January 2003
RG-194 (Revised)

Procedures to Implement the Texas Surface Water Quality Standards

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Water Quality Division

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Procedures to Implement the Texas Surface Water Quality Standards

THIS IS A GUIDANCE DOCUMENT AND SHOULD NOT BE INTERPRETED AS A REPLACEMENT TO THE RULES.

The Texas Surface Water Quality Standards may be found in
30 Texas Administrative Code (TAC) Sections (§§) 307.1-.10.

Prepared by
Water Quality Division

RG-194
January 2003

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Preface

On September 1, 2002, a change took effect in the name of our agency: the Texas Natural Resource Conservation Commission (TNRCC) became the Texas Commission on Environmental Quality (TCEQ). The text of this document had been completed well before the changeover date, but final approval to print the publication and post the final version on the Internet was not received until January 2003. So, the previous name of the agency, as it appears in the text of this document, should be understood to refer to the TCEQ.

Although our Web address will also change to reflect our new name, it will take some time for each page on our site to be moved. In the meantime, be sure to follow this procedure for finding pages mentioned in this publication:

1. Enter the URL exactly as shown in the text—for example, **www.tnrcc.state.tx.us/permitting/waterperm/wqstand/**

2. If the page has not yet been moved, it will appear directly. Continue to use this URL for the time being.

3. If the page has already been moved, you should first see a “redirect page,” which will tell you the new URL for this information. Update your bookmarks accordingly and continue to use the new URL.

4. If you get a “file not found” message, go to our home page (**www.tceq.state.tx.us**) and use the Site Search or Subject Index at the upper right of the page to look for topics that are relevant to the information you need.

Introduction

The Texas Natural Resource Conservation Commission (TNRCC) is responsible for maintaining and enhancing water quality in the state. Legal standards for the quality of surface water in Texas are described in Title 30 of the Texas Administrative Code (TAC), Chapter 307.[1]

The TNRCC applies these Texas Surface Water Quality Standards (TSWQS) when issuing permits for wastewater discharges or other authorized discharges to the surface waters of the state. Wastewater permits are issued under a program called the Texas Pollutant Discharge Elimination System—TPDES.

Who should read this document? This document explains procedures the TNRCC uses when applying the water quality standards to permits issued under the TPDES program. This information should be of interest to regulated facilities that discharge wastewater (for example, domestic sewage treatment plants and industrial plants), to environmental professionals who help such facilities obtain their permits, and to other environmental professionals interested in wastewater permitting. The TNRCC will update this guidance document as needed to reflect changes in the TSWQS and in agency policy and procedures. This document should be interpreted as guidance; it should not be interpreted as a replacement to the rules.

Document approval process. This document was adopted by the TNRCC on August 23, 2002. It was also subject to Environmental Protection Agency (EPA) review and approval in accordance with the Memorandum of Agreement (MOA) between the TNRCC and EPA concerning the TPDES program. In a letter dated November 22, 2002, EPA conditionally approved this document with the exception of two specific permitting issues. These items have been footnoted in the text. In addition, the approval letter indicated that some portions of this document may be included in EPA's consultation with the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act on the new and revised provisions of the TSWQS.

For more information concerning revisions to the TSWQS and to this document, visit the Texas Surface Water Quality Standards page (http://www.tnrcc.state.tx.us/permitting/waterperm/wqstand/) and follow

[1] On July 26, 2000, the TNRCC adopted the most recent revision to Chapter 307, Texas Surface Water Quality Standards (TSWQS).

the link “Revisions to the Texas Surface Water Quality Standards and Implementation Procedures.”

The application review process. The TNRCC believes that a consistent approach to application review is important. A permit applicant may provide information throughout the technical review period to assist TNRCC staff in site-specific assessment and draft permit development. All preliminary determinations by TNRCC staff in the development of a permit (for example, instream uses, impact analysis, antidegradation, effluent limits, and all other specifications of the permit) are subject to additional review and revision through the public hearing process. Case-by-case permitting decisions are subject to Environmental Protection Agency (EPA) review and approval in accordance with the Memorandum of Agreement (MOA) between the TNRCC and EPA concerning the TPDES program.

For more information. Implementing the TSWQS in the TPDES program is just one aspect of TNRCC’s overall program for water quality management. A series of documents, the Continuing Planning Process (CPP), details the agency’s policies and procedures to protect and maintain water quality, in fulfillment of the state’s responsibilities under federal law. For more information about the overall program, visit the Surface and Ground Water Quality page (http://www.tnrcc.state.tx.us/water/quality/) and follow the link “Standards and Planning” and then “Continuing Planning Process.”

A list of abbreviations used throughout this document is provided in Appendix A on page 147.

Same agency, new name. On September 1, 2002, a change took effect in the name of our agency: the Texas Natural Resource Conservation Commission (TNRCC) became the Texas Commission on Environmental Quality (TCEQ). The text of this document had been completed well before the changeover date, but final approval to print the publication and post the final version on the Internet was not received until some time afterwards. So, the previous name of the agency, as it appears in the text of this document, should be understood to refer to the TCEQ.

Determining Water Quality Uses and Criteria

Designated and Presumed Uses

Classified Waters

The designated uses and associated criteria for classified segments in 30 TAC §307.10 Appendix A are normally used to evaluate permit applications. Seven-day, two-year low-flows (7Q2s) for each segment are published in 30 TAC §307.10 Appendix B. However, a site-specific 7Q2 unique to a discharge location within a segment may be used to calculate discharge limits if appropriate.

Unclassified Waters

Unclassified waters are those smaller water bodies that are not designated as segments with specific uses and criteria in Appendix A or D of 30 TAC §307.10 of the TSWQS.

Perennial waters. As stated in 30 TAC §307.4(h)(3), unclassified perennial streams, rivers, lakes, bays, estuaries, and other appropriate perennial waters are presumed to have a high aquatic life use and corresponding dissolved oxygen criterion (see Table 1 in Appendix C of this document). In accordance with results from statewide ecoregion studies, unclassified perennial streams in the eastern and southern portions of Texas (shown as area "A" on Figure 1, page 6) are assigned dissolved oxygen criteria as described in 30 TAC §307.7(b)(3)(A)(ii) and in the section of this document entitled "Eastern and Southern Portions of the State" on page 10. Higher uses will be maintained where they are attainable.

Intermittent streams. Intermittent streams are defined as having a period of zero flow for at least one week during most years. Where flow records are available, a stream with a 7Q2 flow less than 0.1 ft^3/s is considered intermittent. According to 30 TAC §307.4(h)(4), intermittent, unclassified streams that are not specifically listed in Appendix A or D of 30 TAC §307.10 will maintain a 24-hour mean dissolved oxygen concentration of 2.0 mg/L and an absolute minimum dissolved oxygen concentration of 1.5 mg/L. For intermittent streams with seasonal aquatic life uses, dissolved oxygen concentrations commensurate with the aquatic life uses will be maintained during the seasons in which the aquatic life uses occur.

Intermittent streams with perennial pools. Unclassified intermittent streams with significant aquatic life uses created by perennial pools are presumed to have a limited aquatic life use and corresponding dissolved oxygen criterion (see Table 1 in Appendix C of this document). Higher uses will be maintained where they are attainable.

At this time, determination of what constitutes a seasonal aquatic life use, a significant aquatic life use, and perennial pool designation is done on a case-by-case basis using available data and best professional judgement. The TNRCC will continue to develop improved procedures to address the issues of seasonal aquatic life use, significant aquatic life use, and perennial pools.

Playa lakes. The applicability of the TSWQS and the concomitant aquatic life use designation for playa lakes is discussed in the Playa Lake Policy Statement that was signed by the TNRCC's executive director on October 20, 1997 (see Appendix B on page 151 of this document).

In addition to aquatic life uses, unclassified waters can be assigned uses for contact or noncontact recreation and domestic water supply. Basic uses such as navigation, agricultural water supply, and industrial water supply are normally assumed for all waters. A general contact recreation use is presumed for all unclassified waters.

Assessment and Review of Uses

Uses and associated criteria for classified waters are normally assumed as stated in 30 TAC §307.10 Appendices A and D. Implementing 30 TAC §307.4(h) (concerning aquatic life uses and dissolved oxygen) and §307.4(l) (concerning assessment of unclassified waters) requires that appropriate uses be determined for unclassified waters that are affected by permit renewals, permit amendments, and new permit applications.

The assigned uses and associated criteria are used in water quality simulations to determine the effluent limits needed to protect the uses. The criteria for assessing aquatic life use categories are based on categorical characteristics in 30 TAC §307.7(b)(3)(A), which are summarized in Table 1 in Appendix C of this document.

All permit applicants are requested to provide information about the receiving water as part of the permit application. Determining general stream flow characteristics (perennial, intermittent, or intermittent with perennial pools) is of major importance in assigning uses to unclassified streams. Permittees with discharges to small unclassified streams are encouraged to develop and submit additional documentation concerning the general stream type and stream flows at their discharge site.

TNRCC staff evaluate available information and determine appropriate uses and criteria for each permit action for discharge into surface water in the state. For sites where available information indicates that the presumed uses and criteria in the standards for unclassified streams may be inappropriate, additional data may be obtained by the TNRCC or the applicant in the form of a "receiving water assessment." Guidelines for collecting the additional data and evaluating aquatic life uses for receiving water assessments are described in the *TNRCC Receiving Water Assessment Procedures Manual*, GI-253, June 1999 or the most recent revision. This document is available upon request from TNRCC's Water Quality Standards Team; or, on the agency's Web site (http://www.tnrcc.state.tx.us), follow the link for "Publications."

Considerations for determining the aquatic life use categories include the following:

- Aquatic life use determinations are estimated for the same set of hydrologic conditions (normally low-flow or critical conditions) that are used to analyze the impact of permitted discharges. These determinations may consider seasonal uses and associated seasonal hydrologic conditions other than critical conditions. Permit limits for pertinent parameters are established as necessary to protect seasonal uses in both intermittent and perennial streams.

- For existing dischargers seeking permit renewals or amendments, primary assessments of physical, hydrologic, chemical, and biological conditions emphasize the area upstream of and/or unaffected by an existing discharge. Differences in stream morphometry downstream of the discharge are also taken into account in determining appropriate aquatic life uses.

- For new dischargers or facilities that have not yet discharged, primary assessments of physical, hydrologic, chemical, and biological conditions emphasize the area downstream of the proposed discharge point.

- Site-specific modification of the aquatic life criteria in 30 TAC §307.7(b)(3)(A) (summarized in Table 1 of this document) may be considered when sufficient information is available to justify such modifications. Site-specific modifications are evaluated in accordance with guidance for regional development of criteria or other procedures used by TNRCC (see the chapter of this document entitled "Site-Specific Standards and Variances" on page 133).

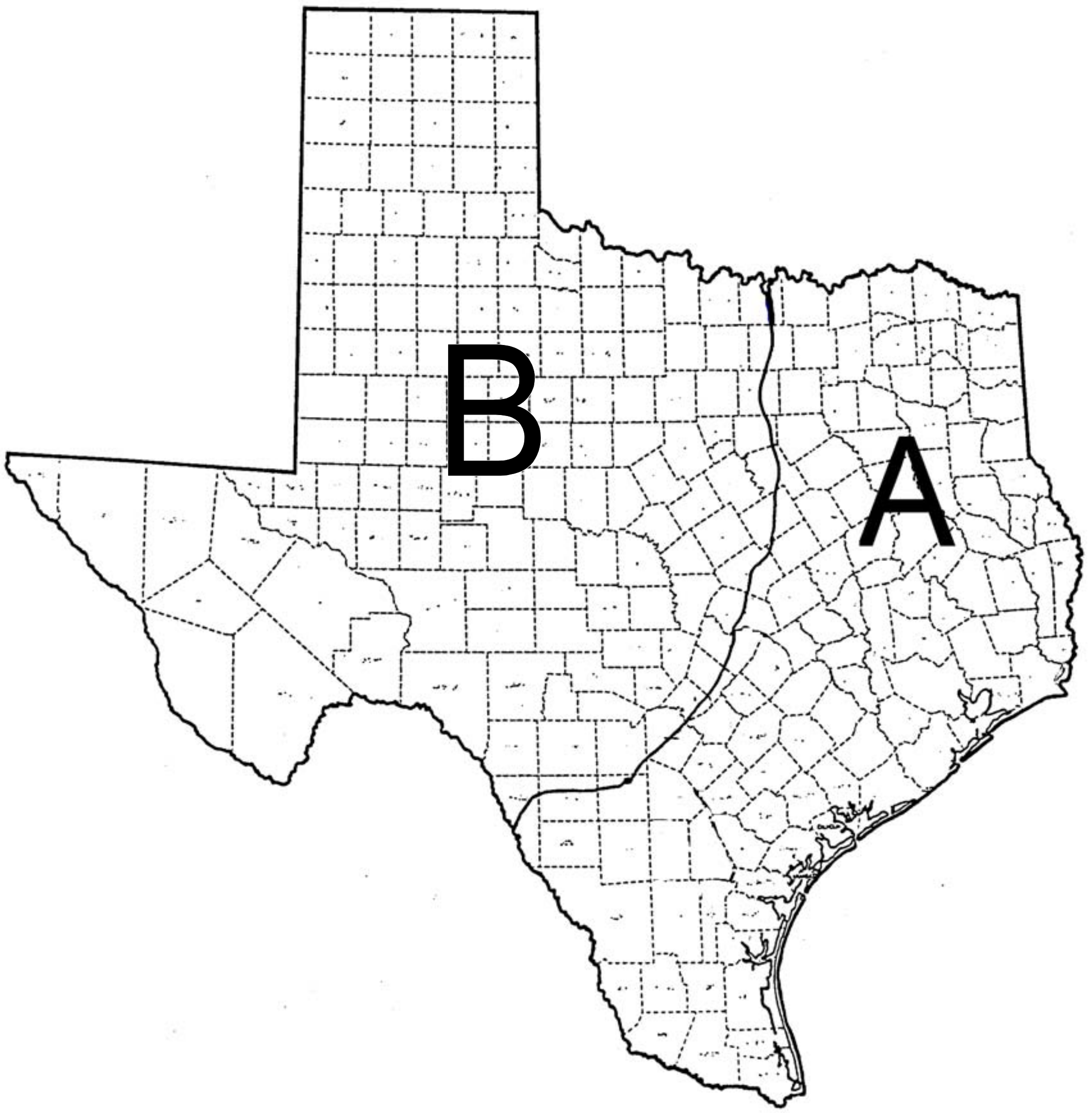

Figure 1. Dissolved oxygen criteria for streams in area "A" are adjusted as stated in 30 TAC §307.7(b)(3)(A)(ii).

- The aquatic life attributes in 30 TAC §307.7(b)(3)(A) (summarized in Table 1 of this document) are used to assign aquatic life use categories. For freshwater streams, the aquatic life use attributes are evaluated primarily from the use of an index of biotic integrity as described in the *TNRCC Receiving Water Assessment Procedures Manual*, GI-253, June 1999 or the most recent revision. Other water body types are evaluated on a case-by-case basis.

- The attribute characteristics in 30 TAC §307.7(b)(3)(A) (summarized in Table 1 of this document) will be further clarified, modified, and "calibrated" as more region-specific data become available.

- The instream uses assigned to unclassified waters at a particular discharge site are not automatically assumed to be appropriate for other discharge sites in the same water body.

- Unclassified perennial waters with sufficient information obtained under these procedures will be considered for classification during the triennial review of the TSWQS.

When an attainable aquatic life use for a particular unclassified water body might be lower than the presumed aquatic life use, a use-attainability analysis (UAA) is conducted (see the section of this document entitled “Site-Specific Standards for Aquatic Life Use” on page 137).

TNRCC staff may review the preliminary determinations of use and the criteria associated with those uses throughout the permit application review if new information becomes available and/or if there are errors in the previous evaluations. The applicant is given an opportunity to discuss the preliminary determinations of use and provide additional information after receiving the draft permit for review. The Notice of Application and Preliminary Decision indicates any preliminary additional uses assigned to the unclassified receiving waters.

Evaluating Impacts on Water Quality

General Information

New permit applications, permit renewals, and permit amendments are reviewed to ensure that permitted effluent limits will maintain instream criteria for dissolved oxygen and other parameters such as bacteria, phosphorus, nitrogen, turbidity, dissolved solids, temperature, and toxic pollutants.

In order to determine impacts from baseline conditions, TNRCC staff review all available information from sources that may include (but are not limited to) the permit application, stream surveys, routine monitoring information, waste load evaluations (WLEs), or total maximum daily loads (TMDLs). Additional information may also be acquired from the TNRCC's regional staff, the applicant, adjacent land owners, river authorities, or governmental entities.

Waste load evaluation (WLE) recommendations and TMDLs are incorporated into permit limits for discharges into segments with completed WLEs or calculated TMDLs. For receiving waters without specific WLEs or TMDLs, oxygen deficit models or other appropriate analyses are conducted to determine permit limits (see the chapter of this document entitled "Modeling Dissolved Oxygen" on page 17). The assessment of appropriate aquatic life uses and dissolved oxygen criteria is conducted as discussed in the previous chapter, "Determining Water Quality Uses and Criteria" (see page 3).

All proposed permit actions that would increase pollution are also evaluated using the procedures discussed in the chapter of this document entitled "Antidegradation" on page 23.

The impact of discharges on endangered and threatened species is considered in accordance with the Memorandum of Agreement (MOA) between the TNRCC and the Environmental Protection Agency (EPA) and with the biological opinion from the U.S. Fish and Wildlife Service (USFWS). For more information, see the section of this document entitled "Federally Endangered and Threatened Species" on page 12.

Throughout any permit hearing process, TNRCC may continue to (1) evaluate water quality impacts of permitted discharges and (2) revise permit effluent limits based on these evaluations. Such evaluations and revisions may also be subject to EPA review and approval.

Eastern and Southern Portions of the State

As specified in 30 TAC §307.7(b)(3)(A)(ii), streams with significant aquatic life uses and those listed in Appendix A or D (of 30 TAC §307.10) in the eastern and southern portions of the state may be evaluated for 24-hour dissolved oxygen attainment at stream flows greater than 7Q2 flows (see Table 2 in Appendix C of this document).[2] The criteria in Table 2 apply to streams that occur in the portion of the state east of a line defined by Interstate Highway 35 and 35W from the Red River to the community of Moore in Frio County, and by U.S. Highway 57 from the community of Moore to the Rio Grande (area "A" in Figure 1 on page 6). The headwater flows shown in Table 2 may be used to evaluate summertime 24-hour dissolved oxygen criteria (see Table 1 of this document) for a presumed, designated, or assigned aquatic life use.

Regression Equation Relating Dissolved Oxygen, Flow, and Bedslope

The flow values in Table 2 were derived from a multiple regression equation using data collected from TNRCC's study of least impacted streams (Texas Aquatic Ecoregion Project). Results of this study indicate a strong dependent relationship for average summertime dissolved oxygen concentrations and several hydrologic and physical stream characteristics—particularly stream flow and bedslope (stream gradient). Stream flows and average dissolved oxygen concentrations were measured during steady-state conditions, and bedslopes were estimated from 1:24,000 scale U.S. Geological Survey (USGS) topographic maps. Approximately 72% of the variation in observed average dissolved oxygen concentrations in these minimally impacted streams is explained by the following regression equation:

$$DO = 7.088 + 0.551 \ln(Q + 0.01) + 0.686 \ln(Bd) - k$$

where:

	DO =	dissolved oxygen (mg/L)
	Q =	flow (ft^3/s)
	Bd =	bedslope (m/km)
	k =	1.61 (constant for 50th percentile of tree canopy cover)

The coefficient of determination (r^2) for this equation, adjusted for degrees of freedom, is 0.72 ($p < 0.0001$). This equation may be used to calculate

[2] According to the November 22, 2002, EPA letter approving this document, this provision will not apply to classified streams (those listed in Appendix A of 30 TAC §307.10) until the EPA approves it as part of TSWQS.

headwater flows for bedslopes within the range of 0.1 m/km to 2.4 m/km. For streams that have bedslopes greater than 2.4 m/km, a bedslope of 2.4 m/km will be used. For stream that have bedslopes less than 0.1 m/km, a bedslope of 0.1 m/km will be used. The headwater flows are calculated for dissolved oxygen concentrations of 0.5 mg/L greater than the criteria obtained from Table 1.

Calculating Bedslope

Bedslopes are calculated from USGS 1:24,000 scale topographic maps for the portion of stream from the first contour line crossing the stream greater than one-half mile upstream of the point of discharge to the first contour line crossing the stream downstream beyond the estimated distance of discharge impact. The actual stream bedslope is calculated using the following equation:

$$Bd = \frac{(E_u - E_d)}{D}$$

where:

Bd = bedslope (m/km)

E_u = upstream elevation (m)

E_d = downstream elevation (m)

D = linear distance along the streambed between the two elevation contours (km)

(Note: the elevations and linear distance in the formula can be calculated in feet and then multiplied by 1,000 to convert to meters per kilometer.)

Guidelines for Adjusting the Regression Equation

The critical low-flow values in Table 2 may be adjusted based on site-specific data. The following guidelines should be followed in order to apply site-specific changes to the regression equation used to calculate the Table 2 flows:

- Collect data on streams in areas that are unaffected by other point source discharges. Data can be collected upstream of a discharger's outfall as long as it is outside the mixing zone **or** on an adjacent stream with similar hydrology, drainage basin size, land use, habitat availability, and canopy cover.

- Collect data during all seasons for at least one year.

- Site-specific flow, temperature, or hydraulic conditions that affect dissolved oxygen can also be used to adjust critical low-flow values.

- Site-specific changes in critical low-flow values will have to be reviewed and approved by the TNRCC.

- EPA will review any site-specific, critical low-flow values that could affect permits or other regulatory actions that are subject to EPA approval.

Minimum and Seasonal Criteria for Dissolved Oxygen

Instantaneous minimum dissolved oxygen criteria (from Table 1 of this document) and seasonal criteria are also considered. When determining seasonal permit limits, TNRCC staff generally use either a low-flow frequency or a seasonal 7Q2 and associated temperatures to estimate critical low-flow conditions in a particular month or season. Procedures for establishing mixing zones for dissolved oxygen considerations are identical to the mixing zone procedures described in the chapter of this document entitled “Mixing Zones and Critical Conditions” (see page 39), in accordance with 30 TAC §307.8(b)(1).

Federally Endangered and Threatened Species

TNRCC reviews permit applications to determine whether discharges could potentially have any adverse effect on an aquatic or aquatic-dependent federally endangered or threatened species, including proposed species. Information that is considered during the review includes the following:

- the Memorandum of Agreement (MOA) between the TNRCC and EPA concerning the TPDES program, available on the agency’s Web site (http://www.tnrcc.state.tx.us)[3]

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[3] Go to the Index and follow these links:
“Texas Pollutant Discharge Elimination System (TPDES)”
“TPDES Assumption Process”
“TNRCC Application to the EPA”
“Chapters”
“Memorandum of Agreement Between the TNRCC and USEPA Region 6"

- the USFWS biological opinion (dated September 14, 1998) associated with assumption of the TPDES program by the State of Texas, available on the agency's Web site (http://www.tnrcc.state.tx.us)[4]

- an update to that biological opinion (dated October 21, 1998)

The USFWS biological opinion includes a list of the USGS hydrological unit codes (HUCs) that cover the watersheds that should be considered in determining whether a listed species could be affected. These HUCs have been matched to both the counties and the classified segments into which the watersheds drain. Subsequent information from the USFWS has identified some specific water bodies where species of critical concern are known to occur. USFWS is informally notified, by way of a supplemental permit information form, of all permit applications declared administratively complete.

Screening Process

After permit applications are declared administratively complete, TNRCC staff screen them as follows:

1. The first segment that the discharge either directly or eventually enters is determined.

2. The list of segments in Table 3 (taken from Appendix A of the USFWS biological opinion and subsequent updates) is consulted to determine whether there is a potential for the listed species to occur anywhere within the watershed of the segment or whether the listed species is known to be only in a particular water body.

3. If the species has a potential of occurring anywhere within the watershed of the segment, TNRCC staff may compare the location of the discharge against the HUCs listed in the biological opinion to more accurately determine whether the discharge may impact listed species.

   Note that TNRCC staff also screen applications from petroleum facilities south of Copano Bay (Segment 2472) to determine whether these discharges could potentially have any adverse effect on the piping plover, a species of high priority.

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[4] Go to the Index and follow these links:
"Texas Pollutant Discharge Elimination System (TPDES)"
"TPDES Assumption Process"
"US Fish and Wildlife biological opinion"

4. If the application screening indicates that the discharge has a potential to affect a listed species, USFWS is formally notified via the Notice of Application and Preliminary Decision, which is mailed after the permit is drafted.

5. TNRCC staff perform further reviews of discharges that are formally reported to USFWS in step 4 to determine whether additional or more stringent permit limits are necessary. In making this determination, the location of the discharge within the county, the distance from the segment or water body in question, the size of the discharge, and the type of species (for example, fish, amphibian, invertebrate, or plant) are all considered.

Additional Permit Limits

The TNRCC may require additional permit limits for discharges that TNRCC staff determine have a high potential of adversely affecting listed species of critical concern. Examples of such discharges include:

- discharges directly to watersheds in which listed species occur
- discharges whose dissolved oxygen sag extends into watersheds where listed species occur.

These types of discharges are issued permits that, if necessary, require dechlorination and contain a daily average ammonia-nitrogen limit of 3.0 mg/L. Additional permit limits may be imposed based on USFWS concerns and other issues as they arise.

Edwards Aquifer

Discharges within and across the contributing and recharge zones of the southern section of the Edwards Aquifer are reviewed to determine whether there will be any effects on threatened and endangered fish, amphibian, invertebrate, or plant species occurring down-gradient from the discharge. The review may include input from TNRCC staff knowledgeable in groundwater and hydrogeology.

Table 4 in Appendix C of this document lists the classified segments that cross the contributing and recharge zones of the southern section of the Edwards Aquifer. This list of segments corresponds to the true geological zones that cover the entire watersheds containing those segments. This list is not identical to the segments covered in 30 TAC §213 (in Medina, Bexar, Comal, Kinney, Uvalde, Hays, Travis, and Williamson Counties) or to those segments having an assigned aquifer protection use in Appendix A of the TSWQS.

Other Applicable Rules

In addition to effluent limits based on dissolved oxygen and other appropriate criteria, the draft permit also includes all treatment requirements of applicable rules such as:

- 30 TAC §309—"Domestic Wastewater Effluent Limitation and Plant Siting"
- 30 TAC §311—"Watershed Protection"
- 30 TAC §213—"Edwards Aquifer"
- 30 TAC §319—"General Regulations Incorporated Into Permits."

These rules are available on the agency's Web site (http://www.tnrcc.state.tx.us); follow the link for "Rules."

Modeling Dissolved Oxygen

General Information

Numerical criteria for dissolved oxygen correspond to specific aquatic life use categories as specified in Table 1 in Appendix C of this document. All classified water bodies have numerical dissolved oxygen criteria specified in the TSWQS. All unclassified water bodies have either assigned or presumed uses, depending on data availability. In cases where data indicate the appropriate use is lower than the presumption, the appropriate use has to be adopted as part of the TSWQS before it can be used to set permit limits.

All TPDES applications for facilities that may negatively affect a water body's dissolved oxygen are evaluated to determine what effluent limits are needed to maintain appropriate dissolved oxygen levels. Numerical models or other techniques are used to develop permit limits for oxygen-demanding constituents, in order to ensure the attainment of numerical criteria for dissolved oxygen.

Model Selection and Inputs

Model selection depends on factors such as:

- the type of water body to be analyzed
- the type and quantity of available site-specific information
- the location of the discharge point
- the availability of previously developed models.

If available, waste load evaluations (WLEs), total maximum daily loads (TMDLs), or models calibrated to site-specific information are used to generate permit limits. In the absence of these, simplified screening level methods are used. These methods can be used with little site-specific information, but substituting site-specific values for default parameters is encouraged when available. The 24-hour mean dissolved oxygen is the principal criterion of concern in these analyses. Effects on dissolved oxygen due to the presence of aquatic plants are usually not considered.

Additional scrutiny is given to applications for discharges that enter water bodies with impaired dissolved oxygen levels. Impaired water bodies are listed on the state's Clean Water Act Section 303(d) List. The 303(d) List is developed by the Surface Water Quality Monitoring Program in cooperation with the TMDL Program.

Screening Level Methods

Nontidal Streams and Rivers

To evaluate discharges into nontidal streams and rivers without specific WLEs, TMDLs, or other calibrated models, the TNRCC uses uncalibrated steady-state models. The preferred model for these analyses is QUAL-TX. Other public domain models may also be used. Using this approach, effluent limits may be derived for the following parameters: biochemical oxygen demand (BOD) or carbonaceous biochemical oxygen demand (CBOD), ammonia-nitrogen (NH_3-N), and dissolved oxygen (DO).

Apart from discharge flow and quality, the most important model inputs for this approach can be categorized as follows:

- stream hydraulic characterization
- chemical kinetic rates
- reaeration rates
- critical conditions
- background water quality.

Many of these parameters are stipulated in a modeling memorandum of agreement (MOA) between the TNRCC and the EPA (see Appendix D). The following paragraphs describe these model inputs in more detail.

Stream hydraulic characterization. Site-specific hydraulic information is used if it is available and of acceptable quality. In the absence of site-specific hydraulic information, generalized hydraulic equations are adopted for the model analysis. The TNRCC has developed these equations using data collected during studies performed throughout the state, and the coefficients represent the median values from those data.

Chemical kinetic rates. The most important kinetic rates for dissolved oxygen analysis are: aerobic CBOD decay rate (K_d), ammonia-nitrogen oxidation rate (K_n), and sediment oxygen demand (SOD). A statistical analysis of rates used in previous calibrated and approved WLE models was performed to arrive at representative default rates. Normality tests performed on these data sets indicate that they are approximately lognormally distributed. The data used in the statistical analysis were taken from approximately 1,300 calibrated model reaches from water bodies throughout the state. For uncalibrated QUAL-TX modeling, the median value for K_d and K_n is normally used. For SOD, a value equivalent to approximately the 75^{th} percentile is used. These values are:

- K_d of 0.10/day
- K_n of 0.30/day
- SOD of 0.35 g/m^2-day.

These rates are expressed at a standard temperature of 20°C and are corrected to the temperature or temperatures used in the modeling analysis.

Reaeration rates. Reaeration rates account for the oxygen exchange between the atmosphere and the water body. Typically, an equation relating stream hydraulic properties to reaeration rate is used to estimate this parameter. The preferred equation for use in dissolved oxygen models of streams and rivers is the Texas Equation:

$$K_2 \,(\text{at } 20^\circ \text{ C}) = \frac{1.923\, V^{0.273}}{D^{0.894}}$$

where: K_2 = reaeration rate (day^{-1})
V = average stream velocity (m/s)
D = average stream depth (m)

This equation was derived from regression of measured reaeration and hydraulic data collected throughout the state and is considered to be adequate for most Texas streams. The Texas Equation can be reliably applied to streams with depths between 0.2 and 1.0 meters coupled with velocities between 0.01 and 0.30 m/s. In specific cases where stream depth or velocity falls outside these ranges, other reaeration equations may be used. K_2 is limited to a maximum value of 10/day at 20°C, and the minimum value for this parameter is not allowed to go below the value calculated from the following equation:

$$K_{2\,\min} \,(\text{at } 20^\circ \text{ C}) = \frac{0.6}{D}$$

where: K_{2min} = minimum allowable reaeration rate (day^{-1})
D = average stream depth (m)

Critical conditions. Critical conditions are those combinations of environmental conditions and wastewater inputs that typically result in the lowest dissolved oxygen levels in a water body. Critical conditions are defined by three primary parameters: ambient flow, wastewater flow, and ambient water temperature.

- Simplified modeling of streams and rivers is performed using low ambient flow values—either the seven-day, two-year low-flow (7Q2) or flows specified in Table 2, as appropriate. If base flow information is not available to estimate the 7Q2, then a value of 0.1 ft^3/s is usually assumed for perennial streams, and a value of 0.0 ft^3/s is used for intermittent streams. For perennial streams, 7Q2 flows may also be estimated using a proportional watershed approach or similar technique. Tenth percentile stream flows may be used to develop seasonal permit limits if measured flow data is readily available.

- For renewal applications, the wastewater flow used in the model is the existing permitted average flow or flows of the facility as reflected in the current permit. For new or amendment applications, the wastewater flow used in the model is the proposed average flow or flows.

- Model analyses for effluent limits are usually performed with summer temperatures. The temperature is normally assumed to be 30.5°C unless critical low-flows reliably occur only at other temperatures. Alternative critical temperatures can be used if justifiable based on analysis of measured temperatures. Ninetieth percentile monthly temperatures are considered appropriate for the development of seasonal permit limits.

Background water quality. Simplified modeling normally employs assumptions for background water quality. These assumptions include an ultimate BOD concentration of 3 mg/L, an ammonia-nitrogen concentration of 0.05 mg/L, and a dissolved oxygen value equivalent to approximately 80% saturation at the model temperature. Alternatively, other values may be used based on analysis of measured data.

Tidal Water Bodies, Ponds, and Lakes

Tidal water bodies. Tidal streams or rivers may be evaluated using an uncalibrated QUAL-TX model or other suitable technique. Bays can be evaluated using previously developed calibrated models or best professional judgement. Near-field dilution models may be used to provide supplementary information.

Ponds. Small impoundments such as ponds may be evaluated using a Continuously Stirred Tank Reactor (CSTR) model or other suitable technique.

Lakes and reservoirs. Due to the highly variable nature of potential discharge locations in large lakes and reservoirs, no single screening level modeling technique is satisfactory for evaluating these discharges. Therefore, the evaluation method employed by TNRCC staff comprises a variety of techniques. While it is desirable to use mathematical models to determine treatment requirements, in some cases an appropriate model cannot be feasibly developed due to the lack of crucial site-specific information or to the large amount of time needed to develop a model. The following factors are considered in the review of these discharges:

- the size and quality of the proposed discharge
- its proximity to other dischargers
- the location of the outfall relative to areas that are likely to be highly limiting (such as small coves, flooded creek channels, or other areas with restricted interaction and water exchange with the main body of the reservoir)
- suitability of analyzing the discharge using a predictive analytical tool.

Direct discharges to relatively open waters can be evaluated using previously developed calibrated models or best professional judgement. Near-field dilution models may be used to provide supplementary information.

Tributaries of lakes and reservoirs. Discharges to tributaries of lakes and reservoirs are generally evaluated with a model or series of models. An uncalibrated QUAL-TX model is normally used to evaluate streams and rivers upstream of the normal pool elevation of the reservoir. However, other suitable models may also be used. If the model predicts that there would be significant levels of oxygen-demanding pollutants remaining in the stream as it enters the impoundment, then some portion of the impoundment is evaluated. Discharges into small coves may be modeled using a CSTR model or other suitable technique.

Water Bodies with a Dissolved Oxygen Impairment

More comprehensive approaches to setting water-quality-based effluent limits (WQBELs) are necessary when impacts from point source dischargers and/or nonpoint sources have caused violations of the water quality criteria for dissolved oxygen. These water bodies are included on the 303(d) List as having dissolved oxygen concentrations lower than the criterion. When evaluating discharges to water bodies with existing WLEs or TMDLs, effluent limits are based on the WLE or TMDL model or report as applicable. WLEs assess the effects of point source waste loading on dissolved oxygen concentrations. TMDLs typically are comprehensive analyses that include both point and nonpoint sources of oxygen-demanding pollutants.

All water bodies contained on the 303(d) List will be considered for TMDL development. Reviews of TPDES applications received before TMDL development may be conducted with the screening level methodologies discussed previously (see page 18). In addition, for applications that are proposing a new or increased load of oxygen-demanding constituents, the potential of the additional loading to negatively affect the listed portion of the water body is assessed.

Antidegradation

Policy

The antidegradation policy and framework for the antidegradation implementation procedures are specified in 30 TAC §307.5. This chapter provides additional guidance for antidegradation implementation. The antidegradation policy affords three tiers of protection to the water in the state.

- The first level (Tier 1) stipulates that water quality sufficient to protect existing uses will be maintained.
- The second level (Tier 2) stipulates that activities subject to regulatory action will not be allowed if they would cause degradation of waters that exceed fishable/swimmable quality. Exceptions to this stipulation can be made if it can be shown to TNRCC's satisfaction that the lowering of water quality is necessary for important economic or social development.
- The third level (Tier 3) stipulates that the quality of outstanding national resource waters will be maintained and protected.

General Applicability

The antidegradation policy applies to actions regulated under state and federal authority that would increase pollution of water in the state. The antidegradation implementation procedures in this document apply to any increase in pollution authorized by TPDES wastewater discharge permits or by other state and federal permitting and regulatory activities.

Increases in pollution are determined by (1) information on effluent characteristics that are provided in the application for the TPDES permit, the draft permit, and/or in other available sources; and (2) final effluent limits for flow, loading, and concentration in the previous permit compared with the proposed permit. Permits that are consistent with an approved WLE or TMDL under the antidegradation policy do not receive a separate antidegradation review for the applicable parameters unless the discharge may cause impacts on the receiving water that were not addressed by the WLE or TMDL.

Tier 1—Protecting Uses

Antidegradation reviews under Tier 1 ensure that existing water quality uses are not impaired by increases in pollution loading. Numerical and narrative criteria necessary to protect existing uses will be maintained. TPDES permit amendments or new permits that allow increased pollution loading are subject to review under Tier 1 of the antidegradation policy, and all pollution that could cause an impairment of existing uses is included in the evaluation.

Existing uses and criteria for unclassified waters are established as discussed in the section in this document entitled “Assessment and Review of Uses” on page 4. Applicable uses, and the numerical and narrative criteria needed to support those uses, are established in 30 TAC §307. Uses that may be applicable to individual water bodies include:

- aquatic life categories
- contact and noncontact recreation
- sustainable and incidental fisheries
- public drinking water supply
- aquifer protection
- oyster waters.

Additional uses may be applicable such as:

- navigation
- agricultural water supply
- industrial water supply
- seagrass propagation
- wetland water quality functions.

Numerical criteria may be applicable to individual water bodies for:

- dissolved oxygen
- total dissolved solids (TDS)
- sulfate
- chloride
- pH
- temperature
- bacterial indicators of recreational suitability
- toxic pollutants to protect aquatic life and human health.

Narrative criteria may be applicable to individual water bodies for:

- radioactive materials
- nutrients (phosphorus, nitrogen)
- temperature

- salinity
- dissolved oxygen necessary to protect aquatic life
- habitat necessary to protect aquatic life
- aquatic recreation
- toxic pollutants to protect aquatic life, human health, terrestrial wildlife, livestock, and domestic animals.

Narrative criteria may also apply for aesthetic parameters such as:

- taste and odor
- suspended solids
- turbidity
- foam and froth
- oil and grease.

The review of water quality impacts from a proposed permit action is conducted in accordance with the procedures established in other chapters of this document including “Determining Water Quality Uses and Criteria” on page 3, “Evaluating Impacts on Water Quality” on page 9, and “Toxic Pollutants” on page 51.

