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Local Limits Development Guidance

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Background

The Office of Wastewater Management of the U.S. Environmental Protection Agency's (EPA's) Office of Water prepared this guidance document to assist municipalities that own or operate publicly owned treatment works (POTWs) in developing and implementing local pretreatment programs.

Section 402(b) of the Clean Water Act (CWA) provides for EPA to authorize a State to administer its own National Pollutant Discharge Elimination System (NPDES) permit program. In order to be authorized, a State program must include adequate authority to issue permits that ensure compliance with the CWA including section 307(b) pretreatment standards. The program must ensure that permits issued to POTWs include a program to assure compliance with pretreatment standards by significant sources introducing pollutants subject to such standards to the POTW. [Section 402(b)(8), 33 U.S.C. § 1342(b)(8)]. This guidance will assist POTWs in their efforts to meet their requirement to develop pretreatment programs.

Disclaimer

The discussion in this document is intended solely as guidance. This guidance is not a regulation nor does not it substitute for any requirements under the CWA or EPA's regulations. Thus, it does not impose legally binding requirements on EPA, States, municipalities or the regulated community. The general descriptions provided in this document may not apply to a particular situation based upon the circumstances. This guidance does not confer legal rights or impose legal obligations upon any member of the public.

Among other things, the document describes existing requirements with respect to industrial dischargers and POTWs under the CWA and its implementing regulations at 40 CFR 122, 123, 124, and 403 and chapter I, subchapter N. While EPA has made every effort to ensure the accuracy of the discussion in this guidance, a discharger's obligations are determined, in the case of directly discharging POTWs, by the terms of their NPDES permit and EPA's regulations or, in the case of indirect dischargers, by permits or equivalent control mechanisms issued to POTW industrial users or by regulatory requirements. Nothing in this guidance changes any statutory or regulatory requirement. In the event of a conflict between the discussion in this guidance and any permit or regulation, the permit or regulation would be controlling. EPA and local decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from those described in this guidance where appropriate and authorized by EPA regulations, State law, or local ordinances.

Mention of trade names or commercial products does not constitute endorsement or recommendation for their use.

EPA may decide to revise this guidance without public notice to reflect changes in the Agency's approach to implementing pretreatment standards or to clarify and update text. To determine whether the Agency has revised this guidance and/or to obtain copies, contact the Water Permits Division at (202) 564-9545. You can also determine whether EPA has revised or supplemented the information in this guidance by accessing the document at: http://www.epa.gov/NPDES/pretreatment.

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ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ADRE	Average Daily Removal Efficiency
AHL	Allowable Headworks Loading
AMSA	Association of Metropolitan Sewerage Agencies
BPJ	Best Professional Judgment
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIU	Categorical Industrial User
CWA	Clean Water Act
CWF	Combined Wastestream Formula
EPA	United States Environmental Protection Agency
FOG	Fats, Oils, and Greases
HAP	Hazardous Air Pollutant
HEM	Hexane Extractable Materials
ICP	Inductively Coupled Plasma
IF	Interval Flow
IQR	Interquartile Range
IU	Industrial User
IWS	Industrial Waste Survey
I&I	Inflow and Infiltration

LEL	Lower Explosive Limit
MAHL	Maximum Allowable Headworks Loading
MAIL	Maximum Allowable Industrial Loading
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MG	Million Gallons
MGD	Million Gallons per Day
ML	Minimum Level of Quantitation
MLE	Maximum Likelihood Estimation
MRE	Mean Removal Efficiency
MSDS	Material Safety Data Sheet
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
POC	Pollutant of Concern
POTW	Publicly Owned Treatment Works
PS	Percent Solids
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit
ROS	Regression Order Statistic
SGT-HEM	Silica Gel Treated Hexane Extractable Materials

SIP	State Implementation Plan
SIU	Significant Industrial User
SUO	Sewer Use Ordinance
STEL	Short-Term Exposure Limit
TCLP	Toxicity Characteristic Leaching Procedure
TLV	Threshold Limit Value
TMDL	Total Maximum Daily Load
TPH	Total Petroleum Hydrocarbons
TRE	Toxicity Reduction Evaluation
TSD	Technical Support Document
TSS	Total Suspended Solids
TWA-TLV	Time Weighted Average Threshold Limit Value
UIC	Underground Injection Control
VOC	Volatile Organic Compound
WET	Whole Effluent Toxicity
WQC	Water Quality Criteria
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant

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GLOSSARY

1Q10. The lowest average flow for a one-day period that is expected to occur once every ten years. 1Q10 flows are generally available in the background documentation for the POTW's NPDES permit and also may be obtained from the local district office of the US Geological Survey (http://water.usgs.gov/local_offices.html).

7Q10. The lowest average flow for a seven-day period that is expected to occur once every ten years. 7Q10 flows are generally available in the background documentation for the POTW's NPDES permit and also may be obtained from the local district office of the US Geological Survey (http://water.usgs.gov/local_offices.html).

Biochemical Oxygen Demand (BOD). A measurement of the amount of oxygen utilized by the decomposition of organic material, over a specified time period (usually 5 days) in a wastewater sample. It is used as a measurement of the readily decomposable organic content of wastewater. When five days are prescribed the acronym BOD_5 is used.

Allowable Headworks Loading (AHL). The estimated maximum loading of a pollutant that can be received at a POTW's headworks that should not cause a POTW to violate a particular treatment plant or environmental criterion. AHLs are developed to prevent interference or pass through.

American Conference of Governmental Industrial Hygienists (ACGIH). The American Conference of Governmental Industrial Hygienists is a member-based organization and community of professionals that advances worker health and safety through education and the development and dissemination of scientific and technical knowledge.

Approval Authority. The Director in a NPDES State with an approved State pretreatment program or the appropriate EPA Regional Administrator in a non-NPDES State or NPDES State without an approved State pretreatment program (40 CFR 403.3). The Approval Authority approves POTW pretreatment programs, oversees POTW program implementation, and assumes the responsibility of the Control Authority for those POTWs that do not have a pretreatment program.

Clean Water Act (CWA). The primary Federal law that protects our nation's waters, including lakes, rivers, aquifers and coastal areas. It provides for the establishment of comprehensive programs that include standards, technical tools, permitting, enforcement and financial assistance to address the many causes of pollution and poor water quality, including municipal and industrial wastewater discharges, polluted runoff from urban and rural areas, and habitat destruction.

Clean Air Act (CAA). The Federal Clean Air Act is the Federal law that forms the basis for the national air pollution control effort. Basic elements of the act include National Ambient Air Quality Standards for major air pollutants, Hazardous Air Pollutants Standards, State attainment plans, motor vehicle emissions standards, stationary source emissions standards and permits, acid rain control measures, stratospheric ozone protection, and enforcement provisions.

Code of Federal Regulations (CFR). A codification of the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the Federal Government. The CFR is divided into 50 titles, which represent broad areas subject to Federal regulation. EPA's regulations are in

Title 40. Each title is divided into chapters, which usually bear the name of the issuing agency. Each chapter is further subdivided into parts covering specific regulatory areas. Large parts may be subdivided into subparts. All parts are organized in sections, and most citations to the CFR are provided at the section level.

Combined Wastestream Formula (CWF). As defined in 40 CFR 403.6 (e), a procedure under EPA's pretreatment regulations for calculating alternative discharge limits at industrial facilities where a regulated wastestream from a categorical industrial user is combined with other wastestreams prior to treatment.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA, commonly known as Superfund, was enacted by Congress in 1980. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.

Control Authority. As defined in 40 CFR 403.12, the POTW if the POTW's submission for its pretreatment program (40 CFR 403.3(t)) has been approved in accordance with the requirements of 40 CFR 403.11. If the submission has not been approved, the Control Authority is the Approval Authority. The Control Authority is responsible for implementing the pretreatment program, including establishment of control mechanisms for compliance assessment and enforcement of national standards, categorical standards, and local limits.

Conservative Pollutants. Pollutants that are presumed not to be destroyed, biodegraded, chemically transformed, or volatilized within the POTW. Conservative pollutants introduced to a POTW ultimately exit the POTW solely through the POTW's effluent and sludge. Most metals are considered conservative pollutants.

Flashpoint. The lowest temperature at which vapor combustion will propagate away from its source of ignition.

Headworks. The point at which wastewater enters a wastewater treatment plant. The headworks may consist of bar screens, comminuters, a wet well or pumps.

Industrial User (IU). Non-domestic source of pollutants into a POTW regulated under Section 307(b), (c) or (d) of the Clean Water Act.

Industrial Waste Survey (IWS). The process of identifying and locating industrial users and characterizing their industrial discharges.

Inflow and Infiltration (I&I). Infiltration is the seepage of groundwater into a sewer system, including service connections. Seepage frequently occurs through defective or cracked pipes, pipe joints, connections or manhole walls. Inflow is the water discharged into a sewer system and service connections from sources other than regular connections. This includes flow from yard drains, foundation drains and around manhole covers. Inflow differs from infiltration in that it is a direct discharge into the sewer rather than a leak or seepage into the sewer itself.

Inhibition. Inhibition occurs when pollutant levels in a POTW's wastewater or sludge cause operational problems for biological treatment processes involving secondary or tertiary wastewater treatment and alter the POTW's ability to adequately remove BOD, TSS, and other pollutants.

Interference. EPA uses the term "interference" in its regulations to describe a discharge that, alone or with discharges from other sources, inhibits or disrupts a POTW, its treatment processes and operations, or its sludge processes, use, or disposal and, therefore, causes a violation of the POTW's NPDES permit, increases the magnitude or duration of such a violation, or prevents the proper use or disposal of sewage sludge in compliance with the Clean Water Act, Solid Waste Disposal Act, Toxic Substance Control Acts, or the Marine Protection, Research and Sanctuaries Act.

Lower Explosive Limit (LEL). The minimum concentration in air at which a gas or vapor will explode or burn in the presence of an ignition source.

Maximum Contaminant Level (MCL). The maximum permissible level of a contaminant in water delivered to any user of a public water system. An MCL is an enforceable standard.

Maximum Allowable Industrial Loading (MAIL). The estimated maximum loading of a pollutant that can be received at a POTW's headworks from all permitted industrial users and other controlled sources without causing pass through or interference. The MAIL is usually calculated by applying a safety factor to the MAHL and discounting for uncontrolled sources, hauled waste and growth allowance.

Maximum Allowable Headworks Loading (MAHL). The estimated maximum loading of a pollutant that can be received at a POTW's headworks without causing pass through or interference. The most protective (lowest) of the AHLs (see definition) estimated for a pollutant.

Method Detection Limit (MDL). The minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is present as determined by a specific laboratory method in 40 CFR Part 136, Appendix B.

Minimum Level of Quantitation (ML). The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that all method-specified sample weights, volumes, and cleanup procedures have been employed. The ML is calculated by multiplying the MDL by 3.18 and rounding the result to the number nearest (1, 2, or 5) x 10^n where *n* is an integer.

National Ambient Air Quality Standards (NAAQS). Standards established by EPA that apply for outside air throughout the country.

National Institutes for Occupational Safety and Health (NIOSH). The National Institute for Occupational Safety and Health is the Federal agency responsible for conducting research and making recommendations for the prevention of work-related disease and injury. The Institute is part of the Centers for Disease Control and Prevention.

National Pollutant Discharge Elimination System (NPDES). The permitting system established by the Clean Water Act, which regulates the discharge of pollutants into the waters of the United States. Such a discharge is prohibited unless a NPDES permit is issued by EPA or, where authorized, a State; or a Native American tribal government.

Non-conservative Pollutants. Pollutants that are presumed to be destroyed, biodegraded, chemically transformed, or volatilized within the POTW to some degree.

Occupational Safety and Health Administration (OSHA). The Occupational Health and Safety Administration is part of the U.S. Department of Labor. It regulates worker conditions and was founded in 1971 to save lives, prevent injuries and protect the health of America's workers.

Pass Through. A discharge that enters the waters of the United States from a POTW in quantities or concentrations that, alone or with discharges from other sources, either causes a violation of any requirement of the POTW's NPDES permit, or increases the magnitude or duration of a violation of the POTW's NPDES permit.

Pollutant of Concern (POC). Any pollutant that might reasonably be expected to be discharged to the POTW in sufficient amounts to pass through or interfere with the works, contaminate its sludge, cause problems in its collection system, or jeopardize its workers.

Pretreatment. As defined in 40 CFR 403.3, "pretreatment" means the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW.

Priority Pollutant. Pollutants listed by the EPA Administrator under Clean Water Act Section 307 (a). The list of the current 126 Priority Pollutants can be found in 40 CFR Part 423, Appendix A.

Publicly Owned Treatment Works (POTW). A treatment works, as defined by Section 212 of the CWA, that is owned by the State or municipality. This definition includes any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes and other conveyances only if they convey wastewater to a POTW treatment plant [40 CFR 403.3]. Privately owned treatment works, Federally owned treatment works, and other treatment plants not owned by municipalities are not considered POTWs.

Resource Conservation and Recovery Act (RCRA). Passed by Congress in 1976, RCRA gave EPA the authority to control hazardous wastes from the "cradle to grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. RCRA focuses only on active and future facilities and does not address abandoned or historical sites (see CERCLA). The Federal Hazardous and Solid Waste Amendments are the 1984 amendments to RCRA that required phasing out land disposal of hazardous waste. Some of the other mandates of this strict law include increased enforcement authority for EPA, more stringent hazardous waste management standards, and a comprehensive underground storage tank program.

Sewer Use Ordinance (SUO). A legal mechanism implemented by a local government entity that sets out, among others, requirements for the discharge of pollutants into a POTW.

Short-Term Exposure Level (STEL). Concentrations to which a worker should not be exposed for longer than 15 minutes and which should not be repeated more than four times per day, with at least one hour between exposures (commonly accepted exposure limits identified by the ACGIH).

Significant Industrial User (SIU). As defined in 40 CFR 403.3, all users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR chapter I, subchapter N; and any other industrial user that discharges an average of 25,000 gallons per day or more of process wastewater to a POTW (excluding sanitary, non-contact cooling and boiler blowdown wastewater); contributes a process wastestream that makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the Control Authority defined in 40 CFR 403.12(a) on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement [in accordance with 40 CFR 403.8(f)(6)].

State Implementation Plan (SIP). An EPA-approved State plan required by the Clean Air Act for the establishment, regulation, and enforcement of air pollution standards.

Time Weighted Average Threshold Limit Value (TWA-TLV). The concentration to which a worker can be exposed for 8 hours per day, 40 hours per week and not have any acute or chronic adverse health effects (commonly accepted exposure limits identified by the ACGIH).

Total Maximum Daily Load (TMDL). Total Maximum Daily Load is a calculation of the maximum amount of a pollutant from point and non-point sources that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. The Clean Water Act, Section 303, establishes the water quality standards and TMDL programs.

Total Suspended Solids (TSS). A measure of the suspended solids in wastewater, effluent, or water bodies, determined by tests for "total suspended non-filterable solids."

Toxicity Characteristic Leaching Procedure (TCLP). A laboratory procedure designed to predict whether a particular waste is likely to leach chemicals into groundwater at dangerous levels. Details are provided in 40 CFR Part 261.

Volatile Organic Compound (VOC). As defined in 40 CFR 50.100, "volatile organic compounds" means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.

Whole Effluent Toxicity (WET) Tests. Whole effluent toxicity is the aggregate toxic effect of an effluent measured directly by an aquatic toxicity test. Aquatic toxicity methods designed specifically for measuring WET have been codified in 40 CFR 136. WET test methods employ a suite of standardized freshwater, marine, and estuarine plants, invertebrates, and vertebrates to estimate acute and short-term chronic toxicity of effluents and receiving waters.

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CHAPTER 1 - INTRODUCTION

1.1 PURPOSE OF THIS MANUAL

This manual provides guidance to municipalities on the development and implementation of local controls or limits on discharges to publicly owned treatment works (POTWs). This manual replaces the *Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program* issued by the U.S. Environmental Protection Agency (EPA) in December 1987. The audience for this manual is the POTW personnel responsible for local pretreatment program implementation. The manual provides practical technical assistance and reasoned guidance on the following:

- Determining pollutants of concern (POCs)
- Collecting and analyzing data
- Calculating maximum allowable headworks loadings (MAHLs) for each POC
- Designating and implementing local limits
- Performing local limits reviews and re-evaluations
- Developing local limits to address concerns about collection systems

Appendix A contains a list of supplemental EPA documents to this manual. If a POTW is located in a State with an approved pretreatment program, POTW personnel should also refer to guidance manuals and spreadsheets available from State Approval Authorities.

1.2 LOCAL LIMITS STATUTORY AUTHORITY

A component of the National Pollutant Discharge Elimination System (NPDES) Program, the National Pretreatment Program was developed by EPA to control the discharge of pollutants from POTWs. The statutory authority for the National Pretreatment Program lies in the Federal Water Pollution Control Act of 1972, which was amended by Congress in 1977 and renamed the Clean Water Act (CWA). Under Section 307(b), EPA must develop Pretreatment Standards that prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with POTWs. The 1977 amendments to the CWA required POTWs to ensure compliance with the pretreatment standards by each significant local source introducing pollutants subject to pretreatment standards into a POTW. To meet the requirements of the 1977 amendments, EPA developed the General Pretreatment Regulations for Existing and New Sources of Pollution [40 Code of Federal Regulations(CFR) Part 403].

1.3 LOCAL LIMITS PROCESS

To protect its operations and to ensure that its discharges comply with State and Federal requirements, a POTW will design its local limits based on site-specific conditions. Among the factors a POTW should consider in developing local limits are the following: the POTW's efficiency in treating wastes; its history of compliance with its NPDES permit limits; the condition of the water body that receives its treated effluent; any water quality standards that are applicable to the water body receiving its effluent; the POTW's retention, use, and disposal of sewage sludge; and worker health and safety concerns. The General Pretreatment Regulations require the following:

- POTWs that are developing pretreatment programs must develop and enforce specific limits on prohibited discharges, or demonstrate that the limits are not necessary [40 CFR 403.8(f)(4)].

- POTWs that have approved pretreatment programs must continue to develop and revise local limits as necessary [40 CFR 403.5(c)(1)].

- POTWs that do not have approved pretreatment programs must develop specific local limits if pollutants from non-domestic sources result in interference or pass through and such occurrence is likely to recur [40 CFR 403.5(c)(2)].

EPA and the States have approved more than 1,400 POTW pretreatment programs. Each program must develop, implement, and enforce technically based local limits. Because most of the POTWs that require pretreatment programs now have them, only a few new programs are approved each year. Work on local limits continues, however, because POTWs with approved programs must periodically review these local limits. EPA regulations require that POTWs with approved programs must "provide a written technical evaluation of the need to revise local limits under 40 CFR 403.5(c)(1), following permit issuance or reissuance" [40 CFR 122.44(j)(2)(ii)]. Additionally, EPA recommends that Control Authorities review the adequacy of local limits if current wastewater treatment plant performance fails or will fail to attain applicable NPDES, State, or local permit requirements or other operational objectives, including water quality objectives of receiving waters; and if the performance shortcomings may be reasonably attributed to pass through or interference caused by a POC. Finally, Control Authorities may find it beneficial to re-evaluate their local limits when a change in POTW operations results in a significant change in operational objectives; when the POTW experiences a significantly different influent flow or pollutant characteristics; or when a significant alteration of key environmental criteria occurs.

1.4 National Pretreatment Standards

The National Pretreatment Program consists of three types of national pretreatment standards established by regulation that apply to industrial users (IUs). These include prohibited discharges, categorical standards, and local limits. Prohibited discharges, comprised of general and specific prohibitions, apply to all IUs regardless of the size or type of operation. Categorical standards apply to specific process wastewater discharges from particular industrial categories. Local limits are site-specific limits developed by the POTW to enforce general and specific prohibitions on IUs.

1.4.1 Prohibited Discharges

Prohibited discharges include both general and specific prohibitions, as described below:

- General prohibitions [40 CFR 403.5(a)] forbid the discharge to a POTW of any pollutant that causes pass through or interference. Pass through means a discharge that causes a violation of any requirement of the POTW's NPDES permit. Interference refers to a discharge that inhibits or disrupts the POTW, its treatment process or operations, or its sludge processes and that leads to a violation of the NPDES permits or any other applicable Federal, State, or local regulation.

