



National Whole Effluent Toxicity (WET) Implementation Guidance Under the NPDES Program

DRAFT

November 2004

Notice and Disclaimer

This Whole Effluent Toxicity (WET) Implementation Guidance provides recommendations for implementing National Pollutant Discharge Elimination System (NPDES) WET programs in a manner consistent with existing U.S. Environmental Protection Agency (EPA) guidance and regulations and advances in water quality management under the Clean Water Act. This guidance applies to all NPDES permitting authorities—Federal, State, or Tribal. This document has been developed to promote national consistency in WET implementation programs to the extent practical, and to ensure that the information and requirements for WET in all NPDES permits are clear, well documented, and provide for protection against impacts to aquatic life consistent with State and Tribal water quality standards. This document does not substitute for the Clean Water Act, a NPDES permit, or EPA, State, or Tribal regulations applicable to permits or WET testing; nor is this document a permit or a regulation itself. This document does not and cannot impose any legally binding requirements on EPA, States, Tribes, or NPDES permittees. EPA, State, and Tribal officials retain discretion to adopt approaches on a case-by-case basis that differ from this guidance based on an analysis of site-specific circumstances. This guidance may be revised without public notice to reflect changes in EPA policy.

Acknowledgments

This guidance was prepared through the cooperative efforts of the U.S. Environmental Protection Agency's (EPA) Office of Water and other EPA offices: Office of Wastewater Management, Office of Science and Technology, Office of General Counsel, Office of Enforcement and Compliance Assurance, representatives from EPA Regions and the Office of Research and Development. An EPA Whole Effluent Toxicity (WET) Implementation Workgroup was established with representatives from each of the above offices who reviewed the document during its development. The contributions of all EPA WET Workgroup members, as well as the comments received from EPA's 10 Regions, were instrumental in producing this document. The primary authors and contributors to the development of this document are listed below.

Primary Authors and Contributors

Headquarters

| | |
|--------------------|---|
| Fox, John | Office of Research and Development – National Center for Environmental Assessment |
| Gardner, Thomas | Office of Science and Technology – Standards and Health Protection Division |
| Greenwald, Kathryn | Office of Enforcement and Compliance Assurance, Office of Regulatory Enforcement – Water Enforcement Division |
| Kelly, Marion | Office of Science and Technology – Engineering and Analysis Division |
| Kopylev, Leonid | Office of Science and Technology – Engineering and Analysis Division |
| Phillips, Laura | Office of Wastewater Management – Water Permits Division |
| Swietlik, William | Office of Science and Technology – Health Effects Criteria Division |
| Zobrist, Marcus | Office of Wastewater Management – Water Permits Division |

Regional Offices

| | |
|-------------------|--|
| Hyatt, Marshall | Region 4 – Water Management Division; Permits, Grants, and Technical Assistance Branch |
| Pfeifer, David | Region 5 – Water Division, Water Quality Branch |
| Jennings, Phillip | Region 6 – Water Quality Protection Division, NPDES Permits Branch |
| Denton, Debra | Region 9 – Water Division, Monitoring and Assessment Office |
| Stuber, Robyn | Region 9 – Water Division, Clean Water Act Standards and Permit Office |

Contents

| | <i>page</i> |
|--|-------------|
| Notice and Disclaimer | iii |
| Acknowledgments | v |
| Tables and Figures | ix |
| Executive Summary | xi |
| Acronyms and Abbreviations | xv |
| Glossary | xvii |
| 1 INTRODUCTION | 1 |
| 1.1 BACKGROUND | 1 |
| 1.2 PURPOSE OF THIS GUIDANCE | 2 |
| 1.3 WHAT’S NEW IN THIS GUIDANCE | 3 |
| 1.4 WHO SHOULD USE THIS DOCUMENT | 5 |
| 1.5 DOCUMENT ORGANIZATION | 5 |
| 2 SETTING APPROPRIATE WATER QUALITY GOALS FOR WET | 7 |
| 2.1 EPA’S RECOMMENDED WATER QUALITY CRITERIA FOR WET | 7 |
| 2.1.1 Mixing Zones | 8 |
| 2.2 DESIGNATED USES | 9 |
| 3 STATE IMPLEMENTATION PROCEDURES TO ENSURE WET CRITERIA ARE MET | 11 |
| 3.1 GENERAL RECOMMENDATIONS | 11 |
| 3.1.1 Recommendations for NPDES States | 11 |
| 3.1.2 Recommendations for EPA Regions | 12 |
| 3.2 EPA/NPDES-AUTHORIZED PROGRAM OVERSIGHT | 13 |
| 4 DETERMINING THE NEED FOR WET LIMITS IN NPDES PERMITS | 14 |
| 4.1 DETERMINING THE NEED FOR PERMIT LIMITS <i>WITH</i> EFFLUENT MONITORING DATA | 15 |
| 4.1.1 Characterizing Effluent Quality with Respect to WET | 15 |
| 4.1.2 Determining Validity of WET Data | 15 |
| 4.1.3 WET Data Evaluation Checklist | 16 |
| 4.1.4 Determining Representativeness of WET Data | 16 |
| 4.1.5 Accounting for Effluent Variability | 18 |
| 4.2 APPROACHES FOR DETERMINING THE NEED FOR A WET LIMIT AND SETTING WASTELOAD ALLOCATIONS FOR TOXICITY AND PERMIT LIMITS | 19 |
| 4.2.1 Dynamic Modeling | 20 |
| 4.2.2 Steady-state Modeling | 21 |
| 4.3 DETERMINING THE NEED FOR PERMIT LIMITS <i>WITHOUT</i> EFFLUENT MONITORING DATA | 26 |
| 5 DEVELOPMENT OF WET REQUIREMENTS IN NPDES PERMITS | 27 |
| 5.1 PERMIT DOCUMENTATION RECOMMENDATIONS | 27 |
| 5.2 DERIVATION AND EXPRESSION OF PERMIT LIMITS | 28 |
| 5.2.1 Permit Limit Derivation Procedures | 29 |
| 5.2.2 Mixing Zone Application in WET Permit Conditions | 29 |
| 5.2.3 Expression Of Permit Limits | 29 |
| 5.2.4 EPA’s Recommendation for Deriving Permit Limits for Low-Flow | |

| | |
|---|-----|
| Dilution Situations | 30 |
| 5.3 PERMIT CONDITIONS FOR POSSIBLE OUTCOMES OF A REASONABLE POTENTIAL DETERMINATION | 31 |
| 5.3.1 Permit Conditions for an Excursion above the Applicable Toxicity Water Quality Standard or for the Reasonable Potential for an Excursion above the Applicable Toxicity Water Quality Standard | 31 |
| 5.3.2 Permit Conditions When Reasonable Potential Is Demonstrated With Fewer than 10 Valid WET Data Points | 32 |
| 5.3.3 When Reasonable Potential for WET Is Not Demonstrated With Sufficient Data Points | 36 |
| 5.4 MONITORING FREQUENCY RECOMMENDATIONS | 37 |
| 5.4.1 Monitoring Frequency for Accelerated Testing | 38 |
| 5.5 TOXICITY REDUCTION EVALUATION/IDENTIFICATION STUDIES | 38 |
| 6 CONCLUSION – EPA RECOMMENDATIONS TO REGIONS AND NPDES STATES | 41 |
| 6.1 GENERAL NPDES WET PROGRAM RECOMMENDATIONS AND REQUIREMENTS | 41 |
| 6.2 SPECIFIC RECOMMENDATIONS ON WET EFFLUENT TEST DATA USED FOR DETERMINING RP | 42 |
| 6.3 GENERAL RECOMMENDATIONS FOR DEVELOPING VALID AND REPRESENTATIVE WET NPDES PERMIT LIMITS, NUMERIC MONITORING TRIGGERS AND/OR OTHER PERMIT CONDITIONS | 42 |
| 6.4 SPECIFIC RECOMMENDATIONS FOR ISSUING PERMITS WITH WET EFFLUENT LIMITS, NUMERIC MONITORING TRIGGERS AND OTHER PERMIT CONDITIONS | 43 |
| APPENDIX A – EXAMPLE: PERMIT LIMIT DERIVATION PROCEDURES | A-1 |
| APPENDIX B – EXAMPLE: DERIVING PERMIT LIMITS FOR LOW-FLOW DILUTION SITUATIONS | B-1 |
| APPENDIX C – 1994 EPA WET CONTROL POLICY | C-1 |
| APPENDIX D – BIBLIOGRAPHY | D-1 |

Tables and Figures

| | |
|---|-------|
| Table 1. Permit Requirements | 12 |
| Table 2. WET Permit Requirements and Examples of Conditions | 28 |
| Table 3. Likelihood of Detecting at Least One Toxic Event Using n Observations, For Specified True Rates of Occurrence | 37 |
| Figure 1. Overview | 4 |
| Figure 2. WET reasonable potential flowchart | 21 |

Executive Summary

Background

The Clean Water Act (CWA) was enacted in 1972 with the objective of “*restoring the chemical, physical, and biological integrity of the Nation’s waters.*” Among the U.S. Environmental Protection Agency’s (EPA’s) efforts to achieve this objective is implementation of the National Pollutant Discharge Elimination System (NPDES) program. This program is designed to control toxic discharges, implement water quality standards, and restore and maintain “fishable and swimmable” designated beneficial uses in waters of the United States. In the 32 years since the CWA was enacted, EPA and States authorized to administer EPA’s NPDES permitting program have made significant progress toward achieving these goals. Point sources that discharge pollutants must comply with the terms and conditions of NPDES permits. One approach that NPDES permits use to control the discharge of toxic pollutants is to control whole effluent toxicity (WET).

History

During the 1980s, NPDES permits for industries and publicly owned treatment plants (POTWs) included technology-based treatment requirements. In addition, permits for POTWs included pretreatment programs to control the passthrough of and interference by pollutants from industrial users of the POTW. Even with those technological solutions, many discharges remained toxic. WET data gathered in the early 1980s indicated that some NPDES facilities had discharged effluents with sufficient toxicity to cause water quality problems. Further reductions were necessary in order to achieve compliance with State water quality standards that prohibited the discharge of toxic pollutants in toxic amounts, or otherwise provided for the maintenance and propagation of a balanced population of aquatic life.

Therefore, EPA developed a policy to reduce or eliminate toxic discharges. The “Policy for the Development of Water Quality-based Permit Limitations for Toxic Pollutants” (49 FR 9016, March 9, 1984) introduced EPA’s integrated toxics control program under NPDES. This program consists of both chemical-specific and biological methods for the assessment and reduction of toxic discharges. In 1989, EPA promulgated regulations specifying procedures for determining when water quality-based effluent limitations are required in NPDES permits. This regulation also established that, where necessary, the level of water quality to be achieved by such limits must be derived from and comply with water quality standards. In support of these regulations, EPA developed the Technical Support Document for Water Quality-based Toxics Control (TSD) in 1985 and revised it in 1991. The TSD provides guidance on water quality implementation issues, including chemical and biological approaches.

On July 7, 1994, EPA issued a national policy on effluent limitations in NPDES permits to control WET for the protection of aquatic life (USEPA 1994d) (see Appendix C of this document). Comprising eight policy statements, the document reaffirmed EPA’s strong continuing commitment to the existing CWA provisions and water quality permitting regulations at 40 CFR 122.44(d)(1). This guidance reaffirms those eight policy statements and builds upon that foundation to provide further clarification for NPDES authorities (Regions, States, and Tribes). Based on existing regulations, NPDES authorities must determine whether a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above a numeric criterion or a narrative criterion within an applicable State water quality standard and, where appropriate, establish permit limits on WET, for lethal and sub-lethal effects. On October 26, 1995, EPA promulgated WET test methods (USEPA 1993a,b,c; 1994a,b) and added them to the list of EPA methods approved under Section 304(h) of the CWA (40 CFR 136) for use in the

NPDES program. The methods were subsequently challenged, and under a settlement agreement, EPA conducted a round-robin study, which evaluated 12 of those test methods (USEPA 2001b,c) EPA also prepared a WET test method variability guidance document (*Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination System*, USEPA 2000b) and a WET test methods guidance document (USEPA 2000c). In November 2002, EPA promulgated the revised WET test methods (USEPA 2002 a,b,c) [see 67 FR 69951-69972, November 19, 2002].

Why WET Testing

Whole effluent toxicity is the aggregate toxic effect of an aqueous sample (e.g., a reference toxicant, an effluent, or a receiving water) measured directly by an aquatic toxicity test. Aquatic toxicity tests are laboratory experiments that measure biological effects (e.g., growth, survival, and reproduction) of a test sample (effluents or receiving waters) on aquatic organisms. In aquatic toxicity tests, organisms of a particular species and age are held in test chambers and exposed to different concentrations of an aqueous sample. Observations are then made at predetermined exposure periods. At the end of the test, the responses of test organisms are used to estimate the effects of the test sample, either in absolute terms or relative terms (i.e., the effects of an effluent in receiving waters).

Whole effluent toxicity test results are an integral tool in the assessment of water quality. For the protection of aquatic life, EPA's integrated strategy includes the use of three control approaches: the chemical-specific control approach, the WET control approach, and the biological criteria/bioassessment approach. The two primary advantages of using WET controls over individual, chemical-specific controls are (1) WET tests evaluate the integrated effects of all chemical(s) in the aqueous sample; and (2) while EPA has established aquatic life criteria for a relatively small number (126) of chemical-specific pollutants, WET tests can measure toxicity caused by other compounds for which EPA does not have chemical-specific numeric criteria for the protection of aquatic life or approved parameter-specific analytical test methods. Another advantage to using WET testing is that it enables prediction and avoidance of a toxic impact before the detrimental impact might occur (i.e., after the aquatic population in the receiving water has experienced prolonged exposure to such toxicity). Reliance solely on chemical-specific numeric criteria or bioassessments could result in a considerably less effective toxics control program. These toxicity tests therefore should be fully implemented in a NPDES authority's water quality control program. EPA policy and guidance recommend that States and Tribes use chemical-specific, toxicity, and biological measurements and criteria to monitor and protect designated uses. In 1991, EPA established its policy on independent application [Transmittal memorandum of Final Policy on Biological Assessment and Criteria from Tudor Davies to Regions, June 19, 1991(USEPA 1991c)]. EPA's independent application policy addresses how assessments based on these three kinds of criteria are to be used to make water quality management decisions related to protection of aquatic life and aquatic life uses. This National WET Implementation Guidance presents EPA's approaches to addressing some issues concerning WET implementation through the three overall goals outlined after this section.

Effect of This Guidance

EPA Headquarters expects permits issued by EPA Regions to be consistent with this guidance. EPA strongly encourages States¹ authorized to administer the NPDES program to implement the recommendations in this guidance so that national consistency in implementing the WET program can be

¹ State means any of the 50 States, the District of Columbia, Guam, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, or an Indian Tribe as defined in 40 CFR 122 which meets the requirements of § 123.3.

achieved. State permitting authorities may need to revise their current procedures (water quality standards or NPDES, or both) to fully implement the national recommendations presented in this document.

This document clarifies several issues regarding WET implementation and reaffirms EPA guidance in the TSD (USEPA 1991a) and the Agency's 1994 WET Control Policy. This document provides NPDES regulatory authorities and all stakeholders, including permittees, with guidance and recommendations on how to implement WET in NPDES permits. EPA's recommendations and conclusions are detailed in Chapter 6. A summary of the recommendations and a re-emphasis of existing regulatory requirements referenced in this document include the following:

- Under the CWA, States are required to have statewide WET implementation procedures (see Section 3) for their numeric or narrative WET standards.
- Pursuant to EPA regulations at 40 CFR 122.44 (d)(1), during permit development, the permit writer must determine whether the discharge causes, has the reasonable potential to cause or contribute to non-attainment of WQS for WET [reasonable potential (RP) determination]. The RP determination may be based on toxicity data, if available, or without specific WET data (if there is none). Based on the RP outcome, permit conditions are expressed as either WET limits or WET numeric monitoring triggers (see Section 4).
- Permit limits for WET should be expressed as both a monthly average (or a monthly median limit, for zero dilution situations) and a daily maximum² (see Section 5.2).
- Permit limits should be specific regarding the WET testing requirements [i.e., specify the test type (acute and/or chronic), statistical endpoint to be derived and reported, test species, and test method to be used.] (See Section 3.1, Table 1, and Section 5.4, Table 2).
- Permits with WET limits or monitoring requirements should include EPA's recommended "step-wise approach" to trigger remedial follow-up actions when the WET limits or numeric monitoring triggers are exceeded (see Section 5).
- Permits with WET limits or monitoring requirements should establish an appropriate frequency for toxicity testing sufficient to appropriately characterize the discharge and assess compliance (see Section 5.5).
- Permittees are responsible for maintaining compliance with permit requirements and for the quality of their self-monitoring data.

GOALS OF THIS DOCUMENT

This document addresses three goals concerning WET implementation:

1. **National Consistency:** provide the framework for a WET program that is nationally consistent across NPDES States, Tribes, and EPA Regions.

² This document provides examples using toxic units (TUs); however, EPA recognizes that permitting authorities also use other means to quantify and express WET values [(e.g., effluent concentrations related to a receiving water concentration (RWC)]. In cases where effluent concentrations are used, the permit limits would be expressed as minimums rather than maximums. For example, where a limit might be a maximum of two toxic units (therefore the permit limit expressed as ≤ 2.0 TU), a similar limit expressed as an effluent concentration would be expressed as a minimum NOEC value ($\text{NOEC} \geq 50\%$ effluent).

2. **NPDES Regulatory Compliance:** reinforce compliance with existing NPDES regulations, including the RP determination regulations at 40 CFR122.44(d) by reiterating the technical and regulatory basis for toxicity requirements in NPDES permits, while allowing flexibility consistent with the regulations where appropriate (e.g., allowing time to collect additional data for RP determination to supplement limited data sets).
3. **Emphasis on Existing Guidance, Policy, and Regulations:** restate and clarify, where necessary, existing guidance, policy, and regulations on WET testing in the NPDES program, by referring the reader to portions of the TSD, WET test methods (USEPA 2002a,b,c), and various WET guidance documents.

Acronyms and Abbreviations³

| | |
|------------------|---|
| 1Q10 | lowest one-day stream flow during any 10-year period |
| 7Q10 | lowest consecutive seven-day average stream flow during any 10-year period |
| ACR | acute-to-chronic ratio |
| AML | average monthly limit |
| AWL | average weekly permit limit |
| CCC | criterion continuous concentration/chronic criterion |
| Ce | concentration of effluent |
| CFR | Code of Federal Regulations |
| CFS | cubic feet per second |
| ChV | chronic value |
| CMC | criterion maximum concentration/acute criterion |
| CV | coefficient of variation |
| CWA | Clean Water Act |
| DMR | discharge monitoring report |
| EPA | U.S. Environmental Protection Agency (also, the Agency) |
| FR | Federal Register |
| GLI | Great Lakes Initiative (Water Quality Guidance for the Great Lakes System) |
| IC ₂₅ | inhibition concentration, 25 percent |
| LC ₅₀ | lethal concentration, 50 percent |
| LOEC | lowest observed effect concentration |
| LTA | long-term average (LTA _a = acute LTA; LTA _c = chronic LTA; LTA _{a,c} = acute-to-chronic LTA, expressed in chronic units) |
| MDL | maximum daily limit |
| MGD | million gallons per day |
| MML | monthly median limit |
| NOEC | no observed effect concentration |
| NPDES | National Pollutant Discharge Elimination System |
| PCS | Permit Compliance System |
| PMSD | percent minimum significant difference |
| POTW | publicly owned treatment works |
| QA | quality assurance |
| QC | quality control |

³ These acronyms and abbreviations may have other meanings in other EPA programs or documents.

| | |
|--------|---|
| Qe | effluent flow |
| Qs | receiving water flow |
| RP | reasonable potential |
| RPMF | reasonable potential multiplier factor |
| RWC | receiving water concentration (sometimes referred to as in-stream waste concentration, IWC) |
| STORET | EPA Storage and Retrieval Database |
| TAC | test acceptability criterion/criteria |
| TIE | toxicity identification evaluation |
| TMDL | total maximum daily load |
| TRE | toxicity reduction evaluation |
| TSD | EPA's Technical Support Document for Water Quality-based Toxics Control (USEPA, 1991a) |
| TU | toxic unit (TU_a = acute toxicity; TU_c = chronic toxicity) |
| UAA | use attainability analysis |
| WET | whole effluent toxicity |
| WLA | wasteload allocation |
| WQBEL | water quality-based effluent limit |
| WQS | water quality standard |

Glossary⁴

Acute-to-Chronic Ratio (ACR) is the ratio of the acute toxicity of an effluent or a toxic to its chronic toxicity. It is used as a factor for estimating chronic toxicity on the basis of acute toxicity data, or for estimating acute toxicity on the basis of chronic toxicity data.

Acute Toxicity Test is a test to determine the concentration of effluent or ambient waters that causes an adverse effect (usually death) on a group of test organisms during a short-term exposure (e.g., 24, 48, or 96 hours). Acute toxicity is measured using statistical procedures (e.g., point estimate techniques or a hypothesis test).

Ambient Toxicity is measured by a toxicity test performed using solely receiving water.

Average Monthly Limit (AML) is the highest allowable value for the average of daily discharges obtained over a calendar month.

Chronic Toxicity Test is a short-term test, usually 96 hours or longer in duration, in which sublethal effects (e.g., significantly reduced growth or reproduction) are usually measured in addition to lethality. Chronic toxicity is defined as $TU_c = 100/NOEC$ or $TU_c = 100/EC_p$ or IC_p .

ChV is the chronic value, the geometric mean of the NOEC and LOEC.

Coefficient of Variation (CV) is a standard statistical measure of the relative variation in a distribution or set of data, defined as the standard deviation divided by the mean. It is also called the relative standard deviation (RSD). The CV can be used as a measure of within-laboratory and between-laboratory precision or as a measure of precision among replicates for each treatment concentration.

Criterion Continuous Concentration (CCC) is the highest in-stream concentration of a toxic or an effluent to which organisms can be exposed indefinitely without causing unacceptable effects such as the exceedence of a chronic water quality criterion.

Criterion Maximum Concentration (CMC) is the highest in-stream concentration of a toxic or an effluent to which organisms can be exposed for a brief period of time without causing an acute effect such as the exceedence of an acute water quality criterion.

Discharge Monitoring Report (DMR) is EPA's standardized reporting form for the reporting of self-monitoring results by permittees. DMRs must be used by "NPDES-approved States," as well as by EPA. The EPA standardized forms may be modified to substitute the State agency's name, address, logo, and other similar information, as appropriate, in place of EPA's.

Effect Concentration is a point estimate of the toxic concentration that would cause an observable adverse effect (e.g., death, immobilization, or serious incapacitation) in a given percent of the test organisms. EC_{25} is a point estimate of the toxic concentration that would cause an observable adverse effect in 25 percent of the test organisms.

Effluent Flow (Qe) is the flow (in cubic feet per second or million gallons per day) of a wastewater discharge from a NPDES-regulated facility expressed in standard NPDES formulas by permit writers as "Qe" to calculate water quality based effluent limits.

⁴ These terms may have other meanings in other EPA programs or documents, including other programs under the CWA.

Endpoint is a biological measurement used to quantify the results obtained from analytical methods such as whole effluent toxicity testing [e.g., lethal concentration (LC_{50}); inhibition concentration (IC_{25}); and no observed effect concentration (NOEC)]. Such endpoints are quantitative measurements of the responses of test organisms (e.g., survival, growth, mobility, reproduction, and weight gain or loss) in response to exposure to a serial dilution of effluent.

Hypothesis Testing is a statistical technique (e.g., Dunnett’s test) for determining whether a tested concentration results in a statistically different response from that observed in the control. For the multi-concentration tests, the reported values determined by hypothesis testing are the “no observed effect concentration (NOEC)” and “lowest observed effect concentration (LOEC).”

Inhibition Concentration is a point estimate of the toxic concentration that would cause a given percent reduction in a non-lethal biological measurement (e.g., reproduction or growth). IC_{25} is a point estimate of the toxic concentration that would cause a 25-percent reduction in a biological measurement of a test organism (i.e., an endpoint).

In-stream Waste Concentration is the concentration of a toxic in the receiving water after mixing, if allowed by State water quality standards (WQS). The in-stream waste concentration is the inverse of the dilution factor. It is also referred to as the receiving water concentration (RWC).

Lethal Concentration, 50 Percent (LC_{50}) is the toxic or effluent concentration that would cause death in 50 percent of the test organisms over a specified period of time.

Long-term Average (LTA) of pollutant concentration or effluent toxicity is calculated from a wasteload allocation (WLA), typically assuming that the WLA is a 99th percentile value (or another upper bound value) based on the lognormal distribution. One LTA is calculated for each WLA (typically an acute LTA and a chronic LTA for aquatic life protection). The LTA represents expected long-term average performance from the permitted facility required to achieve the associated WLA.

Lowest Observed Effect Concentration (LOEC) is the lowest concentration of an effluent or test sample with an effect different from the control effect according to the statistical test used for analysis of toxicity that results in adverse effects on the test organisms (i.e., where the values for the observed endpoints statistically differ from the control).

Maximum Daily Limit (MDL) is the highest allowable discharge measured during a calendar day or 24-hour period representing a calendar day.

Minimum Significant Difference (MSD) is a measure of test sensitivity that establishes the minimum difference required between a control and a test treatment in order for that difference to be considered statistically significant.

Mixing Zone is an area where an effluent discharge undergoes initial dilution with water from upstream and is extended to cover the secondary mixing in the ambient water body; an allocated impact zone in which water quality criteria can be exceeded provided that acutely toxic conditions are prevented. States determine whether mixing zones are allowed.

National Pollutant Discharge Elimination System (NPDES) is the EPA program that regulates discharges to the nation’s waters. Discharge permits issued under the NPDES program are required by EPA regulation to contain, where necessary, effluent limits based on water quality criteria for the protection of aquatic life and human health.

No Observed Effect Concentration (NOEC) is the highest tested concentration of an effluent or test sample whose effect is not different from the control effect, according to the statistical test used (see LOEC). The NOEC is usually the highest tested concentration of an effluent or toxic that causes no observable adverse effect on the test organisms (i.e., the highest concentration of toxicity at which the values for the observed responses do not statistically differ from the controls).

Percent Minimum Significant Difference (PMSD) is the minimum significant difference divided by the control mean, expressed as a percent (see minimum significant difference).

Point Estimate is a statistical inference that estimates the true value of a parameter by computing a single value of a statistic from a set of sample data.

Publicly Owned Treatment Works (POTWs) are facilities, operated by local communities or States or their contractors, that treat domestic wastewater or wastewater from indirect dischargers (e.g., industrial facilities).

Quality Assurance (QA) is a practice in toxicity testing that addresses all activities affecting the quality of the final effluent toxicity data. QA includes evaluation of effluent sampling and handling, source and condition of test organisms, equipment condition, test conditions, instrument calibration, replication, use of reference toxics, record keeping, data, and other aspects of the test and testing procedures.

Quality Control (QC) is the set of focused, routine, day-to-day activities carried out as part of an overall QA program.

Reasonable Potential (RP) is the likelihood that an effluent will cause or contribute to an excursion above a water quality standard based on a number of factors, including the use of data (e.g., whole effluent toxicity test data). In the context of this document, references to RP and WET limits include both lethal and sub-lethal effects.

Reasonable Potential Multiplier Factor (RPMF) is a numerical value that multiplies the maximum observed effluent value in an effluent data set.

Receiving Water Concentration (RWC) is the concentration of a toxic in the receiving water after mixing, sometimes referred to as the in-stream waste concentration (IWC).

Receiving Water Flow (Qs) is the flow of the water receiving the discharge expressed in cubic feet per second or millions of gallons per day.