Protecting Impaired Waters under Tier 1

The procedures in this section address proposed wastewater discharges to water bodies listed on the Clean Water Act Section 303(d) List as not meeting instream water quality standards. The procedures are intended to assist in establishing permit requirements until a TMDL is completed. Provisions in 40 CFR Parts 122, 123, 124, and 131 are also applicable.

Definitions

Listed water body refers to the area of a water body that does not meet water quality standards and is listed in the current 303(d) List.

Listed pollutant refers to a pollutant or pollutants that cause the failure of a listed water body to attain water quality standards. For a listing due to a failure to attain dissolved oxygen criteria, the pollutants of concern include oxygen-demanding organic substances and ammonia-nitrogen.

An existing or proposed discharge is considered to be a ***discharge to a listed water body*** if (1) the discharge is directly to a listed water body, or (2) the discharge is in close enough proximity to potentially impact the listed area.

General Provisions

Permits for discharges to listed water bodies will not allow:

- an increase in the loading of a listed pollutant that will cause or contribute to the violation of water quality standards

- other conditions that will cause or contribute to the violation of water quality standards.

Subsequent references to increased loadings of listed pollutants will also include consideration of other conditions that will cause or contribute to the violation of water quality standards.

Permit applications are reviewed by the TNRCC to identify discharges into the watersheds of listed segments.

Permittees with existing discharges to water bodies on the 303(d) List will be required to monitor listed pollutants that are present in significant amounts in their effluent.[5]

Applicability to Specific Parameters

Substances that deplete instream dissolved oxygen: Effluent limits will be established to avoid an increase in BOD loading (carbonaceous or nitrogenous) unless it is demonstrated that (1) water quality standards for dissolved oxygen will be attained in the area affected by the discharge; or (2) the proposed discharge will not lower instream concentrations of dissolved oxygen in any areas that are not meeting dissolved oxygen standards. Evaluation and modeling of dissolved oxygen impacts are conducted as discussed in the chapter in this document entitled "Modeling Dissolved Oxygen" (see page 17).

Toxic pollutants: Effluent limits will be established to avoid an increase in the permitted loading of a listed toxic pollutant unless (1) it is demonstrated that water quality standards for the listed pollutant will be attained in the area affected by the discharge; or (2) water quality standards for the listed pollutant will be attained at the "end-of-pipe." Demonstrations of standards attainment may include instream monitoring of listed pollutants.

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[5] This provision has not been approved by the EPA. According to the November 22, 2002, EPA letter approving this document, EPA will require permit limits if the listed pollutant is present in the effluent.

However, no increase in loading will be allowed (1) for toxic pollutants listed for drinking water concerns; (2) for toxic pollutants that accumulate in bottom sediments, fish tissue, or deep layers of water (typically indicated by a bioconcentration factor (BCF) equal to or greater than 1,000); or (3) where fishing advisories are present.

Dissolved salts (TDS, chloride, sulfate): Effluent limits will continue to be established as discussed in the chapter of this document entitled "Screening Procedures and Permit Limits for Total Dissolved Solids" (see page 87). The current procedures preclude additional TDS loadings when ambient TDS concentrations in the area affected by the discharge are at or above standards.

Bacteria: Effluent limits are established to avoid an increase in permitted loading unless (1) it can be demonstrated that water quality standards for the listed pollutant will be attained in the area affected by the discharge, or (2) water quality standards for the listed pollutant will be attained at the "end-of-pipe."

Listings based on narrative standards: Effluent monitoring is required when relevant pollutants are present in the effluent, as determined by effluent screening for permit applications or other available information.[6] A proposed increase in loading of a pollutant that would cause or contribute to the existing violation of water quality standards will not be allowed.

Procedures for Discharges to Listed Water Bodies

Requirements for discharges to listed water bodies apply to:

- discharges that are directly to a listed water body
- discharges to adjacent water bodies that are within a reasonable distance of and may affect a listed water body.

Application procedures, requirements for effluent screening by permittees, and review of the application for administrative completeness are the same as for discharges to unlisted water bodies. Effluent screening for permit applications is conducted in accordance with the sampling requirements in current application forms.

If a listed pollutant is determined to be present in significant amounts in the effluent of an existing discharge, or if it is expected to be present in

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[6] This provision has not been approved by the EPA. According to the November 22, 2002, EPA letter approving this document, EPA will require permit limits if the listed pollutant is present in the effluent.

significant amounts in the effluent of a proposed discharge, then the permit will require effluent monitoring for that pollutant. The monitoring requirement applies even if no increase in loading of that pollutant is anticipated. For example, if a listed toxic pollutant is detected at or above the MAL, effluent monitoring for that toxic pollutant will be included in the permit.[7]

During review of permit applications, the TNRCC identifies discharges to listed water bodies and summarizes the listing in the modeling memo. For discharges that potentially increase the loading of a listed pollutant, the permit is developed in accordance with the requirements discussed beginning on page 26. The Wastewater Permitting Section will determine, when drafting the proposed permit, whether an increase in loading is anticipated.

Information on evaluating storm water discharges is contained in the section of this document entitled "Antidegradation Review of Storm Water Permits" on page 129.

Interim compliance periods and temporary variances will not allow an increase in loading of a listed pollutant that contributes to the violation of water quality standards.

For discharges that withdraw from and discharge to the same listed water body, an increase in permitted flow does not cause an "increase in loading" if it is demonstrated that the facility does not add listed pollutants to the discharge or cause other conditions that contribute to the violation of water quality standards.

Additional permit requirements will be imposed as necessary to address potential water quality impacts from listed pollutants.

The permit's fact sheet or statement of basis/technical summary (which is publicly available) notes (1) that the discharge is to a listed water body and (2) the reasons why the water body is listed.

Applicability of Pollution Reduction Programs

Pollution prevention programs of the TNRCC may focus on watersheds of listed water bodies where such programs can potentially reduce the loading of listed pollutants.

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[7] This provision has not been approved by the EPA. According to the November 22, 2002, EPA letter approving this document, EPA will require permit limits if the listed pollutant is present in the effluent.

Additional pretreatment requirements may be considered for discharges from publicly owned treatment works (POTWs) to listed water bodies where industrial users of the wastewater system contribute listed pollutants.

Examples of Permitting to Listed Water Bodies

- A proposed discharge is projected to increase the concentration of a listed pollutant in the area of the water body that is not attaining standards for that pollutant. The additional loading will not be permitted.

- An increase in discharge flow is proposed, and the discharge contains significant concentrations of a listed pollutant (for example, a listed toxic pollutant is present at a concentration at or above the MAL). The additional flow may be permitted if permit limits are established that preclude an increase in loading of the listed pollutant by reducing its concentration.

- For some pollutants, additional loading will not adversely affect water quality if no instream dilution is allowed, so that standards are attained at the "end-of-pipe." This provision does not apply when a listed pollutant accumulates in bottom sediments, fish tissue, or deep layers of water. Such accumulation is typically indicated by a bioconcentration factor (BCF) equal to or greater than 1,000 or by an advisory for fish consumption.

- For discharges that withdraw from and discharge to the same listed water body, an increase in discharge flow can be allowed if it is demonstrated that the facility is simply "passing through" the pollutant of concern, so that it does not add more of the listed pollutant to the discharge effluent or cause other conditions that contribute to the violation of water quality standards.

- For discharges that are well upstream from a listed area, some pollutants, such as BOD, might be shown to completely dissipate by the time the discharge flow reaches the listed area.

- At some sites, water quality models might predict that an additional discharge of BOD from a highly treated effluent would have no adverse effect on instream dissolved oxygen. This additional load could be allowed if the model reasonably predicts that existing conditions of dissolved oxygen in the water body will not be adversely affected.

Tier 2—Protecting High-Quality Waters

Applicability

Antidegradation reviews under Tier 2 ensure that where water quality exceeds the normal range of fishable/swimmable criteria, such water quality will be maintained unless lowering it is necessary for important economic or social development. The second tier of the antidegradation policy generally applies to water bodies that have existing, designated, or presumed uses of contact recreation and intermediate, high, or exceptional aquatic life waters. (Note that Tier 1 of the antidegradation policy applies to all water bodies, including those that are eligible for Tier 2 review.) TPDES permit amendments and new permits that allow an increase in loading are subject to review under Tier 2 of the antidegradation policy.

For Tier 2 reviews, the parameters of concern for individual water bodies may include:

- dissolved oxygen
- TDS
- sulfate
- chloride
- pH
- temperature
- toxic pollutants
- bacterial indicators of recreational suitability
- radioactive materials
- nutrients (phosphorus, nitrogen)
- taste and odor
- suspended solids
- turbidity
- foam and froth
- oil and grease
- any other constituents that could lower water quality.

Conditions that are usually **not** subject to an antidegradation review under Tier 2 include the following:

- Increases in pollutant loading at a specific discharge point that result from consolidating existing wastewater from other discharge points, so that overall loadings to a particular water body are not increased

- A new or increased loading in an individual discharge that is either

    - authorized in a waste load evaluation (WLE) or total maximum daily load (TMDL) that has been certified as an update to the Water Quality Management Plan (WQMP), or

- authorized by a TPDES general permit,

  provided that a Tier 2 review was previously conducted on the WLE, TMDL, or general permit

- A new or increased discharge authorized by a temporary or emergency order

- New data on effluent composition indicates that a pollutant that was either (1) not previously tested for or (2) not previously detected above the agency-specified minimum analytical level (MAL) is now detected above the current MAL, and there is no proposal to increase the loading of the pollutant.

Evaluating the Potential for Degradation of Water Quality

The effect of a proposed discharge is compared to baseline water quality conditions in order to assess the potential for degradation of water quality. The applicable date for establishing baseline water quality conditions is November 28, 1975, in accordance with 40 CFR Part 131 (EPA standards regulation). Baseline conditions are estimated from existing conditions, as indicated by the latest edition of the Texas Surface Water Quality Inventory or other available information, unless there is information indicating that degradation in ambient water quality has occurred in the receiving waters since November 28, 1975.

Analyses to assess the impact of a proposed discharge on water quality include procedures that are established in other chapters of this document, such as “Determining Water Quality Uses and Criteria” on page 3, “Evaluating Impacts on Water Quality” on page 9, and “Toxic Pollutants” on page 51.

Proposed increases in loading are initially screened to determine whether sufficient potential for degradation exists to require further analysis. This initial screening procedure does not define degradation. It is intended only as general guidance to indicate when an increase in loading is small enough to preclude the need for additional evaluation. The following guidelines are used for initial screening of existing and new discharges.

Existing discharges. Increases in permitted loading of less than 10% over the loading allowed by the existing discharge permit are usually not considered to constitute potential degradation if (1) the increase will attain all water quality standards, (2) the aquatic ecosystem in the area is not unusually sensitive to the pollutant of concern, and (3) the discharge is not relatively large.

The cumulative effect of repeated small increases in successive permit actions or from multiple discharges may require additional screening evaluation, even though the current permit application may be for a less than 10% increase in loading for any constituents of concern.

New discharges. Increases in loading that use less than 10% of the existing assimilative capacity of the water body at the edge of the mixing zone are usually not considered to constitute potential degradation as long as the aquatic ecosystem in the area is not unusually sensitive to the pollutant of concern. For constituents that have numerical criteria in the water quality standards, the following equation may be used to estimate changes in assimilative capacity:

$$\%\,\text{change} = \frac{100\left[C_P - C_A\right]}{C_C}$$

where:

	% change =	the percent change to the assimilative capacity
	C_P =	the predicted concentration at the edge of the mixing zone
	C_A =	the ambient concentration at the edge of the mixing zone
	C_C =	the numerical criterion for the constituent of concern

This screening procedure is not applicable to dissolved oxygen or pH. Predicted concentrations at the edge of the mixing zone are calculated at applicable critical conditions using estimated effluent concentrations, which are based on available information, categorical limits, or other information. See the subsection of this document entitled "Procedure for Developing Permit Limits" on page 67 for more information on how the ambient concentration at the edge of the mixing zone is determined.

Additional screening. If needed, additional screening is conducted to assess the potential for degradation. If proposed loadings exceed additional screening guidelines, then further evaluation is needed. The additional screening guidelines do not define degradation. The cumulative effect of repeated small increases in successive permit actions may require additional screening evaluation.

Examples Where Degradation Is Unlikely to Occur

The following examples are usually not considered to constitute degradation except where site-specific biological, chemical, or physical conditions in a water body create additional sensitivity or concern, or where background concentrations are adversely elevated:

- Increased TSS loading—if effluent concentrations are maintained at 20 mg/L or less

- Increased temperature loading—if the "end-of-pipe" temperatures are not expected to be significantly higher than applicable instream temperature criteria

- Increased loading of recreational indicator bacteria—if the applicable instream criteria are maintained in the effluent at the "end-of-pipe" or the effluent is disinfected

- Increased loading of oxygen-demanding materials—if the dissolved oxygen in the "sag zone" is lowered by less than 0.5 mg/L from baseline instream concentrations, and if the potentially affected aquatic organisms are not unusually sensitive to changes in dissolved oxygen

- Increased loading of constituents that affect pH—if the instream criteria for pH in the nearest downstream segment are attained in the effluent at the "end-of-pipe"

- Increased loading of TDS, chloride, or sulfate in freshwater—if the instream criteria are attained in the effluent at the edge of the mixing zone at critical conditions

- Increased loading of total phosphorus, nitrate, or total nitrogen—if it can be reasonably demonstrated that detrimental increases to the growth of algae or aquatic vegetation will not occur.

- Increased loading of toxic pollutants that are:

    - below concentrations that require a water-quality-based effluent limit (WQBEL) or require monitoring and reporting as a permit condition

    - not bioaccumulative (that is, the bioconcentration factor is less than 1,000)

    - not a potential cause of concern to a public drinking water supply

    - not discharged in an area where there are aquatic organisms of unusual sensitivity to the specific toxicant of concern.

Examples Where Degradation Is Likely to Occur

The following examples are intended to provide general guidelines as to when degradation becomes likely. The examples do not define degradation, nor do they address all pollutants and situations that can cause degradation. Final determinations are case-specific and can depend on the characteristics of the water body and local aquatic communities. Lower increases in loading may constitute degradation in some circumstances, and higher loadings may not constitute degradation in other situations. Examples where degradation is likely to occur include:

- Increased loading of oxygen-demanding substances that is projected to decrease dissolved oxygen by more than 0.5 mg/L for a substantial distance in a water body that has exceptional quality aquatic life and a relatively unique and potentially sensitive community of aquatic organisms

- Increased loading of bioaccumulative pollutants (that is, the bioconcentration factor is greater than 1,000) that use more than 10% of the assimilative capacity at the edge of the human health mixing zone, or a substantial increase in the loading of a toxic pollutant that would directly affect an important or unusually sensitive aquatic organism

- Increased loading of phosphorus and/or nitrogen into a reservoir that supplies public drinking water, if the loading would result in significant elevations in algae or potentially detrimental aquatic vegetation over a substantial area

- A new discharge that is made directly into a tidal wetland or estuary and that would be expected to detrimentally affect emergent or submerged vegetation over a substantial area

- Increased loading of TSS that would produce a visible turbidity plume extending past the designated aquatic life mixing zone

Evaluation of Alternatives and Economic Justification

When initial and additional screening under Tier 2 preliminarily indicates that the proposed discharge is expected to degrade water quality, then the applicant is notified so that the following information can be provided to TNRCC by the applicant:

- Any additional information about the nature of the discharge and the receiving waters that could affect the evaluation of whether degradation is expected

- An analysis of alternatives to the proposed discharge that could eliminate or reduce the anticipated degradation, and an assessment of cost and feasibility for reasonable alternatives

- An evaluation of whether the proposed discharge will provide important economic and social development in the area where the affected waters are located, considering factors such as:

  - Employment
  - Increased production that improves local economy
  - Improved community tax base
  - Housing
  - Correction of an environmental or public health problem.

Agency Review of Degradation

When degradation is anticipated, the TNRCC reviews the preliminary determination of potential degradation, the evaluation of alternatives, and economic and social justification. The TNRCC then determines whether a lowering of water quality is expected from the proposed discharge. If it is, the TNRCC then determines whether the lowering of water quality is necessary for important economic or social development and whether reasonable alternatives to the lowering of water quality are unavailable. The TNRCC may also refer questions concerning an antidegradation review to the State Office of Administrative Hearings for further review and consideration for an administrative hearing. Any proposed TPDES permit that allows degradation is subject to EPA review and approval.

Tier 3—Outstanding National Resource Waters

Outstanding national resource waters (ONRWs) are defined in 30 TAC §307.5(b)(3) as high-quality waters within or adjacent to national parks and wildlife refuges, state parks, wild and scenic rivers designated by law, and other designated areas of exceptional recreational or ecological significance. In accordance with 30 TAC §307.5(b)(3), the quality of such waters will be maintained and protected. No increase in pollution that could cause degradation of water quality is allowed into ONRWs.

ONRWs are specifically designated in 30 TAC §307.5. Any designation of an ONRW should include a geographic description of the ONRW and of the applicable watershed to which the restrictions on increased loadings apply. Currently there are no designated ONRWs in Texas.

Watershed Protection Rules

Additional protection of specific, sensitive watersheds is provided by requirements for wastewater discharge permits in 30 TAC §311. Requirements for discharges in specified watersheds can include phosphorus limits, advanced treatment of CBOD and ammonia-nitrogen, and prohibitions of discharge except by irrigation. Water bodies and their adjacent watersheds that are addressed in 30 TAC §311 include:

Water Body/Watershed	Segment Number
Lake Travis	1404
Lake Austin	1403
Inks Lake	1407
Lake Buchanan	1408
Clear Lake	2425
Lake Houston	1002
Colorado River Below Town Lake	1428
Onion Creek	1427
Lake Lyndon B. Johnson	1406
Marble Falls Lake	1405
Lake Worth	0807
Eagle Mountain Reservoir	0809
Bridgeport Reservoir	0811
Cedar Creek Reservoir	0818
Lake Arlington	0828
Benbrook Lake	0830
Richland-Chambers Reservoir	0836

In addition to the above rules, additional protection is provided to the recharge and contributing zones of the Edwards Aquifer in 30 TAC §213.

Public Notice

The Notice of Application and Preliminary Decision (public notice) concerning a proposed permit or permit amendment includes any preliminary additional uses assigned to unclassified receiving waters. If the proposed discharge is to a water body listed as impaired on the current 303(d) List, this fact is noted in the permit’s fact sheet, statement of basis/technical summary, or other publicly available information.

When the proposed permit affects receiving waters whose quality is exceptional, high, or intermediate, the public notice also indicates whether a lowering of water quality is anticipated. Information in the public notice about uses and antidegradation is indicated as preliminary and is subject to additional review and revision before approval of the permit by the TNRCC. A summary of anticipated impacts and the criteria for preliminary determinations of whether degradation will occur is publicly available in the permit file.

The public notice provides opportunity to comment and to submit additional information on the determination of existing uses and criteria, anticipated impacts of the discharge, baseline conditions, the necessity of the discharge for important economic or social development if degradation of water quality is expected under Tier 2, and any other applicable aspects of the antidegradation policy.

Mixing Zones and Critical Conditions

General Information

This chapter describes how TNRCC assigns mixing zones (MZ) and zones of initial dilution (ZIDs) and determines their associated critical mixing conditions for discharges into different types of water bodies.

Mixing zones are defined in permits for:

- domestic discharge permits with a flow of 1 million gallons per day (MGD) or greater (or with numerical criteria and/or whole effluent toxicity tests specifically expressed as permit limitations)

- industrial permits (excepting discharges that consist entirely of storm water runoff).

The mixing zone may not encompass an intake for a domestic drinking water supply that includes an organized treatment system as defined in 30 TAC §290.

Mixing Zones and ZIDs for Aquatic Life Protection

Mixing zone size and shape may be varied in individual permits to account for differences in:

- stream flow
- bay, estuary, and reservoir morphometry
- effluent flow
- stream geometry
- ecological sensitivity at the discharge site
- zone of passage concerns
- discharge structures.

ZIDs are specified for different receiving water types in 30 TAC §307.8(b)(2) and are not usually specified in individual permits. Complete mixing of effluent and receiving waters is assumed at mixing zone boundaries unless available information shows otherwise.

Intermittent streams. No mixing zone is assigned to discharges to intermittent streams or to intermittent streams with perennial pools.

Perennial streams and rivers. Mixing zones for discharges into perennial streams or rivers are expressed in the permit in terms of longitudinal stream distance. The typical mixing zone extends 300 feet downstream and 100 feet upstream from the discharge point. Mixing zones may not preclude passage of free swimming or drifting aquatic organisms to the extent that aquatic life use is significantly affected.

ZIDs may not exceed a size of 60 feet downstream and 20 feet upstream from the point of discharge and may not encompass more than 25% of the volume of the stream flow at or above the seven-day, two-year low-flow (7Q2). ZIDs cannot extend across perennial streams or rivers or impair migration of aquatic organisms.

Lakes and reservoirs. Mixing zones for discharges into lakes and reservoirs are normally expressed in the permit as a maximum radius that extends over the receiving water in all directions from the point of discharge. The typical mixing zone radius is no greater than 100 feet but does not exceed one-half the width of the receiving water at the discharge point.

ZIDs may not exceed a 25-foot radius in all directions (or equivalent volume or area for discharges through diffuser systems) from the point of discharge and are normally assigned a value that is one-fourth the radius of the mixing zone. This is generally equivalent to 6.3% of the mixing zone surface area.

Bays, estuaries, and wide tidal rivers. Mixing zones for discharges into bays, estuaries, and wide tidal rivers ($\geq$ 400 feet across) are expressed in the permit as a maximum radius that extends over the receiving water in all directions. The typical mixing zone radius is no greater than 200 feet but does not exceed one-half the width of the receiving water at the discharge point.

ZIDs may not exceed a 50-foot radius in all directions (or equivalent volume or area for discharges through diffuser systems) from the point of discharge and are normally assigned a value that is one-fourth the radius of the mixing zone.

Wetlands. Generally, no mixing zone is assigned to discharges to wetlands. Discharges to permanently inundated wetlands may be assigned a mixing zone. The size of the mixing zone is evaluated on a case-by-case basis.

Critical Conditions for Aquatic Life Protection

Effluent concentration limits for specific toxic materials are calculated for acute and chronic numerical toxic criteria, as appropriate, using an effluent fraction that represents critical mixing conditions (see the section of this document entitled "Deriving Permit Limits for Aquatic Life Protection" on page 52). This effluent fraction, when expressed as a percentage, is also referred to as the critical dilution, and is used as the primary concentration for whole effluent toxicity testing (see the subsection of this document entitled “Dilution Series, Dilution Water, and Type of WET Test” on page 108).

Intermittent streams. For discharges into intermittent streams with no significant aquatic life uses, acute toxic criteria apply at the point of discharge, and no dilution is assumed (that is, the critical dilution is 100%). If the discharge reaches a perennial stream within three miles, chronic toxic criteria apply at the perennial stream (see discussion below). For discharges into intermittent streams with significant aquatic life uses created by perennial pools, acute and chronic toxic criteria apply at the point of discharge, and no dilution is assumed (that is, the critical dilution is 100%).

Perennial streams and rivers. For discharges into perennial streams and rivers, chronic toxic criteria apply at the edge of the mixing zone in the perennial water body using the effluent dilution that occurs at the 7Q2. In addition, acute toxic criteria apply at the edge of the ZID in the perennial water body using the effluent dilution that occurs at the 1Q2, which is estimated as 25% of the 7Q2. The following equations are used to calculate the effluent dilutions:

$$\%\ \text{effluent @ edge of MZ} = \frac{Q_E}{Q_E + 7\text{Q2}} \times 100\%$$

$$\%\ \text{effluent @ edge of ZID} = \frac{Q_E}{Q_E + 0.25(7\text{Q2})} \times 100\%$$

where: Q_E = effluent flow

For more information about what effluent flow is used in these equations, see the section of this document entitled “Deriving Permit Limits for Aquatic Life Protection” on page 52. For more information on how the 7Q2 is determined, see the section of this document entitled “Determining the 7Q2” on page 43.

Lakes, reservoirs, bays, estuaries, and wide tidal rivers. Critical conditions at mixing zone boundaries for discharges into lakes, reservoirs, bays, estuaries, and wide tidal rivers are estimated from appropriate models of discharge plume dispersion. To estimate dilution, TNRCC uses the horizontal Jet Plume equation (based on Fischer, H.B., E.J. List, R.C.Y. Koh, J. Imberger, N.H. Brooks, 1979. *Mixing in Inland and Coastal Waters*. Chapter 9: Turbulent Jets and Plumes, p. 328):

$$\%\ \text{effluent} = \frac{2.8 \times D \times (3.14)^{1/2}}{R} \times 100\%$$

where: *D* = pipe diameter (ft) that corresponds to effluent flow (based on Manning's equation, but not less than 3 ft)

R = radius (ft) of mixing zone or ZID

Model results and empirical data indicate that the following initial assumptions are appropriate for discharges of less than or equal to 10 MGD:

- The percentage of effluent at the edge of the mixing zone is 15% for lakes and 8% for bays, estuaries, and wide tidal rivers.

- The percentage of effluent at the edge of the ZID is 60% for lakes and 30% for bays, estuaries, and wide tidal rivers.

These assumed critical dilutions are based on a pipe diameter of 3 feet and the standard mixing zone sizes of 100 feet (lakes and reservoirs) and 200 feet (bays, estuaries, and wide tidal rivers). If it is necessary to assign a smaller mixing zone, these effluent percentages will increase. TNRCC assigns a critical dilution of 100% effluent for discharges equal to or greater than 100 MGD. TNRCC staff may use data from appropriately performed effluent dispersion dye studies or effluent mixing models to vary from the conservative initial dilution assumptions.

Effluent concentration limits for specific toxic materials are initially calculated to meet numerical standards for chronic toxicity at the edge of the mixing zone and numerical standards for acute toxicity at the edge of the ZID. The estimated effluent concentration at the edge of the mixing zone is also used as the primary concentration for chronic whole effluent toxicity testing.

Narrow tidal rivers. Critical conditions at mixing zone boundaries for discharges into narrow tidal rivers (< 400 feet across) are calculated as for perennial streams and rivers if upstream flow data from USGS gages or other sources are available. The typical mixing zone extends 300 feet downstream and 100 feet upstream from the discharge point.

In the absence of site-specific data such as dispersion dye studies or nearby flow measurements, minimum critical dilutions of 8% effluent at the edge of the mixing zone and 30% effluent at the edge of the ZID are assumed. Because mixing conditions in tidal rivers with upstream flow are not well understood, these minimum dilutions should provide narrow tidal rivers with the same level of protection given to bays, estuaries, and wide tidal rivers.

If upstream flow data from USGS gages or other sources is unavailable, the horizontal Jet Plume equation is used to calculate critical conditions. In these cases, the mixing zone radius is one-half the width of the narrow tidal river at the discharge point, and the critical dilutions are greater than 8% at the edge of the mixing zone and greater than 30% at the edge of the ZID. TNRCC staff may also consider tracer analyses, empirical data, or other models to determine site-specific instream dilution in narrow tidal rivers.

Wetlands. For discharges into wetlands, very little mixing is likely to occur. Therefore, in the absence of site-specific data (such as dispersion dye studies), acute and chronic toxic criteria apply at the point of discharge, and no dilution is assumed (that is, the critical dilution is 100%).

Determining the 7Q2

The 7Q2 is defined in the TSWQS as “the lowest average stream flow for seven consecutive days with a recurrence interval of two years, as statistically determined from historical data.” Effluent limits in TPDES wastewater discharge permits are designed to maintain the applicable numerical water quality standards for the protection of aquatic life when instream flows are at or above the 7Q2.

Many of the numerical water quality standards, as established in 30 TAC §307, do not apply when stream flow conditions are less than “critical low-flow conditions.” Generally, critical low-flow conditions are determined as the 7Q2. The following criteria apply at and above the 7Q2:

- numerical criteria for dissolved oxygen
- numerical criteria for temperature and pH
- numerical criteria for fecal coliform or other bacteriological indicators
- numerical criteria to protect aquatic life from acute toxicity (apply at and above ¼ of the 7Q2)
- numerical criteria to protect aquatic life from chronic toxicity
- requirements to preclude chronic toxicity in whole effluent toxicity testing.

For purposes of water quality regulation, the 7Q2 is calculated from approximately 30 years of flow data at USGS gages. A shorter period of record is used if the longer period of record is unavailable or inappropriate. If a major, permanent hydrologic alteration has occurred, such as upstream reservoir construction, then only the flows recorded after the alteration are used in the 7Q2 calculation.

Gage data is also examined for trends, and the period of record may be adjusted if a trend is identified. Appendix B of the TSWQS lists 7Q2s for designated stream segments, but the TSWQS also allow the 7Q2 to be recalculated to incorporate new flow data.

If less than five years of continuous daily average flow data is available, the tenth percentile flow is normally used as an estimate of the 7Q2. Otherwise, the following procedure is used in a FORTRAN program to calculate the 7Q2 using USGS gage daily average flow data:

1. Determine the minimum seven-day average flow for each year of data.

2. Rank the minimum seven-day average flows from lowest to highest.

3. Calculate the recurrence interval for each minimum seven-day average flow. If N is the total number of years of flow data, then the recurrence interval is (N+1)/rank.

4. The 7Q2 is the minimum seven-day average flow with a recurrence interval of 2. If an even number of years is used, interpolate the 7Q2.

In the absence of USGS flow data, other sources of flow information may be used to estimate the 7Q2. These sources include, but are not limited to: self-reporting data from upstream dischargers, Surface Water Quality Monitoring (SWQM) stations, receiving water assessments (RWAs), intensive surveys, or Clean Rivers Program (CRP) targeted monitoring. Estimates of the 7Q2 using this kind of data are generally based on comparing flow measurements from the ungaged site with a nearby USGS gage.

In the absence of flow data, a drainage area ratio is used to estimate the 7Q2. For this purpose, the 7Q2 is assumed to be directly proportional to drainage area. The drainage area above the point of discharge is determined, a nearby gage is selected for the comparison, and the following equation is used to estimate the 7Q2:

$$7Q2_d = \frac{7Q2_g}{DA_g} \times DA_d$$

where:

$7Q2_d$ = 7Q2 just above the discharge point

DA_d = drainage area above the discharge point

$7Q2_g$ = 7Q2 of the gage

DA_g = drainage area above the gage

Mixing Zones and Critical Conditions for Human Health Protection

Intermittent streams. No human health mixing zone is applied to discharges to intermittent streams with no significant aquatic life uses, since human health toxic criteria do not apply. If the effluent reaches perennial waters or an intermittent stream with perennial pools within three miles of the discharge point, human health criteria apply at those waters.

Intermittent streams with perennial pools. Human health mixing zones for discharges into intermittent streams with perennial pools typically extend 300 feet downstream and 100 feet upstream from the discharge point. Human health criteria apply at the edge of the human health mixing zone using the effluent dilution that occurs at the harmonic mean flow. The equation under “Perennial streams and rivers” is used to calculate the human health effluent dilution.

Perennial streams and rivers. Human health mixing zones for discharges into perennial streams or rivers typically extend 300 feet downstream and 100 feet upstream from the discharge point. Human health criteria apply at the edge of the human health mixing zone using the effluent dilution that occurs at the harmonic mean flow. The following equation is used to calculate the human health effluent dilution:

$$\%\ \text{effluent @ edge of HH MZ} = \frac{Q_E}{Q_E + HM} \times 100\%$$

where: Q_E = effluent flow

HM = harmonic mean flow

For more information on what effluent flow is used in this equation, see the section of this document entitled “Deriving Permit Limits for Human Health Protection” on page 60. For more information on how the harmonic mean flow is determined, see the section of this document entitled “Determining the Harmonic Mean Flow” on page 47.

Lakes and reservoirs. The typical human health mixing zone radius for lakes and reservoirs extends no greater than 200 feet in all directions over the receiving water from the point of discharge. At this distance, the assumed effluent dilution is 8% for discharges of less than or equal to 10 MGD. If it is necessary to assign a smaller human health mixing zone radius, this effluent percentage will increase. These effluent dilutions are based on the horizontal Jet Plume equation discussed in the section of this document entitled “Critical Conditions for Aquatic Life Protection” on page 40.

TNRCC assigns an effluent percentage of 100% for discharges equal to or greater than 100 MGD. The staff may use the results of appropriately performed effluent dispersion dye studies or effluent mixing models to vary from these assumptions.

Bays, estuaries, and wide tidal rivers. The typical human health mixing zone radius for bays, estuaries, and wide tidal rivers extends no greater than 400 feet in all directions over the receiving water from the point of discharge. At this distance, the assumed effluent dilution is 4% for discharges of less than or equal to 10 MGD. If it is necessary to assign a smaller human health mixing zone radius, this effluent percentage will increase. These effluent dilutions are based on the horizontal Jet Plume equation discussed in the section of this document entitled “Critical Conditions for Aquatic Life Protection” on page 40.

TNRCC assigns an effluent percentage of 100% for discharges equal to or greater than 100 MGD. The staff may use the results of appropriately performed effluent dispersion dye studies or effluent mixing models to vary from these assumptions.

Narrow tidal rivers. In narrow tidal rivers, the critical conditions for human health protection are calculated as for perennial streams and rivers if upstream flow data from USGS gages or other sources are available. In this case, the human health mixing zone typically extends 300 feet downstream and 100 feet upstream from the discharge point.

In the absence of site-specific data such as dispersion dye studies or nearby flow measurements, a minimum effluent dilution of 4% effluent at the edge of the human health mixing zone is assumed. Because mixing conditions in tidal rivers with upstream flow are not well understood, this minimum dilution should provide narrow tidal rivers with the same level of protection given to bays, estuaries, and wide tidal rivers.

If upstream flow data from USGS gages or other sources is unavailable, the horizontal Jet Plume equation is used to calculate the effluent dilution. In these cases, the mixing zone radius is equal to the width of the river at the discharge point, and the effluent dilution is greater than 4% at the edge of the human health mixing zone.

More protective human health critical conditions may be used where bioaccumulative or persistent pollutants are a concern. TNRCC staff may also consider tracer analyses, empirical data, or other models to determine site-specific instream dilution in narrow tidal rivers.

Wetlands. Generally, no human health mixing zone is assigned to discharges to wetlands. Discharges to permanently inundated wetlands may be assigned a human health mixing zone whose size is evaluated on a case-by-case basis. Very little mixing is likely to occur in a wetland, so in the absence of site-specific data (such as dispersion dye studies), human health criteria apply at the point of discharge, and no dilution is assumed (that is, the effluent percentage is 100%).

Determining the Harmonic Mean Flow

The harmonic mean flow is defined in the TSWQS as "a measure of mean flow in a water course which is calculated by summing the reciprocals of the individual flow measurements, dividing this sum by the number of measurements, and then calculating the reciprocal of the resulting number." Harmonic mean flows are usually, but not always, greater than 7Q2s. Effluent limits in TPDES wastewater discharge permits are designed to maintain the applicable numerical water quality standards for the protection of human health when instream flows are at or above the harmonic mean flow.

Many of the numerical water quality standards, as established in 30 TAC §307, do not apply when stream flow is less than the harmonic mean flow. The following criteria apply at and above the harmonic mean flow:

- Numerical toxic criteria to protect human health
- Numerical criteria for total dissolved solids, sulfate, and chloride.

For purposes of water quality regulation, the harmonic mean flow is calculated from approximately 30 years of flow data at USGS gages. A shorter period of record is used if the longer period of record is unavailable or inappropriate. If a major, permanent hydrologic alteration has occurred, such as upstream reservoir construction, then only the flows recorded after the alteration are used in the harmonic mean calculation.

Gage data is also examined for trends, and the period of record may be adjusted if a trend is identified. Harmonic mean flows for designated stream segments are listed in Appendix B of the TSWQS, but the TSWQS also allow the harmonic mean flow to be recalculated to incorporate new flow data.

The following equation is used to calculate the harmonic mean flow for any set of flow data:

$$HM = \left[\frac{\sum_{i=1}^{N_T - N_0} \frac{1}{Q_i}}{N_T - N_0} \right]^{-1} \times \left[\frac{N_T - N_0}{N_T} \right]$$

where:

where:	HM	=	harmonic mean flow
	Q_i	=	nonzero flow
	N_T	=	total number of flow values
	N_0	=	number of zero flow values

In order to calculate water-quality-based effluent limits (WQBELs) for human health protection, a harmonic mean flow is determined for all perennial streams and for streams that are intermittent with perennial pools. Sometimes these streams have days on which measured flow is zero. Because a zero flow cannot be used in the calculation of harmonic mean flow, the second term in the harmonic mean equation is an adjustment factor used to lower the harmonic mean to compensate for days on which the flow was zero. This is the same correction used by the EPA computer program DFLOW.

In the absence of any flow data at all, a drainage area ratio is used to estimate the harmonic mean flow. For this purpose, the harmonic mean flow is assumed to be directly proportional to drainage area. The drainage area above the point of discharge is determined, a nearby gage is selected for the comparison, and the following equation is used to estimate the harmonic mean flow:

$$HM_d = \frac{HM_g}{DA_g} \times DA_d$$

where:	HM_d	=	harmonic mean flow just above the discharge point
	DA_d	=	drainage area above the discharge point
	HM_g	=	harmonic mean flow of the gage
	DA_g	=	drainage area above the gage

Diffusers

Diffusers installed at the end of discharge pipes may increase mixing and lower critical dilutions. The model most commonly used to design diffusers and evaluate the resulting mixing conditions is CORMIX. Mixing should be evaluated under both summer and winter temperature conditions and at different combinations of effluent and receiving water densities. The highest effluent percentages at the edge of the mixing zone and ZID are used to determine WQBELs for the protection of aquatic life. The highest effluent percentage at the edge of the human health mixing zone is used to determine WQBELs for the protection of human health.

Toxic Pollutants

General Provisions

The TSWQS for toxic pollutants include general provisions, specific numerical criteria, and total (whole effluent) toxicity criteria. As stated in 30 TAC §307.6:

- Water in the state shall not be acutely toxic to aquatic life. Although acute criteria may be exceeded in a zone of initial dilution (ZID), there shall be no lethality to aquatic organisms that move through the ZID.

- Water in the state shall not be chronically toxic to aquatic life except in mixing zones, below critical low-flow, and where there are no significant aquatic life uses.

- Water in the state shall be maintained to preclude adverse toxic effects on human health resulting from contact recreation, consumption of aquatic organisms, or consumption of drinking water after reasonable treatment. Specific human health concentration criteria apply to water in the state with sustainable fisheries and/or designation or use as a public drinking water supply. These criteria do not, however, apply within human health mixing zones or below harmonic mean stream flows.

- Water in the state shall be maintained to preclude adverse toxic effects on aquatic life, terrestrial wildlife, livestock, or domestic animals, resulting from contact, consumption of aquatic organisms, or consumption of water.