- Specific prohibitions [40 CFR 403.5(b)(1) to (8)] forbid the following eight categories of pollutant discharges to POTWs: 1) Pollutants that create fire or explosion hazards; 2) Pollutants that will cause structural damage due to corrosion; 3) Pollutants that will cause obstructions in the flow of discharges to the POTW; 4) Pollutants released at excessive rates of flow or concentrations; 5) Excessive heat in amounts that inhibit biological activity;

6) Certain oils that cause pass through or interference; 7) Pollutants that result in the presence of toxic gases, vapors, or fumes; and 8) Trucked or hauled pollutants, except at discharge points designated by the POTW.

1.4.2 Categorical Standards

Categorical standards are uniform, technology-based, and applicable nationwide. Developed by EPA, these standards apply to specific categories of IUs and limit the discharge of specified toxic and non-conventional pollutants to POTWs. Expressed as numerical limits and management standards, the categorical standards are found at 40 CFR 405 through 471. They include specific limitations for 35 industrial sectors. Appendix B provides a list of the industries for which EPA has promulgated categorical standards. Appendix C contains a list of pollutants regulated by categorical pretreatment standards.

1.4.3 Local Limits

Local limits are developed by POTWs to enforce the specific and general prohibitions, as well as any State and local regulations. The prohibitions and categorical standards are designed to provide a minimum acceptable level of control over IU discharges. They do not, however, take into account site-specific factors at POTWs that may necessitate additional controls. For example, a POTW that discharges into a river designated a "scenic river" under the Wild and Scenic Rivers Act may have extremely stringent discharge limits. To comply with its discharge permit, the POTW may need to exert greater control over IU discharges. This additional control can be obtained by establishing local limits.

1.5 The Relationship of Local Limits to Categorical Standards

Categorical standards and local limits are complementary types of pretreatment standards.[1] The former are developed to achieve uniform technology-based water pollution control nationwide for selected pollutants and industries. The latter are intended to prevent site-specific POTW and environmental problems due to non-domestic discharges. As shown in Table 1-1, local limits can be broader in scope and more diverse in form than categorical standards. The development of local limits requires the assessment of local conditions and the judgment of POTW personnel.

EPA's promulgation of categorical standards does not relieve a POTW from its obligation to evaluate the need for and to develop local limits to meet the general and specific prohibitions in the General Pretreatment Regulations. Because specific prohibitions and categorical standards provide only general protection against pass through and interference, local limits based on POTW-specific conditions may be necessary. Developed in accordance with 40 CFR 403.5(c), local limits are Pretreatment Standards for the purposes of CWA Section 307(d) [see 40 CFR 403.5(d)]. Therefore, EPA can take enforcement actions against an IU that violates a local limit. Affected third parties also may sue IUs or POTWs with approved pretreatment programs for violations of local limits under the CWA's citizen suit provisions. A POTW may impose local limits on an IU that are more stringent, or cover more pollutants, than an applicable categorical standard. This may be necessary for the POTW to meet its discharge permit or sludge quality limits. If a local limit is less stringent than an applicable categorical standard, however, the industry to which the local limit applies still must meet the applicable categorical standard. Guidance on permitting, including the comparison of Categorical Standards and local limits, is available in two EPA

[1] A direct comparison of categorical standards and local limits may not be possible because local limits may apply at the point(s) where an IU connects to the POTW collection system, while categorical standards may apply at the end of the IU's regulated process(es) or immediately after pretreatment prior to mixing with other unregulated wastewater flows.

guidance manuals: *Industrial User Permitting Guidance Manual* (EPA 833-B-89-001, September 1989) and *Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula* (EPA 833-B-85-210, September 1985).

Table 1-1: Comparison of Categorical Pretreatment Standards and Local Limits

Characteristic	Categorical Standards	Local Limits
Agency responsible for development	EPA	Control Authority (usually POTW)
Potential sources regulated	Industries specified in Clean Water Act, or as determined by EPA	All non-domestic dischargers
Objective	Uniform national control of non-domestic discharges	Protection of POTW and local environment
Pollutants regulated	Primarily Priority Pollutants listed under Clean Water Act Section 307 (toxic and non-conventional pollutants only)	Any pollutant that may cause pass through or interference
Basis	Technology based	Technically based on site-specific factors: • Allowable headworks loadings • Toxicity reduction evaluation • Technology in use • Management practice
Point of application	At the end of the regulated process(es) or in-plant	Depends on development methodology [usually at the point of discharge(s) into the collection system]

1.6 Organization of the Guidance Manual

This guidance manual provides an organized approach to the development and re-evaluation of local limits. Chapter 2 outlines the general approach for determining when to develop and when to re-evaluate local limits (providing a roadmap through the remainder of the manual). It also provides an overview of the local limits development process using the maximum allowable headworks load approach. Chapters 3 through 6 cover limit development and implementation. Chapter 7 discusses reviews and re-evaluations of local limits, and Chapter 8 describes approaches to local limits development based on collection system concerns. The final chapter, Chapter 9, provides additional information in a question-and-answer format on numerous issues that have arisen in local limits development efforts.

CHAPTER 2 -
OVERVIEW OF LOCAL LIMITS DEVELOPMENT

Local limits development is a continual process for Control Authorities (usually POTWs). Technically based limits are typically developed when a Control Authority/POTW first creates its local pretreatment program. As noted in Chapter 1, a POTW required to develop a pretreatment program also must develop and enforce local limits, as necessary, to protect against pass through, interference, and conditions detrimental to the collection system infrastructure or dangerous to workers. In addition, a Control Authority's legal authority to impose local limits on industrial and commercial users actually derives from State law. Therefore, State law must confer the minimum Federal legal authority on a Control Authority. Section 6.7 of Chapter 6 provides a more complete discussion of the need for and application of this authority.

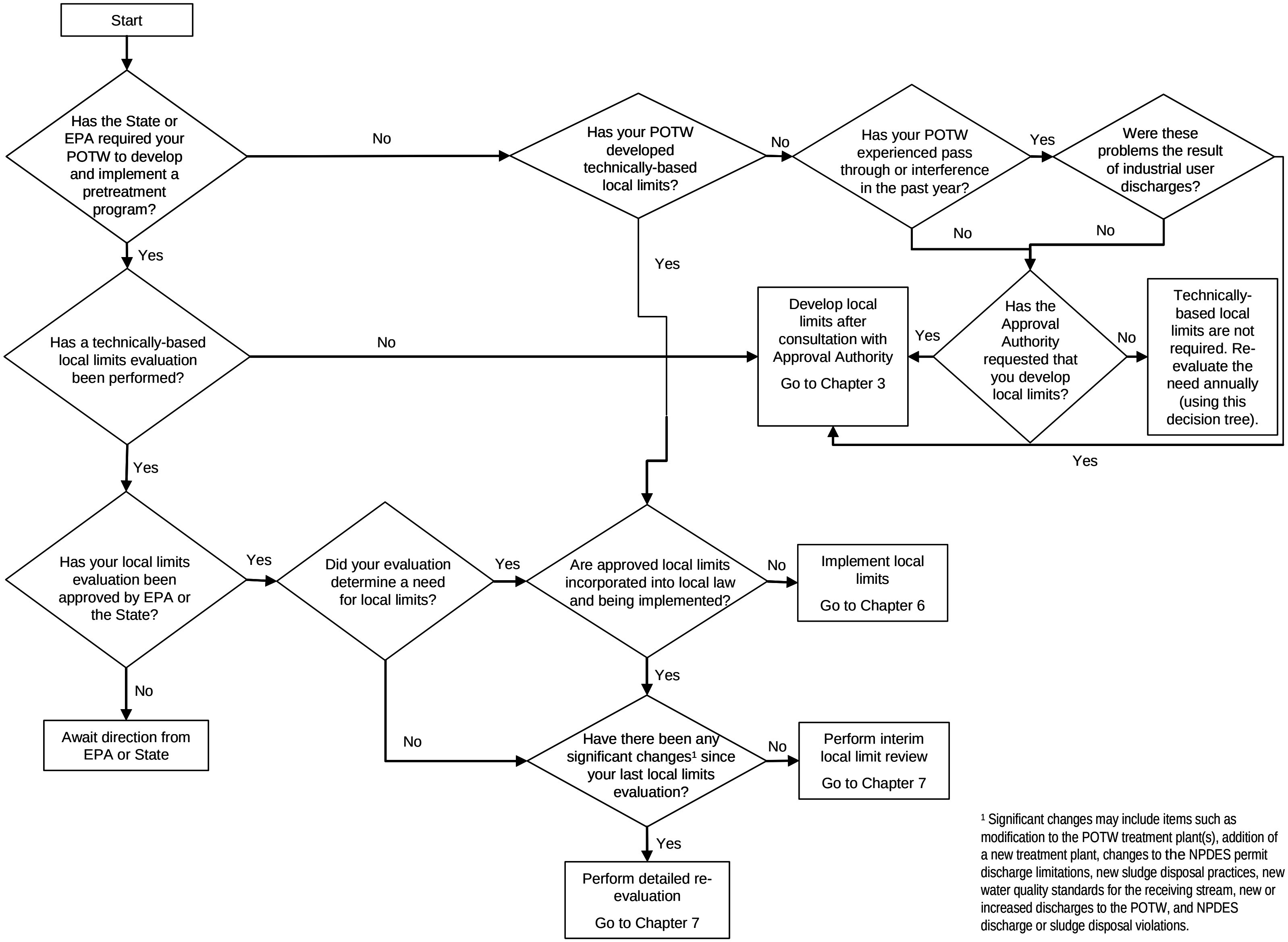
Once local limits have been developed, POTWs may wish to review them periodically and revise them as necessary. Chapter 2 provides an overview of the local limits development process.

2.1 LOCAL LIMITS DECISION TREE

Figure 2-1 presents a decision tree that POTWs can use to determine the appropriate local limit implementation procedures. POTWs can follow the approach to evaluate their need for new local limits, and the adequacy of existing limits. Three months before their annual reports are due, POTWs with approved pretreatment programs are encouraged to evaluate their local limits through a "review" or a "detailed re-evaluation" process if the plant went through significant changes the past year. Then the results may be discussed in their annual reports. *Although EPA recommends reviewing the entire manual, following the steps presented in Figure 2-1 will lead readers to the chapters of this manual that are appropriate for their situations.*

Whenever possible, EPA recommends development of local limits to address constituents that could pass through or cause interference *before* such problems occur. While developing a new local limit, or re-evaluating an existing one, a POTW will need to consider all relevant plant and environmental information—including trends that may indicate likely future conditions. Anticipating changes and setting local limits accordingly may reduce the need for future revisions, saving POTW resources and enhancing IU compliance. For example, a POTW that anticipates changing its sludge disposal practices can develop local limits that will be protective of more restrictive sludge standards that may apply in the near future. Similarly, if economic growth within the service area is likely, a POTW can factor in a safety margin, or hold some allowable headworks loading capacity in reserve so that an allocation will be available in the future. Otherwise, new industrial hook-ups may have to be prohibited, or local limits may have to be revised.

Figure 2-1: POTW Local Limits Decision Tree



[1] Significant changes may include items such as modification to the POTW treatment plant(s), addition of a new treatment plant, changes to the NPDES permit discharge limitations, new sludge disposal practices, new water quality standards for the receiving stream, new or increased discharges to the POTW, and NPDES discharge or sludge disposal violations.

2.2 MAHL APPROACH TO LOCAL LIMITS DEVELOPMENT

EPA recommends that POTWs base their local limits on the maximum allowable headworks loading (MAHL)[1] calculated for each pollutant of concern. A pollutant's MAHL is determined by first calculating its allowable headworks loading (AHL)[2] for each environmental criterion; the most stringent AHL would be the MAHL (see Exhibit 2-1).

Exhibit 2-1: Example MAHL Determination Based on AHLs

To determine the MAHL for cadmium, a POTW:

- Determines that it will meet its NPDES permit limit if the AHL at its headworks does not exceed 14 lb/day.
- Determines that it will meet its land application requirements for sludge if the AHL at its headworks does not exceed 30 lb/day.
- Reviews its records and determines that an AHL at the headworks of 60 lb/day would protect its operations from toxic inhibition.

Assuming no other criteria apply to this plant, its MAHL for cadmium would be 14 lb/day (the most limiting criterion).

The MAHL approach enables POTWs to calculate local limits taking into account the portion of the MAHL that is readily controllable (i.e., from industrial users (IUs)) and the portion that is not as easy to control (i.e., from domestic sources and background concentrations). The maximum allowable industrial loading (MAIL) is the portion of the MAHL available to IUs. It is based on sampling data (see Exhibit 2-2). As discussed in Chapter 6, local limits are based on the allocation of MAILs as uniform concentrations that apply to all IUs, as mass allocations provided individually to each IU, or some combination of the two options.

Exhibit 2-2: Example MAIL Determination

To determine the MAIL for cadmium, a POTW collects sampling data and finds that 6 of the 10 lb of cadmium received at its treatment plant every day comes from domestic/background/commercial (i.e., uncontrollable) sources.

With a MAHL of 14 lb/day for cadmium—and assuming no other uncontrollable sources exist—the MAIL would be 8 lb/day (14 lb/day allowable minus 6 lb/day from uncontrollable sources).

Calculating MAHLs is not the appropriate method to evaluate all pollutants. Pollutants may create collection system conditions that can be harmful to workers such as fires, explosions, corrosion, flow obstructions, high temperature, and toxic fumes. To address these issues, EPA recommends that POTWs consider the options presented in Chapter 8. Developing and implementing local limits with the MAHL approach requires the following five basic steps:

1. Determine the pollutants of concern (POCs)[3]
2. Collect and analyze data
3. Calculate MAHLs for each POC
4. Designate and implement the local limits
5. Address collection system concerns

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[1]A MAHL is the estimated maximum loading of a pollutant that can be received at a POTW's headworks without causing pass through or interference. It is the most protective (lowest) of AHLs (see definition) estimated for an individual pollutant.

[2]An AHL is the estimated maximum loading of a pollutant that can be received at a POTW's headworks that should not cause a POTW to violate a particular treatment plant or environmental criterion. AHLs are developed to prevent interference or pass through.

[3]A POC is any pollutant that might reasonably be expected to be discharged to the POTW in sufficient amounts to pass through or interfere with the works, contaminate its sludge, cause problems in its collection system, or jeopardize its workers.

2.2.1 Step 1: Determine Pollutants of Concern

The first step in the MAHL approach is to identify the pollutants that should be evaluated to determine the need for local limits to control them. Among these are pollutants with known environmental criteria (such as limits in the POTW's NPDES permit), other pollutants that are known to be discharged to the POTW, and pollutants known to be discharged to POTWs in general. The POTW should collect a limited amount of screening data to determine which of these potential pollutants of concern should be subject to more extensive data collection through the local limits sampling program. Chapter 3 discusses the procedures POTWs can use to determine POCs.

2.2.2 Step 2: Collect and Analyze Data

After identifying the POCs that warrant a closer look, the POTW should undertake the collection of the necessary data, including additional sampling and analysis of selected wastewater streams and sludge to gauge the potential impacts of these POCs. The recommended procedures for collecting and analyzing data used to calculate MAHLs are provided in Chapter 4.

2.2.3 Step 3: Calculate MAHLs for Each POC

After collecting and evaluating the necessary data, the POTW should calculate AHLs for each POC based on its treatment efficiency and on environmental criteria for pass through and interference. As previously noted, the most stringent AHL will determine the MAHL. Chapter 5 discusses the procedures used by POTWs to calculate MAHLs.

2.2.4 Step 4: Designate and Implement Local Limits

Having calculated the MAHLs, the POTW needs to compare these allowable loadings with the actual and potential loadings received at the treatment plant to determine whether local limits are needed for each POC. Once the need has been established, the POTW develops appropriate local limits. This process will include determining the amount of each pollutant that can be allocated to IUs, submitting a development package to the Approval Authority for its review and approval, incorporating the local limits into local law (which includes following public notice requirements), and applying the local limits to the IUs. Chapter 6 discusses these implementation procedures.

2.2.5 Address Collection System Concerns

In addition to the MAHL approach to setting local limits, POTWs may need to develop local limits to address collection system concerns – fires and explosions, corrosion, flow obstructions, high temperature, and toxic gases, vapors or fumes – to meet the requirements of 40 CFR 403.5(b) regarding prohibited discharges. Chapter 8 discusses developing limits to address these concerns.

CHAPTER 3 -
DETERMINING POLLUTANTS OF CONCERN

POTWs develop local limits to protect their collection systems, treatment plants, the health and safety of their workers, and the environment. Chapter 3 provides guidance on identifying which pollutants of concern (POCs) need to be controlled to meet these goals and to meet Federal, State, and local requirements.

A POC is any pollutant that might reasonably be expected to be discharged to the POTW in sufficient amounts to cause pass through or interference, cause problems in its collection system, or jeopardize its workers. Pollutants that are contributing to or known to cause operational problems are also considered POCs even if the pollutants are not currently causing National Pollutant Discharge Elimination System (NPDES) permit violations. Some Approval Authorities have guidelines that POTWs can use in determining POCs, and POTWs should contact their Approval Authority for details. The methods used to determine POCs should account for daily fluctuations in POTW pollutant loadings and for the fact that decisions often are based on limited data.

3.1 NATIONAL POCS

EPA has identified 15 pollutants often found in POTW sludge and effluent that it considers potential POCs. They are listed in Exhibit 3-1. Ten of the pollutants were first identified in the *Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program* (EPA 833-B87-202, December 1987).[1] EPA added molybdenum and selenium because they are part of the Federal biosolids regulations for the land application of sludge. EPA added the conventional pollutants 5-day Biochemical Oxygen Demand (BOD_5) and total suspended solids (TSS) because many POTWs have ongoing problems with excessive loadings of these pollutants from industrial and commercial sources. EPA also added ammonia as a "conditional" POC, for POTWs that accept non-domestic sources of ammonia, because many POTWs experience toxicity in their effluent from ammonia.

EPA recommends that each POTW, at a minimum, screen for the presence of the 15 pollutants presented in Exhibit 3-1 using data on industrial user (IU) discharges and collected from samples of POTW influent, effluent, and sludge.

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[1] Cadmium, chromium, copper, lead, nickel, and zinc are listed "because of their widespread occurrence in POTW influents and effluents in concentrations that warrant concern. Also, since they are usually associated with the suspended solids in the wastestream, their presence may prohibit the beneficial reuse of municipal sewage sludge and reduces the POTW options for safe sludge disposal." Memorandum entitled "Local Limits Requirements for POTW Pretreatment Programs," from Rebecca W. Hanmer, Director, Office of Water Enforcement and Permits, to Regional Water Management Division Directors and NPDES State Directors, August 5, 1985. [Copy of memo located in Appendix B of *Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program* (EPA 833-B87-202), December 1987.] Arsenic, cyanide and silver are "not as widespread in POTW influents as the six metals but they have particularly low biological process inhibition values and/or aquatic toxicity values. In the case of cyanide, production of toxic sewer gases is also a concern." *Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program* (EPA 833-B87-202, December 1987) p. 2-17.

3.2 Other Potential POCs

To identify additional potential POCs, EPA recommends that a POTW:

- Determine the environmental standards and other statutory and regulatory requirements that it must meet.
- Define measures necessary to protect the plant, collection system, and workers.
- Identify the pollutants in the POTW influent, effluent, and sludge.
- Identify pollutants for which a total maximum daily load (TMDL) has been or will be developed for the POTW's receiving water.
- Characterize IU and other non-domestic discharges including hauled wastewater to assess which discharges, and which pollutants in those discharges, pose potential problems.
- Consider pollutants that have contributed to operational or maintenance problems at the POTW.

Exhibit 3-1: EPA's 15 POCs

10 Original POCs

Arsenic	Lead
Cadmium	Mercury
Chromium	Nickel
Copper	Silver
Cyanide	Zinc

5 New POCs

Molybdenum
Selenium
5-day Biochemical Oxygen Demand
Total Suspended Solids
Ammonia (for plants that accept non-domestic sources of ammonia)

At a minimum, a POTW's local limits must ensure that a POTW will meet the statutory and regulatory requirements of the Clean Water Act, General Pretreatment Regulations, and any applicable State or local requirements. Because NPDES permit conditions, sludge disposal practices, and State and local requirements vary from one POTW to another, they need to be addressed through local limits.

