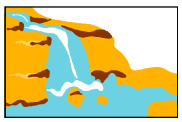
Streams and Rivers
Use Support Assessment

Dolan Falls on the Devils River north of Del Rio



Streams and Rivers Use Support Assessment

For the 2002 report, 544 streams and rivers (225 classified, 319 unclassified) encompassing approximately 20,286 miles were surveyed. The surveyed miles represent 50.5 percent of the State's 40,194 miles of perennial streams and rivers or about 10.6 percent of the estimated 191,228 miles of all streams and rivers, including intermittent streams that flow only during wet periods (Figure 8-1). Most of the surveyed streams and rivers are perennial water bodies that flow year round. Approximately 2,945 more stream and river miles were surveyed in 2002 than in 2000, the last year a full statewide assessment was conducted by the TNRCC. The increase in surveyed miles is due to additions of new monitoring sites within existing water bodies to improve spatial coverage and increase in new monitoring of small unclassified streams. Included in the 2002 mileage are 196 streams and rivers that were not monitored in 2000.

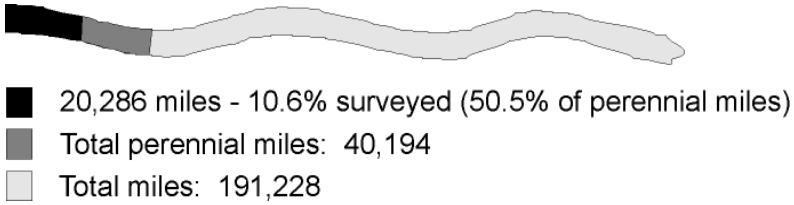


Figure 8-1. Streams and River Miles Surveyed

Of the 20,286 stream and river miles surveyed, sufficient monitoring data were available for assessment of at least one designated use in 17,575 miles (86.6%). About 79.7 percent of the 17,575 assessed stream and river miles fully support all of their designated beneficial uses (Figure 8-2). Some form of pollution impairs the remaining 20.3 percent of assessed stream and river miles. The framework, indicators, and criteria used to assess support of designated uses are discussed in the "Surface Water Assessment Methodology" section and shown in Tables 18-28.

Figure 8-3 identifies the causes and sources of pollutants that impair stream and river miles (i.e., prevent them from fully supporting designated uses). Causes that contribute most to overall impairment of designated uses in streams and rivers include elevated bacterial densities (contact recreation), elevated dissolved mineral concentrations (general uses), and depressed dissolved oxygen concentrations (aquatic life uses)(Figure 8-3).

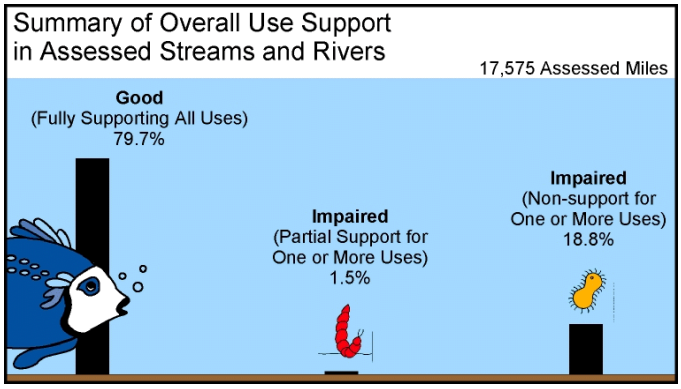
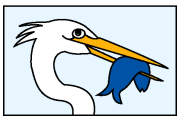


Figure 8-2. Summary of Use Support in Assessed Streams and Rivers

The sources of pollution for most streams and rivers are presently unknown (Figure 8-3). Municipal sewage treatment plants account for the largest category of known pollution sources, polluting approximately 22 percent of impaired stream and river miles. Urban runoff, agricultural sources (irrigated crop production and confined animal feeding operations), and natural sources are also identified as significant known sources of pollution.

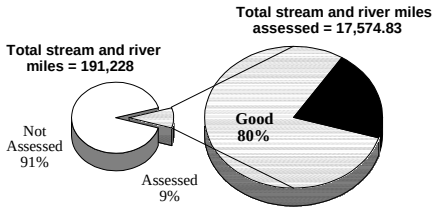


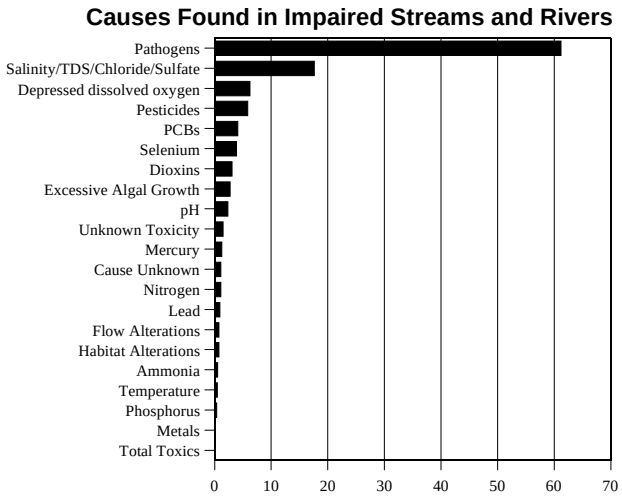
Aquatic Life Use Support

Individual use support information provides additional detail about water quality problems in streams and rivers. Approximately 20,286 stream and river miles were surveyed to determine support of the aquatic life use. Sufficient data were available to provide assessment of 11,365 miles (56% of surveyed miles) (Table 8-1). Of these assessed miles, 96 percent fully supported the aquatic life use, while one percent partially supported the use, and three percent failed to support the use. Impairment of the aquatic life use was identified as the third leading cause of overall use impairment in streams and rivers (Figure 8-3).

The number of surveyed miles and miles assessed are not equal for most indicators. This disparity may be due to insufficient spatial coverage by monitoring sites or too few samples that prevents comprehensive assessment over entire stream and river reaches. For example, if one monitoring site is located on a stream that is 100 miles long, only a 25-mile portion is reported as assessed, provided sample numbers exceed required minimum requirements at the site. In the above example, the remaining 75-mile portion of the stream is reported as not assessed.

In another example, if four sites are generally equally spaced along a stream that is 100 miles long and more than the minimum number of





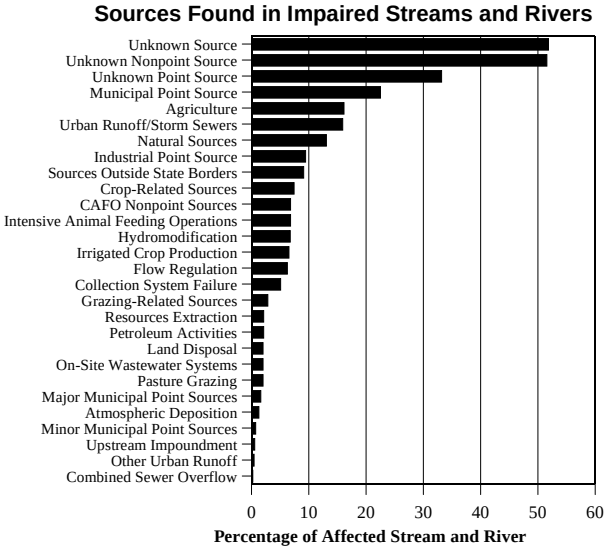
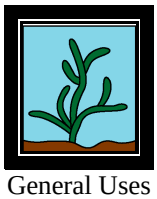


Figure 8-3. Causes and Sources in Streams and Rivers

Table 8-1. Individual Overall Use Support in Streams and Rivers - 2002

Designated Use	Miles Surveyed	Miles Assessed	Percent of Miles Assessed	Percent of Assessed Miles		
				Good (Fully supporting)	Fair (Partially Sup-porting)	Poor (Not Supporting)
 Aquatic Life Support	20,286.44	11,364.83	56.02	96	1	3
 Fish Consumption	20,286.44	2,051.90	10.12	86	5	9
 Contact Recreation	20,199.34	9,223.58	45.66	76	X*	24
 Noncontact Rec reation	27.00	23.90	88.52	100	X*	0
 Public Water Supply	8,779.70	8,779.70	100.00	100	0	< 1
 General Uses	14,238.30	13,755.20	96.61	94	1	5

* Category not applicable

samples are available at all sites, then the entire length is reported as assessed. However, if only five dissolved oxygen measurements were made at each of the two lower sites and 15 measurements were made at each of the upper two sites, then only the upper 50 miles of the stream would be considered assessed. The lower 50 miles is reported as not assessed, due to data limitations (a minimum of ten measurements is required for assessment purposes).

For the first time in 2002, the lower two stations in the above example would be identified with Tier 1 water quality concerns provided some exceedances occurred. For water quality concerns, four to nine samples must be available for analysis and at least one exceedance of criteria must occur.

Determination of overall use support for streams and rivers and for individual designated uses (aquatic life, fish consumption, and general uses) where multiple indicators are involved requires aggregation of assessment data. Due to inconsistent overlap of the assessed miles for each indicator, the total reported assessment mileage may be more or less than the largest amount of any one indicator. This relationship between surveyed and assessed stream and river miles is similar for subsequent sections of the report dealing with reservoirs and lakes, bays and estuaries, and oceans.

The third most common cause of impaired aquatic life use in freshwater and tidal streams is depressed dissolved oxygen concentrations (Figure 8-3). Depressed instantaneous (grab sample) dissolved oxygen concentrations, which were compared to the absolute minimum criteria, was the most common indicator used to assess support of the aquatic life use (11,267 miles; 56% of surveyed miles) (Table 8-2). Of the miles assessed by instantaneous dissolved oxygen measurements (compared to minimum criteria), 98 % fully supported aquatic life uses, about one percent partially supported the use, and one percent failed to support the use. TCEQ, CRP partners, and TMDL contractors are gearing up to substantially increase the spatial coverage of 24-hour dissolved oxygen monitoring. However, for the 2002 reporting cycle, less than one percent of stream and river miles received this coverage.

Depressed dissolved oxygen concentrations contribute to partial support in one reach and nonsupport in a different reach in Adams Bayou Tidal (Segment 0508), Cow Bayou Tidal (Segment 0511), Country Club Bayou (Segment 1007), and Dickinson Bayou (Segment 1103)(Table 8-3). Low dissolved oxygen contribute to partially supported aquatic life uses in 18 stream and river water body segments (6 classified and 12 unclassified). The aquatic life use is not supported in 10 stream and river water body segments (3 classified and 10 unclassified) due to depressed dissolved oxygen concentrations.

