

**APPENDIX M**

**SELECTION OF KEY WATER QUALITY PARAMETERS  
AND BASELINE WATER QUALITY CONDITIONS**



## Appendix M

### Selection of Key Water Quality Parameters and Baseline Water Quality Conditions

#### M.1 Key Water Quality Parameters Selection

Regional Water Planning Groups are charged with selecting key water quality parameters that are important to water uses in the region, and assessing impacts of water management strategies on these parameters. This appendix provides the parameter selection process and establishes baseline water quality conditions for the selected parameters.

In order to provide some basis for selection of parameters and for quantitative comparisons between different water bodies within the region, regulatory standards and screening levels are referenced throughout this memorandum. However, it is not the intent of this memorandum to evaluate regulatory compliance of any water body within the region. These regulatory standards are only used as “yardsticks” for relative comparisons of water quality within the region.

##### M.1.1 Process of Selecting Key Water Quality Parameters

Selection of key water quality parameters for surface water and groundwater involved a two-stage process. The first stage included a compilation of potential water quality parameters from various sources. These sources are described below:

- a) Parameters regulated by the Texas Commission on Environmental Quality (TCEQ) in the Texas Surface Water Quality Standards (TSWQS);
- b) Parameters considered for the TCEQ Water Quality Inventory in evaluation of whether water body uses are supported, not supported, or have water quality concerns. The designated water body uses included in the Water Quality Inventory are:
  - i. Aquatic life use
  - ii. Contact recreation use
  - iii. General use
  - iv. Fish consumption use
  - v. Public water supply use;
- c) Parameters that may impact suitability of water for irrigation; and
- d) Parameters that may impact treatability of water for municipal or industrial supply.

Categories a and b above were selected to represent environmental water quality parameters, and Categories c and d were selected to be representative of water quality as related to irrigation uses and treatability for municipal or industrial supplies.

For the second stage of the process, key water quality parameters were selected from this compiled list of potential parameters based on general guidelines which were established in Appendix P of the 2006

Region C Plan. The general guidelines used to further develop a manageable and meaningful list of key water quality parameters are described below.

- a) Selected parameters should be representative of water quality conditions that may be impacted on a regional scale and that are likely to be impacted by multiple water management strategies within the region. Water quality issues associated with localized conditions (such as elevated levels of a toxic material within one water body) will be addressed as necessary within the environmental impact evaluations of the individual water management strategies for each water user group. In addition, water quality parameters that could impact specific advanced treatment processes (e.g., membranes or ozone) will be addressed as necessary during pilot testing and/or preliminary design.
- b) Sufficient data must be available for a parameter in order to include it as a key water quality parameter. If meaningful statistical summaries cannot be carried out on the parameter, it should not be designated as a key water quality parameter.

### **M.1.2 Selection of Parameters for the 2016 Plan**

Potential key water quality parameters were assessed for the Region C planning area according to the process described above. Little has changed since 2011 in terms of parameters that may impact suitability for irrigation, municipal, or industrial purposes. Since development of the 2011 Plan, the TCEQ has added Surface Water Quality Standards for the following parameters:

- Toxics:
  - Nonylphenol and diazinon standards for all segments.
  - Site-specific copper and aluminum standards for various segments.
- Site-specific dissolved oxygen standards for various classified and unclassified segments.
- Site-specific chlorophyll-a standards for various reservoirs.
- Site-specific E. coli standards for various unclassified segments.

Any entity that proposes to discharge treated wastewater must show that the discharge will not cause a violation of the Surface Water Quality Standards to obtain a discharge permit. In addition, most of the new standards only apply to a few segments/locations in Region C. Therefore, with the exception of chlorophyll-a, it has been assumed that the newly regulated parameters will be addressed as necessary for each water user group within the environmental impact evaluations of the individual water management strategies or during preliminary wastewater treatment design.

Therefore, the first stage in the process of selecting key water quality parameters yielded the same candidate parameters as those in the 2006 and 2011 Region C Water Plans. In addition, baseline conditions are not anticipated to have changed significantly in the years since the 2006 Plan development and were not re-assessed in this round of planning. Due to similar baseline conditions and

unchanged assessment criteria, the key surface water quality parameters selected for the 2016 Plan are the same as those assessed in the 2011 Plan. Further information on specific candidate parameters and basis for selection, is available in Appendix P of the 2006 Plan.

Similarly, key water quality parameters were identified for groundwater based on an evaluation of the parameters regulated by drinking water standards and those known to be potential problems for groundwater in Region C.

The following key water quality parameters were selected to assess impacts from water management strategies:

- Surface Water:
  - Ammonia-nitrogen
  - Nitrate-nitrogen
  - Total phosphorous
  - Chlorophyll-a
  - Total dissolved solids (TDS)
- Groundwater
  - TDS

## **M.2.0 Baseline Water Quality Conditions**

Baseline water quality conditions were evaluated using data obtained from the Texas Surface Water Quality Monitoring Database. Water quality data for reservoirs and streams located within Region C were evaluated, as well as sources located outside of Region C that are currently being considered for use or are in use as raw water sources for the region. Statistical analyses were conducted to determine the number of data points (count), mean, median, 75<sup>th</sup> percentile, maximum, and minimum for each water body assessed. Data from 1/1/1998 through 12/31/2009 were assessed for each parameter. Statistical summaries for each surface water parameter are presented in Section 3.0 of this document.