3.2.1 NPDES Permit Conditions

The term "NPDES permit" as used in this guidance means either an EPA- or a State-issued permit. The NPDES permit issued to a POTW typically contains the following:

- Specific effluent limitations.
- Water quality-based toxic pollutant limitations.
- Whole effluent toxicity (WET) requirements expressed either as a narrative limitation (e.g., "no toxics in toxic amounts") or a numerical criterion.
- Criteria and other conditions for sludge use or disposal.
- Removal efficiency requirements (e.g., "85-percent removal of BOD").
- Requirements that the POTW be well operated and maintained.

These permit conditions, and other applicable requirements, establish the objectives that the POTW must meet to prevent pass through and interference. POTWs are required to prohibit discharges from IUs in amounts that result in or cause a violation of any requirement of the POTW's NPDES permit [see 403.2(a)&(b), 403.3(i) and 403.3(n)]. If pass through or interference is the result of inadequately pretreated industrial discharges, the POTW must develop local limits for the pollutants responsible for the pass through or interference.

Examples of POCs stemming from NPDES permit conditions include the following:

- Pollutants with specific limits.
- Pollutants that have caused violations or operational problems at the POTW, including conventional pollutants.
- Pollutants reasonably expected to lead to pass through, interference, sludge contamination, collection system problems, or increased worker jeopardy.
- Pollutants designated as "monitor only" in the NPDES permit.[2]
- Pollutants responsible for toxicity found through WET testing.

3.2.2 Water Quality Criteria

Water quality criteria have been developed by EPA for protection of surface water, including receiving water for permitted discharges. States may adopt EPA's criteria, or establish more stringent criteria of their own.[3] A POTW does not have to develop a local limit for every pollutant for which there is a water quality standard or criterion. However, EPA recommends that where a POTW permit includes a narrative water quality-based condition (e.g., "no discharge of toxics in toxic amounts"), the POTW may wish to evaluate the discharge of a particular toxic pollutant by considering its effect on water quality for that pollutant relative to EPA or State criteria for the pollutant. EPA recommends that any pollutant that has a "reasonable potential" to be discharged in amounts that could exceed water quality standards or criteria should be considered a POC and evaluated accordingly.[4]

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[2] Only discrete pollutants should be considered when a "monitor only" requirement is present in an NPDES permit. Where the POTW is required to conduct scans for priority pollutants, the entire set of pollutants would not need to be considered.

[3] Federal water quality criteria are listed in Appendix D, but readers should contact their States to determine whether stricter criteria must be met.

[4] Discharge of a pollutant that results in a violation of a water quality standard is actionable even if the discharger's NPDES permit does not include a specific permit condition limiting the discharge of that particular pollutant. The Ninth Circuit has held that a general permit condition prohibiting the discharge of wastewater that violates water quality standards, including a State water quality standard expressed as a broad narrative criterion, subjects a POTW to citizen suit under Section 505 of the Clean Water Act. See Northwest Environmental Advocates, et al. v. City of Portland, 56 F.3d 979 (9th Cir. 1995). In appropriate conditions, therefore, Section 403.5(c) would require a POTW to develop local limits to ensure compliance with the POTW's permit condition requiring it to comply with State water quality standards. Such conditions consist of those where the record demonstrates that a discharge from a POTW is causing or would cause violation of State water quality standards, including qualitative or broad narrative criteria, and the permit includes a permit condition prohibiting a discharge that violates State water quality standards.

3.2.3 Sludge Quality Standards

POTWs must prohibit IU discharges in amounts that cause a violation of applicable sludge disposal or use regulations, or that restrict the POTW's use of its chosen sludge disposal or use option. The national sludge standards are found at 40 CFR Part 503 and are shown in Exhibit 3-2. They are based on human health and environmental risks and include numerical pollutant limits, operational standards, management practices, and requirements for sampling, record keeping, and reporting. The sludge use and disposal options are:

- Land application
- Surface disposal
- Incineration
- Deposition in a municipal solid waste landfill

Exhibit 3-2: Pollutants Regulated Under 40 CFR Part 503

The pollutants that are regulated depend on the type of sludge disposal method used:

- **Land application**: arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc.
- **Surface disposal:** arsenic, chromium, nickel
- **Incineration**: beryllium and mercury (National Emission Standards for Hazardous Air Pollutants under 40 CFR Part 61), lead (National Ambient Air Quality Standard), plus arsenic, cadmium, chromium, nickel (risk-specific concentrations).

To dispose of its sludge by land application, surface disposal, or incineration, a POTW must ensure that its sludge meets the pollutant limits that apply to the selected disposal option. Therefore, any pollutant limited by an applicable sludge disposal standard should be considered a POC and evaluated. If sewage sludge is disposed of in a municipal solid waste landfill, no specific pollutant limitations apply; however, narrative requirements in 40 CFR 257, 258, and 261 do apply.

The sludge standards found at 40 CFR 503 are presented in Appendix E. States are free to establish their own sludge use and disposal standards, as long as they are at least as stringent or are as protective as the Federal requirements. POTWs should contact their Approval Authorities or other State agencies for a copy of the relevant State standards and adhere to the more stringent standards. *EPA recommends that POTWs consider the attainment of EPA "clean sludge" standards. These are spelled out in Table 3 of 40 CFR 503.13*, and provide the broadest choice of beneficial use options for sludge disposal. Further, achievement of these standards is consistent with the objectives of the National Pretreatment Program, which are listed at 40 CFR 403.2.

POTWs that normally dispose of their sludge in landfills also may be adversely affected by IU discharges. EPA recommends that these POTWs also develop local limits to ensure their sludge disposal options are not restricted. When slated for disposal in a landfill, sludge and residual ash from the incineration of sludge should be tested using the Toxicity Characteristic Leaching Procedure (TCLP) discussed in Appendix II of 40 CFR Part 261. Sludge is considered a hazardous waste if TCLP test results on sludge exceed concentrations listed in the TCLP method. Hazardous wastes must be disposed of in accordance with the Resource Conservation and Recovery Act (RCRA), which will likely increase disposal costs. The pollutant limits for the TCLP rule are listed in Appendix F.

3.2.4 Air Quality Standards

Air quality standards are generally not the basis for POCs. However, there are circumstances where a State adopts a State Implementation Plan (SIP), to comply with National Ambient Air Quality Standards (NAAQS), that requires a POTW to control emission standards. In addition, POTWs should be aware that on October 21, 2002, amendments to the National Emission Standards for Hazardous Air Pollutants (NESHAP) for POTWs were finalized. All newly re-constructed or new treatment plants required to develop a pretreatment program (40 CFR 403.8) and defined as major sources of hazardous air pollutants (HAP) must institute air pollution controls (covers on emission points) or demonstrate low HAP emissions. In addition, the regulations define industrial POTWs as those that provide treatment and control for a wastestream regulated by an industrial NESHAP. (The industrial discharger complies with NESHAP by using the treatment and controls located at the POTW.) In effect, the industrial POTW acts as an agent of the industrial facility by treating the facility's wastewater to meet NESHAP. As of 1999, EPA had identified only six POTWs that are major sources of HAP. Several POTWs have been identified as industrial POTWs, and these numbers may increase as more industrial NESHAP are promulgated (40 CFR Part 63, Subpart VVV, 63.1580-1595).

3.2.5 RESOURCE PROTECTION CRITERIA

POTWs should be aware that some States integrate resource protection (watershed and aquifer protection) criteria into permits separate from NPDES permits (for example, aquifer protection permits in the arid Southwest States.) EPA recommends that POTWs consider those pollutant limits in determining POCs.

3.2.6 PROHIBITIONS ON TREATMENT PLANT INTERFERENCE

The General Pretreatment Regulations include prohibitions, at 40 CFR 403.5(a), against the discharge by any user of a POTW of pollutants that cause interference. Interference, as defined by EPA, means a discharge that inhibits or disrupts a POTW and therefore causes a violation of the POTW's NPDES permit or non-compliance with the POTW's sewage sludge requirements. Consequently, EPA recommends that a POTW consider pollutants that may interfere with the treatment work's operation to be potential POCs. And if a POTW has experienced interference in the past, the pollutants that caused the interference should be considered POCs. Where a POTW has identified the pollutant that caused an interference event and eliminated the problem – for example a one-time event that is not expected to reoccur – the pollutant need not be considered a POC.

Although some pollutant discharges may not cause NPDES permit or sludge disposal violations, they might disrupt POTW operations or increase operation and maintenance costs. For example, IU discharges that inhibit a POTW's biological treatment system could reduce treatment efficiency and, as a result, increase operating costs. Inhibition may result in the production of sludge that requires special treatment before disposal, or that requires disposal in a manner not generally used by the POTW. Therefore, EPA recommends that POTWs also consider pollutants that are known to cause operational or maintenance problems.

Some pollutants that can cause inhibition, and the estimated concentrations at which inhibitory effects have been reported, are listed in Appendix G. The inhibition data presented in Appendix G should be used with caution. Data collected at other POTWs must be examined carefully to assure that the treatment process and unit operations are similar to the POTW for which local limits are being developed. POTWs are encouraged to develop site-specific inhibition data for their POTW, and rely on Appendix G only to verify the values.

3.2.7 PROHIBITIONS TO PROTECT THE TREATMENT WORKS, COLLECTION SYSTEM, AND WORKERS

The prohibitions in this category apply to discharges of pollutants that can cause a fire or explosion, corrosive structural damage at the treatment plant, obstruction of flow, inhibition of biological activity due to heat, and discharges that cause the formation of toxic gases, vapors, or fumes. A local sewer use ordinance that applies to a POTW typically contains definitions or local limits that implement the specific prohibitions. Definitions may consist of descriptions from 40 CFR 403.5(b), or more specific quantitative definitions (e.g., specific readings on an explosimeter to protect against fire or explosion). Specific quantitative limits generally are more effective for avoiding ambiguity and for supporting IU compliance and POTW enforcement of IU non-compliance. Chapter 8 provides additional detail on procedures for identifying POCs based on these concerns and for setting local limits to address these concerns.

Explosive and Flammable Substances
Explosive and flammable pollutants discharged to a POTW can threaten the integrity of the collection system and the health and safety of POTW workers. Under the right conditions, the accumulation of such pollutants in treatment works can produce explosions or fires. Local limits can be used to regulate the discharge of these explosive or flammable pollutants. Lower explosive limits (LELs) and closed cup flashpoints for various organic compounds are provided in Appendices H and I.

Fume Toxicity
The fume toxicity level of a pollutant discharged to a POTW indicates the likelihood that a POTW worker will suffer an adverse health effect when the level is approached or exceeded. This level can be measured by the time weighted average threshold limit value (TWA-TLV), which is the concentration to which a worker can be exposed for eight hours per day, 40 hours per week and not have any acute or chronic adverse health effects. Similarly, short-term exposure limits (STELs) are concentrations to which a worker should not be exposed for longer than 15 minutes or more than four times per day (with at least one hour between each exposure). Guidelines on TWA-TLVs and STELs for gases that pose the threat of acute or chronic health effects in people can be found in Appendix J.

Volatile organic compound (VOC) vapors are a major concern because they can be toxic and carcinogenic, and may produce acute and chronic health effects after various periods of exposure. Also of concern are the hazards associated with toxic gases produced when certain inorganic discharges mix in the collection system. For example, acidic discharges can combine with nonvolatile substances such as sulfide and cyanide to produce toxic gases and vapors (e.g., hydrogen sulfide and hydrogen cyanide, respectively), which are hazardous to people. To respond to this threat, POTWs can establish local limits based on the maximum recommended levels of these POCs in air. A list of pollutants and the NIOSH, OSHA, and ACGIH guidelines and exposure levels also can be found in Appendix J.

3.2.8 Scans of POTW Influent, Effluent, and Sludge to Identify Priority Pollutants

Historical results of priority pollutant scans of POTW influent, effluent, hauled wastewater, and sludge, especially those conducted during the previous 12 months, can help identify pollutants discharged to the POTW; and to determine which are potential POCs. Priority pollutants[5] specified under the CWA are listed in Appendix D. EPA recommends that a POTW also analyze the influent, effluent, and sludge for other pollutants that might reasonably be expected to be present, based on information about IU discharges gathered by the POTW from previous sampling and from its industrial waste survey. The analytical methods and sampling procedures are reviewed in Chapter 4.

EPA recommends that the POTW should conduct additional screening for any pollutant found in the priority pollutant scans of its influent, effluent, or sludge to determine whether the pollutant should be listed as a POC. Although a pollutant found in this way is a potential POC, the POTW may determine, based on the pollutant's concentration and on other data from IUs and commercial dischargers, that the pollutant need not be selected as a POC for the full headworks analysis.

[5] POTWs should be familiar with the chemicals and chemical impurities that are added to treat drinking water and wastewater or to maintain the collection system. These chemicals may affect the levels of priority pollutants introduced or pollutant characteristics being measured at the plant.

3.2.9 Evaluations of Industrial and Commercial Discharges

A POTW cannot make informed decisions about potential problem discharges without a comprehensive understanding of the IU discharges to its collection system. Whenever possible, EPA encourages the use of site-specific (actual) data on IUs and commercial discharges for the identification of POCs. Site-specific data are particularly important when an individual IU's discharges make up a large portion of the POTW's total industrial loading, or when POCs are known to be, or are suspected of being, discharged in large quantities or concentrations. Monitoring at IU discharge points and at other points in the collection system may detect discharges that could cause problems in the collection system or at the treatment works. POTWs may decide that discharges from commercial facilities also should be assessed because some of these facilities (such as hospitals, dentists' offices, and photo processors) can be significant sources of pollutant loadings.

In lieu of sampling data, numerous sources of information about IUs, commercial users, and their discharges are available to POTWs. Collecting and reviewing data from such sources is an important initial step in identifying POCs. Some of the available sources include the following:

- Industrial waste surveys (IWSs)
- IU permit applications
- The results of IU self-monitoring and POTW compliance monitoring
- The results of POTW inspections of IUs
- Chambers of Commerce and local trade organizations
- General surveillance of the types of facilities in an area
- EPA Pretreatment Program guidance manuals (see Appendix A)
- Approval Authorities
- State pollutant and chemical databases
- The Internet and the World Wide Web

Table 3-1 on the following page presents details on some of these potential sources of information.

Table 3-1: Selected Information Sources for Determining Potential POCs

Source	Information Provided
Industrial Waste Survey (IWS)	POTWs can request in the IWS information that may help identify and assess the pollutants discharged, or potentially discharged, by each user surveyed. The information gained from the IWS can help the POTW: • Identify IUs of which the POTW had been unaware, or that have recently moved into the POTW's service area. • Identify pollutants likely to be discharged to the collection system that should be considered potential POCs. • Identify previously unknown characteristics of an IU and its discharges. • Evaluate the potential for slug loadings and periods of increased loadings from variable discharges (e.g., from facilities that experience seasonal fluctuation in their discharges and from batch dischargers). • Plan a sampling program to help ensure efficient use of POTW resources. • Estimate raw waste loadings of pollutants for which analytical methods are unavailable. • Identify opportunities for pollution prevention. Most, if not all, POTWs that have approved pretreatment programs will have conducted initial IWSs. POTWs also may find it helpful to review IWS data in conjunction with pollutant occurrence data for various industries.
IU Permit Applications	Details of the pollutants likely to be discharged by an IU and received at the POTW. Through permits or local ordinances, POTWs can require IUs to provide toxicity data for pollutants detected in the IU's wastewater. IUs can sometimes get such data from the manufacturers of their raw feedstock, solvents, surfactants, and other chemicals from material safety data sheets (MSDSs).
IU Self-Monitoring, POTW Compliance Monitoring, and Inspections	Indications of the pollutants discharged, or potentially discharged, by IUs. Also, confirmation of information provided by the industrial waste survey and IU permit applications.
EPA Pretreatment Program Guidance Manuals	Lists of priority pollutants likely to be found in discharges from various industries, lists of guidance and other manuals, and information on how to obtain copies of the manuals. A list of pretreatment guidance manuals and information on how to obtain copies is provided in Appendix A.
Approval Authorities	Data on pollutants detected in direct dischargers' effluents, which can be reviewed by POTWs to identify pollutants that may be discharged by similar IUs in their service areas.
State Pollutant and Chemical Databases	Sources of information about industrial effluent*
*The North Carolina Department of Resources and Community Development has created databases using reports of POTW effluent toxicity and the associated discharges of toxics from IUs, as well as information provided by chemical manufacturers about the chemical characteristics, such as measured toxicity, of biocidal compounds.	

3.2.10 HAULED WASTE

When determining POCs, EPA recommends that POTWs consider the pollutants in, and resultant pollutant loadings from, any hauled waste that they accept for treatment and disposal.[6] Hauled waste has the potential to cause pass through, interference, or problems in the collection system as well as to endanger POTW personnel. Although it typically consists of domestic sewage or septage, hauled waste tends to be more concentrated than typical domestic wastewater and can contain the following:

[6] The General Pretreatment Regulations cover "pollutants from non-domestic sources covered by Pretreatment Standards that are indirectly discharged into or transported by truck or rail or otherwise introduced into POTWs" [40 CFR 403.1(b)]. This means that any hauled waste from industries subject to categorical pretreatment standards should comply with the standards before being accepted for treatment at the POTW. A POTW that has implemented a federally required pretreatment program should have adequate legal authority to regulate its receipt of all non-domestic waste, including non-domestic hauled waste.

- Industrial and commercial waste
- Grease and sand trap waste
- Chemical toilet waste
- Hazardous waste
- Groundwater remediation site waste
- Landfill leachate (see Appendix K for landfill leachate loadings)

An EPA analysis of nine POTWs found that hauled septage may contain relatively high amounts of heavy metals and organic solvents.[7] Many POTWs receive hauled chemical toilet wastes as well as septage. Chemical toilet waste may contain significant concentrations of paradichlorobenzene (up to 14,000 µg/L) as a deodorizing chemical. In March 1995, a truckload of contaminated solvent was discharged to the Wareham, Massachusetts POTW and resulted in one plant employee suffering from upper respiratory problems and major treatment plant disruption as half of the digester microorganisms were killed.

Many POTWs accept only domestic wastes from waste haulers and will specify this limitation in their sewer use ordinances. If accepting hauled industrial wastes, however, the POTW should ensure that any potential POCs in these wastes are identified and considered in the local limits evaluation. Additional information on the acceptance and characterization of hauled wastes at POTWs is available in the *Guidance Manual for the Control of Waste Hauled to Publicly Owned Treatment Works* (EPA/833-B98-003).

The guidance discusses collection of information on waste haulers, characterization of hauled waste received, evaluation of potential impacts and the development and implementation of controls. Figure 3-1 on the following page is a flow chart from this manual on characterizing hauled waste. The guidance also includes case studies of successful waste hauler programs. POTWs should periodically monitor hauled wastes to confirm that only appropriate wastes are being brought by waste haulers and to identify any potential POCs that should be addressed by local limits.

