C in March and May 2007 at Texas City and Marchand 519, respectively, to a maximum of 34.6 °C in August 2006 at Bayou Dr. Median pH (table 3) for all sites varied from 7.1 to 8.7. The maximum measured pH of 9.1 was at Fairwood in July 2006, and the minimum pH was 7.0 at Hitchcock and Fairwood in March and July 2007,

Table 2. Summary of 24-hour water temperature data collected at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[TCEQ, Texas Commission on Environmental Quality; --, no data]

Site (reach) short name	TCEQ site (reach) number	Statistic	Measured water temperature (degrees Celsius)							
			July 2006	August 2006	September 2006	October 2006	March 2007	May 2007	July 2007	August 2007
Hitchcock	16491	Maximum	30.7	--	28.9	26.7	23.2	26.7	30.7	29.5
		Minimum	28.8	--	26.3	26.2	22.4	25.2	28.6	28.7
		Mean	29.7	--	27.5	26.4	22.8	25.7	29.4	29.0
Marchand 519	16490	Maximum	31.9	--	29.7	27.5	24.7	26.5	31.2	31.6
		Minimum	29.5	--	26.8	27.0	22.8	22.1	29.4	30.0
		Mean	30.4	--	28.3	27.4	23.7	24.7	30.1	30.8
Fairwood	11415	Maximum	33.9	32.4	--	29.2	25.9	28.7	28.7	--
		Minimum	30.1	29.7	--	27.9	24.4	26.2	27.5	--
		Mean	31.8	30.6	--	28.4	25.1	27.4	28.0	--
Bayou Dr	20005	Maximum	31.1	34.6	--	29.0	26.1	29.2	31.1	--
		Minimum	26.7	29.7	--	26.9	23.4	25.4	28.5	--
		Mean	28.4	31.5	--	27.6	24.8	27.2	29.7	--
Texas City	16488	Maximum	--	32.9	--	29.3	25.1	26.8	--	34.1
		Minimum	--	28.9	--	27.4	22.1	24.8	--	31.4
		Mean	--	30.6	--	28.2	23.5	25.7	--	32.7

respectively. Specific conductance (table 4) generally was lower at upstream sites Hitchcock and Marchand 519 than at other sites. For all sites, specific conductance ranged from 149 microsiemens per centimeter at 25 °C (μS/cm) at Marchand 519 to 36,100 μS/cm at Texas City. Because available specific conductance data reflect only small time periods, the true extent of tidal influence is not indicated by the data.

Dissolved oxygen is a primary component used to evaluate the suitability of a stream to sustain aquatic life. Fish that are intolerant of low levels of oxygen become stressed when concentrations of dissolved oxygen are less than about 5 milligrams per liter (mg/L) (Fram, 2006). At levels below 2 mg/L, fish kills can result. To maintain dissolved oxygen levels that will support fish, TCEQ has established mean and minimum criteria for dissolved oxygen levels in natural waters, depending on the type of stream (freshwater, intermittent, or tidal) (Texas Commission on Environmental Quality, 2003a) (table 5). The 24-hour mean dissolved oxygen criterion is 5.0 mg/L for freshwater streams, 3.0 mg/L for intermittent streams, and 4.0 mg/L for tidal streams. The minimum criterion for freshwater and tidal streams is 3.0 mg/L and for intermittent streams is 2.0 mg/L. The criteria for tidal streams apply to Highland and Marchand Bayous.

Continuously monitored dissolved oxygen at all sites (table 5) was less than the respective 24-hour mean dissolved oxygen criterion for some percentage of the time in at least one monitoring period for the Hitchcock, Marchand 519, and Fairwood sites but not for the Bayou Dr and Texas City sites. Minimum dissolved oxygen concentrations at all sites were less than the respective criterion 20 to 100 percent of the time. The lowest concentrations of dissolved oxygen were measured in March 2007 at Hitchcock. Graphs of dissolved oxygen concentration from the Fairwood and Bayou Dr sites for March 28–30, 2007 (fig. 4), show diurnal patterns, although minimum concentrations were not less than the minimum criterion (3.0 mg/L) for the period shown.

Periodically Collected Water-Quality Properties and Constituents

Chloride and Sulfate

Chloride and sulfate are not used as indicators for the suitability of streams for aquatic life use; they were established in the Texas Surface Water Quality Standards to ensure support of multiple uses and as tools to identify and manage the influences of point and nonpoint sources of pollution (Texas Commission on Environmental Quality, 2003a). The

Table 3. Summary of 24-hour pH data collected at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[TCEQ, Texas Commission on Environmental Quality; --, no data]

Site (reach) short name	TCEQ site (reach) number	Statistic	Measured pH (standard units)							
			July 2006	August 2006	September 2006	October 2006	March 2007	May 2007	July 2007	August 2007
Hitchcock	16491	Maximum	7.4	--	8.3	7.3	7.2	7.6	7.5	7.5
		Minimum	7.3	--	7.5	7.1	7.0	7.5	7.1	7.3
		Median	7.3	--	7.6	7.2	7.1	7.5	7.2	7.4
Marchand 519	16490	Maximum	7.9	--	8.1	7.5	7.7	7.9	7.7	8.2
		Minimum	7.4	--	7.5	7.2	7.4	7.4	7.5	7.4
		Median	7.6	--	7.7	7.3	7.5	7.6	7.6	7.6
Fairwood	11415	Maximum	9.1	8.8	--	8.7	8.6	8.3	7.3	--
		Minimum	7.6	7.4	--	7.2	7.9	7.5	7.0	--
		Median	8.0	8.0	--	8.0	8.3	7.8	7.1	--
Bayou Dr	20005	Maximum	7.7	8.9	--	8.6	8.1	8.6	8.3	--
		Minimum	7.2	8.4	--	7.9	7.8	8.0	7.7	--
		Median	7.4	8.7	--	8.2	8.0	8.4	7.9	--
Texas City	16488	Maximum	--	8.5	--	8.2	8.1	7.9	--	8.3
		Minimum	--	7.7	--	7.7	7.9	7.6	--	7.7
		Median	--	8.0	--	7.8	8.0	7.7	--	8.1

maximum chloride concentration (fig. 5) was 13,000 mg/L at Texas City, and the minimum was 30.6 mg/L at Hitchcock. The median chloride concentration from all five sites sampled was 1,160 mg/L. Maximum sulfate concentration was 1,730 mg/L at Texas City, and the minimum was 9.47 mg/L at Hitchcock. The median sulfate concentration from all sites was 165 mg/L.

Nutrients

Nitrogen compounds occur naturally in the environment, usually in small amounts in surface water, and include ammonia, organic nitrogen, nitrite, and nitrate. The largest ammonia plus organic nitrogen concentration was 120 mg/L at Bayou Dr (fig. 6; appendix 1). The median ammonia plus organic nitrogen concentration from all five sites was 0.98 mg/L. The largest concentration of ammonia was 0.24 mg/L, measured at Hitchcock. The median ammonia concentration from all five sites was 0.04 mg/L. The largest nitrate plus nitrite concentration was 0.994 mg/L at Bayou Dr. The median nitrate plus nitrite concentration for all sites was less than 0.016 mg/L. The maximum nitrite concentration was 0.033 mg/L at Bayou Dr. The median nitrite concentration was 0.002 mg/L.

Orthophosphate is an inorganic form of phosphorus that is used by plants. It is produced by natural processes and also is found in sewage (Hem, 1985). Orthophosphate concentrations were largest at Hitchcock, where the maximum concentration was 0.094 mg/L (fig. 6; appendix 1). The median orthophosphate concentration for all sites was 0.0205 mg/L.

Total phosphorus includes dissolved forms as well as phosphorus attached to sediment particles and in living organisms like algae and bacteria. Total phosphorus concentrations were largest at Bayou Dr; the maximum concentration was 10.0 mg/L. The median total phosphorus concentration from all sites was 0.10 mg/L.

Biochemical Oxygen Demand, Chlorophyll-*a*, and *Escherichia Coli*

BOD is a measure of the oxygen consumed by bacteria from the decomposition of organic matter (Sawyer and McCarty, 1978). If the BOD of decomposition is large,

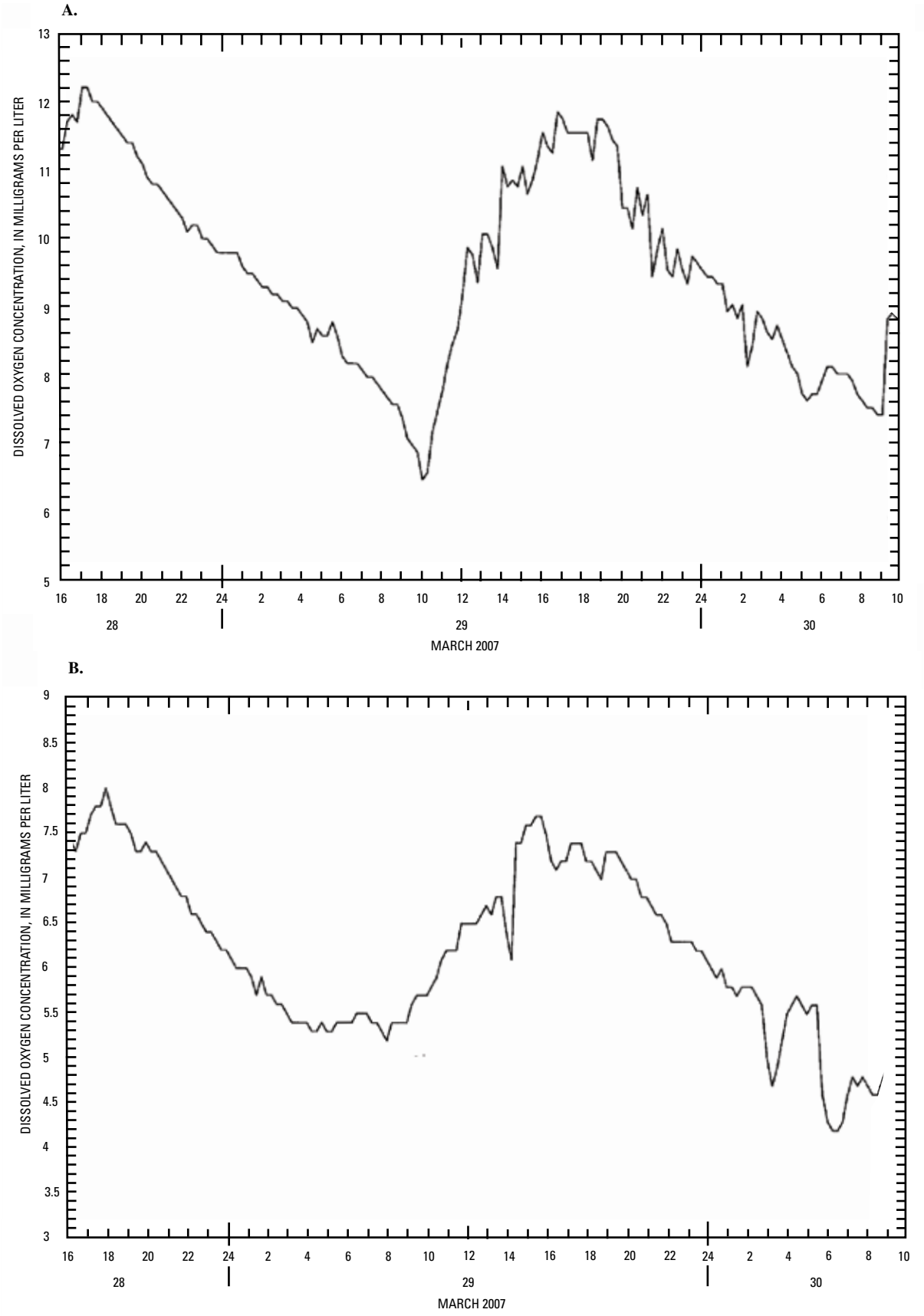

Figure 4. Continuous dissolved oxygen at sites (reaches) (A) Highland Bayou at Fairwood Road, La Marque, Texas, and (B) Highland Bayou at Bayou Drive, La Marque, Texas, March 28–30, 2007.

Table 4. Summary of 24-hour specific conductance data collected at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[TCEQ, Texas Commission on Environmental Quality; --, no data]

Site (reach) short name	TCEQ site (reach) number	Statistic	Measured specific conductance (microsiemens per centimeter at 25 degrees Celsius)							
			July 2006	August 2006	September 2006	October 2006	March 2007	May 2007	July 2007	August 2007
Hitchcock	16491	Maximum	1,100	--	8,480	9,800	676	1,990	337	633
		Minimum	951	--	4,410	9,020	631	1,890	264	608
		Mean	1,030	--	5,540	9,360	651	1,940	314	616
Marchand 519	16490	Maximum	946	--	9,940	17,000	1,040	4,230	557	1,690
		Minimum	538	--	1,000	7,810	942	149	440	489
		Mean	700	--	4,890	12,500	1,000	1,500	483	920
Fairwood	11415	Maximum	1,460	2,670	--	13,700	2,510	9,850	2,810	--
		Minimum	848	1,910	--	7,330	1,600	1,020	407	--
		Mean	1,150	2,240	--	10,400	2,080	5,910	1,270	--
Bayou Dr	20005	Maximum	14,100	6,720	--	24,800	9,720	9,790	4,370	--
		Minimum	2,410	2,880	--	13,400	1,010	1,010	2,390	--
		Mean	5,100	4,250	--	20,200	1,820	3,090	2,950	--
Texas City	16488	Maximum	--	3,560	--	36,100	2,560	2,640	--	2,290
		Minimum	--	2,060	--	27,600	1,650	2,000	--	1,540
		Mean	--	3,000	--	34,400	2,140	2,240	--	2,040

dissolved oxygen concentrations can be close to zero. The largest measured BOD (8.1 mg/L) was at Bayou Dr (fig. 7; appendix 1) in August 2006. The median BOD concentration from all five sites was 3.7 mg/L.

Chlorophyll-*a* is a photosynthetic pigment in algae and other green plants. The concentration of chlorophyll-*a* is used to estimate the amount of phytoplankton in a water body (Porter and others, 1993). Some concentrations of chlorophyll-*a* were more than and some were less than the applicable State screening level for tidal streams, 19.2 micrograms per liter (µg/L) (Texas Commission on Environmental Quality, 2003a, table 18) at four of the five sites sampled (fig. 7; appendix 1); at Bayou Dr, all chlorophyll-*a* concentrations were greater than the screening level. The maximum chlorophyll-*a* concentration was 62.6 µg/L at Hitchcock. The median concentration from all sites was 24.8 µg/L.

E. coli is a fecal indicator bacteria used to signal the potential presence of harmful pathogens in the water that come from warm-blooded animals. *E. coli* densities occurred over a wide range and commonly exceeded 394 most probable number per 100 milliliters (MPN/100 mL), the State single-sample value for evaluating contact and non-contact recreation use support (Texas Commission on Environmental Quality, 2003a, table 6) (fig. 7; appendix 2). The largest concentration (46,000 MPN/100 mL) was measured at Hitchcock. The median density from all 10 sites sampled was 310 MPN/100 mL.

Quality Assurance and Quality Control

All sample collection and processing, data management, and documentation followed guidelines of the Texas Natural Resource Conservation Commission (1999) and the Texas Commission on Environmental Quality (2003b). The guidelines are included in the Quality Assurance Project Plan (Jean Wright, Houston-Galveston Area Council, written commun., 2005).

Quality control (QC) samples, consisting of a field blank and replicates (appendix 3), were used to evaluate the extent to which contamination, characteristics of the water (matrix), and measurement variability affected analytical results (Mueller and others, 1997). Further explanation of QC sample types and their use are described by Mueller and others (1997).

Several field blanks were collected and processed at the site, immediately before the associated environmental sample, to identify potential contamination from data collection. No concentrations of any constituent exceeded the minimum reporting level for that constituent. Additional water was collected during the study to split into two samples; one was designated as the environmental sample and the other was a split replicate of that sample. Analytical results from each sample set were compared by computing the relative percentage difference (RPD) for each constituent. The RPD, specified

Table 5. Summary of 24-hour dissolved oxygen data collected at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[TCEQ, Texas Commission on Environmental Quality; n/a, not applicable; --, no data]

Site (reach) short name	TCEQ site (reach) number	Statistic	Dissolved oxygen criteria[1] (milligrams per liter)	Measured dissolved oxygen (milligrams per liter)								Number of monitoring periods dissolved oxygen less than standard
				July 2006	August 2006	September 2006	October 2006	March 2007	May 2007	July 2007	August 2007	
Hitchcock	16491	Maximum	n/a	2.80	--	7.30	4.10	6.10	3.70	3.90	2.50	n/a
		Minimum	3.0	1.00	--	.80	.80	.40	1.20	1.80	1.10	7
		Mean	4.0	1.90	--	2.00	2.20	2.10	2.30	2.50	1.50	7
Marchand 519	16490	Maximum	n/a	7.70	--	6.10	4.40	6.70	7.70	6.50	8.20	n/a
		Minimum	3.0	3.70	--	2.20	1.80	3.90	3.50	4.60	2.10	3
		Mean	4.0	5.20	--	3.70	3.60	5.40	5.80	5.40	6.00	2
Fairwood	11415	Maximum	n/a	13.80	13.10	--	11.50	12.20	10.80	4.30	--	n/a
		Minimum	3.0	3.70	2.10	--	3.30	6.50	5.10	1.60	--	2
		Mean	4.0	7.00	6.50	--	5.60	9.50	6.70	2.50	--	1
Bayou Dr	20005	Maximum	n/a	6.70	14.50	--	7.90	8.00	12.60	9.30	--	n/a
		Minimum	3.0	1.80	3.90	--	2.70	4.20	7.50	5.60	--	2
		Mean	4.0	4.80	8.90	--	5.10	6.30	10.60	7.10	--	0
Texas City	16488	Maximum	n/a	--	8.40	--	7.60	8.30	8.90	--	8.20	n/a
		Minimum	3.0	--	2.30	--	4.20	6.20	6.00	--	4.40	1
		Mean	4.0	--	5.10	--	5.70	7.30	7.50	--	6.40	0

[1] Texas Commission on Environmental Quality, 2003a.

for this project in the Quality Assurance Project Plan as 20 percent, was calculated using the equation

$$RPD = \{|S_1\text{-}S_2|/([S_1 + S_2]/2)\} \text{ X } 100,$$

where

S_1 = concentration from environmental sample; and
S_2 = concentration from replicate sample.

The RPD exceeded 20 percent for six of 27 sample pairs of *E. coli*; the RPD did not exceed 20 percent for any sample pairs of chlorophyll-*a*, pheophytin-*a*, ammonia, or suspended sediment.

Stream-Habitat Data

The physical characteristics of a stream channel and the riparian characteristics can influence the structure and function of the benthic macroinvertebrate and fish communities (Stauffer and others, 2000; Brasher and others, 2003; Powers and others, 2003). Instream cover, which provides habitat for benthic macroinvertebrates and fish, consisted primarily of macrophytes, algae, and minor vegetation overhanging from the banks. Stream-habitat data collected at each site during the study are listed in appendix 4. Habitat quality index values indicated aquatic-life-use scores of "intermediate" at all five reaches except for a score of "high" at the Hitchcock site during August 2006 (table 6).

Biological Data

Benthic Macroinvertebrates

A total of 5,126 macroinvertebrate individuals from the five sites sampled were identified (appendix 5). The largest number of individuals (1,069) was collected at the Texas City site in March 2007. The least number of individuals (9) was collected at the Hitchcock site in August 2006. Overall,

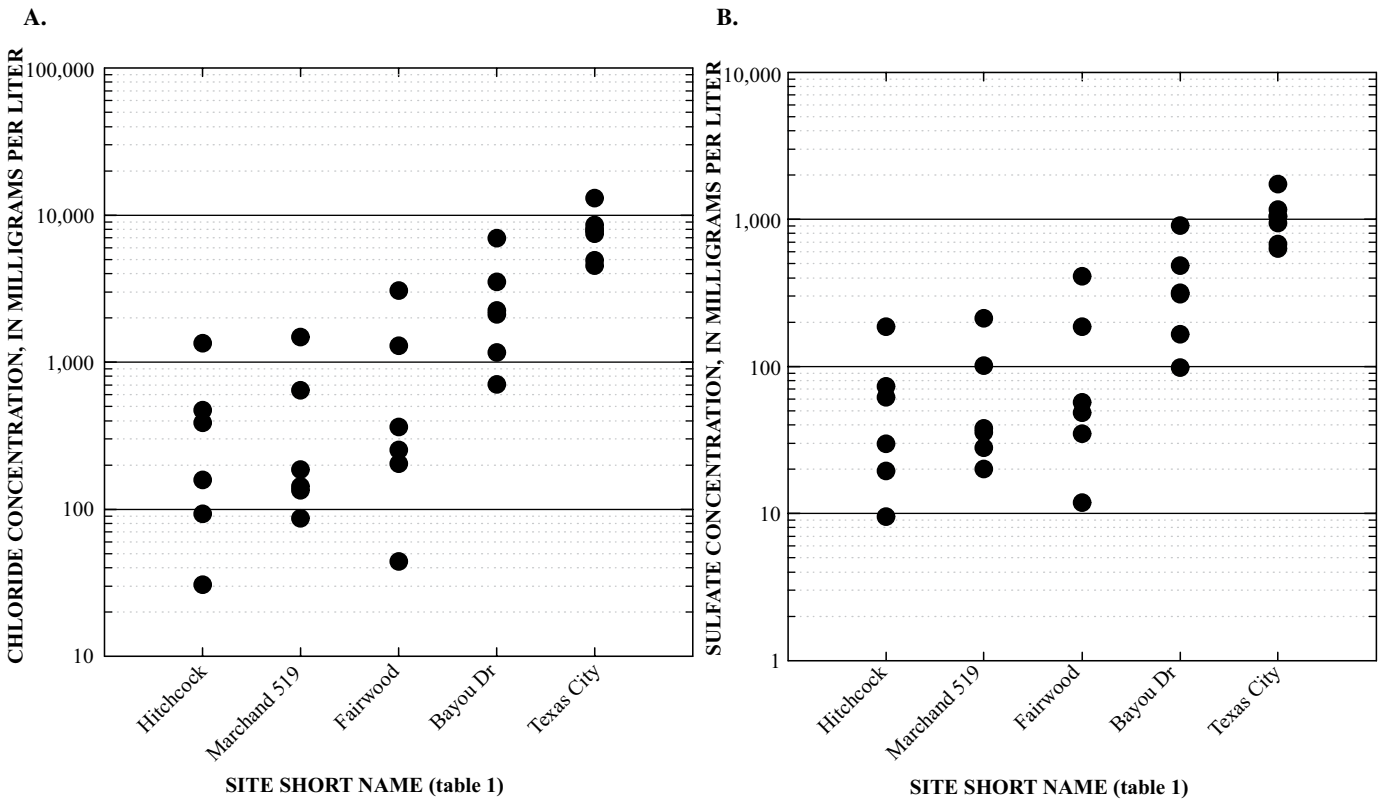

Figure 5. Distribution by site of (A) chloride and (B) sulfate in samples from five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

the most abundant macroinvertebrates belonged to the class Insecta, dominated by the Dipteran family Chironomidae, followed by marine segmented worms (class Polychaeta), Crustacea (class Malacostraca), bivalves (primarily the species *Mytilopsis leucophaeata* and *Mulinia lateralis*), and freshwater segmented worms (subclass Oligochaeta) (appendix 5).