Reference Toxicant Test is a check of the sensitivity of the test organisms and the suitability of the test methodology in a toxicity test. Reference toxicant data are part of a routine QA/QC program to evaluate the performance of laboratory personnel and the robustness and sensitivity of the test organisms.

Significant Difference is defined as a statistically significant difference (e.g., 95 percent confidence level) in the means of two distributions of sampling results.

Standard Deviation is a measure of the variability of a set of data, calculated as the square root of the variance.

Statistic is a computed or estimated quantity, such as the mean, standard deviation, or coefficient of variation.

Test Acceptability Criteria (TAC) are specific criteria for determining whether toxicity test results are acceptable pursuant to EPA's WET test methods in 40 CFR 136 (additional TACs may be established by

a State permitting authority). The effluent and reference toxicant must meet specific criteria as defined in the test method (e.g., for the *Ceriodaphnia dubia* survival and reproduction test, the criteria are: 80% or greater survival of all control organisms and an average of 15 or more young per surviving female in the control solution. Of the surviving control females, 60% must produce three broods.)

Total Maximum Daily Load (TMDL) is the allocation of the pollutant load to each source, which is calculated by estimating the maximum amount of a pollutant that a water body can receive and still meet water quality standards.

Toxicity Test is a procedure using living organisms to determine whether a chemical or an effluent is toxic. A toxicity test measures the degree of the effect of a specific chemical or effluent on exposed test organisms.

Toxic Unit (TU) is a measure of toxicity in an effluent as determined by the acute toxicity units (TU_a) or chronic toxicity units (TU_c) measured. The larger the TU, the greater the toxicity.

Toxic Unit–Acute (TU_a) is the reciprocal of the effluent concentration that causes 50 percent of the organisms to die in an acute toxicity test ($TU_a = 100/LC_{50}$) (see LC_{50}).

Toxic Unit–Chronic (TU_c) is the reciprocal of the effluent concentration that causes no observable effect on the test organisms in a chronic toxicity test ($TU_c = 100/NOEC$ or $100/EC_{25}$) (see NOEC).

Toxicity Identification Evaluation (TIE) is a set of site-specific procedures used to identify the specific chemical(s) causing effluent toxicity.

Toxicity Reduction Evaluation (TRE) is a site-specific study conducted in a step-wise process to identify the causative agents of effluent toxicity, isolate the source of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity after the control measures are put in place.

Variance is a measure of the dispersion in a set of values, defined as the sum of the squared deviations from the mean divided by the total number of values in the set.

Wasteload Allocation (WLA) is the portion of a receiving water's TMDL that is allocated to one of its existing or future point sources of pollution.

Water Quality Criterion. Numeric criteria are scientifically derived ambient concentrations developed by EPA or States for various pollutants of concern to protect human health and aquatic life. Narrative criteria typically are statements that describe the desired water quality goal.

Water Quality-based Effluent Limit (WQBEL) is a NPDES permit limit established by either an EPA or a State permit writer that is developed to assure protection of aquatic life or human health consistent with applicable State or Tribal water quality standards, including the designated uses for a particular water body, the established criteria, and measured analytical data (e.g., chemical, WET or biosurvey), in accordance with the recommendations provided in EPA's 1991 Technical Support Document (TSD).

Water Quality Standard (WQS). Water quality standards are provisions of State or Federal law which consist of a designated use or uses for the waters of the United States and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water, and serve the purposes of the Act. States and authorized Tribes are required to develop and adopt a statewide antidegradation policy and identify the methods for implementing the policy.

Whole Effluent Toxicity (WET) is the total toxic effect of an effluent measured directly with a toxicity test.

1 INTRODUCTION

1.1 BACKGROUND

The Clean Water Act (CWA) was enacted in 1972 with the objective of “*restoring the chemical, physical, and biological integrity of the Nation’s waters.*” Several goals and policies were established in the Act, including the following:

- Eliminate the discharge of pollutants into navigable waters by 1985;
- Achieve, wherever attainable, an interim goal of water quality that provides for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water by November 1, 1983; and
- Prohibit the discharge of toxic pollutants in toxic amounts.

In the 32 years since the CWA was enacted, the U.S. Environmental Protection Agency (EPA) and States authorized to administer EPA’s National Pollutant Discharge Elimination System (NPDES) permitting program have made significant progress toward achieving these goals. The NPDES program is designed to control toxic discharges, implement water quality standards, and restore and maintain “fishable and swimmable” designated beneficial uses in waters of the United States. Point sources that discharge pollutants must comply with the terms and conditions of a NPDES permit. In setting these terms and conditions, EPA and the States have integrated their control of toxic pollutants through the combined use of three approaches, as described in the *Technical Support Document for Water Quality-based Toxics Control* (USEPA 1991a, referred to as the TSD):

- Chemical-specific controls,
- Whole effluent toxicity (WET) controls, and
- Biological criteria/bioassessments.

The WET approach to protection of water quality is the subject of this document.

In 1989, EPA defined WET as “*the aggregate toxic effect of an effluent measured directly by an aquatic toxicity test*” [54 Federal Register (FR) 23868 at 23895, June 2, 1989]. Aquatic toxicity tests are laboratory experiments that measure the biological effect (e.g., growth, survival, and reproduction) of effluents or receiving waters on aquatic organisms. In aquatic toxicity tests, groups of organisms of a particular species are held in test chambers and exposed to different concentrations of an aqueous test sample (e.g., effluent or effluent combined with receiving water). Observations are made at predetermined exposure periods. At the end of the test, the responses of test organisms are used to estimate the effects of the test sample, either in absolute terms or relative terms (i.e., the effects of an effluent in receiving waters).

In the early 1980s, EPA published WET test methods for estimating the short-term acute and chronic toxicity of effluents and receiving waters to freshwater and marine organisms (USEPA 1985a, 1988, 1989e). WET data gathered in the 1980s indicated that some NPDES facilities had discharged effluents with sufficient toxicity to cause water quality problems. Therefore, further reductions in the toxicity of wastewater discharges were necessary to achieve compliance with State water quality

standards that prohibit the discharge of toxic pollutants in toxic amounts, or otherwise provided for the maintenance and propagation of a balanced population of aquatic life.

Therefore, EPA developed a policy to reduce or eliminate toxic discharges. The *Policy for the Development of Water Quality-based Permit Limitations for Toxic Pollutants* (49 FR 9016, March 9, 1984) introduced EPA's integrated toxics control program under the NPDES program. In 1989, EPA promulgated regulations specifying procedures for determining when water quality-based effluent limitations are required in NPDES permits. This regulation also established that, where necessary, the level of water quality to be achieved by such limits must be derived from and comply with water quality standards. To support these regulations, EPA developed the TSD (USEPA 1991a). The TSD provides guidance to regulators on the implementation of WET through NPDES permit requirements and limits.

On October 26, 1995, EPA promulgated WET test methods (USEPA 1993a,b,c; 1994a,b) and added them to the list of EPA methods approved under Section 304(h) of the CWA (40 CFR 136) for use in the NPDES program. The methods were subsequently challenged, and under a settlement agreement, EPA conducted a round-robin study, which evaluated 12 of those test methods (USEPA 2001a,b). EPA also prepared a WET test method variability guidance document (*Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination System*, USEPA 2000b) and a WET test methods guidance document (USEPA 2000c). In November 2002, EPA promulgated the revised WET test methods (USEPA 2002 a,b,c) [see 67 FR 69951-69972, November 19, 2002].

EPA's existing NPDES enforcement guidance and policy regarding WET is included in three major documents: (1) the January 25, 1989 memorandum entitled *Whole Effluent Toxicity Basic Permitting Principles and Enforcement Strategy*; (2) the 1989 *Enforcement Management System, National Pollutant Discharge Elimination System (Clean Water Act)*; and (3) the August 14, 1995 memorandum entitled *National Policy Regarding Whole Effluent Toxicity Enforcement*.

1.2 PURPOSE OF THIS GUIDANCE

EPA Headquarters expects permits issued by EPA Regions to be consistent with this guidance. EPA strongly encourages States⁵ authorized to administer the NPDES program to implement the recommendations in this guidance so that national consistency in implementing the WET program can be achieved. State permitting authorities may need to revise their current procedures (water quality standards or NPDES, or both) to fully implement the national recommendations presented in this document.

Existing regulations and EPA's 1994 WET Control Policy require that regulatory authorities (including States, Tribes, and EPA Regions) must perform a reasonable potential analysis and, where appropriate, establish permit limits for WET when an effluent discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above a numeric or narrative criterion within an applicable State water quality standard. Establishing appropriate permit conditions and limits when necessary to control WET is a crucial step toward achieving the CWA objective of identifying, characterizing, and eliminating toxic effects of discharges to waters of the United States.

⁵ State means any of the 50 States, the District of Columbia, Guam, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific Islands, or an Indian Tribe as defined in 40 CFR 122 which meets the requirements of § 123.3.

This document is intended to promote national consistency in the implementation of WET programs, make certain that the information and requirements for WET relevant to NPDES permits are clear and well documented, and ensure that the appropriate WET requirements are included in permits to protect against impacts to aquatic life. This document has three major goals:

1. **National Consistency:** to provide the framework for a WET program that is nationally consistent across NPDES States, Tribes, and EPA Regions.
2. **NPDES Regulatory Compliance:** to reinforce compliance with existing NPDES regulations, including the reasonable potential (RP) determination regulations at 40 CFR 122.44(d) by reiterating the technical and regulatory basis for toxicity requirements in NPDES permits, while allowing flexibility consistent with the regulations, where appropriate (e.g., allowing time to collect additional data for RP determination to supplement limited data sets).
3. **Emphasis on Existing Guidance, Policy, and Regulations:** to restate and clarify, where necessary, existing guidance, policy, and regulations on WET testing in the NPDES program, by referring the reader to portions of the TSD, WET test methods (USEPA 2002a,b,c), and various WET guidance documents.

EPA's WET testing program is key to identifying, characterizing, and eliminating toxic effects of point source discharges to waters of the United States. WET test methods are scientifically defensible and provide reliable results when performed by qualified staff (see USEPA 2000c). Permitting authorities should establish WET monitoring requirements with appropriate test methods at a testing frequency designed to achieve the program objective and must include NPDES WET limits when reasonable potential has been demonstrated. NPDES limits and other permit conditions are used to ensure that, when toxic effects are predicted or demonstrated on aquatic organisms through the use of WET tests, the permittee will be required to identify and reduce or eliminate the cause(s) so that aquatic life is protected.

This guidance addresses how to appropriately incorporate WET limit or monitoring requirements where necessary into individual (e.g., facility-specific) NPDES permits and presents a range of responses for addressing WET violations. In addition, the TSD, test methods, and various WET guidance documents are referred to throughout this document to help regulatory authorities easily consult the background materials upon which this document is based.

1.3 WHAT'S NEW IN THIS GUIDANCE

Significantly, this guidance recommends EPA's "step-wise approach" to permitting that would standardize the practice of collecting high-quality WET data before or during the NPDES permit development process (see Chapters 3 and 5). This step-wise approach addresses reasonable potential (RP) determinations based on small data sets, which can result in conservative projections of effluent quality and unnecessary permit limits. EPA's step-wise approach in which RP is addressed in the overall regulatory scheme of the "*WQS to NPDES Permits Process*" is highlighted in Figure 1 of this document.

This guidance also recommends EPA's step-wise approach for establishing appropriate effluent limits and other permit conditions. If the permitting authority determines that a facility's discharge is or may be discharged at a level that *causes, has reasonable potential to cause, or contributes* to an excursion above a narrative or numeric water quality criterion for toxicity, the permitting authority must establish a water quality based effluent limit (WQBEL). This WQBEL must be for the parameter WET if the State has *numeric* toxicity criteria [40 CFR 122.44(d)(1)(iv)]. If the State has *narrative* toxicity criteria and the permitting authority can demonstrate, in the fact sheet, that chemical-specific limits are

sufficient to attain and maintain applicable standards, appropriate chemical-specific limits can be established in lieu of WET limits [40 CFR 122.44(d)(1)(v)]. For example, where the State has a narrative criterion for aquatic life protection, and WET RP has been demonstrated, a WET limit is required. However, if the permittee can through using EPA's toxicity reduction evaluation/toxicity identification evaluation (TRE/TIE) procedures identify and confirm that the chemical(s) responsible for an effluent's toxicity [40 CFR 122.44(d)(1)(v)] then chemical(s) limits (for the identified toxicant) in lieu of WET is appropriate. In addition, WET testing would be required in the permit with monitoring triggers. A TRE is a stepwise site-specific study to identify toxics and sources, and to narrow the search for effective control measures for effluent toxicity. TREs are designed to identify the causative agents of WET, evaluate the effectiveness of the toxicity control options, and confirm the reduction in effluent toxicity. If a TIE analysis identifies the toxicant, and the State has a narrative criterion, the regulations at 40 CFR 122.44(d)(1)(v) allow for inclusion of a chemical-specific limit for the identified toxicant(s) in lieu of a WET limit to meet that narrative criterion.

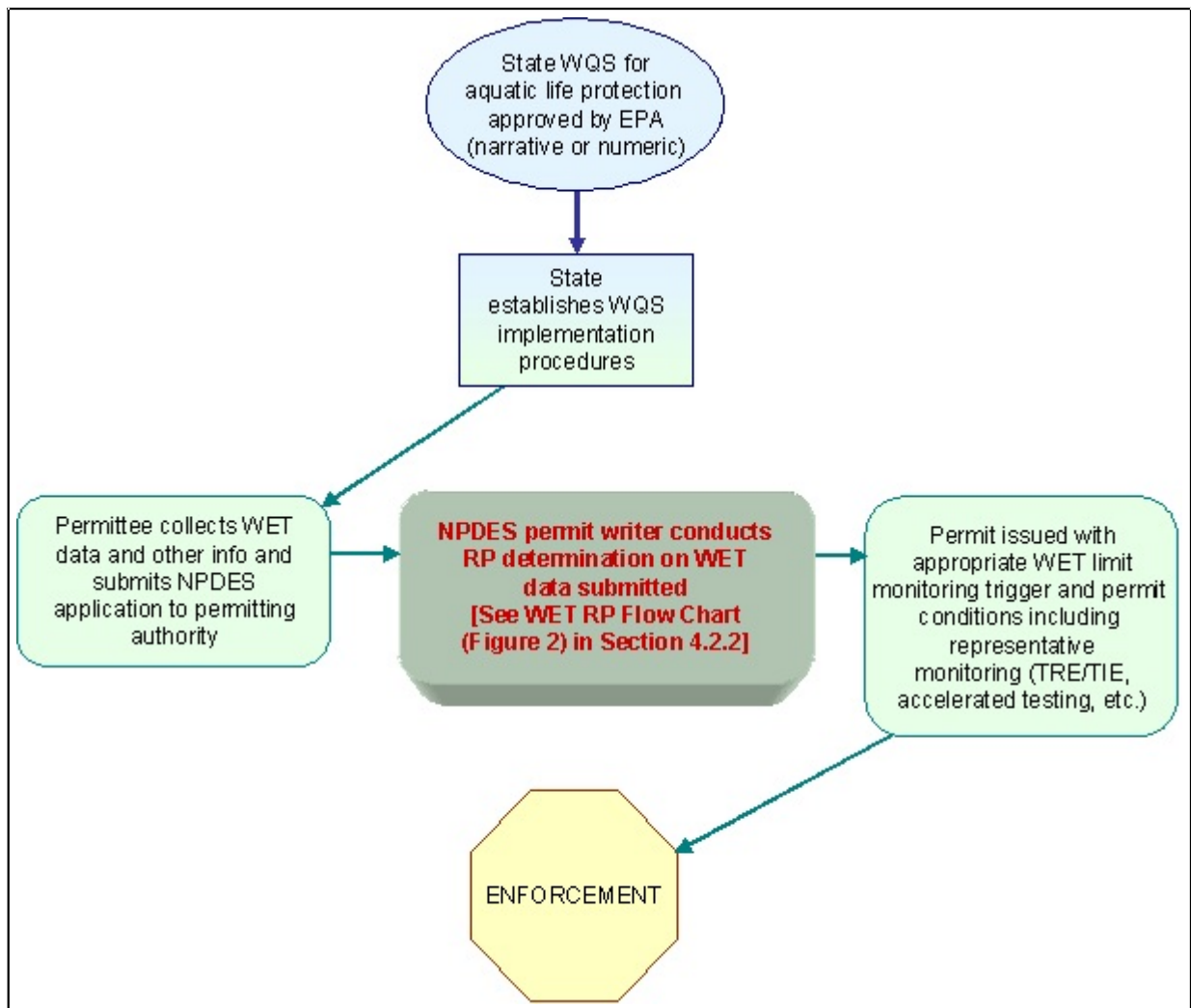


Figure 1. Overview.

Where limits for WET are necessary for continuous discharge, EPA regulations at 40 CFR 122.45(d)(1) stipulate that such limits be expressed as a Maximum Daily Limit (MDL) and an

Average Monthly Limit (AML) unless impracticable for all dischargers other than POTWs. Where limits for WET are necessary for POTWs, EPA regulations at 40 CFR 122.45(d)(2) stipulate that such limits they be expressed as a Average Weekly Limit (AWL) and an Average Monthly Limit (AML) unless impracticable. This document provides examples using toxic units (TUs); however, EPA recognizes that permitting authorities also use other means to quantify and express WET values [e.g., effluent concentrations related to a receiving water concentration (RWC)]. In cases where effluent concentrations are used, the permit limits would be expressed as minimums rather than maximums. For example, a limit might be a maximum of two toxic units (therefore the permit limit expressed as ≤ 2.0 TU). A similar limit expressed as an effluent concentration would be expressed as a minimum NOEC or point estimate value (e.g., NOEC $\geq 50\%$ effluent).

Of particular concern is establishing permit limits for WET for discharges where the effluent flow comprises a high percentage of the available stream flow during critical conditions or otherwise lacks assimilative capacity. In such waters, effluent toxicity may be a source of measurable ambient toxicity (i.e., cause) excursions of numeric or narrative water quality criteria. In this guidance, EPA revises national guidance for establishing appropriate effluent limitations for WET for receiving waters with no assimilative capacity or where dilution is not available. For such situations, the limit derivation procedures described in Chapter 5 of this guidance would result in a maximum daily limit of 1.6 TU_c and an AML of 1.0 TU_c. The 1.0 TU_c AML should be expressed as a monthly median limit instead of an average monthly limit.

EPA's step-wise approach to permitting also includes a requirement for accelerated monitoring when an effluent limit or numeric monitoring trigger value is exceeded. If toxicity re-occurs, the permit should require the permittee to initiate additional measures to investigate the causes of, and identify corrective actions to reduce, effluent toxicity that may cause or contribute to an exceedence of WQ criteria applicable to WET. These measures could include a TRE study that requires toxicity reduction.

1.4 WHO SHOULD USE THIS DOCUMENT

This document provides guidance to EPA Regions, NPDES State permitting authorities, NPDES permittees, WET testing laboratories and consultants, the public and its representatives, and any other stakeholders interested in NPDES WET programs. This document also specifies that permit decisions must take into account applicable Federal and State laws, regulations, guidance, and standards.

1.5 DOCUMENT ORGANIZATION

This document contains six chapters:

- Chapter 1 – Introduction
- Chapter 2 – Setting Appropriate Water Quality Goals for WET
- Chapter 3 – State Implementation Procedures to Ensure WET Criteria are Met
- Chapter 4 – Determining the Need for WET Limits in NPDES Permits
- Chapter 5 – Development of WET Requirements in NPDES Permits
- Chapter 6 – Conclusion – EPA Recommendations to Regions and NPDES States

The Introduction provides the general background and purpose of this document. Chapter 2 presents EPA's recommended water quality criteria for WET and discusses mixing zones, designated uses, and considerations for implementing a narrative toxicity criterion. In addition to general recommendations

regarding narrative criteria, Chapter 3 provides guidance to States for implementing WET programs and outlines considerations for State/Regional implementation. Chapter 4 provides information on determining the need for effluent limits with facility-specific data, determining reasonable potential, and determining the need for effluent limits without facility-specific data. Chapter 5 describes EPA's step-wise approach to WQBELs, providing recommendations on permit documentation, monitoring, and developing WET permit requirements; establishing limits under various scenarios; expression of limits; and TRE/TIE studies. Chapter 6 summarizes the document's guidance and recommendations to regulatory authorities and permittees. Additional information on the topics discussed in the six chapters is provided in four appendices. Appendix A provides details on general permit derivation procedures, including an example calculation. Appendix B provides further details on deriving permit limits for low-flow dilution situations and presents an example calculation. EPA's 1994 WET Control Policy (*Policy for the Development of Effluent Limitations in National Pollutant Discharge Elimination System Permits to Control Whole Effluent Toxicity for the Protection of Aquatic Life*) is reproduced in Appendix C. Appendix D lists the major EPA publications on topics related to WET testing. Appendix D also lists pertinent EPA Web sites where further details of WET and WET testing can be accessed.

2 SETTING APPROPRIATE WATER QUALITY GOALS FOR WET

State water quality standards (WQS) provide the foundation for water quality-based pollution control programs. The purpose of WET limits and monitoring requirements is to ensure compliance with State numeric or narrative water quality criteria established to protect the designated uses of the water body. This chapter provides a brief description of the WQS that are the basis for WET water quality-based effluent limits (WQBELs) in NPDES permits.

2.1 EPA'S RECOMMENDED WATER QUALITY CRITERIA FOR WET

Water quality *standards* are provisions of State (or, in certain instances, Federal) law which define the water quality goals of a water body, or portion thereof, by designating the use or uses to be made of the water body and by setting criteria necessary to protect the uses. States adopt water quality standards to protect public health or welfare, enhance the quality of water, and serve the purposes of the Clean Water Act. Such standards serve the dual purposes of establishing the water quality goals for a specific water body and serve as the regulatory basis for the establishment of water quality-based treatment controls and strategies beyond the technology-based levels of treatment required by sections 301(b) and 306 of the CWA (40 CFR 131.2).

Water quality *criteria* are elements of State WQS, expressed as constituent concentrations, levels, or narrative statements representing a quality of water that supports a particular use. When criteria are met, water quality will generally protect the designated use (40 CFR 131.3). While states have adopted a variety of criteria expressed as constituent concentration levels (or *numeric* criteria) for various pollutants for the protection of aquatic life, all states have adopted criteria expressed as narrative statements (or *narrative* criteria). These narrative criteria, often referred to as “free-from” (or, in the case of toxicity, “no toxics in toxic amounts”) criteria, are an effective tool for controlling the discharge of pollutants where numeric criteria are not available. Narrative criteria are a basis for establishing WET controls in the NPDES permitting regulations at 40 CFR 122.44(d)(1).

Section 304(a) criteria are developed by EPA under authority of section 304(a) of the Act based on the latest scientific information on the relationship that a constituent concentration has on a particular aquatic species and/or human health. This information is issued periodically to the States as guidance for use in developing criteria. In adopting criteria to protect their designated uses, States may establish criteria based on (1) section 304(a) guidance; (2) section 304(a) guidance modified to reflect site-specific conditions; or (3) other scientifically defensible methods.

Although EPA has not published numeric water quality criteria under section 304(a) for whole effluent toxicity, EPA has provided general guidance on appropriate WET limits. The TSD (USEPA 1991a) recommends 0.3 acute toxic units (TU_a) as an acute criterion and 1.0 chronic toxic units (TU_c) as a chronic criterion, for most water bodies. While effective for CWA purposes only in the Great Lakes Basin, the final Water Quality Guidance for the Great Lakes System in 40 CFR 132 (also known as the Great Lakes Initiative) also establishes 0.3 TU_a and 1.0 TU_c, either as numeric criteria or as equivalent numeric interpretations of narrative criteria, for receiving waters of the Great Lakes [40 CFR 132, Appendix F, Items A.1. and A.2].

Federal regulations at 40 CFR 122.44(d)(1)(i) establish different approaches for implementing a water quality criterion for toxicity in NPDES permits, depending on whether the criterion is expressed in a numeric or narrative form. If the State has not adopted a numeric criterion for WET, EPA expects the permitting authority to *interpret* the State narrative criterion so that the appropriate effluent limits, including any necessary toxicity numeric limits, can be established. States should identify the method they intend to use in regulating toxics based on narrative criteria and describe how their toxics control

program will protect aquatic life and attain the narrative criterion [40 CFR 131.11(a)(2)]. The procedure to implement the narrative criteria using a whole effluent approach should specify, at a minimum, the testing procedure, the duration of the tests (acute or chronic), the test species, the frequency of testing required, and the numeric benchmarks that are used to interpret the narrative criteria.⁶

As indicated in Section 2.1, EPA's TSD provides a basis for establishing criteria for aquatic toxicity. Criteria consist of three components: (1) magnitude, (2) duration, and (3) frequency.

Magnitude refers to the concentration of the pollutant. EPA's recommended magnitudes for WET are as follows:

- For acute protection, a criterion maximum concentration (CMC) is specified to protect against acute (short-term) effects. The CMC should be set at 0.3 TU_a to the most sensitive of at least three test species for acute tests (e.g., one fish and two invertebrate, or two fish and one invertebrate).
- For chronic protection, a criterion continuous concentration (CCC) is specified to protect against chronic (long-term) effects. The CCC should be set at 1.0 TU_c to the most sensitive of at least three test species for chronic tests (fish, invertebrate, plant).

Duration is the period of time (averaging period) over which the in-stream concentration is averaged for comparison with criteria concentrations. This specification limits the length of time that in-stream concentrations may exceed the criteria concentrations. EPA's recommended duration for aquatic life criteria, including toxicity are:

- For acute criteria, EPA recommends an averaging period of one hour to be representative of fast-acting toxicants. The 1-hour acute averaging period was derived primarily from data on response time for toxicity to ammonia, a fast-acting toxicant. The 1-hour average exposure should not exceed the CMC. Scientifically justifiable alternative (site-specific) averaging periods can be derived (see TSD, page 35, Section 2.3.4).
- For chronic criteria, EPA recommends an averaging period of four days. That is, the 4-day average exposure should not exceed the CCC. Different chronic averaging periods could be derived, depending on the nature of the pollutant and the toxic endpoint of concern (e.g., the rate of uptake and accumulation and the mode of action). EPA selected the 4-day averaging period based on the shortest duration in which chronic effects are sometimes observed for certain species and toxics, and thus should be fully protective even for the fastest-acting toxics (see TSD, page 35, Section 2.3.4).

Frequency is how often the criteria can be exceeded and still be protective to allow the aquatic community sufficient time to recover from excursions of aquatic life criteria. For frequency, neither acute nor chronic criteria should be exceeded for the above durations more than once per three years on the average. Based on site-specific considerations, a State may allow for a different frequency (see TSD, page 36, Section 2.3.5).

2.1.1 Mixing Zones

Federal regulation 40 CFR 131.13 states that "States may, at their discretion, include in their State standards, policies generally affecting their application and implementation, such as mixing zones, low

⁶ See text box in Section 3.1.1 of this guidance.

flows and variances. Such policies are subject to EPA review and approval.” EPA has addressed mixing zones as an area near the discharge where certain numeric water quality criteria may be exceeded, as long as there is no lethality to organisms passing through the mixing zone, no significant risk to human health, and the designated uses of the water body are not impaired (see 63 FR 36788). Permitting authorities may use mixing zones for WET provided use of mixing zones is authorized in State water quality standards. If mixing zones are not allowed by State regulations for acute or chronic toxicity, then the criteria must be applied at the end of the pipe. In determining whether an in-stream excursion of a water quality criterion for WET exists, the effect of effluent dilution in the receiving water may be considered when appropriate and allowed by the permitting authority’s mixing zone policy consistent with the applicable water quality standards. This determination is made at permit issuance. Where State water quality standards and policy allow mixing zones, the permit must ensure that effluent limits derive from and comply with the applicable State WQS.