Permits for discharges into intermittent streams are designed to protect against acute toxicity at the point of discharge. Permits for discharges within three miles of perennial waters or perennial pools with significant aquatic life uses are designed to protect against chronic toxicity and to protect human health in those waters. Permits for discharges into classified and unclassified water bodies with significant aquatic life uses are designed to protect against acute and chronic toxicity and to protect human health. Permits for discharges to the Houston Ship Channel are also designed to protect against acute and chronic toxicity and to protect human health.

Specific Numerical Criteria

The numerical criteria for the protection of aquatic life (30 TAC §307.6(c)) are expressed for freshwater acute, freshwater chronic, marine water acute, and marine water chronic conditions. The numerical criteria for the protection of human health (30 TAC §307.6(d)) are expressed as receiving water concentrations to prevent contamination of drinking water, fish, and other aquatic life to ensure safe levels for human consumption. The three categories of human health criteria given in the standards are (1) water and fish, (2) freshwater fish only, and (3) saltwater fish only. These standards apply whether or not they are addressed specifically in a wastewater discharge permit.

When submitting a permit application, the following types of facilities are required to include effluent data for those elements and compounds for which there are standards and that the TNRCC believes likely to be present in the effluent:

- domestic facilities requesting a permitted average flow equal to or greater than 1 million gallons per day (MGD) and/or with an approved pretreatment program

- domestic facilities requesting a permitted average flow less than 1 MGD on a case-by-case basis when facility inspection or other information provides reasonable potential to expect the presence of toxic pollutants in the receiving water or effluent

- industrial facilities.

Deriving Permit Limits for Aquatic Life Protection

General Approach

In order to determine the effluent concentration of a toxic pollutant necessary to protect instream water quality criteria, TNRCC staff use the general approach found in the EPA publication entitled *Technical Support Document for Water Quality-based Toxics Control*, EPA/505/2-90-001.

- TNRCC staff apply acute criteria for discharges into intermittent streams with no significant aquatic life use and assume a critical low-flow of 0.0 ft^3/s.

- Discharges into intermittent streams that flow into perennial waters within a moderate distance downstream (normally 3 miles) are analyzed using acute and chronic criteria and the critical low-flow of the perennial waters to determine whether more stringent requirements are needed to protect those perennial waters.

- Permit limits are developed to ensure that intermittent streams with significant seasonal aquatic life uses will meet chronic toxic criteria during the seasons and typical flow conditions in which these uses occur.

- TNRCC staff apply chronic criteria at critical mixing conditions for other water bodies with aquatic life uses (lakes, bays, estuaries, tidal rivers) unless acute criteria are more protective.

Water Quality Parameters That Affect Aquatic Life Criteria

For certain substances, water quality criteria are a function of one or more of the following receiving water parameters:

- hardness
- pH
- chloride
- total suspended solids (TSS).

Fifteenth percentile (15th) values of segment hardness, pH, and TSS data are considered critical conditions (see Table 5 in Appendix C of this document). Basin values are used when there is insufficient segment data.

The fiftieth (50th) percentile value of segment chloride data is used to implement the freshwater silver standard for aquatic life protection (see Table 5). Basin values are used when there is insufficient segment data.

TNRCC staff usually obtain this information from Table 5 but may also use information in the TNRCC's Surface Water Quality Monitoring (SWQM) database. The permittee may also supply site-specific data. The procedures to collect site-specific data for hardness, pH, chloride, TSS, and partition coefficients are outlined in the section of this document entitled "Collecting Site-Specific Data" on page 73.

The numerical standards for toxic pollutants apply to total recoverable concentrations, except for designated metals. For these metals, the numerical standards apply to dissolved concentrations. Saltwater and freshwater metals criteria listed in Table 1 of the TSWQS were derived by multiplying the current standard by the appropriate listed conversion factor to obtain a percent dissolved standard. The resultant value is the percent dissolved metal in the tests used by EPA to derive the criteria.

In order to determine instream compliance with the numerical standards for dissolved concentrations, TNRCC staff use partition coefficients based on the information shown in Table 7 (in Appendix C of this document) and/or on site-specific data. The use of partition coefficients determines how much metal is dissolved in the receiving water. Guidelines for developing a site-specific partition coefficient are given in the section of this document entitled "Collecting Site-Specific Data" on page 73.

The TNRCC evaluates metals not included in Table 7 by assuming the dissolved concentration equals the total recoverable concentration unless sufficient additional information and data are presented that justify a different fraction of dissolved metal.

Calculating Waste Load Allocations

The first step in developing water-quality-based effluent limits (WQBELs) for aquatic life protection is to calculate a waste load allocation from the acute criteria (WLAa) and a waste load allocation from the chronic criteria (WLAc).

- The ***WLAa*** equals the effluent concentration that will not cause instream criteria to be exceeded outside the zone of initial dilution (ZID).
- The ***WLAc*** equals the effluent concentration that will not cause instream criteria to be exceeded outside the mixing zone (MZ).

This calculation requires the use of the appropriate effluent fraction as well as the bioavailable fraction of the pollutant. (For more information on calculating the bioavailable fraction, see the subsection of this document entitled “TSS, Partition Coefficients, and Bioavailable Fractions of Metals” on page 76.) The proportion of effluent at the edge of the mixing zone is used to calculate the WLAc, and the proportion of effluent at the edge of the ZID is used to calculate the WLAa. The following equations are used to calculate the waste load allocations:

$$WLAa = \frac{Acute\ Criterion}{(Bioavailable\ Fraction)(E_F\ @\ Edge\ of\ ZID)}$$

$$WLAc = \frac{Chronic\ Criterion}{(Bioavailable\ Fraction)(E_F\ @\ Edge\ of\ MZ)}$$

where:		
	WLAa =	waste load allocation based on acute criterion
	WLAc =	waste load allocation based on chronic criterion
	Acute Criterion =	aquatic life acute numerical criterion
	Chronic Criterion =	aquatic life chronic numerical criterion
	Bioavailable Fraction =	fraction of the pollutant that is defined to be available to organisms
	E_F *@ Edge of ZID* =	proportional contribution of effluent to receiving water at the edge of the ZID
	E_F *@ Edge of MZ* =	proportional contribution of effluent to receiving water at the edge of the mixing zone

Calculating Effluent Fractions

Unless available information shows otherwise, complete mixing is assumed at the edge of the mixing zone, allowing the fraction of effluent at this location to be calculated.

Perennial freshwater streams and rivers and some narrow tidal rivers. For discharges to perennial streams and rivers and narrow tidal rivers (that are < 400 feet across and have upstream flow data), 25% of the 7Q2 is used to calculate the dilution at the edge of the ZID. The effluent fraction (E_F) used in each WLA is calculated as follows:

$$E_F \text{ @ Edge of } MZ = \frac{Q_E}{\left[Q_S + Q_E\right]}$$

$$E_F \text{ @ Edge of } ZID = \frac{Q_E}{\left[(0.25)(Q_S) + Q_E\right]}$$

where:		
	Q_E =	effluent flow
	Q_S =	7Q2 stream flow

Lakes, bays, wide tidal rivers, and some narrow tidal rivers. For discharges to lakes, bays, wide tidal rivers ($\geq$ 400 feet across), and narrow tidal rivers (< 400 feet across) that do not have upstream flow data, the fraction of effluent used in each WLA is the amount of effluent at the edge of the ZID or mixing zone as predicted by empirical models. A more complete discussion of the mixing assumptions and exceptions and corresponding effluent fractions is provided in the chapter of this document entitled, “Mixing Zones and Critical Conditions” on page 39.

Effluent flow. The effluent flow that is used for dilution calculations is determined on a case-by-case basis. In general, however:

- Domestic wastewater discharge assessments are based upon the final average permitted flow.

- Industrial wastewater discharge assessments are based upon the highest monthly average discharge of the preceding two-year period. Other flows may be used if the highest monthly average discharge does not reflect normal operating conditions. The effluent flow used to calculate the WLA is also used to calculate the final mass limits.

Calculating the Long-Term Average

Once the WLAa and the WLAc are calculated, the TNRCC determines the long-term average (LTAa and LTAc) of the treatment system performance that is necessary to meet the respective WLA with a given probability. The TNRCC bases its calculation on a lognormal probability distribution that is known to describe treatment system performance. Figure 2 shows the general shape of a lognormal probability distribution. The LTAa and the LTAc are calculated with equations that describe this function. See the *Technical Support Document for Water Quality-based Toxics Control*, EPA/505/2-90-001, for more information.

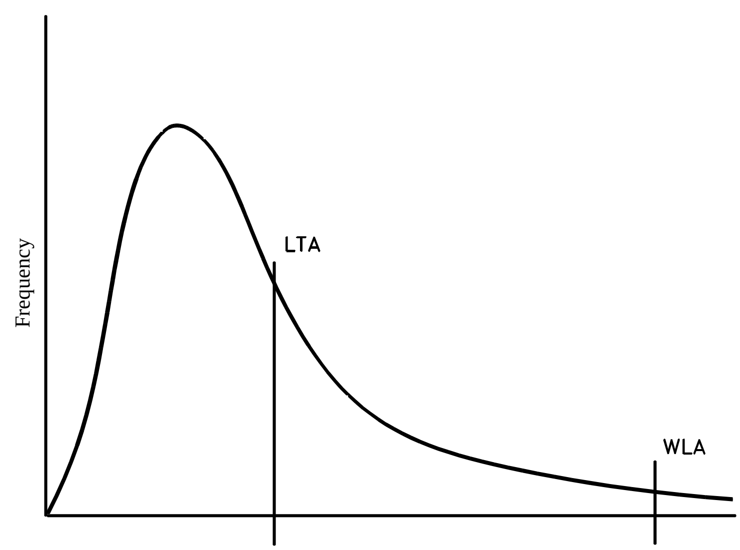


Figure 2. Probability Distribution that Describes Treatment System Performance

The final equations used to calculate the LTAa and the LTAc are:

$LTAa = 0.32\ WLAa$	(99% probability)
$LTAa = 0.573\ WLAa$	(90% probability)
$LTAc = 0.61\ WLAc$	(99% probability)
$LTAc = 0.770\ WLAc$	(90% probability)

While the derivation of these equations is quite complex (see Figure 3 on page 58), the important thing to recognize is that the equations are driven by the values that are assumed for n (averaging period), CV (coefficient of variation), and Z (probability distribution factor). The values that TNRCC assumes for these variables are:

n =	7	(7-day average, for chronic criteria)
	1	(24-hour average, for acute criteria)
Z =	1.282	(90% probability for discharges to freshwater streams, rivers, and narrow tidal rivers with upstream flow data)
	2.326	(99% probability for discharges to lakes, reservoirs, bays, estuaries, wide tidal rivers, and narrow tidal rivers without upstream flow data)
CV =	0.6	

Calculating Daily Average and Daily Maximum Permit Limits

The calculated values of LTAa and LTAc are compared. The smaller LTA is limiting and is used to calculate the daily average and daily maximum concentration limits (DLY AVG and DLY MAX, respectively) using the following equations:

$DLY\ AVG = 1.47\ LTA$	(n = 12)
$DLY\ MAX = 3.11\ LTA$	(n = 1)

These equations are driven by the values for Z (2.326), CV (0.6), and n, where n is now the number of sample events per month. For the daily average concentration limit, the TNRCC assumes n = 12 for consistency, even if the sampling frequency defined in the permit is not 3 per week. For the daily maximum concentration limit, the TNRCC uses n = 1. See Figure 4 on page 59 for detailed derivations of these equations.

Once the daily average and daily maximum concentration limits are determined, a mass limit is calculated using the same effluent flow used to calculate the WLA.

$$LTA = \exp(u_n + 0.5s_n^2)$$
$$u_n = \ln(WLA) - Zs_n$$
$$s_n^2 = \ln[1 + (CV^2/n)]$$

Acute Criteria

$$s_n^2 = \ln[1 + (0.6^2/1)] = 0.307$$
$$s_n = 0.555$$

For Z = 2.326 (99% probability):

u_n = ln(WLAa) - (2.326)(0.555)
u_n = ln(WLAa) - 1.291
LTAa = exp[(ln(WLAa) - 1.291 + 0.5(0.307)]
LTAa = exp[ln(WLAa) -1.137]
LTAa = WLAa/$e^{1.137}$
LTAa = 0.32 × WLAa

For Z = 1.282 (90% probability):

u_n = ln(WLAa) - (1.282)(0.555)
u_n = ln(WLAa) - 0.712
LTAa = exp[(ln(WLAa) - 0.712 + 0.5(0.307)]
LTAa = exp[ln(WLAa) - 0.558]
LTAa = WLAa/$e^{0.558}$
LTAa = 0.573 × WLAa

Chronic Criteria

$$s_n^2 = \ln[1 + (0.6^2/7)] = 0.050$$
$$s_n = 0.224$$

For Z = 2.326 (99% probability):

u_n = ln(WLAc) - (2.326)(0.224)
u_n = ln(WLAc) - 0.521
LTAc = exp[(ln(WLAc) - 0.521 + 0.5(0.050)]
LTAc = exp[ln(WLAc) -0.496]
LTAc = WLAc/$e^{0.496}$
LTAc = 0.61 × WLAc

For Z = 1.282 (90% probability):

u_n = ln(WLAc) - (1.282)(0.224)
u_n = ln(WLAc) - 0.287
LTAc = exp[(ln(WLAc) - 0.287 + 0.5(0.050)]
LTAc = exp[ln(WLAc) - 0.262]
LTAc = WLAc/$e^{0.262}$
LTAc = 0.770 × WLAc

Figure 3. Derivation of Equations Used to Calculate the Long-Term Average

$$LIMIT = \exp(u_n + Zs_n)$$
$$u_n = \ln(LTA) - 0.5s_n^2$$
$$s_n^2 = \ln[1 + (CV^2/n)]$$

Daily Average

$$s_n^2 = \ln[1 + (0.6^2/12)] = 0.030$$
$$s_n = 0.173$$
$$u_n = \ln(LTA) - (0.5)(0.030)$$
$$u_n = \ln(LTA) - 0.015$$
$$DLY\ AVG = \exp[(\ln(LTA) - 0.015 + (2.326)(0.173)]$$
$$DLY\ AVG = \exp[\ln(LTA) + 0.387]$$
$$DLY\ AVG = LTA \times e^{0.387}$$
$$\mathbf{DLY\ AVG = 1.47 \times LTA}$$

Daily Maximum

$$s_n^2 = \ln[1 + (0.6^2/1)] = 0.307$$
$$s_n = 0.555$$
$$u_n = \ln(LTA) - (0.5)(0.307)$$
$$u_n = \ln(LTA) - 0.154$$
$$DLY\ MAX = \exp[(\ln(LTA) - 0.154 + (2.326)(0.555)]$$
$$DLY\ MAX = \exp[\ln(LTA) + 1.137]$$
$$DLY\ MAX = LTA \times e^{1.137}$$
$$\mathbf{DLY\ MAX = 3.11 \times LTA}$$

Figure 4. Derivation of Equations Used to Calculate Daily Average and Daily Maximum Concentration Limits

Deriving Permit Limits for Human Health Protection

General Approach

In order to calculate the effluent concentration of a toxic pollutant necessary to protect instream water quality criteria, TNRCC staff use the general approach found in the EPA publication entitled *Technical Support Document for Water Quality-based Toxics Control*, EPA/505/2-90-001, March 1991.

- The human health criteria in Table 3 of the TSWQS apply to all water bodies with (1) a designation or use as a public drinking water supply and/or (2) sustainable fisheries, including:
    - all designated segments
    - perennial streams with a stream order of three or greater
    - lakes having a volume equal to or greater than 150 acre-feet and/or a surface area equal to or greater than 50 acres
    - all bays, estuaries, and tidal rivers
    - permanently inundated wetlands
    - any other waters that potentially have sufficient fish production or fishing activity to create significant long-term (sustainable) human consumption of fish.
- Human health criteria are applied to any discharge located within three miles upstream of the types of water bodies listed above.
- Waters with an aquatic life use but no sustainable fishery are considered to have an incidental fishery. Numerical criteria applicable to waters with incidental fisheries are ten times higher than for sustainable fisheries because the consumption rates assumed in the TSWQS for incidental fisheries are ten times lower than those for sustainable fisheries. This level of human health protection applies to discharges directly to or within three miles upstream of waters with an incidental fishery.
- Specific human health criteria are applied as long-term average exposure criteria designed to protect populations over a lifetime (70 years).

Calculating the Waste Load Allocation

The first step in developing water-quality-based effluent limits (WQBELs) for human health protection is to calculate a waste load allocation (WLAh). The WLAh equals the effluent concentration that will not cause criteria to be exceeded outside the human health mixing zone. This calculation requires the use of the appropriate effluent fraction as well as the bioavailable fraction of the pollutant. (For more information on calculating the bioavailable fraction, see the subsection of this document entitled "TSS, Partition Coefficients, and Bioavailable Fractions of Metals" on page 76.) The proportion of effluent at the edge of the human health mixing zone is used to calculate the WLAh. The following equation is used to calculate the waste load allocation:

$$WLAh = \frac{HH\,Criterion}{(Bioavailable\,Fraction)(E_F\ @\,Edge\ of\ HH\ MZ)}$$

where:

	HH Criterion	=	appropriate human health numerical criterion
	Bioavailable Fraction	=	fraction of the pollutant that is defined to be available to organisms
	E_F *@ Edge of HH MZ*	=	proportional contribution of effluent to receiving water at the edge of the human health mixing zone

Calculating the Effluent Fraction

Unless available information shows otherwise, complete mixing is assumed at the edge of the mixing zone, allowing the fraction of effluent at this location to be calculated.

Perennial freshwater streams and rivers, intermittent streams with perennial pools, and some narrow tidal rivers. For discharges to perennial freshwater streams and rivers, intermittent stream with perennial pools, and narrow tidal rivers (that are < 400 feet across and have upstream flow data), the proportion of effluent used in WLAh is calculated as follows:

$$E_F\ @\ Edge\ of\ HH\ MZ = \frac{Q_E}{\left[Q_{HM} + Q_E\right]}$$

where:

	Q_E	=	effluent flow
	Q_{HM}	=	harmonic mean stream flow

TNRCC staff use data from the nearest stream gaging station or available site-specific information to determine the harmonic mean flow.

Lakes, bays, wide tidal rivers, and some narrow tidal rivers. For discharges to lakes, bays, wide tidal rivers ($\geq$ 400 feet across), and narrow tidal rivers (< 400 feet across) that do not have upstream flow data, the fraction of effluent used in the WLAh is the amount of effluent at the edge of the human health mixing zone as predicted by empirical models. A discussion of the mixing assumptions and exceptions and corresponding effluent fractions is given in the chapter of this document entitled "Mixing Zones and Critical Conditions" on page 39.

Effluent flow. The effluent flow that is used for dilution calculations is determined on a case-by-case basis. In general, however:

- Domestic wastewater discharge assessments are based upon the final average permitted flow.

- Industrial wastewater discharge assessments are based upon the average of monthly average flow values over the preceding two-year period.

Calculating the Long-Term Average and Permit Limits

The WLAh is considered to be an annual average (n = 365 days). The long-term average (LTAh), daily average concentration (DLY AVG), and daily maximum concentration (DLY MAX) are calculated at 99% probability (Z = 2.326) using the same process that was used for the aquatic life calculations (see Figure 3 on page 58 and Figure 4 on page 59). The final equations are as follows:

$$LTAh = 0.930\ WLAh \qquad (n = 365)$$

$$DLY\ AVG = 1.47\ LTAh \qquad (n = 12)$$

$$DLY\ MAX = 3.11\ LTAh \qquad (n = 1)$$

Establishing Permit Limits for Toxic Pollutants without Criteria

In some instances, potentially toxic materials for which no specific numerical criteria have been developed are used in a treatment process or are present in an effluent. Where necessary, permit limits are developed for these materials using available toxicity data and the method described in this section. For substances without standards that are reported in the permit application, TNRCC staff screen the reported value against the agency-specified minimum analytical level (MAL). Parameters less than the MAL are screened out with no further action necessary. Numerical criteria and permit limits are developed, if appropriate, for parameters exceeding the MAL. For substances that commonly occur naturally at concentrations above the MAL, alternative screening criteria are used.

Aquatic Life Criteria

TNRCC develops permits that protect against acute and chronic toxicity (as appropriate) in receiving waters at and above critical conditions. Critical conditions in receiving waters are established using methods discussed in the chapter of this document entitled “Mixing Zones and Critical Conditions” on page 39. As stated in 30 TAC §307.6(c)(7), water quality criteria for the protection of aquatic life are established using the methods described in this subsection.

Specific numerical criteria are calculated using the method outlined in *Guidelines for Deriving Water Quality Criteria for the Protection of Aquatic Life and Its Uses* (45 FR 79341-79347 November 28, 1980) and *Summary of Revisions to “Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses”* (50 FR 30792-30793, July 29, 1985) if toxicity data requirements outlined in those documents are met.

Acute criteria. If the data requirements in the documents cited above are not met, acute water quality criteria are calculated as follows:

ACUTE CRITERIA = (LC50 of most sensitive species)(0.3)

where: LC50 = the concentration of a toxicant that is lethal (fatal) to 50% of the organisms tested in a specified time period

Chronic criteria. The derivation of chronic water quality criteria for the protection of aquatic life depends on the persistence and bioaccumulative capacity of the material. A pollutant’s potential to bioaccumulate can be expressed by any of the following:

- the bioaccumulation factor (BAF)
- the bioconcentration factor (BCF)
- the octanol-water partition coefficient (Kow).

The BAF and the BCF measure the concentration of a substance in a living organism relative to the concentration of the substance in the surrounding medium.

The BAF accounts for substance intake from both food and the surrounding medium, while the BCF accounts for intake from the surrounding medium only. The Kow estimates the tendency of a substance to partition from water to organic media, such as lipids present in living organisms. The Kow can be used in place of the BCF or BAF when limited experimental data are available.

For the purposes of this section, the TNRCC will use the following criteria to determine whether a chemical is persistent or bioaccumulative:

- A chemical is ***persistent*** if it has a soil, sediment, or water half-life of four days or greater. It is ***highly persistent*** if it has a soil, sediment, or water half-life of six months or greater.

- A chemical is ***bioaccumulative*** if its bioaccumulation factor (BAF) or bioconcentration factor (BCF) is 1,000 or greater. It is ***highly bioaccumulative*** if either its BAF or BCF is 5,000 or greater.

The following methods for deriving chronic criteria are consistent with 30 TAC §307.6(c)(7).

NONPERSISTENT TOXIC COMPOUNDS:

CHRONIC CRITERIA = (LC50 of most sensitive species)(0.1)

PERSISTENT TOXIC COMPOUNDS:

CHRONIC CRITERIA = (LC50 of most sensitive species)(0.05)

BIOACCUMULATIVE TOXIC COMPOUNDS:

CHRONIC CRITERIA = (LC50 of most sensitive species)(0.01)

Toxicity data used in these equations should be derived from tests using the most sensitive species. LC50s are selected that have appropriate end points (mortality), appropriate duration (96 hours for vertebrates and 48 hours for invertebrates), and appropriate species (freshwater or saltwater). Toxicity tests using aquatic plants are not considered at this time. There may be instances when toxicity data are only available for species not representative of the receiving waters, test durations are varied, or other circumstances exist that may require a method that differs from the one described in this section.

If acute or chronic criteria need to be derived for biocides, other water treatment chemicals, or other constituents present in the effluent for which water quality standards are not established, the methods just described are used. The following information is typically needed to determine these criteria:

- product information sheet
- material safety data sheet (MSDS) if available
- product toxicity data
- permitted discharge volume
- expected concentration of product in effluent
- discharge location.

Human Health Criteria

Water quality criteria for human health protection are derived as stated in 30 TAC §307.6(d)(8) and (9).

- For known or suspected carcinogens, a cancer risk of 10^{-5} (1 in 100,000) is applied to the most recent numerical criteria adopted by EPA and published in the *Federal Register*.

- For toxic materials not defined as carcinogens, the most recent numerical criteria adopted by EPA and published in the *Federal Register* are applicable.

- In both cases, if a maximum contaminant level (MCL) applies and is less than the resulting criterion, then the MCL applies to public drinking water supplies as stated in 30 TAC §307.6(d)(3)(G).

- Numerical criteria for pollutants that bioconcentrate are derived in accordance with the general procedures in the EPA guidance document entitled *Assessment and Control of Bioconcentratable Contaminants in Surface Waters* (March 1991).

In the absence of available criteria, numerical criteria may be derived from available information and calculated using the following formulas:

WATER AND FISH, CARCINOGENS:

$$\text{HH CRITERIA}(\mu\text{g/L}) = \frac{(RL)(BW)(U)}{CPF\left[WI + (FC)(LC)(BCF)\right]}$$

WATER AND FISH, NONCARCINOGENS:

$$\text{HH CRITERIA}\ (\mu\text{g/L}) = \frac{(RfD)(BW)(U)}{WI + (FC)(LC)(BCF)}$$

FISH TISSUE ONLY, CARCINOGENS:

$$\text{HH CRITERIA}(\mu\text{g/L}) = \frac{(RL)(BW)(U)}{(CPF)(FC)(LC)(BCF)}$$

FISH TISSUE ONLY, NONCARCINOGENS:

$$\text{HH CRITERIA}(\mu\text{g/L}) = \frac{(RfD)(BW)(U)}{(FC)(LC)(BCF)}$$

where:

where:	*RL*	=	risk level (1 in 100,000, or 10^{-5})
	RfD	=	reference dose (mg toxicant/kg human body weight/day)
	BW	=	body weight of average adult (70 kg)
	U	=	unit conversion factor to express criteria in µg/L (1000 µg/mg)
	CPF	=	carcinogenic potency factor (oral slope factor, kg-day/mg)
	WI	=	amount of water consumed per day (2 L/day)
	FC	=	amount of fish tissue consumed (0.01 kg/day for freshwater; 0.015 kg/day for saltwater)
	LC	=	lipid correction factor to adjust BCFs normalized to 7.6% lipids to represent a 3% lipid content (3% ÷ 7.6%)
	BCF	=	bioconcentration factor (L/kg)

The formulas shown on the previous page convert BCFs that are normalized to 7.6% lipid content to represent a 3% lipid content. When using a BCF that is already normalized to 3% lipid content, the lipid correction factor (LC) equals one.

Correcting for Background Concentrations

In the development of water-quality-based effluent limits (WQBELs), the preferred method of accounting for background concentrations of toxic pollutants is through total maximum daily load (TMDL) allocations. However, until TMDLs are approved and available for particular segments and toxic pollutants of concern, the procedure discussed in this section is used to screen applications and develop permit limits.

For purposes of this section, the following definitions apply:

Background concentration: the water quality in a particular water body that would occur if that water body were relatively unaffected by human activities.

Ambient concentration: the existing water quality in a particular water body.

Procedure for Developing Permit Limits

The procedure for screening application data and developing permit limits is shown in Figure 5 on page 68. If an approved total maximum daily load (TMDL) exists for a particular pollutant and segment, the permit incorporates a limit as established by the TMDL procedure. In the absence of an approved TMDL, application data is screened using reliable background concentration data, if such data exist.

Table 6 in Appendix C of this document lists reliable background concentration data that are used routinely in application screening. Data are added to Table 6 as they become available.

When reliable background concentration data are not available, data are screened with the assumption that the background concentration is zero and permits include a reopener clause. The assumption of a zero background concentration may be reconsidered on a case-by-case basis as new information becomes available.

When the background concentration is less than the instream criterion, a mass balance approach is used to determine waste load allocations for

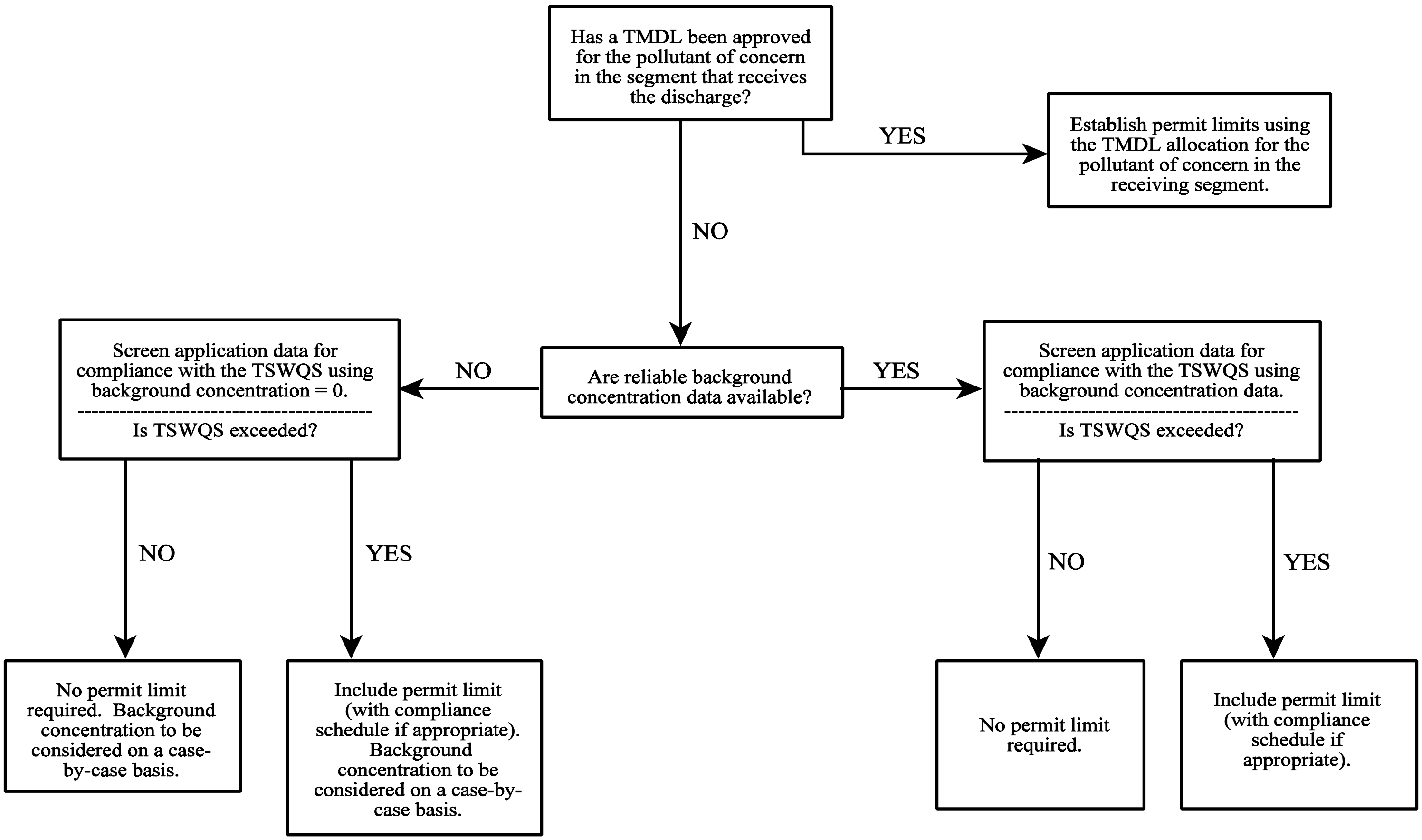


Figure 5.
Protocol for the Inclusion of Background Concentrations in Establishing Permit Limits

affected parameters. This approach is applicable for calculating permit limits for both aquatic life and human health protection. The following equation is used to calculate the waste load allocation (WLA):

$$WLA = \frac{Criterion - \left[(1 - E_F)(C_B)(Bioavailable\ Fraction)\right]}{(Bioavailable\ Fraction)(E_F)}$$

where:

	WLA	=	waste load allocation (total concentration)
	Criterion	=	appropriate numerical criterion (dissolved, free ion, or total concentration as specified in 30 TAC §307.6, Table 1 or 3)
	E_F	=	proportional contribution of effluent to receiving water
	C_B	=	background concentration of pollutant (total concentration)
	Bioavailable Fraction	=	fraction of the pollutant that is defined to be available to organisms

When the background concentration is assumed to be zero, the equation above reduces to those shown in the sections of this document entitled, "Deriving Permit Limits for Aquatic Life Protection" on page 52 and "Deriving Permit Limits for Human Health Protection" on page 60.

When the background concentration is equal to or greater than the instream criterion, then effluent permit limits are developed to ensure that no degradation of water quality will occur, in accordance with the procedures to protect existing uses (see the chapter of this document entitled “Antidegradation” on page 23).

Obtaining Reliable Water Quality Data

Reliable background concentration data are needed for application screening. Samples should be collected, analyzed, and handled as follows:

1. Collect and preserve samples using techniques that conform with EPA-approved methods. Collect and preserve samples for metals using clean techniques (see item 3a below) or equivalent.

2. Analyze samples using EPA-approved methods. Analyses should meet agency-specified minimum analytical levels (MALs) (see Table 8 and Table 9 in Appendix C) for the pollutant or pollutants of concern.

3. Sample collection, preservation, handling, storage, analysis, quality assurance, and quality control procedures should be comparable to those specified in the following documents:

    a. *Surface Water Quality Monitoring Procedures Manual, GI-252*, Texas Natural Resource Conservation Commission, June 1999 (or latest revision).

    b. Work Plan/Quality Assurance Project Plan for Near Coastal Waters Project, Sec. 104(b)(3), Grant No. X-006559-01-0, *Total Maximum Daily Loads of Selected Heavy Metals in the Houston Ship Channel, San Jacinto River (Tidal) and Upper Galveston Bay*, Texas Water Commission, Environmental Assessment Division, August 1993.

    c. Benoit, G. and P. H. Santschi, 1991; *Trace Metals in Texas Estuaries*; Prepared for the Texas Chemical Council; Texas A&M University at Galveston, Department of Marine Science.

4. Collect freshwater samples during moderate or low stream flow conditions. Collect marine or tidally influenced water samples during low freshwater inflow conditions. Such flow conditions should prevail for at least one week prior to data collection.

5. When gathering data for metals, measure TSS and hardness at each freshwater sample site. When gathering data for silver, measure chloride at each sample site.

Once-through Cooling Water Discharges

Applicability

As stated in 30 TAC §307.8(d), the TNRCC does not require water-quality-based effluent limits (WQBELs) for those pollutants discharged in once-through cooling water where no measurable increase of the pollutant concentration occurs in the effluent as compared to the intake water.

This exemption applies exclusively to once-through cooling water discharges. It excludes facilities withdrawing from one water body and subsequently discharging the cooling water into a different water body; such facilities have to maintain and protect water quality and applicable water quality standards in the receiving water. Exceptions to this exclusion are considered on a case-by-case basis (for example, intake is in a tidal water body and discharge is to a downstream bay or estuary).

Permit Action

A permittee should request a once-through cooling water exemption during the wastewater permit application process. The terms and conditions of the new permit may vary depending on existing permit conditions and the amount of data available.

- If an existing permit has final WQBELs for the pollutant of concern, these limits will remain in the new permit until sufficient monitoring has been conducted to support the exemption.

- If an existing permit does not include WQBELs for the pollutant of concern, interim effluent limits or monitoring requirements may be included in the permit. The permit will be issued for a term of up to three years to allow time for the permittee to perform a statistical study and source evaluation.

  Language will also be included in the "Other Requirements" section of the permit that outlines what the permittee must do and the time frame (up to three years) in which it must be done. Included in this language will be a statement as follows: "If the permittee does not conduct or complete the study at least 180 days prior to the permit expiration date, the following effluent limits for (pollutant of concern) will become effective immediately in a reissued permit."

The TNRCC will coordinate with the EPA on case-by-case reviews for these situations.

The permit will contain a special provision stating that the exemption will be approved or denied based upon the findings of the statistical study and the findings of the source investigation.

Statistical Study

To demonstrate that no measurable increase in the pollutant of concern occurs through the once-through cooling water outfall, the applicant needs to perform a statistical analysis to determine whether a pollutant's average concentration demonstrates a statistically significant increase at the 95 percent confidence level. All applicants considering an exemption are urged to work with TNRCC staff to determine an acceptable work plan.

Data collection. The applicant should collect at least 10 paired grab samples, where the term "paired" refers to both intake and discharge samples being collected within one hour of each other. In cases where the hydraulic retention time in the cooling system exceeds one hour, the paired samples may be collected more than one hour apart. Information regarding the hydraulic retention time should be included in the study report.

Each intake sample should be depth integrated from the water surface down to the depth of the intake pipe. For discharges to a marine water body, samples should be collected during slack tide. Samples should be collected at least 10 days apart from each other and be representative of normal operating conditions. Clean techniques for field and analytical procedures should be considered when determining trace metal levels in noncontact cooling water (USEPA Method 1669 - April 1995).

Statistical analysis. To demonstrate that no measurable increase in a pollutant occurs through the once-through cooling water outfall, the applicant should perform a statistical analysis to determine whether the pollutant's average concentration demonstrates a statistically significant increase at the 95 percent confidence level. The two-tailed Student's t-test should be used to compare the influent concentrations to the effluent concentrations. The applicant should calculate the mean and standard deviation for each paired data set using a lognormal distribution. When portions of a data set are at concentrations less than the MAL, the applicant should adjust the mean and standard deviation calculation with appropriate methodology.

Examples of appropriate methods include the delta lognormal approach as described in the *Technical Support Document for Water Quality-based Toxic Control*, EPA/505/2-90-001, and the Cohen test method described in the *Statistical Analysis of Ground Water Monitoring Data at RCRA Facilities*, NTIS No. PB89-151047.

Source Investigation

A source investigation of the pollutant will also be performed by the applicant requesting the exemption. All applicants performing source investigations are urged to work with TNRCC staff to determine appropriate sampling locations. Potential sources include but are not limited to:

- current and historical sources of the pollutant in question (such as metal cleaning waste)
- cooling tubes
- pollutants in tributaries entering the reservoir
- pollutants in the soils surrounding the reservoir.

This information can be used to support the applicant's contention that the discharge of once-through cooling water does not contribute to the pollutant concentration in the reservoir. Low-volume waste streams are addressed by:

- demonstrating that the pollutant of concern cannot be added by the waste stream, or

- establishing a permit limit to attain water quality standards at the internal outfall.

Exemption Approval or Denial

Based on the results of the statistical analysis and the source investigation, TNRCC staff recommend granting or denying the exemption.

- If the exemption is approved, the permit is issued without WQBELs for the pollutant of concern. A statement is included in the "Other Requirements" section of the permit that a once-through cooling water exemption for the pollutant of concern has been approved for the appropriate outfall. Long-term monitoring for the exempted pollutant is also included in the "Other Requirements" section of the permit.

- If the exemption is not approved, the permit is amended to include appropriate WQBELs, including any appropriate compliance period.

Note that if the receiving water body does not attain water quality standards for the pollutant in question, the exemption can still be granted, but the applicant may be required to submit additional data.

Collecting Site-Specific Data

Permittees may collect data on site-specific hardness, pH, chloride, TSS, or metals to support calculation of some water quality criteria and site-specific partition coefficients or bioavailable fractions of metals.