Table 8-2. Individual Indicators for Assessment of Aquatic Life, Fish Consumption, and General Use Support in Streams and Rivers - 2002

Designated Use	Miles Surveyed	Miles Assessed	Percent of Miles Assessed	Percent of Assessed Miles		
				Good (Fully supporting)	Fair (Partially Supporting)	Poor (Not Supporting)
Aquatic Life Support						
Instantanous Dissolved Oxygen - min	20,286.44	11,266.53	55.54	98	1	<1
24-hour Dissolved Oxygen	20,286.44	0.80	0.00	0	0	100
Metals in Water	20,286.44	1,794.20	8.84	90	0	10
Organics Substances in Water	20,286.44	80.00	0.39	100	0	0
Water Toxicity	20,286.44	54.90	0.27	11	43	46
Sediment Toxicity	20,286.44	2.50	0.01	0	0	100
Macrobenthos Community	20,286.44	295.45	1.46	79	X	21
Habitat	20,286.44	35.00	0.17	100	X	0
Fish Community	20,286.44	222.85	1.10	87	X	13

Table 8-2. Individual Indicators for Assessment of Aquatic Life, Fish Consumption, and General Use Support in Streams and Rivers, 2002 (Continued)

Designated Use	Miles Surveyed	Miles Assessed	Percent of Miles Assessed	Percent of Assessed Miles		
				Good (Fully supporting)	Fair (Partially Sup-porting)	Poor (Not Supporting)
Fish Consumption						
Advisories / Closures	20,286.44	395.10	1.95	28	27	45
Human Health Criteria	20,286.44	1,616.20	7.97	100	0	0
General Uses						
Water Temperature	14,238.30	8,115.70	57.00	99	< 1	0
pH	14,238.30	7,771.30	54.58	99	1	0
Chloride	13,617.20	13,084.20	96.09	96	X*	4
Sulfate	13,617.20	13,142.20	96.51	99	X	< 1

Table 8-2. Individual Indicators for Assessment of Aquatic Life, Fish Consumption, and General Use Support in Streams and Rivers, 2002 (Continued)

Designated Use	Miles Surveyed	Miles Assessed	Percent of Miles Assessed	Percent of Assessed Miles		
				Good (Fully supporting)	Fair (Partially Supporting)	Poor (Not Supporting)
Total Dissolved Solids	13,617.20	13,123.20	96.37			
				95	X	5

* Category not applicable
X* - Category not applicable

Table 8-3. Streams and Rivers with Partially Supported or Nonsupported Aquatic Life Uses, Tier 1, and Tier 2 Concerns Due to Depressed Dissolved Oxygen Concentrations

Segment Number	Water Body	Water Type	DO Grab Average	DO Grab Min	24hr Average	24hr Min
0201A	Mud Creek (unclassified water body)	Freshwater	T2			
0202D	Pine Creek (unclassified water body)	Freshwater	T2			
0303	Sulphur/South Sulphur River	Freshwater	T2			
0303B	White Oak Creek (unclassified water body)	Freshwater	T2			
0401A	Harrison Bayou (unclassified water body)	Freshwater	T2	T2		
0401B	Kitchen Creek (unclassified water body)	Freshwater		T1		
0402	Big Cypress Creek Below Lake O' the Pines	Freshwater	T2	T2		
0402A	Black Cypress Bayou (unclassified water body)	Freshwater	T2	PS/T1		
0404	Big Cypress Creek Below Lake Bob Sandlin	Freshwater			T1	T1
0404B	Tankersley Creek (unclassified water body)	Freshwater		T1		
0404C	Hart Creek (unclassified water body)	Freshwater	T2			

Table 8-3. Streams and Rivers with Partially Supported or Nonsupported Aquatic Life Uses, Tier 1, and Tier 2 Concerns Due to Depressed Dissolved Oxygen Concentrations (Continued)

Segment Number	Water Body	Water Type	DO Grab Average	DO Grab Min	24hr Average	24hr Min
0406	Black Bayou	Freshwater	T2	PS/T1	T1	T1
0407	James' Bayou	Freshwater	T2	T2		
0409	Little Cypress Bayou (Creek)	Freshwater	T2	PS		
0501B	Little Cypress Bayou (unclassified water body)	Freshwater		T1		
0502	Sabine River Above Tidal	Freshwater	T2			
0502A	Nichols Creek (unclassified water body)	Freshwater	T2	PS		
0505G	Wards Creek (unclassified water body)	Freshwater	T2	PS		
0506A	Harris Creek (unclassified water body)	Freshwater	T2			
0506G	Little White Oak Creek (unclassified water body)	Freshwater		T1		
0507A	Cowleech Fork Sabine River (unclassified water body)	Freshwater	T2			
0508	Adams Bayou Tidal	Saltwater	T2	NS/PS		
0508A	Adams Bayou Above Tidal (unclassified water body)	Freshwater	T2	T2		
0508C	Hudson Gully (unclassified water body)	Saltwater	T2	NS		
0511	Cow Bayou Tidal	Saltwater	T2	NS/PS		
0511A	Cow Bayou Above Tidal (unclassified water body)	Freshwater	T2	PS		
0511B	Coon Bayou (unclassified water body)	Saltwater	T2	PS		
0511E	Terry Gully (unclassified water body)	Freshwater	T2	T2		
0512A	Running Creek (unclassified water body)	Freshwater	T2			

Table 8-3. Streams and Rivers with Partially Supported or Nonsupported Aquatic Life Uses, Tier 1, and Tier 2 Concerns Due to Depressed Dissolved Oxygen Concentrations (Continued)

Segment Number	Water Body	Water Type	DO Grab Average	DO Grab Min	24hr Average	24hr Min
0512B	Elm Creek (unclassified water body)	Freshwater	T2	T2		
0514	Big Sandy Creek	Freshwater		T1		
0601A	Star Lake Canal (unclassified water body)	Saltwater	T2			
0602A	Booger Branch (unclassified water body)	Freshwater	T2	NS		
0606	Neches River Above Lake Palestine	Freshwater	T2	T2	T1	T1
0606A	Prairie Creek (unclassified water body)	Freshwater	T2			
0607	Pine Island Bayou	Freshwater	T2	PS/T2	T1	T1
0607A	Boggy Creek (unclassified water body)	Freshwater	T2			
0607B	Little Pine Island Bayou (unclassified water body)	Freshwater	T2	PS		
0607C	Willow Creek (unclassified water body)	Freshwater	T2			
0608C	Cypress Creek (unclassified water body)	Freshwater	T2	T2		
0608E	Mill Creek (unclassified water body)	Freshwater	T2			
0609	Angelina River Below Sam Rayburn Reservoir	Freshwater	T2			
0701	Taylor Bayou Above Tidal	Freshwater	T2		T1	T1
0704	Hillebrandt Bayou	Freshwater	T2		T1	T1
0802	Trinity River Below Lake Livingston	Freshwater	T2			
0820C	Muddy Creek (unclassified water body)	Freshwater	T2			
0825	Denton Creek	Freshwater	T2			
0831	Clear Fork Trinity River Below Lake Weatherford	Freshwater	T2			

Table 8-3. Streams and Rivers with Partially Supported or Nonsupported Aquatic Life Uses, Tier 1, and Tier 2 Concerns Due to Depressed Dissolved Oxygen Concentrations (Continued)

Segment Number	Water Body	Water Type	DO Grab Average	DO Grab Min	24hr Average	24hr Min
0833	Clear Fork Trinity River Above Lake Weatherford	Freshwater	T2	PS		
0902	Cedar Bayou Above Tidal	Freshwater	T2			
1002B	Luce Bayou (unclassified water body)	Freshwater	T2	T2		
1004	West Fork San Jacinto River	Freshwater	T2			
1006F	Big Gulch Above Tidal (unclassified water body)	Freshwater	T2			
1006I	Unnamed Tributary of Halls Bayou (unclassified water body)	Freshwater	T2	T2		
1006J	Unnamed Tributary of Halls Bayou (unclassified water body)	Freshwater	T2			
1007H	Pine Gully Above Tidal (unclassified water body)	Freshwater	T2	NS		
1007I	Plum Creek Above Tidal (unclassified water body)	Freshwater	T2	NS		
1007K	Country Club Bayou Above Tidal (unclassified water body)	Freshwater	T2	NS/PS		
1007N	Unnamed Non-Tidal Tributary of Sims Bayou (unclassified water body)	Freshwater	T2			
1007O	Unnamed Non-Tidal Tributary of Buffalo Bayou (unclassified water body)	Freshwater	T2	NS		
1007P	Brays Bayou Above Tidal (unclassified water body)	Freshwater	T2			
1007Q	Sims Bayou Above Tidal (unclassified water body)	Freshwater	T2	PS		
1007R	Hunting Bayou Above Tidal (unclassified water body)	Freshwater	T2	NS		
1008	Spring Creek	Freshwater	T2	T2		

Table 8-3. Streams and Rivers with Partially Supported or Nonsupported Aquatic Life Uses, Tier 1, and Tier 2 Concerns Due to Depressed Dissolved Oxygen Concentrations (Continued)

Segment Number	Water Body	Water Type	DO Grab Average	DO Grab Min	24hr Average	24hr Min
1008B	Upper Panther Branch (unclassified water body)	Freshwater	T2	T2		
1008G	Upper Panther Branch above Bear Branch (unclassified water body)	Freshwater	T2			
1009	Cypress Creek	Freshwater	T2			
1013A	Little White Oak Bayou (unclassified water body)	Freshwater	T2	PS		
1013C	Unnamed Non-Tidal Tributary of Buffalo Bayou Tidal (unclassified water body)	Freshwater	T2			
1014M	Neimans Bayou (unclassified water body)	Freshwater	T2	NS		
1014N	Rummel Creek (unclassified water body)	Freshwater	T2			
1014O	Spring Branch (unclassified water body)	Freshwater	T2			
1016B	Unnamed Tributary of Greens Bayou (unclassified water body)	Freshwater	T2			
1016C	Unnamed Tributary of Greens Bayou (unclassified water body)	Freshwater	T2			
1016D	Unnamed Tributary of Greens Bayou (unclassified water body)	Freshwater	T2	PS		
1017D	Unnamed Tributary of White Oak Bayou (unclassified water body)	Freshwater	T2	NS		
1017E	Unnamed Tributary of White Oak Bayou (unclassified water body)	Freshwater	T2			
1102	Clear Creek Above Tidal	Freshwater	T2			
1103	Dickinson Bayou Tidal	Saltwater	T2	NS/T2	PS/T1	NS/T1
1103B	Bordens Gully (unclassified water body)	Saltwater	T2	T2		
1103C	Geisler Bayou (unclassified water body)	Saltwater	T2			

Table 8-3. Streams and Rivers with Partially Supported or Nonsupported Aquatic Life Uses, Tier 1, and Tier 2 Concerns Due to Depressed Dissolved Oxygen Concentrations (Continued)