2.2 DESIGNATED USES

A water body’s designated use is a fundamental articulation of its role in the aquatic and human environments. All of the water quality protections established by the CWA follow from the water body’s designated use. As designated uses are critical in determining the water quality criteria that apply to a given water body, determining the appropriate designated use is of paramount importance is establishing criteria that are appropriately protective of that designated use.

It is in designating uses that States and Tribes establish the environmental goals for their water resources, and it is in designating uses that States and Tribes are allowed to evaluate the attainability of those goals. Water quality standards perform the dual function of establishing water quality goals and ultimately serving as the regulatory basis for water quality-based treatment controls and strategies, typically, although not exclusively, via water quality criteria protecting those uses. Thus, a State or Tribe often weighs the environmental, social, and economic consequences of its decisions in designating uses. The regulation allows the State or Tribe some flexibility in weighing these considerations and adjusting these goals over time. Reaching a conclusion on the uses that appropriately reflect the potential for a water body, determining the attainability of those goals, and appropriately evaluating the consequences of a designation, however, can be a difficult and controversial task. Appropriate application of this process involves a balancing of environmental, scientific, technical, and economic and social considerations, as well as public opinion.

Section 131.10 of the regulation describes States’ and authorized Tribes’ responsibilities for designating and protecting uses. The regulation

- requires that States and Tribes specify the water uses to be achieved and protected,
- requires protection of downstream uses,
- allows for sub-category and seasonal uses,
- sets out minimum attainability criteria,
- lists six factors of which at least one must be satisfied to justify removal of designated uses that are not existing uses,
- prohibits removal of existing uses,
- establishes a mandatory upgrading of uses that are existing but not designated, and

- establishes conditions and requirements for conducting use attainability analyses.

In addition, the regulations effectively establish a “rebuttable presumption” that the uses of protection and propagation of fish, shellfish and wildlife, and recreation in and on the water are attainable and should apply to a water body, unless it has been affirmatively demonstrated that such uses are not attainable.

40 CFR 131.10(a) require that States specify appropriate water uses to be achieved and protected. The classification of the waters of the State must take into consideration the use and value of water for public water supplies, protection and propagation of fish, shellfish, and wildlife, recreation in and on the water, and agricultural, industrial, and other purposes, including navigation. Changing designated uses for a specific water body requires a change in the water quality standards. Like all new and revised State and Tribal water quality standards, these changes are subject to EPA review and approval.

Where appropriate, a State may subcategorize or refine the aquatic life use designations for the receiving water. States may adopt subcategories of a use and set the appropriate criteria to reflect varying needs of such subcategories of uses, for instance, to differentiate between cold water and warm water fisheries [see 40 CFR 131.10(c)]. States may also adopt seasonal uses [40 CFR 131.10(f)]. If seasonal uses are adopted, water quality criteria should be adopted to reflect the seasonal uses; however, such criteria shall not preclude the attainment and maintenance of a more protective use in another season.

For example, aquatic toxicity criteria have been modified in the State of Ohio based on refined designated uses. Ohio’s WQS regulations specify that a chronic toxicity level of 1.0 TU_c shall apply outside the mixing zone to warm water, exceptional warm water, cold water, seasonal salmonid, and modified warm water habitat use designations. The chronic toxicity level, however, does not apply to waters designated as “limited resource waters.” (See Ohio Administrative Code Chapter 3745-2-09.)

The Ohio example illustrates how a highly refined, biologically based designated use system can be implemented through refined water quality criteria. It is not an example of a general use system typical to many states. States with a general aquatic life protection designated use must adopt criteria and implementation procedures to apply the protection needed to all waters to which the use applies. Tiered criteria and implementation procedures are only possible where there are tiered uses.

EPA does not believe that tiered aquatic life uses per se can be established solely through an implementation procedure. Any new or revised WQS, including changes to designated uses, must meet the requirements of the regulations at 40 CFR 131.

In the *Strategy for Water Quality Standards and Criteria* (EPA-823-R-03-010), EPA is committed to issuing methods on the use of bioassessments to help states and tribes refine designated aquatic life uses. Further discussion of tiering and subcategorizing uses can be found in *Guidance: Coordinating CSO Long-Term Planning With Water Quality Standards Reviews* (EPA-833-R-01-002).

3 STATE IMPLEMENTATION PROCEDURES TO ENSURE WET CRITERIA ARE MET

The WET approach to toxics control should specify the applicable water quality criterion and the method of interpreting the narrative criterion (see Chapter 2). The approach should also discuss how to select appropriate testing procedures, the duration of the tests (acute or chronic), the test species, the frequency of testing required, and biological and statistical endpoints, as discussed below. The WET approach to toxics control should also specify in writing the procedure for determining when an effluent limit is necessary and how to establish appropriate limits and other permit conditions. These procedures, which should be consistent with 40 CFR 122.44(d)(1), are discussed in Chapters 4 and 5, respectively.

To ensure that the narrative criteria for toxicants are attained, States should develop implementation procedures. Such implementation procedures describe how the State's toxics control program adequately protects the aquatic life and attains the narrative criterion.

3.1 GENERAL RECOMMENDATIONS

3.1.1 Recommendations for NPDES States

States should develop implementation procedures that provide clear direction to permit writers regarding NPDES permit development so the permittee and all stakeholders, including the public, can clearly understand the requirements and expectations contained in the NPDES permit. The implementation procedures should establish the methods to be used for making specific decisions in permits. A decision-tree approach allows permit writers to address each permit in a unique manner, matching the discharge situation to the appropriate implementation procedure scenario, and enabling them to choose the most appropriate permit condition while maintaining program consistency. When establishing permit WET limits and conditions, providing detailed requirements in the permit is essential. The permit should specify the types of requirements listed in Table 1 in this section. Examples of these requirements are provided in Chapter 5, Section 5.1 and Table 2.

Recommended Elements for WET Implementation Procedures

States should specify the following elements when implementing narrative criteria:

- Method of interpreting the narrative criterion, with numeric benchmarks
- Test methods, species selection, sampling type, monitoring frequency, etc.
- RP procedures
- WET limit expression
- Steps to address toxicity

Although Federal regulations require the permit to include limits for WET after RP determination, other decisions are made based on the State's WQSs and implementation procedures. Examples of such decisions are how critical low flow and effluent dilution series are determined; receiving stream aquatic life use designations; frequency of monitoring; use of marine species or freshwater species for testing; sample type, test type, and biological and statistical endpoints; conditions under which acute or chronic testing is required; and the decisional basis for requiring WET limits. Note that states may consider how these above factors would be applied for assessing storm water toxicity or a State's ambient toxicity testing program. A State may recommend different applications of various factors, such as frequency of monitoring, stepwise approach to address toxicity, or different methods of collecting sample renewals for routine versus continuous discharge sources. States should develop written implementation guidance that explains these types of decisions and their rationale, as appropriate. These decisions should be explained clearly in the permit fact sheet to inform the permittee and the public of the basis for decisions about permitting requirements for WET (see Chapter 5, Section 5.4). Permitting authorities should maintain staff with the level of expertise necessary for thorough WET data review when performing RP determinations, compliance monitoring review, and TRES for WET.

| Table 1. Permit Requirements | |
|---|---|
| WET Testing Methods | Test Type |
| Test Statistical Endpoint (LC ₅₀ , NOEC, etc.) | Test Species |
| Sample Type | Test Conditions (e.g., dilution water, temperature, duration) |
| Specify Receiving Water Concentration (RWC) | Effluent Dilution Series |
| Test Acceptability Criteria | Criteria for Test Validity |
| Testing Frequency | Accelerated Testing Requirements |
| Reporting Requirements | Toxicity Reduction Evaluation Requirements |
| WET Limit or WET Numeric Monitoring Trigger | Steps to Address Toxicity |

Ensuring that samples are collected and tested in a manner that is consistent with EPA sampling and testing procedures is critical. Permitting authorities should encourage and work with permittees to ensure they select a laboratory that has qualified staff who follow EPA's WET test methodology (40 CFR 136) and that produces quality test results in a timely and consistent manner. EPA has developed guidance for laboratories, permittees, and regulatory authorities on considering variability in WET testing, including both analytic and effluent variability (USEPA 2000b). Three critical areas are identified to minimize WET test method variability: (1) obtaining a representative effluent sample, (2) conducting the toxicity tests properly to generate biological endpoints, and (3) calculating the appropriate statistical endpoints to enable confidence in the effect concentration. EPA's variability guidance also presents specific guidance for the testing laboratories (see Section 7.2.1 in USEPA 2000b).

As part of the Test Review section of the toxicity test manuals, the test review should be conducted on each test by both the testing laboratory and the regulatory authority. The WET methods require data quality objectives and a quality assurance plan (USEPA 2002b,c). In addition, the WET methods require that each multi-concentration test reported under the NPDES program be reviewed to ensure that calculated test results are interpreted appropriately (USEPA 2000b; 2002a,b,c). The promulgated WET methods specifically require that when NPDES permits specify hypothesis testing endpoints [i.e., NOEC, LOEC using sublethal Methods 1000.0, 1002.0, 1003.0, 1006.0, or 1007.0] the within-test variability must be reviewed and variability criteria must be applied [see Section 10.2.8.2 of WET promulgated methods (USEPA 2002a,b,c)].

3.1.2 Recommendations for EPA Regions

Where the EPA Region is the NPDES permitting authority (e.g., due to non-delegated State NPDES status), the EPA Region shall have written Regional Guidance to implement the Region's WET program for issuing NPDES permits (which are consistent with established EPA guidance, regulations, and policies). The *EPA Regions 9 & 10 Guidance for Implementing Whole Effluent Toxicity Testing Programs* document (USEPA 1996e) is an example. Regions shall implement oversight procedures for approved NPDES States, as well as the following:

- should establish and maintain their expertise through ongoing training of EPA and State permit writers;
- routinely inspect toxicity testing laboratories, or should have a lab certification program similar to those in California or North Carolina;
- review WET test data and TRE/TIE reports;
- review WQSs and implementation procedures for WET;

- review NPDES permits with WET requirements;
- develop Regional WET guidance that is consistent with national EPA regulations, policy, and guidance; and
- review responses to WET violations.

3.2 EPA/NPDES-AUTHORIZED PROGRAM OVERSIGHT

EPA encourages all NPDES permitting authorities to develop WET implementation policies and procedures that are consistent with applicable regulations [see 40 CFR 122.44(d)(1)(ii); 40 CFR 123.22(c); 40 CFR 123.63(5); and 40 CFR 130.5(b)(1)] or amend existing policies and procedures if necessary. Once the permitting authority has developed its WET implementation procedures (including RP determination procedures), the NPDES authority—if it is an authorized State—should submit the procedures to the appropriate EPA Regional Office for review. This submittal may be included as part of an existing Regional NPDES program review or State WQS.

EPA often reviews State determinations on WET when EPA reviews individual State-issued NPDES permits. EPA is authorized to object to permits it finds inconsistent with the requirements of the CWA and is authorized to assume authority for permit issuance in such circumstances.

4 DETERMINING THE NEED FOR WET LIMITS IN NPDES PERMITS

NPDES regulations at 40 CFR 122.44(d)(1)(i) require the establishment of an effluent limit for any pollutant that is or may be discharged at a level that “will cause, have a reasonable potential to cause, or contribute to an excursion above any State water quality standard, including State narrative criteria for water quality (RP determination).” In determining the need for an effluent limit, the permit writer must consider existing controls on other point and non-point sources, the variability of the pollutant or pollutant parameter in the discharge, the sensitivity of the test species (for WET) and, where appropriate and allowed in State WQSs or regulations, the dilution of the discharge in the receiving water [40 CFR 122.44(d)(ii)]. This section presents EPA’s interpretation and application of 40 CFR 122.44(d)(1) with respect to WET RP determination. When the RP determination is demonstrated based on a numeric toxicity criterion, the permit must contain effluent limits for WET [40 CFR 122.44(d)(1)(iv)]. If a State designates a water body for the protection of aquatic life, the permit must include appropriately derived limits to protect that use, regardless of the attainment status of the water body if warranted after the RP determination.

EPA’s TSD provides guidance on how to apply RP requirements. This section reaffirms EPA’s TSD approach to determining RP and suggests additional flexibility when the WET RP determination is based on sparse data sets. Facility-specific effluent monitoring data should be used, where available, to project receiving water concentrations (RWC), which are then compared to applicable water quality criteria for aquatic life. This comparison consists of (1) calculating the RWC threshold in the receiving water after considering dilution (if appropriate and allowed by applicable water quality standards), the contributions of other point and nonpoint sources, and the uncertainty associated with sparse data sets and effluent variability to justify projecting higher effluent concentrations than have actually been measured; and (2) comparing this calculation to the applicable water quality criterion or aquatic life (hereafter referred to in this document to as “toxicity criterion”). Both the TSD and this guidance identify the flexibility to determine the appropriate approach for the RP determination. For example, the NPDES authority may opt to use a stochastic dilution model that incorporates both ambient dilution and effluent variability rather than using a steady-state dilution model with a statistically defined maximum effluent concentration. Also, a permitting authority may determine the need for a WQBEL for WET even in the absence of facility-specific effluent monitoring data. Regardless of which approach the NPDES authority selects, its RP determinations must satisfy all requirements of 40 CFR 122.44(d)(1)(ii) summarized above (see Section 4.3). One of the three outcomes listed in the text box below will be reached when using the TSD procedures:

Three Possible Outcomes of the RP Determination for WET

- Facility has demonstrated it causes or contributes to an excursion above the water quality criterion for WET.
- Facility discharge has reasonable potential to cause an excursion above a water quality criterion for WET.
- Facility discharge does not have reasonable potential to cause an excursion above a water quality criterion for WET.

Whether the permit contains WET limits or WET numeric monitoring triggers (both contain monitoring requirements), the permit conditions should include these two permit requirements when the toxicity that occurs above a limit or numeric monitoring trigger. For example, a test result which is greater than the WET permit limit expressed in toxic units or the numeric monitoring trigger may result in an increase in the WET testing frequency. Any unacceptable test result measured during the period of increased testing frequency may then trigger a requirement to perform a TRE.

4.1 DETERMINING THE NEED FOR PERMIT LIMITS WITH EFFLUENT MONITORING DATA

The need for a WET limit should be determined using a sequential, tiered process (see TSD, Chapter 3 and 40 CFR 132, App. F, Procedure 6). In the first step, historical effluent data for WET and appropriate statistics derived from those data are used to statistically estimate the maximum effluent concentration, which for WET is expressed as acute or chronic toxicity units (unless expressed as an effluent concentration; see Section 1.3 of this document). The uncertainty multiplier multiplies the maximum observed effluent concentration to account for the fact that effluent toxicity monitoring is discontinuous and values greater than those observed could have occurred during the times when the effluent was not being monitored. The uncertainty associated with small samples decreases with increasing sample size. In the second step, this higher concentration (the maximum observed value times the multiplier value) is then used in the mass balance equation to project the maximum resultant in-stream concentration for WET. If the projected in-stream concentration is less than the applicable ambient toxicity criterion, the permit writer must then exercise judgement as to whether RP exists; however, if the estimated in-stream concentration is greater than the applicable criterion, a limit is required.

4.1.1 Characterizing Effluent Quality with Respect to WET

In all RP determinations based on effluent data, only valid and representative data should be used to evaluate the need for a permit limit. An important premise in the TSD and in this guidance is that the effluent pollutant data used to project maximum effluent quality are valid data that are representative of the effluent. Permittees should ensure that their permit applications report valid, representative data [see 40 CFR 122.41(j)(1)]. Where the permittee believes certain effluent measurements are not representative of the effluent, the permittee should notify the permitting authority. If representative facility-specific effluent monitoring data for WET are available from a point source to the waters of the United States, the permitting authority should apply the procedures specified in this guidance or similar State procedure.

4.1.2 Determining Validity of WET Data

A valid WET test is one performed consistently with the procedures specified in 40 CFR 136, that meets all applicable test acceptability criteria (TAC) specified in those procedures, and meets any additional QA/QC and testing requirements established in the permit.

The permittee must submit all WET test results to the permitting authority [40 CFR 122.41(l)(4)(ii)]. The regulations for NPDES permit applications also contain requirements concerning submission of WET data. The regulations at 40 CFR 122.21(g)(11) are for industrial applicants and the regulations at § 122.21(j)(5) are for municipal applicants. Valid, representative effluent data should not be ignored. The permitting authority may require additional information, for example, results of tests determined to be invalid for any reason (e.g., too many control organisms in the test die). If the permittee is concerned about any WET test data or suspects that any data are not valid, the permittee should notify the permitting authority early in the permitting process and should indicate why the permittee considers the data to be invalid. Those data should be provided immediately to the permitting authority for review.

WET tests are deemed invalid when the laboratory does not meet the TAC for the specific method. The permit toxicity language should include a statement requiring that if a test result is invalid, then the permittee must collect another effluent sample and re-test the newly collected effluent sample within a reasonable time period (e.g., less than two weeks). The permittee should schedule tests early enough in the reporting period to allow a re-test when a scheduled test does not meet the TAC.

4.1.3 WET Data Evaluation Checklist

The text box on the next page entitled *Steps for Evaluating WET Data* provides a guide for the permit writer to evaluate and review WET test results. This information should be used as a checklist for individual tests and does not cover the full range of quality control practices necessary for successful completion of test data analysis. EPA also recognizes that individual State programs or EPA Regions may have detailed guidance that is beneficial to ensuring a successful WET program.

4.1.4 Determining Representativeness of WET Data

Effluent data used as the basis for effluent characterization should be representative of the monitored activity (i.e., the discharge under current conditions with current treatment and management practices at the plant) [40 CFR 122.41(j)(1)]. Representative WET data are those WET test results that appropriately characterize the permittee's effluent with respect to ongoing facility operations, including the periodic discharge of toxic pollutants (e.g., seasonal use of biocides). The permitting authority must determine whether available effluent data are representative of the current operating conditions at the facility. For example, data obtained prior to significant treatment, pretreatment, or pollution prevention modifications may no longer be representative of the discharge. Where such are data no longer representative of the current discharge, the permitting authority may choose to exclude such data in the RP determination (i.e., because the data pre-date current operating conditions and treatment at the facility). In this case, the RP determination should be based on data produced subsequent to the modification(s), assuming a sufficient amount of recent representative data has been generated with which to make the RP determination.

Ensuring that data are representative also includes consideration of whether effluent samples are collected, preserved, shipped, and stored in a manner that is consistent with the permit and test method. Samples collected and used for WET testing should approximate, as nearly as possible, effluent effects in the receiving stream. Collection considerations include the use of appropriate collection equipment and sampling location. For example, POTW effluent samples used for WET testing should be collected after the final treatment and before discharge, not prior to chlorination/dechlorination processes. EPA test methodology requires that effluent chlorine residual be determined within 15 minutes of sampling. Samples for WET testing are generally 24-hour composite samples, thus there would be considerable loss of chlorine during sampling and shipping. Therefore, where the effluent contains residual chlorine, samples used for WET testing would generally not be reflective of actual in-stream exposure and test results would not be representative of the effluent's actual toxic potential in-stream. If an effluent is known to contain residual chlorine at levels which may result in unacceptable toxicity in-stream, *in situ* testing is recommended.

Care should also be taken when determining if data are representative where ammonia is controlled or removed from samples used for WET testing. While this practice may be appropriate in some circumstances, it does not apply under all conditions. When ammonia stripping or a CO₂ cap is used to adjust samples for ammonia or pH drift, consideration should be given to the receiving stream conditions, seasonal variations in temperature and pH, and whether test solutions are renewed on a daily basis. Additional EPA guidance regarding representative WET samples and toxicity related to chlorine and ammonia is discussed in Summary Statement No. 7 in EPA's 1994 WET Control Policy (Appendix C of this document) and item number one (pH and ammonia control) in EPA's Policy Memorandum—*Clarifications Regarding Flexibility in 40 CFR Part 136 Whole Effluent Toxicity (WET) Test Methods* (USEPA 1996d). Also see USEPA 2002a, section 9.5.9.

Steps for Evaluating WET Data

Permit Review:

1. Examine the test results to verify that the laboratory is using the test method and dilution series as required in the NPDES permit. The dilution series being tested should always include the receiving water concentration (RWC). Note: This may need to be performed only after a permit has been first issued.
2. Evaluate the test results against the permit requirements for WET to assess whether the limit or numeric monitoring trigger is being achieved. For example, where a WET limit or numeric monitoring trigger is expressed in terms of TUs, then the value is expressed as a value “not to be exceeded.” Where a WET limit or numeric monitoring trigger is expressed in terms of “% effluent at the RWC,” the value is expressed as a value that the % effluent must be at or above.

Test Review:

Test review is an important part of the overall quality assurance program and is necessary for ensuring that all test results are reported accurately. Test review should be conducted on each test by both the testing laboratory and the regulatory authority. Note, see the chapter on Test Review of the specified toxicity test manual.

1. Examine the results to verify the sample was maintained at the proper temperature from time of collection to arrival at the testing laboratory. Also, does the sample meet the test initiation and renewal holding time requirements?
2. Evaluate the test results for the effluent to verify that the laboratory met the TAC as specified in the test method. See the individual “Summary of Test Conditions and TAC” section for each test method. All invalid tests must be repeated with a newly collected sample, as specified in permit.
3. Examine the “Summary of Test Conditions and TAC” section for the specific method to determine whether the required and recommended test conditions were met. Below is a single example for a required test condition and a recommended test condition that would be specific to the particular toxicity test method listed in the permit.
 - a. Did the laboratory conduct the test using the required test conditions? Some of the test conditions listed are specified as “required” and therefore the condition must be met. For example, did the test use the required minimum number of replicates, number of test organisms, test type, etc.? All required test conditions must be met or the test is considered invalid and must be repeated with a newly collected sample.
 - b. Did the laboratory conduct the test using the recommended test conditions? Some of the test conditions listed are specified as “recommended” and therefore the range should be obtained. For example, when the test method specifies number of test organisms per test chamber, the test condition will provide a recommended number of test (e.g., 10 larvae per test chamber), as recommended. A testing laboratory can use more than the recommended number of test organisms per chamber as long as the loading capacity is maintained.
4. Examine the statistical results to verify the recommended flowcharts for statistical analysis were followed. Any deviation from the recommended flowcharts for selection of statistical methods should be noted in the data report.
5. Examine the concentration-response relationships as these must be reviewed to ensure that calculated test results are interpreted appropriately. All WET test results (from multi-concentration tests) reported under the NPDES program should be reviewed and reported according to USEPA guidance on the evaluation of concentration-response relationship (see USEPA 2000c).
6. Test review of a given effluent or receiving water test should include review of the associated reference toxicant test and current control chart. Were out-of-control reference toxicant test results evaluated to determine appropriate corrective action?
7. The within-test variability of individual tests should be reviewed. When NPDES permits require sublethal hypothesis testing endpoints from Methods 1000.0, 1002.0, 1003.0, 1006.0, and 1007.0 (e.g., growth or reproduction NOECs and LOECs), within-test variability must be reviewed and variability criteria must be applied as described in the Method Manuals Section on Test Review.

Effluent toxicity monitoring data should be generated before permit limit development for the following reasons:

- The presence or absence of effluent toxicity can be more clearly determined.
- Effluent variability can be more clearly defined.
- A TRE can be initiated by the permittee to discover and control toxicity, thus possibly eliminating the need for a WET limit by identifying a specific chemical that may be limited instead, if the State has a narrative criterion for WET. 40 CFR 122.44(d)(1)(v).
- Required to complete the NPDES permit application package.

When a permittee has a limited amount of valid WET data in advance of the permit application or modification, permittees are encouraged to gather additional WET data from the permittee. The use of larger data sets of 10 data points or more decreases the uncertainty associated with small sample sizes and removes reliance on the default assumptions about variability associated with reliance on fewer than 10 data points. As discussed in more detail below in Section 4.1.5, the permitting authority may opt to use an alternative approach which allows up to 18 months to gather and analyze the recommended minimum of 10 valid WET data points for the most sensitive species (where authorized by State WQSs or permitting regulations).

4.1.5 Accounting for Effluent Variability

RP determinations based on very few data points, using the statistical procedure described in this guidance (and essentially similar to the procedures described in the TSD), can result in conservative projections about possible effluent toxicity and thus may result in unnecessary permit limits. The procedures in this guidance are designed to estimate a projected effluent value at a specified percentile and confidence level based upon whatever representative effluent data are available. For example, when a small data set is being used to make this projection, or in the extreme case, where only one data point is being used, the projected effluent quality using EPA's recommended procedure will be 6.2 times the observed value [assuming a coefficient of variation (CV) of 0.6 and a 95th percentile confidence level]. This statistical procedure remains valid even for very small data sets. EPA also recognizes that the more data there are to characterize a discharge, the more accurate the projected effluent pollutant distribution will be.

Where dischargers are concerned that the results of the statistical analysis using a small data set (e.g., a single valid and representative data point) result in a conservative decision, the discharger can remedy the situation by collecting more effluent samples and reporting additional WET test results to the permitting authority prior to permit issuance or re-issuance. EPA encourages this practice. Effluent data in the vast majority of cases become available to the permitting authority via reporting by the discharger. In other words, the discharger almost always has the same effluent data that the permitting authority has and the permittee is in the best position to remedy any perceived inadequacy in the data set presented to the permitting authority.

To further reinforce the goal that RP determinations be based on the most accurate projected effluent distribution possible, where the statistical RP procedure projects the need for a new or more stringent WET limit based on a small data set, EPA suggests that the permit specify a period of time (not to exceed 18 months) for the permittee to collect the additional WET effluent data before the limit becomes effective (when allowed by the applicable State water quality standards). If sufficient additional data are

collected prior to the WET limit becoming effective, the larger data set will project a more accurate estimate of effluent quality and therefore, the initial (more conservative) RP determination based on the small data set and a high factor for uncertainty will no longer be necessary. Where the discharger reports only a single valid and representative data point, however, such data must not be ignored.

Limited amounts of test data result in greater uncertainty about the effluent's potential to impair receiving waters. EPA's statistical approach accounts for effluent variability and the uncertainty associated with small data sets to project an estimated upper confidence bound on a 95th or 99th percentile estimated maximum concentration for the effluent. The estimated maximum concentration is calculated as the upper bound of the expected lognormal distribution of effluent concentrations at a high confidence level (e.g., 95 percent or 99 percent). The projected effluent concentration after consideration of dilution, where allowed and appropriate, can then be compared to an appropriate water quality criterion to determine the need for a WET limit (the RP determination).

For $n < 10$ (thus when a CV of 0.6 is used), the RPMF will decrease with increasing sample size, n . When $n \geq 10$, the facility-specific CV will determine the RPMF. For $n > 10$, the RPMF will tend to decrease as n increases. RPMF will not necessarily decrease as n is increased because the CV, mean, and standard deviation are random variables that can change as observations are added. However, these quantities will be more precisely determined from more data, and the RPMF will tend to decrease as n increases above 10. A minimum of 10 data points should be used to determine the variability of effluent, because this reduces the uncertainty (of CV and variance) associated with small data sets. The fact sheet should emphasize that if more data are gathered, the RPMF will decrease predictably for $n < 10$ (and CV = 0.6) and will tend to decrease for $n > 10$ (using a site-specific CV), making it less likely that the RP procedure will indicate a need for a WET limit, but the fact sheet should then also note that the sample maximum may increase with n .