- Hardness—water quality criteria for certain metals (cadmium, trivalent chromium, copper, lead, nickel, and zinc) depend on hardness.
- pH—water quality criteria for pentachlorophenol depend on pH.
- Chloride—the percentage of dissolved silver that is in free ionic form depends on chloride.
- TSS—partition coefficients, and hence, bioavailable fractions of metals, depend on TSS.
- Metals—the bioavailable fractions of metals can be determined directly by measuring dissolved concentrations and total recoverable concentrations.

TNRCC usually uses segment or basin values for hardness, pH, chloride, and TSS from Table 5 in Appendix C of this document. Permittees who think that these default values do not adequately reflect conditions in their receiving water may collect site-specific data and submit it to TNRCC for review.

Guidelines for collecting hardness, pH, and chloride data are presented in the next subsection, entitled "Hardness, pH, and Chloride." Guidelines for collecting TSS and metals data and for developing site-specific partition coefficients and bioavailable metals fractions are presented in the subsection entitled "TSS, Partition Coefficients, and Bioavailable Fractions of Metals" on page 76.

Hardness, pH, and Chloride

Hardness. In general, most metals are more toxic in water that has low hardness values (soft water). Therefore, water quality criteria are more stringent for receiving waters having a low hardness value. TNRCC uses the 15th percentile of basin or segment hardness data (ranked from lowest to highest value) to calculate hardness-dependent criteria. Before collecting any site-specific data, it is advisable for the permittee to determine what default value was used in TNRCC's calculations.

The following items outline acceptable procedures for collecting site-specific hardness data:

- Collect samples from the receiving water upstream of the discharge, if available, and outside of the regulatory mixing zone. For more information about mixing zones, see 30 TAC §307.8(b) of the TSWQS and the section of this document entitled "Mixing Zones and Critical Conditions for Aquatic Life Protection" on page 39.

  If no water is present upstream of the discharge, samples may be taken from a nearby perennial stream or from the nearest downstream perennial stream. Be sure to sample above the confluence with the receiving stream so that samples are not affected by the effluent hardness.

- Collect a minimum of 30 samples from the receiving water. TNRCC prefers 30-50 samples to ensure that there are at least 30 valid data points and to get a more statistically reliable number for estimating the 15th percentile value.

- Measure hardness as mg/L of $CaCO_3$.

- If the permit includes whole effluent toxicity (WET) testing requirements **and** receiving water is used as the control, control hardness values may also be used to supplement any site-specific data that is collected. Laboratory dilution water may not be used to provide hardness data.

pH. Pentachlorophenol is more toxic in water that has low pH (acidic). Therefore, the permit limit for pentachlorophenol is more stringent for facilities whose receiving water has low pH. TNRCC uses the 15th percentile of basin or segment pH data (ranked from lowest to highest value) to calculate freshwater criteria for pentachlorophenol. Before collecting any site-specific data, it is advisable for the permittee to determine what default value was used in TNRCC's calculations.

The following items outline acceptable procedures for collecting site-specific pH data:

- Collect samples from the receiving water upstream of the discharge, if available, and outside of the regulatory mixing zone. For more information about mixing zones, see 30 TAC §307.8(b) of the TSWQS and the section of this document entitled, "Mixing Zones and Critical Conditions for Aquatic Life Protection" on page 39.

  If no water is present upstream of the discharge, samples may be taken from a nearby perennial stream or from the nearest downstream perennial stream. Be sure to sample above the confluence with the receiving stream so that samples are not affected by the effluent pH.

- Collect a minimum of 30 samples from the receiving water. TNRCC prefers 30-50 samples to ensure that there are at least 30 valid data points and to get a more statistically reliable number for estimating the 15th percentile value.

Chloride. More silver is present in free ionic form (and is therefore more toxic) in water that has low chloride concentrations. Therefore, the permit limit for silver is more stringent for facilities whose receiving water has low chloride concentrations. TNRCC uses the 50th percentile of basin or segment chloride data to calculate the percentage of dissolved silver that is in free ionic form. Before collecting any site-specific data, it is advisable for the permittee to determine what default value was used in TNRCC's calculations.

The following items outline acceptable procedures for collecting site-specific chloride data:

- Collect samples from the receiving water upstream of the discharge, if available, and outside of the regulatory mixing zone. For more information about mixing zones, see 30 TAC §307.8(b) of the TSWQS and the section of this document entitled, "Mixing Zones and Critical Conditions for Aquatic Life Protection" on page 39.

If no water is present upstream of the discharge, samples may be taken from a nearby perennial stream or from the nearest downstream perennial stream. Be sure to sample above the confluence with the receiving stream so that samples are not affected by chloride concentration in the effluent.

- Collect a minimum of 30 samples from the receiving water. TNRCC prefers 30-50 samples to ensure that there are at least 30 valid data points and to get a more statistically reliable number for estimating the 50th percentile value.

TSS, Partition Coefficients, and Bioavailable Fractions of Metals

For most metals, with the exceptions of mercury and selenium, the water quality criteria for aquatic life protection are expressed as dissolved concentrations. The dissolved concentration of a metal is the bioavailable fraction of the total metal concentration. The ratio of the dissolved concentration to the total recoverable concentration is expressed in terms of the partition coefficient (K_p) and TSS concentration:

$$\frac{C_d}{C_T} = \frac{1}{1 + (K_p \times TSS \times 10^{-6})}$$

where:

C_d = dissolved metal concentration
C_T = total metal concentration
K_p = partition coefficient (L/kg)
TSS = total suspended solids (mg/L)

The partition coefficient is itself a function of TSS concentration:

$$K_p = 10^b \times (TSS)^m$$

where:

K_p = partition coefficient (L/kg)
b = intercept (found in Table 7)
TSS = total suspended solids (mg/L)
m = slope (found in Table 7)

Table 7 in Appendix C of this document lists the slope and intercept values for the relationship between TSS and the partition coefficient for most metals. TNRCC typically uses the segment-specific TSS values from Table 5 in Appendix C of this document along with the values and equations in Table 7 to calculate the bioavailable fraction of a metal. The bioavailable fraction is then used in the waste load allocation (WLA). For more information on WLAs, see the subsection of this document entitled "Calculating Waste Load Allocations" on page 54.

Permittees have some options available to them for modifying the calculation of bioavailable fractions:

- Collect site-specific TSS data—this allows the partition coefficient to be calculated using a site-specific TSS value in place of the 15th percentile of the basin or segment values. The resulting bioavailable fraction will also be modified.

- Collect site-specific total and dissolved metals concentrations—this allows the ratio of C_d to C_T to be measured directly without calculating a revised partition coefficient.

Both of these options are discussed in more detail below.

Collect site-specific TSS data. TNRCC uses the 15th percentile of basin or segment TSS data (ranked from lowest to highest value) to calculate partition coefficients. Before collecting any site-specific data, it is advisable for the permittee to determine what default value was used in TNRCC's calculations.

The following items outline acceptable procedures for collecting site-specific TSS data:

- Collect samples from the receiving water upstream of the discharge, if available, and outside of the regulatory mixing zone. For more information about mixing zones, see 30 TAC §307.8(b) of the TSWQS and the section of this document entitled, "Mixing Zones and Critical Conditions for Aquatic Life Protection" on page 39.

  If no water is present upstream of the discharge, samples may be taken from a nearby perennial stream or from the nearest downstream perennial stream. Be sure to sample above the confluence with the receiving stream so that samples do not include TSS from the effluent.

- Collect a minimum of 30 samples from the receiving water. TNRCC prefers 30-50 samples to ensure that there are at least 30 valid data points and to get a more statistically reliable number for estimating the 15th percentile value.

- If the permit includes whole effluent toxicity (WET) testing requirements **and** receiving water is used as the control, control TSS values may also be used to supplement any site-specific data that is collected. Laboratory dilution water may not be used to provide TSS data.

Collect site-specific total and dissolved metals concentrations. Where slopes and intercepts to calculate a partition coefficient are not available in Table 7, or where a permittee wishes to develop a site-specific bioavailable fraction for a metal (but not a site-specific TSS value), the TNRCC has established the following guidelines:

- Collect samples from the receiving water **upstream of the discharge** and outside the regulatory mixing zone. These samples should be mixed with the effluent at the proportion representative of the critical dilution. The critical dilution can be obtained from the TNRCC. If upstream water is not available, the critical dilution is 100%.

- Collect a minimum of 30 samples from the receiving water. The TNRCC prefers 30-50 samples to ensure that there are at least 30 valid data points and to get a more statistically reliable estimate of the 85th percentile value of the dissolved-to-total ratio.

- Collect samples to reflect different receiving water characteristics that exist at various times of the day and week. This may require collecting samples for a full year.

- Measure both dissolved and total recoverable metal concentrations.

- Use clean techniques for all metals sampling and analytical procedures to avoid contamination.

- Collect site-specific TSS data according to the procedures outlined previously.

- Collect effluent TSS data. If effluent TSS exceeds ambient conditions, a correction factor will be applied to remove the influence of the effluent TSS on the dissolved metal concentration.

- Once the data are collected and the ratios of the dissolved concentration to the total recoverable concentration are calculated, the ratios are ranked from lowest to highest, and the 85th percentile value is used as the bioavailable fraction when calculating the waste load allocation. (For more information on WLAs, see the subsection of this document entitled “Calculating Waste Load Allocations” on page 54.)

For aluminum, available information indicates that measurements of the dissolved portion of the metal may underestimate the bioavailable fraction. Therefore, the permittee will need to demonstrate that the use of an aluminum partition coefficient different from the default value of one used by the TNRCC will not cause instream effects.

To demonstrate this, the permittee should determine the No Observable Effects Concentration (NOEC) for total aluminum-spiked effluent using, at a minimum, three standard 48-hour acute toxicity tests employing an appropriately sensitive test species (a species from one of the three genera in the family *Daphnidae*, preferably *Ceriodaphnia dubia*). Once a mean total-aluminum NOEC is determined, it will be compared to the proposed effluent limits calculated by using the site-specific partition coefficient in the WLA acute criteria equation. A mean NOEC significantly greater than the proposed effluent limits meets the requirement to demonstrate that the proposed aluminum effluent limits will not cause instream effects.

Calculating Permit Limits for Silver

The TSWQS express the freshwater criterion for silver in terms of the free ionic form, which is considered to be the most biologically toxic component of dissolved silver. This section describes how the free ionic criterion is translated into a total recoverable permit limit.

Before applying the translation method, the fraction of total silver that is in the dissolved form is calculated using a partition coefficient. (For more information on calculating and using partition coefficients, see the subsection of this document entitled "TSS, Partition Coefficients, and Bioavailable Fractions of Metals" on page 76.)

For silver, the TNRCC uses partition coefficient slopes and intercepts (see Table 7 in Appendix C of this document) derived from data collected by the Texas Environmental Advisory Council (TEAC). In 1994, the TEAC conducted statewide sampling of various water bodies and analyzed for both total and dissolved silver concentrations and total suspended solids (TSS). This information has since been published (Wen, L., P.H. Santschi, G.A. Gill, C.L. Paternostro, and R.D. Lehman. 1997. Colloidal and Particulate Silver in River and Estuarine Waters of Texas. *Environmental Science & Technology*, 31:723-731).

Once the partition coefficient has been calculated, the percentage of dissolved silver in free ionic form is calculated. Data collected from a variety of water bodies throughout the United States show that a correlation exists between the dissolved chloride concentration and the percent free ionic silver (see *Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water - Part 1*, EPA 600/6-85-002a, 1985). Using this data, the following regression equation (r^2 of 0.87) was developed to calculate the percentage of dissolved silver in free ionic form:

$$Y = \exp\left[\ \exp\left(\frac{1}{(0.6559 + 0.0044(Cl))}\right)\right]$$

where: Y = % of dissolved silver in free ionic form

Cl = dissolved chloride concentration (mg/L)

In this equation, TNRCC uses the 50th percentile value of dissolved chloride concentrations for each segment (shown in Table 5) or for each basin if there is insufficient segment data. Site-specific data may also be used (see the subsection of this document entitled "Hardness, pH, and Chloride" on page 74).

When the 50th percentile chloride value exceeds 140 mg/L (the upper extent of the regression's data range), the percentage of silver in the free ionic form is set at 8.98%.

Finally, the proportion of dissolved silver that is in the free ionic form is multiplied by the proportion of total silver that is dissolved to obtain the fraction available as follows (see page 76 for variable definitions):

$$Fraction\ Available = \frac{C_d}{C_T} \times \frac{Y}{100}$$

The fraction available is used in the waste load allocation equation. For example, if 30% of the silver is dissolved and 50% of the dissolved silver is in free ionic form, the fraction available used in the WLA equation is 0.15 (0.3 multiplied by 0.5).

Calculating Permit Limits for Dioxin/Furan

The TNRCC addresses the differences in the relative toxicity of dioxin/furan congeners in comparison to 2,3,7,8 TCDD (most toxic dioxin/furan congener) with the use of toxicity equivalency factors (TEFs). The EPA has listed TEFs for 11 dioxin/furans in the document titled *Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans and 1989 Update*, EPA/625/3-89/016. The TSWQS contain TEFs for seven congeners. The compounds and their TEFs as adopted by the TNRCC are given in the table that follows.

Compound	TEF
2378 TCDD	1
12378 PeCDD	0.5
2378 HxCDD's	0.1
2378 TCDF	0.1
12378 PeCDF	0.05
23478 PeCDF	0.5
2378 HxCDF's	0.1

The concentration of each dioxin/furan compound in an effluent analysis is multiplied by the compound's TEF. The sum of these products of concentrations and TEFs is the toxicity equivalence (TEQ) of the mixture, expressed as if the toxicity were due entirely to 2,3,7,8 TCDD. The potential additive effects of various forms of dioxin/furans with different relative toxicities are thereby taken into account. The TNRCC evaluates compliance with appropriate dioxin/furan permit limits based on this TEQ method. Permittees that are required to monitor their effluent for dioxin/furans may also be required to sample receiving water fish tissue and/or sediments for dioxin/furans.

Dioxin/furan permit limits are calculated according to the method outlined previously in the section of this document entitled "Deriving Permit Limits For Human Health Protection" on page 60.

Calculating Permit Limits for Chromium

The TSWQS for the protection of aquatic life are expressed as dissolved concentrations for hexavalent chromium (Cr^{+6}) and trivalent chromium (Cr^{+3}). The method to calculate permit limits for total recoverable concentrations of Cr^{+3} and dissolved concentrations for Cr^{+6} is described in this section.

As part of the permit application, permittees analyze their effluent for dissolved Cr^{+6} and total recoverable chromium. Total recoverable chromium is the sum of dissolved Cr^{+6}, adsorbed Cr^{+6}, dissolved Cr^{+3}, and adsorbed Cr^{+3}:

$$total\,recoverable\,Cr = dissolved\ Cr^{+6} + adsorbed\ Cr^{+6}$$
$$+ dissolved\ Cr^{+3} + adsorbed\ Cr^{+3}$$

The analytical method for Cr^{+6} measures only for the dissolved form. The TNRCC assumes that the amount of adsorbed Cr^{+6} is negligible. Therefore, total Cr^{+3} is calculated by subtracting dissolved Cr^{+6} from the total recoverable chromium:

$$total\,Cr^{+3} = total\,recoverable\,Cr - dissolved\ Cr^{+6}$$

The partition coefficient for chromium, listed in Table 7 in Appendix C, is not applicable to Cr^{+6} because dissolved concentrations alone are measured. Therefore, the Cr^{+6} permit limit is calculated using standard procedures and assuming 100% of Cr^{+6} is dissolved. The effluent concentration is compared to the calculated permit limit to determine whether monitoring or permit limits are needed.

The partition coefficient in Table 7 and standard procedures are used to calculate Cr^{+3} permit limits. The calculated permit limit is compared to the total Cr^{+3} concentration in the effluent to determine whether monitoring requirements or permit limits are needed.

The partition coefficient in Table 7 and standard procedures are used to calculate chromium limits for the protection of human health. The permit limit is expressed as total recoverable chromium.

Establishing Permit Limits for Toxic Pollutants

Application Screening

TNRCC staff calculate daily average and daily maximum effluent limits required to maintain the surface water quality standards based upon the instream criteria established in 30 TAC §307.6 (c) and (d). During the application review, the effluent data provided in the application are compared to the calculated daily average effluent limits.

- If the effluent data are based on one sample and the effluent concentration for a pollutant equals or exceeds 70% of the calculated daily average effluent limit, the TNRCC may request the applicant to either (1) submit historical data or (2) resample and conduct additional analysis for that particular pollutant using four effluent samples. Samples should either be all composites or all grabs, as appropriate.

- If the effluent data submitted with the application are based on four samples, additional sampling is not typically requested.

Sometimes the effluent analysis contains one or more samples that have reported nondetectable levels of a pollutant. (Reported nondetectable levels are the “<” values in laboratory reports.) When this occurs in all four resamples and the reported nondetectable levels are equal to or less than the TNRCC’s minimum analytical level (MAL), the TNRCC will use a zero for each value. If the four retests have both detectable and nondetectable concentrations at or below the TNRCC’s MAL, then the nondetectable concentrations are averaged as one-half the reported nondetectable levels, and the detectable concentrations are averaged as their reported values.

The average concentration of the effluent data is then compared to the daily average effluent limit.

- If the average of the effluent data equals or exceeds 70% but is less than 85% of the calculated daily average limit, monitoring for the toxic pollutant will usually be included as a condition in the permit.

- If the average of the effluent data is equal to or greater than 85% of the calculated daily average limit, the permit will generally contain effluent limits for the toxic pollutant. The permit may specify a compliance period to achieve this limit if necessary.

If a toxic pollutant is quantified below the MAL and equals or exceeds 70% of the calculated daily average permit limit, the applicant may be required to submit historical data or to retest as described above. The applicant may also be required to establish a site-specific MAL for the effluent.

Analytical Procedures

As required by 30 TAC §319.11, all analyses of effluents must meet the requirements specified in the regulations published in 40 CFR Part 136 or the latest edition of *Standard Methods for the Examination of Water and Wastewater* (Standard Methods). If any regulated pollutant is not included in 40 CFR Part 136 or Standard Methods, the permittee may use a TNRCC-recommended analytical method or a method approved for the specific compound in water or wastewater by the EPA. All quality assurance/quality control practices must strictly adhere to those outlined in each EPA-approved analytical method.

The following terms are used to quantify sensitivity of analytical test procedures:

Method Detection Limit (MDL). In 40 CFR Part 136 Appendix B, the method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero; it is determined from the analysis of a sample in a given matrix containing the analyte.

Minimum Analytical Level (MAL). In 30 TAC §307, the minimum analytical level (MAL) is defined as the lowest concentration at which a particular substance can be quantitatively measured with a defined accuracy and precision level, using approved analytical methods. The MAL is not the published MDL for an EPA-approved analytical method, which is based on a single laboratory analysis of the substance in reagent (distilled) water. The MAL is based on analyses of the analyte in the matrix of concern (that is, wastewater effluents).

The TNRCC will establish general MALs that are applicable when information on matrix-specific MALs are unavailable. General MALs are established in this document (see Table 8 and Table 9 in Appendix C).

The MALs were developed by the TNRCC to establish a benchmark for analytical procedures for measuring the toxic pollutants regulated by 30 TAC §307.6. One of the goals of establishing the MALs has been to provide consistent analytical data for industrial and domestic wastewater permit applicants and compliance monitoring of their discharges. The MALs serve as a measure of the analytical sensitivity of each laboratory procedure performed on standard laboratory equipment by qualified personnel.

Alternate Analytical Test Methods

Because of interferences and matrix problems associated with the analysis of toxic pollutants in wastewater, the TNRCC has received requests for the use of alternate analytical test method procedures. The procedures may range from an alteration of an EPA-approved reference method to a completely new, or "candidate," method. Guidelines are given below for accepting or rejecting those alternate analytical test methods for compliance monitoring of TPDES permits.

If a permittee wishes to initiate the evaluation process for an alternate analytical test method procedure, the permittee may send a written request for authorization to the Quality Assurance Manager and/or the Section Manager of the Wastewater Permitting Section. The request must include details required by 30 TAC §319.12. The information required in 40 CFR

Part 136.4(c) (Application for Alternate Test Procedures) should also be submitted. All candidate methods should undergo a comparability study. A comparability study should compare the performance of the alternate or candidate analytical method to an EPA-approved reference method.

If the permittee cannot attain the MAL for a specific pollutant and has exhausted all available techniques to solve interference and matrix problems, the permittee may apply for an alternate MAL through the same procedure used to request an alternate analytical test method, provided that all documentation of attempted solutions to the interference/matrix problems is included with the application. This documentation needs to include all quality assurance/quality control data.

Because analysis of cyanide by the amenable to chlorination method has frequent interferences from organics, the TSWQS indicate that compliance can be determined using either this method or the weak acid dissociable method.

Defining Permit Limits

Permit limits are normally developed from total recoverable concentrations. The permit limit is expressed as the calculated daily average and daily maximum concentration and/or the daily average and daily maximum mass loading.

If the permit limit is lower than the MAL, it is still included in the permit, but a level of compliance based on the MAL is also included except where a substance is of particular concern (for example, if the toxicant has a high bioconcentration factor). If the TNRCC believes it is necessary to establish a permit level of compliance below the MAL, the permittee will be required to develop an effluent-specific MDL.

When necessary, the permit applicant may request an opportunity to demonstrate an alternative site-specific MAL for the effluent to account for interfering factors associated with the wastewater in question. See the discussion for requesting an alternate MAL through the alternate analytical test method procedure in the previous subsection of this document entitled "Alternate Analytical Test Methods" (see page 84).

When establishing monitoring frequencies, TNRCC staff use 30 TAC §319 and TNRCC guidance established in document number 98-001.000-OWR-WQ, “Guidance Document for Establishing Monitoring Frequencies for Domestic and Industrial Wastewater Discharge Permits,” May 1998.

Screening Procedures and Permit Limits for Total Dissolved Solids

Introduction

Concentrations and relative ratios of dissolved minerals such as chloride and sulfate that compose total dissolved solids (TDS) will be maintained to protect existing and attainable uses. The aquatic life attributes in 30 TAC §307.7(b)(3)(A) are used to assign the aquatic life use categories.

Applicability. The screening procedure will be applied to all domestic dischargers that have an average permitted flow of ≥1 MGD, all industrial majors, and industrial minors that discharge process water.

Discharges to freshwater. For discharges to freshwater, a screening procedure is used to determine whether either a TDS permit limit or further study of the receiving water is required. Screening may also be performed for individual components of TDS, including chloride and sulfate, since these anions have specific numerical criteria in the TSWQS. If screening demonstrates elevated levels of TDS, then appropriate permit limits are calculated.

Discharges to saltwater. For discharges to saltwater, TDS is evaluated on a case-by-case basis. Even though salinity criteria have not been established, the absence of numerical criteria do not preclude evaluations and regulatory actions based on estuarine salinity. Careful consideration is given to all activities that may detrimentally affect estuarine salinity gradients.

Wastewater recycling. Certain facilities reduce water consumption by recycling their wastewater before discharge, which may increase the effluent TDS concentration. The procedures in this chapter will be applied to such facilities to ensure protection of water quality.

Overview of procedures. The general procedure for screening TDS concentrations in permit applications and then developing permit limits is as follows:

1. Select the appropriate screening procedure for the receiving water type. A detailed discussion begins on page 88 in the section entitled "Screening Procedures for TDS."

2. Perform the screening calculation or calculations.

3. If the screening criteria are exceeded, calculate effluent TDS concentrations using the appropriate method for the receiving water type. A detailed discussion begins on page 95 in the section entitled “Establishing Permit Limits for TDS.”

4. Compare the effluent TDS concentrations obtained in step 3 with the calculated effluent limits using the 70%, 85% procedure (see the section of this document entitled “Application Screening” on page 82) to determine whether a monitoring requirement or effluent limit is needed in the permit.

5. If necessary, place monitoring or effluent limits in the permit.

Screening Procedures for TDS

The following screening procedures are typically used by TNRCC staff to assess TDS in wastewater discharges to various water body types. See Figure 7 on page 99 for a summary of screening methods as they apply to different types of water bodies.

1. *Unclassified intermittent stream.* Use Equation 1 (below) to determine the TDS screening value, C_{SV}, for a discharge to an unclassified intermittent stream without perennial pools. The effluent TDS concentration, C_E, as reported in the permit application, will be compared to the screening value to determine whether a TDS permit limit is needed.

Equation 1

$$C_{TDS} = \frac{C_C}{500 \text{ mg/L}} \times 2{,}500 \text{ mg/L}$$

where:	C_{TDS}	=	TDS concentration (mg/L) used to determine the TDS screening value
	C_C	=	TDS criterion (mg/L) at the first downstream segment
	500 mg/L	=	median concentration of TDS in Texas streams
	2,500 mg/L	=	minimum TDS screening value

If the value of C_{TDS} in Equation 1 is less than 2,500 mg/L, then 2,500 mg/L is used as the screening value. If C_{TDS} is between 2,500 mg/L and 6,000 mg/L, then C_{TDS} is used as the screening value. If C_{TDS} is greater than 6,000 mg/L, then 6,000 mg/L is used as the screening value unless the applicant demonstrates that a higher TDS value is more representative of the receiving stream. The following table summarizes the conditions in this paragraph.

If C_{TDS}	**then C_{SV}**
≤ 2,500 mg/L,	= 2,500 mg/L
> 2,500 mg/L but ≤ 6,000 mg/L,	= C_{TDS}
> 6,000 mg/L,	= 6,000 mg/L

In addition, some specific types of intermittent streams have alternative default screening values. These stream types and screening values are summarized in the following table:

Other Specific Types of Intermittent Streams	**C_{SV}**
Intermittent streams that are demonstrated to be dry except for very short-term flow in immediate response to rainfall	≥ 4,000 mg/L
Constructed ditches that convey storm water and/or wastewater effluent that are considered water in the state	≥ 4,000 mg/L
Intermittent streams that enter tidal waters within three miles of the discharge point	= 6,000 mg/L

TDS screening guidelines for intermittent streams are intended to protect livestock, wildlife, shoreline vegetation, and aquatic life during periods when the stream is flowing; the screening is also intended to preclude excessive TDS loading in watersheds that could eventually impact distant downstream perennial waters.

2. ***Unclassified perennial stream or river.*** Screen for TDS using Equation 2 (below), which compares the concentration of TDS at the edge of the human health mixing zone downstream of the discharge (right side of equation) with the TDS criterion (C_C) for the first downstream segment (left side of equation). A permit limit is usually not required when Equation 2 is satisfied (that is, $C_C \geq$ right side of equation).

Equation 2

$$C_C \geq \frac{Q_S C_A + Q_E C_E}{Q_E + Q_S}$$

where:

- C_C = segment TDS criterion (mg/L)
- Q_S = harmonic mean flow (ft^3/s) of the perennial stream or river
- C_A = ambient TDS concentration (mg/L)
- Q_E = effluent flow (ft^3/s)
- C_E = effluent TDS concentration (mg/L)

The following items explain the variables used in Equation 2:

C_C The TDS criterion for the first downstream segment is found in Appendix A of the TSWQS. If the permittee wishes to change the segment TDS criterion, an intensive study is needed. Such a study involves sampling the entire classified segment during different seasons. A site-specific amendment to the TSWQS is then needed to change the TDS segment criterion.

Q_S The harmonic mean flow is determined as described in the section of this document entitled "Determining the Harmonic Mean Flow" on page 47.

C_A The ambient TDS concentration is the median (50th percentile) concentration of TDS for the first downstream segment. Sources for determining the median TDS concentration include: (1) Table 5 in Appendix C of this document; (2) the most recent five years of TDS data in the Surface Water Quality Monitoring (SWQM) database (telephone 239-DATA); or (3) other available data. The permittee may supply site-specific data if the median TDS concentration for the first downstream segment does not appear to be representative of the TDS concentration in the receiving water.

Q_E The effluent flow used is generally the average permitted flow for domestic discharges and the average of the monthly average flows for the last two years for industrial discharges.

C_E The effluent TDS concentration is based on the average effluent data provided in the permit application.

3. ***Classified stream or river.*** Screen for TDS using Equation 2. Use the harmonic mean flow (Q_S) of the classified segment, and use the median TDS value for the classified segment as the ambient concentration (C_A). A permit limit is usually not required when Equation 2 is satisfied (that is, $C_C \geq$ right side of equation).

4. ***Unclassified intermittent stream within 3 miles of a perennial freshwater body.***

a. Screen for TDS at the intermittent stream as described in item 1.
b. Screen for TDS at the perennial freshwater body using the appropriate protocol described in item 2, 3, 6, or 7.
c. Compare the screening values from (a) and (b) and use the more stringent one.

Freshwater bodies more than 3 miles downstream of the discharge may be evaluated if they contain a drinking water supply or aquatic life that is particularly sensitive to increases in TDS.

5. ***Unclassified intermittent stream with perennial pools.***

a. Screen for TDS as described in item 1.
b. Screen for TDS using Equation 2 using the harmonic mean flow (Q_s) for the intermittent stream with perennial pools.
c. Compare the screening values from (a) and (b) and use the more stringent one.

6. ***Classified lake.*** Screen for TDS using Equation 3 (below), which compares the concentration of TDS at the edge of the human health mixing zone (right side of equation) with the TDS criterion (C_C) for the segment (left side of equation). A permit limit is usually not required when Equation 3 is satisfied (that is, $C_C \geq$ right side of equation).

Equation 3

$$C_C \geq (E_F)(C_E) + (1 - E_F)(C_A)$$

where:

C_C = segment TDS criterion (mg/L)
E_F = effluent fraction at the edge of the human health mixing zone
C_E = effluent TDS concentration (mg/L)
C_A = ambient TDS concentration (mg/L)

The following items explain the variables used in Equation 3:

C_C The TDS criterion for the segment is found in Appendix A of the TSWQS. If the permittee wishes to change the segment TDS criterion, an intensive study is needed. Such a study involves sampling the entire classified lake during different seasons. A site-specific amendment to the TSWQS is then needed to change the TDS segment criterion.

E_F The effluent fraction at the edge of the human health mixing zone is calculated as described in the section of this document entitled "Mixing Zones and Critical Conditions for Human Health Protection" on page 45.

C_E The effluent TDS concentration is based on the average effluent data provided in the permit application.

C_A The ambient TDS concentration is the median (50^{th} percentile) concentration of TDS for the segment. Sources for determining the median TDS concentration include (1) Table 5 in Appendix C of this document; (2) the most recent five years of TDS data in the Surface Water Quality Monitoring (SWQM) database (telephone 239-DATA); or (3) other available data. The permittee may supply site-specific data if the median TDS concentration for the entire segment does not appear to be representative of the TDS concentration in the vicinity of the discharge.

The secondary maximum contaminant levels for drinking water (SMCLs, given at 30 TAC §§290.101 - 290.119) are considered for use as C_C if the lake is a public water supply.

7. *Unclassified lake.* Screen for TDS using Equation 3. Differences between screening procedures for unclassified lakes compared to classified lakes are as follows:

C_C The criterion for TDS from the nearest **appropriate** segment is used.

C_A TDS or converted conductivity data (using a conversion factor of 0.65) from the unclassified lake may be used to determine C_A. If such data are unavailable, use the ambient TDS concentration (median) from the nearest appropriate segment. Sources for determining the median TDS concentration include (1) Table 5 in Appendix C of this document; (2) the most recent five years of TDS data in the Surface Water Quality Monitoring (SWQM) database (telephone 239-DATA); or (3) other available data. The permittee may supply site-specific data if the median TDS concentration from the nearest appropriate segment does not appear to be representative of the TDS concentration in the receiving water.

The secondary maximum contaminant levels for drinking water (SMCLs, given at 30 TAC §§290.101 - 290.119) are considered for use as C_C if the lake is a public water supply.

8. *Bay or wide tidal river.* Compare the effluent TDS concentration to the segment TDS median and maximum. Sources for determining the median and maximum TDS concentrations include (1) Table 5 in Appendix C of this document; (2) the most recent five years of TDS data in the Surface Water Quality Monitoring (SWQM) database (telephone 239-DATA); or (3) other available data. Tidal waters will be protected from the adverse effects of excessively high or excessively low salinities (compared to the normal salinity range of the receiving water). The absence of numerical criteria will not preclude evaluations and regulatory actions to protect estuarine salinity.

Identifying Site-Specific Ambient TDS Values

High levels of TDS in an **existing** discharge may be justified occasionally due to elevated levels of TDS in the receiving water. In this case, the permittee has the option to submit information demonstrating that higher ambient levels of TDS exist in the receiving water and/or segment. This information can then be used to derive a site-specific ambient TDS concentration (C_A).

In order to satisfy the statistical requirements for site-specific data collection, 50 TDS values should be collected over the course of one year. TNRCC staff may allow applicants to monitor conductivity and convert it to TDS using a factor of 0.65. In streams and rivers, samples should be collected upstream of an existing discharge or in a separate, nearby reference stream. In lakes and reservoirs, samples should be collected at least 500 feet from any discharge point. Equation 2 or 3 is re-evaluated if a site-specific ambient TDS concentration (C_A) is approved (see Figure 6 on page 94).

If the permittee wishes to change the segment TDS criterion, a more intensive study is needed. Such a study involves sampling the entire segment under various flow regimes and seasons. A site-specific amendment to the TSWQS is then needed to change the TDS segment criterion.

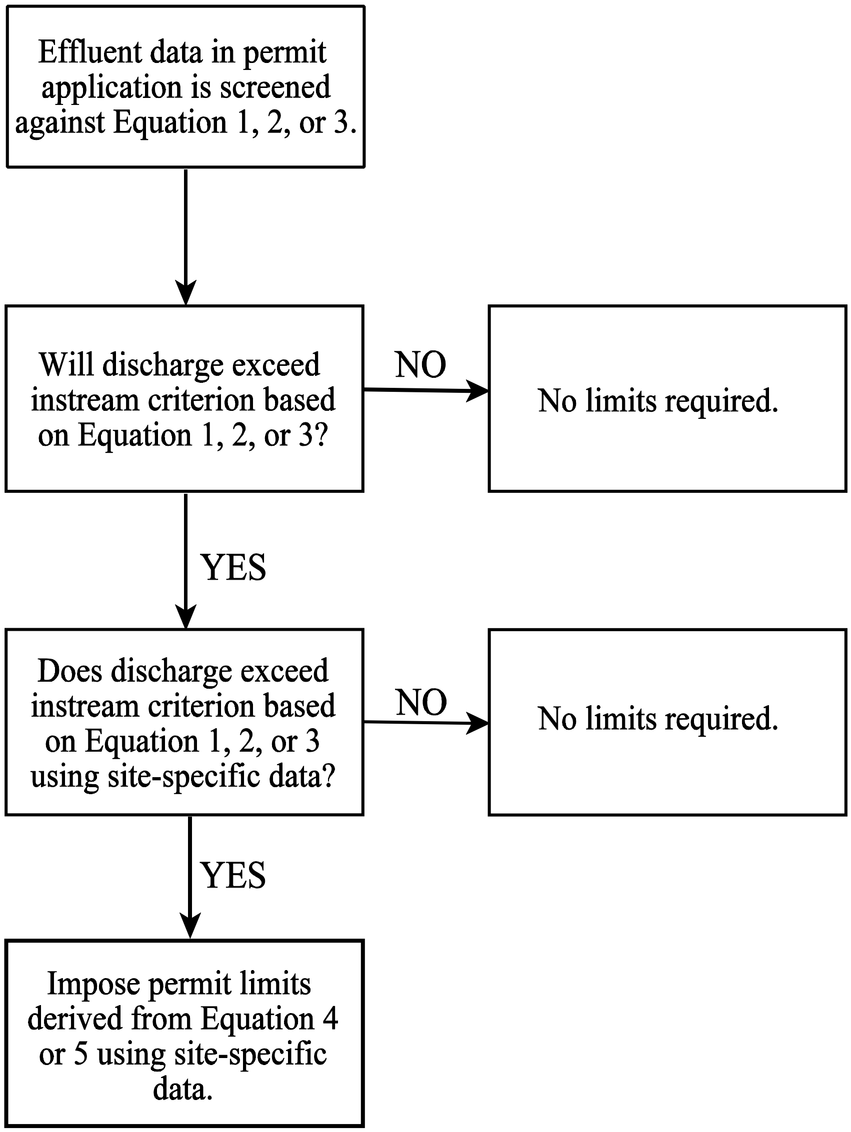


Figure 6. Establishing Permit Limits for Total Dissolved Solids

Establishing Permit Limits for TDS

If the screening criteria are exceeded and site-specific data are either not proposed or not justified, a TDS permit limit is calculated for the discharge. Similar procedures may be followed for individual constituents of TDS (that is, sulfate and chloride) if they are determined to be of concern. See Figure 7 on page 99 for a summary of permit limit calculation methods as they apply to different types of water bodies.

Unclassified intermittent streams. For discharges to unclassified intermittent streams, if the average effluent concentration of TDS in the permit application (or other available effluent data) is greater than the screening value determined using Equation 1, then TNRCC staff consider effluent control measures for TDS.

When a limit is appropriate, the screening value or other appropriate site-specific value may be used as the daily average effluent limit for TDS. The daily maximum effluent limit for TDS is generally 2.12 times the daily average limit. The 2.12 multiplier is the ratio of the multipliers used to convert the human health LTA to daily maximum and daily average permit limits. See the section of this document entitled "Deriving Permit Limits for Human Health Protection" on page 60.

Perennial streams and rivers and intermittent streams with perennial pools. For discharges to perennial streams and rivers or to intermittent streams that have perennial pools, Equation 4 is used to calculate the effluent TDS concentration that is used to determine TDS permit limits:

Equation 4

$$C_E = \frac{(C_C)(Q_E + Q_S) - (Q_S)(C_A)}{Q_E}$$

where:

C_E = calculated effluent TDS concentration (mg/L)

C_C = segment TDS criterion (mg/L)

Q_E = effluent flow (ft^3/s)

Q_S = harmonic mean flow (ft^3/s) of the receiving water or first perennial water body downstream of the discharge

C_A = ambient TDS concentration (mg/L)

Lakes. For discharges to lakes, Equation 5 is used to calculate the effluent TDS concentration that is used to determine TDS permit limits:

Equation 5

$$C_E = \frac{C_C - (1 - E_F)(C_A)}{E_F}$$

where:

C_E = calculated effluent TDS concentration (mg/L)

C_C = segment TDS criterion (mg/L)

E_F = effluent fraction at the edge of the human health mixing zone

C_A = ambient TDS concentration (mg/L)

If either Equation 4 or 5 produces a negative value for C_E, then C_E is set equal to the segment TDS criterion (C_C) in the absence of additional information.

Final calculations for lakes, perennial streams and rivers, and intermittent streams with perennial pools. The calculated effluent TDS concentration (C_E) from Equation 4 or 5 is the annual average TDS concentration from which daily average and daily maximum permit limits may be determined. These limits are calculated by considering C_E to be a waste load allocation (WLA) averaged over 365 days and calculating a long-term average (LTA) effluent concentration. This procedure is outlined in the section of this document entitled "Deriving Permit Limits for Human Health Protection" on page 60.