The most abundant benthic invertebrate taxon overall was the chironomid genus *Chironomus* sp. (class Insecta), accounting for about 30 percent of all identified benthic macroinvertebrate taxa collected. The majority of *Chironomus* sp., however, were collected in the March 2007 samples; this taxon was either absent or substantially reduced in the August–July 2006 and August–July 2007 samples. Other relatively abundant taxa included the chironomid genus *Tanypus* sp., and the polychaete species *Streblospio benedicti* and *Amphicteis floridus*. The largest numbers for these species were again collected in the March 2007 samples.

The diversity and relative abundance of insect taxa (class Insecta) were generally larger in the more upstream sites (Hitchcock and Marchand 519), whereas Crustacea taxa (class Malacostraca), typical of more estuarine environments, generally had a larger relative abundance in the more downstream sites (Bayou Dr, and Texas City) (fig. 8). One exception to this general pattern was seen in March 2007 when large numbers of the relatively tolerant chironomid genus *Chironomus* sp. were collected at the Bayou Dr site. Marine segmented worms (class Polychaeta) were relatively ubiquitous and showed no general pattern across sites. The diversity and relative abundance of freshwater segmented worms (subclass Oligochaeta) were largest in the Marchand 519 and Fairwood sites.

Benthic macroinvertebrate assemblages were scored using indexes specified by the Texas Commission on Environmental Quality (2007). Aquatic-life-use scores (table 7) were "limited" during all surveys at the Hitchcock site, at the Fairwood site in July 2006, and at the Bayou Dr site in March 2007. Scores were "intermediate" during all surveys at the Marchand 519 and Texas City sites, at the Fairwood site in March and July 2007, and at the Bayou Dr site in July 2006 and July 2007.

The TCEQ aquatic-life-use assessment method was not specifically designed for tidally influenced systems such as Highland Bayou; some aspects of the assessment warrant further discussion.

Ephemeroptera, Plecoptera, and Tricoptera (EPT) taxa presence and abundance provide a measure of environmental quality in freshwater streams (Moring, 2003). EPT taxa were relatively abundant only at the Marchand 519 site and consisted of a single taxa (the relatively tolerant genus *Caenis* sp.). Plecoptera, which are adapted to cool water conditions, are not generally found in coastal systems and were not collected at any of the sites. Six individuals of the Tricopteran species *Hydroptila potosina* were collected at the Bayou

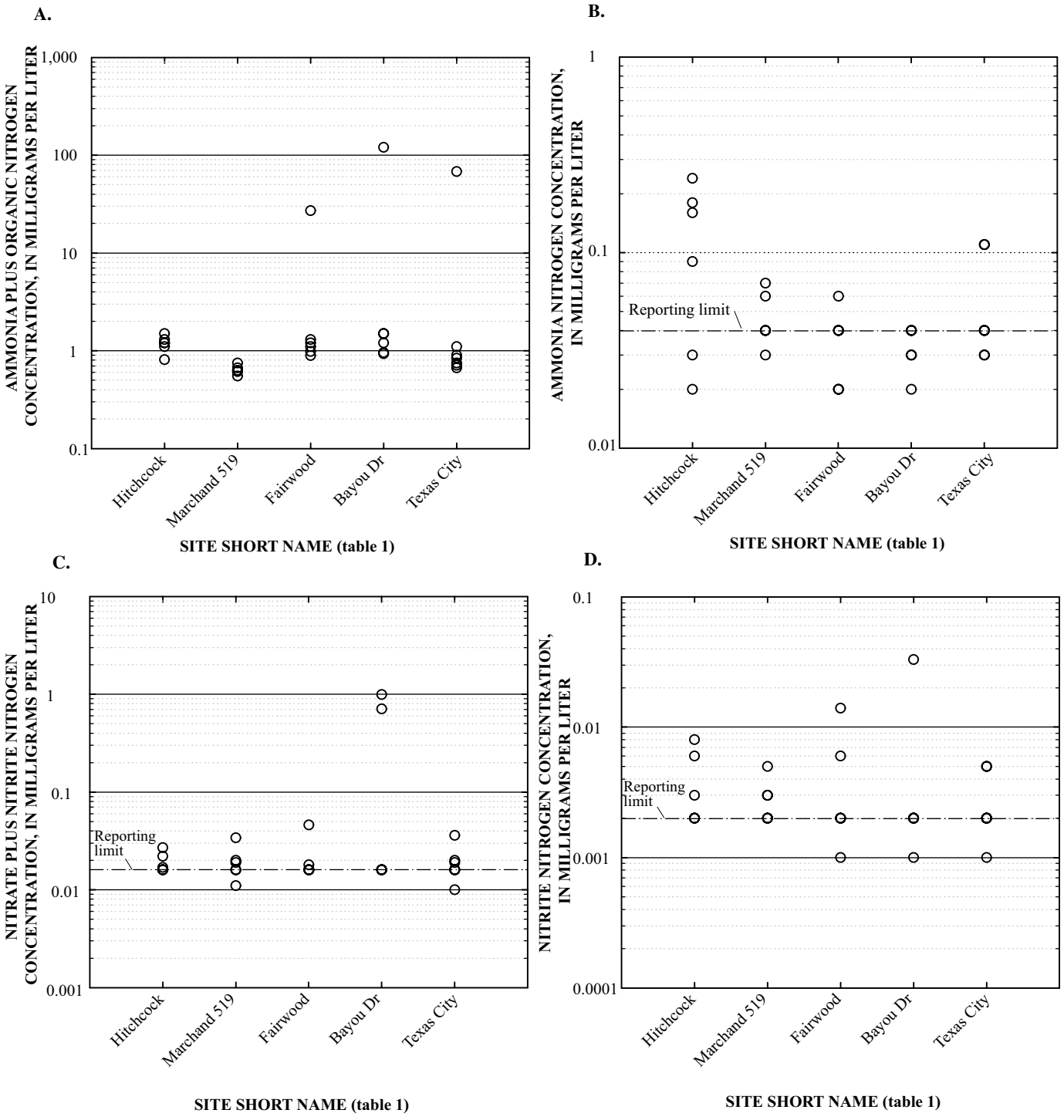

Figure 6. Distribution by site of (A) ammonia plus organic nitrogen, (B) ammonia nitrogen, (C) nitrate plus nitrite nitrogen, (D) nitrite nitrogen, (E) orthophosphate phosphorus, and (F) total phosphorus in samples from five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

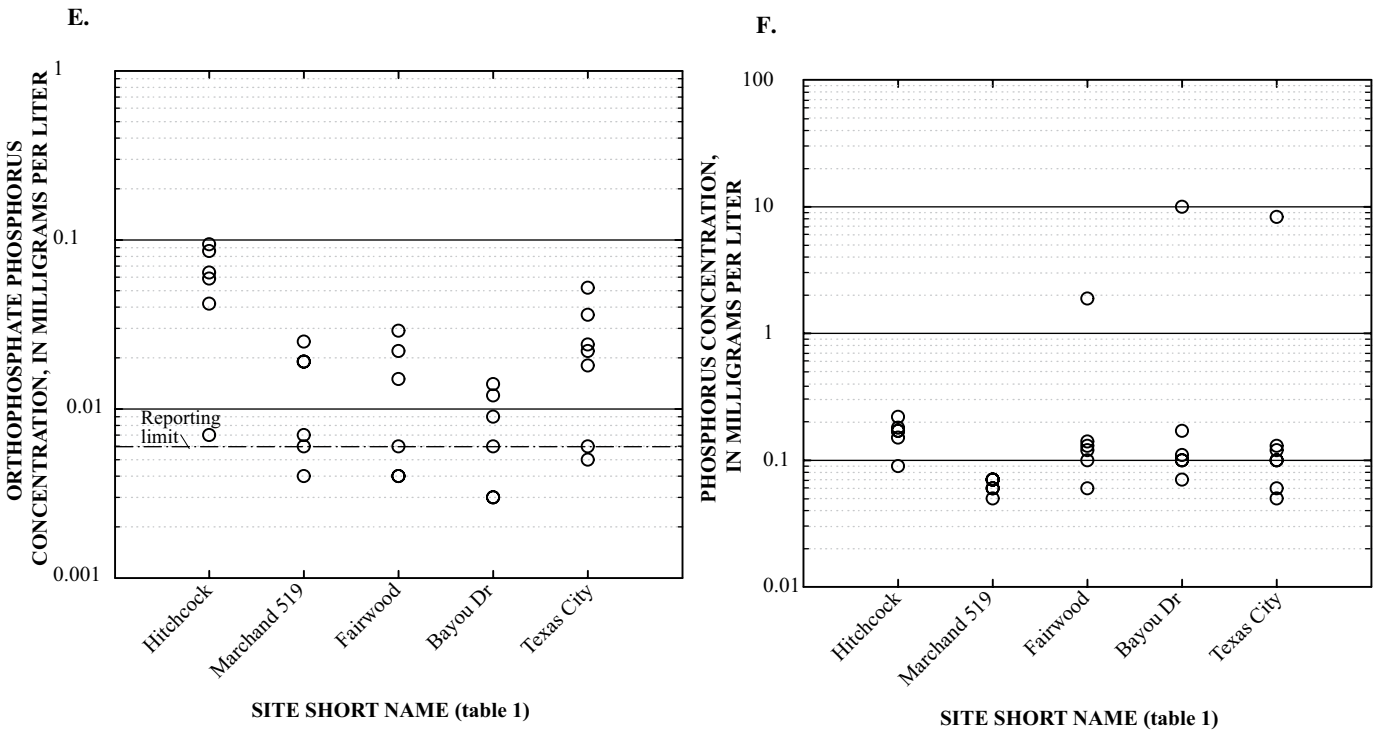

Figure 6.—Continued.

Dr reach in July 2006. However, this species is not typical of mud-bottom estuarine systems and may represent an incidental species washed down from a more freshwater location upstream.

Benthic macroinvertebrate communities were compared by computing the Hilsenhoff biotic index (HBI) (Hilsenhoff, 1988). The HBI assigns a tolerance value to individual taxa and then calculates an overall tolerance value for the community. Individual tolerance values are measured on a scale from 0 to 10 with increasing tolerance values indicating increasing tolerance to physiochemical degradation.

This index is computed using the equation

$$HBI = \frac{[(TV_i)(n_i)]}{N}$$

where

TV_i = tolerance value for each species;
n_i = number of individuals in the species; and,
N = total number of individuals in the collection.

HBIs ranged from 6.00 at site Hitchcock to 10.0 at sites Texas City, Hitchcock, and Bayou Dr.

In freshwater streams HBI values are inversely related to stream quality (taxa/species with lower values indicate the presence of higher stream quality). However, because HBI calculations include only taxa that have assigned tolerance values and because the TCEQ tolerance values were developed for freshwater systems, few of the estuarine adapted taxa have available tolerance values. In addition, the freshwater taxa in tidally influenced systems are generally the more tolerant freshwater taxa. Therefore HBI scores for Highland Bayou (1 at all sites, table 7) might reflect a lack of available tolerance values for estuarine adapted taxa and not necessarily relatively poor water quality compared to other estuarine systems.

Vannote and others (1980) proposed that the types of macroinvertebrate communities in rivers form a continuum from the headwaters to the mouth and correlate with the sources of nutrition in the rivers. Smaller streams of the headwaters would be dominated by macroinvertebrates that are capable of using coarser vegetation (shredders and scrapers); macroinvertebrates that could use finer organic particulate matter (filterers and gatherers) would increase in number downstream. The relative abundance of benthic macroinvertebrate functional feeding groups in Highland Bayou is dominated by collectors and predators (table 7) with relatively fewer filterers and grazers. However, a large percentage of the taxa at most sites have not been formally classified and are categorized as unknown. Several of the taxa commonly found in this study such as the tube dwelling polychaete worms *Amphicteis floridus* and *Streblospio benedicti* are known to be collectors that feed on detritus (Fauchald and Jumars, 1979), whereas others such as the polychaete genera *Polydora* are considered to be partially or wholly filter feeders (Fauchald and Jumars, 1979). A more complete classification of estuarine benthic macroinvertebrates in terms of feeding methods would likely increase the relative percentage of collectors and filterers at these sites.

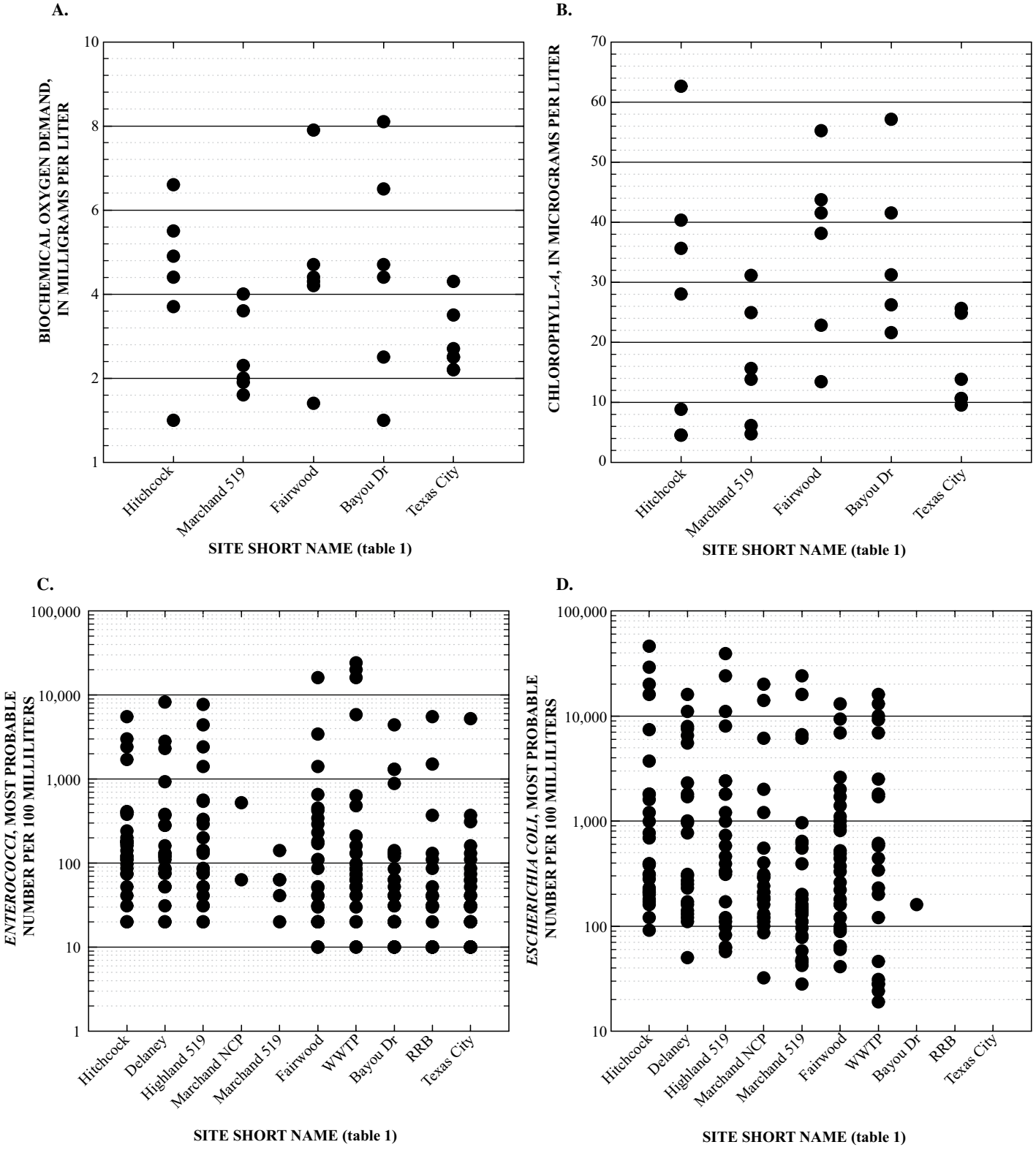

Figure 7. Distribution by site of (A) biochemical oxygen demand and (B) chlorophyll-*a* in samples from five sites (reaches); (C) *Enterococci* and (D) *Escherichia coli* in samples from 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

Table 6. Scores for stream-habitat metrics and habitat quality index for representative reach at each of five sites, Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

Stream-habitat metric	Hitchcock			Marchand 519			Fairwood			Bayou Dr			Texas City		
	August 2006	March 2007	July 2007	July 2006	March 2007	August 2007	July 2006	March 2007	July 2007	July 2006	March 2007	July 2007	July 2006	March 2007	August 2007
Instream cover	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1
Riffles	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pools	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Bank stability:															
Slope component	3	0	3	1	1	1	1	1	1	3	3	3	3	3	3
Erosion component	3	2	2	2	2	2	2	2	2	3	3	3	2	2	2
Riparian buffer vegetation	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2
Channel flow status	3	3	3	2	2	2	3	3	3	3	3	3	3	3	3
Channel sinuosity	3	3	3	1	1	1	1	1	1	2	2	2	0	0	0
Bottom substrate	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Aesthetics	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Habitat quality index	20	16	19	15	15	15	15	15	15	19	19	19	15	15	15
Aquatic-life-use category[1]	H	I	I	I	I	I	I	I	I	I	I	I	I	I	I

[1] Texas Commission on Environmental Quality (2007); H, high (20–25); I, intermediate (14–19).

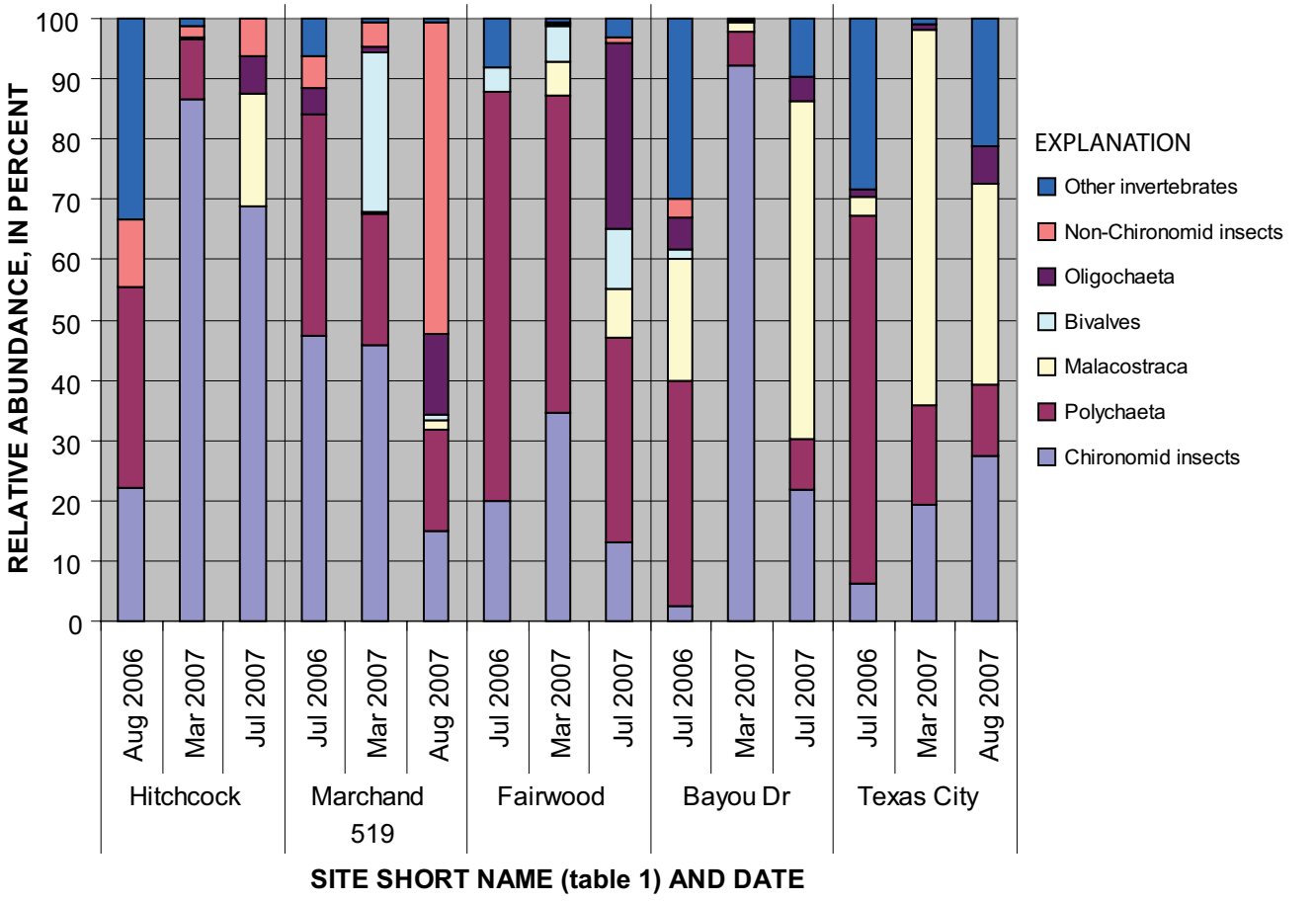

Figure 8. Relative abundance of benthic macroinvertebrates for representative reach at each of five sites, Highland and Marchand Bayous, Galveston County, Texas, 2006–07

Table 7. Scores for benthic macroinvertebrate metrics and aquatic life use for representative reach at each of five sites, Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[EPT, Epheroptera, Plecoptera, Trichoptera]

Benthic macroinvertebrate metric	Hitchcock			Marchand 519			Fairwood			Bayou Dr			Texas City		
	August 2006	March 2007	July 2007	July 2006	March 2007	August 2007	July 2006	March 2007	July 2007	July 2006	March 2007	July 2007	July 2006	March 2007	August 2007
Taxa richness	1	4	1	4	4	4	1	4	2	3	2	3	2	3	2
EPT taxa abundance	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hilsenhoff biotic index (HBI)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Percentage dominant taxon	2	1	2	2	3	3	1	3	3	3	1	4	2	1	3
Percentage dominant functional feeding group	4	1	1	4	3	4	4	4	4	4	1	4	4	4	4
Percentage predators	2	4	1	4	4	3	4	1	1	1	2	1	4	3	2
Ratio of intolerant to tolerant taxa	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1
Percentage total Trichoptera as Hydropsychidae	1	1	1	1	1	1	1	1	1	4	1	1	1	1	1
Number of non-insect taxa	2	4	2	4	4	4	3	4	4	4	4	4	4	4	4
Percentage of total number as Elmidae	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Percentage Chironomidae	1	1	1	1	1	2	1	1	2	4	1	1	3	1	1
Percentage collector-gatherers	1	1	1	3	2	3	1	2	1	1	1	1	1	1	1
Total score	18	21	17	27	26	28	20	24	22	28	17	23	25	22	22
Aquatic life use[1]	L	L	L	I	I	I	L	I	I	I	L	I	I	I	I

[1] Texas Commission on Environmental Quality (2007); L, limited (less than 22); I, intermediate (22–28).

Fish

Thirty-four species of fish representing 28 families were collected from Highland and Marchand Bayous. Fish taxa and individual counts from each survey are listed in appendix 6. A total of 6,057 fish were collected. Juveniles of the genus *Brevoortia* sp. were the most abundant taxa; other abundant taxa included *Menidia beryllina*, *Leiostomus xanthurus*, *Anchoa mitchilli*, *Mugil cephalus*, and *Lagodon rhomboides*.