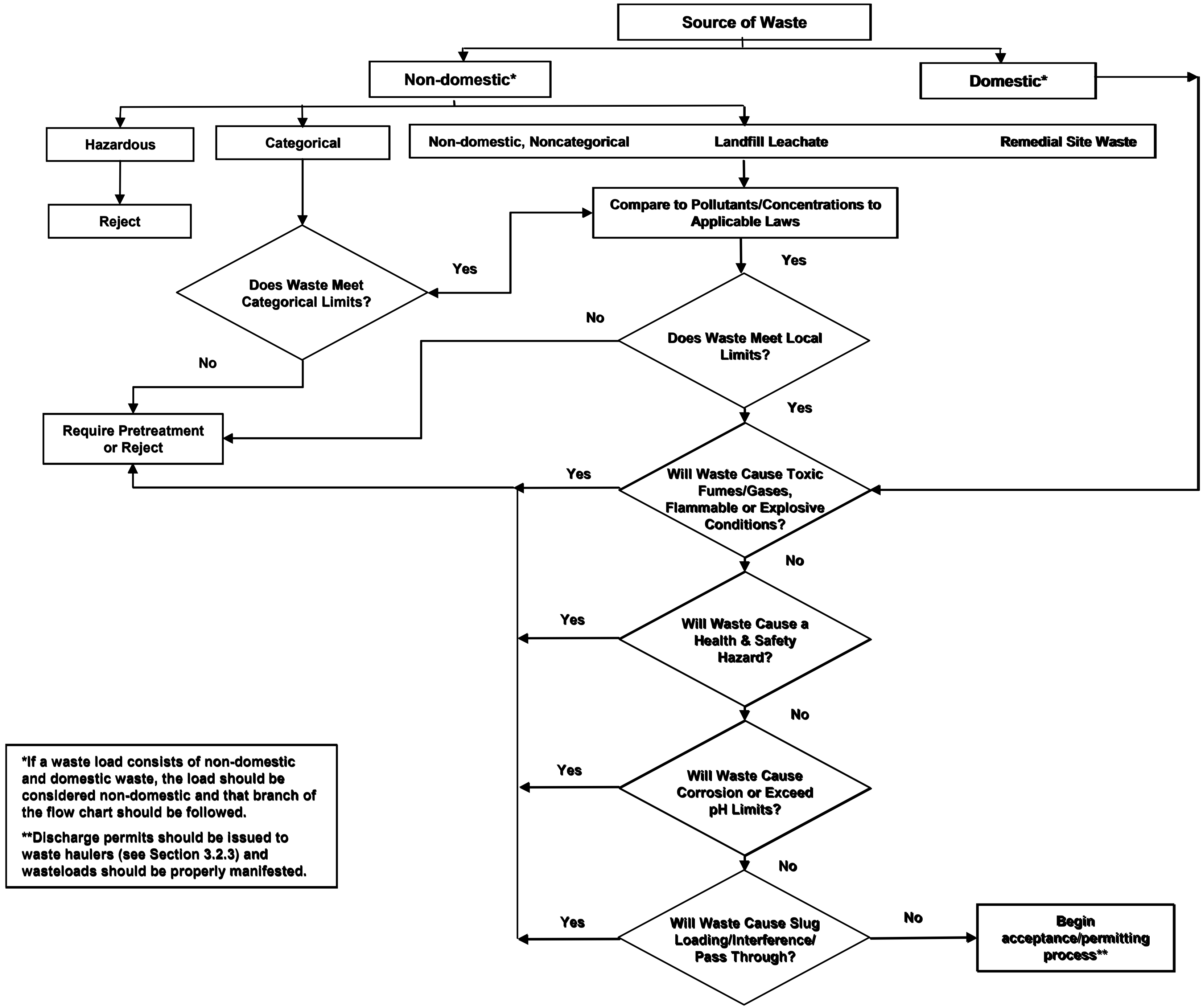
3.2.11 Remediation Site Waste

Waste from remediation sites, especially groundwater remediation sites, may be discharged to the collection system or hauled to POTWs for treatment and disposal. Site operators should provide the receiving POTW with information on waste volume, pollutants present, and pollutant concentrations. POTWs can use such information to identify potential POCs. Remediation wastes from sites being cleaned up under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) may include:

- Landfill leachate
- Contaminated groundwater
- Aqueous waste stored in containers
- Wastes from tanks and surface impoundments
- Treatment sludges
- Runoff from contaminated soils

[7] The monitoring data provided to the nine POTWs by septage haulers are summarized in Appendix L.

Figure 3-1: Determining Hauled Waste Characteristics



Wastes from CERCLA sites commonly contain trichloroethylene, lead, toluene, benzene, polychlorinated biphenyls, chloroform, tetrachloroethylene, phenol, arsenic, and cadmium. Although many CERCLA wastes are quite dilute, some sites have reported high concentrations of metals and organics. EPA recommends that POTWs considering whether to accept CERCLA clean-up wastes require detailed analyses and treatability testing before making any decisions. Data from these activities can be used to determine the presence of POCs. Additional guidance on CERCLA wastes is available from the *CERCLA Site Discharges to POTWs Guidance Manual* (EPA 542/6-90-005). POCs identified from the analysis of remediation waste may include pollutants that require analytical methods not currently listed in 40 CFR Part 136.

3.2.12 Hazardous Wastes

Wastes identified as hazardous under the Resource Conservation and Recovery Act (RCRA)[8] can be legally introduced to a POTW by being discharged into the collection system through an IU's normal sewer connection. RCRA hazardous wastes may be transported to the POTW by truck, rail, or dedicated pipeline if the POTW is complying with the RCRA permit-by-rule requirements for treatment, storage, and disposal facilities found at 40 CFR 270.60. A POTW that accepts hazardous wastes may need considerable resources to comply with CWA and RCRA requirements. The responsibility and liability of POTWs accepting hazardous wastes in this manner are explained in EPA's 1987 document *Guidance Manual for the Identification of Hazardous Wastes Delivered to POTWs by Truck, Rail, or Dedicated Pipeline.* POTWs should note that acceptance of hazardous waste by truck, rail, or dedicated pipe (even unknowingly) will make them subject to the RCRA permit-by-rule requirements.

When mixed with domestic sewage in a POTW's collection system before reaching the boundary of the treatment works' property, RCRA hazardous wastes are excluded from regulation under RCRA by the Domestic Sewage Exclusion, 40 CFR 261.4(a)(1). (They are, however, subject to the CWA, must be reported to the POTW, and should meet all applicable categorical and local discharge limits.) As part of their implementation of the industrial pretreatment program, municipal officials should ensure that IUs control and properly manage their hazardous waste. EPA recommends that the POTW determine which pollutants are being discharged and should evaluate whether the pollutants ought to be considered POCs. POCs identified from the analysis of remediation waste may include pollutants that require analytical methods not currently listed in 40 CFR Part 136.

3.3 Approval Authority Screening Process to Select Pollutants for Local Limits Sampling Program and Limit Development

Before undertaking collection and analysis of sampling data for the development of local limits discussed in the next chapter, EPA recommends that a POTW conduct a screening to determine which potential POCs should be included in the full headworks analysis. Some Approval Authorities have guidelines that POTWs can use in determining POCs. POTWs should contact their Approval Authority for details. With input from the Approval Authority, a POTW may then complete POC screening, plan and implement its local limits sampling program (Chapter 4), and conduct a headworks analysis for each remaining POC on its list (Chapter 5). Although the screening process can reduce the number of potential POCs subject to the POTW's more extensive local limits sampling program, EPA recommends in general that local limits sampling and headworks analysis be conducted for the following:

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[8] Hazardous wastes are wastes listed as hazardous at 40 CFR 261.31-33, or wastes that exceed specified levels of ignitability, corrosivity, reactivity, or toxicity as defined at 40 CFR 261.21-24. RCRA also lists hazardous constituents, chemicals of concerns in listed waste in 40 CFR 261, Appendix VIII. These constituents are reproduced in Appendix M of this manual.

- EPA's 15 POCs (see Exhibit 3-1).

- Any pollutant for which the POTW has a pre-existing local limit, has an applicable NPDES limit, State limit, or sludge disposal limit, or has caused inhibition or other problems in the past.

3.4 SUMMARY

After reviewing Chapter 3, POTWs should be able to determine POCs. As explained above, pollutants should be designated POCs if they:

- Are on EPA's list of 15 pollutants that a POTW should assume to be of concern.

- Have a pre-existing local limit.

- Are limited by a permit or applicable environmental criteria.

- Have caused operational problems in the past.

- Have important implications for the protection of the treatment works, collection system, or the health and safety of POTW workers.

EPA recommends that a POTW check with their Approval Authority for methodologies to screen out certain POCs, before expending resources on local limits sampling discussed in Chapter 4.

CHAPTER 4 - DATA NEEDED TO DEVELOP LOCAL LIMITS

Developing maximum allowable headworks loadings (MAHLs), maximum allowable industrial loadings (MAILs), and local limits requires various types of data. Some of the data come from dischargers to the POTW, some come from the operation of the POTW itself, and some come from characterizations of the conditions in the POTW's receiving water. Data such as flows can be measured directly, but other data are acquired by taking samples from the POTW's wastestream and analyzing them to determine which pollutants are present. Accurate and defensible local limits cannot be developed without the collection of site-specific data on pollutant loadings at the POTW and on the POTW's removal of those pollutants. Collecting those data requires a systematic effort. Chapter 4 discusses the types of data that are required and the methods to obtain them. It is recommended that POTWs seek input from their Approval Authority on their sampling plans.

POTWs already conduct some sampling because the majority of NPDES permits require that POTW effluent be monitored for constituents such as biochemical oxygen demand (BOD), fecal coliform bacteria, total suspended solids (TSS), residual chlorine, and pH. In addition, many POTW NPDES permits place limits on nitrogen, phosphorus, and trace metals. Because this monitoring is unlikely to provide all of the data needed for a meaningful local limits calculation, EPA recommends that POTWs that have approved pretreatment programs routinely sample at other sites within the treatment works, both for local limits development and to remain up to date on their loadings of each pollutant.

The sampling and analysis that support the determination of MAHLs and MAILs are used to:

- Identify or confirm the presence of individual pollutants
- Determine pollutants of concern (POCs)
- Determine current POTW pollutant loadings
- Calculate pollutant-removal efficiencies
- Determine site-specific inhibition thresholds
- Estimate loadings from industrial users (IUs), domestic, and other sources

The sampling and flow data needed to calculate local limits are as follows:

- Pollutant concentration data from POTW (influent, effluent, primary effluent, sludge), collection system, receiving stream, and IUs.

- Flow data, such as total POTW flow, POTW sludge flow to the digester, POTW sludge flow to disposal, IU flows, receiving stream, hauled waste, domestic flows, and commercial flows.

If the POTW conducts influent, effluent, and sludge sampling as part of its pretreatment program, the data may be used in subsequent local limits reviews and headworks analyses. EPA recommends that POTWs collect sampling and flow data from the sources noted above to develop a mass balance of pollutant loadings to and pollutant releases from the wastewater treatment plant. If based on accurate monitoring data, the mass loadings can be used to verify measured background loadings (see Section 6.2.1).

4.1 Sampling Locations

In EPA's view, POTWs will want to establish sampling locations within both the treatment works and the collection system. EPA provides guidance on suggested sampling locations, as detailed below.

4.1.1 At the POTW

Most samples in support of local limits development are taken inside the POTW to determine removal rates and the amount of pollutants in sludge. Therefore, at a minimum, EPA recommends that a POTW establish one point to sample influent, one point to sample effluent, and one point to sample sludge.

- **POTW Influent**. EPA recommends that samples be taken at the POTW's headworks to determine the average and maximum levels at which POCs enter the treatment plant. Influent sampling provides data to be used in calculating POTW-specific removal efficiencies and in establishing the level at which the plant is loaded relative to the MAHL. The sample should be drawn from a location that permits the collection of raw wastewater before it is mixed with any wastestreams returned to the headworks from operations within the POTW.

- **POTW Effluent**. Sampling the treatment works' effluent is essential to determining the POTW's overall removal efficiency. Samples taken to demonstrate compliance with the POTW's NPDES permit can be used for this purpose. In addition, the sampling location used for NPDES compliance can also be used to draw samples for POCs that do not have NPDES permit limits or NPDES monitoring requirements.

- **POTW Sludge**. EPA's sludge disposal regulations require that sludge be sampled at the time of its disposal and after addition of conditioners to determine the percentage of solids it contains. For those POTWs that use land application for sludge disposal, EPA recommends that they also sample periodically for other pollutants. The frequency of sampling depends on the amount of sludge generated annually. Sludge samples taken to support compliance with the sludge disposal regulations found at 40 CFR 503 can also be used to calculate local limits.

- **Other Suggested Sites**. EPA encourages POTWs to develop site-specific data for the development of local limits. In particular, site-specific data on pollutant concentrations in various unit processes is valuable for developing site-specific inhibition values. For example, a POTW that digests its sludge, either aerobically or anaerobically, should sample the digester contents to determine the levels of pollutants, primarily metals, that are known to cause digester upset. As discussed in the next chapter, one requirement of a local limit is to guard against plant upset, including digester inhibition. Little information on digester inhibition is available in the literature and site-specific inhibition is difficult to measure. Consequently, site-specific information on pollutant concentrations *that did not cause digester inhibition* are sometimes used to estimate allowable loadings of pollutants to the digester. Similar data on the level of pollutants that did not cause inhibition should be collected on influent to secondary and tertiary biological treatment processes.

4.1.2 IN THE COLLECTION SYSTEM

Knowing the relative contributions of uncontrolled sources (domestic users, inflow and infiltration (I&I), treatment chemicals added to sewers, drinking water, storm water, and some or all of a POTW's commercial dischargers) is important in determining the amount of loading to be allocated to IUs. Uncontrolled sources can contribute significant loadings of pollutants and can therefore have a profound effect on the amount of pollutants available for IUs. However, wastestreams from uncontrolled sources are assumed to contain lower pollutant concentrations than wastestreams from IUs. The pretreatment regulations do not regulate domestic sources. POTWs may choose not to monitor or control commercial sources, either because of the lower concentrations or because too many sources make regulation impractical.

In order to measure pollutant loadings from uncontrolled sources, EPA recommends that a POTW take samples from a point within the collection system that isolates these sources. EPA recommends that POTWs designate representative sampling locations within their collection systems based on the following considerations:

- The size of the service area or collection system.
- The variability of pollutant concentrations and loadings from one sector of the collection system to another. (For example, newer areas of a collection system may have higher concentrations of copper, while older areas may have higher concentrations of zinc or lead.)
- Whether a sewer section is separate or combined or subject to excessive I&I.
- Types of commercial establishments represented.
- Whether more than one drinking water system operates within the POTW's service area. (Different water systems may have different water sources, or may add different chemicals to treat the water or to control corrosion.)

Under most circumstances, a POTW with a small service area will need to establish at least two sampling points within its collection system. More sampling locations may be needed in areas likely to have different pollutant concentrations based on the factors cited above. POTWs should remember that lower loadings from uncontrolled sources give greater flexibility in determining how much of a given pollutant will be available for IUs through the MAIL. Consequently, EPA recommends more extensive sampling in areas of the collection system where uncontrolled loadings appear to consume all of the calculated MAHLs. Other tips for sampling include the following:

- POTWs should take care <u>not</u> to sample during or after periods of heavy rainfall when I&I is also high. Flows at these times will be diluted, and will not be representative of typical residential and commercial flows. I&I sometimes contributes to pollutant loadings—for example, in areas where mining once occurred and heavy rains wash pollutants from slag piles into collection systems. Such instances should be dealt with on a case-by-case and pollutant-by-pollutant basis through the POTW's Approval Authority.

- Although characterizing domestic and commercial loadings separately may appear to be useful, the loadings can be combined to determine the loadings from the aggregate of uncontrolled sources, particularly if cost is a consideration. Only if a POTW intends to regulate commercial sources separately would background levels need to be determined for both domestic and commercial sources.

- The results of POTW influent sampling can serve as a check on the sampling points selected by the POTW to determine uncontrolled loadings. If the POTW's headworks levels are consistently lower than the levels from the residential and commercial source sampling points, then the sampling points do not accurately represent the background levels, or an inordinate amount of I&I may be present.

4.1.3 At Industrial Users

Sampling at IUs is helpful if a POTW wants to set local limits based on IU need through one of the various allocation methods available to the treatment works (see Section 6.3). In order to use one of these methods, the POTW should know the mass of each POC discharged by each IU so it can rank the users by size and, therefore, by need. For these cases, flows should be measured at, and samples taken from, each IU. These data are probably available from the POTW's routine compliance monitoring and the IUs' self-sampling programs. Therefore, if the POTW has already collected such data, there probably is no need to make a special effort during local limits development unless a new POC has been identified.

Concentration and mass loading data from each IU also can be used to assess the impact a MAIL will have on the POTW's industrial base. This assessment will help the POTW to determine how the local limit should be allocated among IUs. Moreover, knowing each facility's level of discharge tells the POTW which facilities will have difficulty meeting any new limits.

4.2 Pollutants for Which POTWs Should Sample

In general, a POTW should sample for all the pollutants to be included in the calculation of MAHLs and the possible development of local limits, including the following:

- The 15 national POCs
  - Arsenic
  - Cadmium
  - Chromium
  - Copper
  - Cyanide
  - Lead
  - Mercury
  - Molybdenum
  - Nickel
  - Selenium
  - Silver
  - Zinc
  - 5-day Biochemical Oxygen Demand
  - Total Suspended Solids
  - Ammonia

- Any POTW-specific POCs
- Clean Water Act (CWA) organic priority pollutants
- TCLP pollutants (if the POTW disposes, or is likely to dispose, of its sludge in landfills)

4.3 SAMPLING FREQUENCIES

Local limits usually are scrutinized during their initial development, reviews, NPDES permit renewals, and when detailed re-evaluations are conducted. Conducted over different time periods, these efforts often have different data requirements and consequently, results. The initial development of local limits, for example, may require rapid data collection and analysis to meet the schedule for developing a Pretreatment Program submission, of which local limits evaluation is a part. In contrast, reviews and detailed re-evaluations should be based on data collected as part of a routine, long-term sampling effort. Detailed below are suggested sampling frequencies for initial program development and ongoing evaluation. The reader should note that these minimum sampling frequencies are *recommendations*. The POTW has flexibility to adjust their sampling frequencies based on local concerns and economics. In addition, EPA has provided guidance on establishing a sampling frequency through statistical means[1] in Appendix N.

4.3.1 SAMPLING FREQUENCIES FOR INITIAL PROGRAM DEVELOPMENT

To support the initial development of local limits, samples should be collected to provide the data necessary to identify POCs, determine MAHLs, calculate MAILs, and implement local limits. Although such sampling frequently occurs during a short period, the sampling program should account for the day-to-day variability at a POTW and for all the pollutants known or suspected to be present in the POTW's influent. Table 4-1 presents the sampling frequencies for influent, effluent, and sludge, as well as suggested sampling frequencies for domestic and commercial dischargers. The limited number of sampling events may not generate enough data to calculate the POTW's efficiency at removing every pollutant in its influent. In such cases, some Approval Authorities may allow—or even require—the use of literature values if they believe a POTW's sampling provides less accurate information.

[1] The use of statistical analyses can help establish an acceptable minimum number of samples needed to adequately represent a population of pollutants in the influent and effluent at an acceptable confidence level. Appendix N provides guidance on the number of samples needed to estimate the true sampling mean based on confidence level, relative error, and variation of the data. Depending on the desired confidence level and relative error, the number of samples needed can be cost-prohibitive. For example, to be 90 percent confident that your sampling mean lies within +/- 10 percent of the true mean, the number of samples needed is 68 (when the sample set has a coefficient of variation of 0.5). A program of continual sampling could ensure that sufficient data are available and distribute the costs of sampling over time.

Table 4-1: Minimum Recommended Sampling Days* for Initial Local Limits Development

Parameter	POTW			Residential/ Commercial
	Influent (days to sample)	Effluent (days to sample	Sludge (days to sample)	Collection System (days to sample)
Organic Priority Pollutants (1)	1 - 2	1 - 2	1	1 - 2
National POCs (2)	7 - 14	7 - 14	2	7
POTW-specific POCs (2)	7 - 14	7 - 14	2	7
Percent solids, sludge (3)			2	
TCLP pollutants (4)			1	

*Sampling days are defined as the number of days that samples are collected for a parameter. Sampling days should be consecutive days for National POCs and POTW-specific POCs. Samples should be 24-hour composite samples unless sampling methods only allow for grab samples (see Section 4.5).

(1) Conducted once or twice to determine potential POCs.
(2) The range of values for sampling days (7-14) for influent and effluent sampling of POCs is a minimum recommended range for the number of days to sample. POTWs that are small [up to 5 million gallons per day (MGD)] should have at least 7 consecutive sampling days for POCs while larger POTWs (5-10 MGD) should have at least 14 consecutive sampling days. POTWs larger than 10 MGD should consider more sampling according to local concerns and economics. POTWs should seek input from the Approval Authority for their sampling plan.
(3) The sludge regulations at 40 CFR Part 503 already require the percentage of solids to be determined every day that sludge is applied to land.
(4) Sample for TCLP pollutants if sludge is disposed, or is likely to be disposed, in a landfill.

4.3.2 Sampling Frequencies for Ongoing Evaluation

The sampling frequencies presented in Table 4-2, based on POTW flow, should be used for ongoing evaluations. The importance of sampling POTW influent should not be overlooked. Not only is this sampling essential for calculating POTW removal efficiency, it also enables the POTW to calculate the headworks loading of each pollutant and compare it to the MAHL, thus indicating the degree to which the treatment works is loaded. The data from headworks sampling also are used to determine when a local limit must be adopted. If cost becomes a constraint, EPA recommends that sampling to calculate removal rates focus on removal throughout the treatment works and that literature values be used for intermediate process removal rates.