In cases where the TDS concentration can be controlled by the process, such as in cooling tower operations, the usual permitting assumption that the coefficient of variation (CV) equals 0.6 may be evaluated and adjusted as appropriate.

Final Evaluation and Additional Considerations for TDS

Preliminary effluent limits are evaluated to determine whether monitoring requirements, specific effluent limits, or other permit conditions are needed to address TDS (or sulfate or chloride).

Measured effluent concentrations are compared to the calculated daily average effluent limit as described in the section of this document entitled “Establishing Permit Limits for Toxic Pollutants” on page 82. Monitoring requirements are established if the measured effluent concentration exceeds 70% of the calculated daily average limit. Effluent limits are established if the measured effluent concentration exceeds 85% of the calculated daily average limit, unless **all** of the following conditions are met:

- The effluent concentration of TDS is comparable to the water supply source; or, for domestic discharges, any elevations of salinity are small and typical of such discharges.

- The water supply source is typical of TDS concentrations of surface waters in the area but does not include brine water that is produced during the extraction of oil and gas, or other sources of brine water that are substantially uncharacteristic of surface waters in the area of discharge.

- For industrial discharges, there are no internal discharges of process water that result in a significant elevation of TDS in the external discharge compared to source water. For domestic discharges, there are no identifiable industrial discharges to the sewerage system that cause a significant elevation of TDS compared to source water.

- The discharge will not result in significant increases in instream concentrations of chloride that would exceed EPA's aquatic life toxic criteria for chloride (as of December 1, 1999), which are 860 mg/L acute criteria and 230 mg/L chronic criteria. This condition does not apply when EPA's criteria are lower than (1) applicable numerical criteria in the TSWQS or (2) typical concentrations of surface waters in the area.

If the above conditions are met, the permit will require instream monitoring if the discharge at permitted discharge flow is predicted to cause numerical criteria for TDS, chloride, or sulfate to be exceeded in a classified segment listed in Appendix A of the TSWQS. Instream monitoring will typically consist of monthly sampling at (1) a site in the receiving water body that is not affected by the discharge (for example, upstream of the discharge); and (2) a site in the receiving water that is affected by discharge (for example, downstream of the designated mixing zone).

If the above conditions are met for a domestic discharge, but the elevation in TDS in the effluent (compared to source water) is greater than "typical," then the permit will contain a requirement for the permittee to develop and implement a plan to identify and reduce sources of TDS to the extent practical consistent with a sound environmental management program. The resolution, however, may not cause or contribute to a violation of the TNRCC narrative criteria for the protection of aquatic life.

Additional general considerations that might indicate an effluent limit for TDS is not required include (but are not limited to) the following:

- For a water body that does not attain numerical criteria for TDS, the discharge does not contribute to the nonattainment. For example, the source water for the discharge is from the same water body, and the discharge does not increase the source water concentration.

- The discharge is intermittent (such as a wet-weather discharge), and the anticipated instream impacts may be evaluated using more applicable screening calculations.

- Reductions in TDS are not economically attainable, and the discharge does not result in a violation of numerical criteria for TDS for the appropriate classified segment in Appendix A of the TSWQS.

- The discharge is demonstrated to not adversely affect aquatic life and other applicable uses. This provision is only applicable if a protocol for this demonstration is approved by the TNRCC. EPA will review any protocol for this demonstration that could affect permits or other regulatory actions that are subject to EPA approval.

When a discharge exceeds the screening criteria, the general considerations in this subsection that preclude an effluent limit are noted in the permit's fact sheet, statement of basis/technical summary, or other publicly available information. More stringent TDS limits may be required to protect unclassified spring-fed streams, streams with unique uses, or other unclassified water bodies where the aquatic life is particularly sensitive to increases in TDS. The antidegradation provisions in 30 TAC §307.5 and in the chapter of this document entitled "Antidegradation" (see page 23) are also applicable.

Water Body Type	Screening Method	Limit Calculation Method
Intermittent stream (see page 88)	If $C_E < C_{SV}$, a TDS limit is usually not required, where: * C_{SV} = 2,500 mg/L if $C_{TDS} \leq$ 2,500 mg/L, * $C_{SV} = C_{TDS}$ if 2,500 mg/L < $C_{TDS} \leq$ 6,000 mg/L, * C_{SV} = 6,000 mg/L if C_{TDS} > 6,000 mg/L. $C_{TDS} = \frac{(C_C)\ (2{,}500\ mg/L)}{500\ mg/L}$ * See page 89 for exceptions to these values.	$C_E = C_{SV}$, or C_E = other appropriate site-specific value.
Perennial stream (see page 89 and page 91)	If $C_C \geq \frac{Q_S C_A + Q_E C_E}{Q_E + Q_S}$, a TDS limit is usually not required.	$C_E = \frac{(C_C)(Q_E + Q_S) - (Q_S)(C_A)}{Q_E}$
Intermittent stream within three miles of a perennial stream (see page 91) or **Intermittent stream with perennial pools** (see page 91)	If $C_E < C_{SV}$ and $C_C \geq \frac{Q_S C_A + Q_E C_E}{Q_E + Q_S}$, a TDS limit is usually not required, where: * C_{SV} = 2,500 mg/L if $C_{TDS} \leq$ 2,500 mg/L, * $C_{SV} = C_{TDS}$ if 2,500 mg/L < $C_{TDS} \leq$ 6,000 mg/L, * C_{SV} = 6,000 mg/L if C_{TDS} > 6,000 mg/L. $C_{TDS} = \frac{(C_C)\ (2{,}500\ mg/L)}{500\ mg/L}$ * See page 89 for exceptions to these values.	$C_E = C_{SV}$, or $C_E = \frac{(C_C)(Q_E + Q_S) - (Q_S)(C_A)}{Q_E}$, or C_E = other appropriate site-specific value, whichever is smaller.
Lake (see page 91 and page 92)	If $C_C \geq (E_F)(C_E) + (1 - E_F)(C_A)$, a TDS limit is usually not required.	$C_E = \frac{C_C - (1 - E_F)(C_A)}{E_F}$
Bay or wide tidal river (see page 93)	Compare C_E to median and maximum segment TDS concentrations.	Avoid adverse effects of excessively high or excessively low effluent TDS concentrations.

Figure 7. Summary of TDS Screening and Limit Calculation Methods

Whole Effluent Toxicity Testing (Biomonitoring)

Applicability

Whole effluent toxicity (WET) testing, also known as biomonitoring, is required in permits where the potential exists for the effluent to cause toxicity in the receiving water (30 TAC §307.6(e)(2)(A) and 40 CFR 122.44(d)(1)(v)). The TNRCC requires WET testing for domestic wastewater facilities with a final permitted average flow of 1 million gallons per day (MGD) or greater, most major industrial facilities, and other facilities that have the potential to cause toxicity in the receiving water.

Domestic dischargers. The TNRCC requires WET testing of domestic wastewater dischargers that have **any** of the following conditions:

- an average permitted flow of 1 MGD or greater
- a final phase of their permit with a design flow of 1 MGD or greater
- an approved pretreatment program with significant industrial users discharging into their collection systems
- the potential to cause toxicity in the receiving water.

Permittees with more than one flow phase in their permit begin WET testing upon expansion to 1 MGD or greater.

Complementing the WET testing requirements, the TNRCC requires all domestic dischargers with an average permitted flow equal to or greater than 1 MGD to dechlorinate their chlorinated effluent or to employ another form of disinfection. TNRCC does not require effluent dechlorination for facilities discharging directly to the Rio Grande.

Industrial dischargers. The TNRCC requires WET testing of:

- EPA-classified major industrial dischargers with continuous-flow outfalls
- other industrial dischargers with continuous-flow outfalls with the potential for causing toxicity.

Although the TNRCC generally does **not** require WET testing of once-through cooling water outfalls or of EPA-classified minor industrial dischargers, the TNRCC will normally require WET testing of such discharges in **any** of the following situations:

- the permittee applies water treatment chemicals or biocides
- the TNRCC determines that the effluent has the potential to cause toxicity in the receiving water
- the permit requires water-quality-based effluent limits (WQBELs) to protect aquatic life because the effluent analysis exceeded the screening criteria
- the permittee commingles other potentially toxic waste streams with the once-through cooling water
- the cooling water source and the receiving water are different water bodies.

The rest of this chapter covers the following topics:

- **types of WET tests** (chronic and 48-hour acute—page 102; 24-hour acute—page 114)
- **test acceptability criteria** (chronic and 48-hour acute—page 104; 24-hour acute—page 116
- **test frequency** (chronic and 48-hour acute—page 105; 24-hour acute—page 116)
- **dilution series, dilution water, and type of WET tests**—page 108
- **toxicity reduction evaluations** (chronic and 48-hour acute—page 111; 24-hour acute—page 117)
- **toxicity control measures** (chronic and 48-hour acute—page 113; 24-hour acute—page 118)
- **toxicity caused by some specific pollutants**—dissolved salts (page 119), ammonia (page 123), and Diazinon (page 125).

Chronic and 48-Hour Acute Tests

The TNRCC may require permittees to conduct 7-day chronic or 48-hour acute WET tests to measure compliance with the requirements of 30 TAC §307.6(e). Toxicity in these tests is defined as a statistically significant difference (at the 95% confidence level) between the survival, reproduction, or growth of the test organisms at or below a specified effluent dilution (the critical dilution) compared to the survival, reproduction, or growth of the test organisms in the control (0% effluent).

Test Types

The permit will specify that tests be conducted using the latest version of the appropriate EPA method. These methods can be found in the following publications (or their most recent versions):

- *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition*, EPA-821-R-02-013, October 2002

- *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms, Third Edition*, EPA-821-R-02-014, October 2002

- *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition*, EPA-821-R-02-012, October 2002.

The permittee may use a revised method if one becomes available during the term of the permit. Alternate test methods are subject to EPA review and approval. Depending on the type of receiving water, the permit will specify chronic or 48-hour acute tests to assess toxicity to freshwater or saltwater organisms. The test organisms used for each type of test are listed below:

Freshwater streams and lakes (salinity < 2 ppt):

CHRONIC	3-brood *Ceriodaphnia dubia* (water flea) survival and reproduction test
	7-day *Pimephales promelas* (fathead minnow) larval survival and growth test
ACUTE	48-hour *Daphnia pulex* (water flea) survival test
	48-hour *Pimephales promelas* (fathead minnow) survival test

Marine receiving water (salinity ≥ 2ppt):

CHRONIC	7-day *Mysidopsis bahia* (mysid shrimp) survival and growth test
	7-day *Menidia beryllina* (inland silverside) larval survival and growth test
ACUTE	48-hour *Mysidopsis bahia* (mysid shrimp) survival test
	48-hour *Menidia beryllina* (inland silverside) survival test

Permittees may substitute other EPA-approved tests and species if they obtain approval from the TNRCC during the permit application process (see the sections of this document entitled "Toxicity Attributable to Dissolved Salts" on page 119 and "Site-Specific Standards for Total Toxicity" on page 145).

Typically, if the segment criterion for total dissolved solids (TDS) or the site-specific TDS concentration in the receiving water is too high to support *Ceriodaphnia dubia* or *Daphnia pulex*, *Daphnia magna* (water flea) will be substituted as the invertebrate test organism after the need to make the substitution is demonstrated. The permittee may submit evidence substantiating the need for an alternative species before or during the application process. However, draft permits with alternate tests, alternate species, or testing requirements that exclude a species are subject to EPA review and approval.

Test Acceptability Criteria

The permittee will have to repeat any toxicity test, including the control and all effluent dilutions, that fails to meet **any one** of the following criteria:

Chronic freshwater

- a mean survival of 80% or greater in the control

- a mean number of 15 or greater water flea neonates per surviving adult in the control

- a mean dry weight of 0.25 mg or greater for surviving fathead minnow larvae in the control

- a coefficient of variation percent (CV%) of 40 or less between replicates in the control and in the critical dilution for

    - the young of surviving females in the water flea reproduction and survival test and
    - the growth and survival endpoints in the fathead minnow growth and survival test.

    However, if statistically significant lethal or sublethal effects are exhibited at any dilution, a CV% greater than 40 does not invalidate the test.

- a test population of < 40% males in a single concentration or < 40% males in a whole test for the water flea reproduction test

Chronic saltwater

- a mean survival of 80% or greater in the control

- a mean dry weight of 0.20 mg or greater for surviving mysid shrimp in the control

- a mean dry weight in the control of 0.50 mg or greater for surviving unpreserved inland silverside and 0.43 mg or greater for surviving preserved inland silverside

- a CV% of 40 or less in the control and in the critical dilution in the growth and survival tests. However, if statistically significant lethal or sublethal effects are exhibited at any dilution, a CV% greater than 40 does not invalidate the test.

48-hour acute freshwater and saltwater

- a mean survival of 90% or greater in the control

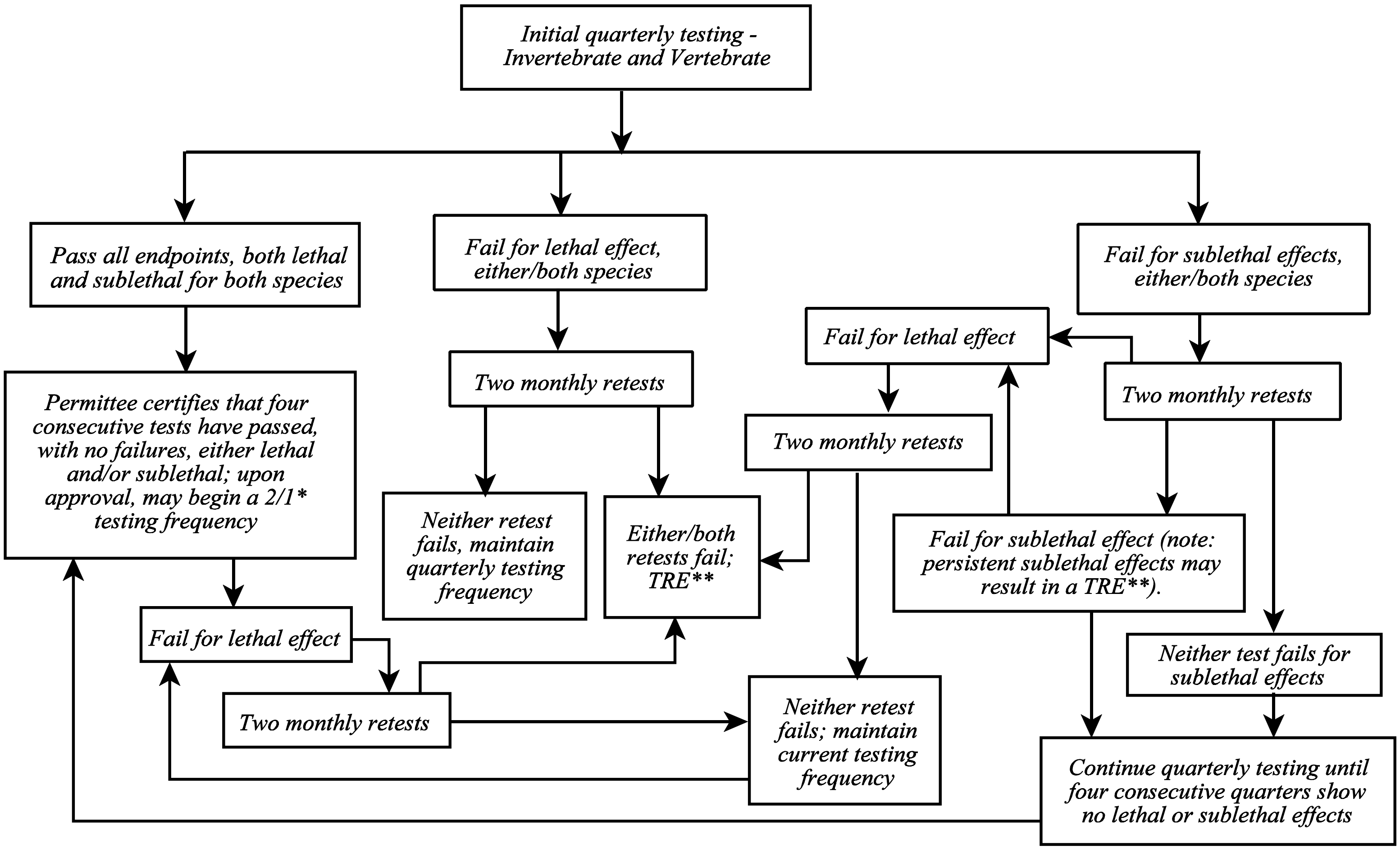
- a CV% of 40 or less in the control and in the critical dilution. However, if significant lethality is demonstrated, a CV% greater than 40 does not invalidate the test.

Also note that tests should be ended within a period of two hours before the appropriate test end time to two hours afterward.

Test Frequencies

General. Figure 8 on page 106 illustrates the WET testing frequencies for domestic and industrial wastewater treatment facilities subject to biomonitoring requirements. Except in unusual circumstances, WET testing is performed quarterly for both the vertebrate and the invertebrate test species for the first year the permit is in effect. Quarterly testing is needed to adequately assess the variability and toxic potential of effluents. Below this minimum frequency, the chance of missing toxic events increases.

Permits issued after adoption of EPA’s Post Third-Round Policy (10/01/1992) contained minimal test frequencies; these were based on intensive WET monitoring data acquired before 1992 that demonstrated an absence of toxicity. This information is now outdated because effluent additives, processes, and treatments may have changed over the long and short term. Periodic reassessment of an effluent’s variability and toxic potential is needed to ensure an adequate level of protection for the receiving water.



Toxicity Reduction Evaluation footnotes:

* 2/1 denotes testing the invertebrate species twice per year and the vertebrate species once per year.
** Toxicity Reduction Evaluation

Figure 8. Chronic and 48-Hour WET Testing Frequencies

If control of toxicity is demonstrated by the absence of significant effects in the last four consecutive quarterly tests for both the invertebrate and the vertebrate test species, the TNRCC may, at the written request of the permittee, reduce the testing frequency to not less than once per six months for the invertebrate and not less than once per year for the vertebrate for the remainder of the permit term. This is the minimum test frequency that will be assigned. Permittees with established WET limits or who are already monitoring at a quarterly frequency for other reasons are not eligible to apply for a reduction in monitoring frequency. Different frequencies may be specified on a case-by-case basis. Due dates for test results are specified in the permit.

Additional considerations. Dischargers will perform quarterly testing when there is insufficient data to determine reasonable potential to cause toxicity. The TNRCC will consider additional factors in determining whether there is reasonable potential to cause toxicity, such as:

- whether the facility has an approved pretreatment program
- existing data from discharge monitoring reports
- compliance history
- whether WQBELs for the protection of aquatic life (derived from Table 1 criteria of the TSWQS) are required, based on data submitted during the application process.

The TNRCC may require more frequent WET testing for permittees that have historical WET testing problems.

During a TRE. The TNRCC will require all dischargers to perform WET tests at least once per quarter if they are conducting a toxicity reduction evaluation (TRE). This frequency only applies to the species that demonstrated significant lethality. For more information on TRE's, see the section entitled "Toxicity Reduction Evaluations" on page 111.

With a WET limit. The minimum testing frequency in a permit with a WET limit is once per quarter for five years following the effective date of the WET limit. This frequency only applies to the species to which the WET limit applies. If no significant lethal effects are demonstrated at or below the critical dilution in any tests for the affected species within five years of the effective date of the WET limit, the discharger may provide a written request to reduce the frequency to twice per year until the permit expiration date.

WET testing frequencies may be specified on a case-by-case basis where seasonal toxicity is apparent. TNRCC staff will use best professional judgement to establish testing frequencies when a chemical-specific (CS) limit or best management practice (BMP) is placed in the permit to control effluent toxicity at the conclusion of a TRE.

Dilution Series, Dilution Water, and Type of WET Test

Dilution series. Chronic and 48-hour acute tests are based on the critical dilution in the receiving water. The critical dilution represents the percentage of effluent at the edge of the mixing zone during critical low-flow (that is, the 7Q2) or critical mixing conditions. The test results at the critical dilution are statistically compared with the test results at the control dilution (0% effluent) to measure compliance. The permit specifies the critical dilution and the dilution series as well as the type of WET tests required.

The dilution series consists of four effluent concentrations in addition to the critical dilution. For domestic dischargers, the average permitted flow is normally used to calculate the critical dilution. For industrial dischargers who are renewing permits, the highest monthly average flow from the preceding two years is normally used to calculate the critical dilution. For new or expanding industrial facilities, the design flow is used to calculate the critical dilution.

Dilution water. As specified in the permit, receiving water unaffected by the discharge should be used as the control and as dilution water for at least the first series of WET tests performed after a new permit is issued.

If the receiving water demonstrates pre-existing instream toxicity (by failing to meet the appropriate test acceptability criteria for survival in the control), the test is considered invalid, and a repeat test has to be performed unless all of the following conditions were met:

- a synthetic lab water control was performed in addition to the receiving water control
- the test indicating receiving water toxicity was carried out to completion
- the permittee submitted all test results indicating receiving water toxicity with the reports and information required by the permit.

Upon demonstrating that the receiving water is toxic, the permittee may, upon TNRCC approval, substitute synthetic dilution water for receiving water as the control and as dilution water in all subsequent tests for that permit term. The physical and chemical properties (for example, pH, hardness, TSS, alkalinity) of the synthetic dilution water should be similar to those of the receiving water. Permittees should submit the substitution request in writing.

Type of test. The TNRCC determines what type of WET test (freshwater or marine, acute or chronic) to place in the permit based on the salinity and critical conditions of the receiving waters. In general, TNRCC staff consider salinities at or above 2,000 mg/L (2 ppt) to represent saltwater conditions.

If the TNRCC determines that WET testing is required for a storm water discharge, TNRCC staff may use an analysis of the watershed to determine runoff volumes for dilution estimates. In addition, the TNRCC may require WET testing or other methods to protect water bodies with endangered species.

Intermittent streams with no significant aquatic life use. Permittees that discharge into intermittent streams with no significant aquatic life use will conduct 48-hour acute testing with a critical dilution of 100% effluent.

Intermittent streams with perennial pools. Permittees that discharge into intermittent streams with perennial pools will conduct chronic testing with a critical dilution of 100% effluent.

Intermittent streams with seasonal aquatic life uses. TNRCC may require dischargers to conduct chronic testing to protect intermittent streams that may have seasonal aquatic life uses. TNRCC determines the critical dilution from the typical flows in the season in which the use occurs.

Intermittent streams within three miles of a perennial freshwater stream. Permittees that discharge into intermittent streams that flow into a perennial stream within a moderate distance downstream (normally 3 miles) will conduct either a 48-hour acute or a chronic test. The type of test depends on the size of the discharge relative to the flow of the perennial water downstream.

If the effluent flow equals or exceeds 10% of the low-flow of the perennial water, the permittee will conduct chronic testing with a critical dilution representative of the percentage of effluent in the perennial stream during low-flow. If the effluent flow is less than 10% of the low-flow in the perennial stream, the permittee will conduct 48-hour acute toxicity tests with a critical dilution of 100% effluent. The TNRCC generally requires permittees that discharge into intermittent streams within 3 miles of a bay, estuary, or tidal river to conduct chronic marine testing.

Perennial freshwater streams. Permittees that discharge directly into perennial freshwater streams or rivers with a designated or significant aquatic life use will conduct chronic testing; the critical dilution will be based on the effluent flow and critical low-flow of the stream or river. If the critical dilution is less than 5%, the TNRCC requires 48-hour acute testing and uses an acute-to-chronic ratio (ACR) of 10:1 to determine the appropriate critical dilution. The ACR is the ratio of the acute toxicity of an effluent or toxicant to its chronic toxicity. It is used to estimate the chronic toxicity based on acute toxicity results. An ACR of 10 represents the upper 90th percentile of the ACR data available to EPA in 1991.

LAKES. Permittees that discharge to a lake will normally conduct chronic WET tests with a critical dilution of 15% if the effluent flow is less than or equal to 10 MGD and the mixing zone is 100 feet wide. If the effluent flow is greater than 10 MGD or if the mixing zone is less than 100 feet wide, the TNRCC typically uses the horizontal Jet Plume equation to determine the percentage of effluent at the edge of the mixing zone (see the chapter in this document entitled “Mixing Zones and Critical Conditions” on page 39). In these cases the critical dilution is generally greater than 15%. The TNRCC assigns a critical dilution of 100% effluent for discharges greater than 100 MGD.

BAYS, ESTUARIES, AND WIDE TIDAL RIVERS. Permittees that discharge into bays, estuaries, and wide tidal rivers (≥ 400 feet across) will normally conduct chronic WET tests with a critical dilution of 8% if the effluent flow is less than or equal to 10 MGD. If the effluent flow is greater than 10 MGD, the TNRCC uses the horizontal Jet Plume equation to determine the percentage of effluent at the edge of the mixing zone (see the chapter of this document entitled “Mixing Zones and Critical Conditions” on page 39). The TNRCC assigns a critical dilution of 100% effluent for discharges greater than 100 MGD.

NARROW TIDAL RIVERS. Permittees that discharge into narrow tidal rivers (< 400 feet across) will normally conduct chronic WET tests with the critical dilution based on upstream flow whenever flow information is available. In the absence of site-specific data such as dispersion dye studies or nearby flow measurements, the critical dilution typically is not less than 8% to ensure the same level of protection given to other marine waters. If upstream flows are not available, the horizontal Jet Plume equation is used to determine the critical dilution at the edge of the mixing zone. Critical dilutions calculated in this way are greater than 8% because the mixing zone size is less than 200 feet.

Diffusers. An effluent diffuser installed at the end of a discharge pipe may increase mixing and lower critical dilutions. See the section of this document entitled “Diffusers” on page 49 for more information. The effluent percentage at the edge of the mixing zone for a diffuser discharge is usually determined through modeling. This effluent percentage, if determined to be appropriate, is normally used as the critical dilution for chronic WET testing. If the critical dilution is less than 5%, the TNRCC may instead require 48-hour acute testing using an ACR of 10:1 to determine the appropriate critical dilution.

Toxicity Reduction Evaluations (TREs)

When is a TRE performed? If a permittee fails a WET test, that is, statistically significant lethality occurs to either test species exposed to effluent at or below the critical dilution, the permittee will conduct two retests. (A retest is another test performed on a sample taken on a different day.) The two retests are to be conducted monthly during the next two consecutive months. If persistent lethality is demonstrated by failure of one or both retests, the permittee will perform a TRE. Note that all test data must be submitted for review regardless of whether the test was valid or invalid.

TRE purpose and content. The purpose of the TRE is to determine the cause and source of toxicity, determine methods to reduce or eliminate the toxicity, and develop a schedule for taking corrective action. Persistent sublethal effects may also have to be addressed by a TRE. Components of a TRE may include, but are not limited to:

- chemical analyses
- effluent characterization test (physical/chemical properties)
- WET tests on effluent before and after characterization test manipulations
- WET tests on effluent after chemical/physical separations
- source identification evaluation or toxicity source evaluation
- instream WET tests
- chemical identification after chemical/physical separations of toxic phase
- assessment of treatment technology available to remove the toxic substance from the effluent.

All test data must be submitted for review regardless of whether the test was valid or invalid.

For more information on methods used in TREs, see the following documents (or their most recent versions):

- *Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I*, EPA/600/6-91/005F, May 1992

- *Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures, Second Edition*, EPA/600/6-91/003, February 1991

- *Methods for Aquatic Toxicity Identification Evaluations: Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity*, EPA/600/R-92/080, September 1993

- *Methods for Aquatic Toxicity Identification Evaluations: Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity,* EPA/600/R-92/081, September 1993

TRE Plan. The permit requires the discharger to submit a general outline for performing a TRE within 45 days of the retest that confirms lethality. The outline should describe the preparations the permittee will take to develop and implement a TRE. Within 90 days of the retest that confirms lethality, the permit requires the discharger to submit a detailed TRE plan. The TRE plan should describe the specific approach and methodology the permittee will use during the TRE and include schedules for chemical and biological testing, specific activities, a sampling plan, a quality assurance plan, and project organization. The TRE schedule and approach may be modified as necessary during the process.

Toxicity attributable to dissolved salts, ammonia, or Diazinon is discussed in the sections of this document entitled:

- “Toxicity Attributable to Dissolved Salts” (see page 119)
- “Ammonia Toxicity” (see page 123)
- “Toxicity Attributable to Diazinon” (see page 125).

Quarterly reports. As required by the permit, the permittee must submit quarterly reports to TNRCC that describe TRE progress and results. The permit also requires the permittee to complete the TRE and submit a final report within 28 months of the retest that confirms lethality. Permittees may request an extension to the 28-month time limit. The extension, however, must be warranted, and approval is contingent upon permittees demonstrating (1) due diligence in pursuit of the TRE and (2) the existence of circumstances beyond their ability to control.

Ceasing a TRE. Permittees may cease TRE activities if they demonstrate to the executive director that the effluent no longer causes lethality to the test organisms. The permit defines a cessation of lethality as no significant lethality at the critical dilution, using test procedures specified in the permit, for a period of 12 consecutive months with at least monthly testing. This permit language accommodates situations where operational errors and upsets, spills, or sampling errors triggered the TRE, in contrast to a situation where a single toxicant or group of toxicants cause lethality.

The permittee may only apply the cessation of lethality provision once every five years. If the effluent again demonstrates persistent, significant lethality to the same species within a five-year period, the TNRCC will amend the permit to add a WET limit with a compliance period (if appropriate). If the permittee can identify and confirm the toxicant and/or identify an appropriate control measure, the permittee may apply for a permit amendment before the effective date of the WET limit, removing the WET limit and replacing it with an alternate toxicity control measure.

When a permittee ceases TRE activities under the cessation of lethality provision, that permittee continues WET testing as required in the permit. This provision is not applicable if the lethality ceases for 12 consecutive months as a result of the permittee taking corrective action. Corrective actions include source reduction or elimination, process changes, housekeeping improvements, changes in chemical use, and/or modification to wastewater treatment.

Toxicity Control Measures

Near the conclusion of the TRE and associated corrective measures, the TNRCC may amend the permit to specify toxicity control measures. These may include a chemical-specific (CS) limit, a best management practice (BMP), or a WET limit, if appropriate, for one or both species demonstrating persistent significant lethality.

CS Limit. The TNRCC may use the CS limit in lieu of a WET limit if the CS limit can adequately address toxicity. In order to be eligible for a CS limit, the permittee has to demonstrate that one or more known toxicants caused the lethality and should attempt to determine a specific concentration of the toxicant that does not cause lethality.

BMP. The TNRCC may specify a permit requirement for a BMP if such a provision can adequately address toxicity. In terms of WET testing, BMPs are defined as a practice or combination of practices that remove toxicity from the effluent by eliminating the source of toxicity. If successful, the BMP becomes an enforceable part of the permit. A BMP does not include making housekeeping changes or operational changes to reduce toxicity. In these cases, the source of toxicity still remains.

WET Limit. Failure to identify the toxicant or toxicants, presence of multiple toxicants, or lack of a routine test method capable of detecting a pollutant at levels causing toxicity, are examples of cases where a CS limit or BMP may be inadequate to address toxicity. In such cases, where

- reasonable potential has been demonstrated to violate the narrative criteria regarding toxicity in 30 TAC §307.6(b)(1) and/or (2) and

- no other appropriate toxicity control measure has been identified,

the permit will be amended to add a WET limit with a compliance period (if appropriate). Upon reaching the effective date of the WET limit, a testing frequency of once per quarter is required for the next five years for the species to which the WET limit applies.

If the permittee does not comply with the WET limit (that is, fails a test), the permittee is considered in violation of the permit and receives a written Notice of Violation (NOV). The testing frequency for the species in question increases to monthly until compliance is demonstrated for a period of three consecutive months. After compliance is demonstrated, the permittee may resume quarterly testing. However, if the permittee fails a test during the increased monthly testing period, the permittee will be referred to TNRCC's Enforcement Division for formal enforcement action. This process is illustrated in Figure 9 on page 115.

24-Hour Acute (100% End-of-Pipe) Tests

In addition to conducting chronic or 48-hour acute tests, dischargers are required to conduct 24-hour acute tests using 100% effluent. This end-of-pipe test measures compliance with 30 TAC §307.6(e)(2)(B) of the TSWQS, which requires that greater than 50% of the test organisms survive exposure to 100% effluent for 24 hours. This provision is designed to ensure that water in the state will not be acutely toxic to aquatic life.

In addition to facilities mentioned previously in the section "Applicability" (see page 101), the TNRCC may require 24-hour acute testing for intermittent process water outfalls and/or storm water outfalls with the potential for causing toxicity. Dischargers with multiple outfalls will test each outfall that has the potential to cause toxicity. Multiple outfall samples may not be composited.

Test Types

The permit will specify that the tests be conducted using the latest version of the appropriate EPA method. These methods can be found in *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition*, EPA-821-R-02-012, October 2002 (or the most recent version). The permittee may use a revised method if one becomes available during the term of the permit. Alternate test methods are subject to EPA review and approval. Depending on the type of receiving water, the permit will specify 24-hour acute tests to assess toxicity to freshwater or saltwater organisms. The test organisms for each type of test are as follows:

Freshwater streams and lakes (salinity < 2 ppt):

- 24-hour *Daphnia pulex* (water flea) survival test

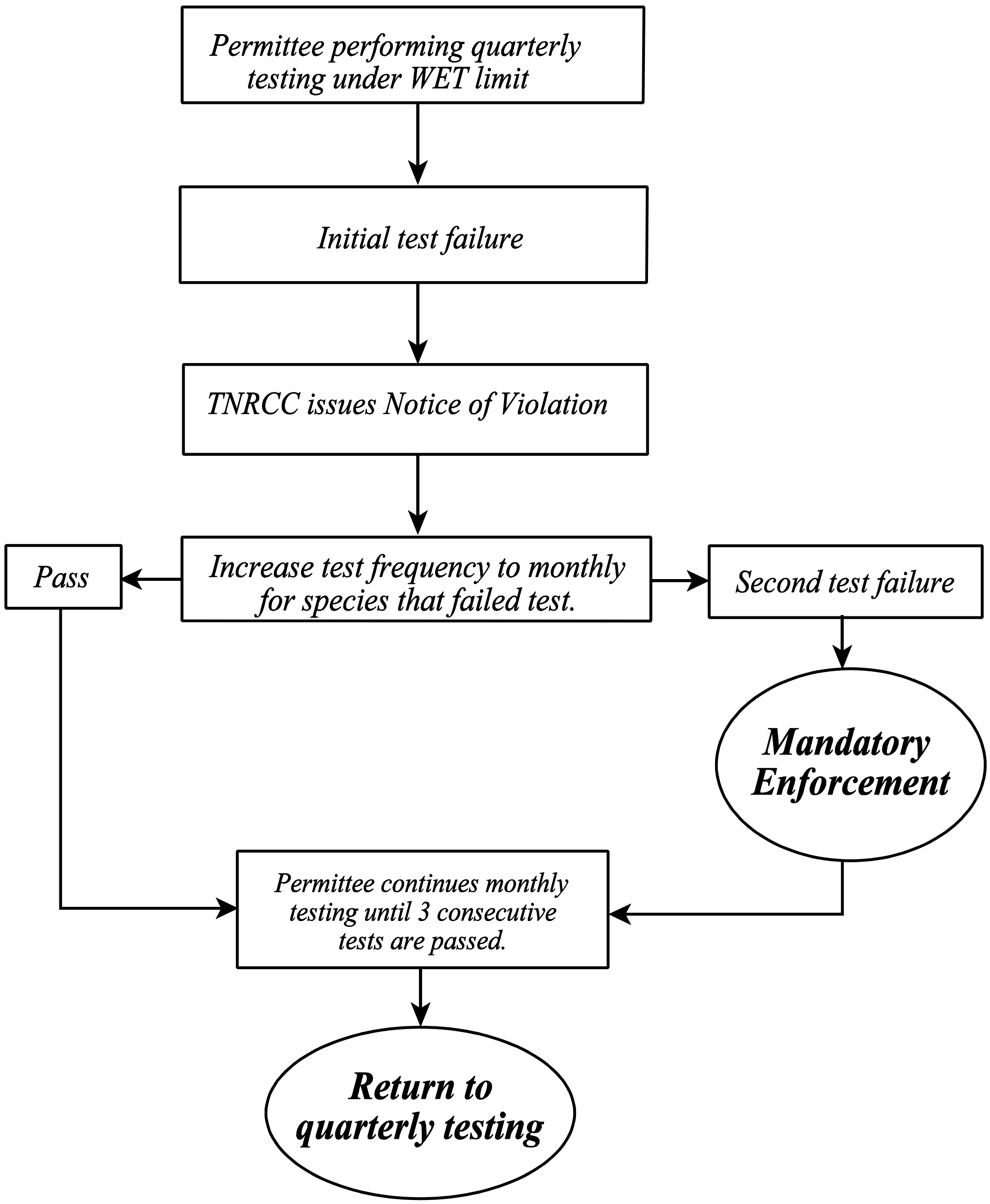


Figure 9. Procedure for Addressing WET Limit Violations

- 24-hour *Pimephales promelas* (fathead minnow) survival test

- 24-hour *Ceriodaphnia dubia* (water flea) survival test. Use of this test species is only allowed where the permittee substitutes the results of the 7-day chronic test for this testing requirement as discussed in the section of this document entitled "Test Substitution" on page 118.

Marine receiving water (salinity ≥ 2 ppt):

- 24-hour *Mysidopsis bahia* (mysid shrimp) survival test

- 24-hour *Menidia beryllina* (inland silverside) survival test

Permittees may substitute other EPA-approved tests and species if they obtain approval from the TNRCC before or during the permit application process (see the sections in this document entitled "Toxicity Attributable to Dissolved Salts" on page 119 and "Site-Specific Standards for Total Toxicity" on page 145).

Typically, if the segment TDS criterion or site-specific TDS concentration in the receiving water is too high to support *Ceriodaphnia dubia* or *Daphnia pulex*, *Daphnia magna* (water flea) is substituted as the invertebrate test organism. However, draft permits with alternate tests, alternate species, or testing requirements that exclude a species are subject to EPA review and approval.

Test Acceptability Criteria

The permittee will have to repeat any toxicity test, including the control, if the mean survival of the control is less than 90%. Also note that tests should end within a period of one hour before the appropriate test end time to one hour afterward.

Test Frequencies

The frequencies for 24-hour acute WET tests are based on (1) previous WET testing results or (2) the results of two 24-hour WET tests performed by the applicant and submitted as part of the wastewater permit application.

- Permit applicants that **are** currently conducting WET tests do not need to resubmit test results or conduct the 24-hour WET tests specified in the permit application.

- Permit applicants that **are not** currently conducting WET tests but meet the criteria for performing WET tests as described in the permit application should conduct the appropriate 24-hour WET tests. These test results should be submitted with the application.

If both application tests pass (exceed 50% survival), the applicant will normally be required to conduct 24-hour acute WET tests at a frequency of once per six months.