To further demonstrate baseline water quality conditions in Region C, each water body was placed in categories based on parameter concentration. The lowest bin (Bin 1) constitutes levels that are less than regulatory or literature levels of concern. The second bin (Bin 2) represents parameter levels that are approaching regulatory standards or levels of concern (nominally 80 percent of regulated standard). The highest bin (Bin 3) represents parameter levels that exceed the stated regulatory standards, levels of concern, or screening criteria. Screening levels for nutrient parameters were based on the TCEQ *2008 Guidance for Assessing and Reporting Surface Water Quality in Texas*. For surface water assessment of TDS, screening levels were based on National Secondary Drinking Water Standards. For the groundwater TDS assessment, screening limits were based on the State of Texas Secondary Drinking Water Standard.

It is important to note that placement in Bins 2 or 3 does not necessarily indicate a violation of a water quality standard or the need for additional treatment levels. As mentioned earlier, the data presented here are summarized over the entire surface water segment (at all depths and all stations located in the

main water body) or the entire aquifer/county area. In many cases, regulatory application of the standard or level of concern is performed on a different group of data than are summarized here (e.g., for lake mixed layer samples only). The bin designations, while derived from regulatory standards, are only provided as a “yardstick” for assessing water quality conditions and as a basis for comparisons between water bodies. The bin designations are not to be used to evaluate whether conditions within a given water body are in compliance with regulatory standards. Tables M-1 and M-2 demonstrate baseline surface water and groundwater quality bins by parameter.

For TDS, the median value is used for comparison with the numerical regulatory standard or level of concern, but for nutrients and chlorophyll-a (parameters subject to the TCEQ secondary screening levels), the 75<sup>th</sup> percentile is used. This value was used for comparison because the TCEQ secondary screening levels are applied such that a source water is “of concern” when more than 25 percent of the samples taken exceed the numerical screening limit.

### **M.2.1 Surface Water Baseline Conditions**

The following sections summarize the baseline water quality conditions for each key surface water quality parameter. As discussed earlier, this review of baseline conditions is not intended to provide an evaluation of compliance with regulatory standards. When referenced, regulatory standards are only used as a means of making relative comparisons between water bodies.

With respect to nutrients, it should be noted that the impact of nutrients on chlorophyll-a concentrations is site-specific and can vary significantly between water bodies. Therefore, high levels of nutrients are not necessarily indicative of poor water quality in any given water body.

#### **Ammonia Nitrogen**

Ammonia Nitrogen levels were measured from 26 reservoirs between 1998 and 2008. Of the 26 reservoirs sampled, six demonstrated 75<sup>th</sup> percentile ammonia nitrogen concentrations ranging between 0.088 and 0.11 mg/L and fell into Bin 2. Lakes with screening levels exceeding 0.11 mg/L fell into Bin 3 and included Lake Ray Hubbard (Segment 820), Lake O’ the Pines (Segment 403), Benbrook Lake (Segment 830), Lewisville Lake (Segment 823), and Ray Roberts Lake (Segment 840). Lake Palestine (Segment 605), which is located on the Neches River in East Texas also had screening levels categorized as Bin 3. Fourteen other reservoirs fell into Bin 1 with screening levels less than 0.088 mg/L.

Of the twenty streams sampled for ammonia nitrogen, all but one stream fell below screening levels and were categorized as Bin 1. One stream exceeded the screening level of 0.33 mg/L and fell into Bin 3 and was the East Fork Trinity River (Segment 819). This contrasts with the 2006 Plan, where an analysis of samples collected between 1993 and 2004 yielded four streams that exceeded a similar screening level and fell into Bin 3.

**Table M-1: Definition of Baseline Surface Water Quality Bins by Parameter**

Parameter	Statistic Used for Comparison	Lower Bound of Bin 3	Basis of Lower Bound, Bin 3	Lower Bound of Bin 2	Basis of Lower Bound, Bin 2
Total Dissolved Solids	Median	500 mg/L	National Secondary Drinking Water Standard	400 mg/L	80 percent of secondary standard
Ammonia-Nitrogen (as N)	75th percentile	0.11 mg/L (reservoir) 0.33 mg/L (stream)	TCEQ 2008 Guidance for Assessing and Recording Surface Water Quality in Texas	0.088 mg/L (reservoir) 0.26 mg/L (stream)	80 percent of screening level
Nitrate-Nitrogen (as N)	75th percentile	0.37 mg/L (reservoir) 1.95 mg/L (stream)	TCEQ 2008 Guidance for Assessing and Recording Surface Water Quality in Texas	0.30 mg/L (reservoir) 1.56 mg/L (stream)	80 percent of screening level
Total Phosphorus (as P)	75th percentile	0.20 mg/L (reservoir) 0.69 mg/L (stream)	TCEQ 2008 Guidance for Assessing and Recording Surface Water Quality in Texas	0.16 mg/L (reservoir) 0.55 mg/L (stream)	80 percent of screening level
Chlorophyll-a	75th percentile	26.7 µg/L (reservoir) 14.1 µg/L (stream)	TCEQ 2008 Guidance for Assessing and Recording Surface Water Quality in Texas	21.4 µg/L (reservoir) 11.3 µg/L (stream)	80 percent of screening level