Municipalities are required to submit at least four WET tests with their NPDES application [40 CFR 122.21(j)(5)]; however, permittees may be able to reduce the RPMF further by providing additional test data (for $n < 10$), either by performing additional tests prior to submitting their permit application for renewal, or by taking advantage of the optional WET data gathering schedule under a new permit, as presented in this document. Permittees should assess the amount of WET data on hand 24 months prior to their permit expiration date which are not older than five years. Permittees should ensure that they have at least 10 valid test results for the most sensitive species by performing voluntary testing to make up the difference. The additional tests should be performed with at least 30 days between test initiation dates. The results of all voluntary tests performed must be submitted for review [see 40 CFR 122.41(j)].

Determining whether a WET limit is needed in a permit requires an understanding of how the quality of the effluent varies over time. EPA's guidance document on WET variability (USEPA 2000b; see specifically Sections 6 and 7) recommends several methods for minimizing variability in WET test used to characterize effluent discharges. In addition, test review is an important part of the overall quality assurance program. (see text box *Steps for Evaluating WET Data*).

4.2 APPROACHES FOR DETERMINING THE NEED FOR A WET LIMIT AND SETTING WASTELOAD ALLOCATIONS FOR TOXICITY AND PERMIT LIMITS

The permitting authority has the flexibility to determine the appropriate approach for assessing the need for a WET limit. This is best accomplished through a decision-making process, based on availability of valid WET data, for determining whether the discharge has the reasonable potential to cause or contribute to excursions above the narrative toxicity criteria. Figure 2 of this document illustrates the decision-making process outlined in this document in Chapters 4 and 5.

The permit limit derivation procedure used by the permitting authority should result in limits that adequately account for effluent variability, consider available receiving water dilution (where allowed and appropriate), protect against acute and chronic toxicity, account for compliance monitoring sampling frequency, and achieve the wasteload allocation (WLA) and, ultimately, protect the applicable water quality standards. The objective of EPA's statistical procedure for the WET RP determination is to provide an upper confidence bound for a percentile. To accomplish these objectives, permitting authorities should use the statistical permit limit derivation procedure discussed below with the outputs from either steady-state or dynamic WLA modeling. For lognormally or normally distributed data, Hahn and Meeker (1991) provide a parametric procedure for the upper confidence bound of a percentile.⁷ This procedure would be an acceptable alternative to the TSD procedure when the number of observations is greater than one.

EPA emphasizes that determining appropriate exposure assumptions, and providing the best estimate possible of the effect of the discharge on the receiving water during the worst expected exposure conditions, is a critical step in determining the need for effluent limits and establishing appropriately protective WET limits. Two major types of water quality models are used to develop WLAs: steady-state and dynamic. Traditional single- or two-value steady-state WLA models calculate aquatic life WLAs at critical conditions, using worst-case assumptions for flow, effluent, and environmental effects.

4.2.1 Dynamic Modeling

Dynamic or probabilistic models are a potentially useful tool for implementing water quality criteria, especially for those criteria protecting aquatic life. EPA considers dynamic models to be a more accurate approach to implementing water quality criteria and continues to recommend their use. Dynamic models make the best use of the specified magnitude, duration, and frequency of water quality criteria and, therefore, provide a more accurate representation of the probability that a water quality standard exceedence will occur. These models provide a way to incorporate site-specific data. Dynamic modeling does require a commitment of resources to develop appropriate data. (See Chapter 4 of the TSD for details on the use of dynamic models.)

Dynamic modeling should be used to determine the need for a WET limit when adequate information on receiving water flow, effluent flow, and toxicity is available to estimate frequency distributions with a high degree of confidence. (See Box A in Figure 2.) Dynamic modeling techniques incorporate the effects of variable receiving stream and effluent flow and toxicity regimes to calculate the frequency and duration of exposure at various levels. To determine the need for a WET limit appropriately, dynamic modeling requires substantial amounts of high-quality data, collected over a long period of time. If such data are not available, the water quality projections calculated by dynamic models may be inaccurate and steady-state models should be used.

Dynamic models simulate the entire distribution of RWCs (expressed as a probability distribution over time or a time series), rather than a single "worst case" based on assumed critical conditions. Water quality criteria for aquatic life generally are expressed as concentrations not to be exceeded for more than 1 hour average in 3 years for acute criteria or 4 days average in 3 years for chronic criteria. If a dynamic model simulation concludes that a toxicity concentration will be exceeded in the receiving water for longer than allowed by the applicable water quality criterion, reasonable potential to cause an exceedence exists. Consequently, a permit limit is necessary. (See Box B in Figure 2.)

Dynamic models have received increased attention as a result of the widespread belief that steady-state modeling is over-conservative due to conservative dilution assumptions. This belief has led to the

⁷ Statistical Intervals: A Guide for Practitioners. 1991. Gerald J. Hahn and William Q. Meeker. New York: Wiley.

misconception that dynamic models will always lead to less stringent NPDES effluent limits than steady-state models, which is not true in every application of dynamic models. Steady-state models frequently apply a number of simplifying, worst-case assumptions that makes them less complex but also potentially less accurate than dynamic models. EPA recognizes that the amount of data required to make use of dynamic models will likely greatly limit their use for most WET RP determinations. Thus, steady-state models continue to be used for the great majority of WET RP determinations. RP determinations and WET limits should not be delayed while data required for dynamic models are collected.

4.2.2 Steady-state Modeling

Steady-state WLA analyses should be used by permitting authorities, especially where few or no WET measurements are available, or where daily receiving water flow and effluent flow records are not available.

Permit limits derived from a steady-state model are designed to be protective of water quality standards at critical conditions and all environmental conditions less than critical. Steady-state models calculate the effects of toxicity by assuming that the effluent discharge is constant and is rapidly and completely mixed with the receiving water. This type of model requires single, constant inputs for effluent flow, effluent concentration, background RWC, and receiving water flow. The frequency and duration of ambient concentrations predicted with a steady-state model must be assumed to equal the frequency and duration of the critical RWC used in the model. Steady-state models should be used when the amount of valid WET test results is limited or when a daily flow record is not available. (See Box A in Figure 2.)

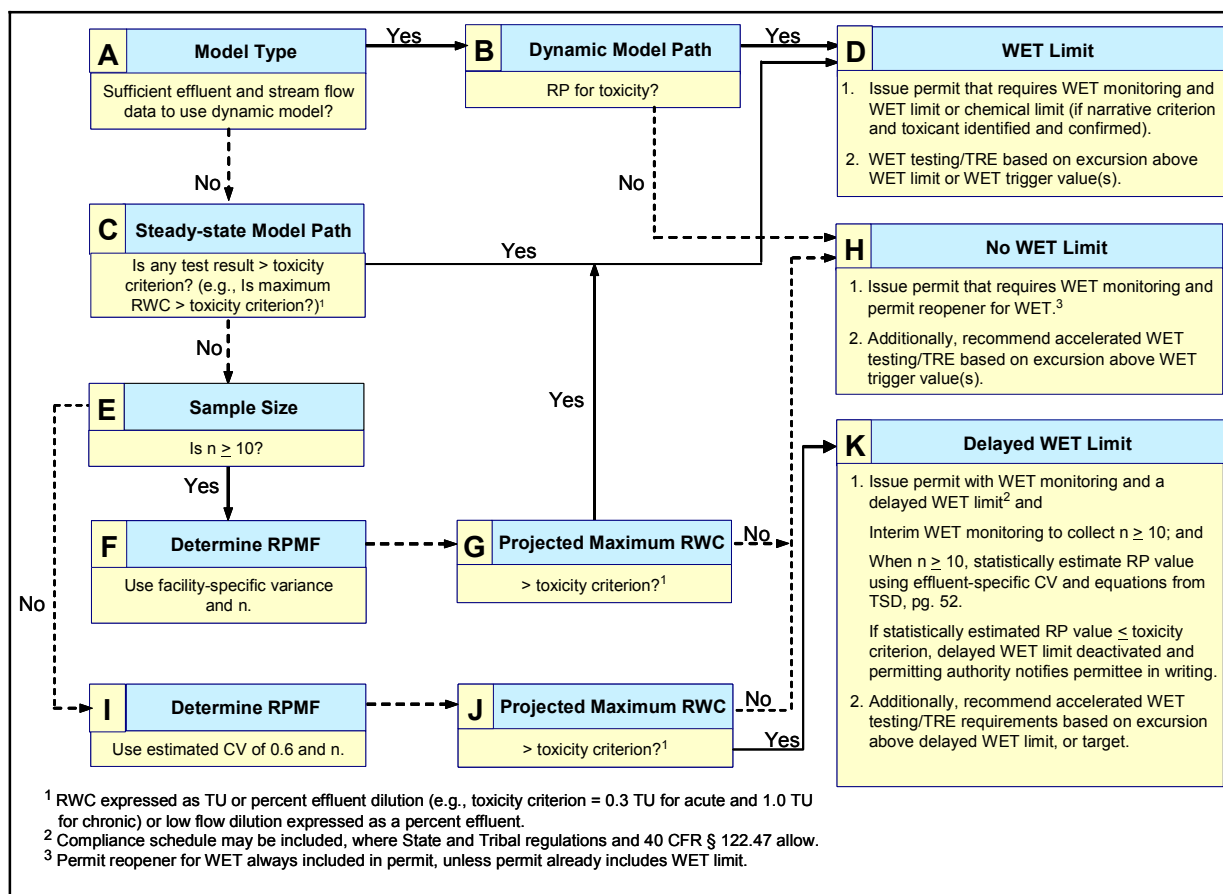


Figure 2. WET reasonable potential flowchart.

Below is an example of a simple steady-state model that takes into consideration the effects of dilution in the receiving water.

$$RWC = \frac{Q_e C_e}{Q_e + (pmf)Q_s}$$

where:

- RWC = Receiving water concentration, the resultant magnitude of toxicity in the receiving water after effluent discharge in TUs (also known as the in-stream waste concentration)
- Q_e = Effluent flow in MGD or cfs
- C_e = Effluent concentration; magnitude of WET expressed in TUs (e.g., highest TU value observed in the effluent) (Note: When toxicity test results are expressed as NOEC % effluent, $C_e = 100/\text{NOEC}$, where NOEC is the lowest NOEC result observed in units of % effluent.)
- pmf = Partial mix factor, percent of Q_s allowed for mixing by State authority
- Q_s = Receiving water flow in MGD or cfs (the 1Q10 for acute and the 7Q10 for chronic should be used when using hydrologically based flow and the 1B3 and the 4B3 when using biologically based flow.⁸ (See text box for EPA's recommendation for determining biologically based flow.)

EPA's Recommendations for Determining Appropriate Stream Design Flow in Steady-state Modeling

In the document, *Technical Guidance Manual for Performing Wasteload Allocation. Book IV: Design Conditions, Chapter 1*, EPA discusses and recommends two methods for determining design flows, the hydrologically based method and the biologically based method, and the flows that should be used for both the CCC and CMC. For wasteload allocation studies in which the hydrologically based method is used, EPA recommends the use of the 1Q10 flow as the design flow for the CMC and the 7Q10 as the design flow for the CCC. The biologically based method makes exact use of whatever duration and frequency are specified in the CMC and CCC. For wasteload allocations using the biologically based flows, EPA recommends the use of the 1B3 for CMC and 4B3 for the CCC or site-specific durations and frequencies.

With respect to determining the most appropriate stream design flow, EPA recommends using DFLOW. DFLOW 3.0 is a Windows-based tool developed to estimate user selected design stream flows for low-flow analysis and water quality standards. This latest version can be readily used by permit writers in State and EPA Regional offices, modelers, or anyone else interested in calculating design flow statistics. DFLOW inputs daily stream flow records (such as those records from the systematic data collection program maintained by the USGS) and calculates user-specified biologically based design flows, hydrologically based design flows, harmonic flows, and percentile flows. DFLOW can simultaneously determine and compare various design flow statistics for numerous water bodies. DFLOW is available at <http://epa.gov/waterscience/dflow/>.

⁸ The 1Q10 and 7Q10 are both hydrologically based design flows. The 1Q10 is the lowest 1-day average flow that occurs (on average) once every 10 years. The 7Q10 is the lowest 7-day average flow that occurs (on average) once every 10 years.

The 4B3 is a biologically based 4-day average flow event that occurs (on average) once every 3 years. The 1B3 is a biologically based 1-day flow event that occurs (on average) once every three years.

EPA has developed the following three-step approach to using a steady-state model and facility-specific WET data to determine whether a discharge causes, has reasonable potential to cause, or contributes to an excursion above a numeric or narrative toxicity criterion. This approach assumes a lognormal distribution of effluent data. (The basis for assuming lognormality of WET data is included in EPA's TSD, Appendix E, pages E-6 through E-10 and Tables E-1 through E-3.)

Step 1. Determine whether a discharge causes an excursion above numeric or narrative water quality criteria for aquatic life (i.e., toxicity). When assessing the need for a WET limit using a steady-state model, the equation for determining the resultant RWC for WET after effluent discharge is:

$$RWC = \frac{QeCe}{Qe + (pmf)Qs}$$

The value used for Ce is the maximum observed TU value. Once RWC is calculated, this magnitude is compared to the toxicity criterion. If the calculated magnitude of the RWC is greater than the toxicity criterion (e.g., $RWC > 0.3 \text{ TU}_a$ for acute toxicity or $RWC > 1.0 \text{ TU}_c$ for chronic toxicity), the discharge causes an excursion above the toxicity criterion (see Box C in Figure 2), and a WET limit is necessary (see Box D in Figure 2).

Regulatory authorities should calculate the facility-specific CV using point estimate techniques to determine the need for and derive a permit limit, even if the permit compliance monitoring test results will be determined using hypothesis test procedures (USEPA 2000c, see sections 3.4.1 and 6.2). Point estimates make the best use of the WET test data for purposes of estimating the CV, LTA, and RP factor and calculating the permit limit.

Alternatively, if the calculated magnitude of RWC is less than or equal to the toxicity criterion (e.g., $RWC \leq 0.3 \text{ TU}_a$ or $RWC \leq 1.0 \text{ TU}_c$), the discharge does not cause, but may still have reasonable potential to cause, an excursion above the toxicity criterion. The permitting authority then evaluates whether the discharge has reasonable potential to cause an excursion above the applicable toxicity criterion based on the sample size [i.e., the number of available WET data points (n), see Box E in Figure 2].

Step 2. Determine whether a discharge has reasonable potential to cause an excursion above numeric or narrative water quality criteria for aquatic life (i.e., toxicity). EPA's statistical approach for determining whether a discharge will have reasonable potential to cause an excursion above a water quality criterion is outlined below and described in Section 3.2.2 of the TSD. This approach accounts for effluent variability and uncertainty associated with small effluent data sets by calculating a projected effluent value associated with the upper 95-percent or 99-percent confidence bound representing the 95th or 99th percentile of the lognormal distribution. Censored data may be encountered in WET test results. These are data reported as "greater than" or "less than," for example "> 100% effluent" or "< 6.25% effluent." Such data would be expressed in toxic units for reasonable potential calculations ("< 1.0 TU_c " or "> 16.0 TU_c "). It is not appropriate to ignore such data or assign an arbitrary value such as detection limit or one-half the detection limit, and to then proceed with calculations as if such values were uncensored data. Two reasonable methods are available for accommodating censored data in calculations used to determine reasonable potential and permit limitations (see text box *Treatment of Censored Data Sets*).

Steps for determining RP using a reasonable potential multiplying factor (RPMF) are described below. Permitting authorities also can calculate RP multipliers directly using the equations in Appendix E

of EPA's TSD. The RPMF is a function of the number of WET tests (n); the TSD recommends use of a default value of $CV = 0.6$ if n is less than 10. The process is described below (*NOTE: Use point estimates rather than NOEC for these calculations*):

- a. If 10 or more valid, facility-specific WET data points for the most sensitive species are available ($n \geq 10$), calculate the facility-specific variance of $\log(TU)$ or $\log(\text{concentration})$ using the equations in EPA's TSD (Appendix E, page E-8, page E-15) (see Box F in Figure 2). [Do not calculate variance from the CV as shown in Box 5-2 (page 100).]

-or-

- b. If fewer than 10 valid, facility-specific WET data points are available ($n < 10$), the permitting authority should use the recommended default CV of 0.6. This CV is an empirical estimate of effluent variability in relation to the mean developed using WET data presented in EPA's TSD, Appendix A (see Box I in Figure 2).

Treatment of Censored Data Points

1. The delta-lognormal method described in the TSD (USEPA 1991a) may be applied, provided there is only one censoring level, for example, 100% (1 TU_c). The delta-lognormal is expected to provide reasonable estimates for the mean and variance, even if the distribution is a mixture of a lognormal and a point mass at the censoring level. For the case of one or more censoring levels, one should consider the ROS method (below) or maximum likelihood methods (Cohen 1991).
2. The regression-on-order-statistics (ROS) methodology is expected to provide reasonable estimates for the mean, variance, and possibly for high percentiles (Helsel and Cohn 1988, Hirsch and Stedinger 1987, Kroll and Stedinger 1996, Shumway et al. 2002). These authors evaluated the method for estimating the 90th percentile with small ($n = 10$) samples. For higher percentiles, we are not aware of any similar evaluations, but one must expect greater variability than reported for the 90th percentile. The ROS method accommodates multiple detection limits. Be warned that the articles by Helsel and Cohn (1988) and Hirsch and Stedinger (1987) contained an inaccurate formula for C_j , and the articles did not address ties in uncensored observations or the occurrence of uncensored observations below the lowest detection limit. The formula for C_j is: $C_j = B_j - (A_j - 1 + B_j - 1)$, where $A_0 = B_0 = 0$.
3. If the frequency of data at a detection limit is greater than expected from the censoring of a single parent distribution, a mixture model may be needed. The ROS method is not intended to deal with this situation. The delta-lognormal method (USEPA 1991a) and the approach described by Taylor et al. (2001) are two ways of handling this situation

Cohen, A.C. 1991. Truncated and Censored Samples. New York: Marcel Dekker.

Helsel, D.R., and T.A. Cohn. 1988. Estimation of Descriptive Statistics for Multiply Censored Water Quality Data. Water Resour. Res. 24:1997–2004.

Hirsch, R.M., and J.R. Stedinger. 1987. Plotting Positions for Historical Floods and Their Precision. Wat. Resour. Res. 23:715–727.

Kroll, C.N., and J.R. Stedinger. 1996. Estimation of Moments and Quantiles Using Censored Data. Wat. Resour. Res. 32:1005–1012.

Shumway, R.H., R.S. Azari, and M. Kayhanian. 2002. Statistical Approaches to Estimating Mean Water Quality Concentrations with Detection Limits. Environ. Sci. Technol. 36:3345–3353.

Taylor, D.J., L.L. Kupper, S.M. Rappaport, and R.H. Lyles. 2001. A Mixture Model for Occupational Exposure Mean Testing with a Limit of Detection. Biometrics 57:681–688.

The next step is to use Chapter 3 of the TSD to obtain an RPMF for the 99th percentile (see Table 3-1 of the TSD) or the 95th percentile (see Table 3-2 of the TSD), using the number of WET data points and the CV determined by (a) or (b) above. These values can then be used to calculate the *RWC* with the following equation:

$$RWC = \frac{Qe(rpmf)Ce}{Qe + (pmf)Qs}$$

In this case, *Ce* will be the projected 95th or 99th percentile and is the product of the RPMF and the observed maximum TU value. Once *RWC* is calculated, this magnitude of toxicity is compared to the appropriate toxicity criterion.

If $n \geq 10$ and

- the calculated toxic magnitude of *RWC* is greater than the toxicity criterion (e.g., *RWC* > 0.3 TU_a for acute toxicity or *RWC* > 1.0 TU_c for chronic toxicity), the discharge has reasonable potential to cause an excursion above the toxicity criterion (see Box G in Figure 2). A WET limit is necessary (see Box D in Figure 2).
- the calculated toxic magnitude of *RWC* is less than or equal to the toxicity criterion (e.g., *RWC* ≤ 0.3 TU_a or *RWC* ≤ 1.0 TU_c), the discharge does not have reasonable potential to cause an excursion above the toxicity criterion. A WET limit need not be established (see Box H in Figure 2), and the permit should contain a monitoring-only requirement on WET, with numerical WET triggers for conducting accelerated testing and/or a TRE.

If $n < 10$ and

- the calculated toxic magnitude of *RWC* is greater than the toxicity criterion (e.g., *RWC* > 0.3 TU_a or *RWC* > 1.0 TU_c), the discharge has reasonable potential to cause an excursion above the toxicity criterion (see Box J in Figure 2). A WET limit must be established. *This limit may be a delayed WET limit, as described in Section 5.3.2 of this guidance* (see Box K in Figure 2).
- the calculated toxic magnitude of *RWC* is less than or equal to the toxicity criterion (e.g., *RWC* ≤ 0.3 TU_a or *RWC* ≤ 1.0 TU_c), the discharge does not have reasonable potential to cause an excursion above the toxicity criterion. A WET limit is not necessary (see Box H in Figure 2). The permit should contain a monitoring-only WET requirement.

Step 3. Determine whether a discharge *contributes to an excursion above numeric or narrative water quality criteria for aquatic life (i.e., toxicity)*. In two situations, the permitting authority may assess the facility's contribution to excursions above toxicity criteria:

1. If a facility discharges to a receiving water that is known or believed to have toxicity from other sources (as discussed in Section 3.3.4 of the TSD); or
2. If the permitting authority has no knowledge of or data on the presence or absence of toxicity in the stream.

Because each effluent discharge may contain various toxic substances, a mixture of the effluents in a receiving water produces a mixture of these individual pollutants. The cumulative toxic effect of the

discharge on levels of toxicity in the receiving water can be measured by a WET test that uses upstream receiving water as dilution water for the test. The aggregate toxic effect of the discharge and receiving water levels of toxicity may be additive, synergistic, or antagonistic. WET testing that uses receiving water as dilution water (where controls are valid) accounts for toxicity present in the receiving water, as well as the toxic assimilative capacity or mitigating effects of the receiving water. To determine the need for a WET limit for these types of facilities, see Steps 1 and 2 above.

When conducting an RP determination with facility-specific effluent monitoring data, the permitting authority should provide in the permit fact sheet an adequate basis of how the requirements of 40 CFR 122.44(d)(1)(ii) were satisfied, particularly how the need for a WET limit was determined using the available valid and representative WET data.

4.3 DETERMINING THE NEED FOR PERMIT LIMITS *WITHOUT* EFFLUENT MONITORING DATA

If a regulatory authority chooses, or if the situation warrants it (i.e., past compliance history or documented information on the facility's operation that is known to cause toxicity), the permitting authority may decide to develop and impose a limit for WET without facility-specific toxicity effluent monitoring data, or prior to the generation of effluent data. In doing so, the regulatory authority must satisfy all the requirements of 40 CFR 122.44(d)(1)(ii). Should the permit writers choose to impose permit limits using this approach, they should present a clear rationale in the permit fact sheet for the approach.

When determining whether or not a discharge causes, has the reasonable potential to cause, or contributes to an excursion of a narrative or numeric water quality criterion for individual toxics or toxicity, the permitting authority can use a variety of factors and information where facility-specific effluent monitoring data are unavailable. These factors should also be considered with available effluent monitoring data. These factors include the following factors, which are described in detail in the TSD (Section 3.2):

- Dilution
- Type of industry
- Type of publicly owned treatment works
- Existing data on toxic pollutants
- History of compliance problems and toxic impact
- Type of receiving water and designated use

The presence of a combination of the factors described above, such as low available dilution, high-quality receiving waters, poor compliance record, and clustered industrial and municipal discharges, could constitute a high priority for effluent limits for WET (i.e., based on a reasonable potential for toxicity). If the permitting authority chooses to impose an effluent limit without facility-specific effluent monitoring data, it will need to provide adequate justification for the limit in the permit fact sheet. *However, the permitting authority should obtain facility-specific WET monitoring data before permit re-issuance.* The permitting authority may obtain these data through the information gathering authority under CWA Section 308, or similar State authority.

5 DEVELOPMENT OF WET REQUIREMENTS IN NPDES PERMITS

This chapter describes the elements that should be covered in a NPDES permit for WET, such as the derivation and expression of the permit limit, the expression of a monitoring trigger, application of the mixing zone if applicable, testing frequency, and steps to address toxicity such as accelerated testing and TRE triggers. Based on the outcome of the RP determination (Chapter 4), the only difference in the outcome is whether a WET limit or numeric monitoring trigger is based on State WQS. The derivation of the WET limit or numeric monitoring trigger procedure is the same as described in the TSD.

5.1 PERMIT DOCUMENTATION RECOMMENDATIONS

Recommendations for NPDES permits are made to ensure that the permit provisions and requirements avoid ambiguity, provide clear instructions or guidance to the permittee on the intended expectations, and ensure enforceability. permits should be issued with the following requirements stated in the permit (see Table 2). The examples provided are not necessarily recommendations. They are intended to represent the specific type of condition a permitting authority might require to meet the permit requirement. Below are a few of the types of conditions to be considered for inclusion in a permit:

- **Test species/methods.** Toxicity testing species and methods should be accurately referenced in the permit.
- **Frequency.** States should require permittees to monitor regularly for toxicity and ensure that the frequency of monitoring appropriately and adequately characterizes and represents their effluent, taking into consideration all pertinent features of the facility's entire operation and production.
- **Number of Species.** A minimum of three species should be tested (invertebrate, vertebrate, plant), at least through the screening phase. A minimum of three screening tests is recommended in order to determine the most sensitive species for continued monitoring. See the TSD (Section 1.3.4, page 16) for further details.
- **Quality Assurance/Quality Control (QA/QC).** The permit should specify that if the TAC or required test conditions of the WET test manual are not achieved, then the permittee must collect an additional effluent sample and conduct a new test within at least two weeks.
- **Toxicity Reduction Evaluation/Toxicity Identification Evaluation (TRE/TIE) Language.** The permit should reference the appropriate TRE/TIE documents and numerical TRE triggers, including significant dates. Limits should be written with numerical TRE triggers. Note: Regardless as to whether the permit contains a WET limit or a WET numeric monitoring trigger both need to discuss steps to address toxicity including accelerated testing and TRE triggers. A meeting with the permitting authority should be held near the beginning of the TRE (EPA 2001a). TREs that fail to identify and reduce or eliminate the source of toxicity such as TREs that do not meet established targets (e.g., an action level for the permit when the permit does not have a WET limit) are incomplete and typically should continue until all goals are met. Also, inconclusive TIE results should lead investigators to seek assistance from others with additional experience, such as experts at EPA Headquarters or Regional offices or State or local experts.

Table 2. WET Permit Requirements and Examples of Conditions

| Permit Requirement | Example Condition |
|--|--|
| WET Testing | WET numeric monitoring triggers or limits (MDL/AML/MML) with accelerated testing triggers |
| Test Type | Acute/chronic and marine/freshwater with reference to specific test and appropriate WET method manual |
| Test Statistical Endpoint | LC ₅₀ , NOEC, IC ₂₅ |
| Test Species | Invertebrate, vertebrate, plant |
| Sample Type | Grab/composite (duration and minimum number of sub-samples for composites) |
| Dilution Water | Uncontaminated receiving water or lab synthetic of similar pH and hardness |
| Critical Low-flow Dilution | < 1 percent – 100 percent |
| Effluent Dilution Series | 0%, 12.5%, 25%, 50%, 75%, 100% or or 0%, 4%, 8%, 16%, 32%, 64% |
| Test Acceptability Criteria | All criteria required by the test methodology, plus any additional requirements established by the permitting authority |
| Test Validity | A valid WET test must be submitted for each species during each reporting period for that species |
| Testing Frequency | See EPA's 1991 <i>Technical Support Document</i> (U.S. EPA 1991a) |
| Accelerated Testing Requirements | 6 additional tests at 14-day intervals for the affected species, required after exceeding a WET permit limit or WET numeric monitoring trigger |
| Reporting Requirements | Permit Compliance System (PCS) reporting codes associated with test endpoints |
| Toxicity Reduction Evaluation Requirements | Mandatory initiation of TRE study and reporting for failure of any additional tests in the accelerated testing mode |

- **WET Limits.** The limit established in the permit should be based on a statistical derivation procedure that adequately accounts for effluent variability. The permit should include a maximum daily limit and an average monthly limit (AML) or monthly median limit (MML) for a low-flow receiving water body.
- **Triggers.** Whether the permit contains WET limits or WET numeric monitoring triggers (both contain monitoring requirements), the permit conditions should include these two requirements when toxicity occurs above a limit or monitoring trigger. For example, a test result which is greater than the WET permit limit expressed in toxic units or the monitoring trigger may result in an increase in the WET testing frequency. Any unacceptable test result measured during the period of increased testing frequency may then trigger a requirement to perform a TRE.