If either application test fails, the permittee has the opportunity during the application process to conduct two retests in consecutive weeks for each species that failed. All test data must be submitted for review regardless of whether the test was valid or invalid.

If any of the retests fail, the permittee is required to initiate a TRE upon permit issuance. For more information, see the section of this document entitled "Toxicity Reduction Evaluations" on page 117.

If all retests pass, the permittee is required to conduct 24-hour acute WET tests at a minimum frequency of once per quarter for the species that initially failed and once per six months for the species that passed.

Toxicity Reduction Evaluations (TREs)

Failing a 24-hour acute WET test necessitates two retests over consecutive weeks. If both retests pass, the permittee continues testing at the original frequency designated in the permit. If one or both of the retests fail, the permittee is required to initiate a TRE. From the date that lethality is confirmed, the permittee has three years to comply with 30 TAC §307.6(e)(2)(B). Permittees may request an extension to the three-year limit. As stated in the permit language, however, the extension must be warranted and is contingent upon permittees demonstrating (1) due diligence in pursuit of the TRE and (2) the existence of circumstances beyond their ability to control.

The 24-hour acute TRE requirements are similar but not identical to those discussed in the section of this document entitled "Toxicity Reduction Evaluations" on page 111. Since the permittee should normally comply with 30 TAC §307.6(e)(2)(B) within three years, the permit specifies completion of the TRE and submission of a final TRE report within 18 months of the failed retest. Permittees may request (in writing) an extension to the 18-month time limit. The extension, however, must be warranted and is contingent upon permittees demonstrating (1) due diligence in pursuit of the TRE and (2) the existence of circumstances beyond their ability to control.

The permit also specifies that the TRE continue unless the permittee demonstrates to TNRCC that the effluent has ceased to cause lethality. The permit defines a cessation of lethality as greater than 50% survival after 24 hours of exposure to 100% effluent for 12 consecutive weeks with at least weekly sampling and testing.

Toxicity Control Measures

Near the third year's end, the TNRCC will amend the permit to include a CS limit, a BMP, or a WET limit. A CS limit or a BMP must adequately address the effluent's toxicity. If not, the permit is amended to add a WET limit with a compliance period (if appropriate). Upon reaching the effective date of the WET limit, a testing frequency of once per quarter is required for the next five years.

If the permittee does not comply with the WET limit (that is, fails a test), the permittee is considered in violation of the permit and receives a written Notice of Violation (NOV). The testing frequency for the species in question increases to monthly until compliance is demonstrated for a period of three consecutive months. After compliance is demonstrated, the permittee may resume quarterly testing. If, however, the permittee fails a test during the increased testing period, the permittee will be referred to TNRCC's Enforcement Division for potential formal enforcement action. This process is illustrated in Figure 9 on page 115.

Test Substitution

The TNRCC normally requires permittees to conduct the chronic or 48-hour acute WET tests and the 24-hour acute (100% end-of-pipe) WET tests as separate permit requirements. If the chronic or 48-hour acute WET test includes a test of 100% effluent in the dilution series, the permit allows the results from that test (after 24 hours of exposure) to fulfill the requirements in the 24-hour acute tests. The permittees then report the survival of organisms in the 100% effluent concentrations after 24 hours.

The permit stipulates that the 24-hour acute WET testing provision applies whether the test results submitted are for this requirement, the 48-hour acute requirements, or the chronic requirements. The permittee may add a 100% effluent dilution to chronic or 48-hour acute tests and submit the results after 24 hours to fulfill the 24-hour acute testing requirements.

Toxicity Attributable to Dissolved Salts

Permittees may be exempt from compliance with the total toxicity provisions in the TSWQS if they demonstrate that dissolved salts are causing the effluent to be toxic. This exemption is allowed under the definition of toxicity in the TSWQS and under the 24-hour, 100% end-of-pipe acute toxicity provisions (30 TAC §307.6(e)(2)(B)).

The definition of toxicity in the TSWQS excludes adverse effects caused by concentrations of dissolved salts when the salts originate in a permittee's source water. This exemption would affect compliance with the chronic and 48-hour acute WET testing provisions.

According to 30 TAC §307.3(a)(65), "Source water is defined as surface water or groundwater that is used as a public water supply or industrial water supply (including cooling water supply). Source water does not include brine water that is produced during the extraction of oil and gas, or other sources of brine water that are substantially uncharacteristic of surface waters in the area of the discharge."

Also, dischargers that exhibit 24-hour acute toxicity caused by (1) concentrations of dissolved salts that originate from the source water or (2) an excess, deficiency, or imbalance of dissolved salts in the effluent are exempted from compliance with the 24-hour, 100% end-of-pipe acute toxicity provision. These exemptions, which are specified in 30 TAC §307.6(e)(2)(B), do not include instances where individually toxic components (for example, the pollutants listed in Table 1 of the TSWQS) have formed a salt compound that is causing the effluent to be toxic.

Figure 10 on page 121 outlines the steps necessary for proving that dissolved salts are responsible for the toxicity and for receiving the exemption. The following two sections further explain the exemptions for dissolved salts.

TDS Exemption—24-Hour Acute (100% End-of-Pipe) Tests

When a permittee believes failure of the 24-hour acute tests occurred because of dissolved salts and seeks an exemption for that demonstration of toxicity, the permittee will have to demonstrate that dissolved salts are **a** cause of toxicity in the effluent. Because the effluent may have multiple toxicants, the permittee then has to prove that dissolved salts are the **primary** cause of toxicity. The following paragraphs describe the process in more detail.

Are dissolved salts a cause of toxicity? To confirm that dissolved salts are a cause of toxicity in the effluent, the permittee is required to conduct at least one set of toxicity identification evaluation (TIE) characterization tests including an ion-exchange procedure.

- If the TIE tests fail to prove that dissolved salts are a cause of toxicity, the permittee will continue with the TRE to identify the toxicant or toxicants and to reduce or eliminate the acute toxicity.

- If the TIE tests show that dissolved salts are a cause of toxicity in the effluent, the permittee then has to prove that they are the **primary** cause of acute toxicity.

Are dissolved salts the primary cause of toxicity? The permittee should use a combination of the following techniques to show that dissolved salts are the primary cause of acute toxicity:

- conduct WET tests using an alternate species that is more tolerant of dissolved salts

- conduct side-by-side WET tests using the toxic effluent as well as a mock effluent formulated to mimic the ionic composition of the effluent

- perform measurements of high levels of dissolved salts in the effluent

- perform an analysis of the ionic components of the dissolved salts

- use computer models that predict the acute toxicity of saline waters

- perform WET tests using sea salts that are formulated to correct ionic imbalances.

The permittee may suggest other methods to demonstrate that dissolved salts are the primary cause of toxicity for the TNRCC's review and consideration.

- If these techniques show that dissolved salts are not the primary cause of acute toxicity, the permittee will continue with the TRE to address the toxicity.

- If the techniques prove that dissolved salts are the primary cause of toxicity, the TRE requirements cease.

When the TRE requirements cease because dissolved salts are the primary source of acute toxicity, the TNRCC evaluates or requires the permittee to evaluate the use of an alternative test species or modified test protocol. The permittee may be required to continue conducting the 24-hour acute tests if an alternate test protocol successfully resolves the acute toxicity

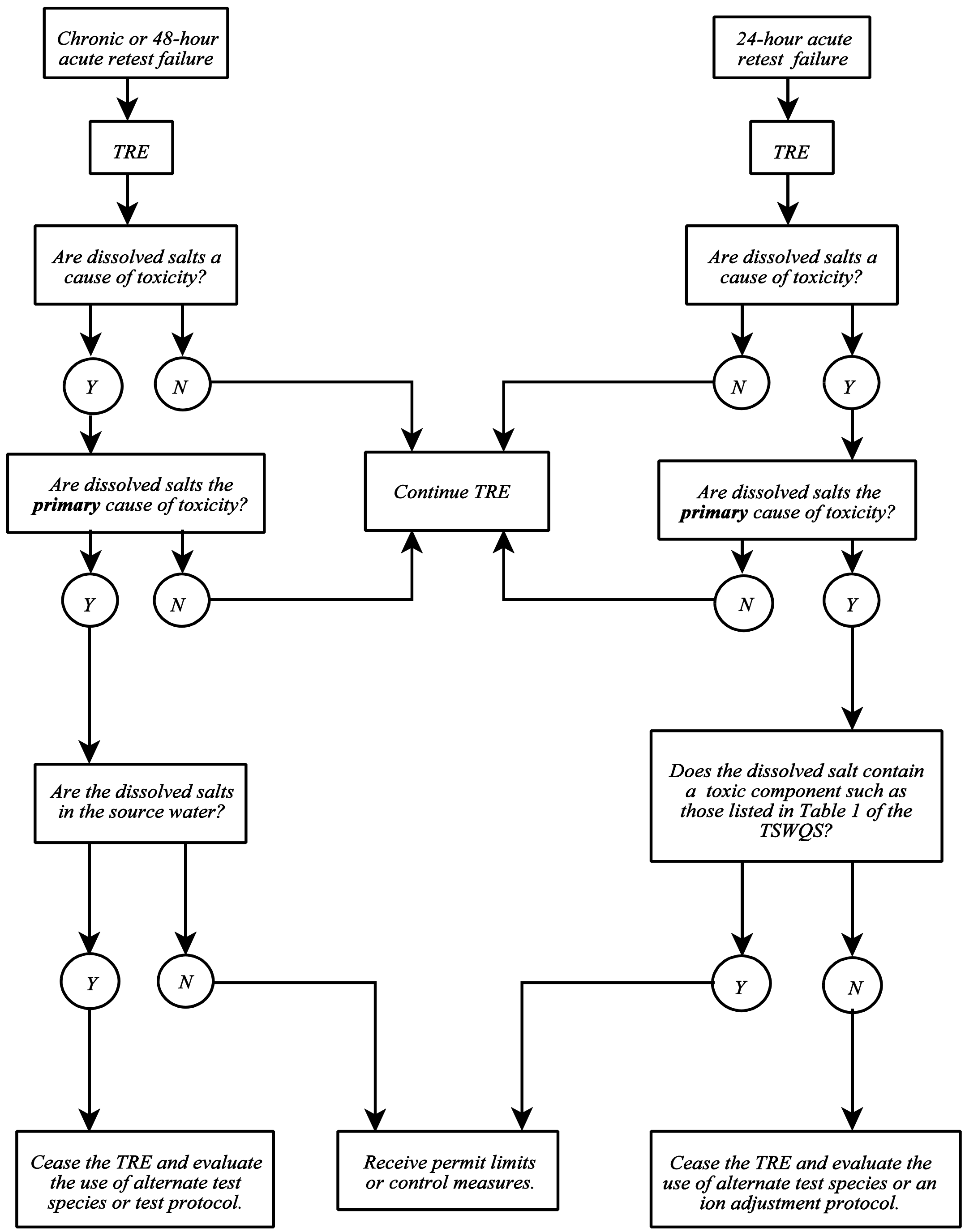


Figure 10. Procedure for Exemption from Total Toxicity Requirements because of Dissolved Salts

caused by the dissolved salts in the effluent. The TNRCC then initiates an amendment of the permit to include these measures.

If an alternate species is unavailable, or if test protocol modifications such as ionic adjustments are unsuccessful, the permittee will most likely be required to continue testing with the standard test species that is unaffected by the dissolved salts.

TDS Exemption—Chronic and 48-Hour Acute Tests

When a permittee believes effluent toxicity evidenced by a chronic or 48-hour acute WET test is caused by dissolved salts and seeks an exemption for that demonstration of toxicity, the permittee should follow an approach similar to that described in the previous subsection. EPA will review any protocol that could affect permits or other regulatory actions that are subject to EPA approval.

First, permittees have to show that dissolved salts are **a** cause of toxicity in the effluent. Since the effluent may contain multiple toxicants, permittees have to prove that dissolved salts are the **primary** source of toxicity. Next, permittees have to show that the dissolved salts are coming from their source water. Permittees need to complete each step in this process to receive the exemption for dissolved salts. The following paragraphs describe this process in more detail.

Are dissolved salts a cause of toxicity? To confirm that dissolved salts are a cause of effluent toxicity, the permittee will conduct at least one set of TIE characterization tests including an ion-exchange procedure. If the TIE tests show that dissolved salts are not a cause of effluent toxicity, the permittee will continue with the TRE to identify the toxicant or toxicants and to reduce or eliminate the toxicity.

If the TIE tests show that dissolved salts are a cause of effluent toxicity, the permittee then has to prove that they are the **primary** cause of toxicity.

Are dissolved salts the primary cause of toxicity? The permittee may use the techniques described in the previous section “24-Hour Acute (100% End-of-Pipe) Tests” on page 119 to prove that dissolved salts are the primary cause of toxicity. If these techniques fail to do so, the permittee will continue with the TRE to address the toxicity. If the techniques prove that dissolved salts are the primary cause of toxicity, the permittee then has to prove that the dissolved salts are coming from the source water.

Are dissolved salts coming from source water? To help prove that dissolved salts originate from the source water, the permittee should sample the facility's intake water and/or raw water source and compare its dissolved salt concentration and ionic composition with those of the effluent. Increases in the dissolved salt content of the effluent due to process evaporation should also be evaluated where appropriate. In any case, if the effluent's TDS concentration is greater than that of the source water or if the effluent's ionic composition varies significantly from that of the source water, effluent limits or control measures may be included in the permit.

- If the dissolved salts are not from the source water, the permittee has to comply with the total toxicity provisions of the TSWQS. If a protocol for an instream biological survey is approved by EPA, it may be possible for the permittee to attempt to demonstrate that aquatic life in the receiving water is not adversely affected by the total dissolved solids (TDS) levels in the proposed permit.

- If the dissolved salts are from the source water, the permittee may cease the TRE. Upon cessation of the TRE, TNRCC staff will, in conjunction with the permittee, evaluate the use of an alternative test species or a modified test protocol. The permittee may be required to continue testing if modifying the test protocol or using an alternate species resolves the toxic effect of the dissolved salts in the effluent. The TNRCC will then amend the permit to include these measures.

  If an alternate species is unavailable or tests using a modified test protocol still demonstrate toxicity due to dissolved salts, the permittee will most likely be required to continue testing with the standard test species that is unaffected by the dissolved salts.

Discharges to marine waters are reviewed on a case-by-case basis and are subject to EPA review and approval in accordance with the MOA between the TNRCC and EPA concerning the TPDES program.

Ammonia Toxicity

Controlling Potential Ammonia Toxicity

Ammonia, a common component of domestic wastewater, has been shown to be toxic to aquatic organisms. Models used to determine effluent limits for oxygen-demanding constituents do not account for the toxicity that ammonia can exert. Therefore, to preclude instream toxicity, some permits may now include either modified limits for total ammonia **or** a WET limit with a WET testing frequency of six times a year when all of the following conditions are met:

- the discharge is to freshwater **and**
- the facility has a critical dilution of 50% or greater **and**

- the facility has permitted ammonia limits to maintain instream dissolved oxygen criteria, or it has categorical ammonia limits.

The modified ammonia limits or WET limit apply to the following types of facilities:

- major domestic facilities (average permitted flow ≥1 MGD)

- minor domestic facilities (average permitted flow <1 MGD) that discharge to a water body that
  - contains a threatened or endangered species or
  - is listed for ammonia on an EPA-approved 303(d) list

- all major industrial facilities.

By following these guidelines, TNRCC will ensure that it is not authorizing the discharge of toxic amounts of ammonia.

Toxicity Attributable to Ammonia

TNRCC recognizes that a technology-based daily average ammonia-nitrogen limit of 3 mg/L generally precludes toxicity to freshwater test species, specifically the fathead minnow. Therefore, the TNRCC will implement this limit as the TRE resolution for toxicity attributable to ammonia. This resolution applies solely to domestic wastewater treatment plants discharging to freshwater with ammonia as the primary toxicant. The ammonia limit will be implemented in permits as follows:

- For those facilities whose permits contain interim or final effluent phases that include a daily average ammonia-nitrogen limit of 3 mg/L, the persistent lethality requirements are suspended until the effective date of the limit.

- For those facilities whose permits do not contain interim or final effluent phase that include a daily average ammonia-nitrogen limit of 3 mg/L, TNRCC staff will amend the permits to include this limit.

- Facilities whose permits contain interim or final effluent phases that include seasonal ammonia-nitrogen limits or ammonia-nitrogen limits greater than 3 mg/L will be evaluated by TNRCC staff on a case-by-case basis for the appropriateness of the specified limit. If the limit appears incapable of precluding toxicity, TNRCC staff will amend the permit to include a daily average ammonia-nitrogen limit of 3 mg/L.

The 3 mg/L ammonia-nitrogen limit is normally implemented in lieu of a WET limit. However, should this limit prove ineffective in precluding toxicity, TNRCC staff will amend the permit to include an alternative limit and/or corrective measures protective of the receiving waters.

Toxicity Attributable to Diazinon

The TSWQS contain a special provision (30 TAC §307.6(e)(2)(E)) for those domestic wastewater facilities demonstrating Diazinon as the primary cause of effluent toxicity. Once the permittee demonstrates this, using standard TIE characterization tests and other analytical techniques, and also demonstrates that Diazinon is ubiquitous within the wastewater collection system, TNRCC will amend the permit. The amendment requires the permittee to address toxicity as follows:

1. ***Public Education Program (PEP).*** The permittee will be required to implement a PEP, emphasizing education and awareness to prevent Diazinon from entering the collection system. The PEP should include, but not be limited to, the following components:

    a. *Users Survey*—The permittee should survey all suspected users of Diazinon. The survey should be comprehensive, including individuals as well as businesses. The survey should identify those source groups and/or individuals that should receive the information described in 1.b.

    b. *Information Development*—The permittee should develop information for dissemination to source groups and individuals. This information should include best management practices for use of Diazinon and other pesticides and alternative methods of pest control besides the use of organophosphate pesticides.

    c. *Disseminating Information*—The targeted audience should be assured of receiving the developed information through a number of means, including the media, mailings, and public presentations.

2. ***Diazinon Monitoring.*** The permittee will monitor wastewater influent and effluent for Diazinon while continuing to biomonitor using the most sensitive species. The results of the WET testing and the Diazinon monitoring should be submitted in quarterly reports.

Should Diazinon not prove to be the primary cause of toxicity or not be ubiquitous within the wastewater collection system, the permittee will resume the TRE. In addition, should the permittee not address Diazinon toxicity as described above with due diligence, the TRE requirements remain in effect. In either case, TNRCC may amend the permit to specify appropriate toxicity control measures as given in 30 TAC §307.6(e)(2)(D).

TPDES Storm Water Permits

General Provisions

This chapter describes storm water discharges subject to TPDES permit requirements, which include discharges associated with industrial activities, construction activities, and regulated discharges of storm water from municipal separate storm sewer systems (MS4s). These types of discharges are identified by state and federal regulation (30 TAC §281.25(4) and 40 CFR Part 122).

Currently, the TNRCC has not developed routine procedures for setting chemical-specific effluent limits on storm water discharges, based upon the TSWQS. In certain circumstances such as industrial storm water discharges, technology-based effluent limits for storm water discharges will be applied in individual permits. The TNRCC may require an operator of an industrial facility, authorized by a general permit, to apply for an individual TPDES permit because of:

- a total maximum daily load (TMDL) and implementation plan
- the anti-backsliding policy—see 40 CFR 122.44(l)
- a history of substantive noncompliance
- other site-specific considerations.

Reviewing Permit Applications

Permit application review procedures for storm water discharge activities are described in this section. These procedures are different from the permit application review procedures associated with wastewater discharges (discussed in the subsection of this document entitled “Application Screening” on page 82) because storm water discharges are normally intermittent and occur during wet weather conditions.

As stated in 30 TAC §307.8(e), controls on the quality of permitted storm water discharges are largely based on implementing best management practices and/or technology-based limits in combination with instream monitoring to assess standards attainment and to determine whether additional controls on storm water are needed. Consistent with the approach described in the EPA’s Interim Permitting Approach guidance (61 FR 43761, November 6, 1996), implementation of storm water permits includes the following items:

- Specific conditions or limitations are incorporated as conditions of the discharger's TPDES permit, as necessary and appropriate, based upon surface water quality data or other acceptable information.

- Where data are not available to characterize the quality of storm water and the receiving water, the TPDES permit may include specific conditions for instream and outfall monitoring. In this situation, data collection will supplement the implementation of necessary controls. This data will be used to make any necessary permit modifications. Additionally, the data will be used to consider necessary permit revisions at the time of permit renewal. In subsequent permit actions, the TNRCC may continue to require instream and monitoring requirements, as appropriate.

Special circumstances may warrant a review similar to that applied to wastewater discharges. Some examples include:

- Storm water management systems designed to retain water and to discharge during static or low-flow conditions.

- Storm water management systems designed to commingle storm water with other waste streams, such as process, utility, or sanitary wastewater.

The Clean Water Act (CWA) Sections 301, 304, and 401 (33 United States Code (U.S.C.) 1331, 1314 and 1341) provide that National Pollutant Discharge Elimination System (NPDES) permits must include effluent limitations requiring authorized discharges to:

- meet standards reflecting levels of technological capability

- comply with EPA-approved state water quality standards

- comply with other state requirements adopted under authority retained by states under CWA §510, 33 U.S.C. §1370.

In general, TPDES storm water permits do not contain numerical water-quality-based effluent limits (WQBELs). Instead, they emphasize requirements that facilities must prevent or effectively reduce exposure of storm water to pollution (for example, by building shelters that protect materials and activities in general from exposure to the elements, including rainfall and rainfall runoff). Such permit requirements are similar to those of previously issued NPDES storm water permits that are based on a strategy of reducing pollution at the source, as opposed to treatment before discharge. Nothing in this chapter, however, precludes the TNRCC from implementing WQBELs on a storm water discharge.

Site-Specific Information

Site-specific information may be used to develop unique storm water management practices associated with a storm water drainage system. Conditions and effluent limits may be based on, but not limited to, the following considerations:

- the existing storm water system design
- local climatic conditions
- the water body being listed on the state's Clean Water Act Section 303(d) List
- assessments of habitat and biological integrity of receiving waters
- extent of success already achieved in preventing and minimizing storm water pollution
- preferences and alternatives provided by the permit applicant
- economically achievable and feasible measures for pollution reduction, including application of structural controls, treatment facilities, management practices and operational methods, and similar considerations.

Such information may be found in a storm water pollution prevention plan (SWP3) or storm water management plan for TPDES applicants. These plans are documents prepared by the permit applicant describing how the site should be managed to prevent or significantly reduce discharge of pollutants from the site. These plans will be updated when necessary and made readily available to TNRCC personnel upon request.

Antidegradation Review of Storm Water Permits

Antidegradation reviews of TPDES permit applications for storm water discharges are conducted in accordance with 30 TAC §307.5. Antidegradation reviews are conducted both for individual permits (such as MS4s and specific industrial facilities) and for general permits developed to address storm water discharges from small MS4s and categories of industrial activity (including construction activity).

Discharges to Impaired Waters

New sources or new discharges of the constituent or constituents of concern to impaired waters are not authorized by permit unless otherwise allowable under 30 TAC §305 ("Consolidated Permits") and applicable state law. For discharges not eligible for coverage under a general storm water permit, the discharger must apply for and receive an individual or other applicable general TPDES permit prior to discharging.

Impaired waters are those that do not meet one or more of the applicable water quality standards and that are listed on the state's 303(d) List.

Constituents of concern are those for which the water body is listed as impaired.

A discharge of the constituent or constituents of concern to impaired water bodies for which there is a TMDL implementation plan[8] is only eligible for coverage under a general storm water permit if:

- it is consistent with the approved TMDL and the TMDL implementation plan **and**

- the facility incorporates the limitations, conditions, and requirements applicable to its discharge, including monitoring frequency and reporting required by TNRCC rules, into its SWP3 or storm water management plan

Even if a TMDL has not yet been developed and implemented for the constituent or constituents of concern, discharges to impaired water bodies must not cause or contribute to the impairment (see 30 TAC §305 "Consolidated Permits").

Discharges to the Edwards Aquifer Recharge Zone

Discharges of storm water associated with industrial activity, and other non-storm water discharges, cannot be authorized where those discharges are prohibited by 30 TAC §213 ("Edwards Aquifer"). New discharges located within the Edwards Aquifer Recharge Zone, or within that area upstream from the recharge zone and defined as the Contributing Zone, must meet all applicable requirements of, and operate according to, 30 TAC §213.

[8] According to the November 22, 2002, EPA letter approving this document, permits must be issued in accordance with the TMDL, regardless of whether a separate implementation plan will be developed.

Discharges to Specific Watersheds and Water Quality Areas

Discharges of storm water associated with industrial activity, and other non-storm water discharges, cannot be authorized where prohibited by provisions of 30 TAC §311 (“Watershed Protection”) for water quality areas and watersheds.

Site-Specific Standards and Variances

General Provisions

As stated in 30 TAC §307.2(d)(3), the narrative provisions, the designated uses, and the numerical criteria of the TSWQS may be amended to account for local conditions. Adoption of a site-specific standard is an explicit amendment to the TSWQS that requires EPA approval and an opportunity for public hearing.

In cases where "site complications" require substantial additional time to justify, review, and approve a site-specific standard, a temporary variance (variance) for an **existing** facility may be requested before or during the permit application process to allow the permittee time to gather information to support a site-specific standard. A variance is not equivalent to a site-specific standard, which is a rule change. Variance procedures are defined in 30 TAC §307.2(d)(5). **Preliminary evidence indicating that a site-specific standard may be appropriate should be submitted to TNRCC to show that a variance is warranted.**

The information necessary to justify a variance is only a part of the process of justifying a site-specific standard. The applicant should continue to develop more comprehensive information to support the site-specific standard. Technical guidance to support a site-specific standard is given in the following sections of this document: “Site-Specific Standards for Aquatic Life Use” (see page 137), “Site-Specific Numerical Standards for Aquatic Life” (see page 140), and “Site-Specific Standards for Total Toxicity” (see page 145).

Interim Permit with a Variance

A variance may be requested before or during the permit application process. TNRCC includes all variance requests in the Notice of Application and Preliminary Decision, and the public is given the opportunity to request a hearing on both the variance and the TPDES permit. A variance for a TPDES permit also requires EPA approval. The TNRCC's approval of a variance along with the TPDES permit formally recognizes that a site-specific standard may be justified based on preliminary evidence provided by the applicant. The variance is approved by the TNRCC as conditions in the permit that provide interim effluent limits or monitoring requirements. Permit conditions for the pollutant or pollutants of concern are normally the same as in the previous permit. However, the application of a variance cannot impair an existing, attainable, or designated use. As stated in 30 TAC §307.2(d)(5)(D), the permit must preclude degradation. A TPDES permit that contains an approved variance is issued for up to a three-year term.

The variance consists of special provisions in the TPDES permit, which establish a schedule for the permittee to submit a work plan to study the stream characteristics, aquatic life uses, or other site-specific information about the receiving water. Upon approval of the work plan, the permittee performs the study in accordance with the approved work plan. Final effluent limits based upon the existing standard are not applied in the permit, since the appropriateness of the existing standard is in question and under study. However, the permit will specify the effluent limits that would be applied in the next permit if the permittee does not comply with the requirements of the variance or if the existing standard is not revised.

The variance provisions in the short-term permit allow the permittee time to gather information necessary to fully support a site-specific standard. With this information, the applicant should request the site-specific standard in writing and submit the approved study to TNRCC at least 180 days before the expiration date of the permit.

A permittee may also request a variance where an **existing** permit already includes a compliance period to meet the TSWQS. In this case, the existing permit (which includes a compliance period for the pollutant of concern) is amended to recognize the variance request. If granted, the variance will expire no later than three years following the issue date for the permit that previously specified a compliance period.

Variance Extensions

When the TNRCC receives the permit renewal application and the study of stream characteristics, aquatic life uses, or other site-specific information about the receiving water, a technical review of this information is conducted. A recommendation on the effluent limits for the succeeding permit is made, based upon the permittee’s fulfillment of the variance requirements and whether the TNRCC agrees the site-specific standard is warranted.

Recommendation that the standard be revised: In this situation, the TNRCC determines that the proposed site-specific standard is appropriate, and EPA determines that it is technically approvable. If the revision to the TSWQS can be processed and completed before the TPDES permit is renewed, then the permit is issued with final effluent limits based upon the revised standard. Otherwise, the succeeding permit is renewed with a variance extension. The interim effluent limits will be extended from the previous permit to allow additional time for a site-specific standard to be adopted into the TSWQS and approved by EPA.

Once the site-specific standard is adopted and approved by EPA, the permittee can seek to have the TPDES permit amended to include effluent limits to reflect the new standard. If this new standard requires an upgrade in treatment, the permit may include a compliance schedule to achieve the effluent limits needed to meet the final standard. As described in 30 TAC §307.2(f), up to three years from the effective date of the permit's issuance is provided to allow sufficient time for the permittee to modify the effluent quality.

Recommendation that the standard not be revised: In this situation, TNRCC (or EPA) does not believe the study supports the site-specific standard. The succeeding permit may include a compliance schedule to achieve the effluent limits needed to meet the existing standard. As described in 30 TAC §307.2(f), up to three years from the effective date of the permit's issuance is provided to allow sufficient time for the permittee to modify the effluent quality.

When the permittee has not complied with the conditions in the variance, then the succeeding permit is issued with final effluent limits based upon the existing standard, effective immediately. The TNRCC does not grant a compliance period with interim effluent limits in this situation, since the permittee did not perform the required study or otherwise fulfill the requirements of the variance.

Coordinating with EPA

In the Memorandum of Agreement (MOA) with the EPA on assumption of the NPDES program, the TNRCC agreed that EPA would review all draft TPDES permits that include a recommendation of a variance. The TNRCC routes draft permits with a variance or variance extension to EPA, along with the technical information that the permittee provides to support the variance request. The EPA reviews the variance request within 45 days and may confer with the USFWS on endangered species issues during this review period. By the end of the 45-day review, EPA either (1) approves the variance and draft permit or (2) specifies any interim objections. Any interim objections have to be resolved before the TNRCC can proceed.

Further details of procedures for federal review of TPDES permits can be found in the TPDES MOA, which is available on the agency's Web site (see footnote 2 on page 12).

Temporary Standards

Where a criterion is not attained and cannot be reasonably attained for one or more of the reasons listed in 40 CFR Part131.10(g), then a temporary standard for a specific water body may be adopted as part of 30 TAC §307.10 as an alternative to downgrading uses. Reasons for a temporary standard are as follows:

- Naturally occurring pollutant concentrations prevent the attainment of a use
- Natural, ephemeral, intermittent, or low-flow conditions or water levels prevent the attainment of the use
- Human-caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place
- Dams, diversions, or other types of hydrological modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or operate such modification in a way that would result in the attainment of a use
- Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses
- Controls more stringent than those required by sections 301(b) and 306 of the federal Clean Water Act would result in substantial and widespread economic and social impact.

In accordance with 30 TAC §307.2(g), the following provisions apply to temporary standards:

- A criterion that is established as a temporary standard must be adopted as stated in the provisions of 30 TAC §307.2(d)(3).
- A temporary standard must identify the water body or water bodies where the criterion applies.
- A temporary standard will identify the numerical criteria that will apply during the existence of the temporary standard, and a remediation plan to address compliance with designated uses and criteria will be provided for approval by EPA.

- A temporary standard does not exempt any discharge from compliance with applicable technology-based effluent limits.

- A temporary standard must expire no later than the completion of the next triennial revision of the TSWQS.

- When a temporary standard expires, subsequent discharge permits will be issued to meet the applicable existing water quality standards.

- If sufficiently justified as stated in the provisions of §307.2(d)(3), a temporary standard can be renewed during revision of the TSWQS.

- A temporary standard cannot be established that would impair an existing use.

Permits including a limit based on a temporary standard typically (1) are issued for three years, (2) are amended by staff after three years, or (3) include another option that precludes allowing limits to be based on the temporary standard for an extended (five-year) period if the temporary standard is removed from the TSWQS.

Site-Specific Standards for Aquatic Life Use

For unclassified water bodies, aquatic life uses are assessed as described in the chapter of this document entitled "Determining Water Quality Uses and Criteria" on page 3. In cases where the preliminary assessment indicates that the attainable aquatic life use for a particular unclassified water body might be lower than the presumed aquatic life use, a use-attainability analysis (UAA) is conducted as discussed in this section. UAAs are also conducted on classified streams where the attainable aquatic life use has become lower than the designated use.

The rest of this section explains:

- the procedures used to review and approve UAAs

- how to conduct UAAs for typical sites on unclassified streams

- the kinds of site complications that require additional analysis.

UAA Review and Approval Procedure

Data collection, compilation, and analysis may be conducted by TNRCC, the applicant, river authorities, or governmental or other entities. TNRCC staff review each UAA in order to ensure conformance with the basic protocol. If TNRCC decides a lower aquatic life use designation is justified, then TNRCC sends the UAA to EPA Region 6 for review and preliminary approval.

UAAs for unclassified streams. Within 30 days after receiving a UAA for a "typical site" on an unclassified stream, EPA reviews the UAA in accordance with the protocol entitled "UAA for Typical Sites (Unclassified Streams)" on page 138 and provides a response to the TNRCC. Additional time may be needed for EPA review of streams with "site complications" (see page 140 for more information). Preliminary approval of a UAA by EPA constitutes a finding that the requested aquatic life uses and criteria for the stream are "approvable" for a site-specific designation in the TSWQS.

TNRCC will designate site-specific aquatic life uses in the TSWQS. To the extent possible, the public notification and public hearing requirements for adopting a site-specific standard may be conducted in conjunction with the public participation procedures for any permit actions that affect the particular site.

After TNRCC and EPA final approval of the revised TSWQS, TPDES discharge permits are issued with effluent limits based upon the new site-specific standard designation. The new site-specific standard is also included in the TNRCC's Water Quality Management Plan (WQMP).

UAAs for classified streams. For classified streams, EPA may need more than 30 days to review the UAA. Lowering a designated aquatic life use on a classified water body takes a more extensive study than for lowering the presumed aquatic life use of an unclassified stream. A UAA for a classified stream requires that representative sites throughout the segment be evaluated rather than one typical site as for an unclassified stream.

The TNRCC reviews the UAA to ensure conformance with basic protocol. If the UAA indicates that the attainable use is lower than the designated use, the TNRCC sends the UAA to EPA. After reviewing the UAA, EPA sends a response to the TNRCC. Preliminary approval of a UAA by EPA for classified streams constitutes a finding that the lowered aquatic life use is "approvable" as the new designated use for the classified stream. The change in the designated use is placed in the next revision of the TSWQS.

UAAs for Typical Sites (Unclassified Streams)

Applicability. The UAA procedures in this section may be used under the following conditions:

- A sample site unimpacted by a pollutant source is available (or data already exists for a reference area), such as in the projected area of impact for a new permit, or upstream of an existing permit.

- The attainable use is not impaired by other sources of pollution at critical conditions.

- The characteristic aquatic life use in unimpacted reference areas is lower than the statewide or region-wide presumed use. This corresponds to one or more of the following reasons for lowering a designated use listed in 40 CFR Part 131:

  - Naturally occurring poor water quality prevents the attainment of the use.

  - Natural stream flow conditions prevent the attainment of the use.

  - Physical characteristics of the stream channel (morphometry) preclude attainment of aquatic life uses.

  - Hydrologic modifications (dams, spillways, intake structures, and so on) preclude the attainment of the use, and the impacts cannot be reasonably mitigated.

Summary of UAA Procedures. The following items summarize the UAA procedures for typical sites:

- Identify reference areas and define stream reach or reaches to be included in the assessment.

- Summarize stream morphometry, flow characteristics, and habitat characteristics in the reference area in accordance with:

  - a standardized stream characteristics form (from a TNRCC wastewater permit application), which also contains a description of the proposed or existing discharge; or

  - the *TNRCC Receiving Water Assessment Procedures Manual,* GI-253, June 1999 or the most recent publication. This document is available upon request from TNRCC's Water Quality Standards Team; or, on the agency's Web site (http://www.tnrcc.state.tx.us), follow the link for "Publications."

- Conduct fish sampling (or in some cases macroinvertebrate sampling) in the reference area in accordance with the GI-253 (see preceding bulleted item).

- Apply quantitative indices in accordance with the GI-253, cited above.

TNRCC sends the results of the UAA to EPA as a summary report with the presentation of results on a standardized receiving water assessment form (Appendix D of GI-253, cited above).

Site Complications Requiring Additional Justification

In unusual situations, there may be site-specific complications that indicate more information is needed to justify an aquatic life use that is less than the presumed use for an unclassified water body. Examples of such situations and the types of additional information that may be appropriate are listed below.

Examples of Site-Specific Complications

- The reasonably attainable uses in the receiving waters are impacted by an existing discharge and are considered to be lower than the naturally occurring uses in an appropriate reference area (for example, upstream).

- No suitable reference areas are available for sampling.

- Dissolved oxygen criteria for a particular aquatic life use are inappropriate for the site.

Examples of Additional Analyses

- Water quality modeling simulations to evaluate treatment options

- Additional investigation of pollutant sources and instream impacts

- Sampling and evaluation of additional parameters, such as diel measurements of dissolved oxygen

- Technical and economic feasibility of attaining the presumed use.

Site-Specific Numerical Standards for Aquatic Life

A permittee may pursue a standards modification where local site-specific factors suggest that the numerical criteria are inappropriate for a particular water body. These factors are defined in 30 TAC §307.6(c)(10).

The following paragraphs discuss these factors in more detail. Information that may establish the presence of these factors should be submitted as part of a permit application. Based on the existence of these factors, a permittee may seek a permit amendment to modify final effluent limits. An application to amend a permit does not delay the effective date of final effluent limits as established in an existing permit; therefore, an amendment application should be submitted well in advance of the effective date of the final effluent limits to allow full TNRCC consideration and final decision. The remainder of this section discusses each factor and how TNRCC staff evaluate information submitted by a permit applicant.

Where an applicant believes that a metal standard is inappropriate, the applicant should carefully evaluate recent effluent analytical data to ensure that effluent metals concentrations do in fact exceed levels necessary to comply with existing standards. The applicant should employ clean techniques for all sample-handling and analytical procedures to avoid sample contamination.

Background concentrations of specific toxics of concern in receiving waters, sediment, and/or indigenous biota. (See 30 TAC §307.6(c)(10)(A).) Through sampling of the receiving water in an area unimpacted by dischargers, the applicant should demonstrate that toxic pollutants exist naturally at concentrations higher than the instream criteria. Where the background concentration is greater than the instream criteria, the TNRCC establishes effluent limits that will preclude further increase in the background concentration.

Persistence and degradation rate of specific toxic materials. (See 30 TAC §307.6(c)(10)(B).) The applicant may demonstrate that a specific toxic pollutant in the effluent has a short half-life within the defined mixing zone of the receiving water due to chemical reactions with naturally occurring compounds, degradation in ultraviolet light, and so forth. This demonstration should be made using receiving water while simulating natural conditions as much as possible. The applicant may also use instream studies of existing discharges.