**Table M-2: Definition of Baseline Groundwater Quality Bins by Parameter**

Parameter	Statistic Used for Comparison	Lower Bound of Bin 3	Basis of Lower Bound, Bin 3	Lower Bound of Bin 2	Basis of Lower Bound, Bin 2
Total Dissolved Solids	Median	1000 mg/L	State of Texas Secondary Drinking Water Standard	500 mg/L	National Secondary Drinking Water Standard

## **Nitrate Nitrogen**

Twenty-three reservoirs were sampled for nitrate nitrogen concentrations in the Region C planning area. Nine of the 23 reservoirs demonstrated 75<sup>th</sup> percentile concentrations exceeding the Bin 3 screening criteria of 0.37 mg/L. Four reservoirs fell in Bin 2 (0.30 to 0.37 mg/L) and included Eagle Mountain Reservoir (Segment 809), Richland-Chambers Reservoir (Segment 836), Joe Pool Lake (Segment 838), and Cedar Creek Reservoir (Segment 818).

Of the 15 streams sampled for nitrate nitrogen concentrations, eleven fell below screening criteria and were classified into Bin 1 (< 1.56 mg/L). Four streams exceeded the screening criteria of 1.95 mg/L and were placed in Bin 3. Streams categorized as Bin 3 included Elm Fork Trinity River above Ray Roberts Lake (Segment 824), Upper Trinity River (Segment 805), Lower West Fork Trinity River (Segment 841), and East Fork Trinity River (Segment 819). There were no streams that fell within Bin 2 with concentrations ranging between 1.56 and 1.95 mg/L.

## **Total Phosphorous**

None of the 26 reservoirs sampled for total phosphorous in Region C exhibited 75<sup>th</sup> percentile concentrations that exceed the TCEQ screening level of 0.20 mg/L to be placed into Bin 3. One reservoir was found to approach screening levels and was placed into Bin 2 (0.16 to 0.20 mg/L). Wright-Patman Lake (Segment 302) demonstrated a 75<sup>th</sup> percentile concentration of 0.17 mg/L.

The same streams that fell into Bin 3 for elevated nitrate nitrogen concentrations demonstrated 75<sup>th</sup> percentile total phosphorous concentrations above the TCEQ screening level. In addition to these four streams, the Trinity River above Lake Livingston (Segment 804) exceeded screening levels ( $\geq 0.69$  mg/L) and was placed into Bin 3. Fourteen out of twenty streams sampled for total phosphorous were below the screening criteria and fell in Bin 1. One stream, Clear Fork Trinity River below Lake Weatherford (Segment 831) fell within Bin 2 with a 75<sup>th</sup> percentile concentration of 0.63 mg/L.

## **Chlorophyll-a**

Of the 25 reservoirs sampled for chlorophyll-a, fourteen fell into Bins 2 or 3, demonstrating 75<sup>th</sup> percentile concentrations approaching or exceeding screening levels. Five reservoirs fell into Bin 2 with concentrations ranging from 21.4 to 26.7  $\mu\text{g/L}$ , and nine exceeded 26.7  $\mu\text{g/L}$  and fell into Bin 3. Bin 2 reservoirs included Lake Texoma (Segment 203), Lake Fork (Segment 512), Grapevine Lake (Segment 826), Bardwell Reservoir (Segment 815), and Lewisville Lake (Segment 823).

Ten out of nineteen streams that were sampled for chlorophyll-a exceeded screening criteria of 14.1  $\mu\text{g/L}$  and fell into Bin 3. Two streams were categorized in Bin 2 with concentrations ranging from 11.3 to 14.1  $\mu\text{g/L}$ . Bin 2 streams included Clear Fork Trinity River above Lake Weatherford (Segment 833) and West Fork Trinity River above Bridgeport Reservoir (segment 812).



## **Total Dissolved Solids**

In general, concentrations of TDS in surface water for sampled water bodies were relatively low. Eight of 45 reservoirs and streams in the area approached or exceeded screening levels for TDS. Three water bodies were categorized into Bin 2 with median concentrations ranging from 400-500 mg/L. Bin 2 water bodies included the Upper Trinity River (Segment 805), Clear Fork Trinity River below Lake Weatherford (Segment 831), and the Lower West Fork Trinity River (Segment 841). Five water bodies demonstrated median concentrations above 500 mg/L and included East Fork Trinity River (Segment 819), Clear Fork Trinity River above Lake Weatherford (Segment 833), Red River above and below Lake Texoma (Segments 202 and 204), and Lake Texoma (Segment 203).

### **M.2.2 Groundwater Baseline Conditions**

The sole key water quality parameter selected for groundwater in Region C was TDS. Baseline conditions for TDS in groundwater have changed very little since development of the 2006 Plan and were not re-assessed in this round of planning. The groundwater quality data summary table may be found in Appendix P of the 2006 Plan. The following is a summary of data found in Appendix P of the 2006 Plan.