Table 4-2: Minimum Recommended Sampling Frequencies for Ongoing Local Limits Analysis and Evaluation

Parameter	Location	Less than 5 MGD	5 – 10 MGD	10 – 50 MGD	Greater than 50 MGD
Pollutants for which local limits were adopted	Influent, Effluent, Sludge	Once every 3 months	Once every 3 months	Once every 3 months	Once every 2 months
Pollutants for which MAHLs were calculated, but for which no local limits were adopted	Influent, Effluent, Sludge	Once every 12 months	Once every 6 months	Once every 6 months	Once every 3 months
Organic Priority Pollutants	Influent	Once per year	Once per year	Once per year	Once every 6 months
TCLP Pollutants (1), sludge	Sludge	Once per year	Once per year	Once per year	Once per year
Sludge percent solids and specific gravity (2)	Sludge	Once every 6 months	Once every 4 months	Once every 3 months	Once every 2 months

(1) Conducted if sludge is (or is likely to be) disposed of in a landfill.
(2) The sludge regulations at 40 CFR Part 503 already require the percentage of solids to be determined every day that sludge is applied to land.

4.4 OTHER SAMPLING TIPS

Local limits sampling should attempt to depict the POTW under typical operating conditions. Therefore, the sampling program should not bias the results by using sampling procedures that ignore the day-to-day and seasonal variability that the POTW expects to encounter. To ensure that sampling data are representative of the variety of conditions, EPA recommends that the POTW consider the following points when setting its sampling schedule:

- Sampling should be conducted randomly and should be representative of the different days, months, and conditions throughout the year. If a POTW establishes a rigid sampling schedule (for example, the first Wednesday of each month), it may bias the local limits development process.

- If infrequent, yet routine, activities are conducted within the POTW, its collection system, or at its IUs, the sampling schedule established by the POTW should collect data representative of these events. Such activities should be represented in the sampling at approximately the frequency at which they occur. Sampling documentation should note if any activity of this type occurred during the sampling period. Examples of infrequent, yet routine, activities include receipt of hauled waste, tank cleaning, or other maintenance activities that might affect wastewater characteristics.

- Ideally, POTW sampling should account for hydraulic retention times between the influent and effluent sampling points. If unlagged historical data show wastestream loadings do not vary by more than 10 percent and POTW removal efficiencies remain relatively constant, delayed sampling based on hydraulic retention time may not be critical. However, because the retention time for sludge will likely be greater than the period when local limits monitoring occurs and because of the nature of the sludge sampling procedure itself, neither more frequent sludge sampling nor lagging samples for sludge retention times is warranted.

- The sampling schedule should ensure the collection of samples that are representative of the weather conditions that affect POTW operations (i.e., wet weather; hot or cold ambient temperatures).

4.5 SAMPLING METHODS

The purpose of any sampling is to accurately quantify the contents of the wastestream being sampled. Samples of wastewater typically are one of three types: flow-proportioned composites, time composites, or grab samples. Each type has its use in the local limits development process, but the 24-hour, flow-proportioned composite samples are the most accurate for this purpose. This sampling technique should be used whenever feasible for all pollutants except those that require grab samples.

A **flow-proportioned sample**, sometimes called a flow-weighted sample, is one in which a set aliquot of the wastestream is taken after the passage of a set amount of wastewater. Samples are commonly taken by an automatic sampler connected to a device that measures flow. For example, a 500 milliliter (mL) sample may be taken from the wastestream every time 1,000 gallons has been discharged. The sample volumes and flow intervals are usually determined by the capacity of the sampler and the expected total flow of the source.

Time-composite samples consist of equal-volume aliquots taken at regular intervals throughout the sampling period. Because the volume of discharge can vary between the times aliquots are drawn, time-composite samples are not considered to be as accurate as flow-proportioned samples. However, the accuracy of the time-composite samples approaches that of the flow-proportioned samples as the wastestream's flow rate becomes increasingly uniform. Time-composite samples can be used to accurately profile pollutants for local limits development, but the statistical variability of their data will be greater than that of flow-proportioned samples. Consequently, more time-composite samples will be required to support a given confidence interval. EPA generally recommends using flow-proportioned samples instead of time-composite samples.

Grab samples are individual aliquots collected at intervals of at least 15 minutes without regard to flow rate. They normally are drawn manually, rather than by automatic equipment. During the local limits development process, grab samples should be avoided for most pollutants, except for the following:

- pH
- Cyanide
- VOCs
- Total phenols
- Oil and grease
- Total petroleum hydrocarbons
- Sulfide
- Flashpoint
- Temperature

When grab samples are required, at least four should be collected, although more than 12 grab samples are desirable. If enough grab samples are taken over the sampling period, they may be combined to create a grab composite sample. The aliquots must be collected in separate containers, preserved appropriately, and either composited manually at the laboratory to create a single sample for analysis, or analyzed separately and the results averaged into a single value. If the interval wastestream flow between each grab sample is known, a flow-proportioned grab composite sample may be prepared (see Table 4-3). As an alternative, the grab samples may be analyzed separately and the results averaged according to flow weight (see Table 4-4). Samples to be analyzed for pH should not be manually composited, however, and the results for pH should not be averaged.

Sludge samples require that a composite sample be taken of the sludge mass. To do that, a POTW should use the sampling technique specified for demonstrating compliance with the sludge regulations found at 40 CFR 503. Specifically, several aliquots are taken from randomly selected locations within the sludge mass and the aliquots are composited to form a single sample for analysis. As with other types of composite sampling, the more aliquots taken, the more accurate the determination of pollutant levels. Additional discussion of this sampling method can be found in *Environmental Regulations and Technology: Control of Pathogens and Vector Attraction in Sewage Sludge, 1999 Edition* (EPA/625-R-92-013), *POTW Sludge Sampling and Analysis Guidance Document* (EPA/833-B-89-100), and *A Plain English Guide to the EPA Part 503 Biosolids Rule* (EPA/832-R-93-003).

Table 4-3: How to Prepare a Flow-Proportioned Grab Composite Sample

Sample	Sample Collection/Meter Read Date and Time	Meter Reading in million gallons(MG)	Interval Flow (IF) Volume (MG)	Flow-Proportioned Composite (IF/TF * 1000 mL)
	08/16/99 @ 01:12	6,306.5	-	
1	08/16/99 @ 06:00	6,307.5	1.0	128 mL
2	08/16/99 @ 10:48	6,309.2	1.7	218 mL
3	08/16/99 @ 15:36	6,312.0	2.8	359 mL
4	08/16/99 @ 20:34	6,313.5	1.5	192 mL
5	08/17/99 @ 01:12	6,314.3	0.8	103 mL
		Total Flow (TF)	7.8	
Note: This example assumes that a 1-liter (1,000-mL) composite sample is prepared. If a different composite volume is used, calculate the flow proportioned composite (the individual grab sample volume to be included in the grab composite) using that volume.				

Table 4-4: Example of a Flow-Proportioned Average Based on Grab Sample Results and Flow Intervals

Sample	Sample Collection Date and Time	Total Cyanide (TC) (µg/L)	Interval Flow (IF) Volume (MG)	Flow-Proportioned Average (IF/TF * TC)
1	08/16/99 @ 06:00	49	1.0	6 µg/L
2	08/16/99 @ 10:48	120	1.7	26 µg/L
3	08/16/99 @ 15:36	110	2.8	39 µg/L
4	08/16/99 @ 20:34	97	1.5	19 µg/L
5	08/17/99 @ 01:12	20	0.8	2 µg/L
		Average: 79	Total Flow (TF): 7.8	Flow-weighted Average: 92 µg/L

4.6 Analytical Methods

NPDES and pretreatment regulations require that all wastewater samples be analyzed for the presence of pollutants using the approved methods found at 40 CFR Part 136. EPA recommends that these analytical methods also be used in the development of local limits. When sampling sludge for metals and total solids, however, the requirements in the sludge regulations in 40 CFR Part 503 still apply.[2]

[2]The analysis of sludge for the presence of metals should be performed according to EPA test method SW-846 and for total solids according to Part 2540 G of the *Standard Methods for the Examination of Water and Wastewater, 18th Edition.*

A principal reason for using the Part 136 methods is to allow the comparison of local limits and categorical limits to determine which are more stringent, as required by the General Pretreatment Regulations. However, a POTW may encounter a POC that is not regulated by the categorical standards or for which no sampling and analytical techniques are listed in Part 136. In such cases, when the POTW adopts the local limit, it would also specify the sampling and analytical technique used for measurement. Prior approval, however, must be obtained from the Approval Authority through the provisions of the General Pretreatment Regulations at 40 CFR 403.12(g)(4).

To ensure that samples are analyzed properly, EPA recommends that a POTW consider the following factors:

- Anticipated pollutant concentration.
- Potential interferences.
- Total vs. a fraction thereof (e.g., total vs. dissolved metals, or total vs. amenable cyanide[3]).
- The minimum detection level (MDL) of the analytical method to detect the presence of pollutants in trace amounts and the corresponding minimum level (ML) of quantitation (generally 3.18 times the MDL) to determine removal efficiencies.

When selecting methods, POTWs likely will balance these considerations with the cost of the analyses. However, costs should not influence the selection of methods to the extent that necessary detectable levels are not achieved. A data set that has a significant number of non-detectable results will provide limited information for use in local limits development and may compromise the validity of the local limits. If that were to occur, the reduced costs would actually be a waste of money. POTWs should use approved methods with the lowest detection levels to ensure the local limits calculation is robust and defensible. If some of the analytical results are reported as below the MDL, it may be due to the POTW's sampling techniques or the analytical methods that were selected. Given the need to accurately detect trace levels of pollutants, POTWs should thoroughly examine potential sources of gross and trace contamination, then select analytical methods that can detect very low levels of pollutants. (See Appendix O on Minimizing Contamination in Samples.)

Table 4-5 presents MDLs for different EPA wastewater analytical methods for metals. The table includes some methods – inductively coupled plasma (ICP), flame atomic absorption, and graphite furnace atomic absorption – listed in 40 CFR Part 136. The table also includes the 1600 series with detection limits in the nanogram per liter range for metals. Of the 1600 series, only Method 1631 for mercury is listed in 40 CFR Part 136. Although these methods were developed for ambient water quality monitoring,[4] they can improve the reliability of the data collected. EPA recommends POTWs check with their Approval Authority before adopting the 1600 series methods for wastewater analysis per 40 CFR 403.12(g)(4).

Also listed in 40 CFR Part 136, Method 1664 has been developed for oil and grease and is actually two methods. One is the n-hexane extractable materials (HEM) method and the other is the silica gel treated HEM(SGT-HEM). HEM measures all oils and greases while SGT-HEM is specific to mineral oils (non-

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[3]Amenable cyanide refers to those metallic, cyanide-bearing compounds that are "amenable" to alkaline chlorination or electrochemical chlorination treatment processes that will reduce the cyanide complexes to non-toxic chlorides, carbonates and hydroxides.

[4] See *EPA Methods and Guidance for Analysis of Water,* Version 2, EPA 821-C-99-004, June 1999.

Table 4-5: MDLs (µg/L) for EPA Wastewater Analytical Methods

	Method Listed in 40 CFR Part 136				Method Not Listed in 40 CFR Part 136				
Metal (Total)	**Flame/ Other**	**Furnace**	**ICP (200.7)**	**(1631)**	**(1632)**	**(1637)**	**(1638)**	**(1639)**	**(1640)**
Arsenic	2* (206.3)	1 (206.2)	8		0.003				
Cadmium	5 (213.1)	0.1 (213.2)	1			0.0075	0.013	0.023	0.0024
Chromium	50 (218.1)	1 (218.2)	4						
Copper	20 (220.1)	1 (220.2)	3				0.087		0.024
Cyanide	5** (335.3)								
Lead	100 (239.1)	1 (239.2)	10			0.036	0.015		0.0081
Mercury	0.2† (245.1)			0.0002					
Molybdenum	100 (246.1)	1 (246.2)	4						
Nickel	40 (249.1)	1 (249.2)	5				0.33	0.65	0.029
Selenium	2* (270.3)	2 (270.2)	20				0.45	0.83	
Silver	10 (272.1)	0.2 (272.2)	2				0.029		
Zinc	5 (289.1)	0.05 (289.2)	2				0.14	0.14	

* Gaseous Hydride Method
† Cold vapor technique
**Manual Distillation
ICP - Inductively Coupled Plasma
Flame/Other = Flame Atomic Absorption unless otherwise indicated
Furnace - Graphite Furnace Atomic Absorption
(numbers in parentheses) = EPA-approved analytical methods

Sources: 40 CFR 136.3 Table 1B and Method 1669, "Sampling Ambient Water for Determination of Metals at EPA Water Quality Criteria Levels," EPA, July 1996 (which included information about MDLs for 1600 series).

polar) and is considered a substitute for the total petroleum hydrocarbon (TPH) analysis. It should be noted that compounds other than TPH are extracted by n-hexane and this can lead to test results higher than actual TPH values. Laundry detergents and surfactants contribute to the interference. This is a potential source of interference when samples are collected. For additional information on sample collection, preservation, documentation and analysis, see *Industrial User Inspection and Sampling Manual for POTWs*, EPA Office of Water, EPA 831-B-94-001.

4.7 INFORMATION COLLECTION AND MAINTENANCE

To document that sampling was conducted properly, EPA recommends POTWs use field measurement records and chain-of-custody records. The latter are used to identify the person(s) who collected a sample and the persons who may have handled the sample before it was received by the laboratory. They also may be used for inter-laboratory transfers of samples. Chain-of-custody records often contain such information as the type of sample collected, the date(s) and time(s) of the collection, any chemical preservatives added, type of sample container used (i.e., glass, amber glass, or polyethylene), and sample temperature. These records also may include the weather conditions and ambient temperature when the sample was taken, the color and odor of the sample, or other pertinent sampling information.

Laboratory reports not only give POTWs data to use in developing local limits, they also provide data to verify that the holding times were met and the appropriate analytical methods were used. In addition to the analytical results, reports should contain the unique sample ID assigned by the laboratory, the date and time of the sample preparation and analysis, the preparation and analytical methods used, the identity of the analysts, and quality control data if problems were encountered (including an explanation of the problems and how they were addressed). The POTW will want to maintain these records for as long as the data they contain are used to support the local limits developed by the treatment works.

4.8 REVIEW AND EVALUATION OF ANALYTICAL RESULTS

To develop sound, technically based local limits, the POTW should, out of necessity, review and evaluate the data collected to ensure they are accurate, reliable, and representative. Only data that meet the POTW's quality assurance/quality control (QA/QC) requirements should be used to support the development of local limits. The EPA guidance document, *Procuring Analytical Services: Guidance for Industrial Pretreatment Programs*, October, 1998 (EPA 833/B-98-004) provides pretreatment authorities and IUs with guidance for procuring analytical services necessary to support CWA programs. (The document is available at the "publications" link at http://www.epa.gov/npdes.)

Sampling data evaluations may reveal improperly collected data, elevated detection limits, and new POCs. Improperly collected data may mean a sample was taken from the wrong location, was collected as a grab sample instead of a composite, or was improperly handled (i.e., the wrong container was used or the required chemical preservative was not added). In response to improperly collected data, the POTWs will want to educate the responsible person on data collection requirements and ask for additional samples to replace the rejected data.

Measurements below the MDL are fairly common in sampling for local limits development (such as during a scan of organic priority pollutants). However, if an elevated number of non-detects is reported, EPA recommends that the POTW:

- Verify that the method detection limit of the analytical method can address compliance with applicable criteria. If necessary, sampling and analysis should be performed at a lower MDL.

- Evaluate possible matrix interferences, other analytical methods, or sampling problems if an elevated number of non-detects are reported unexpectedly.

New POCs may be identified by a POTW's sampling of influent, sludge, controlled or uncontrolled sources. Additionally, a Toxicity Reduction Evaluation (TRE), or a change in applicable standards could identify new POCs. A vigilant POTW may be able to identify changes in loadings quickly and add the new POCs to its ongoing regimen of evaluation sampling. New POCs identified as a result of a TRE or a change in standards may require multiple samples collected over a short period of time, in addition to being added to the POTW's ongoing sampling program.

4.9 FLOW DATA

To calculate MAHLs and MAILs, data about the flow of various wastestreams will need to be collected so that mass quantities can be computed. The flows for which data are needed are described in the following sections.

4.9.1 TOTAL POTW FLOW

POTWs routinely measure the total flow into the treatment works. The measurement of total flow encompasses all sources, including industrial, domestic, commercial, and I&I. Any hauled wastes treated by the POTW also may be measured at the headworks, depending on where the hauled wastes are introduced to the treatment system. Total POTW flow is needed for the calculation of effluent-quality based allowable headworks loadings (AHLs) (see Section 5.2.2) and inhibition-based AHLs (see Section 5.2.4).

In EPA's view, the POTW will not want to use design flow to calculate local limits because the purpose of a local limit is to protect the treatment works and the environment under existing conditions. If the design flow were used and the actual influent flow is significantly less, a mass limit would exaggerate the domestic and background loadings of pollutants to the POTW and possibly restrict unnecessarily the pollutant load given to IUs.

4.9.2 SLUDGE FLOW TO THE DIGESTER

Primary and secondary sludge sent to an aerobic or anaerobic digester will contain sorbed pollutants whose mass a POTW will want to determine. The flow and concentration values of sludge will be used to calculate an AHL to prevent digester inhibition (see Section 5.2.4). Consequently, the average daily flow rate of all sludge flows to digestion will need to be known.

4.9.3 SLUDGE FLOW TO DISPOSAL

Because one of the most significant environmental impacts an IU discharge can have is on POTW sludge quality and its reuse as a resource, the mass of pollutants in sludge applied to the surface of the land or disposed of in landfills will need to be known. Most POTWs do not dispose of sludge every day because weather conditions, among other factors, interfere with scheduling. To simplify the calculations, EPA recommends that the flow of sludge to disposal be reported as an average over the entire year. This value is calculated by dividing the total volume of sludge disposed in million of gallons by 365 to yield the average volume of sludge disposed in millions of gallons per day. The sludge flow along with the pollutant concentration in sludge are used to calculate an AHL to prevent sludge concentrations from exceeding the sludge disposal pollutant concentration criteria (see Sections 5.2.3).

4.9.4 FLOWS FROM CONTROLLED SOURCES

Converting MAHLs to MAILs requires knowing the flows from all controlled sources (IUs, hauled waste, or specific commercial users) that the POTW intends to regulate with numerical local limits. Some commercial sites (such as photo finishers) may discharge pollutants in quantities that can be controlled by local limits. Discharges from waste haulers may be regulated by POTWs and thus considered controlled sources. Flow rates are commonly determined by compiling flow data from water use records, IU inspections, and periodic reporting from controlled sources. Controlled source flow rates are used to allocate MAILs among controlled sources.

Hauled wastes that are a significant source of pollutant loadings should be controlled through local limits. Therefore, EPA recommends that the average daily volumes of hauled wastes accepted by the POTW be included in the measurement of total industrial flows. While hauled wastes commonly contain high concentrations of pollutants, the wastes generally are low in mass. Thus, for a POTW to determine the additional loading contributed by hauled wastes, the POTW will need extensive sampling of the wastes. Mass loadings can then be calculated and factored into the local limits calculations.

POTWs usually use the sum of all IUs' total plant wastewater flow to develop local limits. Thus, the local limits apply "at the curb," where the flow leaves an IU's property. However, this may pose some problems for categorical industrial users (CIUs) because categorical standards always apply at the end of the regulated process. Each POTW will need to carefully examine flow data from its IUs to assure that all wastewater to be regulated by the local limits is being properly quantified. Analysis results and flow data used to evaluate compliance with categorical pretreatment standards may not include all wastewater from the industry. Ideally, categorical standards are applied at the end of the regulated processes after pretreatment. Other wastestreams not subject to categorical standards, but subject to local limits, may be discharged downstream of the categorically regulated process wastewater flow.