The applicant should provide proof of degradation and determine that receiving water concentrations of the toxic pollutants of concern do not exceed appropriate criteria. In addition, the applicant should determine the worst-case scenario or demonstrate that the degradation rate is independent of seasonal fluctuations in water chemistry (for example, temperature, pH, dissolved oxygen, and hardness).

Synergistic, additive, or antagonistic interactions of toxic substances with other toxic or nontoxic materials. (See 30 TAC §307.6(c)(10)(C).) A *synergistic interaction* is a situation in which the combined effect of two or more chemicals is greater than the sum of the effect of each substance alone. An *additive interaction* is a situation in which the toxicity of a mixture of chemicals is approximately the same as that expected from a simple summation of the known toxicity of each of the individual chemicals in the mixture. An *antagonistic interaction* is a situation in which a mixture of toxicants exhibits a less-than-additive toxic effect.

The applicant may demonstrate that toxicity in an effluent is caused by a synergistic, antagonistic, or related interaction. By modifying the concentration of a certain chemical in the effluent, the applicant may be able to show that a reduction of effluent toxicity will result without the removal of other suspected toxicants. This demonstration should be made by performing whole effluent toxicity (WET) tests on effluent or in-situ, either from a working wastewater treatment system or a pilot project, using receiving waters. A synergistic interaction may, however, necessitate stricter permit limits to protect the receiving waters.

Measurements of total effluent toxicity. (See 30 TAC §307.6(c)(10)(D).) To demonstrate that a site-specific standard may be appropriate, an applicant may perform WET tests using indigenous receiving water species. The WET tests should be conducted before submitting the permit application. The applicant should conduct an assessment of the receiving water to determine the species present. A diverse, representative, and sensitive group of species should be tested for short- and long-term impacts. The permittee should also demonstrate that sensitive, indigenous species will not be adversely affected, and aquatic life and other uses will not be impaired.

Effluent limits based on specific numerical criteria may not be raised if bioaccumulation or persistence in the food chain or the environment may produce long-term impacts that cannot be measured by WET tests. All alternate site-specific conditions related to chronic or 48-hour acute WET testing are subject to EPA review and approval.

Indigenous aquatic organisms that may have different responses to particular toxic materials. (See 30 TAC §307.6(c)(10)(E).) An applicant may demonstrate that indigenous aquatic organisms are not affected by the effluent at the same concentration as species used to develop the criteria in the standards. This demonstration may be accomplished by performing a detailed survey of aquatic organisms in the water body in areas in and out of the effluent plume. The applicant should also prepare a statistical analysis of the impacts to the receiving water. In addition, the applicant should evaluate the relative sensitivities of indigenous organisms to particular toxicants of concern.

The permittee may calculate a site-specific criterion if the assemblage of indigenous aquatic organisms satisfies the minimum family and genus totals defined in *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* by the U.S.

Environmental Protection Agency, Office of Research and Development, NTIS Accession Number PB85-227049, (Stephan et al.), 1985.

Technological or economic limits of treatability for specific toxic materials. (See 30 TAC §307.6(c)(10)(F).) If the permittee cannot achieve the required effluent limits (normally no lower than the MAL) by best available technology (BAT), then the permittee may apply for a modification of the effluent limit. An applicant seeking an effluent limit modification due to treatment technology limitations should demonstrate, through the use of pilot tests, the level to which the specific toxic pollutant of concern can be treated using state-of-the-art treatment.

The permittee should submit an evaluation of the costs of treatment required to meet the water-quality based effluent limit and include a comparison of BAT or existing costs with estimated costs of state-of-the-art treatment. In this evaluation, the applicant should outline the incremental changes to the existing wastewater treatment facility to achieve state-of-the-art treatment. These changes might include alterations in raw materials, manufacturing processes, products produced, and energy requirements. Also, the applicant should demonstrate that improvements in best management practices or a simple raw material substitution would not achieve the treatment level required to meet the water-quality-based effluent limits (WQBELs).

The applicant should show that existing or designated receiving water quality uses are not impaired due to the modified permit limits.

Bioavailability of specific toxic substances of concern, as determined by water-effect ratio tests or other analyses approved by the agency. (See 30 TAC §307.6(c)(10)(G).) The applicant may demonstrate that the chemical species of a particular substance in the effluent does not induce toxic effects or has a much less toxic effect than another species of that substance. The applicant should prove that the species present in the effluent does not convert chemically or biologically to a more toxic form upon entering and mixing with receiving waters. If the demonstration is successful, the permit limit may be established based on the combined toxicity of the chemical species in the effluent.

If, however, a toxic substance in an effluent converts chemically or biologically to a more toxic species upon entering or mixing with receiving waters, then the permit limit may be established based upon the toxicity of the more toxic chemical species.

When a permit limit based on an aquatic life criterion is proposed, the applicant may wish to develop a water-effect ratio (WER) to adjust the criterion. A WER accounts for the difference in the toxicity of a metal in laboratory water from the toxicity of metals in the permittee’s receiving water. Permittees should follow EPA's guidance document, *Interim Guidance on Determination and Use of Water-Effect Ratios for Metals*, EPA-823-B-94-001, 1994 (or most recent revision), when conducting these studies.

WERs obtained using the methods described in this EPA guidance document cannot be used to adjust aquatic life criteria that were derived for metals in other ways. Therefore, WERs using these methods cannot be used to adjust the residue-based chronic criterion for mercury, or the field-based selenium freshwater criteria.

Permit applicants may also develop WERs using EPA's *Streamlined Water-Effect Ratio Procedure for Discharges of Copper*, EPA-822-R-01-005, March 2001. The streamlined procedure does not supersede the 1994 interim guidance; rather it provides an alternative approach for discharges of copper into a freshwater environment. Permittees in this situation may choose between using the 1994 interim guidance or the streamlined procedure. Some of the features of the streamlined procedure are as follows:

- The procedure applies to continuous discharges of copper into freshwater.

- A minimum of two sampling events should be performed at least one month apart.

- The site water should be prepared by mixing effluent and upstream receiving water to achieve the critical dilution.

- The WER for a single sampling event is calculated by dividing the site water LC50 by the greater of

  - the lab water LC50, or
  - the species mean acute value (SMAV). The SMAV, which is usually found in EPA criteria documents, is the mean LC50 or EC50 from a group of published toxicity tests with laboratory water.

- A minimum of two WERs should be used to calculate the final WER.

- The final WER is the geometric mean of the two (or more) sampling event WERs.

New information concerning the toxicity of a particular substance. (See 30 TAC §307.6(c)(10)(H).) An applicant or other interested party may provide new or updated information that indicates that the toxicity of a substance is significantly different from the numerical criteria in the

TSWQS. This information will typically consist of additional or revised toxicity exposure testing. This testing should be conducted in accordance with *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* by the U.S. Environmental Protection Agency, Office of Research and Development (Stephan, et al.), 1985.

Site-Specific Standards for Total Toxicity

Additional chemical-specific or whole effluent toxicity limits may be established in a permit as a result of confirming whole effluent toxicity at the critical dilution. These chemical-specific or whole effluent toxicity limits may be adjusted based on site-specific factors discussed in the following paragraphs. However, any discharge limit that fails to prevent significant toxicity to a test species at the designated critical dilution requires a demonstration that instream uses will not be impaired (see 30 TAC §307.6(e)(2)(F)). An effluent limit that could exceed the total toxicity requirements of the TSWQS requires a site-specific amendment to the rule.

The remainder of this section discusses each factor to be considered in establishing permit limits and how TNRCC staff evaluate information submitted by an applicant. All alternate site-specific conditions related to chronic or 48-hour acute WET testing are subject to EPA review and approval.

Background toxicity of unimpacted receiving waters. (See 30 TAC §307.6(e)(2)(F)(i).) Where background instream toxicity exists, the TNRCC may establish whole effluent or chemical-specific limits that preclude further increase in the background receiving water toxicity. The applicant should demonstrate background toxicity by assessing toxicity in an area unimpacted by the discharge.

Persistence and degradation rate of principal toxic materials that are contributing to the total toxicity of the discharge. (See 30 TAC §307.6(e)(2)(F)(ii).) The applicant may demonstrate that chemicals responsible for toxicity in the effluent have a short half-life within the defined mixing zone of the receiving water due to chemical reactions with naturally occurring compounds, degradation in ultraviolet light, and so forth. This demonstration should be made using receiving water while simulating natural conditions as much as possible. The applicant may also use instream studies of existing discharges. The applicant should provide proof of chemical degradation and determine that the receiving water’s total toxicity measurements do not violate appropriate criteria.

Site-specific variables that may alter the impact of toxicity in the discharge. (See 30 TAC §307.6(e)(2)(F)(iii).) An applicant may demonstrate that existing receiving-water-specific variables alter the toxic impacts of an effluent. The applicant should use receiving water biological studies or should perform whole effluent toxicity (WET) tests at critical conditions on receiving water samples collected immediately within the discharge plume to the end of the mixing zone.

Indigenous aquatic organisms that may have different levels of sensitivity than the species used for total toxicity testing. (See 30 TAC §307.6(e)(2)(F)(iv).) An applicant may demonstrate that indigenous aquatic organisms are not affected by the effluent at the same exposure concentration as the standard WET test species defined in the permit. This may be accomplished by performing a detailed survey of aquatic organisms in the water body in areas in and out of the effluent plume coupled with a statistical analysis of the data. In addition, the applicant should evaluate the relative sensitivities of indigenous organisms to particular toxicants of concern using literature information or WET tests.

Technological, economic, or legal limits of treatability or control for specific toxic materials. (See 30 TAC §307.6(e)(2)(F)(v).) If the permittee cannot achieve the required total toxicity or chemical-specific permit limits with best available technology (BAT), then the permittee may apply for a modification of the effluent limit. An applicant seeking an effluent limit modification because of the limitations of treatment technology should demonstrate, through the use of pilot tests, the level to which the specific toxic pollutant of concern can be treated using state-of-the-art treatment.

The permittee should submit an evaluation of the costs of treatment required to meet the effluent limit and include a comparison of BAT or existing costs with estimated costs of state-of-the-art treatment. In this evaluation, the applicant should outline the incremental changes to the existing wastewater treatment facility to achieve state-of-the-art treatment. These changes might include alterations in raw materials, manufacturing processes, products produced, and energy requirements.

Also, the applicant should demonstrate that improvements in best management practices, such as source control, public education, housekeeping, a simple raw material substitution, or a water treatment chemical substitution, would not achieve the treatment level required to meet the water-quality-based effluent limits (WQBELs). The applicant should show that existing or designated receiving water quality uses are not impaired due to the modified permit limits.

Appendix A. Abbreviations

Abbreviation	Full Name
ACR	acute-to-chronic ratio
BAF	bioaccumulation factor
BAT	best available technology
BCF	bioconcentration factor
BMP	best management practice
BOD	biochemical oxygen demand
CBOD	carbonaceous biochemical oxygen demand
CFR	Code of Federal Regulations
CPP	Continuing Planning Process
CRDL	contract required detection limit
CRP	Clean Rivers Program
CRQL	contract required quantitation level
CS	chemical-specific
CSTR	Continuously Stirred Tank Reactor
CV	coefficient of variation
CWA	Clean Water Act
DO	dissolved oxygen
EPA	Environmental Protection Agency
FR	Federal Register
HUC	hydrological unit code
LTA	long-term average
MAL	minimum analytical level
MCL	maximum contaminant level
MDL	method detection limit
MGD	million gallons per day
MOA	Memorandum of Agreement
MQL	minimum quantitation level
MS4	municipal separate storm sewer system
MSDS	material safety data sheet
MZ	mixing zone
NH_3-N	ammonia-nitrogen
NOEC	No Observable Effects Concentration
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
ONRW	outstanding national resource water
PEP	public education program

Abbreviation	Full Name
POTW	publicly owned treatment works
RWA	receiving water assessment
7Q2	seven-day, two-year low-flow
SMAV	species mean acute value
SMCL	secondary maximum contaminant level
SOD	sediment oxygen demand
SWP3	storm water pollution prevention plan
SWQM	Surface Water Quality Monitoring
TAC	Texas Administrative Code
TDS	total dissolved solids
TEAC	Texas Environmental Advisory Council
TEF	toxicity equivalency factor
TEQ	toxicity equivalence
TIE	toxicity identification evaluation
TMDL	total maximum daily load
TNRCC	Texas Natural Resource Conservation Commission
TPDES	Texas Pollution Discharge Elimination System
TRE	toxicity reduction evaluation
TSS	total suspended solids
TSWQS	Texas Surface Water Quality Standards
UAA	use-attainability analysis
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WER	water-effect ratio
WET	whole effluent toxicity
WLA	waste load allocation
WLE	waste load evaluation
WQBEL	water-quality-based effluent limit
WQMP	Water Quality Management Plan
ZID	zone of initial dilution

Appendix B. Playa Lake Policy Statement

Playa Lake Policy Statement

Except as otherwise provided in this policy, a permit or order of the Commission, the discharge from any existing industrial or domestic wastewater treatment facility that is authorized to use and has used a playa lake, which does not feed into any surface water of the state, as a wastewater retention facility before July 10, 1991, the effective date of TNRCC adoption of related revisions to the Texas Surface Water Quality Standards, 30 TAC Chapter 307, shall not be subject to meeting such standards or other requirements for discharges to waters in the state. However, additional requirements may be imposed in existing permits so that such discharges shall not create a nuisance or otherwise impair public health, nor cause contamination of groundwater. Such requirements include, but are not limited to, the prohibition of the discharge of raw, untreated wastewater into a playa.

Accordingly, public access to the playa lake shall be limited (e.g., by fencing and/or "no trespassing" signs) and applicable buffer zones shall be required. Additionally, because of the uncertainty of the impermeability and durability of the natural clay liner found on the bottom of a playa lake, as well as the exact location and depth of the underlying water table, groundwater quality monitoring and reporting shall be a condition of the permit or permit renewal. If groundwater contamination from the discharge is detected, a corrective action plan shall be developed and remediation measures shall be required.

If the wastewater is used for irrigation, the discharge must also meet applicable treatment levels and application rates based upon soil depth and characteristics, topography, whether the land has been plowed, crop uptake rates, and other relevant factors.

New discharges to playa lakes not previously authorized to be used as wastewater treatment or retention facilities before July 10, 1991, shall meet applicable surface water quality standards in addition to the groundwater protection requirements above. Additionally, if a finding is made that a waste discharge into a playa of industrial or municipal waste (authorized before July 10, 1991) is subject to the TPDES program, any existing permit will be amended to include a reasonable compliance period, consistent with other agency rules. Such discharges are subject to the TPDES program if the playa is considered as waters of the United States. Unclassified playa shall be presumed to have the same standards as that for an unclassified intermittent water body until more specific standards are established for this water in the state.

Dan Pearson, Executive Director
TNRCC

10/20/97
Date

Appendix C. Tables

Table 1. Aquatic Life Use Subcategories

Aquatic Life Use Sub-category	Dissolved Oxygen Criteria (mg/L)			Aquatic Life Attributes					
	Freshwater mean/ minimum	**Freshwater in Spring mean/ minimum**	**Saltwater mean/ minimum**	**Habitat Characteristics**	**Species Assemblage**	**Sensitive Species**	**Diversity**	**Species Richness**	**Trophic Structure**
Exceptional	6.0/4.0	6.0/5.0	5.0/4.0	Outstanding natural variability	Exceptional or unusual	Abundant	Exceptionall y high	Exceptionall y high	Balanced
High	5.0/3.0	5.5/4.5	4.0/3.0	Highly diverse	Usual association of regionally expected species	Present	High	High	Balanced to slightly imbalanced
Intermediate	4.0/3.0	5.0/4.0	3.0/2.0	Moderately diverse	Some expected species	Very low in abundance	Moderate	Moderate	Moderately imbalanced
Limited	3.0/2.0	4.0/3.0	—	Uniform	Most regionally expected species absent	Absent	Low	Low	Severely imbalanced

Table 2. Critical Low-flow Values for Dissolved Oxygen for the Eastern and Southern Texas Ecoregions as Described in 30 TAC §307.7(b)(3)(A)(ii)

Bedslope (m/km)	Critical Low-flow (ft^3/s)				
	DO[a] =	6.0 mg/L	5.0 mg/L	4.0 mg/L	3.0 mg/L
0.1		— [b]	18.3	3.0	0.5
0.2		— [b]	7.7	1.3	0.2
0.3		28.6	4.7	0.8	0.1
0.4		20.0	3.3	0.5	0.1
0.5		15.2	2.5	0.4	0.1
0.6		12.1	2.0	0.3	0.1
0.7		10.0	1.6	0.3	0.0
0.8		8.4	1.4	0.2	0.0
0.9		7.3	1.2	0.2	0.0
1.0		6.4	1.0	0.2	0.0
1.1		5.7	0.9	0.2	0.0
1.2		5.1	0.8	0.1	0.0
1.3		4.6	0.8	0.1	0.0
1.4		4.2	0.7	0.1	0.0
1.5		3.9	0.6	0.1	0.0
1.6		3.6	0.6	0.1	0.0
1.7		3.3	0.5	0.1	0.0
1.8		3.1	0.5	0.1	0.0
2.1		2.5	0.4	0.1	0.0
2.4		2.2	0.4	0.1	0.0

[a] Dissolved oxygen criteria in this table apply as 24-hour averages at all stream flows at or above the indicated stream flow for each category.

[b] Flows are beyond the observed data used in the regression equation.

Example: If the bedslope of the stream is 1.1 m/km, and the DO criterion is 5.0 mg/L, then the critical low-flow value is 0.9 ft^3/s.

Table 3. Locations of Federally Endangered and Threatened Aquatic and Aquatic-Dependent Species in Texas

Segment No.	County	Common Name	Water Body [1]
0101	Hemphill Hutchinson Roberts	Arkansas River shiner	
0103	Oldham Potter	Arkansas River shiner	
1202	Austin	Houston toad	Deep Creek
1209	Leon	Houston toad	Running Creek
1211	Burleson	Houston toad	Second Davidson Creek
1212	Bastrop	Houston toad	Marshy Branch
1212	Milam	Houston toad	Hills Branch
1212	Lee	Houston toad	Blue Branch
1242	Burleson	Houston toad	Sweet Gum Branch
1302	Colorado	Houston toad	Hayes Creek
1402	Colorado	Houston toad	Redgate Creek
1409	Lampasas San Saba	Concho water snake	
1410	Brown Coleman McCulloch Mills San Saba	Concho water snake	
1411	Coke	Concho water snake	
1412	Coke Mitchell	Concho water snake	
1416	Menard	Clear Creek gambusia	Clear Creek
1421	Concho Tom Green	Concho water snake	including Dry Hollow in Concho Co.
1426	Coke Runnels	Concho water snake	including: Ballinger Municipal Lake in Runnels Co. Bluff Creek Coyote Creek Elm Creek
1426	Concho	Concho water snake	Kickapoo Creek
1430	Hays Travis	Barton Springs salamander [2]	including: Barton Spring above Barton Springs Municipal Pool Barton Springs outflows in Travis County Eliza Springs Parthenia (= Main) Springs Sunken Garden Springs

Segment No.	County	Common Name	Water Body [1]
1433	Coleman Concho Runnels	Concho water snake	
1434	Bastrop	Houston Toad	Alum Creek Copperas Creek Gills Branch Piney Creek Price Creek Puss Hollow
1605	Lavaca	Houston toad	Laughlin Sandy Creek
1809	Hays	Comal Springs dryopid beetle [2]	Fern Bank Springs
1811	Comal	Peck's Cave amphipod [2]	Comal Springs
1811	Comal	Comal Springs dryopid beetle [2]	Comal Springs
1811	Comal	Comal Springs riffle beetle [2]	Comal Springs
1811	Comal	Fountain darter [2]	including Landa Lake
1812	Comal	Peck's Cave amphipod [2]	Hueco Springs
1814	Hays	San Marcos salamander [2]	including: San Marcos National Fish Hatchery refugium San Marcos Spring outflows San Marcos Springs Spring Lake
1814	Hays	Texas blind salamander [2]	Ezell's Cave pool F. Johnson's fissure pool Primer's fissure pool Rattlesnake Cave pool San Marcos Springs San Marcos Springs outflows SWTSU artesian well outlet
1814	Hays	Texas wild-rice [2]	including: San Marcos National Fish Hatchery refugium Spring Lake
1814	Hays	San Marcos gambusia [2]	including Spring Lake
1814	Hays	Fountain darter [2]	including Spring Lake
1814	Hays	Comal Springs riffle beetle [2]	San Marcos Springs
2109	Uvalde	Comanche Springs pupfish	Uvalde National Fish Hatchery refugium
2109	Uvalde	Texas wild-rice [2]	Uvalde National Fish Hatchery refugium
2109	Uvalde	Fountain darter [2]	Uvalde National Fish Hatchery refugium
2304	Kinney Val Verde	Devil's River minnow	Sycamore Creek
2304	Kinney	Devil's River minnow	Las Moras Creek
2306	Brewster	Big Bend gambusia	Big Bend National Park refugium
2309	Kinney	Devil's River minnow	Phillips Creek

Segment No.	County	Common Name	Water Body [1]
2309	Val Verde	Devil's River minnow	
2311	Culberson Reeves	Pecos pupfish	Salt Creek
2311	Pecos	Leon Springs pupfish	Diamond Y Draw Diamond Y Spring
2311	Jeff Davis Reeves	Comanche Springs pupfish	Balmorhea irrigation canals Giffin Spring Phantom Lake Spring in Jeff Davis Co. San Solomon Spring in Reeves Co. Toyah Creek
2311	Jeff Davis	Pecos gambusia	Balmorhea irrigation canals Phantom Lake Spring
2311	Pecos	Pecos gambusia	Diamond Y Draw Diamond Y Spring
2311	Reeves	Pecos gambusia	Balmorhea irrigation canals East Sandia Spring Giffin Spring San Solomon Spring
2311	Jeff Davis	Little Aguja pondweed	Little Aguja Creek
2313	Val Verde	Devil's River minnow	San Felipe Creek
2411	Jefferson	Piping plover	Petroleum facilities [3]
2421	Chambers Galveston	Piping plover	Petroleum facilities [3]
2422	Chambers Galveston	Piping plover	Petroleum facilities [3]
2423	Galveston	Piping plover	Petroleum facilities [3]
2424	Brazoria Galveston	Piping plover	Petroleum facilities [3]
2432	Brazoria	Piping plover	Petroleum facilities [3]
2433	Brazoria	Piping plover	Petroleum facilities [3]
2434	Brazoria	Piping plover	Petroleum facilities [3]
2435	Brazoria	Piping plover	Petroleum facilities [3]
2439	Galveston	Piping plover	Petroleum facilities [3]
2441	Matagorda	Piping plover	Petroleum facilities [3]
2442	Brazoria Matagorda	Piping plover	Petroleum facilities [3]
2451	Calhoun Matagorda	Piping plover	Petroleum facilities [3]
2452	Matagorda	Piping plover	Petroleum facilities [3]
2461	Calhoun	Piping plover	Petroleum facilities [3]

Segment No.	County	Common Name	Water Body [1]
2461	Calhoun	Whooping crane	
2462	Calhoun	Piping plover	Petroleum facilities [3]
2462	Calhoun	Whooping crane	
2463	Aransas	Piping plover	Petroleum facilities [3]
2463	Aransas	Whooping crane	
2471	Aransas	Piping plover	Petroleum facilities [3]
2471	Aransas	Whooping crane	
2472	Aransas Refugio	Whooping crane	
2473	Aransas	Whooping crane	
2481	Nueces	Piping plover	Petroleum facilities [3]
2483	Nueces	Piping plover	Petroleum facilities [3]
2491	Cameron Kenedy Kleberg Nueces Willacy	Piping plover	Petroleum facilities [3]
2492	Kenedy Kleberg	Piping plover	Petroleum facilities [3]
2493	Cameron	Piping plover	Petroleum facilities [3]

[1] The water bodies listed in this column are where the endangered, threatened, or proposed species are known to occur. Unless the word “including” is used, the species are not found in the segment, only in watersheds that drain to the segment.

[2] Includes segments that cross the contributing and recharge zones of the southern section of the Edwards Aquifer (see Table 4) as well as the Comal River (Segment 1811) and Lower San Marcos River (Segment 1808).

[3] Discharges from petroleum facilities are evaluated to determine if there is an affect on Piping Plovers. No other types of facilities are reviewed for potential affects to Piping Plovers.

Table 4. Segments that Cross the Contributing and Recharge Zones of the Southern Section of the Edwards Aquifer

Segment Number	Segment Name
1804	Guadalupe River Below Comal River
1805	Canyon Lake
1806	Guadalupe River Above Canyon Lake
1808	Lower San Marcos River (above City of Martindale)
1809	Lower Blanco River
1810	Plum Creek
1811	Comal River
1812	Guadalupe River Below Canyon Dam
1813	Upper Blanco River
1814	Upper San Marcos River
1815	Cypress Creek
1816	Johnson Creek
1817	North Fork Guadalupe River
1818	South Fork Guadalupe River
1903	Medina River Below Medina Diversion Lake
1904	Medina Lake
1905	Medina River Above Medina Lake
1906	Lower Leon Creek
1907	Upper Leon Creek
1908	Upper Cibolo Creek
1909	Medina Diversion Lake
1910	Salado Creek
2111	Upper Sabinal River
2112	Upper Nueces River (upper portion)
2113	Upper Frio River
2114	Hondo Creek
2115	Seco Creek

Table 5. Segment-Specific Values for TSS, pH, Total Hardness, TDS, Chloride, and Sulfate

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
0101	8	7.5	540	2910	840	439
0102	3	8.1	218	1170	335	275
0103	18	7.9	190	2080	610	369
0104	3	7.6	190 (a)	848	278	65
0105	21	8.3	194 (a)	740	45	43
0201	27	7.0	169 (a)	598	142	112.5
0202	24	7.1	160	760	180	140
0203	3	7.6	53 (a)	1242	330	219
0204	30	7.8	360	2750	1040	600
0205	33	7.8	790	4350	1700	1075
0206	11	7.5	169 (a)	13300	6520	2440
0207	15	7.5	1900	15900	17000	3060
0208	10	6.7	53 (a)	132	5	14
0209	4	6.7	53 (a)	104	7	15
0210	3	7.6	53 (a)	494	124	40
0211	28	7.2	36	430	67	12
0212	4	7.9	53 (a)	418	139	11
0213	5	8.0	53 (a)	306 (b)	49	13
0214	17	7.5	990	3010	1200	570
0215	4	7.8	53 (a)	3100	1130	725
0216	5	7.5	830	3120	1110.1	750
0217	4	7.52	53 (a)	3130	1135	784
0218	8	7.6	460	8060	4100	2100
0219	22	7.5	53 (a)	1004 (b)	340	65
0220	14	7.55	1148 (c)	21690	9600	2678
0221	7	7.4	169 (a)	2632 (b)	735	1070
0222	5	7.7	1500	2750	269	1350
0223	3	7.75	53 (a)	396	45	85
0224	5	7.6	169 (a)	1610	440	510
0225	12	6.4	169 (a)	120	15	6
0226	5	7.5	940	22400	5309.1	2600

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
0227	9 (a)	7.4 (a)	169 (a)	2360 (a)	944 (a)	690 (a)
0228	2	7.6	53 (a)	374	10	90
0229	8	7.7	169 (a)	1010	164	250
0230	9	7.4	1148 (c)	7530	3580	1690
0301	10	6.8	54 (a)	163	11	18
0302	7	7.0	57 (a)	132	11	17
0303	22	7.0	79	246	15	36
0304	6	6.5	54 (a)	300	76	31
0305	10	7.3	99	453	31	140
0306	25	7.4	54 (a)	418	27	58
0307	7 (a)	7.1	57 (a)	142 (b)	5.8	12
0401	3	5.9	17.8	88	13	12
0402	2	6.06	20.2 (a)	82	15	16
0403	2	6.4	27.5	110	15	24
0404	7	6.4	38	184	32	40
0405	3	6.6	23 (a)	92	15	17
0406	5	6.2	20.2	94	11	6
0407	5	5.9	20.2 (a)	76	20	6
0408	1	6.5	35	95	15	24
0409	3	6.1	28	122	19	17
0501	6	6.6	24	438	158	30.5
0502	12	6.5	24	108	16	14.9
0503	3	6.7	29	117	17	16
0504	1.5	6.5	28	126	19	15.4
0505	16	6.7	41	237	42	26
0506	16	6.8	50	201	35	27
0507	5	7.3	70	148	6	12
0508	11	6.4	36.4	406	66	26.7
0509	5	6.7	33 (a)	160	25	22
0510	3	6.2	33 (a)	98 (b)	28	14
0511	8	6.3	36	3110	317	30
0512	1.5	6.8	43	130	15	16
0513	5	6.02	12	32 (b)	5.01	2.5

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
0514	3	6.4	24	104	18.9	14
0515	11	6.7	51	216	42	30
0601	8	6.5	32	2540	590	100
0602	16	6.5	24	111	19	19
0603	6	6.4	26 [(a)]	101 [(b)]	17	19
0604	10	6.5	36	82	24	20
0605	4	6.6	32	112	24	27
0606	5	6.5	23 [(a)]	238	33	34
0607	10	6.22	25	168	23	10
0608	6	5.9	12	84	15	5
0609	2	6.4	20	114	16	18
0610	3	6.5	29.8	146	22	21
0611	9	6.3	30	141	20	22
0612	9	6.5	28	100	10	15
0613	2	6.5	26 [(a)]	73	10.4	9
0614	2	6.4	26 [(a)]	62	7	7
0615	7.45	6.5	29.8 [(d)]	224.5	42	40.6
0701	12	6.66	64	260	68	34
0702	13	6.8	104 [(a)]	11143	4200	566
0703	11	6.7	104 [(a)]	8060	4800	640
0704	11	6.7	74	232	50	37
0801	22	7.4	88	286	40.5	34
0802	8.4	7.4	92	204	26	35
0803	7	7.3	94	236	28	40
0804	40	7.2	116	338	40	58
0805	23	7.1	134	404	52	76.1
0806	10	7.4	140	282	35	38
0807	6	7.59	94 [(a)]	284 [(b)]	35	25
0808	5	7.5	76 [(a)]	268	36	22.7
0809	5	7.75	94 [(a)]	270	36	25.5
0810	12	7.5	76 [(a)]	488	57	40
0811	2	7.58	94 [(a)]	222	32.7	20
0812	28	7.13	76 [(a)]	530	60	40

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
0813	1.5	6.4	94 [(a)]	81	12	9
0814	16	7.5	76 [(a)]	316	21	66.9
0815	5	7.4	94 [(a)]	202 [(b)]	12	26
0816	4	7.2	94 [(a)]	187 [(b)]	7	15
0817	5	7.5	94 [(a)]	214 [(b)]	14	39
0818	5.5	7.2	94 [(a)]	114	12.7	25.4
0819	16	7.3	110	358	43	46
0820	5	7.5	94 [(a)]	179	11	26
0821	5	7.7	94 [(a)]	203	8	23
0822	12	7.53	100	269	23	40
0823	5	7.5	94 [(a)]	239	17	29
0824	5	7.6	140	620	57	51
0825	12	7.5	76 [(a)]	244	25	34
0826	5	7.4	94 [(a)]	200	21	27.5
0827	8	7.2	94 [(a)]	198 [(b)]	13	31
0828	5	7.5	101	209 [(b)]	19	29
0829	8	7.5	76 [(a)]	284	22	30
0830	6.1	7.6	94 [(a)]	215	23.9	27
0831	6	7.7	140	396	41	44
0832	4	7.6	94 [(a)]	294 [(b)]	44	31
0833	7	7.66	156	588	95	67
0834	2	7.1	94 [(a)]	185 [(b)]	30	11
0835	9	7.2	110	244 [(b)]	40	42
0836	2	7.25	94 [(a)]	182	12	33.3
0837	25	7.2	76 [(a)]	292	23	42
0838	4	7.5	156	358	21	110
0839	10	7.6	76 [(a)]	322 [(a)]	21	22
0840	3	7.2	94 [(a)]	190 [(b)]	17	16
0841	16	7.1	140	480	75	74
0901	18	7.5	1700	6760	2570	218
0902	4	7.14	54	322	81	17
1001	9	6.4	52	3250	2200	250
1002	9	6.79	40	167	26	9

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
1003	10	6.4	33	152	35	6
1004	12	6.8	60	194	40	10
1005	13	7.5	734	13088	6750	935
1006	11	7.1	419	5750	3700	570
1007	9	7.0	104	2360	1080	189
1008	13	6.7	30	239	53	10
1009	14	6.9	34	364	57	19
1010	6	6.5	37 [(a)]	105	16	5
1011	4	6.4	37 [(a)]	93	19	4
1012	3	7.0	61	135	16	4
1013	13	7.2	55	395	52	19
1014	18	7.2	43	396	74	25
1015	10	6.41	41	135 [(b)]	41	10
1016	19	7.5	78	502	86	45
1017	10	7.4	50	500	88.4	28
1101	17	7.4	492	1478	620	86
1102	19	7.3	136	521	120	40
1103	10	7.3	127	3550	2095	320
1104	13	7.2	158	538	108	62
1105	15	7.3	356	4936	2009	220
1107	19	7.6	2400	10500	4951	620
1108	12	7.2	170	461	110	48
1109	14	7.4	160	4660	1792	300
1110	15	7.3	133	302	68	30
1111	9	7.8	3644	27100	13880	2010
1113	16	7.5	161 [(a)]	2900	1187	145
1201	10	7.5	378	6912	3500	500
1202	33	7.6	160	437	92	67
1203	4	7.5	104 [(a)]	828	367	209
1204	5	7.8	230	1170	473	248
1205	5	7.5	104 [(a)]	1560 [(b)]	460	250
1206	7	7.7	230	1500	590	306
1207	2	7.4	104 [(a)]	2268	652.3	370

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
1208	19	7.7	430	4240	1900	900
1209	28.6	7.25	82	326	55	49
1210	18	7.4	104 [(a)]	176	9.4	12
1211	22	7.3	160 [(a)]	278 [(b)]	54	67
1212	8	7.2	104 [(a)]	280	43	56.3
1213	31	7.6	158	325	42	36
1214	15	7.4	170	424	23	28
1215	2	7.6	160 [(a)]	292	40	19
1216	3	7.5	104 [(a)]	396	57	21
1217	4	7.7	160 [(a)]	624	204	26
1218	4	7.2	160 [(a)]	390	51	47
1219	7	7.2	160 [(a)]	358	39	33
1220	3	7.5	104 [(a)]	282	39	29
1221	10	7.5	160 [(a)]	484	81	48
1222	10	7.66	104 [(a)]	450	101.2	47
1223	4	7.62	160 [(a)]	712	260	81.5
1224	4	7.4	104 [(a)]	382	95	48
1225	5	7.5	126	228	19	24
1226	4	7.4	160 [(a)]	295	25	29
1227	5	7.2	160 [(a)]	339	38	45
1228	6	7.5	104 [(a)]	193 [(b)]	12	15
1229	4	7.8	160 [(a)]	430	25	46.5
1230	5	7.2	104 [(a)]	312 [(b)]	42	35
1231	5	7.7	104 [(a)]	396 [(b)]	121	20
1232	16.8	7.7	580	2550	573	876
1233	3	7.7	216	632	242	63.6
1234	2	7.5	104 [(a)]	216	27	37
1235	12	7.8	104 [(a)]	1040	170	191
1236	5	7.8	200	494	94	78
1237	5	7.8	104 [(a)]	804	187	125
1238	5	7.5	1680	36400	15000	2410
1239	4	7.5	160 [(a)]	641 [(b)]	119	160
1240	4	7.9	104 [(a)]	482	102	41

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
1241	8	7.7	540	4380	1310	1380
1242	12	7.7	231.2	776	193	114
1243	0.94	7.3	160 [(a)]	290	14	16.8
1244	2.5	7.4	160 [(a)]	452	69	41
1245	16	7.2	140	376	73	50
1246	4	7.6	160 [(a)]	348	17	56
1247	8	7.6	104 [(a)]	270	20	24
1248	3	7.7	170	283	18	20
1249	2.5	7.4	104 [(a)]	288	11.8	17
1250	2	7.7	160 [(a)]	276	18	23
1251	0.5	7.8	200	284	13	22
1252	4	7.1	66	174	23	18
1253	17	7.3	66	276	25	16
1254	5	7.5	104 [(a)]	228	12	53
1255	5	7.4	160 [(a)]	597 [(b)]	102	49
1256	7.3	7.7	227.2	610	240	108
1257	2.25	7.6	230 [(e)]	631 [(e)]	317	190
1301	12	7.3	230	2090	2920	215
1302	18	7.2	65	280	54	18
1304	13	7.33	124	1120	182	61
1305	16	7.3	65 [(a)]	346	45	15
1401	10	7.55	224	9650	330	90
1402	10	7.8	200	334	54	42
1403	1	7.6	180	306	60	39
1404	1	7.44	190	304	65	38.8
1405	2.5	7.6	176	322	73	43
1406	3	7.4	179	304	72.8	43
1407	2	7.5	181	388	100	67
1408	2	7.54	195	414	106	66
1409	17	7.71	252	496	114	79
1410	15	7.6	320	1198 [(f)]	360 [(f)]	242 [(f)]
1411	5	7.8	188 [(a)]	2963	730	445
1412	11	7.6	610	5020	1600	990

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
1413	7	7.8	188 [(a)]	341 [(b)]	43	61
1414	5	8.0	184	420	56	32.1
1415	2.5	7.9	150	239	22	14
1416	10	7.8	174 [(a)]	310	24	18
1417	12	7.8	140	578 [(b)]	125	71
1418	5	7.48	188 [(a)]	306	80	39
1419	3	7.4	188 [(a)]	342	73	47
1420	10	7.4	174 [(a)]	640	147	102
1421	13	7.69	381	1220	475	250
1422	9	7.9	188 [(a)]	600	185	81
1423	5	7.85	188 [(a)]	472	102	51
1424	2.5	7.6	174 [(a)]	372	49	16
1425	5	7.7	188 [(a)]	531	85	44
1426	15	7.68	190	2460 [(f)]	850 [(f)]	774 [(f)]
1427	2	7.5	170	283	23	32
1428	4	7.4	180	348	57.8	42
1429	2	7.5	199	328	52.1	39
1430	2	7.4	79	258	18	28
1431	5	7.25	174 [(a)]	690	213	89
1432	5	7.6	174 [(a)]	540	101	73
1433	2	7.5	188 [(a)]	1050	336	224
1434	5	7.8	190	346	59	44.1
1501	17	7.35	173 [(a)]	512	290	60.9
1502	14	7.5	111 [(a)]	514	117	23
1601	10	7.57	50 [(a)]	452	92	27
1602	7	7.6	150	441	71	24
1603	6.9	7.6	50	265 [(b)]	58	43
1604	7.4	7.15	54.4	145 [(b)]	19	11
1605	5	7.55	146	480	81	17
1701	31	7.85	— [(g)]	5800	1305	220
1801	43	7.55	157	430	72	51
1802	41.8	7.7	200.6	327 [(h)]	65.2	52
1803	11.14	7.76	190.9	325	36	30