Segment Number	Water Body	Water Type	DO Grab Average	DO Grab Min	24hr Average	24hr Min
1104	Dickinson Bayou Above Tidal	Freshwater	T2			
1110	Oyster Creek Above Tidal	Freshwater	T2			
1209G	Cedar Creek (unclassified water body)	Freshwater	T2			
1209H	Duck Creek (unclassified water body)	Freshwater	T2			
1209I	Gibbons Creek (unclassified water body)	Freshwater	T2	NS		
1211A	Davidson Creek (unclassified water body)	Freshwater	T2	T2		
1221	Leon River Below Proctor Lake	Freshwater	T2			
1223	Leon River Below Leon Reservoir	Freshwater	T2	T2		
1242D	Thompson Creek (unclassified water body)	Freshwater	T2	PS		
1245	Upper Oyster Creek	Freshwater	T2	T2		
1253	Navasota River Below Lake Mexia	Freshwater	T2	T1		
1255	Upper North Bosque River	Freshwater	T2			
1305	Caney Creek Above Tidal	Freshwater	T2			
1402C	Buckners Creek (unclassified water body)	Freshwater	T2			
1402H	Skull Creek (unclassified water body)	Freshwater			T1	T1
1412	Colorado River Below Lake J. B. Thomas	Freshwater	T2			
1416A	Brady Creek (unclassified water body)	Freshwater		T1		
1417	Lower Pecan Bayou	Freshwater	T2			
1430A	Barton Springs (unclassified water body)	Freshwater	T2	T2		

Table 8-3. Streams and Rivers with Partially Supported or Nonsupported Aquatic Life Uses, Tier 1, and Tier 2 Concerns Due to Depressed Dissolved Oxygen Concentrations (Continued)

Segment Number	Water Body	Water Type	DO Grab Average	DO Grab Min	24hr Average	24hr Min
1434B	Cedar Creek (unclassified water body)	Freshwater	T2			
1501	Tres Palacios Creek Tidal	Saltwater	T2			
1602	Lavaca River Above Tidal	Freshwater			T1	T1
1803B	Sandies Creek (unclassified water body)	Freshwater	T2			
1906	Lower Leon Creek	Freshwater	T2			
1910	Salado Creek	Freshwater	T2			
1912A	Upper Medio Creek (unclassified water body)	Freshwater	T2			
1913	Mid Cibolo Creek	Freshwater	T2			
2002	Mission River Above Tidal	Freshwater	T2			
2004	Aransas River Above Tidal	Freshwater	T2			
2117	Frio River Above Choke Canyon Reservoir	Freshwater	T2			
2201	Arroyo Colorado Tidal	Saltwater	T2			
2202	Arroyo Colorado Above Tidal	Freshwater	T2			
2304	Rio Grande Below Amistad Reservoir	Freshwater	T2			
2311	Upper Pecos River	Freshwater	T2			
2422B	Double Bayou West Fork (unclassified water body)	Saltwater		T1		
2424A	Highland Bayou (unclassified water body)	Saltwater	T2	PS/T2		
2424C	Marchand Bayou (unclassified water body)	Saltwater	T2	PS		
2425C	Robinson Bayou (unclassified water body)	Saltwater	T2			

Most of the water bodies with partially supported or nonsupported aquatic life uses based on depressed dissolved oxygen concentrations are freshwater streams (22), but seven tidally influenced water bodies were also identified (Table 8-3). Determination of partial and nonsupport of the aquatic life use in freshwater streams and rivers was based solely on comparison of instantaneous measurements to the absolute minimum criteria. In only Dickinson Bayou Tidal (Segment 1103) was impairment of the aquatic life use based on 24-hour measurements.

Many of the impaired streams occur in East Texas where low stream velocity, dense tree canopy shading, low stream gradients (small changes in stream bed elevations), few riffle areas (limited replenishment of dissolved oxygen by physical reaeration), and high sediment oxygen demands are naturally occurring factors that contribute to low dissolved oxygen concentrations. In other areas of the state, low stream velocity associated with low stream flow, caused by drought, or sluggish tidal activity are thought to contribute heavily to depression of dissolved oxygen concentrations. Assimilation of even minor point and nonpoint source pollutant loads in streams already stressed by low flows and near stagnant velocities, contributes further to depression of dissolved oxygen concentrations.

Also identified in Table 8-3 are streams and rivers with Tier 1 and Tier 2 concerns based on dissolved oxygen exceedances. Tier 1 concerns were identified when only four to nine samples were available and at least one exceedance was observed. Tier 1 concerns are embedded in the mileage considered not assessed, since the ten-sample minimum requirement was not met. Tier 1 concerns are identified so that additional monitoring resources will be devoted to the water bodies. Additional monitoring events will be required to provide sufficient dissolved oxygen data for full assessments of aquatic life uses during the next reporting cycle.

For Tier 1 concerns for dissolved oxygen are determined in two ways: (1) 24-hour measurements compared to the 24-hour and absolute minimum criteria when four to nine samples are available and (2) instantaneous measurements compared to the absolute minimum when four to nine samples are available for assessment.

Tier 2 concerns for dissolved oxygen are embedded in the mileage reported as fully supporting, since more than ten samples were available for assessment and the few exceedances do not trigger partial or nonsupport of the aquatic life use. Tier 2 concerns are also identified so that monitoring on the affected water bodies will continue to ensure that sufficient data will be available to provide full assessment of the use during the next

reporting cycle. Tier 2 concerns for dissolved oxygen are determined in three ways: (1) 24-hour measurements compared to the 24-hour criteria when ten or more samples are available, (2) instantaneous measurements compared to the absolute minimum when ten or more samples are available, and (3) instantaneous measurements compared to the 24-hour criteria when ten or more samples are available.

Portions of seven streams and rivers had both Tier 1 and Tier 2 concerns (Table 8-3). The number of streams and rivers identified with Tier 2 concerns (109) far outnumbered those with Tier 1 concerns (18). Most of the Tier 1 and Tier 2 concerns were based on instantaneous measurements. However, 24-hour measurements were used to identify Tier 1 concerns in Big Cypress Creek (Segment 0404), Black Cypress Bayou (Segment 0406), Neches River (Segment 0606), Pine Island Bayou (Segment 0607), Dickinson Bayou (Segment 1103), Skull Creek (Segment 1402), and Lavaca River Tidal (Segment 1602).

Nineteen streams and rivers were identified with Tier 2 concerns due to exceedance of the both the absolute minimum and 24-hour criteria by instantaneous measurements (Table 8-4). However, by far the largest number of Tier 2 concerns (90) were identified for streams and rivers based on exceedances of the 24-hour criteria by instantaneous measurements alone.

The aquatic life use is not supported in four stream and river water bodies due to elevated concentrations of toxic substances in water (Table 8-4). The aquatic life use in is not supported in the Wichita River (Segment 0218) and Middle Fork Wichita River due to chronic exposure to selenium. Similar chronic exposures cause nonsupport of aquatic life uses in the Neches River below Lake Palestine (Segment 0604; lead). Acute and chronic zinc exposures cause nonsupport of aquatic life uses in the Neches River above Lake Palestine (Segment 0606). Tier 1 concerns were identified for the remaining 16 streams and rivers. The Tier 1 concern for chronic exposures to malathion in the Neches River Tidal was the only river affected by organic substances in water.

Significant effects in ambient water toxicity test results contribute to partial support of the aquatic life use in Nichols Creek (Segment 0502) and nonsupport in Palo Gaucho Bayou (Segment 0504), both unclassified streams. Tier 1 concerns, based on ambient water toxicity tests, were identified in Little Cypress Bayou (Segment 0409), Little Cypress Bayou

Table 8-4. Streams and Rivers with Nonsupported Aquatic Life Uses and Tier 1 Concerns Due to Toxic Substances in Water

Segment Number	Water Body	Concern Parameter(s)	Not Supporting Parameter(s)	Concern or Support Code
0218	Wichita/North Fork Wichita River		selenium (chronic)	NS
0218A	Middle Fork Wichita River (unclassified water body)		selenium (chronic)	NS
0303B	White Oak Creek (unclassified water body)	aluminum (acute)		T1
0402	Big Cypress Creek Below Lake O' the Pines	lead (chronic)		T1
0402A	Black Cypress Bayou (unclassified water body)	cadmium (acute and chronic), copper (acute and chronic), lead (chronic)		T1
0406	Black Bayou	lead (chronic)		T1
0407	James' Bayou	copper (acute), lead (chronic)		T1
0409	Little Cypress Bayou (Creek)	lead (chronic)		T1
0601	Neches River Tidal	malathion (chroic)		T1
0604	Neches River Below Lake Palestine		lead (chronic)	NS
0606	Neches River Above Lake Palestine	zinc (acute and chronic)	zinc (acute and chronic)	T1/NS
0606A	Prairie Creek (unclassified water body)	zinc (acute and chronic)		T1
0607	Pine Island Bayou	cadmium (chronic), zinc (acute)		T1
0607C	Willow Creek (unclassified water body)	cadmium (chronic)		T1
0608	Village Creek	aluminum (acute), lead (chronic)		T1
0608B	Big Sandy Creek (unclassified water body)	cadmium (chronic), copper (acute)		T1
0608C	Cypress Creek (unclassified water body)	aluminum (acute), cadmium (acute and chronic), zinc (acute)		T1

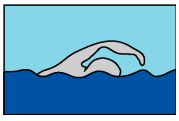
Table 8-4. Streams and Rivers with Nonsupported Aquatic Life Uses and Tier 1 Concerns Due to Toxic Substances in Water (Continued)

Segment Number	Water Body	Concern Parameter(s)	Not Supporting Parameter(s)	Concern or Support Code
0608D	Hickory Creek (unclassified water body)	cadmium (chronic)		T1
0608F	Turkey Creek (unclassified water body)	cadmium (chronic)		T1
0823A	Little Elm Creek (unclassified water body)	silver (acute)		T1
1016	Greens Bayou Above Tidal	chromium (chronic)		T1

(Segment 0501), Little White Oak Creek (Segment 0506), Alligator Bayou (Segment 0702) and the Rio Grande (Segment 2304). In a portion of Little Cypress Bayou (Segment 0501), a Tier 2 concern was identified due to a few significant effects in ambient water toxicity tests.

Only one water body (Houston Ship Channel Segment 1006) was identified with an impaired aquatic life use based on ambient sediment toxicity tests. However, Tier 1 concerns were identified in Big Cypress Creek (Segment 0404) and the Rio Grande (Segment 2308).

Direct determination of aquatic life uses based on biological and habitat assessments identified six streams and rivers with impairments (Table 8-5). Agreement between fish and macrobenthic community indicators occurred in Cummins Creek (Segment 1402). Nonsupport of the aquatic life use was based on fish in one additional stream (Alligator Bayou, Segment 0702) and four additional streams by benthic macroinvertebrates. Due to low sample numbers, Tier 1 concerns were identified in four streams by fish assessments, eight for benthic macroinvertebrate assessments, and six by habitat assessments.