Therefore, there may be more than one sampling location established within a CIU to evaluate compliance with local limits and categorical pretreatment standards. Non-categorically regulated wastestreams often are discharged before treatment at an IU and upstream of the sampling point. The combined wastestream formula (CWF) is used to adjust the CIU standards. Flow and pollutant concentration data that represent total plant wastewater from an IU should be used to develop local limits. This may require that the developer of local limits become more familiar with all sampling points, sewer outfalls, and the wastewater characteristics at each IU, especially CIUs. Detailed discussions on how to establish effluent limits for categorical industries that do not segregate regulated wastestreams from non-regulated or dilute wastestreams are provided in the *Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula* (EPA 833-B-85-201, September 1985) and in the *Industrial User Permitting Guidance Manual* (EPA 833-B-89-001, September 1989).

4.9.5 Flows from Uncontrolled Sources

Converting MAHLs to MAILs also requires knowing the flows of sources that the POTW does not control, such as domestic sources, some commercial sites,[5] infiltration and inflow, storm water, waste haulers not regulated by local limits, and others. As discussed in Section 4.1.2 and 6.2.1, sampling points to determine uncontrolled source flows must be within sections of the collection system that receive wastewater only from these sources.

4.10 Summary

After reviewing Chapter 4, POTWs should be able to support the determination of MAHLs through the collection of various types of data. The applicability and accuracy of the collected data requires an understanding of how pollutant types, sampling locations and frequencies, analytical methods, quality assurance and quality control (QA/QC) requirements, and information collection and maintenance procedures will affect the overall evaluation process. Chapter 5 describes how to use this information to develop MAHLs.

[5] These refer to commercial sources with low pollutant discharges or with too many sites to make regulation practical.

CHAPTER 5 - CALCULATION OF MAXIMUM ALLOWABLE HEADWORKS LOADINGS

Following the approach suggested by EPA, the POTW will have determined pollutants of concern (Chapter 3) and analyzed and collected sufficient data to develop local limits (Chapter 4). This chapter presents the methodology for calculating maximum allowable headworks loadings (MAHLs)—the third step in the four-step recommended MAHL approach to determining local limits. Later, this guidance will show the POTW how to evaluate the need for local limits, calculate and allocate the maximum allowable industrial loadings (MAILs), and develop final local limits (Chapter 6).

A **MAHL** is an estimate of the upper limit of pollutant loading to a POTW intended to prevent pass through or interference. MAHLs are the basis for local limits. As shown in Figure 5-1, a MAHL for a single pollutant of concern (POC) is calculated in three steps:

- Calculate POTW removal efficiency for the POC
- Calculate allowable headworks loadings (AHLs) for each environmental criterion
- Designate as the MAHL the most stringent AHL for the POC

States have an integral role in the development of MAHLs. In addition to State environmental criteria being the basis of many AHL calculations, some Approval Authorities require that the MAHL calculation be performed on specific spreadsheet models. The spreadsheet models ensure consistency in the collection and analysis of data and simplify the AHL calculation by providing the pertinent State standards. POTWs should check with their Approval Authorities to determine if a spreadsheet model is recommended. For example, EPA Region 5, EPA Region 7, and EPA Region 8 have spreadsheet models.

5.1 CALCULATION OF REMOVAL EFFICIENCIES

Removal efficiency is the fraction or percentage of the influent pollutant loading that is removed from the wastestream across an entire wastewater treatment works or specific wastewater treatment unit within the works. Removal efficiency values for each POC are fundamental inputs to MAHL calculations. Removal efficiency methodologies vary by degree of data quality and calculation method. This section will:

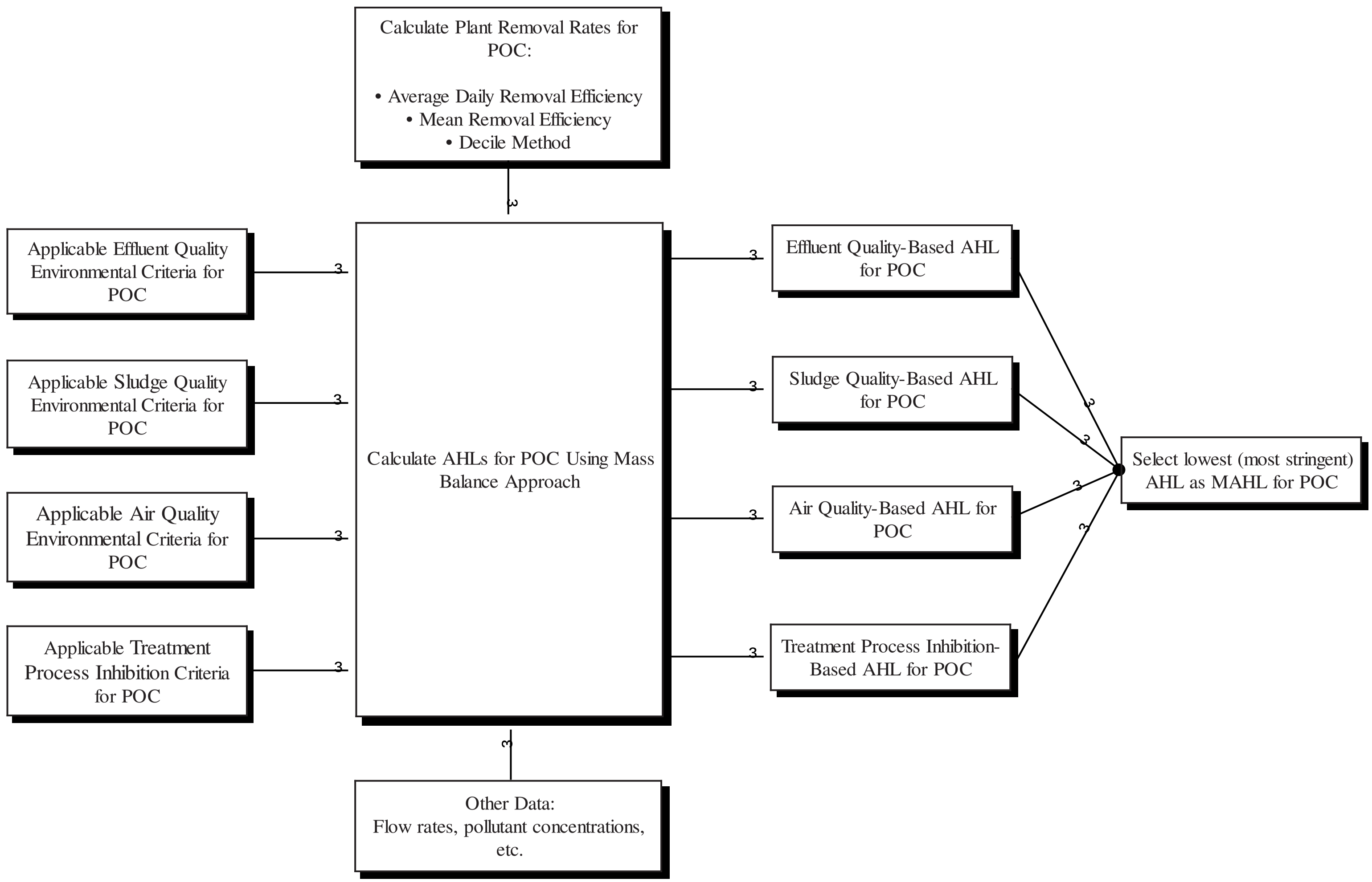
- Explain three different types of removal efficiency calculations methodologies: average daily removal efficiency, mean removal efficiency, and the decile method.

- Suggest when to use certain methodologies.

- Offer guidance on data quality.

- Discuss applying removal efficiencies reported by other POTWs or industry surveys.

Figure 5-1: Process Flow Diagram for Calculating MAHL for a Single POC



5.1.1 REMOVAL EFFICIENCY CALCULATION METHODOLOGIES

This section explains the three removal efficiency calculation methodologies commonly used by POTWs. They are the average daily removal efficiency, the mean removal efficiency, and the decile method.

Average Daily Removal Efficiency

The **average daily removal efficiency (ADRE)** calculation requires that an influent sample be paired with a lagged effluent sample to reflect removal efficiency accurately. Samples are lagged by the hydraulic residence time of wastewater within the treatment plant. As shown in Equation 5.1, a series of daily removal efficiencies based on paired headworks influent (I_n) and POTW effluent data $(E_{potw,\,n})$ is calculated first. This series of removal efficiencies is then summed (symbolized in the equation by the Greek letter ∑) and divided by the total number of paired observations (N) to yield the removal efficiency (R_{potw}) across the entire wastewater treatment plant (from headworks to plant effluent). To calculate the removal efficiency from headworks to primary treatment effluent (R_{prim}), use paired headworks influent (I_n) and primary treatment effluent data $(E_{prim,\,n})$. To calculate the removal efficiency from headworks to secondary treatment effluent (R_{sec}), use paired headworks influent (I_n) and secondary treatment effluent data $(E_{sec,\,n})$.

Equation 5.1: Removal Efficiency Calculated Using Average Daily Removal Efficiency

$$R_{potw} = \frac{\Sigma (I_n - E_{potw,n})/I_n}{N}$$

$$R_{prim} = \frac{\Sigma (I_n - E_{prim,n})/I_n}{N}$$

$$R_{sec} = \frac{\Sigma (I_n - E_{sec,n})/I_n}{N}$$

Where:

R_{potw} =	Plant removal efficiency from headworks to plant effluent, as decimal
R_{prim} =	Removal efficiency from headworks to primary treatment effluent, as decimal
R_{sec} =	Removal efficiency from headworks to secondary treatment effluent, as decimal
I_n=	POTW influent pollutant concentration at headworks , mg/L
$E_{potw,\,n}$ =	POTW effluent pollutant concentration
$E_{prim,\,n}$ =	Primary treatment effluent pollutant concentration, mg/L
$E_{sec,n}$ =	Secondary treatment effluent pollutant concentration, mg/L
n =	Paired observations, numbered 1 to N

Mean Removal Efficiency

More flexible than the ADRE method, the **mean removal efficiency (MRE)** can be used with paired data lagged for retention time suitable for the ADRE method and data that have not been lagged or paired. As shown in Equation 5.2, instead of averaging observed paired removal efficiencies, the MRE calculation *first* averages (symbolized in the equation by the overbars) all plant influent values (I_r) and all plant effluent values $(E_{potw,\,t})$ separately and then calculates removal efficiency across the entire wastewater treatment plant from headworks to plant effluent (R_{potw}). The MRE calculation averages all headworks influent data (I_r) and all primary treatment effluent data $(E_{prim,\,x})$ to calculate the removal efficiency from headworks to primary treatment effluent (R_{prim}). The MRE calculation averages all headworks influent data (I_r) and all secondary treatment effluent data $(E_{sec,y})$ to calculate the removal efficiency from headworks to secondary treatment effluent (R_{sec}).

Unpaired historical data from the same time period (such as alternating months during the same year) should not introduce bias. However, unpaired historical data from different time periods, if used in the MRE calculation, can introduce bias when significant changes in the POTW's industrial base (such as the opening or closing of an industry or the installation of significantly more efficient pretreatment equipment units or source control) occurred between data collection times. Current levels of POTW influent should be compared to historical levels to determine if they are of the same general magnitude. In addition, unpaired sampling data representing some unusual one-time event should not be included in the MRE calculation.

Equation 5.2: Removal Efficiency Calculated Using Mean Removal Efficiency

$$R_{potw} = \frac{\overline{I_r} - \overline{E_{potw,t}}}{\overline{I_r}}$$

$$R_{sec} = \frac{\overline{I_r} - \overline{E_{sec,y}}}{\overline{I_r}} \qquad R_{prim} = \frac{\overline{I_r} - \overline{E_{prim,x}}}{\overline{I_r}}$$

Where:

R_{potw} =	Plant removal efficiency from headworks to plant effluent, as decimal
R_{prim} =	Removal efficiency from headworks to primary treatment effluent, as decimal
R_{sec} =	Removal efficiency from headworks to secondary treatment effluent, as decimal
I_r =	POTW influent pollutant concentration at headworks, mg/L
$E_{potw,\,t}$ =	POTW effluent pollutant concentration, mg/L
$E_{prim,\,x}$ =	Primary treatment effluent pollutant concentration, mg/L
$E_{sec,\,y}$ =	Secondary treatment effluent pollutant concentration, mg/L
t =	Plant effluent samples, numbered 1 to T
r =	Plant influent samples, numbered 1 to R
x =	Primary treatment effluent samples, numbered 1 to X
y =	Secondary treatment effluent samples, numbered 1 to Y

Decile Method

Mean removal efficiency does not indicate how often the derived removal efficiency was achieved. The **decile method** requires at least nine daily removal efficiency values based on paired sets of influent and effluent data. However, instead of averaging the daily removal efficiency values, the decile method sorts daily removal efficiency data from highest to lowest and calculates the percentage of the daily removal efficiency above or below a specified removal efficiency. The methodology is similar to a data set median. A median divides an ordered data set into two equal parts: with half the data set above the median and the other half below. The decile method is similar except it divides the ordered data set into 10 equal parts. Therefore, 10 percent of the data set is below the first decile; 20 percent of the data set is below the second decile, etc. The fifth decile is equivalent to the data set median. The results of an applied decile method approach are shown in Figure 5-2.

Figure 5-2: Decile Results for Hypothetical POTW

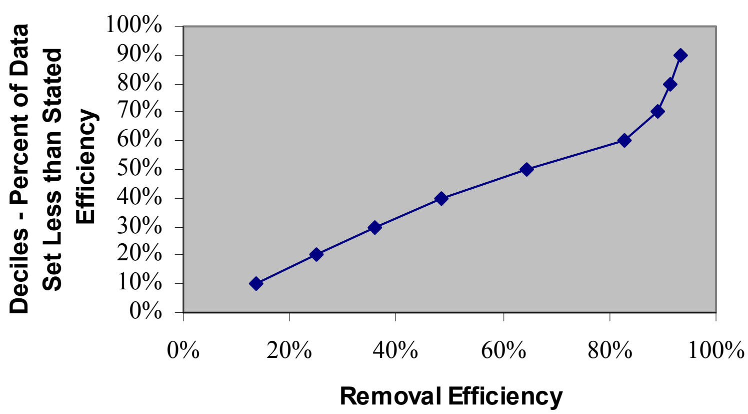


Figure 5-2 shows the decile values (labeled "Deciles - Percent of Data Set Less than Stated Efficiency") on the Y-axis and the corresponding removal efficiencies on the X-axis. From this figure, a POTW can gain an understanding of the likelihood of certain removal efficiencies. As illustrated at the fifth decile or median, this hypothetical POTW has an overall plant removal efficiency *(R_{potw})* of 64.5 percent less than half of the time. As illustrated in the third decile, the POTW achieves a removal efficiency of below 36 percent less than 30 percent of the time. If concerned about recurring effluent limitation violations due to plant operation variation, the POTW may decide, based on historical knowledge, to use the more conservative third decile, instead of the median fifth decile, as the removal efficiency. However, POTWs should be aware that a lower removal efficiency for those pollutants that accumulate in sludge would lead to lower, more protective, effluent-based local limits but higher, less protective, sludge-based local limits. Appendix P includes sample calculations of removal efficiencies using ADRE, MRE, and decile methods.

Conservative Pollutant Removal Efficiency Derived from Sludge Data

For conservative pollutants, such as metals, the portion removed during POTW processes ends up in the sludge. Therefore, for conservative pollutants, POTWs can also use sludge data to estimate removal efficiency across the entire plant *(R_{potw})*. Sludge data should be used in place of effluent data when a POTW has influent data above detection but does not have adequate effluent data above detection and, therefore, believes sludge data provide more representative removal efficiencies. (In general, accurate representative sampling results are more difficult to attain in the sludge than in the POTW effluent sampling.) As shown in Equations 5.3 and 5.4, ADRE and MRE can be used to calculate removal efficiency across the entire plant *(R_{potw})* by comparing the sludge and headworks pollutant loading. Sludge loading is calculated by multiplying the sludge concentration *(S)* by the sludge flow rate *(Q_{sldg})*, specific gravity *(G_{sldg})*, and percentage solids *(PS)*. Influent pollutant loading is calculated by multiplying the influent concentration *(I)* by the average POTW flow rate *(Q_{potw})*. The influent pollutant concentration *(I)* should be a monthly average in order to be compared with sludge pollutant concentration, which accounts for pollutants that have accumulated for 20 to 30 days. The MRE method is often more suitable technique than the ADRE in this situation because:

Equation 5.3: Plant Removal Efficiency Calculated Using ADRE and Sludge Data

$$R_{potw} = \frac{\Sigma (S_n * PS/100 * Q_{sldg} * G_{sldg})/(I_n * Q_{potw})}{N}$$

Equation 5.4: Plant Removal Efficiency Calculated Using MRE and Sludge Data

$$R_{potw} = \frac{\overline{(S_u * 8.34 * PS/100 * Q_{sldg} * G_{sldg})}}{\overline{(I_r * 8.34 * Q_{potw})}}$$

Where:

R_{potw} =	Plant removal efficiency from headworks to plant effluent, as decimal
I_n, I_r=	POTW influent pollutant concentration at headworks, mg/L
PS =	Percentage solids of sludge to disposal,
Q_{sldg} =	Total sludge flow rate to disposal, MGD
Q_{potw} =	POTW average flow rate, MGD
G_{sldg} =	Specific gravity of sludge, kg/L
8.34 =	Unit conversion factor
S_n, S_u =	Sludge pollutant concentration, mg/kg
n =	Paired observations, numbered 1 to N
u =	Sludge samples, numbered 1 to U
r =	Influent samples numbered 1 to R

1. Most POTWs will not have monthly average influent pollutant concentrations readily available.

2. Sludge settling times are difficult to estimate when developing paired observations.

5.1.2 GUIDANCE ON USING DIFFERENT METHODOLOGIES

EPA offers the following guidance on implementing the three different methodologies:

- EPA recommends the MRE over the ADRE method if less than ten data pairs are available, because it is generally less sensitive to variation in daily removal efficiencies.

- Although requiring more data, the decile approach allows for a more comprehensive view of removal rates than the ADRE and MRE methods because it provides a frequency distribution and allows for explicit incorporation of daily removal efficiency.

- Although an overall depiction of the POTW removal efficiency frequency is gained in the decile method, an individual decile estimate, depending on how conservative the POTW wants to be in establishing removal efficiencies, can be less precise than the MRE and ADRE estimates.

Appendix P of this manual provides additional guidance in the form of an example and an examination of the different methodologies applied to one data set.

5.1.3 DATA QUALITY

This section reviews some issues related to data quality, quantity, and analytical method limits that often cause problems during local limits calculations.

Outliers

The following two simple tests can be conducted to see if outliers exist in a given data set:

1. If the data are known to closely follow a "bell-shaped" normal distribution, then any data point that lies more than two standard deviations from the mean is considered an outlier.

2. If the data values do not approximate a normal distribution, outliers can be determined based on the interquartile range (IQR) of the data set. The IQR equals the values between the 1st and 3rd quartile. Any data point that lies more than 1.5 times this IQR below Q1, or 1.5 times this IQR above Q3 is considered an outlier.

Both of these methods are demonstrated in Appendix P with a sample data set.

Concentrations Below the Minimum Level of Quantitation (ML)

A POTW's sampling program will probably yield some sampling results that indicate a pollutant was below the ML in the analyzed sample. The manner in which the POTW uses these data in the local limits development process can significantly affect the MAHL calculation. Table 5-1 details the different options available to POTW users.

Table 5-1: Options for Managing Sampling Results Below the ML in Removal Efficiency Calculations

If only a few data values are below the ML:	If most data values are below the ML:
Option 1: Use surrogate value of ½ ML.	Option 1: Re-evaluate the need for a local limit for the pollutant. (However, if the pollutant is one of the 15 EPA POCs an AHL should be developed.)
Option 2: Discard the few samples below the ML. (Influent and effluent data should be discarded in pairs.)	Option 2: Use removal rate data from other plants. (See Section 5.1.4.)

In general, the surrogate value results in a greater bias when calculating the mean or standard deviation and accuracy decreases as the proportion of non-detects increases.

Other statistical methods—Regression order statistics (ROS), probability plotting, and maximum likelihood estimations (MLE)—are detailed in Appendix Q. The probability plotting method provides slightly more accurate results when non-detects represent 30 percent or more of the data set. The MLE method works well when the data distribution is exactly normal or lognormal[1] and when non-detects are less than 30 percent of the data set. Other references for using statistics to analyze data sets containing values below limits include:

- Appendix E in the *Technical Support Document for Water Quality-based Toxics Control*, EPA/505/2-90-001, March 1991.