Fish communities were scored using a regional index designed for the Western Gulf Coastal Plain (Texas Commission on Environmental Quality, 2007). Aquatic-life-use scores (table 8) were "limited" during all surveys at the Fairwood, Bayou Dr, and Texas City sites; at the Hitchcock site in August 2006; and at the Marchand 519 site in March 2007. Fish communities were scored as "intermediate" at the Hitchcock site in March and July 2007 and at the Marchand 519 site in July 2006 and August 2007.

The presence and relative abundance of tolerant and intolerant fish reflect stream conditions. Intolerant fish species indicate high and moderate quality sites (Linam and Kleinsasser, 1998) and become increasingly scarce with pollution or destruction of suitable habitat. Tolerant fish species have increased distribution and abundance when site conditions are less favorable and become dominant in disturbed sites. Of the 34 fish species collected in Highland Bayou, nine were identified as having a specific tolerance or intolerance to pollution (Linam and Kleinsasser, 1998). Eight of the species were identified as tolerant (appendix 6)—sheepshead minnow (*Cyprinodon variegatus*); western mosquitofish (*Gambusi affinis*); sunfish (*Lepomis macrochirus*, *Lepomis cyanellus*, *Lepomis gulosus*); sailfin molly (*Poecilia latipinna*); gar (*Lepisosteus oculatus*), and gizzard shad (*Dorosoma cepedianum*). One species, spotted seatrout (*Cynoscion nebulosus*), was identified as being intolerant to pollution. However, western mosquitofish are common to most waters in Texas and are not used when calculating values for tolerance indexes (Texas Commission on Environmental Quality, 2007).

Tolerant species constituted only a small part of the overall fish communities (table 9) at the downstream sites (Bayou Dr and Texas City) and the most upstream site (Hitchock). The largest values for relative abundance of tolerant species

Table 8. Scores for fish metrics and index of biotic integrity for representative reach at each of five sites, Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

Fish metric	Hitchcock			Marchand 519			Fairwood			Bayou Dr			Texas City		
	August 2006	March 2007	July 2007	July 2006	March 2007	August 2007	July 2006	March 2007	July 2007	July 2006	March 2007	July 2007	July 2006	March 2007	August 2007
Total number of fish species	3	5	5	5	5	5	3	5	5	3	3	5	3	3	3
Number of native cyprinid species	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Number of benthic invertivore species	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Number of sunfish species	1	5	5	3	3	5	1	1	1	1	1	1	1	1	1
Number of intolerant species	1	1	1	1	1	1	1	1	1	5	1	1	1	1	1
Percent of individuals as tolerant (excluding western mosquitofish)	5	5	5	5	5	3	5	5	1	5	5	5	5	5	5
Percent individuals as omnivores	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1
Percent individuals as invertivores	1	1	1	1	1	5	1	1	1	1	1	3	1	1	5
Number of individuals in sample[1]	3	5	5	3	2	1	1	3	1	1	3	1	1	1	1
Percent individuals as nonnative species	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Percent individuals with diseases or anomolies	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Total score (ecoregion 34)	27	35	35	31	30	35	25	29	23	29	27	29	25	25	29
Index of biotic integrity[2]	L	I	I	I	L	I	L	L	L	L	L	L	L	L	L

[1] Average of number of individuals per seine haul and number of individuals per electrofishing minute.

[2] Linam and others (2002); Texas Commission on Environmental Quality (2007); L, limited aquatic life use (less than 31); I, intermediate aquatic life use (31–38).

Table 9. Relative abundance of tolerant fish species, excluding western mosquitofish, for representative reach at each of five sites, Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

Site short name	Sampling date				
	July 2006	August 2006	March 2007	July 2007	August 2007
Hitchcock	--	2.0	5.0	5.4	--
Marchand 519	5.3	--	26.5	--	37.5
Fairwood	2.6	--	4.1	57.1	--
Bayou Dr	0	--	0	.3	--
Texas City	0	--	.4	--	0

Table 10. Average aquatic-life-use category indicated by stream habitat, benthic macroinvertebrates, and fish for representative reach at each of five sites, Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[I, intermediate; L, limited]

Category indicator	Average aquatic life use				
	Hitchock	Marchand 519	Fairwood	Bayou Dr	Texas City
Stream habitat[1]	I	I	I	I	I
Benthic macroinvertebrates[2]	L	I	I	I	I
Fish[3]	I	I	L	L	L

[1] Habitat quality index aquatic-life-use scores (Texas Commission on Environmental Quality, 2007).

[2] Benthic macroinvertebrate aquatic-life-use scores (Texas Commission on Environmental Quality, 2007).

[3] Index of biotic integrity aquatic-life-use scores for ecoregion 34 (Linam and others, 2002; Texas Commission on Environmental Quality, 2007).

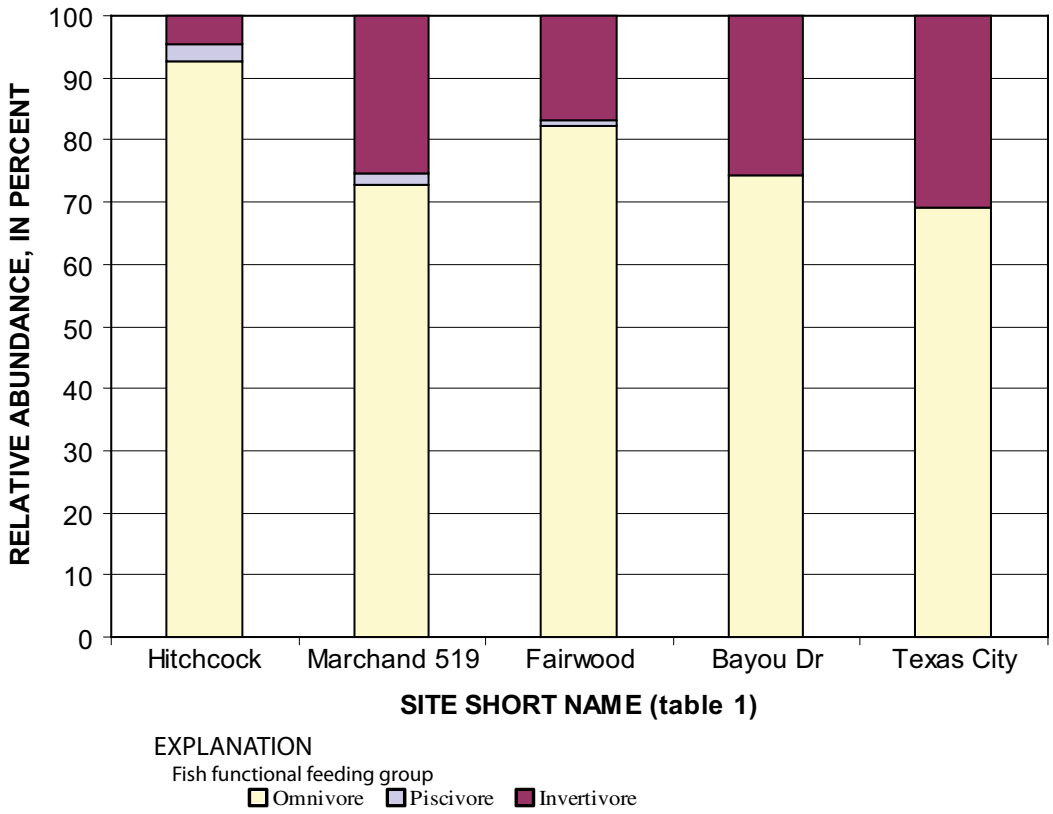

Figure 9. Relative abundance of fish functional feeding groups for representative reach at each of five sites, Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

occurred in the summer sampling when tolerant freshwater sunfish composed a large part of the catch at the Marchand 519 site and tolerant euryhaline pupfishes and livebearers composed a majority of the catch at the Fairwood site.

However, as with the benthic macroinvertebrates, most of the estuarine species collected in Highland Bayou do not have assigned tolerance values and freshwater species found in tidally influenced systems are generally more tolerant. High tolerance values in Highland Bayou may reflect the dynamic physiochemical environment common to tidally influenced systems and not necessarily poor water quality.

Fish species can be separated into trophic groups, which describe the manner in which they feed. There are three trophic (feeding) groups (fig. 9): omnivores (generalized feeders); invertivores (feed on invertebrates, mostly insects); and piscivores (feed on other fish). The majority of fish collected

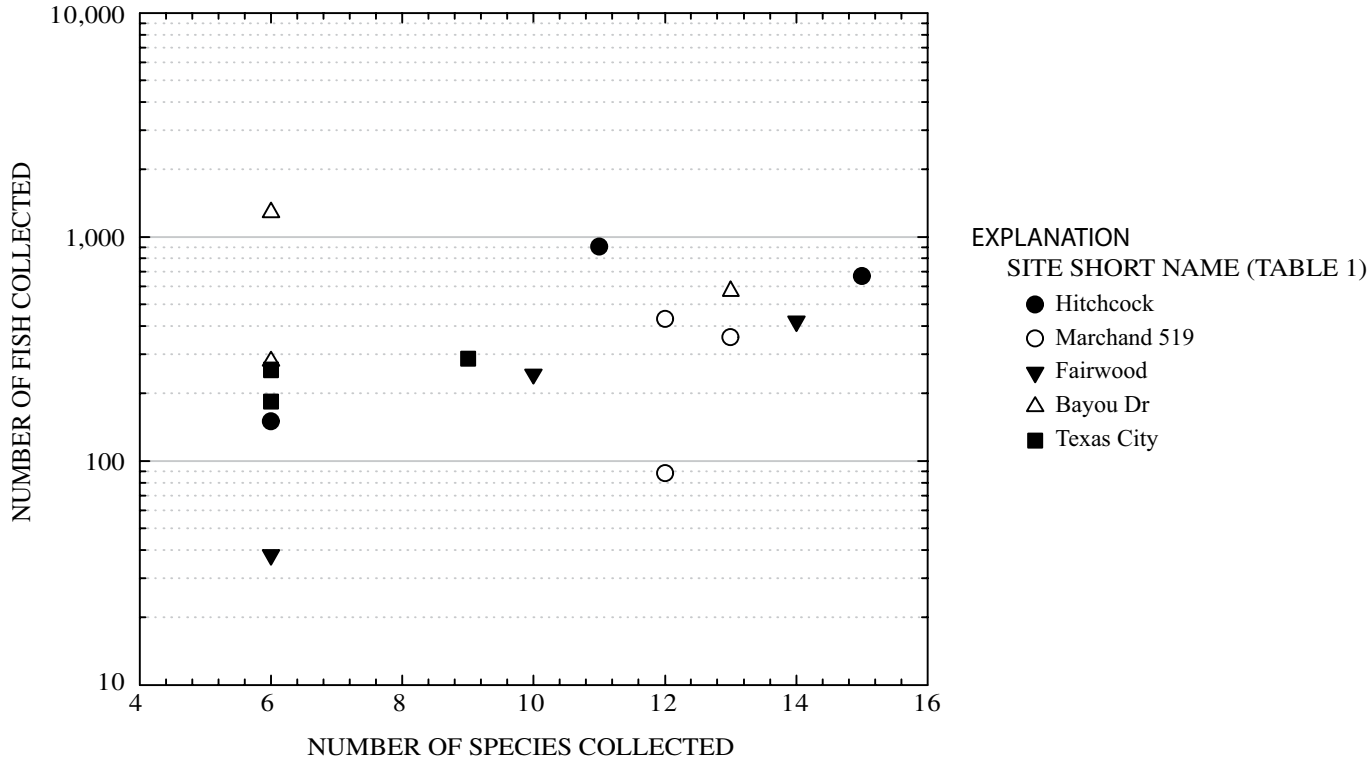

Figure 10. Number of fish collected relative to number of fish species from representative reach at each of five sites, Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

at the five sites were omnivores and the next most abundant were invertivores. Trophic composition metrics may help to evaluate the quality of the stream habitat and chemical quality in that more generalized feeders, such as omnivores, become a larger percentage of the population with degradation of conditions (Linam and Kleinsasser, 1998).

The distribution of the total number of fish collected relative to the number of species from each site is shown in figure 10. If the number of species is proportional to the number of individuals collected (high sampling efficiency), a graph of data for the sites would have a linear relation. Departures from a linear relation between the number of fish and species can reflect several factors, including sampling efficiency (bias), seasonality, and local site conditions.

The average aquatic-life-use category indicated by stream-habitat, macroinvertebrate, and fish data collected between July 2006 and September 2007 are presented in table 10. The average aquatic-life-use category for stream habitat was “intermediate” at all sites. Aquatic life use based on macroinvertebrate data was “limited” at the Hitchcock site and “intermediate” at the remaining sites. Average aquatic life use based on the index of biotic integrity for fish was “limited” at the Fairwood, Bayou Dr, and Texas City sites and “intermediate” at the remaining sites.

Summary

The Texas Commission on Environmental Quality (TCEQ) administers water-quality management programs with the goal of protecting, maintaining, and restoring water resources in Texas. One such program is the Texas Clean Rivers Program (CRP), which was established by the 1991 Texas Legislature. Under the CRP, water-quality monitoring and assessments are conducted in 23 river and coastal basins statewide through contracts with partner agencies. The Houston-Galveston Area Council (H-GAC) is the partner agency for a 13-county area in southeastern Texas that includes the Houston metropolitan area. Every 2 years, CRP partners may perform systematic monitoring studies, whereby a variety of data are collected in water bodies that are not monitored routinely. Data from these special studies help to determine whether additional assessment is needed to evaluate human health concerns, the status of ecological conditions, or designated stream uses.

The coastal basins of Highland and Marchand Bayous in Galveston County were chosen for this monitoring study. Both bayous currently (2008) are listed on the 303(d) list of impaired waters in Texas for low dissolved oxygen. Parts of Highland Bayou and all of Marchand Bayou also are listed as

impaired because of high bacteria concentrations. The U.S. Geological Survey, in cooperation with H-GAC and TCEQ, collected data during 2006–07 to document water-quality, stream-habitat, and biological conditions in the bayous.

This report presents the water-quality, stream-habitat, and biological data collected from Highland and Marchand Bayous; describes data-collection methods; and presents data to compare water-quality changes at and among sites during the study period.

Data for this report were collected at 10 sites (reaches) in the Highland and Marchand Bayous watershed. Water-quality data collected include continuously monitored data—properties measured with a multiprobe instrument at each site and water sampling data—properties and constituents determined from periodically collected samples.

Four properties (water temperature, pH, specific conductance, and dissolved oxygen) were monitored continuously at five sites for periods ranging from 24 hours to several days during July–October 2006, and March, May, July, and August 2007. The same four properties plus transparency and turbidity were measured, and chloride, sulfate, residue, nutrients, total organic carbon, biochemical oxygen demand, carbonaceous biochemical oxygen demand, chlorophyll-*a*, pheophytin-*a*, and suspended sediment were sampled periodically (one to five times per month during 2006–07) at five sites. Water temperature, pH, specific conductance, dissolved oxygen, transparency, and turbidity were measured, and the fecal indicator bacteria *Enterococci*, *Escherichia (E.) coli*, and total coliform were sampled periodically at all 10 sites.

Stream-habitat data were collected at five sites three times during the study, July–August 2006, March 2007, and July–August 2007. At each site, a representative stream reach was selected and within this reach, five evenly-spaced stream transects were determined. At each transect, stream (wetted channel width, water depth, bottom material, instream cover) and riparian (bank slope and erosion potential, width of natural vegetation, type of vegetation, percentage tree canopy) attributes were measured. Habitat quality index values indicated aquatic-life-use scores of "intermediate" at all five reaches except for a score of "high" at the Hitchcock site during August 2006.

Benthic macroinvertebrate data were collected from a representative reach at each of the same five sites used for habitat evaluation. A total of 5,126 macroinvertebrate individuals from the five sites sampled were identified. Overall, the most abundant macroinvertebrates belonged to the class Insecta, dominated by the Dipteran family Chironomidae, followed by marine segmented worms (class Polychaeta), Crustacea (class Malacostraca), bivalves (primarily the species *Mytilopsis leucophaeata* and *Mulinia lateralis*), and freshwater segmented worms (subclass Oligochaeta).

Benthic macroinvertebrate assemblages were scored using indexes specified by the TCEQ. Aquatic-life-use scores were "limited" during all surveys at the Hitchcock site, at the Fairwood site in July 2006, and at the Bayou Dr site in March 2007. Scores were "intermediate" during all surveys at the Marchand 519 and Texas City sites, at the Fairwood site in March and July 2007, and at the Bayou Dr site in July 2006 and July 2007.

Fish surveys were done at a representative reach of the same five sites used for habitat evaluation. Fish were collected using a combination of seining and electrofishing methods. After collection and identification at the stream, the fish were released. Fish collected using the seining method were kept separate from fish collected using the electrofishing method for identification and enumeration so that the effectiveness of each method could be assessed.

Thirty-four species of fish representing 28 families were collected from Highland and Marchand Bayous. A total of 6,057 fish were collected. Fish communities were scored using a regional index designed for the Western Gulf Coastal Plain. Aquatic-life-use scores were "limited" during all surveys at the Fairwood, Bayou Dr, and Texas City sites; at the Hitchcock site in August 2006; and at the Marchand 519 site in March 2007. Fish communities were scored as "intermediate" at the Hitchcock site in March and July 2007 and at the Marchand 519 site in July 2006 and August 2007.

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Appendixes 1–6

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[USGS, U.S. Geological Survey; --, no data; <, nondetection less than laboratory reporting level; E, estimated; >, greater than]

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Trans-parency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temper-ature, water, degrees Celsius	Alkalinity, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter as calcium carbonate	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter
08077700	6/28/2006	1540	--	--	--	--	20	5.7	8.1	7230	30.2	--	--
08077700	7/10/2006	1030	--	5.3	--	--	7.1	1.9	7	799	28.4	88	108
08077700	7/31/2006	1020	--	--	--	--	18	3.7	7.6	1220	30.6	--	--
08077700	8/21/2006	1100	--	--	0.3	--	28	4.7	7.8	2480	29.6	--	--
08077700	8/23/2006	1138	--	--	0.3	--	23	3.9	7.8	2260	29.8	--	--
08077700	8/25/2006	1118	0.85	--	0.3	--	20	6.1	8.1	2390	29.9	--	--
08077700	8/28/2006	1140	0.85	--	0.3	--	37	6.4	7.6	1980	29.7	--	--
08077700	8/30/2006	1126	0.91	--	0.3	--	27	5.4	8.3	2040	29.7	--	--
08077700	8/31/2006	1135	0.85	--	0.3	0.3	28	6.2	8.5	1650	29.2	127	146
08077700	9/1/2006	1034	0.88	--	0.3	--	22	5.7	8.5	1750	29	--	--
08077700	9/25/2006	1212	0.82	--	0.3	1	25	1.8	7	1730	24	--	--
08077700	10/5/2006	0948	1	--	0.3	0.5	11	3.4	7.4	4760	25.8	99	119
08077700	10/30/2006	1108	1.04	--	0.3	1.1	20	4.6	7.1	379	19.6	--	--
08077700	11/27/2006	1145	--	--	0.3	1.5	11	10.5	8.2	8160	18.3	--	--
08077700	12/20/2006	1149	--	--	0.3	2	11	2	7.6	15100	19.4	--	--
08077700	1/24/2007	1237	--	--	0.3	1.2	39	9.4	7.8	871	9.6	--	--
08077700	1/25/2007	1116	--	--	0.3	1.1	38	10.6	6.6	356	9.2	--	--
08077700	1/30/2007	1047	--	--	0.3	1	46	8.4	7.9	611	12	--	--
08077700	2/27/2007	1034	--	--	0.3	1.6	21	8.7	8	3020	18.2	--	--
08077700	3/20/2007	1028	--	--	0.3	0.9	40	10.8	7.8	377	21.1	--	--
08077700	3/26/2007	1139	--	-29	0.3	1.4	18	4.2	7.8	575	23.4	122	148
08077700	4/26/2007	0945	--	--	0.3	1.2	26	4.1	7.5	666	21.7	--	--
08077700	5/10/2007	0921	--	--	0.3	1.5	17	3	7.5	1990	25	192	232
08077700	5/29/2007	1129	--	--	0.3	1.1	15	6.2	7.5	6100	25.8	--	--
08077700	5/30/2007	1220	--	--	0.3	1.5	21	1.7	7.2	7800	25.8	--	--
08077700	5/31/2007	0921	--	--	0.3	1.1	16	3.7	7.3	6460	26	--	--
08077700	6/19/2007	0937	--	--	0.3	0.9	25	1.1	7	10900	28.5	--	--
08077700	7/10/2007	1005	--	-5.8	0.3	2	9.9	1.9	7	273	28.8	63	77
08077700	7/10/2007	1006	--	--	--	--	--	--	--	--	--	--	--
08077700	7/25/2007	0832	--	--	0.3	1.6	14	3.2	7.1	358	27.4	--	--
08077700	8/9/2007	0840	--	--	0.3	1.4	15	3.3	6.9	337	29.1	--	--