5.2 DERIVATION AND EXPRESSION OF PERMIT LIMITS

When deriving water quality based effluent limits (WQBELs) for NPDES permits, the regulatory authority needs to examine the State's applicable water quality criterion for aquatic life, the State's mixing zone policy, and the permit limit derivation procedures to express the appropriate permit limits or numeric monitoring triggers.

5.2.1 Permit Limit Derivation Procedures

WQBELs are based on maintaining effluent quality at a level that will comply with applicable State water quality criteria for aquatic toxicity, even during critical low flow conditions in the receiving water. These effluent limits are based on the allowable effluent loading concentration or wasteload allocation (WLA). Pollutant WLAs can be adjusted for effluent variability using statistics calculated from historical effluent data. These adjusted WLAs define the desired levels of performance, or targeted LTA discharge conditions for specific applicable criterion effect levels (i.e., acute or chronic). Permit limits for WET are calculated using statistics derived from historical effluent data and the most limiting target LTA to protect both acute and chronic toxicity criteria. NPDES regulations require both an AML and a maximum daily limit for WET, unless otherwise specified by State WQS. Section 5.4.1 of the TSD provides general guidance for permitting authorities developing and implementing two-value, steady-state water quality based effluent limits for acute or chronic toxicity. These procedures are described in Appendix A of this document.

5.2.2 Mixing Zone Application in WET Permit Conditions

When deriving permit limits, mixing zones are considered based on available assimilative capacity based on dilution, and where appropriate and allowed, under State water quality standards and regulations. If mixing zones are not allowed by State regulations for acute or chronic toxicity, then the appropriate criterion (acute or chronic) must be applied at the end of the pipe. Even though a State's WQSs may allow the consideration of mixing zones, they may not be appropriate under certain circumstances. Such circumstances include discharges to ephemeral streams (when the receiving water provides no dilution) or to a receiving water that has no capacity to assimilate additional toxic loads (i.e., the ambient toxicity of the water upstream of the discharge point is equal to or exceeds the WQS for toxicity). If considering the effects of a mixing zone at a discharge location is not appropriate, the discharge must comply with the water quality criterion for toxicity at the end of the pipe.

When allowed to be considered by State procedures or water quality standards, the effect of mixing can be determined by either dynamic or steady-state modeling. Permitting authorities should consider all available relevant data and information, including biological information from the receiving stream, where appropriate, when establishing the exposure assumptions used to determine whether the discharge will cause, have reasonable potential to cause, or contribute to an excursion above the applicable water quality standard, including State narrative criteria for water quality.

5.2.3 Expression Of Permit Limits

WQBELs for WET must be consistent with State water quality standards, expressed as the monthly or daily values developed using the steady-state statistical approach, or other methods as previously discussed. The NPDES regulations at 40 CFR 122.45(d) require that all permit limits be expressed, unless impracticable, as both an AML and a maximum daily limit for all discharges other than those for POTWs and as an average weekly limit (AWL) and average monthly limits for POTWs. The use of an AWL is not appropriate for WET. The maximum daily limit is the highest allowable discharge measured during a calendar day or 24-hour period representing a calendar day. The permit should contain a notation indicating that the maximum daily limit is interpreted as signifying the maximum test result for that month unless otherwise specified by the State's WQS. The AML is the highest allowable value for the average of daily discharges obtained over a calendar month. For WET this translates into the average of the toxicity test result(s) over a 30-day average. As discussed more fully below, in cases where little dilution is available, or where State standards do not allow mixing zones, the average monthly limit should be expressed as a monthly median.

5.2.4 EPA's Recommendation for Deriving Permit Limits for Low-Flow Dilution Situations

Under some discharge scenarios [e.g., low-flow receiving water body, absence of a mixing zone/dilution policy approved by EPA under CWA Section 303(c)], mixing zones/dilution credits may not be authorized by the permitting authority and State water quality criteria are applied to NPDES discharges without allowing for mixing/dilution with the receiving water body. Currently, States have different approaches for expressing WQBELs for chronic toxicity under these discharge scenarios. In this policy, EPA continues to recommend that numeric WQBELs for chemicals and WET be established using statistical procedures outlined in Section 5.4.1 and Tables 5-1 and 5-2 of the TSD. In addition, this policy expands upon existing TSD guidance (Sections 5.4.2 and 5.7.4) related to implementation considerations unique to WET when a mixing zone/dilution allowance is not authorized for a NPDES discharge.

Where EPA's recommended 1.0 TU_c for chronic toxicity and 0.3 TU_a acute toxicity are applied to a NPDES discharge without a mixing zone/dilution allowance, this policy continues to recommend that maximum daily limits be set in accordance with statistical procedures for calculating maximum daily limits (see TSD Section 5.4.1 and Tables 5-1 and 5-2). For example, when using the 99th percentile to calculate the long term average and an effluent CV of 0.6, the maximum daily limit for chronic WET is 1.6 TU_c and the AML is to 1.0 TU_c (see Appendix B of this document).

Toxicity limits are to be expressed as maximum daily limits and monthly average limits (AML). For the WET AML, The calculation of the AML should be specified in the permit using the median instead of the mean. The median is the middle of the distribution, above and below which lies an equal number of values. Federal regulations at 40 CFR 122.41(1)(iv) specify that the calculation for all limitations that require averaging of measurements shall use an arithmetic mean (i.e., average), unless otherwise specified by the Director in the permit.

EPA expands upon its earlier guidance regarding the use of statistics for calculating an AML when applied in the absence of a mixing zone/dilution allowance because quantifying 1.0 as an average is not mathematically feasible when the first toxicity test is greater than 1.0. Setting a median monthly limit rather than an average monthly limit for chronic toxicity allows for a compliance determination based on multiple toxicity test results from effluent samples collected during a one-month period, while continuing to protect against short-term excursions above the chronic criterion of 1.0 TU_c . This recommendation is to be considered only under these conditions:

1. Establish the monthly effluent limit magnitude at 1.0 TU_c , rather than a statistically calculated magnitude, which is less than 1.0 (see Appendix B).
2. Apply the monthly median to the magnitude of 1.0 TU_c , rather than the traditionally recommended monthly average.
3. Use in conjunction with a maximum daily limit statistically calculated for chronic WET using TSD procedures.
4. Rely upon the basis that the permittee conducted three-species screening to ensure that the most sensitive species is used for routine toxicity testing.

To ensure that a monthly median limit of 1.0 TU_c is protective of the water quality criterion for chronic toxicity, discharge permits issued under this recommendation should include all four components. Further, EPA emphasizes that applying a monthly median of 1.0 TU_c without also applying a maximum daily limit for chronic toxicity that is statistically calculated using TSD procedures is toxicologically

unprotective. Finally, EPA notes that States may continue to establish a monthly average effluent limit for chronic toxicity of 1.0 TU_c, in lieu of a monthly median limit. As described in the TSD (Section 5.7.4), an effluent with a NOEC > 100% contains < 1 TU_c and would meet EPA's recommended 4-day average CCC of 1.0 TU_c for chronic toxicity, if no dilution were available.

5.3 PERMIT CONDITIONS FOR POSSIBLE OUTCOMES OF A REASONABLE POTENTIAL DETERMINATION

This section discusses the possible outcomes of an RP determination for WET and the appropriate permit conditions to be used in NPDES permits based on the amount of WET data made available to the permitting authority before and during permit development.

The three possible outcomes of an RP determination for WET are:

- Facility has demonstrated it causes or contributes to an excursion above the water quality criterion for WET,
- Facility discharge has reasonable potential to cause an excursion above a water quality criterion for WET, or
- Facility discharge does not have reasonable potential to cause an excursion above a water quality criterion for WET.

Two possible scenarios exist with respect to WET data when determining RP as described above in the second bullet. These two scenarios are:

- Reasonable potential is demonstrated based on a data set of at least 10 valid and representative toxicity data points, or
- Reasonable potential is demonstrated based on fewer than 10 valid and representative WET data points.

Note, regardless of the three possible outcomes of an RP determination, each will require some level of toxicity testing with either limits or monitoring triggers and steps to address toxicity if the limits or triggers are exceeded. NPDES permits should include WET limits or numeric monitoring triggers to accelerate the WET monitoring frequency for a specified time period following the exceedence of either the limit or monitoring trigger. NPDES permits should also include a TRE trigger to address the continued toxicity as demonstrated in the accelerated testing mode based on a specific number of toxicity test failures within a specific period of time. Monitoring and reporting requirements, as well as the term of the TRE, should be established within the permit (USEPA 2001a).

5.3.1 Permit Conditions for an Excursion above the Applicable Toxicity Water Quality Standard or for the Reasonable Potential for an Excursion above the Applicable Toxicity Water Quality Standard

If the permitting authority determines that the WET of a facility's discharge is or will be discharged at a level that causes or contributes to an excursion above a narrative or numeric water quality criterion for aquatic life (i.e., toxicity), it must establish a WQBEL in the permit [40 CFR 122.44 (d)(1)(i)]. Or if the regulatory authority has demonstrated that reasonable potential exists where an effluent, in conjunction with other sources of a pollutant, is statistically projected to cause an excursion above the narrative or numeric water quality criterion for aquatic life (i.e., toxicity) using data sets of at least 10 data

points, it must establish a WQBEL in the permit. This projection is based upon an analysis of available data that accounts for limited sample size and effluent variability, as well as consideration of such other factors as the type of facility; existing data on toxic pollutants; type of receiving water and designated uses; and/or compliance history of the facility, as noted in the TSD. Under either scenario—an excursion above the water quality criterion or the reasonable potential to cause an excursion above a water quality criterion—a WQBEL must be established. The WQBEL must be a WET limit, if the State has numeric toxicity criteria [40 CFR 122.44(d)(1)(iv)]. If the State has narrative toxicity criteria and the permitting authority can demonstrate in the fact sheet that a chemical-specific limit(s) is sufficient to attain and maintain applicable water quality standards, appropriate chemical-specific limits can be established in lieu of a WET limit [40 CFR 122.44(d)(1)(v)]. This provision would apply when the permittee has identified and confirmed the chemical(s) resulting in an excursion above the applicable WQS. In addition to the limit, EPA recommends continued WET monitoring and testing triggers in case of a re-occurrence of an unacceptable level of toxicity. For this situation, the permit should be issued with the following:

- A WET limit or a chemical limit with WET numeric monitoring triggers (if the toxic has been identified and confirmed) and compliance monitoring requirements.
- A compliance schedule (if appropriate and where schedules are allowed under applicable WQSs or permitting regulations).
- Accelerated WET testing based on an exceedence of the WET limit or WET numeric monitoring trigger. EPA’s “step-wise approach” to permitting also includes a requirement for accelerated monitoring as a first response to an exceedence of an effluent limit or numeric monitoring trigger. If a first test result is higher than the maximum daily limit or the multiple test results are above the AML, accelerated monitoring for six additional tests bi-weekly over a twelve-week period should occur, beginning within two weeks of the first exceedence of a WET limit or a numeric monitoring trigger.
- TRE triggers are based on an exceedence of the WET limit or numeric monitoring trigger and any toxicity observed in the accelerated tests. In response to continued toxicity, the permit should require that, if the results of any one of the six additional toxicity tests exceed the limit or numeric monitoring trigger, the permittee implement corrective actions identified in a TRE. The purpose of a TRE is to investigate the causes of, and identify corrective actions to reduce, effluent toxicity. A TRE is a site-specific study conducted in a stepwise process to identify source(s) of toxicity and the effective control measures for effluent toxicity. TREs are designed to identify the causative agents of WET, evaluate the effectiveness of the toxicity control options, and confirm the reduction in effluent toxicity. When the source of toxicity is identified and controlled or eliminated, WET RP can be reassessed. A period of up to 24 months should be reasonable to complete a TRE and a shorter period may also be appropriate on a case-by-case basis.
- Requirements for a WET trigger, WET monitoring, and a permit reopener for WET limits if a chemical-specific limit is used in lieu of a WET limit. A permit reopener is a permit clause that stipulates that the permit may be reopened to modify or add permit conditions (in this case, WET permit conditions).

5.3.2 Permit Conditions When Reasonable Potential Is Demonstrated with Fewer than 10 Valid WET Data Points

When a permittee has submitted fewer than 10 valid and representative WET test results, if RP exists after application of the appropriate statistical procedures referenced above, Federal regulations

require a WET limit in the permit. In such cases, where State water quality standards authorize a compliance schedule for toxicity, permitting authorities may consider incorporating a delayed effective date that allows time for the permittee to gather up to 10 samples to be used to validate the finding of the need for a permit limit based on a facility-specific coefficient of variation (as opposed to reliance on the assumed default value of 0.6 otherwise recommended for when there are fewer than 10 data points).

First, allowing the permittee more time to gather additional data enabling an estimate of effluent-specific variability is reasonable. Because the optional data collection opportunity would delay effectiveness of the WET permit limit, the opportunity itself probably constitutes a “schedule of compliance” as defined in the NPDES regulations in that the gathering of facility-specific data could be considered “remedial” (at least from the perspective of a permittee seeking to avail itself of the opportunity) [40 CFR 122.2]. The schedule for data gathering will lead to “compliance,” either because any result exceeding the delayed limit would result in the limit becoming effective, or because, if the facility-specific data demonstrate that a WET limit is not necessary, the permittee would have demonstrated that the limit was unnecessary [40 CFR 122.47(a)]. Second, the compliance schedule regulation requires that any schedule of compliance be “as soon as possible” but not later than the applicable deadline, in this case, in a state water quality standard or implementing regulations for toxicity. Any such data gathering schedule will be necessarily limited by the duration of time necessary to gather up to 10 valid and representative data points; more than 10 data points is unnecessary to determine a facility-specific coefficient of variation. See Section 4.1.5 of this document and the TSD, Appendix E, pg. E-5.

Allowing the permittee up to 18 months would be reasonable, depending on how many additional WET tests were necessary to obtain up to 10 valid and representative WET test results. A schedule allowing up to three months per additional data point necessary to characterize an effluent-specific coefficient of variation could reasonably be shown to be “as soon as possible” within the meaning of 40 CFR Part 122.47(a)(1) to collect the additional data. A reasonable period of time to collect additional data based on the expected sampling interval and the number of additional samples to be collected should be established in the permit. Eighteen months is a reasonable maximum amount of time to collect the additional data and is also consistent with existing sample collection requirements for WET reasonable potential determinations. The NPDES permit application regulations at 40 CFR Part 122.21(j)(5)(iv)(A) require POTWs to provide the results of a minimum of four quarterly WET tests for a year as part of their permit application.⁹ The 18-month period of time provides for an additional 6 WET tests to be conducted at the same quarterly monitoring frequency. Anything greater than 18 months would probably be unreasonable, because permittees are often expected to collect WET data at a much shorter sampling interval.¹⁰

With a more comprehensive set of valid and representative data to characterize the effluent-specific coefficient of variability, the permittee could then conduct a re-assessment of calculations used to determine the need for the WET limit, and thus, determine whether the WET limit goes into effect. All testing and data analysis would need to be completed prior to the WET limit effective date. The WET limit would become effective on its effective date, however, if the re-analysis (using the 10 or more data points) supports the original finding of the need for a WET limit, or if any test demonstrated toxicity at a level that would result in an excursion above the State water quality criterion for aquatic life protection.

⁹ Alternatively, the permittee may submit 4 tests taken over a longer period of time, if certain conditions apply, see 40 122.21(j)(5)(iv)(B).

¹⁰ For example, the recommended monitoring frequency for accelerated testing, as described in Section 5.4.1 of this guidance is 6 additional tests to be performed in 14-day intervals.

This delayed WET limit option should be available in the context of a compliance schedule (for a water quality-based effluent limit in a NPDES permit) but only when each of the following conditions is met:

- without accounting for effluent variability (see Section 4.2.2 Step 1), the discharge would not cause or contribute to an excursion of the applicable water quality criterion for toxicity, because the collection of more data to better characterize effluent variability will not change the outcome of the determination that a WET limit is necessary;
- the permittee has generated fewer than 10 valid WET test results for the most sensitive species, because EPA recommends the minimum of 10 data points to determine effluent variability using a facility-specific coefficient of variation (for more explanation see Section 4.1.5 of this document and the TSD, Appendix E, pg. E-5);
- State water quality standard or implementing regulations do not otherwise preclude a delayed effective date for the WQBEL, (i.e., where State water quality standards authorize a compliance schedule for toxicity);
- the permittee is an existing discharger, because compliance schedules are generally not available for new sources, new dischargers, and recommencing dischargers per 40 CFR Part 122.47; and
- the WET limit being imposed in the permit is a new limit or a revised limit that is more stringent than the previously effective limit.

A WET test, unlike a chemical-specific test, measures the combined toxic effect (additivity, antagonism, and synergism) of an effluent with a complex mixture of constituent parameters. Thus, the toxicity measured by WET may be the result of multiple causative agents that each individually vary over time. Those causative agent(s), however, may be identified (e.g., through a TRE/TIE) and expressly and specifically limited in the permit, in which case, the NPDES permit could impose a chemical-specific limit (or limits) to control that toxicity and that permit need not include a WET limit to achieve the applicable narrative water quality criterion [40 CFR 122.44(d)(v)]. Such a delayed conditional limit is appropriate for the parameter WET because it provides a means to collect more data to provide a better estimate of effluent variability. The use of the delayed conditional limit only for WET and not for other chemical-specific limits is recommended: (1) because WET is a function of multiple chemicals in the effluent that each individually vary over time, more WET data will result in a better estimate of effluent toxicity over time; and (2) the alternative opportunity to control toxicity via chemical-specific limits exists when the causative toxicant can be identified and controlled.

If the reasonable potential determination conducted at the end of the time period demonstrated that the discharge did not cause, have reasonable potential to cause, or contribute to excursions above water quality criteria for aquatic life (i.e., toxicity), the permitting authority could then remove the effluent limit through a permit modification or include a provision in the permit that would provide for automatically deactivating the effluent limit. In this case, monitoring only would be required for WET, with a trigger for accelerated WET testing and/or a TRE in the event of a future demonstration of an unacceptable level of toxicity. When using the automatic deactivation option, the permitting authority would need to be very clear in the permit language and fact sheet when describing precisely the criteria for deactivating the WET effluent limit. For example, the permit might state that

“Each WET test result will be reported on the DMR the month after the month in which the test was performed. In its discretion, the permittee may elect to collect additional samples for WET measurement at a frequency higher than otherwise required by *[insert monitoring*

frequency provision.] If the permittee collects a minimum of [insert # representing 10 minus # of data points upon which WET limit decision was based] valid WET test results by [insert date not to exceed 18 months after permit issuance], then the additional analysis may be conducted enabling re-evaluation of the extent to which the discharge will cause, has the reasonable potential to cause, or contribute to an excursion above the [insert “numeric” or “narrative”] water quality criterion for aquatic life. If the permittee obtains more than [insert # representing 10 minus # of data points upon which WET limit decision was based] data points during this period, all valid data points must be used in the re-calculation. The re-calculation must be performed according to the procedure specified at [insert section and item number] of this permit. If the re-calculation confirms that the discharge has reasonable potential to cause an excursion of [insert applicable WQ aquatic life criterion for WET], the WET effluent limitation will become effective on the date specified in [specify part of permit that includes the limit and its effective date]. If the re-calculation shows that reasonable potential does not exist, the effluent limitation for WET does not become effective. The permittee shall promptly notify the [permitting authority] of the results of the re-calculation. The permitting authority may review the re-calculation of reasonable potential for WET, including upon request by the permittee. Any conclusions regarding the re-calculation by the permitting authority, however, do not represent final agency action. The re-calculation opportunity is not available if the permittee does not collect the additional samples for measurement as described above, or if any of the samples, in fact, causes an excursion above the [insert “numeric” or “narrative”] water quality aquatic life criterion for WET.”

In either case, the permitting authority should acknowledge the reassessment and indicate in writing whether the reassessment changes the status of the WET limit. Note that, if the effluent limitation has never gone into effect, an anti-backsliding analysis is not necessary.

To track the status of a delayed WET limit, the WET limit should be entered into the NPDES national database, Permit Compliance System (PCS), like any other effluent limit. Every effluent limit in PCS has a “modification number.” For a delayed WET limit, the initial limit entered is automatically given a modification number of zero or a “mod 0.” Only key information and monitoring requirements for the permittee will be initially tracked. The delayed WET limit should be entered as a “mod 1” limit with the mod limit start date being up to 18 months after the effective date of the permit and the mod limit end date being equal to the “mod 0” end date, usually the permit expiration date. If monitoring results indicate the WET limit is unnecessary, the permitting authority should delete the delayed WET limit (“mod 1” limit).

Where State water quality standards preclude delaying the effective date of a permit limit (i.e., because State WQS do not authorize a compliance schedule for toxicity) and the data available at the time of permit issuance support the need for a WET limit, the permit must include a WET limit effective upon the effective date of the permit.

When fewer than 10 valid WET data points exist and RP has been demonstrated (based on the statistical methodology of the TSD, or an equivalent approved methodology) to exceed the narrative or numeric toxicity criteria within a State’s WQSs, The permit should contain the following (see Box K in Figure 2):

- A WET limit effective up to 18 months after permit issuance to allow the permittee to obtain 10 valid test results. Provisions should include the requirement to discontinue the 18-month allowance if, during the WET data collection, a WET test failure occurs or if the permittee fails to provide the 10 valid WET data points. The WET limit remains effective if the 10 valid WET data points confirm that the initial RP determination is correct.

- A condition that the WET limit may be re-evaluated if a data set of at least 10 valid WET data points for the most sensitive species is submitted by the date stated in the permit or to determine whether to modify the permit to remove the WET limit.
- Permit language specifying that the permittee will be notified if the permitting authority deactivates the WET limit because the results of the WET RP re-evaluation based on a larger data set result in an RP determination that warrants removal of the WET limit.
- A permit re-opener clause to remove a WET limit and/or add a chemical-specific limit (see Footnote 3 in Figure 2) that is adequately outlined in the permit for the permittee and the public (to satisfy public notice requirements).
- The permittee may still collect additional data and seek a permit modification to remove the WET limit if a reasonable potential re-calculation based on the larger data set (described above) demonstrates that reasonable potential no longer exists.

In addition, a permitting authority may use the approach of accelerated WET testing and TRE as permit requirements triggered by or based on exceedence of the WET limit or may require accelerated WET testing and a TRE/TIE through a CWA Section 308 information request or an enforcement order. A permittee may elect to conduct TRE/TIE activities whenever toxicity is demonstrated without direction from the permitting authority.

5.3.3 When Reasonable Potential for WET Is Not Demonstrated With Sufficient Data Sets

If the permitting authority determines that a discharge from a facility has no reasonable potential (with data sets of 10 or greater) to cause an excursion above a narrative or numeric water quality criterion for aquatic toxicity, then a QBEL for WET is not necessary. Even where reasonable potential to cause an exceedence of water quality criteria does not exist, regular WET monitoring should be performed for the life of the permit. Regular monitoring is especially important if the facility is a POTW that may have unforeseen toxicity related to new industrial users, or an industrial facility adding processes or chemicals not previously introduced into their system (see Section 5.4).

The permitting authority should establish appropriate monitoring requirements and a re-opener clause in the permit (see TSD, Chapter 3.3.3). A re-opener clause authorizes “re-opening” the permit and establishing additional permit conditions based on monitoring results or other new factors that indicate that the effluent may cause, have the reasonable potential to cause, or contribute to an excursion above applicable water quality standards. When permits are “re-opened” in this manner, permitting authorities typically impose QBELs for WET and/or require a permittee to perform a TRE.

When RP is not demonstrated, the permit should include requirements for the following (see Box H in Figure 2):

- Routine WET monitoring that adequately characterizes the effluent discharge to ensure that the WLA is not exceeded and to support an RP determination at permit re-issuance.
- Recommendations for accelerated WET testing and a TRE based on the exceedence of the permit-specified WET numeric monitoring trigger.
- A permit re-opener clause to allow the permitting authority to open the permit and modify it to include WET limits, should unacceptable levels of toxicity be demonstrated in future testing.

5.4 MONITORING FREQUENCY RECOMMENDATIONS

Once the need for a WET limit or monitoring requirement has been determined, the frequency of WET testing must be determined. The frequency for monitoring pollutants or pollutant parameters such as WET should be determined on a case-by-case basis, and decisions for setting the monitoring frequency should be set forth in the permit fact sheet. Some States have their own recommended sampling guidelines that can help a permit writer determine an appropriate monitoring frequency. The intent is to establish a frequency of monitoring that will detect most events of noncompliance without requiring needless or burdensome monitoring (see Table 3).

As discussed in the EPA Permit Writer's Manual (U.S. EPA 1996a)¹² to establish a monitoring frequency, the permit writer should estimate the variability of WET. A highly variable discharge should require more frequent monitoring than a discharge that is relatively consistent over time (particularly in terms of flow or observed toxicity). In addition to the estimated variability, other factors that should be considered when establishing appropriate monitoring frequencies include type of treatment process; environmental significance and nature of the pollutant or pollutant parameter; past compliance record/history; cost of monitoring relative to dischargers capabilities; number of monthly samples used in developing the permit limit; and for intermittent dischargers, the frequency of the discharge (see also TSD, page 113, Section 5.7.5).

| Table 3. Likelihood of Detecting at Least One Toxic Event Using n Observations, For Specified True Rates of Occurrence | | | |
|---|---|------------|------------|
| Number of Observations, n | True Probability of Occurrence^a | | |
| | 10% | 20% | 30% |
| 1 | 0.10 | 0.20 | 0.30 |
| 2 | 0.19 | 0.36 | 0.51 |
| 3 | 0.27 | 0.49 | 0.66 |
| 4 | 0.34 | 0.59 | 0.76 |
| 5 | 0.41 | 0.67 | 0.83 |
| 6 | 0.47 | 0.75 | 0.88 |
| 8 | 0.57 | 0.83 | 0.94 |
| 10 | 0.65 | 0.89 | 0.97 |
| 12 | 0.72 | 0.93 | 0.99 |
| 16 | 0.81 | 0.97 | 0.99 |
| 20 | 0.88 | 0.99 | 0.99 |

^a Assumes (i) negligible serial correlation among observations, and (ii) true rate of occurrence remains the same over time. Probability of occurrence is stated as a percentage of the possible independent sampling events.

¹² See Section 7.1.2, pp.119 – 122.

Regulatory authorities should also consider the risks associated with infrequent WET monitoring, whether the testing is routine or accelerated. Table 3 provides information on the likelihood of detecting at least one toxic event based on a specified true rate of occurrence. The true probability of occurrence refers to the probability that toxicity will be observed at the relevant permit limit or numeric trigger expressed in TUs, using a particular WET method.