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
1804	5	7.58	199	296	20.4	24
1805	2.3	7.6	159	222	15	18
1806	3	7.8	196	286	18	13
1807	4.1	7.65	88	498	102	24
1808	8	7.7	214	330	25.9	27
1809	2	7.6	156 [(a)]	240	13	23
1810	12	7.5	202	783	172	88
1811	1	7.2	221	313	16	24
1812	2.1	7.78	178	249	15	18
1813	1	7.7	166	280	13	25
1814	2	7.4	226	359	19	22.4
1815	0.5	7.5	191	298	13	15
1816	3.1	7.9	156 [(a)]	314	23	10
1817	0.5	7.6	156 [(a)]	286	11	5
1818	0.55	7.8	188	318	10.8	5
1901	37	7.6	298	618	100	99
1902	11	7.6	248	680	114	175
1903	9	7.4	240	408	45	63
1904	2	7.6	212 [(a)]	256	14	44
1905	1.8	7.5	240	339	13	77
1906	6	7.2	248	490	65	69
1907	0.5	7.32	200 [(a)]	404	20	56
1908	1	7.38	150	288	18	26
1909	2	7.5	212 [(a)]	272	12	40
1910	4	7.17	204	372	45	52.9
1911	7	7.3	200	472	53.1	54
1912	13	7.9	228	422	63	63
1913	5	7.2	256	510	57.5	44
2001	14	7.6	170 [(a)]	3450	1240	96
2002	11	7.5	370	1220	570	42
2003	11	7.6	170 [(a)]	964	194	39.6
2004	10	7.6	252 [(a)]	910	289	60
2101	31	7.9	160 [(a)]	12150	2030	300

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
2102	7.5	7.8	166	617	134	54
2103	5	7.8	174 [(a)]	575	71	45
2104	8	7.6	134	505	115	50
2105	5	7.6	160 [(a)]	356	50	43
2106	14	7.6	152	436	130	70
2107	12	7.5	130	988	245	206
2108	10	7.46	187	850	242	300
2109	13	7.6	160 [(a)]	456	88	153
2110	2	7.2	232	586	112	40
2111	0.5	7.61	220	280	13	27
2112	1	7.5	160 [(a)]	244	16	15
2113	0.5	7.7	160 [(a)]	236	13	14
2114	0.5	7.8	160 [(a)]	244	12	34
2115	0.5	7.79	170	248	11.7	40
2116	4	7.3	174	1000	159	78
2117	6.5	7.6	184	800	280	125
2201	12	7.7	371 [(a)]	11500	4990	1232
2202	61	7.4	750	2950	900	820
2203	41	7.83	371 [(a)]	29100 [(f)]	13600 [(f)]	1240 [(f)]
2204	15	7.5	198	8770 [(f)]	3480 [(f)]	546 [(f)]
2301	23	7.7	250 [(a)]	3630	610	358
2302	6	7.61	260	778	150	260
2303	5	7.9	250 [(a)]	724	116	233
2304	5	7.8	250	680	119	220
2305	2	7.9	250 [(a)]	670	121	227
2306	51	7.5	250	1030	118	376
2307	83	7.3	373	1970	556	544
2308	20	7.5	266	908	178	263
2309	1	7.5	180	215	14	9
2310	3	7.8	640	2420	890	510
2311	5	7.6	2128	9652	4030	2360
2312	6	7.6	1839	5244	1983	1500
2313	5	7.6	250 [(a)]	300	18	23

Segment Number	TSS [1] (mg/L)	pH [1] (s.u.)	Total Hardness [1] (mg/L as $CaCO_3$)	TDS [2] (mg/L)	Chloride [2] (mg/L)	Sulfate [2] (mg/L)
2314	25	7.8	250	736	110	235
2411	11	7.2	1100 [(a)]	11700	7200	980
2412	8	6.8	1100 [(a)]	5780	3400	437
2421	10	7.8	755	12700	7843	1025
2422	9	7.8	137	5290	2730	374
2423	12	7.8	872	11000	7040	923
2424	12	7.86	3390	26400	13300	1812
2425	16	7.9	690	13598	6040	800
2426	16	7.6	908	14400	5970	815
2427	10	7.5	826	12650	5660	810
2428	20	7.8	1100 [(a)]	13200	6400	838
2429	10	7.4	1100 [(a)]	11960	5625	815
2430	10	7.4	1100 [(a)]	11740	4998	712
2431	13	7.9	1100 [(a)]	17250	8660	1225
2432	13	7.8	3563	18100	9630	1320
2433	10	7.8	1100 [(a)]	27717	13200	1860
2434	14	7.9	3800	26500	14300	1930
2435	29	7.8	1100 [(a)]	27830	14300	1910
2436	9	7.6	1100 [(a)]	14814	6570	900
2437	9	7.9	1780	24800	12300	1725
2438	9	7.7	2260	18193	7420	1048
2439	10	7.9	1320	18900	10397	1420
2441	26	7.9	1100 [(a)]	19000	10290	1380
2442	20	7.7	1100 [(a)]	22700	11800	1295
2451	12	7.9	1100 [(a)]	25800	13400	1840
2452	10	7.8	1100 [(a)]	23400	11543	1600
2453	12	7.8	1538	18400	9900	1300
2454	11	8.0	1700	20900	11600	1550
2455	11	8.0	1100 [(a)]	22500	11390	1500
2456	26	7.85	1100 [(a)]	5180	2690	400
2461	10	8.0	1100 [(a)]	23400	14300	1900
2462	16	7.95	1100 [(a)]	15100	7650	1070
2463	18	7.9	1100 [(a)]	21100	10400	1400

Segment Number	TSS[1] (mg/L)	pH[1] (s.u.)	Total Hardness[1] (mg/L as $CaCO_3$)	TDS[2] (mg/L)	Chloride[2] (mg/L)	Sulfate[2] (mg/L)
2471	10	7.9	1100 [(a)]	28700	14000	1960
2472	16	7.9	1100 [(a)]	18400	7260	961
2473	16	7.9	1100 [(a)]	21400	10200	1400
2481	11	7.9	4940	35100	16756	2320
2482	19	7.9	1100 [(a)]	32100	15700	2130
2483	11	7.9	1100 [(a)]	30300	15600	2219
2484	11	7.8	5000	35200	16600	2310
2485	34	7.9	1100 [(a)]	42500	17430	2440
2491	13	7.9	1100 [(a)]	35400	18100	2611
2492	19	7.86	1100 [(a)]	39900	21000	3030
2493	16	7.8	1100 [(a)]	34900	18734	2610
2494	13	7.9	1100 [(a)]	35200	17600	2500
2501	10	7.5	1100 [(a)]	29242	15600	2230

1 Values are the (lower) 15th percentile and should be used in place of the basin values found in Table 2 of the TSWQS.

2 Values are the 50th percentile.

(a) Basin-specific value; insufficient segment data available.

(b) Insufficient segment TDS data available; calculated as (0.65) × (50th percentile conductivity for segment).

(c) Data from Segments 0220 and 0230 combined.

(d) Data from Segment 0610.

(e) Data from Segments 1256 and 1257 combined.

(f) Period of record limited to five years (1995-1999) to reflect changes in the watershed.

(g) No data available.

(h) Data from Segments 1802 and 1803 combined.

Table 6. Background Concentrations of Toxic Metals in Texas Estuaries[1]

Segment Number	Water Body	Total Copper[2] (µg/L)	Total Lead[2] (µg/L)	Total Silver[2] (µg/L)	Total Zinc[2] (µg/L)
1401	Colorado Estuary	0.99	0.27	0.003	1.76
2412	Sabine Estuary	1.00	0.19	0.004	1.20
2421	Galveston Estuary	0.75	0.21	0.004	1.90
2439	Galveston Estuary	0.75	0.21	0.004	1.90
2451	Lavaca-Matagorda Estuary	0.57	0.12	0.002	1.25
2453	Lavaca-Matagorda Estuary	0.57	0.12	0.002	1.25
2462	San Antonio Estuary	1.23	0.20	0.003	2.18
2481	Corpus Christi Estuary	0.70	0.14	0.003	4.04

1 Background concentrations represent the geometric mean of the data set.

2 Data compiled from Benoit, G. and P. H. Santschi, 1991; *Trace Metals in Texas Estuaries*; Prepared for the Texas Chemical Council; Texas A&M University at Galveston, Department of Marine Science.

Table 7. Slope and Intercept Values Used to Calculate Partition Coefficients for Metals in Streams, Lakes, and Estuarine Systems

METAL	STREAMS [1]		LAKES [1]		ESTUARINE SYSTEMS [2]	
	Intercept (b)	Slope (m)	Intercept (b)	Slope (m)	Intercept (b)	Slope (m)
Arsenic	5.68	-0.73	Assumed equal to streams		—	—
Cadmium	6.60	-1.13	6.55	-0.92	—	—
Chromium	6.52	-0.93	6.34	-0.27	—	—
Copper	6.02	-0.74	6.45	-0.90	4.85	-0.72
Lead	6.45	-0.80	6.31	-0.53	6.06	-0.85
Mercury	6.46	-1.14	6.29	-1.17	—	—
Nickel	5.69	-0.57	6.34	-0.76	—	—
Silver [3]	6.38	-1.03	Assumed equal to streams		5.86	-0.74
Zinc	6.10	-0.70	6.52	-0.68	5.36	-0.52

$$K_p = 10^b \times TSS^m$$

$$\frac{C_d}{C_T} = \frac{1}{1 + (K_p \times TSS \times 10^{-6})}$$

where:

K_p = partition coefficient (L/kg)

TSS = total suspended solids (mg/L)

b = intercept (from Table 7)

m = slope (from table 7)

C_d/C_T = fraction of metal dissolved

Example: Assume TSS = 15 mg/L in a river. Find K_p and C_d/C_T for Nickel.

$$K_p = 10^{5.69} \times 15^{-0.57} = 0.49 \times 10^6 \times 15^{-0.57} = 0.10467 \times 10^6$$

$$\frac{C_d}{C_T} = \frac{1}{1 + (0.10467 \times 10^6 \times 15 \times 10^{-6})} = 0.389$$

[1] Attachment I in *Technical Guidance Manual for Performing Waste Load Allocations. Book II: Streams and Rivers. Chapter 3: Toxic Substances*, EPA-440/4-84-022, June 1984.

[2] Benoit, G., S.D. Oktay-Marshall, A. Cantu II, E.M. Hood, C.H. Coleman, M.O. Corapcioglu, and P.H. Santschi.1994. Partitioning of Cu, Pb, Ag, Zn, Fe, Al, and Mn Between Filter-Retaining Particles, Colloids, and Solution in Six Texas Estuaries. *Marine Chemistry*, 45:307-336.

[3] Wen, L., P.H. Santschi, G.A. Gill, C.L. Paternostro, and R.D. Lehman. 1997. Colloidal and Particulate Silver in River and Estuarine Waters of Texas. *Environmental Science & Technology*, 31:723-731.

Table 8. Minimum Analytical Levels for Permit Application Screening

Pollutant	CASRN[1]	MAL (µg/L)	Screening Level[2] (µg/L)	Suggested Method
Acrylonitrile	107-13-1	50		624
Aldrin	309-00-2	0.05		608
Aluminum[3]	7429-90-5	30		202.2
Antimony[3, 4]	7440-36-0	60		200.7
Arsenic[3]	7440-38-2	10		206.2
Barium[3]	7440-39-3	10		208.2
Benzene	71-43-2	10		624
Benzidine	92-87-5	50		625
Benzo(a)anthracene	56-55-3	10		625
Benzo(a)pyrene	50-32-8	10		625
Beryllium[3]	7440-41-7	5		200.7
Bis(chloromethyl) ether[5]	542-88-1	—[5]		—[5]
Boron	7440-42-8	20	100	200.7
Bromide	—	2000		320.1
Cadmium[3, 4]	7440-43-9	1		213.2
Carbaryl	63-25-2	5		632
Carbon Tetrachloride	56-23-5	10		624
Chlordane	57-74-9	0.15		608
Chlorobenzene	108-90-7	10		624
Chloroform	67-66-3	10		624
Chloropyrifos	2921-88-2	0.05		1657
Chromium, Total Recoverable[3]	7440-47-3	10		218.2
Chromium, Hexavalent	18540-29-9	10		218.4
Chromium, Trivalent[6]	16065-83-1	—[6]		—[6]
Chrysene	218-01-9	10		625
Cobalt[3]	7440-48-4	5	1500	219.2
Copper[3, 4]	7440-50-8	10		220.2
p-Chloro-m-Cresol (4 chloro-3-methylphenol)	108-39-4	10		625
4,6-Dinitro-o-Cresol (2-methyl-4,6-dinitrophenol)	95-48-7	50		625
p-Cresol (4-Methylphenol)	106-44-5	10		625
Cyanide, Total	57-12-5	20		335.2

Pollutant	**CASRN [1]**	**MAL (µg/L)**	**Screening Level [2] (µg/L)**	**Suggested Method**
Cyanide, Amenable to Chlorination	57-12-5	20		335.1
Cyanide, Weak Acid Dissociable	57-12-5	20		4500-CN I.
4,4' - DDD	72-54-8	0.1		608
4,4' - DDE	72-55-9	0.1		608
4,4' - DDT	50-29-3	0.1		608
2,4 - D	94-75-7	10		615
Danitol [7]	39515-41-8	— [7]		— [7]
Demeton	8065-48-3	0.20		1657
Diazinon	333-41-5	0.5		1657
Dibromochloromethane	124-48-1	10		624
1,2 - Dibromoethane	106-93-4	2		618
p - Dichlorobenzene	106-46-7	10		625
1,2 - Dichloroethane	107-06-2	10		624
1,1 - Dichloroethylene	75-35-4	10		624
1,3 - Dichloropropene	542-75-6	10		624
Dicofol	115-32-2	20		617
Dieldrin	60-57-1	0.1		608
Dioxins/Furans (TCDD Equivalents) 2,3,7,8-TCDD 1,2,3,7,8-PeCDD 2,3,7,8-HxCDDs 1,2,3,4,7,8-HxCDD 1,2,3,6,7,8-HxCDD 1,2,3,7,8,9-HxCDD 2,3,7,8-TCDF 1,2,3,7,8-PeCDF 2,3,4,7,8-PeCDF 2,3,7,8-HxCDFs 1,2,3,4,7,8-HxCDF 1,2,3,6,7,8-HxCDF 1,2,3,7,8,9-HxCDF 2,3,4,6,7,8-HxCDF	 1746-01-6 40321-76-4 39227-28-6 57653-85-7 19408-74-3 51207-31-9 57117-41-6 57117-31-4 70648-26-9 57117-44-9 72918-21-9 60851-34-5	(ppq) 10 50 50 50 50 10 50 50 50 50 50 50		1613
Diuron	330-54-1	0.090		632
Endosulfan I (alpha)	959-98-8	0.1		608
Endosulfan II (beta)	33213-65-9	0.1		608
Endosulfan sulfate	1031-07-8	0.1		608
Endrin	72-20-8	0.1		608
Fluoride	16984-48-8	500		340.3
Guthion	86-50-0	0.1		1657

Pollutant	**CASRN** [1]	**MAL (µg/L)**	**Screening Level** [2] **(µg/L)**	**Suggested Method**
Heptachlor	76-44-8	0.05		608
Heptachlor Epoxide	1024-57-3	1.0		608
Hexachlorobenzene	118-74-1	10		625
Hexachlorobutadiene	87-68-3	10		625
alpha-Hexachlorocyclohexane	319-84-6	0.05		608
beta-Hexachlorocyclohexane	319-85-7	0.05		608
gamma-Hexachlorocyclohexane (Lindane)	58-89-9	0.05		608
Hexachloroethane	67-72-1	20		625
Hexachlorophene	70-30-4	10		604.1
Iron	7439-89-6	5	300	236.2
Lead [3, 4]	7439-92-1	5.0		239.2
Malathion	121-75-5	0.1		1657
Manganese [3]	7439-96-5	2	50	243.2
Mercury [3, 8]	7439-97-6	0.2		245.1
		0.0005		1631
Methoxychlor	72-43-5	2.0		617
Methyl Ethyl Ketone	78-93-3	50		624
Mirex	2385-85-5	0.2		617
Molybdenum [3]	7439-98-7	5	500	246.2
Nickel [3, 4]	7440-02-0	10		249.2
Nitrate-Nitrogen	14797-55-8	1000		352.1
Nitrobenzene	98-95-3	10		625
N-Nitrosodiethylamine	55-18-5	20		625
N-Nitroso-di-*n*-Butylamine	924-16-3	20		625
Parathion (ethyl)	56-38-2	0.1		1657
Pentachlorobenzene	608-93-5	20		625
Pentachlorophenol	87-86-5	50		625
Phenanthrene	85-01-8	10		625
Polychlorinated Biphenyls (PCBs) PCB-1016 PCB-1221 PCB-1232 PCB-1242 PCB-1248 PCB-1254 PCB-1260	1336-36-3 12674-11-2 11104-28-2 11141-16-5 53469-21-9 12672-29-6 11097-69-1 11096-82-5	 1.0 1.0 1.0 1.0 1.0 1.0 1.0		608

Pollutant	CASRN [1]	MAL (μg/L)	Screening Level [2] (μg/L)	Suggested Method
Pyridine	110-86-1	20		625
Selenium [3, 4]	7782-49-2	10.0		270.2
Silver [3, 4]	7440-22-4	2.0		272.2
1,2,4,5 - Tetrachlorobenzene	95-94-3	20		625
Tetrachloroethylene	127-18-4	10		624
Thallium [3, 4]	7440-28-0	10		279.2
Tin	7440-31-5	20		282.2
Titanium	7440-32-6	30	40	283.2
Toxaphene	8001-35-2	5.0		608
2,4,5 - TP (Silvex)	93-72-1	2.0		615
Tributyltin (TBT)	688-73-3	0.010		TNRCC 1001
1,1,1 - Trichloroethane	71-55-6	10		624
Trichloroethylene	79-01-6	10		624
2,4,5 - Trichlorophenol	95-95-4	50		625
TTHM (Total Trihalomethanes) bromodichloromethane dibromochloromethane tribromomethane (bromoform) trichloromethane (chloroform)	 75-27-4 124-48-1 75-25-2 67-66-3	 10 10 10 10		624
Vinyl Chloride	75-01-4	10		624
Zinc [3, 4]	7440-66-6	5.0		289.2

[1] Chemical Abstracts Service Registry Number.

[2] Screening levels are noted for toxic pollutants that (1) do not have numerical criteria in the TSWQS and (2) are of potential concern only at concentrations substantially higher than the MAL.

[3] EPA Method 200.8 may also be used upon request. Such a request should be made in writing to EPA's Houston Laboratory, 10625 Fallstone Road, Houston, Texas, 77099-4303. Once Method 200.8 is approved for use in the NPDES program, no written request will be necessary.

[4] EPA Method 1638 may also be used once it is approved for use in the NPDES program.

[5] Hydrolyzes in water. Will not require applicant to analyze at this time.

[6] Trivalent chromium (Cr) determined by subtracting hexavalent Cr from total Cr.

[7] EPA procedure not approved. Will not require applicant to analyze at this time.

[8] Either method listed for mercury may be used.

Table 9. Analytical Methods for the Determination of Pollutants Regulated by 30 TAC §307.6

Pollutant	Suggested Method	MAL (µg/L)	MDL (µg/L)	MAL Source Documentation
Acrylonitrile	624	50	50	MAL based on the minimum quantitation level (MQL) developed by EPA, Region 6, July 1992. MAL is equal to the minimum level at which the analytical system shall give acceptable calibration points documented in 40 CFR Part 136, Method 1624.
Aldrin	608	0.05	0.004	MAL is approximately ten times the detection limit documented in 40 CFR Part 136, Method 608.
Aluminum [1]	202.2	30	7.8	MAL is approximately four times the detection limit for EPA, Method 200.9 [2].
Arsenic [1]	206.2	10	0.5	MAL is twenty times the detection limit documented in EPA, Method 200.9 [2] and corresponds to the MQL developed by EPA Region 6, July 1992.
Barium [1]	208.2	10	2	MAL is the lowest concentration of the optimum working range given for EPA, Method 208.2 [3].
Benzene	624	10	4.4	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 624.
Benzidine	625	50	44	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 625.
Benzo(a)anthracene	625	10	7.8	MAL based on the MQL developed by EPA, Region 6. July 1992. The MDL is documented in 40 CFR Part 136, Method 625.
Benzo(a)pyrene	625	10	2.5	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 625.
Bis(chloromethyl) ether	— [4]	— [4]	— [4]	Analytical method undetermined.
Cadmium [1, 5]	213.2	1	0.05	MAL is twenty times the detection limit given for EPA, Method 200.9 [2] and corresponds to the MQL developed by EPA Region 6, July 1992.
Carbaryl	632	5.0	0.02	MAL is based on laboratory consensus taken October 1992. MDL is given by EPA, Method 632 [6].
Carbon Tetrachloride	624	10	2.8	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 624.

Pollutant	Suggested Method	MAL (µg/L)	MDL (µg/L)	MAL Source Documentation
Chlordane	608	0.15	0.014	MAL is approximately ten times the detection limit documented in 40 CFR Part 136, Method 608.
Chlorobenzene	624	10	6	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 624.
Chloroform	624	10	1.6	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 624.
Chloropyrifos	1657	0.05	0.004	MAL is approximately ten times the detection limit given by EPA, Method 1657[6].
Chromium, Total Recoverable[1] (Dissolved)	218.2	10.0	0.1	MAL is based on the contract required detection limit (CRDL) published in the EPA Contract Laboratory Program Statement of Work, Doc. No. ILMO2.0, Method 218.2. MDL based on EPA, Method 200.9[2].
Chromium, Hexavalent	218.4	10	1	MAL is ten times the detection limit given by EPA, Method 218.4[3].
Chromium, Trivalent	See documen-tation note.	—	—	Trivalent chromium is determined by subtracting the concentration of hexavalent chromium (dissolved) from the dissolved total chromium concentration.
Chrysene	625	10	2.5	MAL based on the MQL developed by EPA, Region 6, July, 1992. The MDL is documented in 40 CFR Part 136, Method 625.
Copper[1, 5]	220.2	10	0.7	MAL is approximately ten times the detection limit given by EPA, Method 200.9[2].
p-Chloro-m-Cresol (4 chloro-3-methylphenol)	625	10	3	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 625.
4,6-Dinitro-o-Cresol (2-methyl-4,6-dinitrophenol)	625	50	24	MAL based on the MQL Developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 625.
p-Cresol (4-Methylphenol)	625	10	—[4]	MAL based on the contract required quantitation levels (CRQLs) for water from EPA, Region 6, Target Compound List acquired January 14, 1993.

Pollutant	Suggested Method	MAL (µg/L)	MDL (µg/L)	MAL Source Documentation
Cyanide, Total	335.2	20	—[4]	MAL is based on the lowest standard concentration within the applicable range set in EPA, Method 335.2[3]. The CRDL is 10 µg/L published in the EPA Contract Laboratory Program Statement of Work, Document Number ILMO2.0 using Method 239.2.
Cyanide, Amenable to Chlorination	335.1	20	—[4]	Both chlorinated and unchlorinated cyanide sample concentrations are determined using EPA, Method 335.2[3].
Cyanide, Weak Acid Dissociable	4500-CN I.	20	1.4	MAL based on the MDL developed by the TNRCC Laboratory on 12/09/94.
4,4' - DDD	608	0.1	0.011	MAL is approximately ten times the detection limit documented in 40 CFR Part 136, Method 608.
4,4' - DDE	608	0.1	0.004	MAL based on the MQL Developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 608.
4,4' - DDT	608	0.1	0.012	MAL is approximately ten times the detection limit documented in 40 CFR Part 136, Method 608.
2,4 - D	615	10	1.2	MAL is approximately ten times the detection limit given by EPA, Method 615[6].
Danitol	Method under develop-ment	—[4]	—[4]	Method, MAL and MDL developed by the Texas Natural Resource Conservation Commission Laboratory. May be reviewed by EPA, Region 6 for use in Texas.
Demeton	1657	0.20	0.020	MAL is ten times the detection limit given by EPA, Method 1657[6].
Diazinon	1657	0.5	0.038	MAL is approximately ten times the detection limit given by EPA, Method 1657[6].
Dibromochloromethane	624	10	3.1	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 624.
1,2 - Dibromoethane	618	2	0.2	MAL is ten times the detection limit given in EPA, Method 618[6].
p - Dichlorobenzene	625	10	4.4	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 625.
1,2 - Dichloroethane	624	10	2.8	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 624.

Pollutant	Suggested Method	MAL (μg/L)	MDL (μg/L)	MAL Source Documentation
1,1 - Dichloroethylene	624	10	2.8	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 624.
1,3 - Dichloropropene	624	10	5.0	MAL based on the MQL developed by EPA, Region 6, July, 1992. The MDL is documented in 40 CFR Part 136, Method 624 for cis-1,3-Dichloropropene.
Dicofol	617	20	—[4]	MAL based on laboratory consensus taken October 1992 and Method 617[6].
Dieldrin	608	0.1	0.002	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 608.
Dioxins/Furans (TCDD Equivalents) 2,3,7,8-TCDD 1,2,3,7,8-PeCDD 2,3,7,8-HxCDDs 1,2,3,4,7,8-HxCDD 1,2,3,6,7,8-HxCDD 1,2,3,7,8,9-HxCDD 2,3,7,8-TCDF 1,2,3,7,8-PeCDF 2,3,4,7,8-PeCDF 2,3,7,8-HxCDFs 1,2,3,4,7,8-HxCDF 1,2,3,6,7,8-HxCDF 1,2,3,7,8,9-HxCDF 2,3,4,6,7,8-HxCDF	1613	(ppq) 10 50 50 50 50 10 50 50 50 50 50 50	(ppq) 10	MAL based on the MQL developed by the Dioxin National Strategy as reported by EPA, Region 6, July 1992 Minimum Quantification Report and the minimum levels at which the analytical system will give acceptable selected ion current profile and calibration as published in EPA, Method 1613.
Diuron	632	0.090	0.009	MAL is approximately ten times the detection limit given by EPA, Method 632[6].
Endosulfan I (alpha)	608	0.1	0.014	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 608.
Endosulfan II (beta)	608	0.1	0.004	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 608.
Endosulfan sulfate	608	0.1	0.066	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 608.
Endrin	608	0.1	0.006	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 608.

Pollutant	Suggested Method	MAL (µg/L)	MDL (µg/L)	MAL Source Documentation
Fluoride	340.3	500	50	MAL is ten times the lowest concentration of the applicable working range given by EPA, Method 340.3 [3].
Guthion	1657	0.1	0.009	MAL is approximately ten times the detection limit given by EPA, Method 1657 [6].
Heptachlor	608	0.05	0.003	MAL is approximately ten times the detection limit documented in 40 CFR Part 136, Method 608.
Heptachlor Epoxide	608	1.0	0.083	MAL is approximately ten times the detection limit documented in 40 CFR Part 136, Method 608.
Hexachlorobenzene	625	10	1.9	MAL based on the MQL developed by EPA, Region 6, July, 1992. The MDL is documented in 40 CFR Part 136, Method 625.
Hexachlorobutadiene	625	10	0.9	MAL is approximately ten times the detection limit documented in 40 CFR Part 136, Method 625 and corresponds to the MQL developed by EPA, Region 6, July, 1992.
alpha-Hexachlorocyclohexane	608	0.05	0.003	MAL is approximately ten times the detection limit documented in 40 CFR Part 136, Method 608.
beta-Hexachlorocyclohexane	608	0.05	0.006	MAL is approximately ten times the detection limit documented in 40 CFR Part 136, Method 608.
gamma-Hexachlorocyclohexane (Lindane)	608	0.05	0.004	MAL is approximately ten times the detection limit documented in 40 CFR Part 136, Method 608.
Hexachloroethane	625	20	1.6	MAL based on the MQL developed by EPA, Region 6, July, 1992. The MDL is documented in 40 CFR Part 136, Method 625.
Hexachlorophene	604.1	10	1.2	MAL is approximately ten times the detection limit given in EPA, Method 604.1 [6].
Lead [1, 5]	239.2	5.0	0.7	MAL is based on the MQL developed by EPA, Region 6, July, 1992 and is greater than the CRDL of 3 µg/L published in the EPA Contract Laboratory Program Statement of Work, Doc. Number ILMO2.0 using Method 239.2. MDL based on EPA, Method 200.9 [2].
Malathion	1657	0.1	0.011	MAL is approximately ten times the detection limit given in EPA, Method 1657 [6].

Pollutant	Suggested Method	MAL (µg/L)	MDL (µg/L)	MAL Source Documentation
Mercury [1, 7]	245.1	0.2	— [4]	MAL is based on the CRDL published in the EPA Contract Laboratory Program Statement of Work, Document Number ILMO2.0 using Method 245.1 and corresponds with the MQL developed by EPA, Region 6, July 1992.
	1631	0.0005	0.0002	MAL is based on the minimum level published in Method 1631, Revision B [8].
Methoxychlor	617	2.0	0.176	MAL is approximately ten times the detection limit given in EPA, Method 617 [6].
Methyl Ethyl Ketone	624	50	50	MAL is the minimum level at which the analytical system shall give acceptable calibration points documented in 40 CFR 136, Method 1624. MAL is five times the CRQL for water analysis using Method 624 from the EPA, Region 6, Target Compound List acquired January 14, 1993.
Mirex	617	0.2	0.015	MAL is approximately ten times the detection limit given in EPA, Method 617 [6].
Nickel [1, 5]	249.2	10	0.6	MAL is approximately ten times the detection limit given for EPA, Method 200.9 [2].
Nitrate-Nitrogen	352.1	1000	100	MAL is ten times the lowest concentration of the applicable range given by EPA 1979, Method 352.1 [3].
Nitrobenzene	625	10	1.9	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 625.
N-Nitrosodiethylamine	625	20	5	Method, MAL and MDL based on laboratory consensus taken October 1992.
N-Nitroso-di-*n*-Butylamine	625	20	5	Method, MAL and MDL based on laboratory consensus taken October 1992.
Parathion (ethyl)	1657	0.1	0.010	MAL is ten times the detection limit given in EPA Method 1657 [6].
Pentachlorobenzene	625	20	5	Method, MAL and MDL based on laboratory consensus taken October 1992.
Pentachlorophenol	625	50	3.6	MAL based on the MQL developed by EPA, Region 6, July 1992. MAL is based on the CRQL for water analysis using Method 625 from the EPA, Region 6, Target Compound List acquired January 14, 1993.

Pollutant	**Suggested Method**	**MAL (µg/L)**	**MDL (µg/L)**	**MAL Source Documentation**
Phenanthrene	625	10	5.4	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 625.
Polychlorinated Biphenyls (PCBs) PCB-1232 PCB-1242 PCB-1254 PCB-1221 PCB-1248 PCB-1260 PCB-1016	608	 1.0 1.0 1.0 1.0 1.0 1.0 1.0	 ND[4] 0.065 ND[4] ND[4] ND[4] ND[4] ND[4]	MAL based on the MQLs developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 608.
Pyridine	625	20	5	Method, MAL and MDL based on laboratory consensus taken October 1992.
Selenium [1, 5]	270.2	10.0	2.0	MAL is five times the detection limit for Method 270.2.
Silver [1, 5]	272.2	2.0	0.5	MAL is based on the MQL developed by EPA Region 6, July 1992. MDL based on EPA, Method 200.9 [2].
1,2,4,5 - Tetrachlorobenzene	625	20	5	Method, MAL and MDL based on laboratory consensus taken October, 1992.
Tetrachloroethylene	624	10	4.1	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 624.
Toxaphene	608	5.0	0.24	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 608.
2,4,5 - TP (Silvex)	615	2.0	0.17	MAL is approximately ten times the detection limit given by EPA Method 615 [6].
Tributyltin (TBT)	TNRCC 1001	0.010	3.2×10^{-6}	Method is entitled "Measurement of Butyltin Species in Water by n-Pentyl Derivatization with Gas Chromatography/Flame Photometric Detection (GC/FPD) and Gas Chromatography/Mass Spectrometry (GC/MS)." MAL is equal to EPA tributyltin advisory level.
1,1,1 - Trichloroethane	624	10	3.8	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 624.
Trichloroethylene	624	10	1.9	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is documented in 40 CFR Part 136, Method 624.

Pollutant	Suggested Method	MAL (μg/L)	MDL (μg/L)	MAL Source Documentation
2,4,5 - Trichlorophenol	625	50	10	MAL is five times the minimum level at which the analytical system shall give acceptable calibration points documented in 40 CFR Part 136, Method 1625. MAL is based on the CRQL for water analysis using Method 625 from the EPA, Region 6, Target Compound List acquired January 14, 1993.
TTHM (Total Trihalomethanes) bromodichloromethane dibromochloromethane tribromomethane (bromoform) trichloromethane (chloroform)	624	 10 10 10 10	 2.2 3.1 4.7 1.6	MAL is based on the CRQL for water analysis using Method 624 from the EPA, Region 6, Target Compound List acquired January 14, 1993. Method detection limits are documented in 40 CFR Part 136, Method 624.
Vinyl Chloride	624	10	—[4]	MAL based on the MQL developed by EPA, Region 6, July 1992. The MDL is given as "nd" in 40 CFR Part 136, Method 624.
Zinc[1, 5]	289.2	5.0	0.3	MAL is approximately ten times the detection limit given by EPA, Method 200.9[2].

1 EPA Method 200.8 may also be used upon request. Such a request should be made in writing to EPA's Houston Laboratory, 10625 Fallstone Road, Houston, Texas, 77099-4303. Once Method 200.8 is approved for use in the NPDES program, no written request will be necessary. *Method 200.8. Determination of Trace Elements in Waters and Wastes by Inductively Coupled-Plasma - Mass Spectrometry*, U.S. Environmental Protection Agency, EPA 600-R-94-111, May 1994.

2 *Methods for the Determination of Metals in Environmental Samples*, U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory-Cincinnati, EPA-600/4-91-010, June 1991. Method 200.9 contains accuracy and precision data generated using graphite furnace atomic absorbance spectrophotometer techniques for the following metals: aluminum, arsenic, cadmium, chromium, copper, lead, nickel, selenium, silver and zinc. This accuracy and precision data supports the working ranges and detection limits for each corresponding method found in 40 CFR Part 136.

3 *Methods for the Chemical Analysis of Water and Wastes*, U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory-Cincinnati (EMSL-Cl), EPA-600/4-79-020, Revised March 1983 and 1979 where applicable.

4 Not determined.

5 EPA Method 1638 may also be used once it is approved for use in the NPDES program. *Method 1638. Determination of Trace Elements in Ambient Waters by Inductively Coupled Plasma-mass Spectrometry*, U.S. Environmental Protection Agency, Office of Water, EPA 821-R-96-005, January 1996.

6 *EPA Methods for the Determination of Nonconventional Pesticides in Municipal and Industrial Wastewater*, U.S. Environmental Protection Agency, EPA-821-R-93-010-A & B, August 1993.

7 Either method listed for mercury may be used.

8 *Method 1631, Revision B. Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry*, U.S. Environmental Protection Agency, Office of Water, EPA 821-R-99-005, May 1999.

Appendix D. Modeling Memorandum of Agreement (MOA) between the TNRCC and the EPA

Memorandum of Agreement
between the
Texas Natural Resource Conservation Commission
and the
Environmental Protection Agency - Region 6

for

Application of Uncalibrated Water Quality Modeling

for

Texas Freshwater Streams

The purpose of this Memorandum of Agreement (MOA) is to streamline the processes associated with the review and approval of individual permit waste load allocations (WLAs), water quality management plans (WQMPs), and Texas Pollutant Discharge Elimination System (TPDES) permits while assuring technical acceptability and consistency with the Clean Water Act (CWA).

The Environmental Protection Agency (EPA), Region 6, Water Quality Protection Division and the Texas Natural Resource Conservation Commission (TNRCC), Office of Permitting, Remediation & Registration agree to the following provisions:

1. WLAs for facilities included in a WQMP update with discharge flows less than or equal to 0.2 million gallons per day (MGD), which are developed using uncalibrated QUAL-TX modeling, where appropriate, with the reaction rates outlined below in Number 2, will be considered technically acceptable without EPA Region 6 review. The EPA Region 6 may review these WLAs during the semi-annual evaluations for the Section 106 State Water Pollution Control Program Grant.

2. The TNRCC will use the following reaction rates (expressed at 20º C) when performing uncalibrated QUAL-TX modeling in freshwater streams:

   a. CBOD decay rate: K_d = 0.10/day; and
      CBOD settling rate: Ks = 0.0 m/day

   b. Ammonia-Nitrogen oxidation rate: K_n = 0.30/day

   c. Sediment Oxygen Demand: SOD = 0.35 g/m^2/day

   d. Reaeration Rate: K_2 will be calculated from equations contained in "Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling (Second Edition) June 1985, EPA/600/3-85/040." The equation(s) will be chosen consistent with the hydraulic character of the stream and the following minimum and maximum constraints will apply; $0.6/\text{depth(m)} \leq K_2 \leq 10/\text{day}$.

3. The level of algae specified in the model will be set to zero except in cases where site-specific measurements demonstrate appropriate minimum levels.

4. This agreement does not apply to WLAs for dischargers in the following segments: 1001, 1005, 1006, 1007, 2426, 2427, 2428, 2429, 2430 and 2436.

5. Treatment limits developed from calibrated models and those contained in approved Waste Load Evaluations and Total Daily Maximum Load (TMDL) reports or implementation plans will supersede those derived from this methodology.

6. All remaining WLAs (>0.2 MGD) will be submitted for EPA technical review and approval. The EPA will provide a response to these submittals to the TNRCC within 30 days of receipt of modeling documentation. If a response is not received within 30 days, the WLA will be considered approved as submitted and TPDES permits can be issued without a formal approval on these WLAs from the EPA.

7. The EPA Region 6 will approve WQMP updates for WLAs prepared in accordance with this MOA after the WQMP updates have undergone public participation in accordance with 40 Code of Federal Regulations 25 and are certified by the TNRCC.

8. This MOA may be revised upon mutual consent of the TNRCC and the EPA.

9. The provisions of this MOA will apply to all domestic TPDES applications that are administratively complete on or after the effective date of the "*Procedures to Implement the Texas Surface Water Quality Standards*" which incorporates these modeling parameters. Prior to this date, the EPA will conditionally or fully approve WLAs submitted that were developed with the existing TNRCC Streeter-Phelps modeling protocols unless pollutants in the effluent from those facilities could cause or contribute to pollutants of concern on 303(d) listed streams.

We agree with the provisions outlined in this MOA and commit our agency to implement them in a spirit of cooperation and mutual support.

Sam Becker, Acting Director
Water Quality Protection Division
Environmental Protection Agency, Region 6

4/04/01
Date

Leigh Ing, Deputy Director
Office of Permitting, Remediation & Registration
Texas Natural Resource Conservation Commission

3/22/01
Date