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Chloride, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Residue on evaporation, dried at 180 degrees Celsius, water, filtered, milligrams per liter	Residue, total nonfilterable, milligrams per liter	Ammonia plus organic nitrogen, water, unfiltered, milligrams per liter as nitrogen	Ammonia, water, unfiltered, milligrams per liter as NH4	Ammonia, water, unfiltered, milligrams per liter as nitrogen	Nitrate plus nitrite, water, filtered, milligrams per liter as nitrogen	Nitrate, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter as nitrogen	Nitrite, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Organic nitrogen, water, unfiltered, milligrams per liter
08077700	6/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	7/10/2006	158	29.6	452	<20	1.3	0.31	0.24	0.027	0.084	0.02	0.026	0.008	1
08077700	7/31/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	8/21/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	8/23/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	8/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	8/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	8/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	8/31/2006	386	61.3	888	30	1.5	--	E.02	<.016	--	--	--	<.002	--
08077700	9/1/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	9/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	10/5/2006	1340	186	2630	14	1.2	0.2	0.16	0.017	0.063	0.01	0.009	0.003	1
08077700	10/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	11/27/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	12/20/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	1/24/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	1/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	1/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	2/27/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	3/20/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	3/26/2007	92.8	19.4	328	10	1.2	--	E.03	<.016	--	--	0.008	0.002	--
08077700	4/26/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	5/10/2007	470	73.1	1050	34	1.1	0.12	0.09	<.016	--	--	--	<.002	1.1
08077700	5/29/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	5/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	5/31/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	6/19/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	7/10/2007	30.6	9.47	164	<20	0.81	0.24	0.18	0.022	0.072	0.02	0.019	0.006	0.63
08077700	7/10/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	7/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	8/9/2007	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Total nitrogen, water, unfiltered, milligrams per liter	Ortho-phosphate, water, filtered, milligrams per liter	Orthophos-phate, water, filtered, milligrams per liter as phos-phorus	Phosphorus, water, unfiltered, milligrams per liter	Organic carbon, water, unfiltered, milligrams per liter	Biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Carbonaceous biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Chlorophyll-*a*, phytoplankton, chromatographic-fluorometric method, micrograms per liter	Pheophytin-*a*, phytoplankton, micrograms per liter	Suspended sediment concentration, milligrams per liter
08077700	6/28/2006	--	--	--	--	--	--	--	--	--	--
08077700	7/10/2006	1.3	0.262	0.086	0.18	--	4.4	--	8.8	4.3	4
08077700	7/31/2006	--	--	--	--	--	--	--	--	--	--
08077700	8/21/2006	--	--	--	--	--	--	--	--	--	--
08077700	8/23/2006	--	--	--	--	--	--	--	--	--	--
08077700	8/25/2006	--	--	--	--	--	--	--	--	--	--
08077700	8/28/2006	--	--	--	--	--	--	--	--	--	--
08077700	8/30/2006	--	--	--	--	--	--	--	--	--	--
08077700	8/31/2006	--	0.023	0.007	0.17	--	6.6	5.3	62.6	40.2	66
08077700	9/1/2006	--	--	--	--	--	--	--	--	--	--
08077700	9/25/2006	--	--	--	--	--	--	--	--	--	--
08077700	10/5/2006	1.2	0.195	0.064	0.17	--	3.7	2.9	28	13.6	18
08077700	10/30/2006	--	--	--	--	--	--	--	--	--	--
08077700	11/27/2006	--	--	--	--	--	--	--	--	--	--
08077700	12/20/2006	--	--	--	--	--	--	--	--	--	--
08077700	1/24/2007	--	--	--	--	--	--	--	--	--	--
08077700	1/25/2007	--	--	--	--	--	--	--	--	--	--
08077700	1/30/2007	--	--	--	--	--	--	--	--	--	--
08077700	2/27/2007	--	--	--	--	--	--	--	--	--	--
08077700	3/20/2007	--	--	--	--	--	--	--	--	--	--
08077700	3/26/2007	--	0.287	0.094	0.22	--	4.9	4.2	35.6	21.3	224
08077700	4/26/2007	--	--	--	--	--	--	--	--	--	--
08077700	5/10/2007	--	0.129	0.042	0.15	13.5	5.5	5.3	40.3	16.8	18
08077700	5/29/2007	--	--	--	--	--	--	--	--	--	--
08077700	5/30/2007	--	--	--	--	--	--	--	--	--	--
08077700	5/31/2007	--	--	--	--	--	--	--	--	--	--
08077700	6/19/2007	--	--	--	--	--	--	--	--	--	--
08077700	7/10/2007	0.84	0.182	0.059	0.09	12.7	1	1.6	4.5	2.1	12
08077700	7/10/2007	--	--	--	--	--	--	--	4.5	2.4	--
08077700	7/25/2007	--	--	--	--	--	--	--	--	--	--
08077700	8/9/2007	--	--	--	--	--	--	--	--	--	--

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Trans-parency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temper-ature, water, degrees Celsius	Alkalinity, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter as calcium carbonate	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter
08077720	6/28/2006	1450	--	--	--	--	11	4.4	8.1	9840	28.7	--	--
08077720	7/11/2006	0730	--	2.9	0.3	--	16	--	7.7	744	--	138	167
08077720	7/31/2006	1110	--	--	--	--	8.2	7.2	8.1	1320	30.7	--	--
08077720	8/21/2006	1125	--	--	0.3	--	10	4.9	7.6	346	29.3	--	--
08077720	8/23/2006	1215	1.37	--	0.3	--	13	6.2	7.7	538	29.5	--	--
08077720	8/25/2006	1219	1.4	--	0.3	--	11	6.3	7.8	1380	29.4	--	--
08077720	8/28/2006	1240	1.28	--	0.3	--	16	5.5	7.3	553	29.9	--	--
08077720	8/30/2006	1206	1.26	--	0.3	--	16	5.7	7.7	877	29.3	--	--
08077720	8/31/2006	1030	1.28	1.9	0.3	0.63	10	5.1	7.7	1070	28.6	216	261
08077720	9/1/2006	1139	1.39	--	0.3	--	9.4	5.5	8.3	580	29.3	--	--
08077720	9/25/2006	1338	1.34	--	0.3	1.15	18	3.6	7.2	323	24.4	--	--
08077720	10/5/2006	1048	1.38	0.35	0.3	0.15	8.7	6.3	7.6	5270	26.4	172	207
08077720	11/27/2006	1250	--	--	0.3	2.5	6.2	11.7	8.1	13600	20.8	--	--
08077720	12/20/2006	1345	--	--	0.3	2.1	10	15.9	8.9	17600	20.9	--	--
08077720	1/24/2007	1345	--	--	0.3	0.7	38	10.3	7	239	9.7	--	--
08077720	1/25/2007	1243	--	--	0.3	0.95	45	12.6	7.4	350	10.5	--	--
08077720	1/30/2007	1213	--	--	0.3	1.3	30	9.1	7.9	676	12.9	--	--
08077720	2/27/2007	1222	--	--	0.3	2.2	12	9.1	8	9630	18.8	--	--
08077720	3/20/2007	1200	--	--	0.3	1.4	21	18.3	7.3	651	22	--	--
08077720	3/27/2007	1128	--	1.5	0.3	1.6	9.7	6.8	7.7	1010	23.2	239	289
08077720	4/26/2007	1144	--	--	0.3	1	34	4.4	7.4	416	21.3	--	--
08077720	5/10/2007	1013	--	-1.2	0.3	1.7	14	5.5	7.4	2700	24.9	288	349
08077720	5/29/2007	1208	--	--	0.3	1.4	19	5.6	7.6	263	24.4	--	--
08077720	5/30/2007	1150	--	--	0.3	1.7	16	3.7	7.4	2460	26.5	--	--
08077720	5/31/2007	1038	--	--	0.3	1.4	12	3.8	7.1	8350	26	--	--
08077720	6/19/2007	1015	--	--	0.3	1.5	16	3.9	7.9	12500	29	--	--
08077720	7/25/2007	0933	--	--	0.3	2	12	5.2	7.3	565	28.1	--	--
08077720	8/9/2007	0911	--	--	0.3	2	12	5	7.1	576	30.2	--	--
08077720	8/13/2007	1251	--	-0.21	0.3	2.5	9	5.2	7	1070	30	220	266

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Chloride, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Residue on evaporation, dried at 180 degrees Celsius, water, filtered, milligrams per liter	Residue, total nonfilterable, milligrams per liter	Ammonia plus organic nitrogen, water, unfiltered, milligrams per liter as nitrogen	Ammonia, water, unfiltered, milligrams per liter as NH4	Ammonia, water, unfiltered, milligrams per liter as nitrogen	Nitrate plus nitrite, water, filtered, milligrams per liter as nitrogen	Nitrate, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter as nitrogen	Nitrite, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Organic nitrogen, water, unfiltered, milligrams per liter
08077720	6/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	7/11/2006	86.5	20	342	15	0.63	0.05	0.04	E.011	--	--	0.01	0.003	0.58
08077720	7/31/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	8/21/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	8/23/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	8/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	8/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	8/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	8/31/2006	186	35.5	597	<20	0.63	0.08	0.07	0.019	0.07	0.02	0.011	0.003	0.56
08077720	9/1/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	9/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	10/5/2006	1480	212	2950	15	0.55	--	<.04	<.016	--	--	--	<.002	--
08077720	11/27/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	12/20/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	1/24/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	1/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	1/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	2/27/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	3/20/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	3/27/2007	143	37.8	554	21	0.67	--	<.04	0.02	--	--	--	<.002	--
08077720	4/26/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	5/10/2007	642	101	1490	<20	0.75	--	E.03	<.016	--	--	--	<.002	--
08077720	5/29/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	5/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	5/31/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	6/19/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	7/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	8/9/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	8/13/2007	134	27.9	514	<10	0.61	0.08	0.06	0.034	0.13	0.03	0.015	0.005	0.55

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Total nitrogen, water, unfiltered, milligrams per liter	Ortho-phosphate, water, filtered, milligrams per liter	Orthophos-phate, water, filtered, milligrams per liter as phos-phorus	Phosphorus, water, unfiltered, milligrams per liter	Organic carbon, water, unfiltered, milligrams per liter	Biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Carbonaceous biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Chlorophyll-*a*, phytoplankton, chromatographic-fluorometric method, micrograms per liter	Pheophytin-*a*, phytoplankton, micrograms per liter	Suspended sediment concentration, milligrams per liter
08077720	6/28/2006	--	--	--	--	--	--	--	--	--	--
08077720	7/11/2006	--	0.059	0.019	0.07	--	1.6	1.3	6.1	2.3	8
08077720	7/31/2006	--	--	--	--	--	--	--	--	--	--
08077720	8/21/2006	--	--	--	--	--	--	--	--	--	--
08077720	8/23/2006	--	--	--	--	--	--	--	--	--	--
08077720	8/25/2006	--	--	--	--	--	--	--	--	--	--
08077720	8/28/2006	--	--	--	--	--	--	--	--	--	--
08077720	8/30/2006	--	--	--	--	--	--	--	--	--	--
08077720	8/31/2006	0.65	0.077	0.025	0.07	--	<2.0	<2.0	4.7	1.6	17
08077720	9/1/2006	--	--	--	--	--	--	--	--	--	--
08077720	9/25/2006	--	--	--	--	--	--	--	--	--	--
08077720	10/5/2006	--	--	<.006	0.05	--	2.3	2.5	13.8	2.7	20
08077720	11/27/2006	--	--	--	--	--	--	--	--	--	--
08077720	12/20/2006	--	--	--	--	--	--	--	--	--	--
08077720	1/24/2007	--	--	--	--	--	--	--	--	--	--
08077720	1/25/2007	--	--	--	--	--	--	--	--	--	--
08077720	1/30/2007	--	--	--	--	--	--	--	--	--	--
08077720	2/27/2007	--	--	--	--	--	--	--	--	--	--
08077720	3/20/2007	--	--	--	--	--	--	--	--	--	--
08077720	3/27/2007	0.69	0.022	0.007	0.07	7.7	4	4	24.9	8.4	46
08077720	4/26/2007	--	--	--	--	--	--	--	--	--	--
08077720	5/10/2007	--	--	E.004	0.06	8.2	3.6	3.4	31.1	13.1	--
08077720	5/29/2007	--	--	--	--	--	--	--	--	--	--
08077720	5/30/2007	--	--	--	--	--	--	--	--	--	--
08077720	5/31/2007	--	--	--	--	--	--	--	--	--	--
08077720	6/19/2007	--	--	--	--	--	--	--	--	--	--
08077720	7/25/2007	--	--	--	--	--	--	--	--	--	--
08077720	8/9/2007	--	--	--	--	--	--	--	--	--	--
08077720	8/13/2007	0.65	0.059	0.019	0.06	7.4	1.9	1.6	15.6	6.5	22

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Trans-parency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temper-ature, water, degrees Celsius	Alkalinity, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter as calcium carbonate	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter
08077725	6/28/2006	1320	--	--	--	--	16	9.3	8.7	12000	29.8	--	--
08077725	7/11/2006	0900	--	-34	--	--	18	7	8.1	1080	30.5	97	117
08077725	7/31/2006	1145	--	--	--	--	11	9.9	8.9	2780	32.5	--	--
08077725	8/21/2006	1152	--	--	0.3	--	38	5.9	8	793	30.9	--	--
08077725	8/23/2006	1240	2.47	--	0.3	--	13	4.9	7.9	1880	30.4	--	--
08077725	8/25/2006	1315	2.74	--	0.3	--	11	7.7	8.6	3170	31	--	--
08077725	8/28/2006	1320	2.13	--	0.3	--	12	8.3	7.8	1130	31.5	--	--
08077725	8/30/2006	1445	2.9	--	0.3	--	6.3	8.4	8.4	1420	31.6	98	E111
08077725	8/30/2006	1234	2.71	--	0.3	--	9.7	7.9	8.2	1630	30.9	--	--
08077725	9/1/2006	1222	3.32	--	0.3	--	12	8	7.6	1230	30	--	--
08077725	9/25/2006	1415	2.16	--	0.3	0.65	45	0.3	7.1	602	25.3	--	--
08077725	10/4/2006	1034	2.19	--	0.3	0.4	10	7.6	8.4	10100	27.3	107	124
08077725	10/30/2006	1302	3.02	--	0.3	1.18	24	6.4	7.4	558	22.2	--	--
08077725	11/27/2006	1330	--	--	0.3	2.3	5.6	13.7	8.5	15400	21.1	--	--
08077725	12/20/2006	1325	--	--	0.3	1.5	--	18.9	9.1	17700	19.9	--	--
08077725	1/24/2007	1432	--	--	0.3	0.9	60	10	7	1720	9.3	--	--
08077725	1/25/2007	1213	--	--	0.3	0.75	71	9.8	8.2	555	9.8	--	--
08077725	1/30/2007	1146	--	--	0.3	1.3	63	8.6	8.4	975	12.5	--	--
08077725	2/27/2007	1120	--	--	0.3	1.8	12	15.3	8.7	8790	19.6	--	--
08077725	3/20/2007	1138	--	--	0.3	1.1	26	15.4	7.1	833	21.4	--	--
08077725	3/27/2007	0912	--	-84	0.3	1.52	14	7.1	7.7	1220	23.2	149	179
08077725	4/26/2007	1115	--	--	0.3	1.5	17	1.9	7.5	10100	23.5	--	--
08077725	5/9/2007	1037	--	--	0.3	1.71	8.4	4.7	7.8	4980	26.7	187	224
08077725	5/29/2007	1143	--	--	0.3	1.4	12	7.1	7.7	6040	26.1	--	--
08077725	5/30/2007	1100	--	--	0.3	1.7	16	2.6	7.4	6540	26.5	--	--
08077725	5/31/2007	1010	--	--	0.3	1.4	13	5.8	7.6	6350	27.4	--	--
08077725	6/19/2007	1153	--	--	0.3	1	15	7	8.8	12500	30.2	--	--
08077725	7/9/2007	1210	--	81	0.3	1	12	3.4	6.9	363	29.1	72	87
08077725	7/25/2007	1125	--	--	0.3	1.3	13	6.7	8	1060	28.7	--	--
08077725	8/9/2007	1023	--	--	0.3	1.3	15	4.6	7.3	582	30.6	--	--

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Chloride, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Residue on evaporation, dried at 180 degrees Celsius, water, filtered, milligrams per liter	Residue, total nonfilterable, milligrams per liter	Ammonia plus organic nitrogen, water, unfiltered, milligrams per liter as nitrogen	Ammonia, water, unfiltered, milligrams per liter as NH4	Ammonia, water, unfiltered, milligrams per liter as nitrogen	Nitrate plus nitrite, water, filtered, milligrams per liter as nitrogen	Nitrate, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter as nitrogen	Nitrite, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Organic nitrogen, water, unfiltered, milligrams per liter
08077725	6/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	7/11/2006	204	34.9	554	<17	1.1	--	E.02	<.016	--	--	0.007	0.002	--
08077725	7/31/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	8/21/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	8/23/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	8/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	8/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	8/30/2006	361	56.7	818	<20	1.3	--	<.04	<.016	--	--	--	E.001	--
08077725	8/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	9/1/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	9/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	10/4/2006	3060	409	5870	13	27	0.05	0.04	0.018	--	--	--	<.002	27
08077725	10/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	11/27/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	12/20/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	1/24/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	1/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	1/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	2/27/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	3/20/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	3/27/2007	253	48.3	659	15	1.2	--	E.02	<.016	--	--	0.046	0.014	--
08077725	4/26/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	5/9/2007	1290	186	2570	15	0.98	0.07	0.06	0.046	0.176	0.04	0.021	0.006	0.92
08077725	5/29/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	5/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	5/31/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	6/19/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	7/9/2007	43.9	11.8	195	17	0.89	--	E.04	<.016	--	--	0.007	0.002	--
08077725	7/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	8/9/2007	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Total nitrogen, water, unfiltered, milligrams per liter	Ortho-phosphate, water, filtered, milligrams per liter	Orthophos-phate, water, filtered, milligrams per liter as phos-phorus	Phosphorus, water, unfiltered, milligrams per liter	Organic carbon, water, unfiltered, milligrams per liter	Biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Carbonaceous biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Chlorophyll-*a*, phytoplankton, chromatographic-fluorometric method, micrograms per liter	Pheophytin-*a*, phytoplankton, micrograms per liter	Suspended sediment concentration, milligrams per liter
08077725	6/28/2006	--	--	--	--	--	--	--	--	--	--
08077725	7/11/2006	--	0.069	0.022	0.13	--	4.7	3.6	41.5	10.4	11
08077725	7/31/2006	--	--	--	--	--	--	--	--	--	--
08077725	8/21/2006	--	--	--	--	--	--	--	--	--	--
08077725	8/23/2006	--	--	--	--	--	--	--	--	--	--
08077725	8/25/2006	--	--	--	--	--	--	--	--	--	--
08077725	8/28/2006	--	--	--	--	--	--	--	--	--	--
08077725	8/30/2006	--	0.046	0.015	0.14	--	7.9	6.3	55.2	18.3	10
08077725	8/30/2006	--	--	--	--	--	--	--	--	--	--
08077725	9/1/2006	--	--	--	--	--	--	--	--	--	--
08077725	9/25/2006	--	--	--	--	--	--	--	--	--	--
08077725	10/4/2006	27	--	<.006	1.89	--	4.2	4	38.1	2.2	14
08077725	10/30/2006	--	--	--	--	--	--	--	--	--	--
08077725	11/27/2006	--	--	--	--	--	--	--	--	--	--
08077725	12/20/2006	--	--	--	--	--	--	--	--	--	--
08077725	1/24/2007	--	--	--	--	--	--	--	--	--	--
08077725	1/25/2007	--	--	--	--	--	--	--	--	--	--
08077725	1/30/2007	--	--	--	--	--	--	--	--	--	--
08077725	2/27/2007	--	--	--	--	--	--	--	--	--	--
08077725	3/20/2007	--	--	--	--	--	--	--	--	--	--
08077725	3/27/2007	--	--	E.004	0.12	10	4.3	3.9	43.7	17.4	14
08077725	4/26/2007	--	--	--	--	--	--	--	--	--	--
08077725	5/9/2007	1	--	E.004	0.06	11.4	4.4	4.1	22.8	8.5	8
08077725	5/29/2007	--	--	--	--	--	--	--	--	--	--
08077725	5/30/2007	--	--	--	--	--	--	--	--	--	--
08077725	5/31/2007	--	--	--	--	--	--	--	--	--	--
08077725	6/19/2007	--	--	--	--	--	--	--	--	--	--
08077725	7/9/2007	--	0.088	0.029	0.1	12.4	1.4	1.2	13.4	4	18
08077725	7/25/2007	--	--	--	--	--	--	--	--	--	--
08077725	8/9/2007	--	--	--	--	--	--	--	--	--	--

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Trans-parency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temper-ature, water, degrees Celsius	Alkalinity, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter as calcium carbonate	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter
08077738	6/28/2006	1040	--	--	--	--	24	10	8.7	18700	29.2	--	--
08077738	7/11/2006	1000	--	--	--	--	16	6.2	8.1	8400	28.4	87	102
08077738	7/31/2006	1008	--	--	--	--	20	4.3	8.3	13700	29.6	--	--
08077738	8/21/2006	1038	--	--	0.3	--	18	5.3	8.1	11000	30	--	--
08077738	8/23/2006	1121	--	--	0.3	--	20	5.2	8.3	12600	29.7	--	--
08077738	8/25/2006	1053	0.58	--	0.3	--	15	7.8	8.4	12200	30.1	--	--
08077738	8/28/2006	1115	0.46	--	0.3	--	25	8	8.4	5320	29.7	--	--
08077738	8/30/2006	1400	1.26	--	0.3	--	15	8.8	8.8	4550	31.4	96	E103
08077738	8/30/2006	1105	0.4	--	0.13	--	28	6.7	8.5	10500	29.2	--	--
08077738	9/1/2006	1006	0.51	--	0.3	--	13	5.6	8.5	15100	28.5	--	--
08077738	9/25/2006	1144	0.46	--	0.3	0.75	44	5.5	7.5	3700	23.3	--	--
08077738	10/4/2006	1001	1.47	--	0.3	0.39	11	5.7	8.2	22000	26.5	101	118
08077738	10/30/2006	1041	0.7	--	0.3	1.2	18	7.6	7.7	8140	21.1	--	--
08077738	10/30/2006	1042	--	--	--	--	--	--	--	--	--	--	--
08077738	11/27/2006	1120	--	--	0.3	2.1	6.8	9.9	8.2	27200	21	--	--
08077738	12/20/2006	1124	--	--	0.3	>1.80	4.8	7.1	8.4	28700	19.3	--	--
08077738	1/24/2007	1212	--	--	--	--	12	10.1	7.7	10500	9.6	--	--
08077738	1/25/2007	1055	--	--	0.11	0.65	43	12.4	7.4	3040	10	--	--
08077738	1/30/2007	1033	--	--	0.13	1	39	11.4	8.9	6760	12.4	--	--
08077738	2/27/2007	1012	--	--	0.1	--	18	10.1	8.7	14000	19.8	--	--
08077738	3/20/2007	1005	--	--	0.3	1	30	4.6	7.7	5740	20.4	--	--
08077738	3/27/2007	0938	--	-188	0.3	1.35	16	7.5	8	6990	22.7	126	152
08077738	4/26/2007	0926	--	--	0.3	1	15	6.1	7.9	5660	22.2	--	--
08077738	5/9/2007	1114	--	--	0.3	1.3	16	10.2	8.2	12100	27.1	149	176
08077738	5/29/2007	1020	--	--	0.3	1.5	9.8	5.9	7.6	21100	25.2	--	--
08077738	5/30/2007	1022	--	--	0.3	1.3	17	3.8	7.3	20800	26.1	--	--
08077738	5/31/2007	1150	--	--	0.3	1.35	15	5.5	7.5	18900	27	--	--
08077738	6/19/2007	1138	--	--	0.3	0.9	29	4.9	8	25100	29.3	--	--
08077738	7/9/2007	1130	--	210	0.3	1.2	22	5.5	7.6	2700	29.3	67	80
08077738	7/25/2007	1110	--	--	0.3	1.2	16	4.6	8.3	10500	28.4	--	--
08077738	8/9/2007	1008	--	--	0.3	1	25	20.2	7.1	6900	29.9	--	--