Contact Recreation Use Support

Bacterial indicators provide evidence of possible fecal contamination that may cause illness if the water is ingested. Fecal coliform and *E. coli* in freshwater streams and enterococci in tidal streams are bacterial indicators that are used to determine if streams and rivers are safe for swimming and drinking. Bacteria commonly enter streams in inadequately treated sewage, through wildlife contributions, and runoff from pastures, feedlots, and urban areas.

Table 8-5. Streams and Rivers With Nonsupported Aquatic Life Uses and Tier 1 Concerns Based on Biological and Habitat Assessments

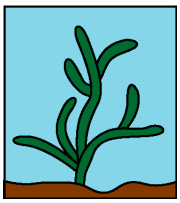
Segment Number	Water Body	Fish	Macrobenthos	Habitat
0404B	Tankersley Creek (unclassified water body)	T1	T1	
0606	Neches River Above Lake Palestine		T1	
0702A	Alligator Bayou (unclassified water body)	NS		T1
1226	North Bosque River	T1		T1
1302	San Bernard River Above Tidal	T1	T1	
1402A	Cummins Creek (unclassified water body)	NS	NS	T1
1403A	Bull Creek (unclassified water body)		NS	
1403E	Stillhouse Hollow (unclassified water body)		T1	
1409	Colorado River Above Lake Buchanan			T1
1416	San Saba River			T1
1421	Concho River		NS	
1427A	Slaughter Creek (unclassified water body)		NS	
1428B	Walnut Creek (unclassified water body)		T1	
1428D	Little Walnut Creek (unclassified water body)		T1	
1429C	Waller Creek (unclassified water body)		NS	
1430	Barton Creek		T1	
2311	Upper Pecos River	T1	T1	T1

Elevated bacterial indicator densities (indicating potential for pathogens) is the leading cause that contributes to impairment of overall uses in streams and rivers (Figure 8-3). Bacterial data were sufficient to provide assessment of the contact recreation use in 9,224 of 20,199 stream and river miles surveyed (46%) (Table 8-1). Of the 9,224 miles assessed, approximately 76 percent fully supported the contact recreation use. Partial support is not evaluated for the contact recreation use. Elevated bacterial densities caused nonsupport of the contact recreation use in 24 percent of assessed stream and river miles. Contact recreation is not supported in 154 streams and rivers (43 classified

and 111 unclassified) (Table 8-6). Forty-two Tier 1 contact recreation concerns were identified due to low sample numbers. The same number of Tier 2 concerns were identified in streams and rivers.

Noncontact Recreation Use Support

Bacterial densities were also used to evaluate support of the noncontact recreation use in streams and rivers. Bacterial data were sufficient to provide assessment of the noncontact recreation use in all 24 miles surveyed (Table 8-1). The noncontact recreation use was fully supported in all stream and river miles assessed.



General Use Support

Water quality criteria for several constituents are established in the TSWQS to safeguard general water quality, rather than for protection of specific uses. Water temperature, pH, chloride, sulfate, and total dissolved solids (TDS) indicators, which are assigned specifically to only classified segments, are included this grouping. General use support is not assessed for unclassified streams. Together these constituents comprise the second leading major category which causes nonsupport of overall uses in streams and rivers (Figure 8-1). Not all classified streams and rivers (those that are tidally influenced) are assigned criteria for chloride, sulfate, and TDS. Since unclassified streams are not assessed for general use support, the total miles surveyed (14, 238) is about 6,000 less than those surveyed for aquatic life, contact recreation, and fish consumption uses (Table 8-1). Water temperature, pH, and dissolved mineral data were sufficient to provide assessment of general uses in 13,755 of 14,238 miles surveyed (97%). Of the miles assessed, 94 percent fully support general uses, while one percent partially supports (due to elevated water temperature and low or high pH values), and five percent failed to support the use. Each of the five indicators used to assess general use support was monitored about equally, with each accounting for over 7,500 assessed miles (>60%) (Table 8-2). General uses were supported in 99 percent of assessed miles for water temperature, 99 percent for pH, 96 percent for chloride, 99 percent for sulfate, and 95 percent for TDS.

Elevated average TDS concentrations contributed to nonsupport of general uses in seven streams and rivers (Table 8-7). General uses were not supported due to elevated average chloride and sulfate concentrations in five and two water bodies, respectively. Low pH values contributed to partial support of general uses in four East Texas water bodies where water is naturally acidic and poorly buffered. Three Tier 1 and five Tier 2 concerns were also identified in East Texas streams and rivers due to low pH. On the other hand, highly

Table 8-6. Streams and Rivers with Nonsupported Contact Recreation Uses, Tier 1 Concerns, and Tier 2 Concerns

Segment Number	Segment Description	Water Body Type	Concern		Non Support
			T1	T2	
0101A	Dixon Creek (unclassified water body)	Freshwater			X
0101B	Rock Creek (unclassified water body)	Freshwater	X		
0103	Canadian River Above Lake Meredith	Freshwater		X	
0103A	East Amarillo Creek (unclassified water body)	Freshwater		X	
0104	Wolf Creek	Freshwater	X		
0201A	Mud Creek (unclassified water body)	Freshwater			X
0202D	Pine Creek (unclassified water body)	Freshwater			X
0202E	Post Oak Creek (unclassified water body)	Freshwater	X		
0203A	Big Mineral Creek (unclassified water body)	Freshwater		X	X
0207A	Buck Creek (unclassified water body)	Freshwater			X
0229	Upper Prairie Dog Town Fork Red River	Freshwater	X		
0230A	Paradise Creek (unclassified water body)	Freshwater	X		
0299A	Sweetwater Creek (unclassified water body)	Freshwater			X
0304	Days Creek	Freshwater	X		
0404	Big Cypress Creek Below Lake Bob Sandlin	Freshwater	X		X
0404B	Tankersley Creek (unclassified water body)	Freshwater	X	X	
0502A	Nichols Creek (unclassified water body)	Freshwater		X	X
0505	Sabine River Above Toledo Bend Reservoir	Freshwater		X	X
0505B	Grace Creek (unclassified water body)	Freshwater	X		
0506	Sabine River Below Lake Tawakoni	Freshwater	X		X
0506G	Little White Oak Creek (unclassified water body)	Freshwater	X		
0507A	Cowleech Fork Sabine River (unclassified water body)	Freshwater		X	X

Table 8-6. Streams and Rivers with Nonsupported Contact Recreation Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

Segment Number	Segment Description	Water Body Type	Concern		Non Support
			T1	T2	
0508	Adams Bayou Tidal	Saltwater		X	X
0508A	Adams Bayou Above Tidal (unclassified water body)	Freshwater			X
0508C	Hudson Gully (unclassified water body)	Saltwater			X
0511	Cow Bayou Tidal	Saltwater		X	X
0511A	Cow Bayou Above Tidal (unclassified water body)	Freshwater		X	
0511B	Coon Bayou (unclassified water body)	Saltwater			X
0511C	Cole Creek (unclassified water body)	Saltwater			X
0511E	Terry Gully (unclassified water body)	Freshwater			X
0512A	Running Creek (unclassified water body)	Freshwater			X
0512B	Elm Creek (unclassified water body)	Freshwater			X
0603A	Sandy Creek (unclassified water body)	Freshwater			X
0604A	Cedar Creek (unclassified water body)	Freshwater	X		
0604B	Hurricane Creek (unclassified water body)	Freshwater			X
0604C	Jack Creek (unclassified water body)	Freshwater		X	X
0604D	Piney Creek (unclassified water body)	Freshwater	X		
0605A	Kickapoo Creek (unclassified water body)	Freshwater		X	X
0606A	Prairie Creek (unclassified water body)	Freshwater		X	X
0608B	Big Sandy Creek (unclassified water body)	Freshwater		X	X
0608C	Cypress Creek (unclassified water body)	Freshwater		X	
0608F	Turkey Creek (unclassified water body)	Freshwater		X	X
0611	Angelina River Above Sam Rayburn Reservoir	Freshwater			X
0611A	East Fork Angelina River (unclassified water body)	Freshwater			X
0611B	La Nana Bayou (unclassified water body)	Freshwater		X	X

Table 8-6. Streams and Rivers with Nonsupported Contact Recreation Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

Segment Number	Segment Description	Water Body Type	Concern		Non Support
			T1	T2	
0611C	Mud Creek (unclassified water body)	Freshwater			X
0612	Attoyac Bayou	Freshwater	X	X	
0810	West Fork Trinity River Below Bridgeport Reservoir	Freshwater			X
0820C	Muddy Creek (unclassified water body)	Freshwater			X
0823A	Little Elm Creek (unclassified water body)	Freshwater			X
0823C	Clear Creek (unclassified water body)	Freshwater		X	
0824	Elm Fork Trinity River Above Ray Roberts Lake	Freshwater	X		X
0825	Denton Creek	Freshwater	X		
0826A	Denton Creek (unclassified water body)	Freshwater	X		
0831	Clear Fork Trinity River Below Lake Weatherford	Freshwater	X		X
0833	Clear Fork Trinity River Above Lake Weatherford	Freshwater	X		
0841	Lower West Fork Trinity River	Freshwater	X		
1004	West Fork San Jacinto River	Freshwater			X
1006D	Halls Bayou Below US 59 (unclassified water body)	Freshwater			X
1006E	Halls Bayou Above US 59 (unclassified water body)	Freshwater			X
1006F	Big Gulch Above Tidal (unclassified water body)	Freshwater			X
1006H	Spring Gully Above Tidal (unclassified water body)	Freshwater			X
1006I	Unnamed Tributary of Halls Bayou (unclassified water body)	Freshwater			X
1006J	Unnamed Tributary of Halls Bayou (unclassified water body)	Freshwater			X

Table 8-6. Streams and Rivers with Nonsupported Contact Recreation Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

Segment Number	Segment Description	Water Body Type	Concern		Non Support
			T1	T2	
1007B	Brays Bayou Above Tidal (unclassified water body)	Freshwater			X
1007C	Keegans Bayou Above Tidal (unclassified water body)	Freshwater			X
1007D	Sims Bayou Above Tidal (unclassified water body)	Freshwater			X
1007E	Willow Waterhole Bayou Above Tidal (unclassified water body)	Freshwater			X
1007F	Berry Bayou Above Tidal (unclassified water body)	Freshwater			X
1007G	Kuhlman Gully Above Tidal (unclassified water body)	Freshwater			X
1007H	Pine Gully Above Tidal (unclassified water body)	Freshwater			X
1007I	Plum Creek Above Tidal (unclassified water body)	Freshwater			X
1007K	Country Club Bayou Above Tidal (unclassified water body)	Freshwater			X
1007L	Unnamed Non-Tidal Tributary of Brays Bayou (unclassified water body)	Freshwater			X
1007M	Unnamed Non-Tidal Tributary of Hunting Bayou (unclassified water body)	Freshwater			X
1007N	Unnamed Non-Tidal Tributary of Sims Bayou (unclassified water body)	Freshwater			X
1007O	Unnamed Non-Tidal Tributary of Buffalo Bayou (unclassified water body)	Freshwater			X
1007P	Brays Bayou Above Tidal (unclassified water body)	Freshwater			X
1007Q	Sims Bayou Above Tidal (unclassified water body)	Freshwater			X
1007R	Hunting Bayou Above Tidal (unclassified water body)	Freshwater			X