For example, suppose the (unknown) probability is 0.20 (e.g., probability of occurrence is 20%) that the NOEC for a chronic *Ceriodaphnia* test will occur at or above the permitted TU value. Then, if testing is performed once per quarter ($n = 4$), the a probability that, in the course of one year, at least one of the four tests will demonstrate a toxicity at or above the permitted TU value is 0.59. The same would apply to monitoring once per year for four years ($n = 4$). As another example of the same true probability of occurrence (20%), quarterly monitoring for three years ($n = 12$) would be expected to exhibit at least results exceeding the permitted TU value with high probability (0.93).

A permit writer may also establish a tiered monitoring schedule that reduces or increases monitoring frequency during a permit cycle. Tiered monitoring, which reduces monitoring over time, may be appropriate for discharges where the initial monitoring shows compliance with effluent limits. The permit should establish a monitoring frequency with a permit clause that would allow a decrease in the testing frequency after at least 20 observations (e.g., 20 independent toxicity test results) are measured and are not deemed toxic (i.e., below the effluent limit or numeric monitoring triggers as specified in the permit) within a four-year period (see Table 3). If a facility expects any changes in inputs or facility treatment, the facility discharge should be assessed for the continued assumption of no toxicity at the higher level of testing frequency to obtain a data set ($n = 20$) based on these new treatment changes before consideration of reduced frequency. Another factor to consider before reducing the frequency of testing is whether the facility has a consistent effluent stream (i.e., no changes in facility inputs or facility treatment changes). Whether the facility is a POTW or an industrial facility should be considered. By the nature of user input to the system, POTWs often produce varying concentration of toxicants and varying types of toxicants can change readily. Therefore, some level of frequency is always necessary to assess the continued potential for a toxic effluent exposure. Factors in favor for minimal level of testing frequency for POTWs are those with no industrial inputs and those with a small discharge volume relative to the volume of the receiving water body. As discussed in Section 5.4.1 below, permits should establish triggers to increase the monitoring frequency of WET testing after a demonstration of an unacceptable level of toxicity (i.e., above the permit limit or numeric monitoring trigger expressed in TUs or as an RWC).

5.4.1 Monitoring Frequency for Accelerated Testing

As previously noted, permits should require numerical triggers to accelerate WET testing for the affected species after a demonstration of an unacceptable level of toxicity (i.e., above the permit limit or numeric monitoring trigger expressed in TUs or RWC). The number of tests and duration of testing should be adequate to establish the presence of continued toxicity in order to perform a TRE. Following notification that a test failure has occurred (and that the failed test met all test acceptability criteria), the permit should trigger at least 6 additional tests, to be performed at 14-day intervals. The recommendation of a minimum of 6 additional tests is based on the probability of encountering at least one exceedence assuming a true, but unknown level of occurrence, as shown in Table 3 above.

5.5 TOXICITY REDUCTION EVALUATION/IDENTIFICATION STUDIES

The purpose of a TRE is to investigate the causes of, and identify corrective actions to reduce, effluent toxicity that may cause or contribute to an excursion above a State water quality criterion for aquatic toxicity. A TRE is a site-specific study conducted in a stepwise process to identify toxics and sources, and

to narrow the search for effective control measures for effluent toxicity. TREs are designed to identify the causative agents of WET, evaluate the effectiveness of the toxicity control options, and confirm the reduction in effluent toxicity. TREs can vary widely in complexity, ranging from simply changing housekeeping procedures to conducting TIEs. The basic numerical TRE trigger, requirements, and objectives should be specified in the permit.

Where toxicity is demonstrated at an unacceptable level (i.e., above the permit limit or numeric monitoring trigger expressed in TUs or RWC) and in any subsequent test performed within accelerated testing mode (the period of triggered increased testing frequency), a TRE should be required. Unless revised in writing by the (permitting authority) the following apply when a TRE is triggered:

- Notice of TRE implementation should be submitted to *(agency contact)* within 10 days of activation of this TRE trigger.
- A TRE Schedule and TRE Action Plan should be submitted to *(agency contact)* within 60 days of the initiation of the TRE.
- The term of the TRE is up to 24 months as follows: The “TRE initiation date” should be the initiation date of the test that confirms toxicity and the “TRE termination date” should be the date up to 24 months from the TRE initiation date.
- A Quarterly TRE Progress Report should be submitted with the DMR to *(agency contact)* at the end of each quarter, based on the TRE initiation date. The progress report should list all activities and findings related to resolution of toxicity, including all WET and chemical test data. The data summaries of the TRE should also be provided in tabulated format with explanations of procedures and findings. Any exceedence of a WET monitoring or permit limit should be reported within 5 working days to the permitting authority. A Final TRE Report should be submitted to *(agency contact)* within 45 days of the TRE termination date. The Final TRE Report should summarize the TRE activities and findings, propose the corrective action(s) to be taken, and propose a schedule to complete any identified corrective action.
- During the TRE, the minimum monitoring frequency for the *(affected species)* is *(once per X)*. However, the permitting authority recommends additional testing, which may include streamlined tests using a single dilution and control, to find toxic samples to work with.
- All samples used for WET testing during the TRE should be analyzed for any toxicant which is identified as being suspect. If later testing dismisses the toxicant as probable, the analysis may be discontinued if the findings are documented in the Quarterly TRE Progress Report. The objective of this testing is to ascertain whether the same level of toxicity occurs when the suspect toxicant level varies. This information may lead to finding additional toxicants or confirming or eliminating the suspect toxicant.
- Where toxicity is intermittent (i.e., occurs at infrequent intervals) the *(permitting authority)* may include these requirements based on best professional judgement.
- This TRE trigger and the actions are the initial responses to the confirmation of a demonstrated toxicity above the WET limit or WET numeric monitoring trigger. These actions do not constitute a compliance order nor do they preclude enforcement action.

EPA has published several guidance documents for conducting TREs and TIEs, which may be performed as part of a TRE. These documents should be reviewed before committing resources to a

particular course of action in the TRE and, as necessary, when performing the TRE. Additional guidance may be available through toxicity specialists in EPA Regions or some NPDES State agencies.

Generally, a TRE may translate into an additional permit control—(a WET limit, a chemical-specific limit, or a direct requirement to reduce or eliminate toxicity). For more information on TREs, see relevant published EPA guidance and other guidance available at <http://www.epa.gov/owm> and <http://www.epa.gov/waterscience/WET>.

When the source of toxicity is identified and controlled or eliminated through a TRE/TIE, WET RP can be reassessed. As discussed in Section 5.3.2 above, to ensure data are representative of the discharge, the reasonable potential reassessment requires at least 10 new data points for the most sensitive species obtained after the TRE is successfully completed. If these new data indicate that the toxicity is eliminated, the permittee may request that the WET limit be removed from the permit at permit renewal or as described in Section 5.3.2 of this document.

6 CONCLUSION – EPA RECOMMENDATIONS TO REGIONS AND NPDES STATES

This document was prepared to address implementation of whole effluent toxicity (WET) tests in the NPDES permits program. The document has three major goals as outlined in Chapter 1 of this document and discussed in further detail in subsequent chapters: (1) *National Consistency* (framework for a nationally consistent WET program); (2) *NPDES Regulatory Compliance* (to re-emphasize compliance with existing NPDES regulations, especially with respect to determining the need for a WET limit while allowing flexibility that is still consistent with regulations); and (3) *Emphasis on Existing Guidance, Policy, and Regulations* (restate and clarify existing guidance, policy, and regulations). The guidance also outlines EPA's step-wise approach and clarifies what this approach is (and what it is not) in order to avoid potential misinterpretations of what is appropriate (and what is not).

6.1 GENERAL NPDES WET PROGRAM RECOMMENDATIONS AND REQUIREMENTS

- **Water Quality Standards** — States should develop (and seek EPA approval of) WQS and WQS implementation procedures in order to appropriately develop NPDES permits. State WQS, including designated uses, should be appropriate and well developed for each receiving water. States should consider incorporating schedules of compliance as part of their WQS and implementing WET regulations to fully take advantage of the recommendations in this guidance (i.e., delayed WET limit to allow for permittee to collect additional WET data when there are less than 10 valid and representative WET data points are available).
- **Monitoring** — States should require permittees to monitor regularly for toxicity and ensure that the frequency of monitoring appropriately and adequately characterizes and represents their effluent, taking into consideration all pertinent features of the facility's entire operation and production.
- **Representative and Valid WET Effluent Data** — States should encourage permittees to collect sufficient effluent samples at an appropriate frequency before permit development so that permit writers are provided a sufficient number of representative and valid WET data points to conduct an RP determination for the need of a WET limit (i.e., ideally 10 or more data points per effluent discharge point before permit issuance) (see USEPA 1995a). WET data should be generated such that the number of data points is 10 and that the data have been accumulated over a year or more to fully characterize effluent variability over time. The sampling dates and times should span a sufficient duration to represent the full range of effluent variability, and the samples must be tested according to EPA's WET test methods in 40 CFR 136.
- **EPA's Technical Support Document for Water Quality-based Toxics Control** — EPA's TSD recommendations should be implemented. The TSD's statistical approach is appropriately protective, regarding both effluent and analytical variability, provided that the criteria and WLA are derived correctly. The TSD encourages permittees to have 10 or more WET data points but maintains that even with little or no WET data, other circumstances, when considered collectively, may warrant inclusion of a WET limit.
- **NPDES WET Program Implementation** — States should strive to incorporate EPA guidance into their NPDES WET programs and at a minimum ensure that their State regulations and law are consistent with the CWA and with EPA's NPDES regulations.
- **WET Training** — States should provide adequate training or seek out available training (i.e., other Federal, State, private, or non-profit resources) for their new and existing permit writers and laboratory inspectors on WET to ensure that permits are appropriately developed and WET

laboratory are operating properly in order to generate valid WET data. EPA's Web site at <http://www.epa.gov/npdes> provides links to the EPA's NPDES basic permit writer's course, which includes a module on WET.

- **EPA Guidance, Policy, and Publications** — States should access current documents available from EPA or through EPA's Web site at <http://www.epa.gov/npdes/pubs> to ensure that both the permit writers and permittees have the same information from which to develop permits and can benefit from the recommendations provided in EPA guidance, policy, and other WET technical publications.
- **Communication** — States and their permittees should communicate regularly and proactively, especially when the permit writer or the permittee are concerned about permit requirement(s) during the permit development process or if the permittee is concerned about the representativeness or validity of their effluent WET data to be submitted (or already submitted).

6.2 SPECIFIC RECOMMENDATIONS ON WET EFFLUENT TEST DATA USED FOR DETERMINING RP

- **Laboratory Selection** — Permittees should choose laboratories such that the data analysis is done by one qualified toxicity testing laboratory for determining reasonable potential, deriving permit limits, and generating self-monitoring test results. All effluent testing must be conducted consistently with the EPA test manuals. In addition, the report must include reference toxicant tests in accordance with EPA test method manuals.
- **Laboratory Performance** — States should inspect and audit WET testing laboratories' SOPs and QA/QC control charts.
- **WET Test Data Review** — Permitting authorities and permittees should review WET test data submitted to ensure that they meet specified effluent holding times, temperature, laboratory control limits, and test acceptability criteria (TAC), and review test requirements.

6.3 GENERAL RECOMMENDATIONS FOR DEVELOPING VALID AND REPRESENTATIVE WET NPDES PERMIT LIMITS, NUMERIC MONITORING TRIGGERS AND/OR OTHER PERMIT CONDITIONS

- **RP Determination** — States and permittees should ensure that the reasonable potential determination of the need for a WET limit is supported by the analysis of the valid and representative WET monitoring data collected and that the monitoring was conducted using the appropriate WET test type and most sensitive species.
- **Permit Documentation** — Permit writers should provide adequate documentation in the permit and the fact sheet to support the analysis of the need for WET and the WET limit itself, monitoring requirements, or other permit conditions included in a permit.
- **Permit Oversight** — Permit writers should include in their permit clear documentation on how permit requirements were derived. The permitting authority should routinely and on schedule monitor the compliance of the permit requirements, especially those requirements or conditions with interim or final schedules (i.e., routine monitoring, accelerated monitoring triggers, TRE/TIE plans).

6.4 SPECIFIC RECOMMENDATIONS FOR ISSUING PERMITS WITH WET EFFLUENT LIMITS, NUMERIC MONITORING TRIGGERS AND OTHER PERMIT CONDITIONS

- **EPA's Step-Wise Approach** — EPA's step-wise approach is one in which all parties can take an active role in the development of the permit requirements and compliance with those requirements. This approach accommodates both small and large WET data sets but provides an incentive to permittees to strive in their WET data generation for large data sets of 10 or more data points that are valid and representative of their discharge(s). The approach incorporates an opportunity (delayed WET limit) to address small data sets concerns by providing eligible permittees with more time to provide additional WET data for the WET RP determination. It also has features that address toxic events such as accelerated monitoring triggers and TIEs/TREs to identify and reduce or eliminate the source of toxicity and achieve State WQS and WET permit limits.
- **NPDES Permit Limit Decisions** — When the WET data RP determination results in a determination that an effluent *causes, has reasonable potential to cause, or contributes* to an excursion above a narrative or numeric water quality criterion for toxicity, the permitting authority must establish a water quality based effluent limit (WQBEL). This WQBEL must be for the parameter WET if the State has *numeric* toxicity criteria. If the State has *narrative* toxicity criteria and the permitting authority can demonstrate, in the fact sheet, that chemical-specific limits are sufficient to attain and maintain applicable standards, appropriate chemical-specific limits can be established in lieu of WET limits.
- **Delayed WET Limit** — Where applicable WQS allow a compliance schedule for WET, this feature of the EPA's step-wise approach is an enhancement of the NPDES WET program's current guidance recommendations, which enables NPDES agencies to provide an alternative to permittees with concerns about WET limits based on small data sets (fewer than 10 data points). This permit feature allows an eligible permittee, as part of their permit requirements, up to 18 months to collect more effluent samples for WET testing to generate additional valid and representative WET data to a permit writer for use in the WET RP determination.
- **Monthly Median WET Limit** — Permit writers may opt to develop WET permit limits that address discharges in which the effluent flow comprises a high percentage of the available stream flow during critical conditions or otherwise lacks assimilative capacity. EPA has provided revised national guidance for establishing appropriate WET effluent limitations for receiving waters with no assimilative capacity. For these situations only, using the limit derivation procedures described in this guidance (Chapter 5), a maximum daily limit of 1.6 TU_c and an AML of 1.0 TU_c can be developed. The 1.0 TU_c AML should be expressed as a monthly median instead of a monthly average, in conjunction with a maximum daily limit.

APPENDIX A
EXAMPLE: PERMIT LIMIT DERIVATION PROCEDURES

APPENDIX A – EXAMPLE: PERMIT LIMIT DERIVATION PROCEDURES

This appendix presents an example of how to derive a permit limit.

The mean and standard deviation of log(TU) or log(chemical concentration) are calculated for each pollutant using historical effluent data). Where historical data regarding effluent variability are insufficient (e.g., $n < 10$), the default CV should be 0.6 (see TSD, Appendix E, pg. E-3). In that case only, the variance of log(TU) or log(chemical concentration) is calculated from the CV using formulas in Box 5-2 of the TSD (page 100). Statistical derivation procedures for the AML for WET should assume that at least four samples (n) will be taken per month.

The WLA required to protect against both acute and chronic effects under critical conditions may be calculated using either steady-state or dynamic models. However, for derivation of the WLA, the equation is rearranged to solve for the effluent concentration (C_d), or WLA, necessary to achieve the appropriate applicable criterion. For compliance purposes, the water quality criterion for aquatic life (toxicity criterion) is set equal to C_r , where C_r is the applicable criterion:

$$WLA = C_d = [C_r(Q_d + \%Q_s)] - [(C_s)(\%Q_s)]/Q_d$$

where:

Q_d = waste discharge flow in cubic feet per second (cfs) or MGD

C_d = waste discharge pollutant concentration in TUs for WET (TU_a or TU_c)

Q_s = background in-stream flow in cfs or MGD above point of discharge

C_s = background in-stream pollutant concentration in TUs for WET (TU_a or TU_c); setting $C_s = 0$ is recommended for WET

$\%Q_s$ = percent of upstream flow allowed by mixing zone standard, if applicable

Q_r = resultant in-stream flow after discharge in cfs or MGD: $\%Q_s + Q_d$

C_r = applicable toxicity criterion = resultant in-stream pollutant concentration in TUs for WET (TU_a or TU_c), in the stream reach (after complete mixing)

In most cases, this steady-state model should be used to calculate the WLA (i.e., allowable effluent concentration) that will meet acute and chronic water quality criteria for the protection of aquatic life at the critical stream flow conditions, for example, 1Q10 and 7Q10 respectively (see TSD, Section 4.2, pg. 68). Ambient flow data from the U.S. Geological Survey are available on STORET.

When calculating the WLA, it should be noted that, if applicable State water quality standards and plans do not explicitly allow the application of mixing zones, the appropriate applicable criterion must be met at the end-of-pipe (i.e., applicable criterion = $C_r = C_d = WLA$). Where mixing zones are allowed, appropriate State procedures should be applied.

If adequate receiving water flow and effluent concentration data are available to estimate frequency distributions, dynamic modeling techniques can be used to calculate allowable effluent loadings that will more precisely maintain water quality standards (see TSD, pg. 97). The steady-state mass balance equation, however, when coupled with the recommended conservative assumptions, should be adequately

protective of receiving water beneficial uses, but may be more protective than necessary under some circumstances.

WLAs determined using State water quality criteria for WET may be converted to maximum daily limits and AMLs. For low-flow situations, maximum daily limits and monthly medians should be used. The following methodology (see TSD, Box 5-2, pg. 100; Figure 5-4, pg. 101; and Tables 5-1, 5-2, and 5-3, pp. 102–103, 106) is designed to derive permit limits for specific pollutants and WET to achieve calculated WLAs at the 99-percent confidence level for maximum daily limits and the 95-percent confidence level for AMLs.

1. Using the mass-balanced equation to solve for the allowable effluent concentration (C_d), or WLA, for WET:

- a. Set C_r equal to acute, chronic criteria.
- b. Background receiving water (Q_s), discharge (Q_d) flows, and background pollutant concentration (C_s) should represent critical conditions.
- c. Solve for acute (WLA_a) and chronic (WLA_c) wasteload allocations.

2. Convert the acute WLA to chronic toxic units ($WLA_{a,c}$), using the acute-to-chronic ratio (ACR). (see TSD, Section 1.3.4, pg.17)

$$WLA_{a,c} \text{ (in TU}_c\text{)} = WLA_a \text{ (in TU}_a\text{)} \times \text{ACR.}$$

3. To calculate the standard deviation or CV:

- a. Use the effluent data set of “k” observations (k is ≥ 10) to calculate the mean (μ) and standard deviation (σ) of $\log(\text{TU})$ or $\log(\text{chemical concentration})$ (see TSD, Appendix E).
- b. Where the effluent data set is small ($k < 10$), the conservative value of 0.6 is recommended (see TSD, Appendix E, page E-3) to estimate the CV, from which the variance is then calculated using formulas in Box 5-2 of the TSD (page 100). Numerical values for the case when $\text{CV} = 0.6$ are provided in the TSD (Tables 5-1 and 5-2, pages 102 – 103).

4. To determine LTA discharge conditions:

Use the following equations to calculate acute and chronic LTA discharge conditions ($LTA_{a,c}$ and LTA_c) that will satisfy the acute and chronic wasteload allocation ($WLA_{a,c}$ and WLA_c). The CV calculated above is used to estimate both acute and chronic WLA multipliers (see TSD, Table 5-1, pg. 102).

$$LTA_{a,c} = WLA_{a,c} \times e^{[0.5\sigma^2 - z\sigma]}$$

$$LTA_c = WLA_c \times e^{[0.5\sigma_4^2 - z\sigma_4]}$$

where:

$$e^{[0.5\sigma^2 - z\sigma]} = \text{acute WLA multiplier}$$

$$e^{[0.5\sigma_4^2 - z\sigma_4]} = \text{chronic WLA multiplier}$$

$z = 2.326$ for the 99th percentile occurrence probability for the LTA is recommended

5. Determine the lower (more limiting) LTA discharge condition

$$\text{LTA} = \text{minimum (LTA}_{\text{a,c}} \text{ or LTA}_{\text{c}})$$

6. Calculate the maximum daily limit and average monthly limit using the lower (more limiting long-term average) discharge condition.

Use the following equations to calculate the maximum daily limit and average monthly limit. The CV calculated above is used to estimate both acute and chronic long-term average multipliers (see TSD, Table 5-2, pg. 103).

$$\text{MDL} = \text{LTA} \times e^{[z\sigma - 0.5\sigma^2]}$$

$$e^{[z\sigma - 0.5\sigma^2]} = \text{MDL LTA multiplier}$$

$$z = 2.326 \text{ for the } 99^{\text{th}} \text{ percentile occurrence probability for the MDL is recommended}$$

$$\text{AML} = \text{LTA} \times e^{[z\sigma_n - 0.5\sigma_n^2]}$$

where:

$$e^{[z\sigma_n - 0.5\sigma_n^2]} = \text{AML LTA multiplier}$$

$$z = 1.645 \text{ for the } 95^{\text{th}} \text{ percentile occurrence probability for the AML is recommended}$$

$$n = \text{number of samples/month}$$

Following these procedures, the maximum daily limit and average monthly limit may then be incorporated into the permit as justifiable WQBELs.

APPENDIX B
EXAMPLE: DERIVING PERMIT LIMITS FOR LOW-FLOW
DILUTION SITUATIONS

APPENDIX B – EXAMPLE: DERIVING PERMIT LIMITS FOR LOW-FLOW DILUTION SITUATIONS

This appendix presents an example of how to derive permit limits for low-flow dilution situations.

Many facilities across the country discharge to streams where the facility flow comprises a high percentage of the available stream flow during critical conditions or for large parts of the year so an alternative approach for deriving permit limits is needed. Receiving waters where little dilution is available still often have a full aquatic life use designation and are afforded all protections based on narrative and numeric State water quality criteria for aquatic life. Due to the low margin of safety in such waters, effluent toxicity may cause ambient impacts and lead to exceedence of numeric or narrative water quality criteria for aquatic life. Where such discharges cause or have the reasonable potential to cause or contribute to excursions of such criteria, WET limits are required by 40 CFR 122.44(d)(1).

Due to the inherent small margin of safety, only limited regulatory flexibility is available from chronic WET limit requirements for discharges to waters where limited or no dilution is available. For low-flow situations, the permit limit derivation procedures calculate 1.6 TU_c as the maximum daily limit.

Following is an example of a POTW discharging to a receiving water for which no assimilative capacity is available (i.e., no dilution). The example shows the steps that a permitting authority would take to establish a WQBEL for WET.

General site description and information. This facility discharges up to 5.8 MGD. Based on the available information, the ACR is 10. The CV, based on available data, is 0.6; the water quality criterion for chronic toxicity is 1.0 TU_c and the acute criterion for acute toxicity is 0.3 TU_a . The State water quality standards allow an assumption of complete mixing.

Determine waste load allocation (WLA). The WLA is used to determine the level of effluent concentration that will comply with water quality standards in receiving waters. Using the information available for dilution, WLAs were calculated for WET using the complete mix equation:

$$\text{WLA } (C_d) = ([C_r(Q_d + Q_s)] - [(C_s)(Q_s)]) / Q_d$$

Because this is an effluent-dominated situation, and background concentration C_s is set to zero, the equation simplifies to:

$$\text{WLA} = C_r[(Q_d + Q_s) / Q_d]$$

$$\text{WLA}_a = 0.3 \times 1 = 0.3 \text{ TU}_a$$

$$\text{WLA}_{a,c} - \text{WLA}_a \times \text{ACR} = 0.3 \times 10 = 3.0 \text{ TU}_{a,c}$$

Calculate Long-term Averages (LTAs). The process for calculating LTAs for toxicity is the same as that for chemical-specific pollutants, except for the additional step of needing to express the WLA for acute toxicity in equivalent chronic TUs.

$$\text{LTA}_{a,c} = \text{WLA}_{a,c} \times e^{[0.05\sigma^2 - z\sigma]}$$

$$\text{LTA}_{a,c} = 3 \times 0.321$$

where:

0.321 is the acute WLA multiplier for $CV = 0.6$ at the 99th percentile (from Table 5-1, pg. 102 of the TSD)

$$LTA_{a,c} = 0.963 TU_c$$

$$LTA_c = WLA_c \times e^{[0.5\sigma_4^2 - z\sigma_4]}$$

$$LTA_c = 1 \times 0.527$$

where:

0.527 is the chronic WLA multiplier at the 99th percentile (from Table 5-1, pg. 102 of the TSD)

$$LTA_c = 0.527 TU_c$$

Select the minimum LTA. The LTA based on the chronic WLA is more limiting and will be used to develop permit limits.

Calculate the maximum daily limit (MDL). The maximum daily limit is calculated as:

$$MDL = LTA \times e^{[z\sigma - 0.5\sigma^2]}$$

where

$$e^{[z\sigma - 0.5\sigma^2]} = \text{MDL LTA multiplier}$$

$$z = 2.326 \text{ for the 99}^{\text{th}} \text{ percentile occurrence probability for the MDL is recommended}$$

$$MDL = 0.527 \times 3.11 \text{ (from the LTA multiplier in Table 5-2, on pg. 102 of the TSD)}$$

$$MDL = 1.6 TU_c$$

Calculate the average monthly limit (AML). Using the 95th percentile and monthly sampling, the AML is calculated as:

$$AML = LTA \times e^{[z\sigma_n - 0.5\sigma_n^2]}$$

where:

$$e^{[z\sigma_n - 0.5\sigma_n^2]} = \text{AML LTA multiplier}$$

$$z = 1.645 \text{ for the 95}^{\text{th}} \text{ percentile occurrence probability for the AML is recommended}$$

$$n = \text{number of samples/month (the TSD recommends that a minimum } n \text{ of 4 be used, even if monitoring is less frequent)}$$

$$AML = 0.527 \times 1.55,$$

where:

1.55 is the LTA multiplier from Table 5-2 on pg. 103 of the TSD.

$$AML = 0.8 TU_c.$$

APPENDIX C
1994 EPA WET CONTROL POLICY

United States
Environmental Protection
Agency

Office of Water
(4203)

EPA 833-B-94-002
July 1994



Whole Effluent Toxicity (WET) Control Policy

POLICY FOR THE DEVELOPMENT OF EFFLUENT LIMITATIONS IN NATIONAL
POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMITS TO CONTROL WHOLE
EFFLUENT TOXICITY FOR THE PROTECTION OF AQUATIC LIFE

July 1994

POLICY FOR THE DEVELOPMENT OF EFFLUENT LIMITATIONS IN NATIONAL
POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMITS TO CONTROL
WHOLE EFFLUENT TOXICITY (WET) FOR THE PROTECTION OF AQUATIC LIFE

INTRODUCTION

EPA is today publishing a national policy on the control of WET in NPDES permits. This policy is intended (i) to promote uniform, nationwide compliance with statutory and regulatory requirements for the control of WET, and (ii) to assist permit writers in implementing these requirements.

This policy reflects EPA's experience in implementing the regulations at 40 C.F.R. § 122.44(d)(1), which were originally published at 54 Fed. Reg. 23868 (June 2, 1989) (also referred to as "the water quality permitting regulations"). In part, this policy restates those regulations and reaffirms EPA's strong, continuing commitment to their prompt and complete implementation. The water quality permitting regulations, as well as the statutory provisions restated in this policy document, are fully binding on EPA Regions as well as States authorized to administer the NPDES program.

This policy also provides guidance to permit writers on implementation of the statutory and regulatory requirements for the control of WET.¹ EPA permit writers are expected to follow the portions of this policy that provide such guidance, although decisions on individual permit provisions should be made on a case-by-case basis, applying the law and regulations to specific facts and justifying decisions in the record for the permit. Similarly, EPA Regions will consider this policy in determining whether State-issued NPDES permits adequately implement the statutory and regulatory requirements for the control of WET.