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Chloride, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Residue on evaporation, dried at 180 degrees Celsius, water, filtered, milligrams per liter	Residue, total nonfilterable, milligrams per liter	Ammonia plus organic nitrogen, water, unfiltered, milligrams per liter as nitrogen	Ammonia, water, unfiltered, milligrams per liter as NH4	Ammonia, water, unfiltered, milligrams per liter as nitrogen	Nitrate plus nitrite, water, filtered, milligrams per liter as nitrogen	Nitrate, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter as nitrogen	Nitrite, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Organic nitrogen, water, unfiltered, milligrams per liter
08077738	6/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	7/11/2006	2240	309	4400	34	1.2	--	<.04	<.016	--	--	--	E.002	--
08077738	7/31/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	8/21/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	8/23/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	8/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	8/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	8/30/2006	1160	165	2350	30	1.5	--	E.02	<.016	--	--	--	<.002	--
08077738	8/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	9/1/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	9/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	10/4/2006	6950	903	13400	14	120	--	E.03	<.016	--	--	--	<.002	--
08077738	10/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	10/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	11/27/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	12/20/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	1/24/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	1/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	1/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	2/27/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	3/20/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	3/27/2007	2110	315	4070	37	0.96	--	E.04	0.707	2.98	0.67	0.108	0.033	--
08077738	4/26/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	5/9/2007	3500	483	6450	31	1.5	--	E.03	0.994	--	--	--	E.002	--
08077738	5/29/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	5/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	5/31/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	6/19/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	7/9/2007	706	98.1	1420	31	0.93	0.05	0.04	<.016	--	--	--	E.001	0.89
08077738	7/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	8/9/2007	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Total nitrogen, water, unfiltered, milligrams per liter	Ortho-phosphate, water, filtered, milligrams per liter	Orthophos-phate, water, filtered, milligrams per liter as phos-phorus	Phosphorus, water, unfiltered, milligrams per liter	Organic carbon, water, unfiltered, milligrams per liter	Biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Carbonaceous biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Chlorophyll-*a*, phytoplankton, chromatographic-fluorometric method, micrograms per liter	Pheophytin-*a*, phytoplankton, micrograms per liter	Suspended sediment concentration, milligrams per liter
08077738	6/28/2006	--	--	--	--	--	--	--	--	--	--
08077738	7/11/2006	--	0.028	0.009	0.11	--	4.4	2.7	31.2	6.4	11
08077738	7/31/2006	--	--	--	--	--	--	--	--	--	--
08077738	8/21/2006	--	--	--	--	--	--	--	--	--	--
08077738	8/23/2006	--	--	--	--	--	--	--	--	--	--
08077738	8/25/2006	--	--	--	--	--	--	--	--	--	--
08077738	8/28/2006	--	--	--	--	--	--	--	--	--	--
08077738	8/30/2006	--	--	E.006	0.17	--	8.1	6.9	57.1	16.9	26
08077738	8/30/2006	--	--	--	--	--	--	--	--	--	--
08077738	9/1/2006	--	--	--	--	--	--	--	--	--	--
08077738	9/25/2006	--	--	--	--	--	--	--	--	--	--
08077738	10/4/2006	--	--	E.003	10	--	4.7	4.7	--	--	16
08077738	10/30/2006	--	--	--	--	--	--	--	--	--	--
08077738	10/30/2006	--	--	--	--	--	--	--	--	--	--
08077738	11/27/2006	--	--	--	--	--	--	--	--	--	--
08077738	12/20/2006	--	--	--	--	--	--	--	--	--	--
08077738	1/24/2007	--	--	--	--	--	--	--	--	--	--
08077738	1/25/2007	--	--	--	--	--	--	--	--	--	--
08077738	1/30/2007	--	--	--	--	--	--	--	--	--	--
08077738	2/27/2007	--	--	--	--	--	--	--	--	--	--
08077738	3/20/2007	--	--	--	--	--	--	--	--	--	--
08077738	3/27/2007	1.7	--	E.003	0.07	--	2.5	1.7	26.2	4.4	24
08077738	4/26/2007	--	--	--	--	--	--	--	--	--	--
08077738	5/9/2007	2.5	0.044	0.014	0.1	11.5	6.5	5.4	41.5	5.1	19
08077738	5/29/2007	--	--	--	--	--	--	--	--	--	--
08077738	5/30/2007	--	--	--	--	--	--	--	--	--	--
08077738	5/31/2007	--	--	--	--	--	--	--	--	--	--
08077738	6/19/2007	--	--	--	--	--	--	--	--	--	--
08077738	7/9/2007	--	0.038	0.012	0.1	10.5	1	2	21.6	3.8	26
08077738	7/25/2007	--	--	--	--	--	--	--	--	--	--
08077738	8/9/2007	--	--	--	--	--	--	--	--	--	--

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Trans-parency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temper-ature, water, degrees Celsius	Alkalinity, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter as calcium carbonate	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter
08077780	6/28/2006	1145	--	--	--	--	63	4.9	7.9	37400	29.2	--	--
08077780	7/10/2006	1000	--	-378	--	--	25	4.9	7.6	24300	28.8	78	94
08077780	7/31/2006	0925	--	--	--	--	20	3.7	7.8	28300	29.7	--	--
08077780	8/21/2006	0952	--	--	0.3	--	22	4.6	8.2	30300	30.4	--	--
08077780	8/23/2006	1024	2.22	--	0.3	--	22	3.7	8	29400	29.8	--	--
08077780	8/25/2006	0958	2.22	--	0.3	--	20	4.5	8	31100	29.6	--	--
08077780	8/28/2006	1002	2.38	--	0.3	--	19	4.7	7.8	25600	29.8	--	--
08077780	8/30/2006	1250	1.84	--	0.3	--	--	5.2	8.2	24400	30	108	E128
08077780	8/30/2006	1002	2.16	--	0.3	--	15	5.4	8.1	27300	29.7	--	--
08077780	9/1/2006	0915	2.27	--	0.3	--	9.8	6	8.2	31700	28.9	--	--
08077780	9/25/2006	1036	0.23	--	0.3	--	24	7.3	7.8	21300	23.1	--	--
08077780	10/4/2006	1158	2.11	--	0.3	0.89	14	5.7	7.8	38000	27.8	104	124
08077780	10/30/2006	0948	2.41	--	0.3	1.74	12	6.9	7.7	19100	20.9	--	--
08077780	11/27/2006	1011	--	--	0.3	2.85	6.2	6.8	7.8	33400	20.9	--	--
08077780	12/20/2006	1008	--	--	0.3	2.5	9.5	7	7.8	35900	18.9	--	--
08077780	1/24/2007	1103	--	--	0.3	--	4.8	10.6	7.5	26700	8.5	--	--
08077780	1/25/2007	0958	--	--	0.3	1.4	19	7.5	6.4	9980	8.6	--	--
08077780	1/30/2007	0919	--	--	0.3	4.4	26	10.7	8.5	16600	11.7	--	--
08077780	2/27/2007	0930	--	--	0.3	2.6	8.7	8.5	8	23000	18.7	--	--
08077780	3/20/2007	0830	--	--	0.3	1.4	12	3.7	7.7	17700	20.6	--	--
08077780	3/26/2007	0952	--	-561	0.3	1.51	12	7.4	7.9	14500	22.4	114	138
08077780	4/26/2007	0913	--	--	0.3	1.6	12	6.8	7.8	16400	22	--	--
08077780	5/9/2007	1241	--	--	0.3	1.65	16	5.9	7.5	26700	27	121	146
08077780	5/29/2007	0917	--	--	0.3	1.74	14	3.8	7.6	29200	24.4	--	--
08077780	5/30/2007	0926	--	--	0.3	2.1	15	3.2	7.6	28900	26.7	--	--
08077780	5/31/2007	1102	--	--	0.3	1.5	15	3.2	7.5	28800	27.2	--	--
08077780	6/19/2007	1055	--	--	0.3	1.2	27	4.8	7.7	31300	28.8	--	--
08077780	7/9/2007	1320	--	--	0.3	1.69	22	7.3	7.5	14900	30.2	75	90
08077780	7/25/2007	1027	--	--	0.3	1.2	19	3.8	7.7	20600	28.9	--	--
08077780	8/9/2007	0950	--	--	0.3	1.3	20	4.4	7.6	18300	30.3	--	--
08077780	8/13/2007	1103	--	-381	0.3	1.28	19	3.8	7.7	22700	31.6	105	127

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Chloride, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Residue on evaporation, dried at 180 degrees Celsius, water, filtered, milligrams per liter	Residue, total nonfilterable, milligrams per liter	Ammonia plus organic nitrogen, water, unfiltered, milligrams per liter as nitrogen	Ammonia, water, unfiltered, milligrams per liter as NH4	Ammonia, water, unfiltered, milligrams per liter as nitrogen	Nitrate plus nitrite, water, filtered, milligrams per liter as nitrogen	Nitrate, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter as nitrogen	Nitrite, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Organic nitrogen, water, unfiltered, milligrams per liter
08077780	6/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	7/10/2006	7880	1050	15600	59	0.9	0.14	0.11	0.02	0.068	0.02	0.016	0.005	0.8
08077780	7/31/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	8/21/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	8/23/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	8/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	8/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	8/30/2006	7930	1040	15600	88	1.1	0.05	0.04	<.016	--	--	--	<.002	1
08077780	8/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	9/1/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	9/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	10/4/2006	13000	1730	25100	54	68	0.05	0.04	0.019	0.075	0.02	0.007	0.002	68
08077780	10/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	11/27/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	12/20/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	1/24/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	1/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	1/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	2/27/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	3/20/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	3/26/2007	4910	676	9080	44	0.71	--	E.03	E.010	--	--	0.008	0.002	--
08077780	4/26/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	5/9/2007	8560	1160	16000	57	0.67	--	E.03	<.016	--	--	--	E.001	--
08077780	5/29/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	5/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	5/31/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	6/19/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	7/9/2007	4520	630	8800	45	0.84	--	E.04	<.016	--	--	--	<.002	--
08077780	7/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	8/9/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	8/13/2007	7440	941	14000	61	0.75	0.14	0.11	0.036	0.136	0.03	0.017	0.005	0.64

Appendix 1. Periodically collected water-quality properties and constituents at five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Total nitrogen, water, unfiltered, milligrams per liter	Ortho-phosphate, water, filtered, milligrams per liter	Orthophos-phate, water, filtered, milligrams per liter as phos-phorus	Phosphorus, water, unfiltered, milligrams per liter	Organic carbon, water, unfiltered, milligrams per liter	Biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Carbonaceous biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Chlorophyll-*a*, phytoplankton, chromatographic-fluorometric method, micrograms per liter	Pheophytin-*a*, phytoplankton, micrograms per liter	Suspended sediment concentration, milligrams per liter
08077780	6/28/2006	--	--	--	--	--	--	--	--	--	--
08077780	7/10/2006	0.92	0.109	0.036	0.1	--	2.5	1.2	10.6	1.4	--
08077780	7/31/2006	--	--	--	--	--	--	--	--	--	--
08077780	8/21/2006	--	--	--	--	--	--	--	--	--	--
08077780	8/23/2006	--	--	--	--	--	--	--	--	--	--
08077780	8/25/2006	--	--	--	--	--	--	--	--	--	--
08077780	8/28/2006	--	--	--	--	--	--	--	--	--	--
08077780	8/30/2006	--	0.054	0.018	0.13	--	4.3	4	24.8	1.1	43
08077780	8/30/2006	--	--	--	--	--	--	--	--	--	--
08077780	9/1/2006	--	--	--	--	--	--	--	--	--	--
08077780	9/25/2006	--	--	--	--	--	--	--	--	--	--
08077780	10/4/2006	68	0.066	0.022	8.28	--	2.5	1.9	--	--	31
08077780	10/30/2006	--	--	--	--	--	--	--	--	--	--
08077780	11/27/2006	--	--	--	--	--	--	--	--	--	--
08077780	12/20/2006	--	--	--	--	--	--	--	--	--	--
08077780	1/24/2007	--	--	--	--	--	--	--	--	--	--
08077780	1/25/2007	--	--	--	--	--	--	--	--	--	--
08077780	1/30/2007	--	--	--	--	--	--	--	--	--	--
08077780	2/27/2007	--	--	--	--	--	--	--	--	--	--
08077780	3/20/2007	--	--	--	--	--	--	--	--	--	--
08077780	3/26/2007	--	--	<.006	0.05	--	2.2	1.8	13.8	0.5	21
08077780	4/26/2007	--	--	--	--	--	--	--	--	--	--
08077780	5/9/2007	--	--	E.005	0.06	6.7	2.2	2	10.6	0.5	22
08077780	5/29/2007	--	--	--	--	--	--	--	--	--	--
08077780	5/30/2007	--	--	--	--	--	--	--	--	--	--
08077780	5/31/2007	--	--	--	--	--	--	--	--	--	--
08077780	6/19/2007	--	--	--	--	--	--	--	--	--	--
08077780	7/9/2007	--	0.072	0.024	0.1	8.3	3.5	4.5	25.6	0.8	23
08077780	7/25/2007	--	--	--	--	--	--	--	--	--	--
08077780	8/9/2007	--	--	--	--	--	--	--	--	--	--
08077780	8/13/2007	0.79	0.16	0.052	0.12	7.1	2.7	1.4	9.5	2.7	28

Appendix 2. Periodically collected water-quality properties and bacteria concentrations at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[USGS, U.S. Geological Survey; --, no data; >, greater than]

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Transparency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temperature, water, degrees Celsius	*Enterococci*, Defined Substrate Technology, water, most probable number per 100 milliliters	*Escherichia coli*, Defined Substrate Technology, water, most probable number per 100 milliliters	Total coliform, Defined Substrate Technology, water, most probable number per 100 milliliters
08077700	6/28/2006	1540	--	--	--	--	20	5.7	8.1	7230	30.2	52	390	46000
08077700	7/10/2006	1030	--	5.3	--	--	7.1	1.9	7	799	28.4	120	390	5900
08077700	7/31/2006	1020	--	--	--	--	18	3.7	7.6	1220	30.6	160	220	8800
08077700	8/21/2006	1100	--	--	0.3	--	28	4.7	7.8	2480	29.6	200	3700	120000
08077700	8/23/2006	1138	--	--	0.3	--	23	3.9	7.8	2260	29.8	63	160	5200
08077700	8/25/2006	1118	0.85	--	0.3	--	20	6.1	8.1	2390	29.9	20	160	6100
08077700	8/28/2006	1140	0.85	--	0.3	--	37	6.4	7.6	1980	29.7	110	1800	22000
08077700	8/30/2006	1126	0.91	--	0.3	--	27	5.4	8.3	2040	29.7	74	230	2800
08077700	8/31/2006	1135	0.85	--	0.3	0.3	28	6.2	8.5	1650	29.2	--	210	9900
08077700	9/1/2006	1034	0.88	--	0.3	--	22	5.7	8.5	1750	29	110	210	9000
08077700	9/25/2006	1212	0.82	--	0.3	1	25	1.8	7	1730	24	1700	46000	>240000
08077700	10/5/2006	0948	1	--	0.3	0.5	11	3.4	7.4	4760	25.8	170	120	7700
08077700	10/30/2006	1108	1.04	--	0.3	1.1	20	4.6	7.1	379	19.6	140	690	11000
08077700	11/27/2006	1145	--	--	0.3	1.5	11	10.5	8.2	8160	18.3	180	1200	20000
08077700	12/20/2006	1149	--	--	0.3	2	11	2	7.6	15100	19.4	380	1800	82000
08077700	1/24/2007	1237	--	--	0.3	1.2	39	9.4	7.8	871	9.6	>24000	29000	170000
08077700	1/25/2007	1116	--	--	0.3	1.1	38	10.6	6.6	356	9.2	5500	20000	92000
08077700	1/30/2007	1047	--	--	0.3	1	46	8.4	7.9	611	12	400	7400	52000
08077700	2/27/2007	1034	--	--	0.3	1.6	21	8.7	8	3020	18.2	86	200	3000
08077700	3/20/2007	1028	--	--	0.3	0.9	40	10.8	7.8	377	21.1	240	990	5800
08077700	3/26/2007	1139	--	-29	0.3	1.4	18	4.2	7.8	575	23.4	20	310	5200
08077700	4/26/2007	0945	--	--	0.3	1.2	26	4.1	7.5	666	21.7	3000	16000	>24000
08077700	5/10/2007	0921	--	--	0.3	1.5	17	3	7.5	1990	25	74	380	16000
08077700	5/29/2007	1129	--	--	0.3	1.1	15	6.2	7.5	6100	25.8	410	180	110000
08077700	5/30/2007	1220	--	--	0.3	1.5	21	1.7	7.2	7800	25.8	31	1600	110000
08077700	5/31/2007	0921	--	--	0.3	1.1	16	3.7	7.3	6460	26	180	770	130000
08077700	6/19/2007	0937	--	--	0.3	0.9	25	1.1	7	10900	28.5	180	91	160000
08077700	7/10/2007	1005	--	-5.8	0.3	2	9.9	1.9	7	273	28.8	120	310	12000
08077700	7/25/2007	0832	--	--	0.3	1.6	14	3.2	7.1	358	27.4	97	170	6900
08077700	8/9/2007	0840	--	--	0.3	1.4	15	3.3	6.9	337	29.1	41	280	6900
08077705	6/28/2006	1520	--	--	--	--	23	7.7	8.5	7400	31	75	140	49000
08077705	7/31/2006	1040	--	--	--	--	16	5.6	8.3	912	31.4	31	110	3700
08077705	8/21/2006	1106	--	--	0.3	--	25	4.2	7.8	567	30.5	380	5500	69000
08077705	8/23/2006	1150	1.13	--	0.3	--	21	3.7	7.7	1210	30.3	130	770	7300

Appendix 2. Periodically collected water-quality properties and bacteria concentrations at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Transparency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temperature, water, degrees Celsius	*Enterococci*, Defined Substrate Technology, water, most probable number per 100 milliliters	*Escherichia coli*, Defined Substrate Technology, water, most probable number per 100 milliliters	Total coliform, Defined Substrate Technology, water, most probable number per 100 milliliters
08077705	8/25/2006	1137	0.88	--	0.3	--	23	5.6	8	1440	30.3	84	170	6100
08077705	8/28/2006	1200	0.94	--	0.3	--	42	5.5	7.6	661	29.8	86	250	12000
08077705	8/30/2006	1139	0.85	--	0.3	--	40	4.7	8	707	30	52	130	4600
08077705	9/1/2006	1057	0.46	--	0.3	--	27	7	8.3	864	29.5	20	160	3100
08077705	9/25/2006	1250	0.85	--	0.3	0.65	51	4.4	7.3	814	23.7	930	7900	>240000
08077705	10/30/2006	1126	0.79	--	0.3	0.67	45	5.9	7.3	273	20.2	120	960	9100
08077705	11/27/2006	1206	--	--	0.3	1.6	10	10.7	8.1	11000	19.7	280	1700	15000
08077705	12/20/2006	1210	--	--	0.3	2.1	9.5	9.5	8.4	16100	19.6	280	1800	49000
08077705	1/24/2007	1252	--	--	0.3	--	110	10.9	7.4	517	8.8	8200	7500	82000
08077705	1/25/2007	1128	--	--	0.3	0.5	120	14.2	6.6	277	8.5	2800	6500	29000
08077705	1/30/2007	1104	--	--	0.3	0.6	86	9.7	8.1	441	12.2	160	2300	15000
08077705	2/27/2007	1054	--	--	0.3	1.6	21	6.9	8	7100	18.2	20	50	890
08077705	3/20/2007	1048	--	--	0.3	0.9	50	12.6	7.4	426	21.3	75	300	9200
08077705	4/26/2007	0958	--	--	0.3	0.9	42	4.6	7.8	736	22.1	2300	11000	>24000
08077705	5/29/2007	1106	--	--	0.3	1.4	16	5.6	7.5	6960	26.8	120	310	39000
08077705	5/30/2007	1207	--	--	0.3	1.3	17	2.7	7.3	6240	26.4	52	1000	87000
08077705	5/31/2007	0933	--	--	0.3	1.2	17	6.5	7.6	5600	27.2	130	270	58000
08077705	6/19/2007	0954	--	--	0.3	1.15	27	1.2	7.5	11900	29	110	230	61000
08077705	7/25/2007	0855	--	--	0.3	1.3	20	3.5	7	389	28.5	370	16000	130000
08077705	8/9/2007	0854	--	--	0.3	1.1	23	2.9	7	347	30.4	52	120	9800
08077710	6/28/2006	1500	--	--	--	--	23	7	8.5	8630	30.8	85	62	41000
08077710	7/31/2006	1100	--	--	--	--	12	5.9	8.4	1010	31.1	31	63	1800
08077710	8/21/2006	1117	--	--	0.3	--	29	3.5	7.7	488	30.6	330	390	28000
08077710	8/23/2006	1200	1.75	--	0.3	--	--	3.8	7.7	854	30.2	52	82	7500
08077710	8/25/2006	1158	1.55	--	0.3	--	21	6.5	8.2	1770	30.3	31	57	7300
08077710	8/28/2006	1220	1.62	--	0.3	--	42	7.6	8	626	30.4	140	580	9300
08077710	8/30/2006	1152	1.58	--	0.3	--	26	5.1	8	749	30	20	120	2400
08077710	9/1/2006	1119	1.57	--	0.3	--	17	6.8	8.2	1080	29.6	86	170	2600
08077710	9/25/2006	1322	1.46	--	0.3	0.5	66	2.9	7.3	569	24.4	290	2400	200000
08077710	10/30/2006	1153	1.58	--	0.3	1.1	32	5.5	7.2	316	21.6	75	990	12000
08077710	10/30/2006	1212	0.58	--	0.3	1.5	13	7.4	7.3	364	21.6	--	330	33000
08077710	11/27/2006	1232	--	--	0.3	2	7.9	11.1	8.2	12800	20.1	140	730	20000
08077710	12/20/2006	1240	--	--	0.3	1.8	13	12.2	8.7	16600	19.6	540	1800	55000
08077710	1/24/2007	1315	--	--	0.05	>.50	53	10.6	7.4	198	9.2	>24000	39000	160000

Appendix 2. Periodically collected water-quality properties and bacteria concentrations at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Transparency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temperature, water, degrees Celsius	*Enterococci*, Defined Substrate Technology, water, most probable number per 100 milliliters	*Escherichia coli*, Defined Substrate Technology, water, most probable number per 100 milliliters	Total coliform, Defined Substrate Technology, water, most probable number per 100 milliliters
08077710	1/25/2007	1152	--	--	0.3	0.6	84	9.3	7.2	341	9.2	4400	8000	55000
08077710	1/30/2007	1120	--	--	0.07	0.5	110	10.1	8.2	634	11.9	200	1800	26000
08077710	2/27/2007	1159	--	--	0.08	--	72	12.2	8.3	4570	20.2	52	110	2200
08077710	3/20/2007	1115	--	--	0.3	0.8	40	13.3	7.4	475	21.1	75	330	5700
08077710	4/26/2007	1014	--	--	0.3	0.8	34	4.6	7.8	819	22.2	7700	11000	>24000
08077710	5/29/2007	1045	--	--	0.3	1.55	12	5	7.5	6970	26	1400	1200	100000
08077710	5/30/2007	1139	--	--	0.3	1.8	14	3	7.5	5530	26.7	41	2400	110000
08077710	5/31/2007	0952	--	--	0.3	1.1	14	7.5	7.6	4790	27.2	75	460	55000
08077710	6/19/2007	1007	--	--	0.3	1.1	18	3.2	7.6	12400	29.2	130	310	73000
08077710	7/25/2007	0918	--	--	0.3	1.2	20	2.8	7.1	406	28.5	560	24000	160000
08077710	8/9/2007	0903	--	--	0.3	1.4	20	3	7	359	30.6	20	98	9200
08077715	6/28/2006	1405	--	--	--	--	8.1	8	7.9	779	29.5	520	110	73000
08077715	7/31/2006	1125	--	--	--	--	3	5.7	7.4	810	29.2	63	130	46000
08077715	8/21/2006	1135	--	--	0.1	--	4.1	4.6	7.4	594	29.1	--	550	77000
08077715	8/23/2006	1225	--	--	0.1	--	3.6	4.8	7.4	681	28.3	--	210	46000
08077715	8/25/2006	1234	0.21	--	0.1	--	3.2	5.5	7.6	837	28.6	--	120	58000
08077715	8/28/2006	1258	0.24	--	0.12	--	3	6.2	7.4	779	29.9	--	290	29000
08077715	8/30/2006	1218	0.24	--	0.08	--	2.1	6.6	7.6	848	28.4	--	160	18000
08077715	9/1/2006	1205	0.2	--	0.07	--	2.1	6.2	7.4	781	29.6	--	86	19000
08077715	9/25/2006	1356	0.27	--	0.09	--	5.1	1.2	7.2	574	25.7	--	210	55000
08077715	10/30/2006	1233	0.27	--	0.09	0.85	3.6	7.6	7.5	819	23.2	--	190	30000
08077715	11/27/2006	1308	0.15	--	0.07	--	14	10.4	7.7	951	20.7	--	100	44000
08077715	12/20/2006	1357	0.19	--	0.06	>.63	18	7.3	7.8	874	20.3	--	310	15000
08077715	1/24/2007	1404	0.67	--	0.3	1.3	20	10.2	6.8	209	10.2	--	20000	140000
08077715	1/25/2007	1230	--	--	0.1	>1.03	15	11.4	7.3	491	13.4	--	14000	58000
08077715	1/30/2007	1159	--	--	0.11	>1.10	12	8.7	7.8	631	14.1	--	1200	24000
08077715	2/27/2007	1140	--	--	0.12	>1.20	41	10.1	7.7	815	19.4	--	32	22000
08077715	3/20/2007	1215	--	--	0.08	>.80	8.7	17.1	7.1	846	21.7	--	290	41000
08077715	4/26/2007	1129	--	--	0.08	>.80	18	4.6	7.4	412	21.9	--	6100	>24000
08077715	5/29/2007	1237	--	--	0.3	>1.20	26	6	7.4	242	26	--	2000	240000
08077715	5/30/2007	1127	--	--	0.14	>1.40	9.4	3.1	7	445	25.8	--	400	37000
08077715	5/31/2007	1027	--	--	0.1	>1.00	6.7	16.8	7	650	25.2	--	180	61000
08077715	6/19/2007	1023	--	--	0.06	>.60	26	5.8	7.4	436	28.1	--	240	87000
08077715	7/25/2007	0945	--	--	0.05	>.50	8.8	3.6	7.2	765	25.2	--	120	77000