Table 8-6. Streams and Rivers with Nonsupported Contact Recreation Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

Segment Number	Segment Description	Water Body Type	Concern		Non Support
			T1	T2	
1008	Spring Creek	Freshwater			X
1009	Cypress Creek	Freshwater			X
1013	Buffalo Bayou Tidal	Saltwater			X
1013A	Little White Oak Bayou (unclassified water body)	Freshwater			X
1013C	Unnamed Non-Tidal Tributary of Buffalo Bayou Tidal (unclassified water body)	Freshwater			X
1014	Buffalo Bayou Above Tidal	Freshwater	X		X
1014H	South Mayde Creek (unclassified water body)	Freshwater			X
1014K	Turkey Creek (unclassified water body)	Freshwater			X
1014M	Neimans Bayou (unclassified water body)	Freshwater			X
1014N	Rummel Creek (unclassified water body)	Freshwater			X
1014O	Spring Branch (unclassified water body)	Freshwater			X
1016	Greens Bayou Above Tidal	Freshwater			X
1016A	Garners Bayou (unclassified water body)	Freshwater			X
1016B	Unnamed Tributary of Greens Bayou (unclassified water body)	Freshwater			X
1016C	Unnamed Tributary of Greens Bayou (unclassified water body)	Freshwater			X
1016D	Unnamed Tributary of Greens Bayou (unclassified water body)	Freshwater			X
1017	Whiteoak Bayou Above Tidal	Freshwater	X		X
1017A	Brickhouse Gully/Bayou (unclassified water body)	Freshwater			X
1017B	Cole Creek (unclassified water body)	Freshwater			X
1017D	Unnamed Tributary of White Oak Bayou (unclassified water body)	Freshwater			X

Table 8-6. Streams and Rivers with Nonsupported Contact Recreation Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

Segment Number	Segment Description	Water Body Type	Concern		Non Support
			T1	T2	
1017E	Unnamed Tributary of White Oak Bayou (unclassified water body)	Freshwater			X
1101	Clear Creek Tidal	Saltwater			X
1101B	Chigger Creek (unclassified water body)	Freshwater			X
1102	Clear Creek Above Tidal	Freshwater			X
1102A	Cowart Creek (unclassified water body)	Freshwater			X
1102B	Mary's Creek/ North Fork Mary's Creek (unclassified water body)	Freshwater			X
1103	Dickinson Bayou Tidal	Saltwater		X	X
1103A	Bensons Bayou (unclassified water body)	Saltwater		X	X
1103B	Bordens Gully (unclassified water body)	Saltwater			X
1103C	Geisler Bayou (unclassified water body)	Saltwater			X
1103D	Gum Bayou (unclassified water body)	Saltwater			X
1104	Dickinson Bayou Above Tidal	Freshwater			X
1202	Brazos River Below Navasota River	Freshwater		X	
1202H	Allen's Creek (unclassified water body)	Freshwater			X
1202J	Big Creek (unclassified water body)	Freshwater			X
1208	Brazos River Above Possum Kingdom Lake	Freshwater		X	
1209	Navasota River Below Lake Limestone	Freshwater		X	X
1209C	Carters Creek (unclassified water body)	Freshwater			X
1209G	Cedar Creek (unclassified water body)	Freshwater		X	X
1209I	Gibbons Creek (unclassified water body)	Freshwater		X	X
1209J	Shepherd Creek (unclassified water body)	Freshwater			X
1209K	Steele Creek (unclassified water body)	Freshwater			X
1210A	Navasota River above Lake Mexia (unclassified water body)	Freshwater			X

Table 8-6. Streams and Rivers with Nonsupported Contact Recreation Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

Segment Number	Segment Description	Water Body Type	Concern		Non Support
			T1	T2	
1211	Yegua Creek	Freshwater		X	
1211A	Davidson Creek (unclassified water body)	Freshwater			X
1212B	East Yegua Creek (unclassified water body)	Freshwater			X
1213	Little River	Freshwater		X	
1217	Lampasas River Above Stillhouse Hollow Lake	Freshwater		X	X
1218	Nolan Creek/ South Nolan Creek	Freshwater		X	X
1221	Leon River Below Proctor Lake	Freshwater			X
1221A	Resley Creek (unclassified water body)	Freshwater	X		
1226B	Green Creek (unclassified water body)	Freshwater			X
1226E	Indian Creek (unclassified water body)	Freshwater			X
1226F	Sims Creek (unclassified water body)	Freshwater			X
1227	Nolan River	Freshwater			X
1241A	North Fork Double Mountain Fork Brazos River (unclassified water body)	Freshwater	X		
1242	Brazos River Above Navasota River	Freshwater			X
1242D	Thompson Creek (unclassified water body)	Freshwater			X
1242F	Pond Creek (unclassified water body)	Freshwater		X	
1242I	Campbells Creek (unclassified water body)	Freshwater			X
1242K	Mud Creek (unclassified water body)	Freshwater			X
1242L	Pin Oak Creek (unclassified water body)	Freshwater			X
1242M	Spring Creek (unclassified water body)	Freshwater			X
1242N	Tehuacana Creek (unclassified water body)	Freshwater			X
1242P	Big Creek (unclassified water body)	Freshwater			X
1244	Brushy Creek	Freshwater	X		
1245	Upper Oyster Creek	Freshwater		X	X

Table 8-6. Streams and Rivers with Nonsupported Contact Recreation Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

Segment Number	Segment Description	Water Body Type	Concern		Non Support
			T1	T2	
1246E	Wasp Creek (unclassified water body)	Freshwater			X
1247A	Willis Creek (unclassified water body)	Freshwater			X
1248C	Mankins Branch (unclassified water body)	Freshwater	X		
1255	Upper North Bosque River	Freshwater			X
1255A	Goose Branch (unclassified water body)	Freshwater			X
1255B	North Fork Upper North Bosque River (unclassified water body)	Freshwater			X
1255C	Scarborough Creek (unclassified water body)	Freshwater			X
1255D	South Fork North Bosque River (unclassified water body)	Freshwater			X
1255E	Unnamed tributary of Goose Branch (unclassified water body)	Freshwater			X
1255F	Unnamed tributary of Scarborough Creek (unclassified water body)	Freshwater			X
1255G	Woodhollow Branch (unclassified water body)	Freshwater			X
1302	San Bernard River Above Tidal	Freshwater			X
1305	Caney Creek Above Tidal	Freshwater			X
1403G	Tanglewood Tributary to Bull Creek (unclassified water body)	Freshwater		X	
1403J	Spicewood Tributary to Shoal Creek (unclassified water body)	Freshwater			X
1403K	Taylor Slough South (unclassified water body)	Freshwater			X
1403R	Unnamed tributary to Lake Austin (unclassified water body)	Freshwater		X	
1425A	North Concho River (unclassified water body)	Freshwater	X		
1428B	Walnut Creek (unclassified water body)	Freshwater	X		

Table 8-6. Streams and Rivers with Nonsupported Contact Recreation Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

Segment Number	Segment Description	Water Body Type	Concern		Non Support
			T1	T2	
1428C	Gilleland Creek (unclassified water body)	Freshwater		X	X
1429C	Waller Creek (unclassified water body)	Freshwater	X		
1501	Tres Palacios Creek Tidal	Saltwater		X	
1502	Tres Palacios Creek Above Tidal	Freshwater			X
1803B	Sandies Creek (unclassified water body)	Freshwater		X	X
1803C	Peach Creek (unclassified water body)	Freshwater			X
1806	Guadalupe River Above Canyon Lake	Freshwater			X
1810	Plum Creek	Freshwater	X		
1901	Lower San Antonio River	Freshwater			X
1902	Lower Cibolo Creek	Freshwater	X		
1906	Lower Leon Creek	Freshwater	X		X
1910	Salado Creek	Freshwater		X	X
1910A	Walzem Creek (unclassified water body)	Freshwater			X
1911	Upper San Antonio River	Freshwater	X	X	X
1912	Medio Creek	Freshwater		X	
2001	Mission River Tidal	Saltwater	X		
2002	Mission River Above Tidal	Freshwater	X		
2003	Aransas River Tidal	Saltwater	X		
2106	Nueces/Lower Frio River	Freshwater	X		
2107	Atascosa River	Freshwater	X		
2117	Frio River Above Choke Canyon Reservoir	Freshwater	X	X	X
2202	Arroyo Colorado Above Tidal	Freshwater	X		X
2302	Rio Grande Below Falcon Reservoir	Freshwater Stream			X
2302A	Arroyo Los Olmos (unclassified water body)	Freshwater Stream	X		

Table 8-6. Streams and Rivers with Nonsupported Contact Recreation Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

Segment Number	Segment Description	Water Body Type	Concern		Non Support
			T1	T2	
2304	Rio Grande Below Amistad Reservoir	Freshwater Stream			X
2306	Rio Grande Above Amistad Reservoir	Freshwater Stream			X
2307	Rio Grande Below Riverside Diversion Dam	Freshwater Stream			X
2314	Rio Grande Above International Dam	Freshwater Stream			X
2424A	Highland Bayou (unclassified water body)	Saltwater			X
2424C	Marchand Bayou (unclassified water body)	Saltwater		X	X
2425B	Jarbo Bayou (unclassified water body)	Saltwater			X
2425C	Robinson Bayou (unclassified water body)	Saltwater			X
2485A	Oso Creek (unclassified water body)	Saltwater	X		X

Table 8-7. Streams and Rivers with Partial and Nonsupported General Uses, Tier 1 Concerns, and Tier 2 Concerns

Segment Number	Water Body	General Use Support Indicator					
		Temp	Low pH	High pH	Chloride	Sulfate	TDS
0211	Little Wichita River						NS
0220	Upper Pease/North Fork Pease River	T2					
0306	Upper South Sulphur River			PS			
0402	Big Cypress Creek Below Lake O' the Pines		T2/PS				
0406	Black Bayou		T2				
0508	Adams Bayou Tidal		T2	T2			
0511	Cow Bayou Tidal		T2/PS				

Table 8.7. Streams and Rivers with Partial and Nonsupported General Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

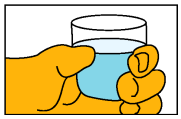
Segment Number	Water Body	General Use Support Indicator					
		Temp	Low pH	High pH	Chloride	Sulfate	TDS
0514	Big Sandy Creek		T1				
0606	Neches River Above Lake Palestine		T1/PS				
0607	Pine Island Bayou		T2				
0608	Village Creek		PS				
0611	Angelina River Above Sam Rayburn Reservoir		T1				
0812	West Fork Trinity River Above Bridgeport Reservoir				T1		T1
1007	Houston Ship Channel/Buffalo Bayou Tidal			T1			
1101	Clear Creek Tidal			T2			
1102	Clear Creek Above Tidal				NS		NS
1113	Armand Bayou Tidal			T2			
1206	Brazos River Below Possum Kingdom Lake	T2					
1226	North Bosque River						
1227	Nolan River					NS	
1238	Salt Fork Brazos River	T1			NS		NS
1248	San Gabriel/North Fork San Gabriel River						NS
1255	Upper North Bosque River						
1426	Colorado River Below E. V. Spence Reservoir				NS		NS
2115	Seco Creek	T2					
2203	Petronila Creek Tidal	PS					
2204	Petronila Creek Above Tidal				NS	NS	NS

Table 8.7. Streams and Rivers with Partial and Nonsupported Uses, Tier 1 Concerns, and Tier 2 Concerns (Continued)

Segment Number	Water Body	General Use Support Indicator					
		Temp	Low pH	High pH	Chloride	Sulfate	TDS
2307	Rio Grande Below Riverside Diversion Dam				NS		NS

alkaline pH values contributed to partial support of general uses in the Upper South Sulphur River (Segment 0306), a Tier 1 concern in the Houston Ship Channel (Segment 1007), and three Tier 2 concerns.