This policy addresses some specific areas where questions have arisen regarding the implementation of statutory and regulatory requirements. It does not address all areas where the regulatory agency will exercise judgment in the implementation of statutory and regulatory requirements. For the questions addressed, it provides EPA's view as to the best course of action in most instances. This policy does not establish or affect legal rights or obligations and is not finally determinative of the issues addressed. Most importantly, nothing in this policy should be interpreted as providing any relief from the statutory and regulatory requirement that permits include conditions as necessary to assure attainment of water quality standards.

¹ A brief summary of existing Agency policy and guidance addressing WET issues is contained in Appendix One to today's policy.

SUMMARY OF STATEMENTS OF POLICY

Eight statements of policy appear below. Explanations of each statement follow.

1. Basis for WET Controls

The permitting authority should evaluate WET water quality criteria attainment for acute WET at the edge of the acute mixing zone and for chronic WET at the edge of the chronic mixing zone except where the State has different requirements for evaluating WET criteria.² The permitting authority will develop WET effluent limitations based upon the more stringent of the acute or chronic criterion applied at the edge of the respective mixing zone, or, alternatively, on both.

2. Evaluation of Dischargers for Reasonable Potential

At a minimum, the permitting authority should review all major dischargers for reasonable potential to cause or contribute to exceedance of WET water quality criteria.

3. Evaluating Reasonable Potential

The permitting authority will consider available WET testing data and other information in evaluating whether a discharger has reasonable potential to cause or contribute to exceedance of WET water quality criteria.

4. Consequences of Establishing Reasonable Potential

Upon finding reasonable potential to cause or contribute to exceedance of WET water quality criteria, the permitting authority will impose effluent limitations to control WET.

5. Whole Effluent Toxicity Monitoring

Where appropriate, the permitting authority should impose WET monitoring conditions upon dischargers that do not have effluent limitations to control WET.

6. Compliance Schedules in NPDES Permits

Where allowed under State and federal law, NPDES permits may contain schedules for compliance with WET effluent limitations.

² Throughout this policy, the term "WET water quality criteria" refers to State numeric water quality criteria for WET and State narrative water quality criteria for toxicity such as "no toxics in toxics amounts" in State water quality standards.

7. Whole Effluent Toxicity Controls and the Pollutants Ammonia and Chlorine

The requirements of the water quality permitting regulations apply without regard to the pollutant(s) that may be causing toxicity, including ammonia and chlorine.

8. Whole Effluent Toxicity Controls and Publicly Owned Treatment Works (POTWs)

The requirements of the water quality permitting regulations apply to all dischargers, including POTWs.

EXPLANATION OF STATEMENTS OF POLICY³

1. Basis for WET Controls

The permitting authority should evaluate WET water quality criteria attainment for acute WET at the edge of the acute mixing zone and for chronic WET at the edge of the chronic mixing zone except where the State has different requirements for evaluating WET criteria. The permitting authority will develop WET effluent limitations based upon the more stringent of the acute or chronic criterion applied at the edge of the respective mixing zone, or, alternatively, on both.

This policy statement describes the procedure permitting authorities should use to evaluate WET water quality criteria attainment and to develop effluent limitations to control WET. In the absence of more specific State requirements, EPA believes this approach most appropriately assures compliance with State water quality standards.^{4,5} The permitting authority must evaluate WET water quality criteria attainment according to the applicable state water quality standard(s). Permitting authorities should assess WET concentrations as diluted in the receiving water at the edge of the acute and chronic mixing zones and apply the more stringent of the acute criterion at the edge of the acute mixing zone or the chronic criterion at the edge of the chronic mixing zone in developing WET effluent limitations. If there is uncertainty as to which of the two criterion so applied is more stringent for the discharge, however, the permitting authority will apply both.

The statement reflects the specific requirement of 40 C.F.R. § 122.44(d) (1) (ii) that "where appropriate, [the permitting

³ To aid the reader in using this policy, Appendix Two contains some background materials on WET testing, the State water quality standards process and WET, and federal statutory and regulatory requirements for development of water quality- based permit limitations for WET.

⁴ State water quality standards or implementation procedures may (1) specify whether and how it is appropriate to account for dilution in establishing WET controls; (2) require the applicable criteria to apply at the outfall point of discharge or may contain a specific policy approved by EPA allowing or prohibiting mixing zones; as well as (3) specify exposure factors for WET which are relevant to the application of this policy statement, such as critical flow requirements for the receiving water, appropriate modeling techniques for determining the fate of the pollutant or pollutant parameter in stream, or required techniques for evaluating the mixing of the pollutant or pollutant parameter in the stream.

⁵ NPDES permitting authorities traditionally measure compliance with effluent limitations at the outfall point of discharge. By issuing this policy statement, EPA does not intend to disturb this well-established permitting practice. Permitting authorities are familiar with procedures for determining the concentration of toxicity in-stream and establishing end-of-pipe effluent limitations on the basis of the information.

authority will consider] the dilution of the effluent in the receiving water” in determining whether a discharge causes, has the reasonable potential to cause, or contributes to exceedance of WET water quality criteria. This statement should assist permitting authorities in establishing WET controls which meet the requirements of sections 301(b)(1)(C) and 402 of the Clean Water Act (CWA) and 40 C.F.R. § 122.44(d)(1).

40 C.F.R. § 122.44(d)(1)(iv) and (v) require the permitting authority to impose effluent limitations to control WET where it determines that a discharge causes, has the reasonable potential to cause, or contributes to exceedance of WET water quality criteria. 40 C.F.R. § 122.44(d)(1)(vii) also requires permitting authorities to establish effluent limitations on point sources which are consistent with the requirements of applicable State water quality standards. This is a basic premise of this policy statement. Where the applicable State water quality standard or implementation procedure requires a different basis for establishing WET controls, the permitting authority must follow applicable State requirements.⁶

The second component of the policy statement also reflects the principle of section 301(b)(1)(C) of the CWA that effluent limitations must assure compliance with all State water quality standards. Here, the permitting authority will establish WET controls for the particular discharge based upon the more stringent of the acute or chronic criterion (or both) applied at the edge of their respective mixing zones in order to achieve both criteria.

Consistent with this policy statement, the permitting authority will establish two independent zones for controlling acute and chronic WET.⁷ The first zone, the acute mixing zone, immediately surrounds the discharge outfall. The acute mixing zone is normally sized to prevent lethality (sometimes also described as “acute effects”) to passing organisms. The permit

⁶ For example, some State water quality standards or implementation procedures do not allow mixing zones at all or restrict mixing zone use for certain dischargers. Where this is the case, the permitting authority will not use the procedure provided in policy statement one concerning the application of mixing zones. The permitting authority must still ensure that the permit includes WET limitations as necessary to achieve the applicable State requirements.

⁷ This policy does not address what is acute or chronic WET. 40 C.F.R. § 122.2 defines “whole effluent toxicity.” Appendix Two, which provides an overview of the water quality standards process and WET, describes traditional acute and chronic toxicity tests and EPA’s recommended magnitudes for acute and chronic WET. States may interpret narrative water quality criteria for toxicity in State implementation procedures. In the absence of such implementation procedures, EPA’s recommended magnitudes for WET are 0.3 acute toxic unit and 1.0 chronic toxic unit at the edge of the appropriate mixing zone. Technical Support Document for Water Quality Based Toxics Control, as revised in March 1991 (EPA/505/2-90-001), at 2.3.3 and 2.3.4 (the TSD).

must include effluent limitations as necessary to meet numeric or narrative water quality criteria for acute toxicity at the edge of the acute mixing zone. The second zone, the chronic mixing zone, is typically a larger zone which surrounds the acute mixing zone. The chronic mixing zone is normally sized to protect the ecology of the water body as a whole from all point-source related stresses including WET. The permit must include effluent limitations as necessary to meet numeric or narrative water quality criteria for chronic toxicity at the edge of the chronic mixing zone.⁸

Once it is determined what the appropriate mixing zones are, the permitting authority will take several additional steps consistent with this policy statement. The permitting authority will (1) evaluate the receiving water concentration of acute WET at the edge of the acute mixing zone and of chronic WET at the edge of the chronic mixing zone for the particular discharge, (2) determine which of the acute criterion or the chronic criterion applied at the edge of the appropriate mixing zone is the more stringent of the two for the particular discharge, and (3) establish effluent limitations to assure attainment of the more stringent criterion (or both where it is unclear which is more stringent). The Technical Support Document for Water Quality-based Toxics Control, as revised in March 1991 (EPA/505/2-90-001) (the TSD) at 3.3 and 5.4, illustrates how to apply this procedure to evaluate a particular discharge for reasonable potential and to develop effluent limitations.

2. Evaluation of Dischargers for Reasonable Potential

At a minimum, the permitting authority should review all major dischargers for reasonable potential to cause or contribute to exceedance of WET water quality criteria.

40 C.F.R. §§ 122.44(d)(1)(iv) and (v) require permitting authorities to impose effluent limitations to control WET whenever a discharge causes, has the reasonable potential to cause, or contributes to an instream excursion of applicable water quality criteria.⁹ This policy statement identifies which

⁸ The implementation of this policy requires permitting authorities to establish mixing zones unless State standards or implementation procedures direct otherwise; however, the specific size of a particular mixing zone depends on a variety of factors which can also be specified in the State water quality standard or implementation procedure. See generally the Water Quality Standards Handbook at 2-7 (1983); the TSD at 2.2.2, for discussions of this issue.

⁹ Throughout this policy, any reference to "reasonable potential" includes both reasonable potential to cause and reasonable potential to contribute to an excursion of numeric water quality criteria for WET or narrative water quality criteria.

dischargers the permitting authority should, as a first priority, assess for reasonable potential.¹⁰

The group of dischargers which the permitting authority should evaluate first for reasonable potential are "major" facilities. EPA defines a major POTW as a POTW having a design flow of one million gallons per day or greater, a service population of 10,000 or greater, or a significant impact on water quality. EPA identifies a major industrial discharger on the basis of a combination of factors, including size, toxic pollutant potential, and stream flow volume.¹¹ EPA believes that these facilities (either POTWs or industrial facilities) have the greatest opportunity for impacting surface water quality and therefore should be evaluated for "reasonable potential" to exceed an applicable State water quality standard.

Permitting authorities should continue to evaluate other dischargers of concern for reasonable potential to exceed WET water quality criteria. Factors which permitting authorities may consider in deciding whether a particular discharge is "of concern" obviously would include those factors which are described in Chapter 3 of the TSD as factors for assessing reasonable potential (including WET data, chemical-specific data, instream survey data, industry or publicly owned treatment work type, compliance history, receiving water type, designated/existing uses, and dilution calculations). Under § 122.44(d)(1)(iv) and (v), permitting authorities must impose effluent limitations to control WET where reasonable potential is established. In addition, the permitting authority should consider WET controls, where appropriate, in issuing general permits.

3. Evaluating Reasonable Potential

The permitting authority will consider available WET testing data and other information in evaluating whether a discharger has reasonable potential to cause or contribute to exceedance of WET water quality criteria.

This policy statement describes what information is considered in evaluating whether a specific discharger has the reasonable potential to cause or contribute to excursion of WET water quality criteria. The permitting authority first determines

¹⁰ This policy statement continues to reflect EPA's position on this matter articulated in the January 25, 1989, memorandum of Rebecca W. Hanmer, Acting Assistant Administrator for Water, to Regional Administrators entitled "Whole Effluent Toxicity Basic Permitting Principles and Enforcement Strategy."

¹¹ See the June 27, 1990, memorandum "New NPDES Non-Municipal Permit Rating System" from James R. Elder, Director of the Office of Water Enforcement and Permits, to Regional Water Management Division Directors, which is Appendix Three to today's policy.

whether valid WET testing data is available that is relevant to the particular discharge.¹² Whole effluent toxicity data may be available from previous monitoring. Additionally, under 40 C.F.R. § 122.21(j), certain POTWs are required to submit WET testing as part of the permit application. The permitting authority may also decide to require the permittee to generate WET data prior to permit issuance or as a condition of the permit. See policy statement five below. If valid WET testing data is available that is relevant to the particular discharge, the permitting authority uses this data to determine if the discharge exhibits reasonable potential under §§ 122.44(d)(1)(iv) or (v).¹³ Where such WET data exist and demonstrate reasonable potential, the permitting authority does not need to gather or generate other information to verify or support the WET results. EPA believes it is appropriate to assess reasonable potential on the basis of WET testing. Whole effluent toxicity testing is comparable in precision to chemical analytical measurements in wide use. See discussions of these questions in 55 Fed. Reg. 30082, 30112-30115 (July 24, 1990); 54 Fed. Reg. 23868, 23874 (June 2, 1989); the TSD at 1.3 and 3.3.

The permitting authority should also consider whether other factors establish reasonable potential for the discharge. The TSD at 3.2 offers a discussion of factors other than facility-specific WET monitoring data which a permitting authority may consider in making a reasonable potential determination for a particular discharge. These factors include 1) industry type (primary, secondary, raw materials used, products produced, best management practices, control equipment, treatment efficiencies, etc.), 2) publicly owned treatment work type (pretreatment, industrial loadings, number of taps, unit processes, treatment efficiencies, chlorination/ammonia problems, etc.), 3) compliance history, 4) existing chemical data from discharge monitoring reports and applications, 5) available instream survey data, 6) receiving water type and designated/existing uses, 7) available dilution, etc. For each individual permit, the permitting authority must include a clear explanation in the statement of basis or fact sheet accompanying the permit of the specific factors considered in evaluating reasonable potential for the particular discharge.

¹² The permitting authority determines whether available WET testing is valid and addresses concerns relative to toxicity for the particular discharge. For example, where a facility discharges to a low flow stream, submission of acute WET testing data showing no toxicity is insufficient (absent conversion of the acute results to chronic results using an acute-to-chronic ratio, as explained in the TSD) to assess reasonable potential for chronic toxicity.

¹³ If additional factors also demonstrate reasonable potential (see main text discussion below), the permitting authority should also discuss these factors in the fact sheet or statement of basis accompanying the permit.

EPA believes this approach to assessing reasonable potential implements the requirements of sections 301(b)(1)(C) and 402 of the CWA and 40 C.F.R. § 122.44(d)(1). 40 C.F.R. § 122.44(d)(1)(ii), (iv), and (v) require the permitting authority to use valid procedures which account for at least the following four factors in establishing whether a discharge causes, has the reasonable potential to cause, or contributes to an exceedance of WET water quality criteria: (1) existing controls on point and nonpoint sources of pollution, (2) the variability of the pollutant or pollutant parameter in the effluent, (3) the sensitivity of the test species when evaluating WET, and (4) the dilution of the effluent in the receiving water where appropriate. 40 C.F.R. § 122.44(d)(1)(v) also explicitly provides that the permitting authority must establish an effluent limitation to control WET where it determines, using "toxicity testing data, or other information," that the discharge causes, has the reasonable potential to cause, or contributes to an exceedance of a narrative water quality criterion.

4. Consequences of Establishing Reasonable Potential

Upon finding reasonable potential to cause or contribute to exceedance of WET water quality criteria, the permitting authority will impose effluent limitations to control WET.

This policy statement reiterates the requirements of sections 301(b)(1)(C) and 402 of the CWA as well as 40 C.F.R. §§ 122.44(d)(1)(iv) and (v). 40 C.F.R. §§ 122.44(d)(1)(iv) and (v) require the permitting authority to establish effluent limitations in a permit to control WET where it determines that a discharge has the reasonable potential to cause or contribute to an instream excursion above a numeric criterion for WET or a narrative criterion.¹⁴

The permitting authority can either modify the permit or reissue the permit upon expiration, as appropriate, to incorporate effluent limitations to control WET. In no instance will the permitting authority reissue the permit without including appropriate effluent limitations to control WET. In appropriate cases, the permitting authority may also require the discharger to conduct a toxicity identification evaluation/toxicity reduction evaluation to identify and eliminate the cause of the toxicity as part of a compliance schedule to comply with effluent limitations to control WET.

¹⁴ Paragraph (v) provides that where the permitting authority determines that a discharge causes, has the reasonable potential to cause, or contributes to an instream excursion above a narrative water quality criterion, the permit must contain (1) a WET effluent limitation or (2) a pollutant-specific limitation, where the permitting authority demonstrates that a pollutant-specific limitation is sufficient to attain and maintain applicable numeric and narrative water quality standards.

5. Whole Effluent Toxicity Monitoring

Where appropriate, the permitting authority should impose WET monitoring conditions upon dischargers that do not have effluent limitations to control WET.

Where appropriate, the permitting authority should impose WET monitoring conditions upon those dischargers for which it did not determine reasonable potential and did not impose effluent limitations to control WET. Where the permitting authority concludes that a continued monitoring requirement is warranted based upon the particular circumstances of the discharger, the permitting authority should require WET monitoring for a reasonable period of time and evaluate the monitoring results at the conclusion of this period.¹⁵

EPA and authorized NPDES States have broad authority under the CWA to require continued monitoring to assure attainment of water quality criteria. Under Sections 308 and 402 of the CWA EPA or a State with an authorized NPDES program can require permittees to provide WET testing data to assure State water quality standards will be attained and maintained. The permitting authority can impose a requirement on the discharger to collect monitoring data through conditions in the NPDES permit or through CWA Section 308 letters. Under sections 301(b)(1)(C) and 402 of the CWA as well as 40 C.F.R. §§ 122.44(d)(1)(iv) and (v), EPA or a State with an authorized NPDES program must impose effluent limitations to control WET where continued monitoring results in a determination of reasonable potential to exceed WET water quality criteria.

6. Compliance Schedules in NPDES Permits

Where allowed under State and federal law, NPDES permits may contain schedules for compliance with WET effluent limitations.

This policy statement reflects the principles for allowing compliance schedules in NPDES permits which were articulated in In re Star-Kist Caribe, Inc., NPDES Appeal No. 88-5 (May 26,

¹⁵ 40 C.F.R. § 122.21(j) requires many new and existing POTWs to collect WET data for submission to the permitting authority at time of application or reapplication for an NPDES permit. Where appropriate, the permitting authority may, in its discretion, require more frequent WET monitoring of POTWs or industrial dischargers. For example, it may be appropriate to impose a continued WET monitoring obligation upon a major industrial discharger for which WET testing data is not available. Similarly, it may be appropriate to impose a monitoring obligation upon a discharger for which available WET data is limited or for which later information raises the possibility of reasonable potential.

1992) (order denying modification request).¹⁶ Section 301(b)(1)(C) of the CWA establishes a deadline of no later than July 1, 1977, for compliance with effluent limitations developed to meet State water quality standards. In light of this CWA provision, EPA has determined that all permits must reflect this deadline, unless the following requirements are met.¹⁷ NPDES permits may contain schedules of compliance beyond July 1, 1977, to meet water quality-based effluent limitations if two requirements are met. The two requirements are: 1) the permit effluent limitation must be based either on a post-July 1, 1977 State water quality standard or a new or revised interpretation of a pre-July 1, 1977 State water quality standard; and (2) the applicable State water quality standard or implementing regulations must explicitly authorize schedules of compliance.

40 C.F.R. § 122.47 also governs compliance schedules in NPDES permits. The regulation authorizes, where appropriate, schedules requiring compliance with effluent limitations as soon as possible and no later than the applicable CWA statutory deadline. The regulation imposes certain restrictions on allowing schedules of compliance for new sources, new dischargers, and recommencing dischargers. The regulation establishes requirements for interim dates for certain schedules of compliance and for permittee reporting. Any compliance schedules developed for WET limitations must also satisfy § 122.47, if applicable.

Thus, to decide whether to allow a compliance schedule in an NPDES permit for effluent limitations to control WET, the permitting authority must answer these questions:

1. Was the applicable State water quality criterion promulgated or interpreted after July 1, 1977?

At this time, most permitting authorities establish effluent limitations to control WET on the basis of State narrative water quality criteria. Most State narrative water quality criteria for toxicity were adopted before July 1, 1977. Where this is the case, the permitting authority can only allow a schedule of compliance in the NPDES permit where the State has made a new or revised interpretation of the applicable narrative water quality criterion after July 1, 1977. Where the permitting authority establishes an effluent limitation to control WET on the basis of a State

¹⁶ 40 C.F.R. § 122.2 defines a "schedule of compliance" as a "schedule of remedial measures included in a 'permit', including an enforceable sequence of interim requirements... leading to compliance with the CWA and regulations."

¹⁷ This entire discussion does not apply to permit limitations which are governed by section 304(1) of the CWA.

numeric water quality criterion for WET, it is more likely that the criterion is a post-July 1, 1977 criterion.

2. Do the State water quality standards or implementing regulations explicitly authorize schedules of compliance?

The State must include an explicit statement authorizing compliance schedules in the State water quality standard or implementing regulations. If the State water quality standard or implementing regulations are silent on whether schedules of compliance are authorized for NPDES permits, the permitting authority cannot place a schedule of compliance in the NPDES permit. Permit writers may find the express authorization in the State statute or water quality standards, water quality planning, or NPDES regulations.

3. Do other relevant provisions of State or federal law or policy allow the schedule of compliance?

Here, for example, the permitting authority should consider whether allowing a schedule of compliance for the specific discharge meets the requirements of 40 C.F.R. § 122.47, if applicable, or any other requirements of State law.

Where the permitting authority answers yes to each of these questions, it may allow a schedule of compliance in the NPDES permit.

The permitting authority, however, is not compelled to establish a schedule of compliance in the NPDES permit where so authorized. The permitting authority should impose a schedule of compliance only where appropriate under the specific conditions of discharge. It has long been EPA's policy that EPA and authorized NPDES States should require compliance with State water quality standards as soon as possible in order to further the goals of the CWA.

7. Whole Effluent Toxicity Controls and the Pollutants Ammonia and Chlorine

The requirements of the water quality permitting regulations apply without regard to the pollutant(s) that may be causing toxicity, including ammonia and chlorine.

This policy statement is designed to address several questions which permitting authorities have encountered in establishing WET controls where ammonia or chlorine is the primary cause of toxicity. The questions typically arise on the following set of facts: A permittee discharges to a stream for

which the State has not established numeric water quality criteria for ammonia or chlorine; the State has adopted a narrative water quality criterion for toxicity which is applicable to the stream; the permittee conducts WET monitoring; and the permittee exceeds the narrative criterion due to ammonia or chlorine. The permitting authority must answer several questions in permitting this discharge: What effluent limitations must it establish in the permit? Will the permitting authority require the permittee to control ammonia or chlorine, so that the permittee does not exceed the narrative criterion due to ammonia or chlorine? Is there a basis to treat ammonia or chlorine differently from other pollutants in applying § 122.44 (d) (1) to these facts?

The requirements of § 122.44(d)(1) apply to all pollutants and pollutant parameters, including ammonia and chlorine. The Agency sees no basis upon which to treat WET due to ammonia or chlorine differently from WET due to other pollutants in applying the requirements of 40 C.F.R. § 122.44(d)(1) or other provisions of federal law.¹⁸ Several provisions of 40 C.F.R. § 122.44(d)(i) provide the answers to the questions posed in this policy statement.

40 C.F.R. § 122.44(d)(1)(v) requires the permitting authority to establish effluent limitations to control WET which causes, has the reasonable potential to cause, or contributes to an excursion above a State narrative water quality criterion. Under § 122.44(d)(1)(v), the permitting authority must establish either a WET effluent limitation designed to meet the narrative criterion or a pollutant-specific effluent limitation where the permitting authority is satisfied it will assure compliance with applicable narrative and numeric criteria to control the WET due to ammonia or chlorine. 40 C.F.R. § 122.44(d)(1)(vi) allows the permitting authority to use one of three options for developing effluent limitations for a pollutant determined to cause an exceedance of a State narrative criterion where the State has developed no numeric water quality criterion for the specific pollutant. These options are (1) establish an effluent limitation using a calculated numeric water quality criterion which will attain and maintain the applicable narrative criteria and fully protect the designated use; (2) establish an effluent limitation

¹⁸ This policy statement does not mean that permitting authorities disregard technical factors which are unique to ammonia and chlorine in implementing regulatory requirements. For example, holding pH constant in the laboratory during a WET test may be necessary to assure a representative WET sample, where WET is due to ammonia. The permitting authority may also use judgment in interpreting testing results and setting limits where temperature has a significant impact upon WET, which may be the case for ammonia discharges during winter. In addition, the permitting authority may require WET testing prior to chlorination if a facility is under a schedule to dechlorinate. Once dechlorination is implemented, then WET testing should be conducted on the final effluent.

on a case-by-case basis using EPA criteria supplemented by other relevant information where necessary; and (3) establish an effluent limitation for an indicator parameter provided certain factors are established.

8. Whole Effluent Toxicity Controls and POTWs

The requirements of the water quality permitting regulations apply to all dischargers, including POTWs.

This policy statement reaffirms EPA's longstanding policy of treating all dischargers on an equal basis in imposing and enforcing effluent limitations to control all pollutants and pollutant parameters. Under sections 301(b)(1)(C) and 402 of the CWA as well as 40 C.F.R. § 122.44(d)(1), all dischargers must meet effluent limitations designed to attain and maintain applicable State water quality standards. Under the current NPDES program, EPA exercises enforcement discretion where appropriate for particular violations of effluent limitations designed to meet State water quality standards, and provides technical guidance and support to dischargers in seeking solutions to water quality-permitting and compliance problems. See Attachment 2 to the January 25, 1989, memorandum from Rebecca W. Hanmer, Acting Assistant Administrator for Water, to EPA Regional Administrators entitled "Whole Effluent Toxicity Basic permitting Principles and Enforcement Strategy." EPA's Enforcement Management System for the National Pollutant Discharge Elimination System (1989) also discusses how EPA exercises such enforcement discretion.

Authorized NPDES States and EPA will work with municipalities (as well as other permittees) to solve water quality-related problems, including those resulting from WET. In 1991, EPA published the revised TSD, which provides comprehensive technical guidance for assessing and regulating the discharge of toxic substances to the waters of the United States. In 1989, the Agency published a specific toxicity reduction manual for the municipal discharger, the Toxicity Reduction Evaluation Protocol for Municipal Wastewater Treatment Plants (EPA 600/2-88/062 April 1989). Since 1985, EPA's National Effluent Toxicity Assessment Center in Duluth, Minnesota has provided assistance to regulatory authorities in connection with dischargers that have complex toxicity problems. EPA has published the Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents. Phase I (EPA-600/6-91/005F) (May 1992), a guidance document designed to assist dischargers and their consultant laboratories in conducting chronic aquatic toxicity identification evaluations.

CONCLUSION

The fundamental premises of today's policy are not new. Because of the importance of WET controls, however, EPA is taking this opportunity to reiterate key principles associated with implementation of existing statutory and regulatory requirements for WET. The publication of this policy is designed to foster consistent nationwide compliance with existing statutory and regulatory provisions for the control of WET, to facilitate the development of appropriate controls for WET in NPDES permits, and to help assure attainment of water quality standards throughout the nation.

APPENDIX ONE

HISTORY OF FEDERAL REGULATION OF WHOLE EFFLUENT TOXICITY (WET)

Since 1984, the Environmental Protection Agency, the States, and the regulated community have employed an integrated strategy consisting of both biological and chemical means to control toxic effects upon water quality beyond Clean Water Act (CWA) technology-based requirements in order to achieve and maintain State water quality standards. One method for measuring the biological effects of toxic effluents upon aquatic life is WET testing. EPA and the States have used the data derived from WET testing to assess compliance with State water quality standards and to establish National Pollutant Discharge Elimination System (NPDES) permit effluent limitations necessary to attain and maintain those standards.