With the exception of the Carrizo-Wilcox Aquifer, most groundwater sources in Region C report median TDS concentrations greater than 500 mg/L, the secondary drinking water standard. The Trinity Aquifer beneath these counties generally reports median concentrations between 500 mg/L and 1,000 mg/L, with the majority of the wells reporting greater than 1,000 mg/L located in Wise, Denton, Collin, Tarrant, Dallas, and Ellis Counties. TDS concentrations in the Woodbine Aquifer are even greater, with the highest median concentrations occurring in the most urban counties and those counties immediately down-gradient (Dallas, Tarrant, Ellis, and Navarro). The southern portion of the Woodbine Aquifer in Dallas, Ellis, and Navarro Counties contains median TDS levels greater than 1,000 mg/L. Limited data were available for the Nacatoch Aquifer, and no data were available for the Queen City Aquifer.

### **M.3.0 Surface Water Quality Data Summary**

Tables M-3 through M-7 summarize surface water quality data by segment and parameter.

## Region C Surface Water Quality Summary by Segment and Parameter

*Data collected 1/1/1998 – 12/31/2009 (Source: TCEQ Water Quality Monitoring Database)*

<b>Table M-3: Ammonia Nitrogen, Total (mg/L as N)</b>									
Segment ID	Segment Description	Water Body Type	Count	Average	Median	75th Percentile	Max	Min	Bin
819	East Fork Trinity River	Stream	86	0.185	0.327	0.438	2.04	0.02	3
605	Lake Palestine	Lake	71	0.05	0.175	0.28	1.13	0.01	3
840	Ray Roberts Lake	Lake	116	0.07	0.184	0.193	1.62	0.02	3
822	Elm Fork Trinity River Below Lewisville Lake	Stream	248	0.1	0.139	0.16	1.42	0.02	1
839	Elm Fork Trinity River Below Ray Roberts Lake	Stream	9	0.05	0.090	0.16	0.24	0.02	1
831	Clear Fork Trinity River Below Lake Weatherford	Stream	44	0.085	0.245	0.153	3.13	0.02	1
824	Elm Fork Trinity River Above Ray Roberts Lake	Stream	121	0.08	0.215	0.15	6.74	0.02	1
823	Lewisville Lake	Lake	78	0.042	0.198	0.15	2.92	0.006	3
805	Upper Trinity River	Stream	287	0.09	0.118	0.14	1.81	0.02	1
825	Denton Creek	Stream	35	0.09	0.186	0.135	1.53	0.05	1
833	Clear Fork Trinity River Above Lake Weatherford	Stream	20	0.06	0.084	0.133	0.17	0.02	1
830	Benbrook Lake	Lake	321	0.05	0.085	0.13	0.89	0.02	3
806	West Fork Trinity River Below Lake Worth	Stream	128	0.05	0.083	0.12	0.4	0.02	1
841	Lower West Fork Trinity River	Stream	162	0.06	0.104	0.12	1.52	0.02	1
403	Lake O' the Pines	Lake	296	0.053	0.126	0.113	6	0.01	3
820	Lake Ray Hubbard	Lake	108	0.05	0.086	0.11	0.49	0.02	3
804	Trinity River Above Lake Livingston	Stream	99	0.05	0.076	0.105	0.44	0.02	1
202	Red River Below Lake Texoma	Stream	41	0.05	0.061	0.1	0.13	0.02	1
814	Chambers Creek Above Richland-Chambers Reservoir	Stream	26	0.055	0.079	0.1	0.22	0.02	1
203	Lake Texoma	Lake	132	0.07	0.069	0.1	0.21	0.01	2
302	Wright-Patman Lake	Lake	329	0.05	0.078	0.1	0.409	0.02	2
815	Bardwell Reservoir	Lake	41	0.05	0.082	0.1	0.43	0.03	2
818	Cedar Creek Reservoir	Lake	781	0.05	0.087	0.1	1.69	0.02	2
838	Joe Pool Lake	Lake	50	0.03	0.065	0.095	0.31	0.02	2
821	Lake Lavon	Lake	9	0.07	0.081	0.09	0.23	0.03	2
810	West Fork Trinity River Below Bridgeport Reservoir	Stream	44	0.05	0.077	0.0825	0.211	0.02	1
204	Red River Above Lake Texoma	Stream	27	0.05	0.070	0.08	0.3	0.021	1
303	Sulphur/South Sulphur River	Stream	136	0.05	0.083	0.08	0.508	0.040	1
829	Clear Fork Trinity River Below Benbrook Lake	Stream	47	0.05	0.069	0.08	0.2	0.05	1
809	Eagle Mountain Reservoir	Lake	740	0.05	0.073	0.08	0.85	0.02	1
836	Richland-Chambers Reservoir	Lake	651	0.05	0.099	0.08	2.62	0.02	1
835	Chambers Creek Below Richland-Chambers Reservoir	Stream	4	0.05	0.073	0.073	0.14	0.05	1
816	Lake Waxahachie	Lake	31	0.05	0.085	0.07	0.47	0.05	1
832	Lake Weatherford	Lake	24	0.05	0.064	0.07	0.17	0.05	1
307	Chapman/Cooper Lake	Lake	68	0.05	0.062	0.0625	0.13	0.05	1
812	West Fork Trinity River Above Bridgeport Reservoir	Stream	16	0.05	0.060	0.060	0.11	0.05	1
507	Lake Tawakoni	Lake	103	0.05	0.048	0.06	0.22	0.001	1
817	Navarro Mills Lake	Lake	39	0.05	0.063	0.06	0.2	0.02	1
827	White Rock Lake	Lake	2	0.055	0.055	0.058	0.06	0.05	1
837	Richland Creek Above Richland-Chambers Reservoir	Stream	8	0.05	0.055	0.053	0.08	0.05	1
504	Toledo Bend Reservoir	Lake	157	0.05	0.080	0.05	2.36	0.001	1
512	Lake Fork	Lake	98	0.05	0.060	0.05	1	0.001	1
807	Lake Worth	Lake	95	0.02	0.034	0.05	0.16	0.02	1
811	Bridgeport Reservoir	Lake	436	0.02	0.042	0.05	0.6	0.02	1
828	Lake Arlington	Lake	184	0.03	0.053	0.05	1.1	0.02	1
826	Grapevine Lake	Lake	128	0.02	0.036	0.04	0.21	0.02	1