Elevated surface water temperatures exceeded criteria in hot summer months causing partial support of general uses in and Petronila Creek (Segment 2204)(Table 8-7). Elevated water temperatures resulted in one Tier 1 concern and two Tier 2 concerns on four streams and rivers.



Public Water Supply Use Support

The public water supply use is assigned to stream and rivers where water is withdrawn and treated for public consumption. Assessment of the use is based on evaluation of organic chemicals in water (after treatment at the entry to distribution systems) specified in the Public Drinking Water Standards.

All 8,778 stream and river miles assigned the public water supply use were assessed (Table 8-1). Due to the very low occurrence of organic chemicals in finished drinking water, nearly all streams and rivers fully support the public water supply use. The lower Sabinal River (Segment 2110) was the only with a nonsupported public water supply use due to elevated nitrite plus nitrate nitrogen concentrations.

Fish Consumption Use Support

Fish consumption advisories are issued by the TDH to protect the public from consuming harmful quantities of toxic pollutants in contaminated noncommercial fish and wildlife. In general, the advisories recommend that the public limit the quantity and frequency of consumption of fish and other organisms (shrimp, crabs, and oysters) from contaminated water bodies. Individual advisories are issued following extensive sampling and completion of a risk assessment for each water body. The advisories are then tailored to each water body to minimize health risks based on contaminant data collected in the fish tissue.

Advisories may completely prohibit consumption in severely polluted waters or limit consumption to several meals for a month or year in cases of less severe contamination. Advisories may target a subpopulation at risk (such as children, pregnant women, or nursing mothers), specific fish species that concentrate toxic pollutants in the flesh, or larger, older fish within a species that may have accumulated high concentrations of a pollutant over a longer lifetime than a smaller, younger fish. In severe cases of pollution, an aquatic life closure may be issued by the TDH, which prohibits the taking of all species from a water body.

Human health criteria for toxic substances in water are other indicators that are used to determine support of the fish consumption use. Human health criteria are back-calculated from fish tissue concentrations. Exceedance of the criteria by average toxic substances concentrations in water suggest that concentrations in fish tissue could also be elevated.

The fish consumption use was only assessed in 1,616 stream and river miles (8% of 20,286 surveyed miles) by human health criteria. All of the assessed miles fully supported the use. Tier 1 concerns were identified for the Angelina River (Segment 0611, lead) and the Houston Ship Channel (Segment 1006, mercury).

The fish consumption use was assessed in only 395 stream and river miles (2% of 20,286 surveyed miles) due to the high cost associated with laboratory preparation and analytical determination of toxic substances (approximately $2,275 per sample for a full scan of toxic substances) (Table 8-2). Within the assessed miles, 86 percent fully support the fish consumption use, five percent partially supported the use, and nine percent failed to support the use. Evaluation of human health criteria with toxic substances in water data was more frequently used to assess support of the fish consumption use than issuance of consumption advisories or closures (Table 8-2). However, only about eight percent of stream and river miles surveyed were assessed for the fish consumption use based on human health criteria. One hundred percent of the 1,616 miles assessed using the human health criteria fully supported the fish consumption use. The East Fork Angelina River (Segment 0611A; lead) and an unnamed tributary to Bryan Municipal Lake (Segment 1209A; arsenic) were the only two streams assessed where contaminants exceeded human health criteria.

Due to existing consumption advisories and closures, 395 stream and river miles (2% of surveyed miles) were considered assessed for the fish consumption use (Table 8-2). Of these assessed miles, about 28 percent fully supported the use, 27 percent partially supported the use, and 45 percent failed to support the use. The fish consumption use is not supported in several reaches

of the upper Trinity River (Segments 0805, 0806, 0829, and 0841) within the Dallas-Fort Worth metroplex due to issuance in January 1990 of an aquatic life closure. The closure prohibits the taking of all fish species from the affected reaches due elevated concentrations of chlordane and PCBs in fish tissue. Chlordane has been used historically for residential pest control. PCBs were used primarily as a dielectric fluid in capacitors and transformers. The use of both chlordane and PCBs have been banned by the EPA for most uses. Both organic substances were probably carried into the river system by urban runoff

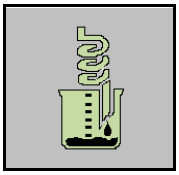
Within the Houston Ship Channel (Segments 1005, 1006, and 1007), the tidal portions of the San Jacinto River (Segment 1001) and Cedar Bayou (Segment 00901), and the tidal portions of unclassified streams that flow into the Houston Ship Channel, the fish consumption use is not supported due to issuance in September 1990 of a no-consumption advisory for children and women of child bearing age. The advisory recommends that this subpopulation not consume catfish and blue crabs due to elevated dioxin in their tissues. A restricted consumption advisory for the Arroyo Colorado (Segment 2202) was issued by the TDH in June 2001, due to elevated DDE, chlordane, and toxaphene concentrations in fish tissue. These pesticides likely entered the stream by agricultural runoff.

The fish consumption use is partially supported in Big Cypress Creek (Segment 0402) upstream of Caddo Lake and Black Cypress Bayou (Segment 402A) due to issuance of restricted consumption advisories for the general population. Largemouth bass and freshwater drum from the streams contain elevated concentrations of mercury in their tissues. Mercury is a naturally occurring element that can be toxic if consumed in contaminated fish by humans and animals. Sources of mercury include weathering of the earth's crust, the burning of fossil fuels and garbage, and factories that use mercury. The specific source of mercury in fish from East Texas is atmospheric deposition. Bioaccumulation of mercury in east Texas fishes occurs primarily because of natural processes in streams and reservoirs related to low pH, elevated organic carbon, and low dissolved oxygen concentrations (Twidwell, 2000).

Streams and Rivers Secondary Concerns Assessment

Water quality criteria for nutrients and chlorophyll *a* in water have not been developed for Texas. The TNRCC is currently evaluating the feasibility of developing nutrient criteria with a goal for implementation in 2003. Sediment criteria have been developed by EPA for only a few parameters. Screening levels for some toxicants in fish tissue were developed from human health

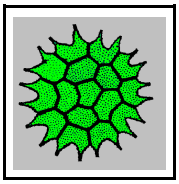
criteria in the TSWQS. The screening levels do not represent adopted state criteria. Secondary standards for dissolved mineral concentrations in finished drinking water are used to identify public water supply concerns. Dissolved mineral data collected from surface water is also screened against the secondary standards to identify public water supply concerns. Exceedances of screening levels for nutrients, chlorophyll *a*, toxic substances in sediment, and toxic substances in fish tissue do not cause direct impairment of designated uses. Instead, they are used to identify areas where elevated concentrations are cause for secondary concerns. The framework, indicators, and screening levels used to evaluate water quality concerns are discussed in the "Surface Water Assessment Methodology" section. Water bodies with identified concerns are targeted by the TNRCC and CRP for increased fixed station monitoring and/or special studies to identify possible causes and sources.



Nutrient Concerns

Approximately 20,286 stream and river miles were surveyed to identify areas of concern caused by elevated concentrations of ammonia nitrogen, nitrite plus nitrate nitrogen, orthophosphorus, and total phosphorus (Table 8-8). Sufficient data were available to provide assessment in about 50 percent of stream and river miles surveyed for each of the four nutrient indicators. Of the miles assessed in streams and rivers, water quality concerns were identified in only 13 percent for ammonia nitrogen, 15 percent for nitrite plus nitrate nitrogen, six percent for orthophosphorus, and 12 percent for total phosphorus.

Ninety-six streams and rivers (37 classified; 59 unclassified) were identified with concerns for ammonia nitrogen; 59 (43 classified; 35 unclassified) with concerns for nitrite plus nitrate nitrogen; 55 (36 classified; 19 unclassified) for orthophosphorus; and 42 (29 classified; 13 unclassified) for total phosphorus (Table 8-8). Most of the streams and rivers identified with nutrient concerns receive heavy municipal point source and urban nonpoint source loadings. In Geronimo Creek (Segment 1804) elevated nitrite plus nitrate nitrogen concentrations originate from groundwater (spring) sources.