Appendix 2. Periodically collected water-quality properties and bacteria concentrations at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Transparency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temperature, water, degrees Celsius	*Enterococci*, Defined Substrate Technology, water, most probable number per 100 milliliters	*Escherichia coli*, Defined Substrate Technology, water, most probable number per 100 milliliters	Total coliform, Defined Substrate Technology, water, most probable number per 100 milliliters
08077715	8/9/2007	0920	--	--	0.05	>.50	18	4.6	7	820	26.5	--	180	65000
08077720	6/28/2006	1450	--	--	--	--	11	4.4	8.1	9840	28.7	63	78	15000
08077720	7/11/2006	0730	--	2.9	0.3	--	16	--	7.7	744	--	140	96	28000
08077720	7/31/2006	1110	--	--	--	--	8.2	7.2	8.1	1320	30.7	20	110	6800
08077720	8/21/2006	1125	--	--	0.3	--	10	4.9	7.6	346	29.3	--	390	26000
08077720	8/23/2006	1215	1.37	--	0.3	--	13	6.2	7.7	538	29.5	--	47	22000
08077720	8/25/2006	1219	1.4	--	0.3	--	11	6.3	7.8	1380	29.4	--	42	24000
08077720	8/28/2006	1240	1.28	--	0.3	--	16	5.5	7.3	553	29.9	--	130	20000
08077720	8/30/2006	1206	1.26	--	0.3	--	16	5.7	7.7	877	29.3	--	81	15000
08077720	8/31/2006	1030	1.28	1.9	0.3	0.63	10	5.1	7.7	1070	28.6	--	58	11000
08077720	9/1/2006	1139	1.39	--	0.3	--	9.4	5.5	8.3	580	29.3	--	46	9300
08077720	9/25/2006	1338	1.34	--	0.3	1.15	18	3.6	7.2	323	24.4	--	960	41000
08077720	10/5/2006	1048	1.38	0.35	0.3	0.15	8.7	6.3	7.6	5270	26.4	--	28	8200
08077720	11/27/2006	1250	--	--	0.3	2.5	6.2	11.7	8.1	13600	20.8	41	140	28000
08077720	12/20/2006	1345	--	--	0.3	2.1	10	15.9	8.9	17600	20.9	63	140	>240000
08077720	1/24/2007	1345	--	--	0.3	0.7	38	10.3	7	239	9.7	--	16000	110000
08077720	1/25/2007	1243	--	--	0.3	0.95	45	12.6	7.4	350	10.5	--	6600	46000
08077720	1/30/2007	1213	--	--	0.3	1.3	30	9.1	7.9	676	12.9	--	640	13000
08077720	2/27/2007	1222	--	--	0.3	2.2	12	9.1	8	9630	18.8	--	46	1700
08077720	3/20/2007	1200	--	--	0.3	1.4	21	18.3	7.3	651	22	--	200	24000
08077720	3/27/2007	1128	--	1.5	0.3	1.6	9.7	6.8	7.7	1010	23.2	--	48	2400
08077720	4/26/2007	1144	--	--	0.3	1	34	4.4	7.4	416	21.3	--	24000	>24000
08077720	5/10/2007	1013	--	-1.2	0.3	1.7	14	5.5	7.4	2700	24.9	--	130	14000
08077720	5/29/2007	1208	--	--	0.3	1.4	19	5.6	7.6	263	24.4	--	6100	24000
08077720	5/30/2007	1150	--	--	0.3	1.7	16	3.7	7.4	2460	26.5	--	610	34000
08077720	5/31/2007	1038	--	--	0.3	1.4	12	3.8	7.1	8350	26	--	180	24000
08077720	6/19/2007	1015	--	--	0.3	1.5	16	3.9	7.9	12500	29	--	550	27000
08077720	7/25/2007	0933	--	--	0.3	2	12	5.2	7.3	565	28.1	--	150	14000
08077720	8/9/2007	0911	--	--	0.3	2	12	5	7.1	576	30.2	--	160	8200
08077720	8/13/2007	1251	--	-0.21	0.3	2.5	9	5.2	7	1070	30	--	110	11000
08077725	6/28/2006	1320	--	--	--	--	16	9.3	8.7	12000	29.8	86	180	18000
08077725	7/11/2006	0900	--	-34	--	--	18	7	8.1	1080	30.5	110	220	11000
08077725	7/31/2006	1145	--	--	--	--	11	9.9	8.9	2780	32.5	31	99	7700
08077725	8/21/2006	1152	--	--	0.3	--	38	5.9	8	793	30.9	110	330	34000

Appendix 2. Periodically collected water-quality properties and bacteria concentrations at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Transparency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temperature, water, degrees Celsius	*Enterococci*, Defined Substrate Technology, water, most probable number per 100 milliliters	*Escherichia coli*, Defined Substrate Technology, water, most probable number per 100 milliliters	Total coliform, Defined Substrate Technology, water, most probable number per 100 milliliters
08077725	8/23/2006	1240	2.47	--	0.3	--	13	4.9	7.9	1880	30.4	20	63	73000
08077725	8/25/2006	1315	2.74	--	0.3	--	11	7.7	8.6	3170	31	420	120	200000
08077725	8/28/2006	1320	2.13	--	0.3	--	12	8.3	7.8	1130	31.5	51	120	960
08077725	8/30/2006	1445	2.9	--	0.3	--	6.3	8.4	8.4	1420	31.6	20	370	6900
08077725	8/30/2006	1234	2.71	--	0.3	--	9.7	7.9	8.2	1630	30.9	30	160	2300
08077725	9/1/2006	1222	3.32	--	0.3	--	12	8	7.6	1230	30	20	1000	92000
08077725	9/25/2006	1415	2.16	--	0.3	0.65	45	0.3	7.1	602	25.3	450	2600	140000
08077725	10/4/2006	1034	2.19	--	0.3	0.4	10	7.6	8.4	10100	27.3	<10	160	16000
08077725	10/30/2006	1302	3.02	--	0.3	1.18	24	6.4	7.4	558	22.2	--	440	12000
08077725	11/27/2006	1330	--	--	0.3	2.3	5.6	13.7	8.5	15400	21.1	290	1400	33000
08077725	12/20/2006	1325	--	--	0.3	1.5	--	18.9	9.1	17700	19.9	230	890	18000
08077725	1/24/2007	1432	--	--	0.3	0.9	60	10	7	1720	9.3	16000	13000	100000
08077725	1/25/2007	1213	--	--	0.3	0.75	71	9.8	8.2	555	9.8	3400	9300	49000
08077725	1/30/2007	1146	--	--	0.3	1.3	63	8.6	8.4	975	12.5	180	810	10000
08077725	2/27/2007	1120	--	--	0.3	1.8	12	15.3	8.7	8790	19.6	10	41	2100
08077725	3/20/2007	1138	--	--	0.3	1.1	26	15.4	7.1	833	21.4	41	520	6500
08077725	3/27/2007	0912	--	-84	0.3	1.52	14	7.1	7.7	1220	23.2	170	260	6500
08077725	4/26/2007	1115	--	--	0.3	1.5	17	1.9	7.5	10100	23.5	1400	6900	>24000
08077725	5/9/2007	1037	--	--	0.3	1.71	8.4	4.7	7.8	4980	26.7	20	60	9600
08077725	5/29/2007	1143	--	--	0.3	1.4	12	7.1	7.7	6040	26.1	340	2000	92000
08077725	5/30/2007	1100	--	--	0.3	1.7	16	2.6	7.4	6540	26.5	52	1700	41000
08077725	5/31/2007	1010	--	--	0.3	1.4	13	5.8	7.6	6350	27.4	650	1100	58000
08077725	6/19/2007	1153	--	--	0.3	1	15	7	8.8	12500	30.2	20	490	17000
08077725	7/9/2007	1210	--	81	0.3	1	12	3.4	6.9	363	29.1	31	93	7300
08077725	7/25/2007	1125	--	--	0.3	1.3	13	6.7	8	1060	28.7	10	64	9200
08077725	8/9/2007	1023	--	--	0.3	1.3	15	4.6	7.3	582	30.6	41	89	5200
08077730	6/28/2006	1100	--	--	--	--	14	9.5	8.8	11800	28.9	10	--	--
08077730	7/31/2006	1200	--	--	--	--	16	12.7	9.2	3360	32.1	63	--	--
08077730	8/21/2006	1205	--	--	0.3	--	37	4.6	7.7	1180	30.3	210	120	18000
08077730	8/23/2006	1300	0.87	--	0.3	--	15	6.9	8.3	2360	30.4	98	19	61000
08077730	8/25/2006	1345	--	--	0.3	--	30	6.8	8.5	4050	29.4	>24000	--	--
08077730	8/28/2006	1340	0.61	--	0.3	--	13	9.2	8.2	1250	32.6	52	46	2600
08077730	8/30/2006	1249	0.68	--	0.3	--	13	10.5	8.6	1990	31.3	41	24	37000
08077730	9/1/2006	1241	0.79	--	0.3	--	15	9.2	8	1460	29.7	73	200	120000

Appendix 2. Periodically collected water-quality properties and bacteria concentrations at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Transparency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temperature, water, degrees Celsius	*Enterococci*, Defined Substrate Technology, water, most probable number per 100 milliliters	*Escherichia coli*, Defined Substrate Technology, water, most probable number per 100 milliliters	Total coliform, Defined Substrate Technology, water, most probable number per 100 milliliters
08077730	9/25/2006	1440	0.64	--	0.3	0.6	68	0.1	7.1	788	25.5	480	2500	200000
08077730	10/30/2006	1327	0.96	--	0.3	1.18	21	8	7.5	1180	23.6	--	440	14000
08077730	11/27/2006	1352	--	--	0.3	2.1	7	12.6	8.5	15300	21.2	63	1800	110000
08077730	12/20/2006	1310	--	--	0.3	>2.35	5.5	11.7	9	18600	20.3	85	340	10000
08077730	1/24/2007	1458	--	--	0.3	0.9	35	9.7	7.1	3390	9.6	20000	10000	49000
08077730	1/25/2007	1257	--	--	0.3	0.7	69	12.3	8	762	10.4	5800	13000	69000
08077730	1/30/2007	1225	--	--	0.3	1	45	10.7	8.1	1880	12.9	160	610	6900
08077730	2/27/2007	1234	--	--	0.13	1.3	21	12.8	8.6	8870	21.3	<10	31	4400
08077730	3/20/2007	1240	--	--	0.3	1.3	25	15.7	7.4	1460	21.9	30	230	7300
08077730	4/26/2007	1158	--	--	0.3	1.2	21	6.1	7.9	2490	23.2	630	6900	>24000
08077730	5/29/2007	1259	--	--	0.3	1.5	11	7.6	7.9	7040	26.5	16000	9200	160000
08077730	5/30/2007	1116	--	--	0.3	1.8	9.2	5.7	7.5	5580	27.3	20	16000	110000
08077730	5/31/2007	1049	--	--	0.3	1.3	11	5.9	7.5	9290	27.1	130	580	24000
08077730	6/19/2007	1035	--	--	0.3	1.2	12	6.7	8.5	13900	29.5	52	1700	73000
08077730	7/25/2007	1004	--	--	0.3	1.2	16	6.3	8.3	2370	28.2	20	28	5200
08077730	8/9/2007	0934	--	--	0.3	1.2	15	6.3	7.7	1400	30.3	10	28	3300
08077738	6/28/2006	1040	--	--	--	--	24	10	8.7	18700	29.2	20	--	--
08077738	7/11/2006	1000	--	--	--	--	16	6.2	8.1	8400	28.4	31	--	--
08077738	7/31/2006	1008	--	--	--	--	20	4.3	8.3	13700	29.6	130	--	--
08077738	8/21/2006	1038	--	--	0.3	--	18	5.3	8.1	11000	30	120	--	--
08077738	8/23/2006	1121	--	--	0.3	--	20	5.2	8.3	12600	29.7	10	--	--
08077738	8/25/2006	1053	0.58	--	0.3	--	15	7.8	8.4	12200	30.1	10	--	--
08077738	8/28/2006	1115	0.46	--	0.3	--	25	8	8.4	5320	29.7	10	--	--
08077738	8/30/2006	1400	1.26	--	0.3	--	15	8.8	8.8	4550	31.4	20	--	--
08077738	8/30/2006	1105	0.4	--	0.13	--	28	6.7	8.5	10500	29.2	20	--	--
08077738	9/1/2006	1006	0.51	--	0.3	--	13	5.6	8.5	15100	28.5	10	--	--
08077738	9/25/2006	1144	0.46	--	0.3	0.75	44	5.5	7.5	3700	23.3	1300	--	--
08077738	10/4/2006	1001	1.47	--	0.3	0.39	11	5.7	8.2	22000	26.5	31	--	--
08077738	10/30/2006	1041	0.7	--	0.3	1.2	18	7.6	7.7	8140	21.1	41	--	--
08077738	11/27/2006	1120	--	--	0.3	2.1	6.8	9.9	8.2	27200	21	41	--	--
08077738	12/20/2006	1124	--	--	0.3	>1.80	4.8	7.1	8.4	28700	19.3	20	--	--
08077738	10/30/2006	1042	--	--	--	--	--	--	--	--	--	--	--	--
08077738	1/25/2007	1055	--	--	0.11	0.65	43	12.4	7.4	3040	10	4400	--	--
08077738	1/30/2007	1033	--	--	0.13	1	39	11.4	8.9	6760	12.4	52	--	--

Appendix 2. Periodically collected water-quality properties and bacteria concentrations at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Transparency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temperature, water, degrees Celsius	*Enterococci*, Defined Substrate Technology, water, most probable number per 100 milliliters	*Escherichia coli*, Defined Substrate Technology, water, most probable number per 100 milliliters	Total coliform, Defined Substrate Technology, water, most probable number per 100 milliliters
08077738	2/27/2007	1012	--	--	0.1	--	18	10.1	8.7	14000	19.8	<10	--	--
08077738	3/20/2007	1005	--	--	0.3	1	30	4.6	7.7	5740	20.4	20	--	--
08077738	3/27/2007	0938	--	-188	0.3	1.35	16	7.5	8	6990	22.7	10	--	--
08077738	4/26/2007	0926	--	--	0.3	1	15	6.1	7.9	5660	22.2	1300	--	--
08077738	5/9/2007	1114	--	--	0.3	1.3	16	10.2	8.2	12100	27.1	41	--	--
08077738	5/29/2007	1020	--	--	0.3	1.5	9.8	5.9	7.6	21100	25.2	63	--	--
08077738	5/30/2007	1022	--	--	0.3	1.3	17	3.8	7.3	20800	26.1	140	--	--
08077738	5/31/2007	1150	--	--	0.3	1.35	15	5.5	7.5	18900	27	20	--	--
08077738	6/19/2007	1138	--	--	0.3	0.9	29	4.9	8	25100	29.3	20	--	--
08077738	7/9/2007	1130	--	210	0.3	1.2	22	5.5	7.6	2700	29.3	10	--	--
08077738	7/25/2007	1110	--	--	0.3	1.2	16	4.6	8.3	10500	28.4	85	--	--
08077738	8/9/2007	1008	--	--	0.3	1	25	20.2	7.1	6900	29.9	130	--	--
08077745	6/28/2006	0945	--	--	--	--	41	7.1	8.3	28000	28.3	31	--	--
08077745	7/31/2006	0945	--	--	--	--	23	5.7	8.2	20600	29.6	10	--	--
08077745	8/21/2006	1010	--	--	0.3	--	18	8.2	8.3	16300	30.6	110	--	--
08077745	8/23/2006	1045	2.01	--	0.3	--	22	5.3	8.2	19300	30	40	--	--
08077745	8/25/2006	1022	2.01	--	0.3	--	19	7	8.4	28300	29.9	10	--	--
08077745	8/28/2006	1033	1.74	--	0.3	--	18	7.6	8.4	11000	29.2	20	--	--
08077745	8/30/2006	1032	1.45	--	0.3	--	20	6.6	8.3	17400	29.3	10	--	--
08077745	9/1/2006	0936	1.54	--	0.3	--	13	5.7	8.3	21100	28.4	30	--	--
08077745	9/25/2006	1110	1.81	--	0.3	0.7	35	7.8	7.9	8250	22.4	1500	--	--
08077745	10/30/2006	1018	1.65	--	0.3	1.58	15	7.3	7.8	13500	21	52	--	--
08077745	11/27/2006	1038	--	--	0.3	2.6	7.3	11.3	8	29600	20.9	41	--	--
08077745	12/20/2006	1041	0.3	--	--	2.1	10	7	8.1	33700	19	31	--	--
08077745	1/24/2007	1139	--	--	1	2.8	6.5	10.7	7.8	15700	8.5	130	--	--
08077745	1/25/2007	1027	--	--	0.3	1.2	21	11.4	7.2	7620	9	5500	--	--
08077745	1/30/2007	1002	--	--	0.3	1.5	21	11.5	9	12500	11.8	86	--	--
08077745	2/27/2007	0954	--	--	0.3	1.4	17	9	8.5	18600	19.8	31	--	--
08077745	3/20/2007	0925	--	--	0.3	1.5	20	5	8.1	9820	20.6	41	--	--
08077745	4/26/2007	1043	--	--	0.3	1.5	18	7.3	7.9	12900	22.7	370	--	--
08077745	5/29/2007	0951	--	--	0.3	1.3	14	5.7	7.7	20500	26.4	31	--	--
08077745	5/30/2007	1000	--	--	0.3	1.6	13	4	7.5	24100	26.7	<10	--	--
08077745	5/31/2007	1130	--	--	0.3	1.6	12	4.9	7.7	23500	27.9	<10	--	--
08077745	6/19/2007	1119	--	--	0.3	1.1	21	5.5	7.9	27200	29.2	<10	--	--

Appendix 2. Periodically collected water-quality properties and bacteria concentrations at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Depth to bottom from water surface, at sampling location, meters	Discharge, instantaneous, cubic feet per second	Sampling depth, meters	Transparency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temperature, water, degrees Celsius	*Enterococci*, Defined Substrate Technology, water, most probable number per 100 milliliters	*Escherichia coli*, Defined Substrate Technology, water, most probable number per 100 milliliters	Total coliform, Defined Substrate Technology, water, most probable number per 100 milliliters
08077745	7/25/2007	1051	--	--	0.08	--	12	6.2	8.2	13800	29.7	10	--	--
08077745	8/9/2007	0958	--	--	0.06	--	9	6.5	7.7	10700	30.8	<10	--	--
08077780	6/28/2006	1145	--	--	--	--	63	4.9	7.9	37400	29.2	31	--	--
08077780	7/10/2006	1000	--	-378	--	--	25	4.9	7.6	24300	28.8	63	--	--
08077780	7/31/2006	0925	--	--	--	--	20	3.7	7.8	28300	29.7	31	--	--
08077780	8/21/2006	0952	--	--	0.3	--	22	4.6	8.2	30300	30.4	130	--	--
08077780	8/23/2006	1024	2.22	--	0.3	--	22	3.7	8	29400	29.8	10	--	--
08077780	8/25/2006	0958	2.22	--	0.3	--	20	4.5	8	31100	29.6	10	--	--
08077780	8/28/2006	1002	2.38	--	0.3	--	19	4.7	7.8	25600	29.8	20	--	--
08077780	8/30/2006	1250	1.84	--	0.3	--	--	5.2	8.2	24400	30	20	--	--
08077780	8/30/2006	1002	2.16	--	0.3	--	15	5.4	8.1	27300	29.7	41	--	--
08077780	9/1/2006	0915	2.27	--	0.3	--	9.8	6	8.2	31700	28.9	10	--	--
08077780	9/25/2006	1036	0.23	--	0.3	--	24	7.3	7.8	21300	23.1	370	--	--
08077780	10/4/2006	1158	2.11	--	0.3	0.89	14	5.7	7.8	38000	27.8	41	--	--
08077780	10/30/2006	0948	2.41	--	0.3	1.74	12	6.9	7.7	19100	20.9	74	--	--
08077780	11/27/2006	1011	--	--	0.3	2.85	6.2	6.8	7.8	33400	20.9	10	--	--
08077780	12/20/2006	1008	--	--	0.3	2.5	9.5	7	7.8	35900	18.9	110	--	--
08077780	1/24/2007	1103	--	--	0.3	--	4.8	10.6	7.5	26700	8.5	310	--	--
08077780	1/25/2007	0958	--	--	0.3	1.4	19	7.5	6.4	9980	8.6	5200	--	--
08077780	1/30/2007	0919	--	--	0.3	4.4	26	10.7	8.5	16600	11.7	31	--	--
08077780	2/27/2007	0930	--	--	0.3	2.6	8.7	8.5	8	23000	18.7	30	--	--
08077780	3/20/2007	0830	--	--	0.3	1.4	12	3.7	7.7	17700	20.6	10	--	--
08077780	3/26/2007	0952	--	-561	0.3	1.51	12	7.4	7.9	14500	22.4	62	--	--
08077780	4/26/2007	0913	--	--	0.3	1.6	12	6.8	7.8	16400	22	160	--	--
08077780	5/9/2007	1241	--	--	0.3	1.65	16	5.9	7.5	26700	27	31	--	--
08077780	5/29/2007	0917	--	--	0.3	1.74	14	3.8	7.6	29200	24.4	86	--	--
08077780	5/30/2007	0926	--	--	0.3	2.1	15	3.2	7.6	28900	26.7	10	--	--
08077780	5/31/2007	1102	--	--	0.3	1.5	15	3.2	7.5	28800	27.2	10	--	--
08077780	6/19/2007	1055	--	--	0.3	1.2	27	4.8	7.7	31300	28.8	52	--	--
08077780	7/9/2007	1320	--	--	0.3	1.69	22	7.3	7.5	14900	30.2	10	--	--
08077780	7/25/2007	1027	--	--	0.3	1.2	19	3.8	7.7	20600	28.9	20	--	--
08077780	8/9/2007	0950	--	--	0.3	1.3	20	4.4	7.6	18300	30.3	10	--	--
08077780	8/13/2007	1103	--	-381	0.3	1.28	19	3.8	7.7	22700	31.6	20	--	--