## Region C Surface Water Quality Summary by Segment and Parameter

*Data collected 1/1/1998 – 12/31/2009 (Source: TCEQ Water Quality Monitoring Database)*

Table M-4: Nitrate Nitrogen, Total (mg/L as N)									
Row Labels	Segment Description	Water Body Type	Count	Median	Mean	75th Percentile	Max	Min	Bin
819	East Fork Trinity River	Stream	16	9.97	10.189	13.25	17.8	4.9	3
841	Lower West Fork Trinity River	Stream	16	9.21	8.018	11.25	12.9	1.53	3
805	Upper Trinity River	Stream	35	7.7	6.723	9.505	13.1	0.07	3
824	Elm Fork Trinity River Above Ray Roberts Lake	Stream	35	4.38	4.659	7.45	12.82	0.18	3
817	Navarro Mills Lake	Lake	6	0.075	1.000	1.915	3.23	0.05	3
814	Chambers Creek Above Richland-Chambers Reservoir	Stream	5	0.8	0.868	1.24	2.1	0.05	1
825	Denton Creek	Stream	9	0.58	0.704	0.96	1.25	0.3	1
806	West Fork Trinity River Below Lake Worth	Stream	13	0.23	0.500	0.83	1.4	0.02	1
839	Elm Fork Trinity River Below Ray Roberts Lake	Stream	7	0.55	0.669	0.825	1.32	0.17	1
810	West Fork Trinity River Below Bridgeport Reservoir	Stream	8	0.51	0.539	0.748	1.09	0.05	1
822	Elm Form Trinity River Below Lewisville Lake	Stream	74	0.5	0.582	0.745	1.73	0.003	1
840	Ray Roberts Lake	Lake	112	0.285	0.633	0.733	5.36	0.003	3
815	Bardwell Reservoir	Lake	6	0.15	0.333	0.663	0.8	0.05	3
821	Lake Lavon	Lake	10	0.46	0.796	0.585	4.57	0.07	3
826	Grapevine Lake	Lake	42	0.255	0.313	0.56	1.15	0.003	3
816	Lake Waxahachie	Lake	6	0.2	0.320	0.545	0.81	0.05	3
820	Lake Ray Hubbard	Lake	95	0.19	0.273	0.455	0.96	0.003	3
823	Lewisville Lake	Lake	64	0.12	0.444	0.423	7.13	0.003	3
828	Lake Arlington	Lake	7	0.36	0.360	0.375	0.4	0.3	3
818	Cedar Creek Reservoir	Lake	54	0.245	0.292	0.365	0.82	0.01	2
838	Joe Pool Lake	Lake	5	0.25	1.350	0.36	5.72	0.2	2
809	Eagle Mountain Reservoir	Lake	131	0.19	0.239	0.34	0.93	0.01	2
836	Richland-Chambers Reservoir	Lake	48	0.245	0.284	0.34	0.79	0.01	2
829	Clear Fork Trinity River Below Benbrook Lake	Stream	8	0.275	0.296	0.335	0.54	0.17	1
811	Bridgeport Reservoir	Lake	24	0.19	0.235	0.29	0.5	0.14	1
830	Benbrook Lake	Lake	18	0.24	0.239	0.25	0.32	0.18	1
303	Sulphur/South Sulphur River	Stream	24	0.065	0.198	0.228	1.44	0.05	1
307	Chapman/Cooper Lake	Lake	20	0.105	0.153	0.218	0.36	0.05	1
507	Lake Tawakoni	Lake	255	0.06	0.132	0.21	1.99	0.003	1
504	Toledo Bend Reservoir	Lake	618	0.05	0.090	0.09	3.12	0.02	1
202	Red River Below Lake Texoma	Stream	1	0.09	0.090	0.09	0.09	0.09	1
512	Lake Fork	Lake	238	0.04	0.067	0.07	0.36	0.02	1
403	Lake O' the Pines	Lake	34	0.05	0.099	0.058	0.56	0.05	1
302	Wright-Patman Lake	Lake	139	0.05	0.060	0.05	0.487	0.01	1
832	Lake Weatherford	Lake	6	0.05	0.057	0.05	0.09	0.05	1
812	West Fork Trinity River Above Bridgeport Reservoir	Stream	6	0.05	0.050	0.05	0.05	0.05	1
203	Lake Texoma	Lake	4	0.02	0.048	0.048	0.13	0.02	1
804	Trinity River Above Lake Livingston	Stream	1	0.03	0.030	0.03	0.03	0.03	1