Chlorophyll a Concerns

Approximately 20,287 stream and river miles were surveyed to identify areas of concern caused by elevated concentrations of chlorophyll *a* (Table 8-8). Sufficient data were available to provide assessment of 5,542 stream and river miles (27% of surveyed miles). Concerns were identified in 17 percent of the assessed stream and river miles. Forty-one (33 classified; 8 unclassified) streams and rivers were identified with elevated chlorophyll *a* concentrations (Table 8-9). Poor correlation is shown between stream and rivers with nutrient concerns and those with chlorophyll *a* concerns. Of the 41 streams and rivers

Table 8-8. Individual Nutrient and Chlorophyll *a* Concerns in Streams and Rivers - 2002

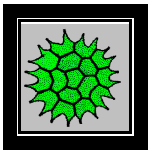
Concern Paramter	Miles Surveyed	Miles Assessed	Percent of Miles Assessed	Percent of Assessed Miles	
				No Concern	Concern
 Ammonia	20,286.44	8,711.00	42.94	87	13
 Nitrate + Nitrite	20,286.44	10,383.66	51.19	85	15
 Orthophosphorus	20,286.44	9,043.83	44.58	89	11
 Total Phosphorus	20,286.44	7,076.60	34.88	88	12
 Chlorophyll a	20,286.44	5,542.00	27.32	83	17

Table 8.9. Streams and Rivers with Secondary Concerns for Nutrients and Chlorophyll *a*

Segment Number	Water Body	Nutrient				Chl *a*
		NH_3-N	NO_2+NO_3 -N	OPhos	TPhos	
0101	Canadian River Below Lake Meredith	X				
0103A	East Amarillo Creek (unclassified water body)		X			
0202D	Pine Creek (unclassified water body)	X		X		
0204	Red River Above Lake Texoma					X
0205	Red River Below Pease River					X
0211	Little Wichita River					X
0214	Wichita River Below Diversion Lake Dam	X		X	X	X
0214A	Beaver Creek (unclassified water body)	X				
0216	Wichita River Below Lake Kemp Dam	X				
0220	Upper Pease/North Fork Pease River	X				
0226	South Fork Wichita River	X				
0229	Upper Prairie Dog Town Fork Red River		X	X	X	
0301	Sulphur River Below Wright Patman Lake					X
0306	Upper South Sulphur River		X	X		
0402	Big Cypress Creek Below Lake O' the Pines					X
0404	Big Cypress Creek Below Lake Bob Sandlin		X	X	X	
0406	Black Bayou	X				
0407	James' Bayou	X				
0409A	Lilly Creek (unclassified water body)	X				
0507A	Cowleech Fork Sabine River (unclas-sified water body)		X	X		
0507B	Long Branch (unclassified water body)		X			

Table 8-9. Streams and Rivers with Secondary Concerns for Nutrients and Chlorophyll *a*

Segment Number	Water Body	Nutrient				
		NH_3-N	NO_2+NO_3 -N	OPhos	TPhos	Chl *a*
0512A	Running Creek (unclassified water body)	X	X			
0512B	Elm Creek (unclassified water body)	X				
0601A	Star Lake Canal (unclassified water body)		X	X	X	
0604A	Cedar Creek (unclassified water body)	X	X			
0604B	Hurricane Creek (unclassified water body)	X				
0604C	Jack Creek (unclassified water body)	X	X			
0605A	Kickapoo Creek (unclassified water body)	X				
0606	Neches River Above Lake Palestine		X			
0611B	La Nana Bayou (unclassified water body)	X				
0611D	West Mud Creek (unclassified water body)		X			
0615A	Papermill Creek (unclassified water body)	X		X	X	
0701	Taylor Bayou Above Tidal					X
0702A	Alligator Bayou (unclassified water body)					X
0704	Hillebrandt Bayou	X				X
0803A	Harmon Creek (unclassified water body)			X	X	
0804	Trinity River Above Lake Livingston		X	X	X	X
0805	Upper Trinity River	X	X	X	X	
0806	West Fork Trinity River Below Lake Worth					X
0819	East Fork Trinity River	X	X	X		

Table 8-9. Streams and Rivers with Secondary Concerns for Nutrients and Chlorophyll *a*

Segment Number	Water Body	Nutrient				
		NH_3-N	NO_2+NO_3 -N	OPhos	TPhos	Chl *a*
0820C	Muddy Creek (unclassified water body)	X	X			
0822	Elm Fork Trinity River Below Lewisville Lake	X				X
0823A	Little Elm Creek (unclassified water body)	X				
0824	Elm Fork Trinity River Above Ray Roberts Lake	X	X	X	X	X
0826A	Denton Creek (unclassified water body)	X				
0831	Clear Fork Trinity River Below Lake Weatherford			X		
0840A	Unnamed tributary of Jordan Creek (unclassified water body)	X		X		
0841	Lower West Fork Trinity River		X	X	X	
1004	West Fork San Jacinto River		X	X		
1006	Houston Ship Channel Tidal	X	X			
1006D	Halls Bayou Below US 59 (unclassified water body)	X				
1006E	Halls Bayou Above US 59 (unclassified water body)	X				
1006F	Big Gulch Above Tidal (unclassified water body)	X				
1006H	Spring Gully Above Tidal (unclassified water body)	X				
1006I	Unnamed Tributary of Halls Bayou (unclassified water body)	X				
1006J	Unnamed Tributary of Halls Bayou (unclassified water body)	X				
1007	Houston Ship Channel/Buffalo Bayou Tidal	X	X	X	X	

Table 8-9. Streams and Rivers with Secondary Concerns for Nutrients and Chlorophyll *a*

Segment Number	Water Body	Nutrient				Chl *a*
		NH_3-N	NO_2+NO_3 -N	OPhos	TPhos	
1007B	Brays Bayou Above Tidal (unclassified water body)	X	X	X	X	
1007C	Keegans Bayou Above Tidal (unclassified water body)	X				
1007D	Sims Bayou Above Tidal (unclassified water body)	X				
1007F	Berry Bayou Above Tidal (unclassified water body)	X				
1007G	Kuhlman Gully Above Tidal (unclassified water body)	X				
1007H	Pine Gully Above Tidal (unclassified water body)	X				
1007I	Plum Creek Above Tidal (unclassified water body)	X				
1007K	Country Club Bayou Above Tidal (unclassified water body)	X				
1007N	Unnamed Non-Tidal Tributary of Sims Bayou (unclassified water body)	X				
1007O	Unnamed Non-Tidal Tributary of Buffalo Bayou (unclassified water body)	X				
1007P	Brays Bayou Above Tidal (unclassified water body)	X				
1007Q	Sims Bayou Above Tidal (unclassified water body)	X	X	X	X	
1007R	Hunting Bayou Above Tidal (unclassified water body)	X				
1008	Spring Creek		X	X	X	
1008B	Upper Panther Branch (unclassified water body)	X			X	
1008G	Upper Panther Branch above Bear Branch (unclassified water body)	X				
1009	Cypress Creek	X	X	X	X	

Table 8-9. Streams and Rivers with Secondary Concerns for Nutrients and Chlorophyll *a*

Segment Number	Water Body	Nutrient				Chl *a*
		NH_3-N	NO_2+NO_3 -N	OPhos	TPhos	
1013	Buffalo Bayou Tidal		X	X	X	
1013A	Little White Oak Bayou (unclassified water body)	X				
1013C	Unnamed Non-Tidal Tributary of Buffalo Bayou Tidal (unclassified water body)	X				
1014	Buffalo Bayou Above Tidal	X	X	X	X	
1014M	Neimans Bayou (unclassified water body)	X				
1014N	Rummel Creek (unclassified water body)	X				
1016	Greens Bayou Above Tidal	X	X	X	X	
1016A	Garners Bayou (unclassified water body)	X				
1016C	Unnamed Tributary of Greens Bayou (unclassified water body)	X				
1016D	Unnamed Tributary of Greens Bayou (unclassified water body)	X				
1017	Whiteoak Bayou Above Tidal	X	X	X	X	
1017A	Brickhouse Gully/Bayou (unclassified water body)	X				
1017B	Cole Creek (unclassified water body)	X				
1017D	Unnamed Tributary of White Oak Bayou (unclassified water body)	X				
1101B	Chigger Creek (unclassified water body)	X				
1102	Clear Creek Above Tidal	X	X	X	X	
1102A	Cowart Creek (unclassified water body)	X				
1102B	Mary's Creek/ North Fork Mary's Creek (unclassified water body)	X				

Table 8-9. Streams and Rivers with Secondary Concerns for Nutrients and Chlorophyll *a*

Segment Number	Water Body	Nutrient				Chl *a*
		NH_3-N	NO_2+NO_3 -N	OPhos	TPhos	
1104	Dickinson Bayou Above Tidal	X				
1113	Armand Bayou Tidal					X
1202	Brazos River Below Navasota River					X
1202H	Allen's Creek (unclassified water body)			X		
1208	Brazos River Above Possum Kingdom Lake					X
1209C	Carters Creek (unclassified water body)		X	X		
1218	Nolan Creek/ South Nolan Creek		X	X	X	
1221	Leon River Below Proctor Lake					X
1226	North Bosque River					X
1226B	Green Creek (unclassified water body)					X
1226E	Indian Creek (unclassified water body)		X			
1227	Nolan River		X	X		
1232	Clear Fork Brazos River		X	X		
1232A	California Creek (unclassified water body)		X			
1232B	Deadman Creek (unclassified water body)		X	X	X	
1238	Salt Fork Brazos River	X				
1241A	North Fork Double Mountain Fork Brazos River (unclassified water body)		X			X
1242D	Thompson Creek (unclassified water body)		X	X		
1243	Salado Creek		X			
1244	Brushy Creek		X	X		

Table 8-9. Streams and Rivers with Secondary Concerns for Nutrients and Chlorophyll *a*

Segment Number	Water Body	Nutrient				
		NH_3-N	NO_2+NO_3 -N	OPhos	TPhos	Chl *a*
1246	Middle Bosque/South Bosque River		X			
1246D	Tonk Creek (unclassified water body)		X			
1246E	Wasp Creek (unclassified water body)		X			
1247A	Willis Creek (unclassified water body)		X			
1253	Navasota River Below Lake Mexia	X				X
1255	Upper North Bosque River	X	X	X	X	X
1255A	Goose Branch (unclassified water body)	X	X	X	X	
1255B	North Fork Upper North Bosque River (unclassified water body)	X		X		X
1255C	Scarborough Creek (unclassified water body)	X		X	X	
1255D	South Fork North Bosque River (unclassified water body)	X				X
1255E	Unnamed tributary of Goose Branch (unclassified water body)	X		X	X	
1304A	Linnville Bayou (unclassified water body)	X				
1402C	Buckners Creek (unclassified water body)					X
1403D	Barrow Preserve Tributary (unclassified water body)		X			
1403E	Stillhouse Hollow (unclassified water body)		X			
1403J	Spicewood Tributary to Shoal Creek (unclassified water body)		X			
1403K	Taylor Slough South (unclassified water body)		X			
1412B	Beals Creek (unclassified water body)		X			

Table 8-9. Streams and Rivers with Secondary Concerns for Nutrients and Chlorophyll *a*

Segment Number	Water Body	Nutrient				Chl *a*
		NH_3-N	NO_2+NO_3 -N	OPhos	TPhos	
1416A	Brady Creek (unclassified water body)		X	X	X	X
1417	Lower Pecan Bayou		X			X
1418A	Hords Creek (unclassified water body)					X
1421	Concho River	X	X			X
1421A	Dry Hollow Creek (unclassified water body)		X			
1421B	Kickapoo Creek (unclassified water body)		X			
1421D	Little Concho River (unclassified water body)		X			
1423A	Spring Creek (unclassified water body)	X				
1426	Colorado River Below E. V. Spence Reservoir	X				X
1426B	Elm Creek (unclassified water body)		X			
1428	Colorado River Below Town Lake		X	X		
1428B	Walnut Creek (unclassified water body)		X		X	
1428C	Gilleland Creek (unclassified water body)		X	X		
1431	Mid Pecan Bayou		X	X	X	
1434	Colorado River above La Grange		X			
1604A	East Mustang Creek (unclassified water body)	X				
1801	Guadalupe River Tidal		X			
1802	Guadalupe River Below San Antonio River		X			
1803B	Sandies Creek (unclassified water body)	X				