Appendix 3. Quality control data associated with periodically collected water-quality and bacteria samples at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[USGS, U.S. Geological Survey; --, no data; <, nondetection less than laboratory reporting level; E, estimated]

USGS site (reach) number (fig. 1)	Date	Sample start time	Sampling depth, meters	Transparency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temperature, water, degrees Celsius	Alkalinity, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter as calcium carbonate	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter	Chloride, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Residue on evaporation, dried at 180 degrees Celsius, water, filtered, milligrams per liter
08077700	8/30/2006	1121	--	--	--	--	--	--	--	--	--	--	--	--
08077700	9/1/2006	1035	0.3	--	--	--	--	--	--	--	--	--	--	--
08077700	9/1/2006	1029	--	--	--	--	--	--	--	--	--	--	--	--
08077700	8/25/2006	1113	--	--	--	--	--	--	--	--	--	--	--	--
08077700	1/25/2007	1117	--	1.1	38	10.6	6.6	356	9.2	--	--	--	--	--
08077700	1/30/2007	1048	--	--	--	--	--	--	--	--	--	--	--	--
08077700	7/10/2007	1006	0.3	2	9.9	1.9	7	273	28.8	69	84	29.4	9.2	149
08077705	9/1/2006	1058	0.3	--	--	--	--	--	--	--	--	--	--	--
08077705	8/21/2006	1101	--	--	--	--	--	--	--	--	--	--	--	--
08077705	8/28/2006	1201	0.3	--	--	--	--	--	--	--	--	--	--	--
08077710	8/21/2006	1118	0.3	--	--	--	--	--	--	--	--	--	--	--
08077710	9/1/2006	1114	--	--	--	--	--	--	--	--	--	--	--	--
08077710	8/28/2006	1215	--	--	--	--	--	--	--	--	--	--	--	--
08077710	10/30/2006	1154	--	--	--	--	--	--	--	--	--	--	--	--
08077710	1/30/2007	1121	--	--	--	--	--	--	--	--	--	--	--	--
08077715	8/21/2006	1136	0.1	--	--	--	--	--	--	--	--	--	--	--
08077715	8/25/2006	1235	0.3	--	--	--	--	--	--	--	--	--	--	--
08077715	2/27/2007	1141	--	--	--	--	--	--	--	--	--	--	--	--
08077720	6/28/2006	1450	--	--	--	4.4	8.1	9840	28.7	--	--	--	--	--
08077720	7/31/2006	1110	--	--	8.2	7.2	8.1	1320	30.7	--	--	--	--	--
08077720	8/23/2006	1210	--	--	12	6.2	7.7	538	29.5	--	--	--	--	--
08077720	8/31/2006	1031	0.3	0.63	10	5.1	7.7	1070	28.6	215	260	186	35.5	593
08077720	8/30/2006	1207	0.3	--	16	5.7	7.7	877	29.3	--	--	--	--	--
08077720	7/31/2006	1111	0.3	--	--	--	--	--	--	--	--	--	--	--
08077720	10/30/2006	1213	--	1.5	13	7.4	7.3	364	21.6	--	--	--	--	--
08077720	1/24/2007	1346	0.3	0.7	38	10.3	7	239	9.7	--	--	--	--	--

Appendix 3. Quality control data associated with periodically collected water-quality and bacteria samples at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Residue, total nonfilterable, milligrams per liter	Ammonia plus organic nitrogen, water, unfiltered, milligrams per liter as nitrogen	Ammonia, water, unfiltered, milligrams per liter as NH4	Ammonia, water, unfiltered, milligrams per liter as nitrogen	Nitrate plus nitrite, water, filtered, milligrams per liter as nitrogen	Nitrate, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter as nitrogen	Nitrite, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Organic nitrogen, water, unfiltered, milligrams per liter	Total nitrogen, water, unfiltered, milligrams per liter	Ortho-phosphate, water, filtered, milligrams per liter	Orthophos-phate, water, filtered, milligrams per liter as phos-phorus
08077700	8/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	9/1/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	9/1/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	8/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	1/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	1/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077700	7/10/2007	<20	0.84	0.25	0.19	0.021	0.067	0.02	0.019	0.006	0.65	0.86	0.179	0.058
08077705	9/1/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077705	8/21/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077705	8/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077710	8/21/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077710	9/1/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077710	8/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077710	10/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077710	1/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077715	8/21/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077715	8/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077715	2/27/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	6/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	7/31/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	8/23/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	8/31/2006	<20	0.66	--	E.06	0.02	0.072	0.02	0.012	0.004	--	0.68	0.101	0.033
08077720	8/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	7/31/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	10/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077720	1/24/2007	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 3. Quality control data associated with periodically collected water-quality and bacteria samples at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Phosphorus, water, unfiltered, milligrams per liter	Organic carbon, water, unfiltered, milligrams per liter	Biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Carbonaceous biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	*Enterococci*, Defined Substrate Technology, water, most probable number per 100 milliliters	*Escherichia coli*, Defined Substrate Technology, water, most probable number per 100 milliliters	Total coliform, Defined Substrate Technology, water, most probable number per 100 milliliters	Chlorophyll-*a*, phytoplankton, chromatographic-fluorometric method, micrograms per liter	Pheophytin-*a*, phytoplankton, micrograms per liter	Suspended sediment concentration, milligrams per liter	Sample type
08077700	8/30/2006	--	--	--	--	--	<1	<1	--	--	--	Laboratory blank
08077700	9/1/2006	--	--	--	--	--	370	7100	--	--	--	Split replicate
08077700	9/1/2006	--	--	--	--	--	<1	<1	--	--	--	Laboratory blank
08077700	8/25/2006	--	--	--	--	<1	--	--	--	--	--	Laboratory blank
08077700	1/25/2007	--	--	--	--	8700	--	--	--	--	--	Split replicate
08077700	1/30/2007	--	--	--	--	340	9100	37000	--	--	--	Split replicate
08077700	7/10/2007	0.1	11.8	1.1	1.1	160	510	11000	--	--	14	Split replicate
08077705	9/1/2006	--	--	--	--	31	--	--	--	--	--	Split replicate
08077705	8/21/2006	--	--	--	--	--	--	<1	--	--	--	Laboratory blank
08077705	8/28/2006	--	--	--	--	120	--	--	--	--	--	Split replicate
08077710	8/21/2006	--	--	--	--	260	--	--	--	--	--	Split replicate
08077710	9/1/2006	--	--	--	--	<1	--	--	--	--	--	Laboratory blank
08077710	8/28/2006	--	--	--	--	<1	--	--	--	--	--	Laboratory blank
08077710	10/30/2006	--	--	--	--	--	--	52	--	--	--	Split replicate
08077710	1/30/2007	--	--	--	--	160	--	--	--	--	--	Split replicate
08077715	8/21/2006	--	--	--	--	--	610	55000	--	--	--	Split replicate
08077715	8/25/2006	--	--	--	--	--	93	37000	--	--	--	Split replicate
08077715	2/27/2007	--	--	--	--	--	42	26000	--	--	--	Split replicate
08077720	6/28/2006	--	--	--	--	20	54	17000	--	--	--	Split replicate
08077720	7/31/2006	--	--	--	--	0	--	--	--	--	--	Split replicate
08077720	8/23/2006	--	--	--	--	--	--	<1	--	--	--	Laboratory blank
08077720	8/31/2006	0.07	--	<2.0	<2.0	--	--	--	4	1.5	1	Split replicate
08077720	8/30/2006	--	--	--	--	--	68	15000	--	--	--	Split replicate
08077720	7/31/2006	--	--	--	--	--	--	--	--	--	--	Split replicate
08077720	10/30/2006	--	--	--	--	--	180	23000	--	--	--	Split replicate
08077720	1/24/2007	--	--	--	--	--	15000	92000	--	--	--	Split replicate

Appendix 3. Quality control data associated with periodically collected water-quality and bacteria samples at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Sample start time	Sampling depth, meters	Transparency, water, in situ, Secchi disc, meters	Turbidity, water, unfiltered, monochrome near infrared LED light, 780-900 nanometers, detection angle 90 ±2.5 degrees, formazin nephelometric units (FNU)	Dissolved oxygen, water, unfiltered, milligrams per liter	pH, water, unfiltered, field, standard units	Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	Temperature, water, degrees Celsius	Alkalinity, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter as calcium carbonate	Bicarbonate, water, filtered, inflection-point titration method (incremental titration method), field, milligrams per liter	Chloride, water, filtered, milligrams per liter	Sulfate, water, filtered, milligrams per liter	Residue on evaporation, dried at 180 degrees Celsius, water, filtered, milligrams per liter
08077720	1/30/2007	1214	--	1.3	30	9.1	7.9	676	12.9	--	--	--	--	--
08077725	7/31/2006	1145	--	--	11	9.9	8.9	2780	32.5	--	--	--	--	--
08077725	8/23/2006	1241	0.3	--	13	4.9	7.9	1880	30.4	--	--	--	--	--
08077725	8/30/2006	1235	0.3	--	9.7	7.9	8.2	1630	30.9	--	--	--	--	--
08077725	8/25/2006	1310	--	--	--	--	--	--	--	--	--	--	--	--
08077725	9/25/2006	1416	--	0.65	45	0.3	7.1	602	25.3	--	--	--	--	--
08077725	3/20/2007	1139	0.3	1.1	26	15.4	7.1	833	21.4	--	--	--	--	--
08077725	5/9/2007	1038	0.3	1.71	8.4	4.7	7.8	4980	26.7	203	244	1290	186	2570
08077730	6/28/2006	1100	--	--	--	9.5	8.8	11800	28.9	--	--	--	--	--
08077730	8/23/2006	1301	0.3	--	--	--	--	--	--	--	--	--	--	--
08077730	8/30/2006	1244	--	--	--	--	--	--	--	--	--	--	--	--
08077730	9/25/2006	1441	--	--	--	--	--	--	--	--	--	--	--	--
08077730	1/25/2007	1258	--	--	--	--	--	--	--	--	--	--	--	--
08077730	2/27/2007	1235	--	--	--	--	--	--	--	--	--	--	--	--
08077738	7/11/2006	1001	--	--	16	6.2	8.1	8400	28.4	83	99	2220	305	4330
08077738	6/28/2006	1040	--	--	--	10	8.7	18700	29.2	--	--	--	--	--
08077738	7/31/2006	1008	--	--	20	4.3	8.3	13700	29.6	--	--	--	--	--
08077738	8/25/2006	1054	0.3	--	15	7.8	8.4	12200	30.1	--	--	--	--	--
08077738	8/28/2006	1116	0.3	--	25	8	8.4	5320	29.7	--	--	--	--	--
08077745	8/23/2006	1040	--	--	--	--	--	--	--	--	--	--	--	--
08077745	1/24/2007	1139	0.3	--	--	--	--	--	--	--	--	--	--	--
08077780	8/21/2006	0953	0.3	--	22	4.6	8.2	30300	30.4	--	--	--	--	--
08077780	3/26/2007	0953	0.3	1.51	12	7.4	7.9	14500	22.4	113	137	4960	682	9170
08077780	8/13/2007	1104	0.3	1.28	19	3.8	7.7	22700	31.6	109	132	7460	942	14600

Appendix 3. Quality control data associated with periodically collected water-quality and bacteria samples at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Residue, total nonfilterable, milligrams per liter	Ammonia plus organic nitrogen, water, unfiltered, milligrams per liter as nitrogen	Ammonia, water, unfiltered, milligrams per liter as NH4	Ammonia, water, unfiltered, milligrams per liter as nitrogen	Nitrate plus nitrite, water, filtered, milligrams per liter as nitrogen	Nitrate, water, filtered, milligrams per liter	Nitrate, water, filtered, milligrams per liter as nitrogen	Nitrite, water, filtered, milligrams per liter	Nitrite, water, filtered, milligrams per liter as nitrogen	Organic nitrogen, water, unfiltered, milligrams per liter	Total nitrogen, water, unfiltered, milligrams per liter	Ortho-phosphate, water, filtered, milligrams per liter	Orthophos-phate, water, filtered, milligrams per liter as phos-phorus
08077720	1/30/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	7/31/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	8/23/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	8/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	8/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	9/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	3/20/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077725	5/9/2007	12	1.1	0.07	0.06	0.046	0.179	0.04	0.018	0.006	1	1.1	--	E.004
08077730	6/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077730	8/23/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077730	8/30/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077730	9/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077730	1/25/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077730	2/27/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	7/11/2006	<17	1.2	--	E.03	<.016	--	--	--	E.002	--	--	0.025	0.008
08077738	6/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	7/31/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	8/25/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	8/28/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077745	8/23/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077745	1/24/2007	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	8/21/2006	--	--	--	--	--	--	--	--	--	--	--	--	--
08077780	3/26/2007	44	0.68	--	E.02	<.016	--	--	0.008	0.002	--	--	--	<.006
08077780	8/13/2007	43	0.76	0.16	0.12	0.037	0.14	0.03	0.017	0.005	0.64	0.8	0.221	0.072

Appendix 3. Quality control data associated with periodically collected water-quality and bacteria samples at 10 sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Date	Phosphorus, water, unfiltered, milligrams per liter	Organic carbon, water, unfiltered, milligrams per liter	Biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	Carbonaceous biochemical oxygen demand, water, unfiltered, 5 days at 20 degrees Celsius, milligrams per liter	*Enterococci*, Defined Substrate Technology, water, most probable number per 100 milliliters	*Escherichia coli*, Defined Substrate Technology, water, most probable number per 100 milliliters	Total coliform, Defined Substrate Technology, water, most probable number per 100 milliliters	Chlorophyll-*a*, phytoplankton, chromatographic-fluorometric method, micrograms per liter	Pheophytin-*a*, phytoplankton, micrograms per liter	Suspended sediment concentration, milligrams per liter	Sample type
08077720	1/30/2007	--	--	--	--	--	600	12000	--	--	--	Split replicate
08077725	7/31/2006	--	--	--	--	--	0	0	--	--	--	Split replicate
08077725	8/23/2006	--	--	--	--	41	--	--	--	--	--	Split replicate
08077725	8/30/2006	--	--	--	--	30	--	--	--	--	--	Split replicate
08077725	8/25/2006	--	--	--	--	--	<1	<1	--	--	--	Laboratory blank
08077725	9/25/2006	--	--	--	--	350	--	--	--	--	--	Split replicate
08077725	3/20/2007	--	--	--	--	--	390	5200	--	--	--	Split replicate
08077725	5/9/2007	0.07	11	3.1	3.1	20	74	16000	27.7	8.9	8	Split replicate
08077730	6/28/2006	--	--	--	--	0	--	--	--	--	--	Split replicate
08077730	8/23/2006	--	--	--	--	--	--	77000	--	--	--	Split replicate
08077730	8/30/2006	--	--	--	--	<1	--	--	--	--	--	Laboratory blank
08077730	9/25/2006	--	--	--	--	--	3300	160000	--	--	--	Split replicate
08077730	1/25/2007	--	--	--	--	--	8600	49000	--	--	--	Split replicate
08077730	2/27/2007	--	--	--	--	<10	--	--	--	--	--	Split replicate
08077738	7/11/2006	0.12	--	4.2	3.1	63	--	--	30.1	6.1	10	Split replicate
08077738	6/28/2006	--	--	--	--	10	--	--	--	--	--	Split replicate
08077738	7/31/2006	--	--	--	--	170	--	--	--	--	--	Split replicate
08077738	8/25/2006	--	--	--	--	10	--	--	--	--	--	Split replicate
08077738	8/28/2006	--	--	--	--	--	--	--	--	--	--	Split replicate
08077745	8/23/2006	--	--	--	--	<1	--	--	--	--	--	Laboratory blank
08077745	1/24/2007	--	--	--	--	130	--	--	--	--	--	Split replicate
08077780	8/21/2006	--	--	--	--	--	--	--	--	--	--	Split replicate
08077780	3/26/2007	0.04	--	2.3	1.7	20	--	--	14.1	0.5	25	Split replicate
08077780	8/13/2007	0.13	7.8	1.7	1.3	<10	--	--	9.8	2.4	28	Split replicate

Appendix 4. Stream-habitat data for representative reach at each of five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[USGS, U.S. Geological Survey; Land development index: 1=unimpacted, 2=low; Aesthetic index: 3=common; Channel flow status: 3=moderate, 4=high; n/a, not applicable: >, greater than]

Metric	USGS site (reach) number (fig. 1)														
	08077700			08077720			08077725			08077738			08077780		
	Aug. 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	Aug. 2007	July 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	Aug. 2007
Stream slope	0.557	0.557	0.557	0.69	0.69	0.69	0.678	0.678	0.678	0.76	0.76	0.76	0.278	0.278	0.278
Drainage area above location	12	12	12	2.74	2.74	2.74	23.9	23.9	23.9	28.4	28.4	28.4	32.8	32.8	32.8
Land development index	2	2	2	1	1	1	2	2	2	2	2	2	2	2	2
Ecoregion	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
Stream order	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1
Number of transects	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Length of segment evaluated (kilometers)	0.49	0.49	0.49	0.22	0.22	0.22	0.47	0.47	0.47	0.54	0.54	0.54	0.64	0.64	0.64
Aesthetic index	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Total number of stream bends	3	3	3	3	3	3	3	3	3	1	1	1	0	0	0
Well defined stream bends	2	2	2	0	0	0	0	0	0	1	1	1	0	0	0
Moderately defined stream bends	1	1	1	2	2	2	1	1	1	0	0	0	0	0	0
Poorly defined stream bends	0	0	0	1	1	1	2	2	2	0	0	0	0	0	0
Channel flow status	4	4	4	3	3	3	4	4	4	4	4	4	3	3	3
Number of riffles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Estimated flow (cubic feet per second)	5.3	[1]29	[1]5.8	2.89	1.52	[1]0.21	[1]33.5	[1]83.6	81.1	n/a	[1]188	210	[1]561	[1]378	[1]381
Mean stream width (feet)	49.6	47.8	46	31	33	34	96	83	83	336	336	320	231	331	285
Mean stream depth (feet)	3.84	3.35	3.82	2.9	1.74	2.71	6.42	6.99	7.06	n/a	3.75	3.85	2.87	2.91	3.08
Maximum pool width (feet)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Maximum pool depth (feet)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Mean bank slope (degrees)	18.6	61.9	18.6	55.5	54.5	52.2	46.8	46.1	46.6	10.5	10.1	10.1	13.4	12.7	11
Mean percent bank erosion	8	23.5	8	24	28.5	28	14.5	16	18	n/a	n/a	n/a	12	12	12
Mean percent tree canopy	9.8	10.4	9.8	94.8	76.4	83.2	0	0	0	0	0	0	0	0	0
Mean percent substrate gravel >2 millimeters	0	0	0	0	5	4	3	3	3	0	0	4	2	2	0
Mean width natural buffer vegetation (feet)	131.5	141.5	131.5	144.1	164	161.5	106.6	108.8	108.8	254.5	254.5	281.5	51.1	53.8	48.7
Mean percent instream cover	9	9	9	11	10	11	8	7	7	0	0	1	0	0	0
Number of instream cover types	5	5	3	5	5	4	7	7	7	1	1	1	4	4	4
Dominant substrate	2	1	2	1	1	1	2	2	2	8	8	2	2	2	2
Riparian vegetation (percent trees)	16	12	16	24.5	25	19	4.5	5	5	0.2	0.2	0.2	0	1	1
Riparian vegetation (percent shrubs)	36	34	36	20	13	15	25	18	18	77.5	77.5	60.5	7.5	8.5	8.5
Riparian vegetation (percent grasses, forbs)	47	46.5	47	22.5	28.5	34	56	60.5	60.5	22.3	22.3	39.3	92.5	90.5	90.5
Riparian vegetation (percent cultivated, fields)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Riparian vegetation (percent other)	1	7.5	1	0	0	32	14.5	18.5	18.5	0	0	0	0	0	0

[1] Possibly affected by changing tide.