## Region C Surface Water Quality Summary by Segment and Parameter

*Data collected 1/1/1998 – 12/31/2009 (Source: TCEQ Water Quality Monitoring Database)*

**Table M-5: Phosphorous Total, Wet Method (mg/L as P)**

Row Labels	Segment Description	Water Body Type	Count	Median	Mean	75th Percentile	Max	Min	Bin
819	East Fork Trinity River	Stream	89	1.7	1.838	2.88	4.82	0.03	3
805	Upper Trinity River	Stream	455	1.15	1.191	1.725	4.17	0.04	3
804	Trinity River Above Lake Livingston	Stream	98	1.08	1.179	1.605	3.3	0.05	3
841	Lower West Fork Trinity River	Stream	156	0.995	1.031	1.415	2.5	0.05	3
824	Elm Fork Trinity River Above Ray Roberts Lake	Stream	111	0.16	0.763	0.93	4.12	0.02	3
831	Clear Fork Trinity River Below Lake Weatherford	Stream	108	0.155	0.608	0.625	7.39	0.02	2
204	Red River Above Lake Texoma	Stream	28	0.205	0.329	0.5	0.99	0.09	1
812	West Fork Trinity River Above Bridgeport Reservoir	Stream	16	0.28	0.312	0.443	0.58	0.06	1
825	Denton Creek	Stream	36	0.195	0.264	0.303	0.94	0.04	1
814	Chambers Creek Above Richland-Chambers Reservoir	Stream	137	0.1	0.268	0.3	2.4	0.01	1
810	West Fork Trinity River Below Bridgeport Reservoir	Stream	44	0.14	0.179	0.22	0.69	0.05	1
837	Richland Creek Above Richland-Chambers Reservoir	Stream	8	0.095	0.145	0.193	0.35	0.06	1
303	Sulphur/South Sulphur River	Stream	142	0.124	0.147	0.19	1.1	0.01	1
833	Clear Fork Trinity River Above Lake Weatherford	Stream	38	0.095	0.145	0.18	0.72	0.01	1
835	Chambers Creek Below Richland-Chambers Reservoir	Stream	4	0.105	0.125	0.18	0.24	0.05	1
302	Wright-Patman Lake	Lake	377	0.12	0.149	0.172	1.65	0.01	2
202	Red River Below Lake Texoma	Stream	33	0.11	0.163	0.17	1.037	0.037	1
822	Elm Form Trinity River Below Lewisville Lake	Stream	223	0.12	0.137	0.15	2.87	0.01	1
840	Ray Roberts Lake	Lake	111	0.06	0.099	0.14	0.5	0.01	1
307	Chapman/Cooper Lake	Lake	73	0.08	0.106	0.13	0.383	0.05	1
818	Cedar Creek Reservoir	Lake	830	0.09	0.119	0.13	1.33	0.01	1
823	Lewisville Lake	Lake	76	0.065	0.190	0.12	2.5	0.01	1
806	West Fork Trinity River Below Lake Worth	Stream	153	0.08	0.099	0.11	0.7	0.02	1
403	Lake O' the Pines	Lake	306	0.06	0.158	0.1	8.34	0.01	1
512	Lake Fork	Lake	117	0.06	0.095	0.1	0.54	0.02	1
605	Lake Palestine	Lake	72	0.07	0.106	0.1	0.68	0.05	1
809	Eagle Mountain Reservoir	Lake	742	0.08	0.087	0.1	0.4	0.01	1
836	Richland-Chambers Reservoir	Lake	640	0.056	0.083	0.099	0.69	0.01	1
203	Lake Texoma	Lake	132	0.072	0.085	0.098	0.457	0.02	1
807	Lake Worth	Lake	95	0.079	0.084	0.095	0.241	0.042	1
507	Lake Tawakoni	Lake	92	0.07	0.079	0.09	0.28	0.01	1
830	Benbrook Lake	Lake	337	0.07	0.074	0.09	0.269	0.02	1
828	Lake Arlington	Lake	184	0.065	0.085	0.085	1.288	0.03	1
817	Navarro Mills Lake	Lake	39	0.06	0.065	0.075	0.25	0.02	1
811	Bridgeport Reservoir	Lake	468	0.05	0.065	0.073	0.664	0.01	1
820	Lake Ray Hubbard	Lake	107	0.06	0.076	0.07	1.5	0.01	1
829	Clear Fork Trinity River Below Benbrook Lake	Stream	47	0.06	0.062	0.07	0.12	0.02	1
832	Lake Weatherford	Lake	24	0.06	0.062	0.07	0.1	0.04	1
827	White Rock Lake	Lake	3	0.06	0.064	0.066	0.072	0.06	1
504	Toledo Bend Reservoir	Lake	113	0.06	0.069	0.06	0.19	0.06	1
815	Bardwell Reservoir	Lake	47	0.05	0.052	0.06	0.25	0.01	1
816	Lake Waxahachie	Lake	31	0.06	0.067	0.06	0.25	0.02	1
826	Grapevine Lake	Lake	128	0.05	0.061	0.06	0.58	0.01	1
838	Joe Pool Lake	Lake	118	0.04	0.058	0.06	0.4	0.01	1
821	Lake Lavon	Lake	10	0.05	0.065	0.058	0.22	0.04	1
839	Elm Fork Trinity River Below Ray Roberts Lake	Stream	6	0.035	0.035	0.04	0.06	0.01	1