In the past ten years, the Agency has published regulations, policy statements, and guidance documents which address a variety of issues associated with WET controls in NPDES permits. In 1984, EPA issued the "Policy for the Development of Water Quality-Based Permit Limitations for Toxic Pollutants" (published at 49 Fed. Reg. 9016 (March 9, 1984)). This policy addresses the use of biological and chemical methods to assure that toxic whole effluent discharges are regulated consistent with federal and State requirements. The document discusses such specific issues as integration of chemical and biological approaches; chemical, physical, and biological testing requirements (WET requirements); use of data; setting of effluent limitations; and monitoring.

On January 25, 1989, Rebecca W. Hanmer, Acting Assistant Administrator for Water, sent to EPA Regional Administrators the memorandum entitled "Whole Effluent Toxicity Basic Permitting Principles and Enforcement Strategy." A group of Regional and State representatives developed the strategy, which discussed the minimum acceptable national requirements for WET permitting.

In 1989, the Agency revised existing 40 C.F.R. § 122.44(d)(1), which previously required NPDES permits to contain any more stringent requirements necessary to achieve State water quality standards. See 54 Fed. Reg. 23868 (June 2, 1989). The revised regulation described in greater detail requirements for NPDES permitting authorities to follow in developing NPDES effluent limitations to assure compliance with State water quality standards. On August 14, 1992, Michael B. Cook, Director, Office of Wastewater Enforcement and Compliance, and Robert H. Wayland, III, Director, Office of Wetlands, Oceans and Watersheds, transmitted a memorandum to the Water Management Division Directors, Regions I-X, entitled "Clarifications Regarding Certain Aspects of EPA's Surface Water Toxics Control

Regulations.” (See Appendix Four.) In 1990, EPA also published new 40 C.F.R. § 122.21(j), which established a requirement for certain publicly owned treatment works (POTWs) to provide the results of valid WET testing with applications for NPDES permits. See 55 Fed. Reg. 30082 (July 24, 1990). The preambles to these regulatory revisions and the 1984 policy provide a detailed explanation of legal and policy support for WET testing and effluent limitations.

Since 1984, the Agency has published various guidance documents which address the subject of water quality-based toxics control, including WET control. See, in particular, the Technical Support Document for Water Quality-based Toxics Control, which was originally published in September and revised in March 1991 (EPA/505/2-90-001) (the TSD). The revised TSD provides an explanation of the technical support for WET testing and gives detailed guidance on development of water quality-based permit limitations for WET and toxic pollutants.

On June 19, 1991, EPA issued the “Policy on the Use of Biological Assessments and Criteria in the Water Quality Program.” In discussing integration of Various assessment methods, the 1991 policy reflects a position of “independent application.” In essence, “independent application” means that appropriate regulatory action should be taken when any one of biosurvey, pollutant-specific, or WET testing methods indicates that an applicable water quality standard is not attained.

APPENDIX TWO

BACKGROUND MATERIALS ON WHOLE EFFLUENT TOXICITY (WET) TESTING. THE STATE WATER QUALITY STANDARDS PROCESS AND WET FEDERAL STATUTORY AND REGULATORY REQUIREMENTS FOR WET, AND WET REDUCTION GUIDANCE

Overview of WET Testing for Aquatic Life Protection

The WET approach to toxics control for the protection of aquatic life involves the use of acute and chronic WET testing to measure the toxicity of wastewaters. Whole effluent toxicity tests typically use standardized, surrogate freshwater or marine plants, vertebrates, or invertebrates to measure the aggregate toxic effect of an effluent. An acute WET test is typically a test of 96-hours or less in duration in which lethality is the measured endpoint. A chronic WET test is typically a longer-term test in which sublethal effects, such as fertilization, growth, and reproduction can be measured in addition to lethality. On December 4, 1989, EPA published proposed Part 136 methods for conducting short-term acute and chronic WET testing for marine and freshwater species. See 54 Fed. Reg. 50216. Once these methods are final, they will constitute approved Part 136 test methods for the NPDES program.

Overview of the State Water Quality Standards Process and WET

Section 303 of the Clean Water Act (CWA) establishes the statutory basis for the current State water quality standards program. Under this provision of the CWA, States bear primary responsibility for adopting water quality standards. State water quality standards represent the means by which EPA and authorized NPDES States control point source discharges when technology-based controls for point source discharges are inadequate.

A water quality standard defines the water quality of a water body by designating the uses to be made of the water, by setting criteria necessary to protect the uses, and by establishing antidegradation policies and implementation procedures that serve to maintain and protect water quality. See section 303(c) of the CWA and 40 C.F.R. Part 131. States adopt water quality standards to protect public health or welfare, enhance the quality of the water, and serve the purposes of the CWA. Among other requirements, State water quality criteria must protect aquatic life.

Under section 303 of the CWA and 40 C.F.R. Part 131, EPA must approve State water quality standards or disapprove State water quality standards and overpromulgate with federal water quality standards. State water quality standards are effective

until EPA overpromulgates with federal standards. Once promulgated, the federal standards are the applicable water quality standards for the State.

State water quality criteria may be expressed as constituent numeric concentrations of pollutants or pollutant parameters or as narrative statements representing a quality of water that supports a particular use. This is true of the pollutant parameter WET. Several States have adopted numeric criteria for WET. Most evaluation and control of WET at this time, however, is based upon maintenance of the State's designated uses for the water body through basic narrative water quality criteria for toxicity. All States have narrative criteria for toxicity which are statements of a desired water quality goal, such as "all State waters must, at all times and flows, be free from substances that are toxic to humans or aquatic life." EPA considers narrative criteria to apply to all designated uses at all flows unless specified otherwise in the State's water quality standards. EPA regards narrative criteria for toxicity to cover both short-term and long-term WET effects (acute and chronic effects, respectively).

Section 303(d) of the CWA establishes requirements for determining the specific pollutant reductions necessary to attain water quality standards. Under section 303(d), the State (or, upon the failure of the State, EPA) must establish a Total Maximum Daily Load (TMDL) for water quality-limited waters. A TMDL is an estimate of the total loading of a pollutant or pollutant stressor that may be allowed within a receiving water and an allocation of the total loading between the sources. See 40 C.F.R. Part 130. A TMDL consists of Wasteload Allocations for point sources, Load Allocations for other sources, and a Margin of Safety to account for uncertainty in the relationship between loadings and water quality. EPA has issued program guidance and revised regulations pursuant to section 303(d) (see Guidance for Water Quality-based Decisions: The TMDL Process (EPA 440/4-91-001 April 1991); 57 Fed. Reg. 33040-33050 (July 24, 1992; and April 13, 1992, memorandum from Geoffrey H. Grubbs, Director, Assessment and Watershed Protection Division, Office of Wetlands, Oceans and Watersheds, entitled "Supplemental Guidance on Section 303 (d) Implementation"). TMDLs may be developed for a single source to support the issuance of an NPDES permit or for a larger water body when multiple sources need to be considered together.

State implementation procedures may further explain how the State implements the applicable narrative criterion to establish effluent limitations to control WET. Many effluent limitations to control WET, however, result from the permitting authority's case-by-case determination of what concentration of WET meets the narrative criterion.

State WET criteria or the procedures implementing the State criteria typically describe the magnitude, duration, and return frequency for WET. The duration and frequency of the discharge may also be defined by the design stream flow appropriate to the criterion. Magnitude is the maximum allowable concentration of WET, which is typically expressed as a concentration of toxicity instream; duration is the period of time over which the instream concentration is averaged for comparison with criteria concentrations, in order to limit the durations of concentrations above the criterion; and return frequency is a designation of how often the criterion may be exceeded without impacting the organisms in the water body. This information is needed because ambient water quality typically varies in response to changes in effluent quality, stream flow, and other factors. Accordingly, organisms in the receiving water typically experience fluctuating exposure to pollutants, including some periods of exposure to high pollutant concentrations, which may have adverse effects. For this reason, criteria indicate a time period over which exposure is to be averaged, as well as a maximum concentration, thereby limiting the duration of exposure to elevated concentrations. In addition, to predict or ascertain the attainment of criteria it is necessary to specify the allowable frequency for exceeding the WET criteria. The permitting authority uses the magnitude, duration, and return frequency provisions of WET criteria to develop wasteload allocations and effluent limitations to control the WET of the discharge.

Whole effluent toxicity criteria as adopted by the State or as implemented by the permitting authority on a case-by-case basis typically consist of two expressions of magnitude of toxicity to surrogate test species, one to protect against acute toxicity effects and one to protect against chronic toxicity effects, along with a duration and return frequency for each. As of the publication date of this policy, EPA has not developed a recommended section 304(a) criterion for WET. The Technical Support Document for Water Quality-based Toxics Control, which was originally published in September 1985 and was revised in March 1991 (EPA/505/2-90-001) (the TSD), contains recommended magnitudes, durations, and return frequencies for assessing acute WET (0.3 acute toxic unit to the most sensitive of at least three species, with an averaging period of one hour and a once in three-year return frequency) and chronic WET (1.0 chronic toxic unit to the most sensitive of at least three species, with an averaging period of 4 days and a once in three-year return frequency). See the TSD at 2.3.3 to 2.3.5.

At their discretion, States may adopt certain policies for implementation of water quality standards, such as critical low flow and mixing zone policies. EPA has the authority to review and approve or disapprove such policies. See 40 C.F.R. § 131.13.

Additionally, EPA and States may establish a Technical Agreement describing procedures that will be used in developing TMDLs and wasteload allocations. TMDLs, wasteload allocations, and permit limitations developed consistent with Technical Agreements are subject to a lesser degree of EPA review. State water quality standards protect water quality for designated uses in critical low flow situations. Under § 131.13, States may designate critical low flows below which numeric water quality criteria do not apply. Mixing zones are small areas in the receiving water near certain discharge outfalls where ambient concentrations above the otherwise applicable State Water quality criteria are allowed. See generally the Water Quality Standards Handbook at 2-7 (1983); the TSD at 2.2.2. Some States prohibit mixing zones entirely for all pollutants or pollutant parameters. Others may allow mixing zones in general, but provide spatial dimensions to limit the areal extent of the mixing zones. Permitting authorities may allow mixing zones on a case-by-case basis for individual discharges. EPA strongly recommends that States have a definitive statement in their water quality standards on whether or not mixing zones are allowed and clearly explain the procedures for defining mixing zones where allowed.

Overview of Federal Statutory and Regulatory Requirements for Development of Water Quality-based Permit Limitations for WET

Section 101(a) of the CWA establishes a national policy of restoring and maintaining the chemical, physical, and biological integrity of the Nation's waters. In addition, section 101(a)(3) of the CWA states the national policy that the discharge of toxic pollutants in toxic amounts is prohibited. Under sections 301 and 402 of the CWA, point source dischargers must obtain an NPDES permit before discharging into waters of the United States. Under sections 301(b)(1)(C) and 402 of the CWA, dischargers with NPDES permits must meet all of the technology-based requirements of the CWA as well as any more stringent requirements necessary to achieve State water quality standards established under section 303 of the CWA.

In 40 C.F.R. § 122.2, EPA defines "whole effluent toxicity" as "the aggregate toxic effect of an effluent measured directly by a toxicity test." EPA has published 40 C.F.R. § 122.44(d)(1), which describes requirements for NPDES permitting authorities to follow in developing water quality-based effluent limitations, including those necessary to control WET. The regulation consists of seven subparagraphs:

1. Section 122.44(d)(1)(i)

Limitations must control all pollutants or pollutant parameters (either conventional, nonconventional, or

toxic pollutants) which the Director determines are or may be discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any State water quality standard, including State narrative criteria for water quality.

2. Section 122.44(d)(1)(ii)

When determining whether a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above a narrative or numeric criteria within a State water quality standard, the permitting authority shall use procedures which account for existing controls on point and nonpoint sources of pollution, the variability of the pollutant or pollutant parameter in the effluent, the sensitivity of the species to toxicity testing (when evaluating whole effluent toxicity), and where appropriate, the dilution of the effluent in the receiving water."

3. Section 122.44(d)(1)(iii)

When the permitting authority determines, using the procedures in paragraph (d)(1)(ii) of this section, that a discharges causes, has the reasonable potential to cause, or contributes to an in-stream excursion above the allowable ambient concentration of a State numeric criteria within a State water quality standard for an individual pollutant, the permit must contain effluent limits for that pollutant."

4. Section 122.44(d)(1)(iv)

When the permitting authority determines, using the procedures in paragraph (d)(1)(ii) of this section, that a discharges causes, has the reasonable potential to cause, or contributes to an in-stream excursion above the numeric criterion for whole effluent toxicity, the permit must contain effluent limits for whole effluent toxicity."

5. Section 122.44(d)(1)(v)

Except as provided in this subparagraph, when the permitting authority determines, using the procedures in paragraph (d)(1)(ii) of this section, toxicity testing data, or other information, that a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above a narrative

criterion within an applicable State water quality standard, the permit must contain effluent limits for whole effluent toxicity. Limits on whole effluent toxicity are not necessary where the permitting authority demonstrates in the fact sheet or statement of basis of the NPDES permit, using the procedures in paragraph (d)(1)(ii) of this section, that chemical-specific limits for the effluent are sufficient to attain and maintain applicable numeric and narrative State water quality standards.”

6. Section 122.44(d)(1)(vi)

“Where a State has not established a water quality criterion for a specific chemical pollutant that is present in an effluent at a concentration that causes, has the reasonable potential to cause, or contributes to an excursion above a narrative criterion within an applicable State water quality standard, the permitting authority must establish effluent limits using one, or more of the following options:

(A) Establish effluent limits using a calculated numeric water quality criterion for the pollutant which the permitting authority demonstrates will attain and maintain applicable narrative water quality criteria and will fully protect the designated use. Such a criterion may be derived using a proposed State criterion, or an explicit State policy or regulation interpreting its narrative water quality criterion, supplemented with other relevant information which may include: EPA’s Water Quality Standards Handbook, October 1983, risk assessment data, exposure data, information about the pollutant from the Food and Drug Administration, and current EPA criteria documents; or

(B) Establish effluent limits on a case-by-case basis, using EPA’s water quality criteria, published under section 304(a) of the CWA, supplemented where necessary by other relevant information; or

(C) Establish effluent limitations on an indicator parameter for the pollutant of concern, provided:

- (1) The permit identifies which pollutants are intended to be controlled by the use of the effluent limitation;
- (2) The fact sheet required by § 124.56 sets forth the basis for the limit, including a finding that compliance with the effluent limit on the indicator

parameter will result in controls on the pollutant of concern which are sufficient to attain and maintain applicable water quality standards;

- (3) The permit requires all effluent and ambient monitoring necessary to show that during the term of the permit the limit on the indicator parameter continues to attain and maintain applicable water quality standards; and
- (4) The permit contains a reopener clause allowing the permitting authority to modify or revoke and reissue the permit if the limits on the indicator parameter no longer attain and maintain applicable water quality standards."

7. Section 122.44(d)(1)(vii)

"When developing water quality-based effluent limits under this paragraph the permitting authority shall ensure that:

(A) The level of water quality to be achieved by limits on point sources established under this paragraph is derived from, and complies with all applicable water quality standards; and

(B) Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with the assumptions and requirements of any available wasteload allocation for the discharge prepared by the State and approved by EPA pursuant to 40 CFR 130.7."

Overview of Toxicity Reduction Guidance

The purpose of a toxicity reduction evaluation (TRE), including a toxicity identification evaluation (TIE), is to investigate the causes and determine corrective actions for WET problems. The permitting authority may require the permittee to conduct these evaluations in specific cases. Section 5.8 of the contains a detailed discussion of EPA's recommended approach for conducting TIES and TREs, including a list of guidance documents EPA has developed describing methods and procedures for conducting TIES and TREs.

**APPENDIX D
BIBLIOGRAPHY**

BIBLIOGRAPHY

- Cohen, A.C. 1991. Truncated and Censored Samples. New York: Marcel Dekker.
- Hahn, G.J., and W.Q. Meeker. 1991. *Statistical intervals: A Guide for Practitioners*. New York: Wiley.
- Helsel, D.R., and T.A. Cohn. 1988. Estimation of Descriptive Statistics for Multiply Censored Water Quality Data. *Water. Resour. Res.* 24:1997–2004.
- Hirsch, R.M., and J.R. Stedinger. 1987. Plotting Positions for Historical Floods and Their Precision. *Wat. Resour. Res.* 23:715–727.
- Kroll, C.N., and J.R. Stedinger. 1996. Estimation of Moments and Quantiles Using Censored Data. *Wat. Resour. Res.* 32:1005–1012.
- North Carolina Department of Environment and Natural Resources. 1998. *North Carolina Biological Laboratory Certification/Criteria Procedures Document*. Division of Water Quality, Water Quality Section. Raleigh, NC.
- Shumway, R.H., R.S. Azari, and M. Kayhanian. 2002. Statistical Approaches to Estimating Mean Water Quality Concentrations with Detection Limits. *Environ. Sci. Technol.* 36:3345–3353.
- Taylor, D.J., L.L. Kupper, S.M. Rappaport, and R.H. Lyles. 2001. A Mixture Model for Occupational Exposure Mean Testing with a Limit of Detection. *Biometrics* 57:681–688.
- USEPA. 1984. *Ambient Water Quality Criteria for Chlorine -1984*. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C.
- USEPA. 1985a. *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms* (3rd Edition). W. Peltier and C.I. Weber, eds. Environmental Monitoring Systems Laboratory. Cincinnati, OH. EPA/600/4-85/013.
- USEPA. 1985b. *Ambient Water Quality Criteria for Ammonia - 1985*. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C.
- USEPA. 1987. *Permit Writer's Guide to Water Quality-Based Permitting for Toxic Pollutants*. Office of Water Enforcement and Permits, Washington, D.C.
- USEPA. 1988. *Short-term Methods for Estimating the Chronic Toxicity of Effects of Receiving Water to Marine/Estuarine Organisms* (1st Edition). C.I. Weber, W.B. Horning, D.J. Klemm, T.W. Neiheisel, P.A. Lewis, E.L. Robinson, J.R. Menkedick, F.A. Kessler, eds. Office of Research and Development. Cincinnati, OH. EPA/600/4-87/028.
- USEPA. 1988. *Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures*. EPA/600/3-88/034. National Effluent Toxicity Assessment Center, Duluth, Minnesota.
- USEPA. 1989a. *Toxicity Reduction Evaluation Protocol for Municipal Wastewater Treatment Plants*. EPA-600-2-88-062. Office of Research and Development, Risk Reduction Engineering Laboratory, Cincinnati, OH.

USEPA. 1989b. *Generalized Methodology for Conducting Industrial Toxicity Reduction Evaluations*. EPA-600-2-88-070. Office of Research and Development, Cincinnati, OH.

USEPA. 1989c. *Methods for Aquatic Toxicity Identification Evaluations: Phase II, Toxicity Identification Procedures*. EPA-600-3-88-035. Office of Research and Development, Duluth, MN.

USEPA. 1989d. *Methods for Aquatic Toxicity Identification Evaluations: Phase III, Toxicity Confirmation Procedures*. EPA-600-3-88-036. Office of Research and Development, Duluth, MN.

USEPA. 1989e. *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (2nd Edition). C.I. Weber, W.H. Peltier, T.J. Norberg-King, W.B. Homing, II, F.A. Kessler, J.R. Menkedick, T.W. Neiheisel, P.A. Lewis, D.J. Klemm, Q.H. Pickering, E.L. Robinson, J.M. Lazorchak, L.J. Wymer, R.W. Freyberg, eds. Office of Research and Development. Cincinnati, OH. EPA/600/4-89/001.

USEPA. 1989f. *The Enforcement Management System. National Pollutant Discharge Elimination System (Clean Water Act)*. Office of Water.

USEPA. 1989g. *Policy Memorandum – Whole Effluent Toxicity Basic Permitting Principles and Enforcement Strategy. January 25, 1989*. R.W. Hanmer (Office of Water) to Regional Administrators.

USEPA. 1989h. *Whole Effluent Toxicity Basic Permitting Principles and Enforcement Strategy (January 25, 1989) Attachment Two: Compliance Monitoring and Enforcement Strategy for Toxics Control*. Office of Water, Washington, DC.

USEPA. 1990. *Seminars–Wastewater Treatment Plant Toxicity Evaluation, Reduction and Control: Presentations*. Vol.1. CERL-89-243. Center for Environmental Research Information, Cincinnati, OH. 441 pp.

USEPA. 1991a. *Technical Support Document for Water Quality-based Toxics Control*. Office of Water. Washington, DC. EPA/505/2-90-001.

USEPA. 1991b. *Methods for Aquatic Toxicity Identification Evaluations: Phase I, Toxicity Characterization Procedures*. 2nd Edition. EPA-600-6-91-003. National Effluent Toxicity Assessment Center, Duluth, MN.

USEPA. 1991c. Transmittal Memorandum: *Final Policy on Biological Assessment and Criteria*. June 19, 1991. T. Davies to Regions. Office of Science and Technology, Washington, DC.

USEPA. 1992a. *Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I*. EPA-600-6-91-005F. National Effluent Toxicity Assessment Center, Duluth, MN.

USEPA. 1992b. *Policy Memorandum -- Clarifications Regarding Certain Aspects of EPA's Surface Water Toxics Control Regulations*. August 14, 1992. M.B. Cook and R.H. Wayland to Water Management Division Directors, Regions I-X.

USEPA. 1993a. *Methods for Aquatic Toxicity Identification Evaluations: Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity*. EPA-600-R-92-080. National Effluent Toxicity Assessment Center, Duluth, MN.

USEPA. 1993b. *Methods for Aquatic Toxicity Identification Evaluations: Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity*. EPA-600-R-92-081. National Effluent Toxicity Assessment Center, Duluth, MN.

USEPA. 1993c. *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms* (4th Edition). C.I. Weber, ed. Office of Research and Development. Cincinnati, OH. EPA/600/4-90/027F.

USEPA. 1994a. *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms* (2nd Edition). D.J. Klemm, G.E. Morrison, T.J. Norberg-King, W.H. Peltier, and M.A. Heber, eds. Office of Research and Development. Cincinnati, OH. EPA/600/4-91/003.

USEPA. 1994b. *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms* (3rd Edition). P.A. Lewis, D.J. Klemm, J.M. Lazorchak, T.J. Norberg-King, W.H. Peltier, and M.A. Heber, eds. Office of Research and Development. Cincinnati, OH. EPA/600/4-91/002.

USEPA. 1994c. *Short-term Methods for Estimating the Sediment Toxicity of Effluents and Receiving Waters to Freshwater and Estuarine Organisms*. Office of Research and Development. Duluth, MN. EPA/600/R-94-001.

USEPA. 1994d. *Policy for the Development of Effluent Limitations in National Pollutant Discharge Elimination System (NPDES) Permits to Control Whole Effluent Toxicity for the Protection of Aquatic Life*. EPA833-B-94-002. Office of Water, Washington, DC.

USEPA. 1994e. *Methods for Determination of Metals in Environment Samples - Supplement I*. EPA 600/R-94/111. Office of Research and Development, Washington, D.C.

USEPA. 1995a. *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms*. G.A. Chapman, D.L. Denton, and J.M. Lazorchak, eds. Office of Research and Development. Cincinnati, OH. EPA/600/R-95-136.

USEPA. 1995b. *Policy Memorandum -- National Policy Regarding Whole Effluent Toxic Enforcement*. August 14, 1995. R. Van Heuvelen and M. Cook to Water Management Division Directors, Regions I-X; Regional Counsels, Regions I-X; and State NPDES Directors. Office of Wastewater Management, Washington, DC.

USEPA. 1995c. Whole Effluent Toxicity: Guidelines Establishing Test Procedures for the Analysis of Pollutants (FR Vol. 60 Number 199, pages 53529-53544), 10/16/95. Office of Science and Technology, EAD.

USEPA. 1996a. *NPDES Permit Writer's Manual*. Office of Water. Washington, DC. EPA/833/B-96-003.

USEPA 1996b. *Guide to Method Flexibility and Approval of EPA Water Methods*. EPA/821/D-96-004.

USEPA. 1996c. *Marine Toxicity Identification Evaluation (TIE): Phase I Guidance Document*. EPA/600/R-96-054. National Health and Environmental Effects Laboratory, Narragansett, RI.

USEPA. 1996d. *Policy Memorandum -- Clarifications Regarding Flexibility in 40 CFR Part 136 Whole Effluent Toxicity (WET) Test Methods, April 10, 1996*. T. Davies to: Water Management Division Directions, Regions I-X and Environmental Services Division Directors, Regions I-X. Office of Science and Technology, Washington, DC.

USEPA. 1996e. *Regions 9 and 10 Guidance for Implementing Whole Effluent Toxicity Testing Programs*. U. S. Environmental Protection Agency, Regions 9 Water Division, San Francisco, CA and Region 10 Office of Water, Seattle, WA.

USEPA. 1997. *Policy Memorandum -- Clarifications Regarding Whole Effluent Toxicity Test Methods Recently Published at 40 CFR Part 136 and Guidance on Implementation of Whole Effluent Toxicity in Permits*. July 21, 1997. T.T. Davies and M.B. Cook to: Water Management Division Directors, Regions I-X and Environmental Services Division Directors, Regions I-X. Office of Science and Technology and Office of Wastewater Management, Washington, DC.

USEPA. 1999b. *Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants (2nd Edition)*. Office of Water. Washington, DC. EPA/833/B-99-002.

USEPA. 1999c. *Errata for Effluent and Receiving Water Toxicity Test Manuals: Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms; Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms; and Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms*. EPA-600-R-98-182. Office of Research and Development, Duluth, MN.

USEPA. 2000a. *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates (2nd Edition)*. Office of Research and Development. Duluth, MN. EPA/600/R-99/064.

USEPA. 2000b. *Understanding and Accounting for Method Variability in Whole Effluent Toxicity Applications Under the National Pollutant Discharge Elimination System Program*. Eds. Denton, D.L., Fox, J., Fulk, F.A., Greenwald, K., Narvaez, M., Norberg-King, T.J., Phillips, L. EPA/833/R-00-003. Office of Water, Washington, DC.

USEPA. 2000c. *Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing (40 CFR Part 136)*. Office of Water, Office of Science and Technology. Washington, DC. EPA/821/B-00-004.

USEPA. 2001a. *Policy Memorandum: Clarifications Regarding Toxicity Reduction and Identification Evaluations in the National Pollutant Discharge Elimination System Program, 3/27/01*. OWM, Washington, D.C.

USEPA 2001b. *Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and acute Whole Effluent Toxicity Test Methods, Vol. 1*. EPA 821-B-01-004. Office of Science and Technology.

USEPA 2001c. *Final Report: Interlaboratory Variability Study of EPA Short-term Chronic and Acute Whole Effluent Toxicity Test Methods, Vol. 2: Appendix*. EPA 821-B-01-004. Office of Science and Technology.

USEPA. 2002a. *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*, 5th edition. EPA 821/R-02/012. Office of Science and Technology.

USEPA. 2002b. *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*, 4th edition. EPA 821/R-02-13. Office of Science and Technology.

USEPA. 2002c. *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms*, 3rd edition. EPA 821/R-02-14). Office of Science and Technology.

WEB SITES

<http://www.epa.gov/waterscience/>

Main EPA site for information on WET analytical methods. Includes updated reference manuals and the text of the 2002 WET methods promulgated rule.

<http://cfpub2.epa.gov/npdes/>

Main EPA site for the National Pollution Discharge Elimination System (NPDES) program. Includes a link to search for publications.

<http://www.epa.gov/clariton/index.htm>

National Environmental Publications Information System, providing many manuals as .pdf files.

<http://www.epa.gov/nscep/>

National Service Center for Environmental Publications, reader may request a hard copy of any manual cited in this document.

<http://www.gpoaccess.gov/nara/index.html>

Office of the Federal Register, providing online access to CFR and FR.