Appendix 5. Benthic macroinvertabrate taxa (number of individuals) collected from representative reach at each of five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[USGS, U.S. Geological Survey]

Phylum	Class	Order	Family	Genus	Taxon	USGS site (reach) number (fig. 1)															Total
						08077700			08077720			08077725			08077738			08077780			
						Aug. 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	Aug. 2007	July 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	Aug. 2007	
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae		*Enchytraeidae*	--	--	--	1	--	--	--	1	--	--	--	--	--	--	--	2
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae		*Lumbriculidae*	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	1
Annelida	Oligochaeta	Haplotaxida	Naididae		*Naididae*	--	2	--	--	3	5	--	1	--	--	--	--	--	--	--	11
Annelida	Oligochaeta	Haplotaxida	Naididae	Nais	*Nais sp.*	--	--	--	1	--	1	--	--	--	--	--	--	--	--	--	2
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Aulodrilus	*Aulodrilus pigueti*	--	--	--	1	--	2	--	--	--	--	--	--	--	--	--	3
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Dero	*Dero borellii*	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	4
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Dero	*Dero sp.*	--	--	--	--	--	3	--	2	--	--	--	--	--	--	--	5
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Spirosperma	*Spirosperma sp.*	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	1
Annelida	Oligochaeta	Haplotaxida	Tubificidae		*Tubificidae*	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	2
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Tubificidae	*Tubificidae w/ cap setae*	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	1
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Tubificidae	*Tubificidae w/o cap setae*	--	--	1	--	2	10	--	--	1	10	--	3	1	9	2	39
Annelida	Oligochaeta	Haplotaxida	Tubificidae	Tubificoides	*Tubificoides heterochaetus*	--	--	--	--	--	--	--	--	35	--	--	--	--	--	--	35
Annelida	Polychaeta	Canalipalpata	Ampharetidae	Amphicteis	*Amphicteis floridus*	3	41	--	4	63	20	--	200	7	40	1	--	--	6	--	385
Annelida	Polychaeta	Scolecida	Capitellidae	Capitella	*Capitella sp.*	--	--	--	--	--	1	--	--	--	--	--	--	--	--	1	2
Annelida	Polychaeta	Aciculata	Nereididae		*Nereididae*	--	--	--	30	--	--	1	--	1	22	--	--	1	--	--	55
Annelida	Polychaeta	Aciculata	Nereididae	Steninonereis	*Steninonereis martini*	--	--	--	--	16	1	--	--	--	--	--	1	--	4	2	24
Annelida	Polychaeta		Orbiniidae	Leitoscoloplos	*Leitoscoloplos sp.*	--	--	--	--	--	--	--	--	--	--	--	--	--	25	--	25
Annelida	Polychaeta		Orbiniidae		*Orbiniidae*	--	--	--	--	--	--	--	--	--	--	--	--	34	--	--	34
Annelida	Polychaeta	Canalipalpata	Spiondae	Polydora	*Polydora cornuta*	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	4
Annelida	Polychaeta	Canalipalpata	Spiondae		*Spionidae*	--	2	--	--	4	--	--	37	1	--	3	3	2	19	--	71
Annelida	Polychaeta	Canalipalpata	Spiondae	Streblospio	*Streblospio benedicti*	--	26	--	--	49	6	--	236	33	--	50	2	--	106	1	509
Annelida	Polychaeta				*Polychaeta*	--	--	--	1	--	6	16	12	--	9	--	--	21	16	--	81
Arthropoda	Arachnida	Trombidoformes	Arrenuridae	Arrenurus	*Arrenurus sp*	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	1
Arthropoda	Arachnida	Sarcoptiformes			*Oribatida*	3	4	--	--	--	--	2	--	1	1	--	--	1	--	--	12
Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis	*Caenis latipennis*	--	--	--	--	--	60	--	--	--	--	--	--	--	--	--	60
Arthropoda	Insecta	Ephemeroptera	Caenidae	Caenis	*Caenis sp.*	--	1	--	1	13	--	--	--	--	--	--	--	--	--	--	15
Arthropoda	Insecta	Diptera	Ceratopogonidae	Bezzia/Palpomyia	*Bezzia/Palpomyia sp.*	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	2
Arthropoda	Insecta	Diptera	Ceratopogonidae		*Ceratopogonidae*	--	1	--	--	7	41	--	--	1	--	--	--	--	--	--	50
Arthropoda	Insecta	Diptera	Chaoboridae	Chaoborus	*Chaoborus sp.*	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	1
Arthropoda	Insecta	Diptera	Chironomidae	Ablabesmyia	*Ablabesmyia mallochi*	--	--	--	--	10	--	--	--	--	--	--	--	--	--	--	10
Arthropoda	Insecta	Diptera	Chironomidae		*Chironomini*	1	4	--	--	1	--	--	1	--	--	--	--	--	--	--	7
Arthropoda	Insecta	Diptera	Chironomidae	Chironomus	*Chironomus sp.*	--	503	5	--	125	--	--	263	--	1	599	--	--	23	--	1,519
Arthropoda	Insecta	Diptera	Chironomidae	Cladotanytarsus	*Cladotanytarsus sp.*	--	1	--	10	43	9	--	2	--	--	--	--	--	--	--	65

Appendix 5. Benthic macroinvertabrate taxa (number of individuals) collected from representative reach at each of five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

Phylum	Class	Order	Family	Genus	Taxon	USGS site (reach) number (fig. 1)															Total
						08077700			08077720			08077725			08077738			08077780			
						Aug. 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	Aug. 2007	July 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	Aug. 2007	
Arthropoda	Insecta	Diptera	Chironomidae	Clinotanypus	*Clinotanypus sp.*	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	1
Arthropoda	Insecta	Diptera	Chironomidae	Cryptochironomus	*Cryptochironomus sp.*	--	2	--	2	3	2	--	1	--	--	--	--	--	--	--	10
Arthropoda	Insecta	Diptera	Chironomidae	Cryptotendipes	*Cryptotendipes sp.*	--	1	--	6	--	--	--	--	--	--	--	--	--	--	--	7
Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes	*Dicrotendipes modestus*	--	28	--	--	41	--	--	--	--	--	--	--	--	--	--	69
Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes	*Dicrotendipes neomodestus*	--	--	--	3	--	--	1	--	--	--	--	--	--	--	--	4
Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes	*Dicrotendipes sp.*	--	8	--	--	9	1	--	--	--	--	--	--	--	--	--	18
Arthropoda	Insecta	Diptera	Chironomidae	Dicrotendipes	*Dicrotendipes tritomus*	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Arthropoda	Insecta	Diptera	Chironomidae	Goeldichironomus	*Goeldichironomus sp.*	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	8
Arthropoda	Insecta	Diptera	Chironomidae	Natarsia	*Natarsia sp.*	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	1
Arthropoda	Insecta	Diptera	Chironomidae	Parachironomus	*Parachironomus sp.*	--	3	6	--	1	--	--	1	--	--	--	--	--	--	--	11
Arthropoda	Insecta	Diptera	Chironomidae	Parakiefferiella	*Parakiefferiella sp.*	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	1
Arthropoda	Insecta	Diptera	Chironomidae		*Pentaneurini*	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	2
Arthropoda	Insecta	Diptera	Chironomidae	Phaenopsectra	*Phaenopsectra sp.*	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	1
Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum	*Polypedilum halterale gr.*	--	11	--	15	1	12	4	18	15	--	--	3	--	--	--	79
Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum	*Polypedilum scalaenum gr.*	1	--	--	2	--	--	--	--	--	--	--	10	--	--	--	13
Arthropoda	Insecta	Diptera	Chironomidae	Polypedilum	*Polypedilum tritum*	--	1	--	--	2	--	--	--	--	--	--	--	--	--	--	3
Arthropoda	Insecta	Diptera	Chironomidae	Procladius	*Procladius sp.*	--	--	--	2	--	--	--	--	--	1	--	--	--	--	--	3
Arthropoda	Insecta	Diptera	Chironomidae	Tanypus	*Tanypus sp.*	--	44	--	1	26	2	--	34	1	3	295	3	6	181	9	605
Arthropoda	Insecta	Diptera	Chironomidae	Tanytarsus	*Tanytarsus sp.*	--	2	--	2	1	3	--	1	--	--	--	--	--	2	--	11
Arthropoda	Insecta	Odonta	Coenagrionidae		*Coenagrionidae*	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	1
Arthropoda	Insecta	Heteroptera	Corixidae		*Corixidae*	--	11	--	--	2	--	--	1	--	--	--	--	--	--	--	14
Arthropoda	Insecta	Odonta	Gomphidae	Aphylla	*Aphylla sp.*	--	1	--	--	--	2	--	--	--	--	--	--	--	--	--	3
Arthropoda	Insecta	Odonta	Gomphidae		*Gomphidae*	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	1
Arthropoda	Insecta	Coleoptera	Hydrophilidae	Berosus	*Berosus sp.*	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	1
Arthropoda	Insecta	Tricoptera	Hydropsychidae		*Hydropsychidae*	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Arthropoda	Insecta	Tricoptera	Hydroptillidae	Hydroptila	*Hydroptila potosina*	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	6
Arthropoda	Insecta	Diptera	Stratiomyidae	Nemotelus	*Nemotelus sp.*	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	1
Arthropoda	Insecta	Diptera	Stratiomyidae		*Stratiomyidae*	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	1
Arthropoda	Malacostraca	Amphipoda	Ampeliscidae	Ampelisca	*Ampelisca sp.*	--	--	--	--	1	--	--	--	--	6	3	--	2	576	2	590
Arthropoda	Malacostraca	Amphipoda	Corophiidae	Apocorophium	*Apocorophium louisianum*	--	--	--	--	--	--	--	44	--	3	5	--	--	55	--	107
Arthropoda	Malacostraca	Amphipoda	Corophiidae		*Corophiidae*	--	--	--	--	--	--	--	--	--	--	--	8	--	--	1	9
Arthropoda	Malacostraca	Amphipoda	Corophiidae	Grandidierella	*Grandidierella bonnieroides*	--	--	--	--	--	--	--	--	--	--	1	16	--	32	--	49
Arthropoda	Malacostraca	Amphipoda	Gammaridae	Mucrogammarus	*Mucrogammarus mucronatus*	--	--	--	--	--	--	--	4	--	--	2	--	--	--	--	6

Appendix 5. Benthic macroinvertabrate taxa (number of individuals) collected from representative reach at each of five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

Phylum	Class	Order	Family	Genus	Taxon	USGS site (reach) number (fig. 1)															Total
						08077700			08077720			08077725			08077738			08077780			
						Aug. 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	Aug. 2007	July 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	July 2007	July 2006	Mar. 2007	Aug. 2007	
Arthropoda	Malacostraca	Amphipoda	Hyalellidae	Hyalella	*Hyalella sp.*	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	2
Arthropoda	Malacostraca	Isopoda	Idoteidae	Edotia	*Edotea montosa*	--	--	--	--	--	--	--	1	--	--	3	--	--	2	--	6
Arthropoda	Malacostraca	Isopoda	Idoteidae	Edotia	*Edotea sp.*	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	2
Arthropoda	Malacostraca	Amphipoda	Leptocheliidae		*Leptocheliidae*	--	--	--	--	--	--	--	3	--	--	--	1	--	--	--	4
Arthropoda	Malacostraca	Tanaidacea	Leptocheliidae		*Leptocheliidae*	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	3
Arthropoda	Malacostraca	Mysida	Mysidae	Americamysis	*Americamysis almyra*	--	--	--	--	--	--	--	--	10	--	--	12	--	--	5	27
Arthropoda	Malacostraca	Mysida	Mysidae		*Mysidae*	--	--	--	--	--	1	--	--	--	--	--	--	--	--	2	3
Arthropoda	Malacostraca	Mysida	Mysidae	Taphromysis	*Taphromysis bowmani*	--	--	3	--	--	1	--	--	--	--	--	--	--	--	--	4
Arthropoda	Malacostraca	Decapoda	Penaeidae		*Penaeidae*	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
Arthropoda	Malacostraca	Amphipoda			*Amphipoda*	--	--	--	--	--	1	--	--	--	8	--	--	1	--	--	10
Arthropoda	Malacostraca	Mysida			*Mysidacea*	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	2
Arthropoda	Malacostraca	Isopoda			*Valvifera*	--	--	--	--	--	--	--	--	--	16	--	--	--	--	--	16
Arthropoda	Ostracoda	Podocopa	Cypridae		*Ostracoda*	--	--	--	3	2	--	--	--	--	--	--	--	--	1	--	6
Mollusca	Bivalvia	Veneroida	Dressenidae	Mytilopsis	*Mytilopsis leucophaeata*	--	--	--	--	139	--	--	--	--	--	--	--	--	--	--	139
Mollusca	Bivalvia	Veneroida	Mactridae	Mulinia	*Mulinia lateralis*	--	--	--	--	20	2	--	54	12	--	4	--	--	1	--	93
Mollusca	Bivalvia				*Bivalvia*	--	1	--	--	--	--	1	--	--	2	--	--	--	--	--	4
Mollusca	Bivalvia	Veneroida			*Dreissenoidea*	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	1
Mollusca	Gastropoda	Basommatophera	Physidae	Physa	*Physa sp.*	--	3	--	--	1	--	--	1	--	--	--	--	--	1	--	6
Mollusca	Gastropoda				*Gastropoda*	--	--	--	1	--	--	--	--	--	--	--	5	--	--	--	6
Nematoda					*Nematoda*	--	1	--	1	1	1	--	--	--	--	--	--	1	--	--	5
Nemertea					*Nemertea*	--	--	--	--	--	--	--	6	3	56	2	2	25	6	7	107
Protozoa	Granuloreticulose	Foraminiferida			*Foraminiferida*	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	3
					Total	9	703	16	95	598	201	25	928	123	190	968	73	95	1,069	33	5,126

Appendix 6. Fish taxa (number of individuals) collected from representative reach at each of five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07.

[E, electrofishing; S, seining; ∑, total (E+S); Trophic group: IF=invertivore, O=omnivore, P=piscivore; N/A, not available; Tolerance: T=tolerant, I=intolerant, species without tolerance designation considered intermediate]

USGS site (reach) number (fig. 1)	Common name[1]	Scientific name[1]	Trophic group[1]	Tolerance[1]	Number of specimens collected														
					July 2006			August 2006			March 2007			July 2007			August 2007		
					E	S	Σ	E	S	Σ	E	S	Σ	E	S	Σ	E	S	Σ
08077700	Bay anchovy	*Anchoa mitchilli*	IF		--	--	--	--	--	--	2	--	2	--	--	--	--	--	--
08077700	Gulf menhaden	*Brevoortia patronus*	O		--	--	--	114	--	114	484	--	484	719	--	719	--	--	--
08077700	Sheepshead minnow	*Cyprinodon variegatus*	O	T	--	--	--	--	--	--	1	--	1	--	--	--	--	--	--
08077700	Gizzard shad	*Dorosoma cepedianum*	O	T	--	--	--	1	--	1	--	--	--	--	--	--	--	--	--
08077700	Western mosquitofish	*Gambusi affinis*	IF	T	--	--	--	--	--	--	2	--	2	--	--	--	--	--	--
08077700	Pinfish	*Lagodon rhomboides*	O		--	--	--	2	--	2	--	--	--	--	--	--	--	--	--
08077700	Spot	*Leiostomus xanthurus*	O		--	--	--	--	--	--	67	--	67	--	--	--	--	--	--
08077700	Spotted gar	*Lepisosteus oculatus*	P	T	--	--	--	1	--	1	3	--	3	5	--	5	--	--	--
08077700	Green sunfish	*Lepomis cyanellus*	P	T	--	--	--	--	--	--	2	--	2	1	--	1	--	--	--
08077700	Warmouth	*Lepomis gulosus*	P	T	--	--	--	--	--	--	4	--	4	11	--	11	--	--	--
08077700	Bluegill	*Lepomis macrochirus*	IF	T	--	--	--	--	--	--	21	--	21	27	--	27	--	--	--
08077700	Longear sunfish	*Lepomis megalotis*	IF		--	--	--	--	--	--	2	--	2	4	--	4	--	--	--
08077700	Redear sunfish	*Lepomis microlophus*	IF		--	--	--	--	--	--	1	--	1	2	--	2	--	--	--
08077700	Inland silverside	*Menidia beryllina*	IF		--	--	--	--	--	--	17	--	17	--	--	--	--	--	--
08077700	Largemouth bass	*Micropterus salmoides*	P		--	--	--	--	--	--	3	--	3	13	--	13	--	--	--
08077700	Striped mullet	*Mugil cephalus*	O		--	--	--	31	--	31	55	--	55	49	--	49	--	--	--
08077700	Sailfin molly	*Poecilia latipinna*	O	T	--	--	--	1	--	1	2	--	2	1	--	1	--	--	--
08077700	White crappie	*Pomoxis annularis*	P		--	--	--	--	--	--	--	--	--	1	--	1	--	--	--
08077720	Yellow bullhead	*Ameiurus natalis*	O		2	--	2	--	--	--	--	--	--	--	--	--	--	--	--
08077720	Bay anchovy	*Anchoa mitchilli*	IF		--	24	24	--	--	--	--	3	3	--	--	--	--	12	12
08077720	Gulf menhaden	*Brevoortia patronus*	O		133	62	195	--	--	--	8	277	285	--	--	--	--	--	--
08077720	Sheepshead minnow	*Cyprinodon variegatus*	O	T	3	--	3	--	--	--	--	--	--	--	--	--	--	--	--
08077720	Golden topminnow	*Fundulus chrysotus*	IF		--	--	--	--	--	--	--	--	--	--	--	--	--	1	1
08077720	Western mosquitofish	*Gambusi affinis*	IF	T	14	1	15	--	--	--	5	--	5	--	--	--	1	3	4
08077720	Pinfish	*Lagodon rhomboides*	O		1	7	8	--	--	--	--	--	--	--	--	--	1	--	1
08077720	Spot	*Leiostomus xanthurus*	O		--	--	--	--	--	--	8	30	38	--	--	--	--	--	--
08077720	Spotted gar	*Lepisosteus oculatus*	P	T	--	--	--	--	--	--	1	--	1	--	--	--	--	--	--
08077720	Green sunfish	*Lepomis cyanellus*	P	T	--	--	--	--	--	--	--	--	--	--	--	--	1	--	1
08077720	Warmouth	*Lepomis gulosus*	P	T	--	--	--	--	--	--	1	--	1	--	--	--	1	--	1
08077720	Bluegill	*Lepomis macrochirus*	IF	T	1	1	2	--	--	--	11	1	12	--	--	--	19	4	23

Appendix 6. Fish taxa (number of individuals) collected from representative reach at each of five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Common name[1]	Scientific name[1]	Trophic group[1]	Tolerance[1]	Number of specimens collected														
					July 2006			August 2006			March 2007			July 2007			August 2007		
					E	S	Σ	E	S	Σ	E	S	Σ	E	S	Σ	E	S	Σ
08077720	Longear sunfish	*Lepomis megalotis*	IF		1	--	1	--	--	--	14	--	14	--	--	--	24	--	24
08077720	Rainwater killifish	*Luciania parva*	IF		--	--	--	--	--	--	1	--	1	--	--	--	--	--	--
08077720	Inland silverside	*Menidia beryllina*	IF		11	26	37	--	--	--	14	27	41	--	--	--	--	3	3
08077720	Largemouth bass	*Micropterus salmoides*	P		3	--	3	--	--	--	--	--	--	--	--	--	7	--	7
08077720	Striped mullet	*Mugil cephalus*	O		52	--	52	--	--	--	28	--	28	--	--	--	7	--	7
08077720	Southern flounder	*Paralichthys lethostigma*	P		--	--	--	--	--	--	1	--	1	--	--	--	--	--	--
08077720	Sailfin molly	*Poecilia latipinna*	O	T	14	--	14	--	--	--	--	--	--	--	--	--	--	4	4
08077725	Bay anchovy	*Anchoa mitchilli*	IF		--	--	--	--	--	--	1	--	1	--	6	6	--	--	--
08077725	Gulf menhaden	*Brevoortia patronus*	O		11	--	11	--	--	--	23	1	24	18	1	19	--	--	--
08077725	Sheepshead minnow	*Cyprinodon variegatus*	O	T	--	1	1	--	--	--	4	--	4	1	27	28	--	--	--
08077725	Bayou killifish	*Fundulus pulvereus*	IF		--	--	--	--	--	--	--	--	--	1	11	12	--	--	--
08077725	Western mosquitofish	*Gambusi affinis*	IF	T	--	--	--	--	--	--	1	--	1	--	62	62	--	--	--
08077725	Pinfish	*Lagodon rhomboides*	O		5	--	5	--	--	--	5	--	5	12	1	13	--	--	--
08077725	Spot	*Leiostomus xanthurus*	O		--	--	--	--	--	--	114	68	182	--	--	--	--	--	--
08077725	Bluegill	*Lepomis macrochirus*	IF	T	--	--	--	--	--	--	--	--	--	3	--	3	--	--	--
08077725	Rainwater killifish	*Luciania parva*	IF		--	--	--	--	--	--	--	--	--	--	5	5	--	--	--
08077725	Inland silverside	*Menidia beryllina*	IF		--	6	6	--	--	--	2	1	3	--	9	9	--	--	--
08077725	Clown goby	*Microgobius gulosus*	IF		--	--	--	--	--	--	--	--	--	--	6	6	--	--	--
08077725	Largemouth bass	*Micropterus salmoides*	P		--	--	--	--	--	--	--	--	--	2	1	3	--	--	--
08077725	Striped mullet	*Mugil cephalus*	O		14	--	14	--	--	--	17	--	17	27	5	32	--	--	--
08077725	Ladyfish	*Paralichthys lethostigma*	P		--	1	1	--	--	--	--	--	--	--	--	--	--	--	--
08077725	Sailfin molly	*Poecilia latipinna*	O	T	--	--	--	--	--	--	6	--	6	1	192	193	--	--	--
08077725	Red drum	*Sciaenops ocellatus*	P		--	--	--	--	--	--	1	--	1	1	--	1	--	--	--
08077738	Bay anchovy	*Anchoa mitchilli*	IF		--	14	14	--	--	--	--	143	143	--	102	102	--	--	--
08077738	Gulf menhaden	*Brevoortia patronus*	O		--	235	235	--	--	--	--	922	922	--	267	267	--	--	--
08077738	Spotted seatrout	*Cynoscion nebulosus*	P	I	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--
08077738	Sheepshead minnow	*Cyprinodon variegatus*	O	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	Gulf killifish	*Fundulus grandis*	IF		--	--	--	--	--	--	--	--	--	--	1	1	--	--	--
08077738	Bayou killifish	*Fundulus pulvereus*	IF		--	--	--	--	--	--	--	--	--	--	1	1	--	--	--

Appendix 6. Fish taxa (number of individuals) collected from representative reach at each of five sites (reaches), Highland and Marchand Bayous, Galveston County, Texas, 2006–07—Continued.

USGS site (reach) number (fig. 1)	Common name[1]	Scientific name[1]	Trophic group[1]	Tolerance[1]	Number of specimens collected														
					July 2006			August 2006			March 2007			July 2007			August 2007		
					E	S	Σ	E	S	Σ	E	S	Σ	E	S	Σ	E	S	Σ
08077738	Code gobie	*Gobiosoma robustum*	IF		--	--	--	--	--	--	--	--	--	--	1	1	--	--	--
08077738	Pinfish	*Lagodon rhomboides*	O		--	2	2	--	--	--	--	2	2	--	7	7	--	--	--
08077738	Spot	*Leiostomus xanthurus*	O		--	--	--	--	--	--	--	110	110	--	6	6	--	--	--
08077738	Rainwater killifish	*Luciania parva*	IF		--	--	--	--	--	--	--	--	--	--	2	2	--	--	--
08077738	Inland silverside	*Menidia beryllina*	IF		--	25	25	--	--	--	--	79	79	--	179	179	--	--	--
08077738	Striped mullet	*Mugil cephalus*	O		--	1	1	--	--	--	--	30	30	--	2	2	--	--	--
08077738	Leatherjacket	*Oligoplites saurus*	O		--	--	--	--	--	--	--	--	--	--	1	1	--	--	--
08077738	Sailfin molly	*Poecilia latipinna*	O	T	--	--	--	--	--	--	--	--	--	--	2	2	--	--	--
08077738	Black drum	*Pogonias cromis*	IF		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
08077738	Chain pipefish	*Syngnathus louisianae*	IF		--	--	--	--	--	--	--	--	--	--	1	1	--	--	--
08077780	Bay anchovy	*Anchoa mitchilli*	IF		--	--	--	--	--	--	--	62	62	--	--	--	--	10	10
08077780	Gulf menhaden	*Brevoortia patronus*	O		--	250	250	--	--	--	--	48	48	--	--	--	--	--	--
08077780	Sheepshead minnow	*Cyprinodon variegatus*	O	T	--	--	--	--	--	--	--	1	1	--	--	--	--	--	--
08077780	Gulf Killifish	*Fundulus grandis*	IF		--	--	--	--	--	--	--	1	1	--	--	--	--	--	--
08077780	Scaled sardine	*Harengula jaguana*	IF		--	1	1	--	--	--	--	--	--	--	--	--	--	--	--
08077780	Pinfish	*Lagodon rhomboides*	O		--	1	1	--	--	--	--	40	40	--	--	--	--	27	27
08077780	Spot	*Leiostomus xanthurus*	O		--	--	--	--	--	--	--	123	123	--	--	--	--	1	1
08077780	Leptocephalus larvae	*Leptocephalus* sp.	N/A		--	--	--	--	--	--	--	1	1	--	--	--	--	--	--
08077780	Inland silverside	*Menidia beryllina*	IF		--	1	1	--	--	--	--	8	8	--	--	--	--	138	138
08077780	Striped mullet	*Mugil cephalus*	O		--	1	1	--	--	--	--	--	--	--	--	--	--	6	6
08077780	Leatherjacket	*Oligoplites saurus*	O		--	--	--	--	--	--	--	--	--	--	--	--	--	2	2
08077780	Black drum	*Pogonias cromis*	IF		--	1	1	--	--	--	--	1	1	--	--	--	--	--	--

[1] Adapted from Linam and Kleinsasser (1998).

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