- *Use of Statistical Methods in Industrial Water Pollution Control Regulations in the United States, Journal of Environmental Monitoring and Assessment*, Volume 12:129-148, 1989.

Although these methods can be applied by those without a background in statistics, EPA strongly recommends that a statistician perform the necessary calculations.

Negative Removal Efficiency
Negative removal efficiencies, which reflect valuable operational data, should not be summarily dismissed as outliers. Unless technical justification (such as poor sampling or analytical technique) to remove them is discovered, negative removal rates should be retained in the data set. Described below are methods to manage negative removal efficiencies. Appendix P provides sample calculations to address negative removal efficiencies.

Use the MRE Method or Decile Approach. Negative removal efficiencies are attributable to the fact that POTWs do not operate in a steady state. Deviations from steady state occur because of variability in POTW influent, recycle streams and performance, accumulation of pollutants in POTW sludge, and incidental generation of pollutants by POTW operations. This variability often leads to the ADRE method of calculating removal efficiency, dependant on retention time lagged data, to yield negative removal efficiencies. In these cases, the MRE method, less sensitive to data variability, should eliminate negative removals efficiencies unless an underlying problem exists in the sampling, data analysis or plant operations. The decile approach, which ranks instead of averages daily removal efficiencies, can be applied to data sets with a few negative daily removal efficiencies because it determines efficiency based on probability of occurrence and not averaging.

Manage data below the ML. In addition, negative removal rates often result from the influent and effluent concentrations below the ML. Readings below the ML that can lead to negative removal efficiencies should be examined as detailed above.

5.1.4 APPLYING REMOVAL EFFICIENCIES REPORTED BY OTHERS

Removal efficiencies are based largely on site-specific conditions such as climate, POTW design, operation and maintenance, plant conditions, and sewage characteristics. Therefore, EPA strongly suggests that site-specific data be used to calculate removal efficiencies. However, some POTWs still do not have adequate data to calculate removals after conducting site-specific sampling and using analytical

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[1] Log-normal distributions are probability distributions that are closely related to normal distributions: if X is a normally distributed random variable, then exp(X) has a log-normal distribution. In other words, the natural logarithm of a log-normally distributed variable is normally distributed.

methods that achieve the lowest detection levels possible. In these instances, POTWs may selectively use removal efficiencies reported by other POTWs or by studies that have been published in professional journals or by EPA. EPA urges POTWs to use performance data from plants employing the same treatment technology and similar contributing sources. Appendix R provides a listing of removal efficiency data for priority pollutants gathered from other POTWs. (These data are the same as those presented in the 1987 Local Limit Guidance Manual.)

5.2 CALCULATION OF ALLOWABLE HEADWORKS LOADINGS

An AHL is the estimated maximum loading of a pollutant that can be received at a POTW's headworks that should not cause a POTW to violate a particular treatment plant limit or environmental criterion. An AHL is developed to prevent interference or pass through. An AHL is calculated for each applicable criterion: pass through, sludge contamination, air quality standards, and the various forms of interference (biological treatment inhibition, sludge digestion inhibition). The AHLs for each POC are calculated based on the various suitable environmental criteria, plant flow rates, and plant removal efficiency. After calculating a series of AHLs for each POC, the lowest AHL is chosen as the MAHL.

Local limits development uses a mass-balance approach to determine the AHLs for a POTW based on the environmental and treatment plant criteria. With the mass-balance approach, the POTW calculates the amount of loading received at the POTW headworks that will still meet the environmental or treatment plant criteria that apply to each pollutant. Steady-state equations are used for conservative pollutants because the amount of pollutant loading is “conserved” throughout the treatment plant. Conservative pollutants can be removed from wastewater via chemical or physical separation or biological treatment but always accumulate in the sludge or remain in wastewater. On the other hand, non-conservative pollutants may be lost through degradation or volatilization in addition to accumulating in the sludge. Because losses through degradation and volatilization do not contribute to pollutant loadings in sludge, it is not valid to assume that all non-conservative pollutants removed during plant treatment are transferred to sludge. Therefore, for non-conservative pollutants, different equations are used to calculate AHLs based on sludge criteria.

Fate and transport software can estimate the effects of biodegradation, sorption onto solids, and volatilization on substances entering a treatment plant. The most widely used model is EPA’s Water9 model for wastewater collection and treatment systems available at:

http://www.epa.gov/ttn/chief/software/water/index.html.

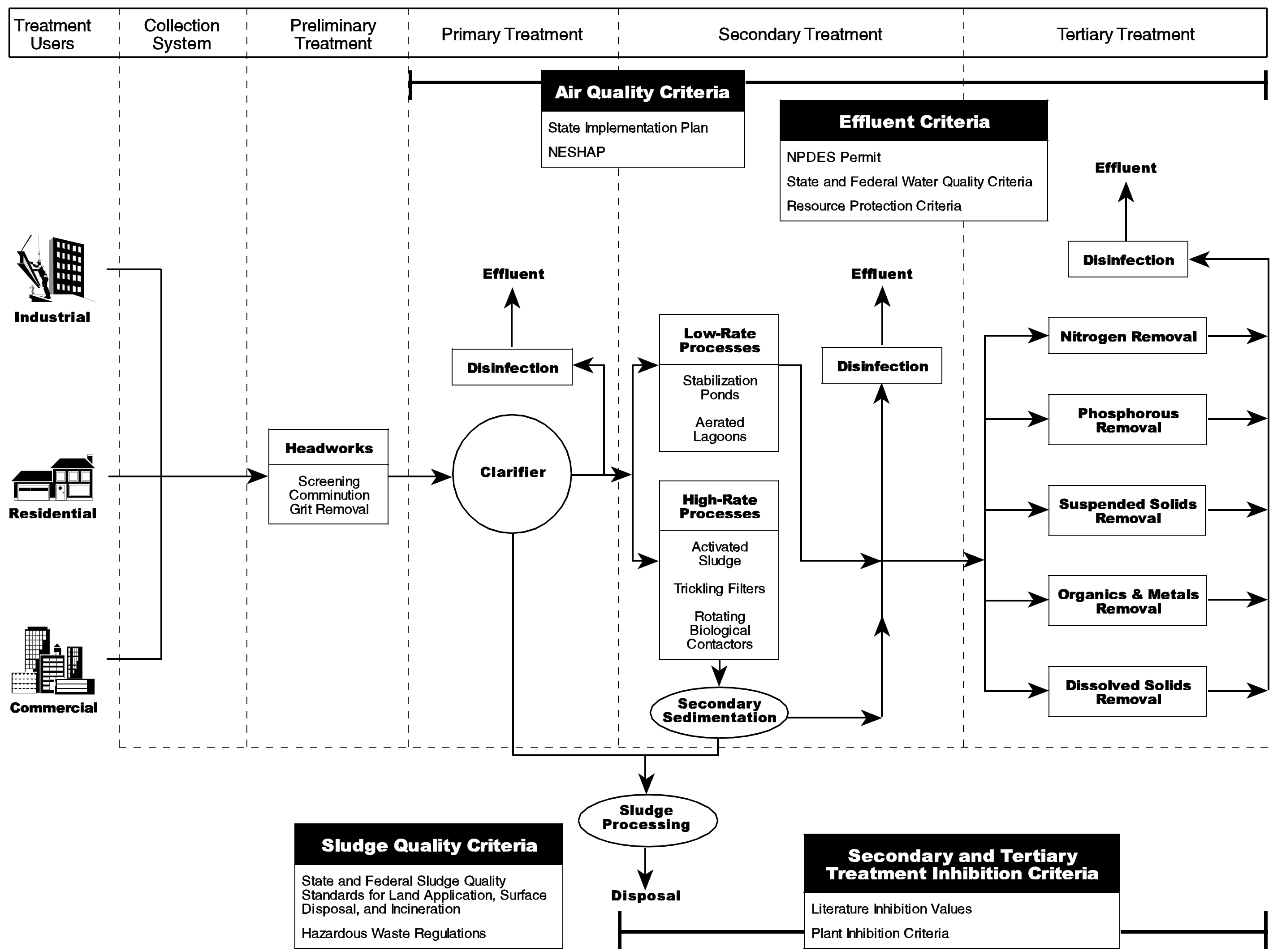
5.2.1 DETERMINATION OF SUITABLE ENVIRONMENTAL CRITERIA

A properly functioning POTW will be in compliance simultaneously with air, effluent, and sludge environmental criteria (see Figure 5-3). For each POC identified, the POTW should examine the appropriate environmental criteria to guard against interference or pass through. From these environmental criteria, along with flow rates and removal efficiencies, AHLs are calculated. These environmental criteria should have all been evaluated as part of the POC development in Chapter 3. Table 5-2 shows suggested criteria that should be evaluated for each POC. The next section provides details regarding how to use these criteria in the AHL calculation.

Table 5-2: Suggested Criteria or Standards to be Considered For Each POC in the Development of AHLs

Effluent Based	Sludge-Based	Inhibition-Based	Air Quality Based	Resource Protection Based
NPDES permit: effluent limitations, water quality-based toxic pollutant limits, Whole Effluent Toxicity (WET) [Source: POTW's own NPDES permit]	State Sludge Quality Criteria: adoption of Federal criteria or stricter [Source: State regulations]	POTW's own in-house guidelines or criteria for process inhibition [Source: POTW reports detailing circumstances surrounding last inhibition]	Local regulatory requirements to meet National Ambient Air Quality Standards (NAAQS) [Source: State Implementation Plan or local regulatory requirements to meet NAAQS]	State and local groundwater, aquifer, and watershed protection permits [Source: State regulations and local codes]
State Water Quality Criteria and Standards: adoption of Federal criteria or stricter [Source: State regulations]	Federal Sludge Standards: land application, surface disposal, or incineration [Source: Appendix E or Federal regulations 40 CFR Part 503]	Literature Inhibition Values for activated sludge, trickling filter, and nitrification processes [Source: Appendix G]		
National Recommended Water Quality Criteria for Priority Pollutants: freshwater/saltwater chronic and acute criteria, human health for consumption criteria [Source: Appendix D or National Recommended Water Quality Criteria- Correction. April 1999, EPA 822-Z-99-001]	Hazardous Waste Criteria: Toxic Characteristic Leaching Procedure (TCLP) [Source: Appendix F or Federal regulations 40 CFR Part 261.24]			

Figure 5-3: POTW Flow Diagram and Environmental Criteria



5.2.2 EFFLUENT-QUALITY BASED AHLS

National Pollutant Discharge Elimination System (NPDES) Permit

One of the most effective means of restricting the discharge of toxic substances into waters of the United States is through a NPDES permit limit. As illustrated in Equation 5.5, the AHL based on NPDES permit limit *(AHL_{npdes})* is the pollutant loading at the NPDES permit limit *($C_{npdes} * Q_{potw}$)* divided by the fraction of the pollutant not removed by the plant *($1-R_{potw}$)*. The NPDES permit limit can appear in many forms—specific technology-based effluent limitations, water quality-based pollutant limits, whole effluent toxicity—and is commonly expressed as milligrams per liter and usually specified as a daily maximum[2] and/or a monthly average[3] discharge limit**.** POTWs should use actual average POTW flow rate data for Q_{potw} and not use design flows (see Exhibit 5-1).

Equation 5.5: AHL Based on NPDES Permit Limit

$$AHL_{npdes} = \frac{(8.34)(C_{npdes})(Q_{potw})}{(1 - R_{potw})}$$

Where:

AHL_{npdes} = AHL based on NPDES permit limit, lb/day
C_{npdes} = NPDES permit limit, mg/L
Q_{potw} = POTW average flow rate, MGD
R_{potw} = Plant removal efficiency from headworks to plant effluent, as decimal
8.34 = Conversion factor

Water Quality Standards or Criteria

In general, POTWs will not have NPDES permit limits for all of the POCs established during the local limits analysis. In such cases, EPA recommends a POTW base its effluent-quality-based AHL on State Water Quality Standards (WQS) or Federal Water Quality Criteria (WQC).[4] State environmental agencies have developed WQS that set maximum allowable pollutant levels for their water bodies, specific to the receiving stream reach's designated uses. Designated uses are identified by taking into consideration the use and value of the water body for public water supply, for protection of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and navigational purposes. Even though the POTW's NPDES permit may not contain a numeric effluent limit for a POC, the permit will probably contain narrative provisions requiring compliance with State WQS and prohibiting the discharge of any toxic pollutants in toxic amounts. A local limit based on a State WQS helps ensure that the POTW can comply with the narrative permit requirement specifying "no discharge of toxics in toxic amounts." In the absence of State WQS, local limits may be based on the EPA ambient WQC found in Appendix D. These criteria are EPA's recommended maximum pollutant levels for protecting aquatic life. They offer a sound basis for developing local limits for pollutants with the potential for causing toxicity problems in the receiving

Exhibit 5-1: Be Conservative in Selecting Criteria

A recurring theme in this guidance manual is to be conservative in making your choices. For example, a POTW's NPDES permit limit for a single pollutant can sometimes be expressed in two forms - daily maximum and monthly average. EPA recommends that only the more conservative monthly average should be used in calculating NPDES-based AHLs. Specific policies regarding this issue should be explored with your Approval Authorities. See Section 6.4.1 for a more detailed discussion of the duration of local limits.

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[2] Daily maximum is the maximum allowable discharge of a pollutant during a 24-hour period.

[3] Monthly average is the arithmetic average value of all samples taken in a calendar month for an individual pollutant parameter.

[4] POTWs should, if possible, use their State's methodology to convert a WQS to NPDES permit limits and then use these calculated NPDES limits to develop the MAHL. Also see Section 3.2.2.

stream. A local limit based on WQC generally would fulfill the narrative permit requirement specifying "no discharge of toxics in toxic amounts."

As illustrated in Equation 5.6, the AHL based on water quality criteria *(AHL_{wq})* is calculated as the hypothetical pollutant loading to the water body at the water quality limit *[$C_{wq}(Q_{str}+Q_{potw})$]* adjusted for the background loading of the water body *($C_{str}*Q_{str}$)* and divided by the fraction of the pollutant not removed by the plant *($1- R_{potw}$)*. The receiving stream background concentration *(C_{str})* can be an average background stream concentration. The receiving stream (upstream) flow rate *(Q_{strm})* should be either the 7Q10 or 1Q10[5] flow based on the particular criteria used. The average POTW flow rate *(Q_{potw})* should be based on actual plant data and not on design flows.[6] Under most water quality based analyses, Equation 5.6 is sufficient and, consequently, is the only one presented here. Another method is the five-step process based on the one described in EPA's *Technical Support Document For Water Quality-based Toxics Control* (EPA, 1991a).

Equation 5.6: AHL Based on Water Quality Criteria

$$AHL_{wq} = \frac{8.34[C_{wq}(Q_{str} + Q_{potw}) - (C_{str} * Q_{str})]}{1 - R_{potw}}$$

Where:

AHL_{wq} = AHL based on water quality criteria, lb/day
C_{str} = Receiving stream background concentration, mg/L
C_{wq} = State WQS or EPA WQC, mg/L
Q_{str} = Receiving stream (upstream) flow rate, MGD
Q_{potw} = POTW average flow rate, MGD
R_{potw} = Plant removal efficiency from headworks to plant effluent (as decimal)
8.34 = Conversion factor

In general, WQS and WQC are classified into three groups: freshwater aquatic life protection, saltwater aquatic life protection, and human health protection. Freshwater and saltwater aquatic life criteria include chronic and acute toxicity criteria. Chronic toxicity criteria are designed to protect aquatic organisms from long-term effects over the organisms' lifetime and across generations of organisms, while acute toxicity criteria generally are designed to protect organisms against short-term lethality. EPA offers the following guidance on the use of WQS and WQC:

- *Hardness, pH, and Temperature Dependence.* WQS and WQC for some metals depend on the hardness of the receiving water. If the State has not factored this in, then the POTW should obtain from the State the appropriate hardness value for its receiving stream and use this value to determine the applicable WQS or WQC. *Formulas for the common pollutants that are affected by hardness can be found in footnote E to Appendix D.* In addition, WQS or WQC for some inorganic pollutants (e.g., ammonia) are pH- and/or temperature-dependent and should be treated similarly. If the State has not established site-specific values, the POTW should contact the State permitting authority to obtain appropriate temperature and pH values for its receiving stream. These values should then be used to calculate WQS or WQC for AHL determinations.

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[5] 1Q10 refers to the lowest average flow for a one-day period that is expected to occur once every ten years. 7Q10 refers to the lowest average flow for a seven-day period that is expected to occur once every ten years. Both values are available in the background documentation for the POTW's NPDES permit issuance and also can be obtained from the local district office of the US Geological Survey (http://water.usgs.gov/local_offices.html).

[6] Some States develop WQS to take into account dilution from the receiving stream and therefore the AHL calculation in Equation 5.6 would not need to be adjusted for the background loading of the water body, Cstr*Qstr. POTWs should consult with their State water quality control agencies.

- *Converting Dissolved Metals to Total Metals*. WQS and WQC for some metals may be expressed in the dissolved form. Most metals measurements, however, are reported in the total or total recoverable form. Total and total recoverable metals concentrations are always at least as high as dissolved metals concentrations because a fraction of the metal has sorbed to particulate matter in the water. If dissolved metals WQS or WQC are used to develop local limits that are expressed as total metals, local limits will be more stringent than if total metals concentrations are used for the WQS. Therefore, POTWs should convert dissolved metals WQS or WQC into the total metals form before using them to calculate water quality-based AHLs (see Exhibit 5-2).

Exhibit 5-2: How to Convert Dissolved Metals Criteria to Total Metals Criteria

NPDES permit writers often use metals translators to convert dissolved water quality standards or criteria to total recoverable equivalents. Translators are specific to each metal and may be 1) the theoretical partitioning coefficients; 2) experimentally determined through site-specific translator studies; or 3) the EPA conversion factors used to convert dissolved metals criteria to total metals criteria. For establishing an AHL, EPA recommends the theoretical partitioning coefficient to calculate metal translators detailed in *The Metals Translator: Guidance For Calculating A Total Recoverable Permit Limit From A Dissolved Criterion* (EPA/823-B-96-007).

- *Chronic and Acute Criteria Guidance.* Chronic and acute criteria should be used in the calculation of AHLs to protect receiving water quality. POTWs should not develop a monthly average limit based solely on chronic criteria or a daily maximum limit based exclusively on acute criteria. AHLs should be calculated based on chronic and acute criteria and the more stringent criterion used for comparison with other AHLs.

- *Stream Flow Guidance*. To calculate limits based on chronic WQS, the receiving stream flow rate should be consistent with State recommendations for chronic criteria, such as 7Q10 flows. To calculate limits based on acute criteria, the POTW should also use the State-recommended receiving stream flow (e.g., 1Q10). POTWs should consult with their State water quality agencies to confirm the correct flow values.

Resource Protection

Many State water quality protection laws that are the basis for POTW permits protect all waters of the State including groundwater. Some POTWs have discharges that have the potential to impact groundwater resources such as water reclamation projects to recharge groundwater, saline intrusion barriers (to minimize the intrusion of saline groundwater into fresh groundwater) or disposal of treated effluent via underground injection control (UIC) wells. Potential groundwater impacts can also be of concern in effluent dominated streams in arid regions of the country. Therefore, groundwater protection may need to be considered during local limits development. Some examples of groundwater protection requirements that might need to be considered in local limits development include the following:

- *Aquifer Protection Permits and Water Reuse Permits*. Arizona issues aquifer protection permits and water reuse permits to POTWs that discharge to effluent-dominated streams or reuse the water for irrigation or other uses. The effluent limits in these permits are designed to protect diminishing groundwater resources and to assure adequate effluent quality for the reuse activity.[7]

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[7] Communication with John E. Watson, City of Phoenix Water Services Division, February 12, 2003.

- *State NPDES Permits*. New York State law specifies groundwater effluent discharge limitations to protect groundwater quality. When an effluent may have an impact on groundwater, State Pollutant Discharge Elimination System permits include effluent limits to protect groundwater.[8]

- *Underground Injection Control (UIC)Program Permits*. The Miami-Dade County POTW system disposes effluent into underground injection wells. The POTW is required to comply with UIC permits as well as its NPDES permits. The most stringent standards are being used in local limits calculations.[9]

UIC, groundwater, or aquifer protection criteria can be used in place of NPDES permit limit (C_{npdes}) in Equation 5.5 to calculate AHLs based on resource protection.