## Region C Surface Water Quality Summary by Segment and Parameter

*Data collected 1/1/1998 – 12/31/2009 (Source: TCEQ Water Quality Monitoring Database)*

**Table M-6: Chlorophyll-a, Spectrophotometric Acid. Method (µg/L)**

Segment ID	Segment Description	Water Body Type	Count	Median	Mean	75th Percentile	Max	Min	Bin
507	Lake Tawakoni	Lake	216	33.5	35.71	50	124	1	3
605	Lake Palestine	Lake	28	27.6	37.38	48.45	143	1	3
828	Lake Arlington	Lake	183	27.6	30.25	40	95.4	3.6	3
818	Cedar Creek Reservoir	Lake	821	23.8	26.75	36	112.3	1	3
302	Wright-Patman Lake	Lake	239	17	25.56	34.85	150	1	3
830	Benbrook Lake	Lake	339	21.4	23.66	34.7	65.4	1.6	3
820	Lake Ray Hubbard	Lake	49	25	25.22	34	49.8	1	3
807	Lake Worth	Lake	95	21	22.91	32	50.7	1	3
806	West Fork Trinity River Below Lake Worth	Stream	147	19	21.67	29.15	94	0.9	3
809	Eagle Mountain Reservoir	Lake	741	21.4	22.04	28.5	67.4	1.8	3
835	Chambers Creek Below Richland-Chambers Reservoir	Stream	4	10	25.83	25.825	73.3	10	3
823	Lewisville Lake	Lake	38	19.8	26.71	25.75	150.1	6.2	2
815	Bardwell Reservoir	Lake	34	14	17.35	24	52.1	1	2
826	Grapevine Lake	Lake	102	15.95	17.60	23.45	58.4	3.8	2
512	Lake Fork	Lake	319	15	16.72	21.5	73.2	1	2
203	Lake Texoma	Lake	132	14.25	17.51	21.45	155	2.88	2
824	Elm Fork Trinity River Above Ray Roberts Lake	Stream	73	10.7	20.30	21.4	163	1	3
836	Richland-Chambers Reservoir	Lake	653	12.7	15.64	21.1	83.7	0.7	1
804	Trinity River Above Lake Livingston	Stream	91	12	16.92	20.45	98.6	0.01	3
832	Lake Weatherford	Lake	17	10	14.72	19.8	35.2	1	1
202	Red River Below Lake Texoma	Stream	33	10	15.35	19.5	73.4	1	3
204	Red River Above Lake Texoma	Stream	13	8.01	14.14	19.2	81.4	1	3
822	Elm Form Trinity River Below Lewisville Lake	Stream	176	11.55	15.85	18.25	81	0.2	3
504	Toledo Bend Reservoir	Lake	283	11	14.85	18	204	1	1
307	Chapman/Cooper Lake	Lake	46	12.15	17.15	17.85	130	10	1
838	Joe Pool Lake	Lake	59	8	16.00	17.65	170	0.003	1
821	Lake Lavon	Lake	5	6	11.86	16	30.3	1	1
805	Upper Trinity River	Stream	300	10.25	12.37	15.6	50.5	0.2	3
841	Lower West Fork Trinity River	Stream	150	10	12.24	15.175	58	0.9	3
816	Lake Waxahachie	Lake	20	10	13.10	14.7	41.4	1	1
819	East Fork Trinity River	Stream	54	10	13.27	14.225	45.6	5	3
812	West Fork Trinity River Above Bridgeport Reservoir	Stream	11	10	12.77	12.5	32	3.2	2
840	Ray Roberts Lake	Lake	31	8	10.19	12.05	37.4	3	1
833	Clear Fork Trinity River Above Lake Weatherford	Stream	31	10	18.98	12	222	0.82	2
403	Lake O' the Pines	Lake	265	10	9.82	11.8	63.4	0.01	1
810	West Fork Trinity River Below Bridgeport Reservoir	Stream	31	10	10.74	10.7	41.6	1	1
814	Chambers Creek Above Richland-Chambers Reservoir	Stream	13	10	9.55	10.7	19.6	1.33	1
817	Navarro Mills Lake	Lake	33	10	8.79	10.7	22.4	0.0002	1
303	Sulphur/South Sulphur River	Stream	105	10	9.90	10	45.4	1	1
825	Denton Creek	Stream	23	10	8.68	10	13.9	1	1
829	Clear Fork Trinity River Below Benbrook Lake	Stream	33	10	9.64	10	30	1	1
831	Clear Fork Trinity River Below Lake Weatherford	Stream	93	3.69	5.61	9.3	38.4	0.2	1
811	Bridgeport Reservoir	Lake	470	5.9	6.52	8	37.9	1	1
837	Richland Creek Above Richland-Chambers Reservoir	Stream	7	1.25	3.24	2.805	12.8	1	1