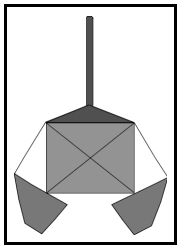
Table 8-9. Streams and Rivers with Secondary Concerns for Nutrients and Chlorophyll *a*

Segment Number	Water Body	Nutrient				Chl *a*
		NH_3-N	NO_2+NO_3 -N	OPhos	TPhos	
1803C	Peach Creek (unclassified water body)	X				
1804	Guadalupe River Below Comal River					X
1804A	Geronimo Creek (unclassified water body)		X			
1810	Plum Creek	X	X		X	
1901	Lower San Antonio River		X	X	X	
1903	Medina River Below Medina Diversion Lake	X	X	X	X	
1908	Upper Cibolo Creek			X		
1911	Upper San Antonio River	X	X	X	X	
1912	Medio Creek			X	X	
1912A	Upper Medio Creek (unclassified water body)	X				
1913	Mid Cibolo Creek	X	X	X	X	
2003	Aransas River Tidal			X		
2101	Nueces River Tidal					X
2107	Atascosa River	X				X
2109	Leona River		X			
2110	Lower Sabinal River		X			
2117	Frio River Above Choke Canyon Reservoir		X			X
2201	Arroyo Colorado Tidal	X	X			
2202	Arroyo Colorado Above Tidal	X	X	X	X	X
2203	Petronila Creek Tidal					X
2204	Petronila Creek Above Tidal					X
2301	Rio Grande Tidal					X
2302	Rio Grande Below Falcon Reservoir				X	

Table 8-9. Streams and Rivers with Secondary Concerns for Nutrients and Chlorophyll *a*

Segment Number	Water Body	Nutrient				
		NH_3-N	NO_2+NO_3 -N	OPhos	TPhos	Chl *a*
2304	Rio Grande Below Amistad Reservoir	X			X	
2306	Rio Grande Above Amistad Reservoir					X
2307	Rio Grande Below Riverside Diversion Dam	X		X	X	X
2308	Rio Grande Below International Dam	X		X	X	
2314	Rio Grande Above International Dam	X				X
2485A	Oso Creek (unclassified water body)		X	X	X	

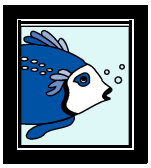
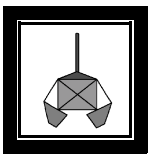
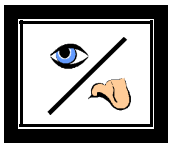
identified with chlorophyll *a* concerns, only seven had concerns for at least one of the nutrient indicators. This demonstrates some of the difficulties that will be encountered in the development of water quality criteria for nutrients. In many cases, elevated nutrient concentrations do not produce responding elevated chlorophyll *a* concentrations. Other factors, such as turbidity, stream flow characteristics, and tree canopy shading influence the availability of nutrients and their assimilation by aquatic plants.

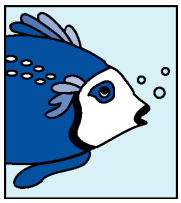


Sediment Concerns

Due to high laboratory costs (approximately $2,175 per sample) associated with analytical determination of metals and organic substances in combination with conventional parameters, sediment sampling is not widespread and is generally targeted to areas likely to be contaminated by point and nonpoint sources. Of the 20,286 stream and river miles surveyed, only 147 (< 1% of surveyed miles) were assessed for sediment concerns (Table 8-10). Of the assessed miles, 92 percent were identified with concerns for one or more metal or organic substance. Eight (6 classified; 2 unclassified) streams and rivers were identified with sediment concerns (Table 8-11). Most of the identified sediment contaminants were metals. Only five stream and rivers were identified with elevated organic substances in sediment.

Table 8-10. Overall Concerns for Public Water Supply, Fish Tissue Contaminants, Sediment Contaminants, and Narrative Criteria in Streams and Rivers

Concern Parameter	Miles Surveyed	Miles Assessed	Percent of Miles Assessed	Percent of Assessed Miles	
				No Concern	Concern
 Public Water Supply	8,779.70	8,779.70	100.00	82	18
 Fish Tissue Contaminant	20,286.44	192.30	0.95	99	< 1
 Sediment Contaminant	20,286.44	146.70	0.72	37	63
 Narrative Criteria	20,286.44	20,286.44	100.00	99	1



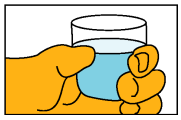
Fish Tissue Concerns

Due to high laboratory costs associated with tissue preparation and analytical determinations of metals and organic substances in tissue, fish tissue sampling in streams and rivers is very limited statewide. Of the 20,286 stream and river miles surveyed, only 192 (<1% of surveyed miles) were assessed for fish tissue concerns (Table 8-10). Of the 192 miles assessed, one percent were identified with fish tissue concerns. Fish from the Black Cypress Bayou (Segment 0402) exceeded screening levels for mercury. A restricted consumption advisory has been issued for the

Table 8-11. Streams and Rivers with Secondary Concerns for Toxic Substances in Sediment

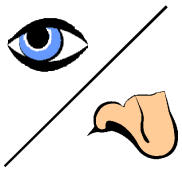
Segment Number	Water Body	Water Type	Sediment Contaminant
0214	Wichita River Below Diversion Lake Dam	Freshwater	nickel
1006	Houston Ship Channel Tidal	Saltwater	1,3-dichlorobenzene, acenapthene, acenapthylene, anthracene, barium, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethyhexyl) phthalate, chromium, chrysene, copper, fluoranthene, fluorene, hexachlorobenzene, hexachlorobutadiene, mercury, napthalene, nickel, phenanthrene, pyrene, zinc
1007	Houston Ship Channel/Buffalo Bayou Tidal	Saltwater	cadmium, copper, zinc
1208	Brazos River Above Possum Kingdom Lake	Freshwater	arsenic, barium, chromium, copper
1429D	East Bouldin Creek (unclassified water body)	Freshwater	benzo(a)anthracene, benzo(ghi)perylene, cadmium, chrysene, dibenz(a,h)anthracene, fluoranthene, ideno(1,2,3-cd)pyrene, lead, phenanthrene, pyrene
1430	Barton Creek	Freshwater	benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, cadmium, chrysene, dibenz(a,h)anthracene, fluoranthene, ideno(1,2,3-cd)pyrene, lead, phenanthrene, pyrene, silver, zinc
1430A	Barton Springs (unclassified water body)	Freshwater	arsenic, copper
1906	Lower Leon Creek	Freshwater	cadmium, chromium, lead, nickel, silver, zinc

stream by the TDH due to elevated mercury concentrations in edible fish tissue. Separate sampling of the water body by the TDH determined that tissue concentrations have no appreciable risk to human consumers.



Public Water Supply Concerns

Concerns are identified in finished drinking water (after treatment at the point of entry to the distribution system) and surface samples from streams and rivers designated for public water supply if average concentrations exceed secondary standards for chloride (300 mg/L), sulfate (300 mg/L), and TDS (1,000 mg/L). Public water supply systems that experience increased costs for demineralization are also identified as concerns. All of the 8,780 stream and river miles designated for public water supply were



assessed and 18 percent were identified with concerns (Table 8-10). Most of the streams and rivers identified with public water supply concerns for finished drinking water and surface water are located in the headwater regions of the Colorado and Brazos River basins or in arid western regions (Table 8-12). In these areas, natural conditions (brine seepage, groundwater seepage, high evaporation rates, and rainfall runoff from salt bearing strata) or inadequate disposal of brine water produced by oil and gas operations influence dissolved mineral concentrations in surface waters. In the Rio Grande, surface water is used repeatedly for irrigation, thereby increasing dissolved mineral concentrations.

Table 8-12. Streams and Rivers with Secondary Concerns for Public Water Supply

Segment Number	Segment Name	Finished Drinking Water			Surface Water			Increased Costs for Demineralization
		Cl	SO_4	TDS	Cl	SO_4	TDS	
1206D	Palo Pinto Creek below Palo Pinto Reservoir (unclassified water body)					X		
1242	Brazos River Above Navasota River							X
1410	Colorado River Below O. H. Ivie Reservoir				X			
1421	Concho River	X	X	X	X	X	X	
1426	Colorado River Below E. V. Spence Reservoir				X	X	X	
2104	Nueces River Above Frio River				X		X	
2104	Atascosa River						X	
2109	Leona River					X		
2117	Frio River Above Choke Canyon Reservoir				X		X	
2302	Rio Grande Below Falcon Reservoir	X	X	X				
2306	Rio Grande Above Amistad Reservoir	X	X	X		X	X	
2307	Rio Grande Below Riverside Diversion Dam				X	X	X	
2310	Lower Pecos River				X	X	X	

Narrative Criteria Concerns

All 20,286 stream and river miles were assessed to identify narrative criteria concerns. As examples, narrative criteria include floating debris and surface oil sheens, suspended solids and excessive foam, odor producing substances, dramatic changes in turbidity or color, and excessive algal growth (Table 8-10). Narrative concerns were identified in only one percent of assessed miles, involving 10 unclassified streams and six classified streams (Table 8-13). The most common narrative concerns identified overstimulation of algae by excessive nutrient concentrations. In Papermill Creek, color and odor of water is influenced by effluent from a paper mill.

Table 8-13. Streams and Rivers with Secondary Narrative Concerns

Segment Number	Water Body	Concern Parameter(s)
0402A	Black Cypress Bayou (unclassified water body)	metals in sediment
0615A	Papermill Creek (unclassified water body)	color
0702A	Alligator Bayou (unclassified water body)	chronic toxicity in sediment, metals in sediment, organics in fish tissue, organics in sediment
0824	Elm Fork Trinity River Above Ray Roberts Lake	excessive algal growth
1006	Houston Ship Channel Tidal	bacteria
1007	Houston Ship Channel/Buffalo Bayou Tidal	bacteria
1209D	Country Club Branch (unclassified water body)	copper in water
1221A	Resley Creek (unclassified water body)	nitrate+nitrite nitrogen
1244A	Brushy Creek Above South Brushy Creek (unclassified water body)	excessive algal growth, noxious aquatic plants
1248C	Mankins Branch (unclassified water body)	elevated nutrients, excessive algal growth
1304	Caney Creek Tidal	DO % saturation swings
1305	Caney Creek Above Tidal	total dissolved solids
1428	Colorado River Below Town Lake	impaired fish community, impaired macrobenthos community
1429C	Waller Creek (unclassified water body)	lead in sediment, organics in sediment
1803A	Elm Creek (unclassified water body)	depressed dissolved oxygen
1902A	Martinez Creek (unclassified water body)	nitrate+nitrite nitrogen, orthophosphorus, total phosphorus
1902B	Salatrillo Creek (unclassified water body)	nitrate+nitrite nitrogen, orthophosphorus, total phosphorus