## Region C Surface Water Quality Summary by Segment and Parameter

*Data collected 1/1/1998 – 12/31/2009 (Source: TCEQ Water Quality Monitoring Database)*

<b>Table M-7: Total Dissolved Solids (mg/L as N) as Residue, Total Filtrable (dried at 180°)</b>									
Segment ID	Segment Description	Water Body Type	Count	Average	Median	75th Percentile	Max	Min	Bin
204	Red River Above Lake Texoma	Stream	28	2415	2421.21	3347.5	4740	666	3
203	Lake Texoma	Lake	132	986.5	981.95	1166.25	1640	395	3
202	Red River Below Lake Texoma	Stream	42	888.5	870.07	1045	2364	45	3
833	Clear Fork Trinity River Above Lake Weatherford	Stream	21	550	564.29	596	874	398	3
819	East Fork Trinity River	Stream	64	542	548.02	648	1300	214	3
841	Lower West Fork Trinity River	Stream	70	448	430.40	486	662	220	2
831	Clear Fork Trinity River Below Lake Weatherford	Stream	68	428	454.49	493.5	968	234	2
805	Upper Trinity River	Stream	85	414	393.21	455	1080	73	2
804	Trinity River Above Lake Livingston	Stream	20	399	361.75	444	490	71	1
824	Elm Fork Trinity River Above Ray Roberts Lake	Stream	114	392	423.98	488.75	1310	144	1
814	Chambers Creek Above Richland-Chambers Reservoir	Stream	87	348	385.44	458.5	964	162	1
838	Joe Pool Lake	Lake	65	344	409.15	386	2260	175	1
810	West Fork Trinity River Below Bridgeport Reservoir	Stream	44	316	350.30	413	760	170	1
812	West Fork Trinity River Above Bridgeport Reservoir	Stream	18	283	578.06	620	3450	109	1
829	Clear Fork Trinity River Below Benbrook Lake	Stream	45	282	276.36	314	690	28	1
821	Lake Lavon	Lake	10	281	276.30	289.25	372	222	1
822	Elm Form Trinity River Below Lewisville Lake	Stream	178	250	257.18	285	708	69	1
832	Lake Weatherford	Lake	25	244	239.40	257	288	166	1
835	Chambers Creek Below Richland-Chambers Reservoir	Stream	4	232	224.25	243	270	163	1
827	White Rock Lake	Lake	2	231	231.00	254.5	278	184	1
825	Denton Creek	Stream	54	228.5	243.27	265.5	354	185	1
837	Richland Creek Above Richland-Chambers Reservoir	Stream	24	227	365.90	426	1010	160	1
815	Bardwell Reservoir	Lake	30	223	222.97	247.5	342	75	1
809	Eagle Mountain Reservoir	Lake	711	222	224.18	236	376	52.2	1
807	Lake Worth	Lake	95	213	217.31	234.5	287	157	1
826	Grapevine Lake	Lake	149	210	201.04	223	258	92	1
823	Lewisville Lake	Lake	127	207	252.46	240	730	67	1
817	Navarro Mills Lake	Lake	28	203.5	207.21	226	256	154	1
830	Benbrook Lake	Lake	331	195	197.26	209	306	153	1
839	Elm Fork Trinity River Below Ray Roberts Lake	Stream	23	195	196.00	204.5	241	169	1
303	Sulphur/South Sulphur River	Stream	149	192	219.72	284	620	76	1
820	Lake Ray Hubbard	Lake	159	192	197.02	210.5	835	118	1
828	Lake Arlington	Lake	184	184	192.66	200	461	114	1
811	Bridgeport Reservoir	Lake	436	184	188.60	206	276	142	1
816	Lake Waxahachie	Lake	29	180	185.45	208	286	64	1
840	Ray Roberts Lake	Lake	176	179	183.84	194	344	38	1
836	Richland-Chambers Reservoir	Lake	654	164	167.99	178	284	59.1	1
605	Lake Palestine	Lake	63	137	142.17	164	250	84	1
307	Chapman/Cooper Lake	Lake	72	134.5	148.03	150	420	101	1
302	Wright-Patman Lake	Lake	339	132	140.69	159.5	536	44	1
818	Cedar Creek Reservoir	Lake	784	121	128.58	134	804	55	1
403	Lake O' the Pines	Lake	178	107.5	118.21	123	376	54	1
507	Lake Tawakoni	Lake	116	107.5	108.84	118	150	78	1
512	Lake Fork	Lake	54	103	130.96	116.25	1300	75	1
504	Toledo Bend Reservoir	Lake	3	77	77.67	81	85	71	1