5.2.3 SLUDGE-QUALITY BASED AHLS

In February 1993, EPA issued the Part 503 Biosolids regulations governing the use or disposal of sewage sludge. Pollutant levels were established for three disposal alternatives: land application to condition the soil or fertilize crops grown in the soil, surface disposal for final disposal, and incineration. The pollutant levels, however, are different for each alternative. In addition to the Federal standards, States may have sludge standards that are more stringent or that regulate more pollutants. Therefore, POTWs should check with their State environmental agencies to confirm the applicable standards. Regardless of how a POTW disposes of sludge, POTWs may wish to consider using land application "clean sludge" values from 40 CFR 503.13 in their calculation of AHLs. Use of these criteria can improve a POTW's beneficial use options for disposal of sludge. The further achievement of these standards is consistent with the objectives of the National Pretreatment Program, which are listed at 40 CFR 403.2. Moreover, the land application standards have a more extensive list of pollutants than either surface disposal or incineration and they help control discharges of toxic pollutants that the other disposal alternatives do not address.

The Part 503 Biosolids Regulations also indicate that biosolids placed in a municipal solid waste landfill, a fairly common practice, must meet only the Federal provisions of Part 258 RCRA Subtitle D landfill regulations or delegated States' regulations. These provisions generally include a hazardous waste evaluation, which is detailed in the last part of this section discussing municipal solid waste landfills.

Land Application

Federal sludge use or disposal regulations, found at 40 CFR Part 503, establish limitations for nine common metals (arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc) that are primarily controlled by the Pretreatment Program. As shown in Appendix E, four types of land application limitations were established and are known by the table number in which they appear:

- Table 1: Ceiling Concentrations [milligrams per kilogram (mg/kg)] establish the maximum concentration that can be in sludge when it is land applied.

- Table 2: Cumulative Pollutant Loading Rates [pounds per acre (lb/acre)] establish the limits that cannot be exceeded over the lifetime of the disposal site.

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[8] See Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR) Chapter 10, Part 703.6.

[9] Memo from M. Mallard Greene, US EPA Region IV dated January 14, 2003 with a copy of the UIC Permit and NPDES permit.

- Table 3: Pollutant Concentrations (mg/kg) set levels considered "clean" sludge and are subject to less restrictive reporting requirements.

- Table 4: Annual Pollutant Loading Rates (lb/acre/year) establishes maximum loadings that can be applied in any given year.

As illustrated in Table 5-3, sludge standards are applied based on biosolid end use. For all land application of biosolids, POTWs must comply with Table 1 ceiling concentrations. If its biosolids are applied to agricultural land, a forest, a public-contact site, or a reclamation site, a POTW must comply with either the cumulative loading rates in Table 2 or the monthly average pollutant concentrations in Table 3. If its biosolids are applied to a lawn or home garden, the sludge pollutant concentration may not exceed the monthly average pollutant concentrations in Table 3. If its biosolids are sold or given away in a bag or other container for land application, the POTW must comply with monthly average pollutant concentrations in Table 3 or the annual pollutant loading rates in Table 4.

Table 5-3: Land Application Requirements

Biosolids End Use	**Table 1 Ceiling limits (mg/kg)**		**Table 2 Cumulative limits (lb/acre)**		**Table 3 "Clean Sludge" Pol. Conc. (mg/kg)**		**Table 4 Annual limits (lb/acre/ year)**
Applied to agricultural land, forest, public contact site, reclamation site	x	and	x	or	x		
Applied to lawn or garden	x			and	x		
Sold or given away in bag or container	x			and	x	or	x

To calculate AHLs based on sludge land application criteria, a POTW should:

- Determine which land application criteria apply to its biosolids by using Table 5-3.

- Determine the applicable Table 1, 2, 3, or 4 criteria in Appendix E for each POC.

- Convert the applicable Table 2 cumulative loading rates *(C_{cum})* and applicable Table 4 annual pollutant loading rates *(C_{ann})* to equivalent sludge standards *(C_{slgstd})* using Equation 5.7 and Equation 5.8, respectively. The values for site life *(SL)* and site area *(SA)* are determined by a POTW's sludge management plan. The POTW determines how long the sites will be used and how much land or acreage is needed for disposal of the total annual volume of sludge generated. Generally, the amount of land needed is determined by dividing the total annual sludge production by the agronomic application rate for nitrogen based on the crop grown.

- Determine the lowest sludge concentration standard *(C_{slgstd})* derived from Equation 5.7, Equation 5.8, Table 1 Ceiling Concentrations, Table 3 Monthly Average Pollutant Concentrations, and suitable State sludge standards.

- Use Equation 5.9 with the lowest sludge concentration standard *(C_{slgstd})* to determine the sludge land-application-based AHL for conservative pollutants. As shown in Equation 5.9, the AHL for land application *(AHL_{sldg})* is the pollutant loading of sludge at the sludge standard *[(C_{slgstd}) * (PS/100) * (Q_{sldg}) * (G_{sldg})]*, divided by the overall plant removal efficiency (R_{potw}).

EPA offers the following guidance in performing the calculations in Equations 5.7 through 5.9:

- Values greater than the Table 1 ceiling concentrations can not be used for C_{slgstd}, because the regulations governing use or disposal of sewage sludge (40 CFR Part 503) expressly prohibit any form of land application if the sludge exceeds these concentration levels for any regulated component. In addition, EPA recommends that the POTW consider using the more conservative pollutant concentration levels for "clean sludge" specified in Table 3 because these levels are more protective of the environment, promote greater flexibility in the beneficial use of sludge, and are subject to less restrictive reporting and management requirements. This grade of sludge would meet the criteria for "exceptional quality"or "low pollutant concentration" sludge.[10]

Equation 5.7: Converting Table 2 Cumulative Loading Rates to Dry Sludge Concentrations

$$C_{slgstd} = \frac{(C_{cum})(SA)}{3046(SL)(Q_{bla})(PS/100)(G_{sldg})}$$

Equation 5.8 : Converting Table 4 Annual Loading Rates to Dry Sludge Concentrations

$$C_{slgstd} = \frac{(C_{ann})(SA)}{3046(Q_{la})(PS/100)(G_{sldg})}$$

Where:

C_{slgstd} =	Equivalent sludge standard, mg/kg dry sludge
C_{cum} =	Federal or State land application cumulative pollutant loading rate, lb/acre over the site life
C_{ann} =	Federal or State land application annual pollutant loading rate, lb/acre/yr
G_{sldg} =	Specific gravity of sludge, kg/L
PS =	Percent solids of sludge to disposal
Q_{bla} =	Sludge flow rate to bulk land application (agricultural, forest, public contact, or reclamation site), MGD
Q_{la} =	Sludge flow rate to non-bulk land application, MGD
SA =	Site area, acres
SL =	Site life, years
3046 =	Unit conversion factor

- Generally, POTWs can assume the specific gravity of sludge *(G_{sldg})* equals that of water (1 kg/L). For a typical wet sludge containing about 5 percent solids *(PS)* the specific gravity of the sludge does not differ significantly from that of water. However, drier sludges such as dewatered sludges with 30 percent solids may have a specific gravity of 1.1 kg/L or greater. In these circumstances, if the specific gravity is not considered, AHLs will be understated and any local limits based on these AHLs may be unnecessarily conservative. Therefore, the POTW can measure the specific gravity of its sludge to correct for the error introduced as the percent solids rises. If the POTW does not have data on the specific gravity of its sludge, it should assume conservatively that the specific gravity is 1 kg/L. Guidelines for determining the specific gravity of sludge are provided in Appendix S.

[10]See Chapter 2 in *A Plain English Guide to the EPA Part 503 Biosolids Rule*, EPA/832/R-93/003, September 1994

- If the POTW's data for sludge flow rate to disposal are expressed in dry metric tons per day (or can be converted to dry metric tons per day), a specific gravity factor is not needed. An equation for calculating an AHL using dry metric tons per day is provided in Appendix T.

- Table 1 sludge ceiling concentrations are instantaneous maximum concentrations, while the "clean sludge" criteria in Table 3 are monthly average concentrations. See Section 6.4.1 for a discussion of how the types of criteria – monthly average, instantaneous maximum – affect the type of local limit developed.

Surface Disposal

Sludge surface disposal occurs at dedicated disposal sites, surface impoundments, waste piles, monofills, or dedicated beneficial use sites. The difference between surface disposal and land application is that land application is performed at rates that do not exceed the agronomic rates of the fertilizer value of the sludge. For a more extensive discussion of surface disposal, see the sludge regulations at 40 CFR 503.20. Surface disposal regulates only three metals (arsenic, chromium, and nickel) at levels near the "clean sludge" levels for land application. The standards apply to sludge disposed at facilities without a liner or a leachate collection system. AHLs based on sludge surface disposal quality should be calculated in the following manner:

Equation 5.9: AHLs Based on Sludge Land Application and Surface Disposal Criteria (for conservative pollutants)

$$AHL_{sldg} = \frac{(8.34)(C_{slgstd})(PS/100)(Q_{sldg})(G_{sldg})}{R_{potw}}$$

Where:

AHL_{sldg} = AHL based on sludge, lb/day
C_{slgstd} = Sludge standard, mg/kg dry sludge
PS = Percent solids of sludge to disposal,
Q_{sldg} = Total sludge flow rate to disposal, MGD
R_{potw} = Plant removal efficiency from headworks to plant effluent, as decimal
G_{sldg} = Specific gravity of sludge, kg/L
8.34 = Unit conversion factor

- Table 1 (40 CFR 503.23) sludge surface disposal criteria should be used directly as the sludge standard *(C_{slgstd})* in Equation 5.9 for conservative pollutants.

- If the sewage sludge unit is less than 150 meters from the property line, Table 2 (40 CFR 503.23) sludge disposal criteria, based upon distance from the property line, should be used directly as the sludge standard *(C_{slgstd})* in Equation 5.9 for conservative pollutants. See Appendix E for a list of Table 1 and Table 2 surface disposal options.

In addition, POTWs should be aware that surface disposal regulations allow for site-specific limits. Site owners or operators may have requested surface disposal criteria from the permitting authority in place of the Table 1 or Table 2 sludge surface disposal criteria. Therefore, the POTW should check with the disposal site owner/operator to determine standards that apply. If the State has developed more stringent sludge disposal standards for surface disposal, the POTW needs to use those standards in its calculation of AHLs when using Equation 5.9.

Incineration

Incineration, the third method of sludge disposal, typically regulates arsenic, cadmium, beryllium, chromium, lead, mercury, and nickel. Limits are site-specific and based on feed rate, stack height (dispersion factor), incinerator type, and control efficiency. EPA offers the following guidance on incineration-based AHLs:

- POTWs that dispose of their sludge through incineration should determine AHLs based on the calculated sludge standards that apply to the sludge feed to the incinerator. These standards may have been calculated by the owner/operator of the incinerator (and listed in a sludge disposal agreement), the State, or EPA from the equations provided in 40 CFR Part 503, and should be expressed in mg/kg dry sludge. These standards should be used directly as the sludge standard (C_{slgstd}) in Equation 5.9 to determine the AHL.

- If no sludge standards have been calculated for the sludge feed to the incinerator, POTWs should use the 40 CFR Part 503 equations (provided in Appendix T) to determine the maximum pollutant concentrations for the incinerator feed. These standards should be used directly as the sludge standard (C_{slgstd}) in Equation 5.9 to determine the AHL. As a general rule, an AHL for incineration will be an order of magnitude or greater than an AHL based on land application.

Municipal Solid Waste Landfill's Hazardous Waste Requirements
According to 40 CFR 503.4, "any person who prepares sewage sludge that is disposed in a municipal solid waste landfill unit shall ensure that the sewage sludge meets the requirements of 40 CFR Part 258. . . ." Part 258 does not allow municipal solid waste landfill units to accept hazardous waste. Whether a POTW's sewage sludge is hazardous waste may be determined by using EPA's TCLP test. If determined to be hazardous waste, sludge must be disposed of according to RCRA requirements. POTWs cannot dispose of sludge determined to be hazardous waste in solid waste landfills designated for non-hazardous waste. In general, POTWs will not generate sludge that exceeds TCLP limits.

However, because the costs and liabilities associated with the management and disposal of hazardous sludge are high, POTWs may find it advantageous to periodically run the TCLP test on their sludge to identify any trends of increasing pollutant concentrations that may lead the sludge to be considered hazardous waste. The POTW should compare the quality of its sludge with the limits in the TCLP and, as necessary, set local limits to help ensure that the pollutant levels in its sludge do not exceed TCLP levels. *If TCLP test results are close to or exceed the TCLP limit, the POTW needs to develop AHLs based on TCLP criteria*. To develop TCLP-based AHLs, the POTW should:

- Determine the dry weight metals and toxic organics concentrations (in mg/kg dry sludge) that would be protective against sludge being classified as hazardous based on the TCLP test from sampling data. The POTW can collect site-specific data for both total pollutant concentrations in the sludge and TCLP concentrations (10-12 data pairs) and use these data to correlate TCLP concentrations with total concentrations in the sludge.

- Use these dry-weight, correlation-based concentrations directly as the sludge standard (C_{slgstd}) in Equation 5.9 to determine the AHL.

5.2.4 INHIBITION-BASED AHLS

Secondary and Tertiary Treatment Unit Inhibition
Pollutant levels in a POTW's wastewater or sludge may cause operational problems for biological treatment processes involving secondary and tertiary treatment. Disruption of a POTW's biological processes is referred to as inhibition and can interfere with a POTW's ability to remove biochemical oxygen demand (BOD) and other pollutants. A POTW should assess any past or present operational problems related to inhibition and follow the protocol outlined below.

- **No Past Inhibition Problems at POTW**. POTWs may not need to calculate AHLs to protect against inhibition because current loadings are acceptable to the treatment work's biological processes. However, a POTW may still choose to calculate AHLs based on biological process inhibition criteria to prevent future loadings that may cause inhibition and should follow the steps outlined below for POTWs with past inhibition problems.

- **Past Inhibition Problems at POTW.** POTWs should calculate AHLs based on inhibition criteria. If site-specific data are needed (see Exhibits 5-3 and 5-4), the POTW may choose to substitute pollutant concentrations that either have occurred in the applicable biological process or are currently in its influent and have not caused inhibition, in place of process inhibition values that have been reported in studies published by EPA or in professional journals. Inhibition criteria for select secondary treatment units (such as activated sludge and trickling filters) and one tertiary treatment unit (nitrification) are presented in Appendix G.

Site-specific inhibition data are preferred to literature data because they more accurately measure pollutant concentrations that cause inhibition in actual biological treatment environments. Inhibition of biological treatment processes could be a function of toxic compounds (not a single toxic compound), synergism, antagonism, pH, temperature, hardness, stressed conditions, microorganism acclimation, and the number and variety of microorganisms present. Sometimes based on laboratory studies using pure cultures, literature values can indicate inhibition at much lower concentrations than in actual biological treatment environments for the following four main reasons: 1) organic chemicals combine with the metals and reduce metal availability to the microbes; 2) activated sludge environments generally have a variety of organisms present that may not be as sensitive to metal

Exhibit 5-3: The Challenge in Determining Plant Inhibition Values

Determining site-specific inhibition values is difficult because the exact point at which pollutant concentration inhibition takes place is difficult to identify. For instance, an activated sludge system's mixed liquor may run at about 1 mg/L zinc. An industrial discharge causes the plant to violate its NPDES permit by upsetting the plant and raising the mixed liquor concentration to 100 mg/L zinc. How can one determine at which concentration the inhibition took place? The concentration lies somewhere between 1 and 100 mg/L. An inhibition value set at 100 mg/L would be incorrect because a lower value could have caused the inhibition. Some POTWs have attempted to estimate site-specific inhibition values by simply using the highest observed pollutant concentration in the biological process that did not cause interference.

Exhibit 5-4: Inhibition Value Study by Chesterfield County (VA)

Chesterfield County's Pretreatment Program conducted a site-specific evaluation of inhibition values for several heavy metals as part of its recent recalculation of local limits. A pilot system was fed with primary effluent from the full-scale facility and was loaded with varying levels of several heavy metals to determine the loading rate that caused measurable deterioration in process performance. The measured inhibition values for this plant were typically found to be much higher than those given in Appendix G. In this case, the controlling factor became the inhibition potential of the anaerobic digesters, and it was possible to substantially increase the local limits as a result of the data generated from pilot testing. [Contact Abha Sharma of Chesterfield County (VA) Pretreatment program.]

concentrations; 3) metals can chelate toxic organics, reducing their toxicity to nitrifiers; 4) acclimated biological treatment populations can accept higher concentrations of metal and organic toxins than laboratory cultures. In addition to the technical drawbacks, literature values, if eventually the limiting basis of a local limit, will most likely engender more regulatory scrutiny.

Equation 5.10 is used to calculate inhibition-based AHLs for secondary treatment processes such as aerated lagoons, stabilization ponds, activated sludge, rotating biological contactors, and trickling filters. Equation 5.11 is used to calculate inhibition-based AHLs for tertiary treatment for various processes to remove nitrogen, phosphorus, suspended solids, organics, metals, and dissolved solids (see Figure 5-3). As shown in Equation 5.10, the AHL based on secondary treatment unit inhibition *(AHL_{sec})* is calculated by dividing the pollutant loading to the secondary treatment unit at the inhibition criterion *(C_{inhib2} * Q_{potw})* by the fraction of the pollutant not removed after primary treatment *($1 - R_{prim}$)*. As shown in Equation 5.11, the AHL based on tertiary treatment unit inhibition *(AHL_{ter})* is calculated by dividing the pollutant loading to the tertiary treatment unit at the inhibition criterion *(C_{inhib3} * Q_{potw})* by the fraction of the pollutant not removed after secondary treatment *($1 - R_{sec}$)*. The POTW flow rate *(Q_{potw})* should be calculated using actual average flow data and not design flow. Appendix U shows where to sample in various plants to calculate inhibition-based loading. (Note that in many POTWs nutrient removal is often more like an advanced secondary process that occurs in the same basin as an activated sludge process. In these cases, the same primary removal efficiency *(R_{prim})*, would be used in both Equations 5.10 and 5.11.)

Equation 5.10: AHLs Based On Secondary Treatment Inhibition

$$AHL_{sec} = \frac{8.34(C_{inhib2})(Q_{potw})}{(1 - R_{prim})}$$

Equation 5.11: AHLs Based On Tertiary Treatment Inhibition

$$AHL_{ter} = \frac{8.34(C_{inhib3})(Q_{potw})}{(1 - R_{sec})}$$

Where:

- AHL_{sec} = AHL based on secondary treatment inhibition, lb/day
- AHL_{ter} = AHL based on tertiary treatment inhibition, lb/day
- C_{inhib2} = Inhibition criterion for secondary treatment, mg/L
- C_{inhib3} = Inhibition criterion for tertiary treatment, mg/L
- Q_{potw} = POTW average flow rate, MGD
- R_{prim} = Removal efficiency from headworks to primary treatment effluent, as decimal
- R_{sec} = Removal efficiency from headworks to secondary treatment effluent, as decimal
- 8.34 = Unit conversion factor

Sludge Digester Inhibition

Sludge digestion is also a biological process that can be upset if pollutants are allowed to accumulate to toxic levels. Plant-specific sludge digestion inhibition thresholds, like inhibition of secondary treatment, are difficult to know. Literature data on sludge digester inhibition criteria are listed in Appendix G. The preponderance of sludge digestion inhibition data are for anaerobic digesters. There is no publicly available data about the effect of metals on aerobic digestion of sludge.

Equation 5.12: AHLs Based On Sludge Digestion Inhibition (Conservative Pollutants)

$$AHL_{dgstr} = \frac{8.34(C_{dgstinhib})(Q_{dgstr})}{R_{potw}}$$

Equation 5.13: AHLs Based On Sludge Digestion Inhibition (Non-conservative Pollutants)

$$AHL_{dgstr} = (L_{infl}) * \frac{C_{dgstinhib}}{C_{dgstr}}$$

Where:

AHL_{dgstr} = AHL based on sludge digestion inhibition, lb/day
L_{infl} = POTW influent loading, lb/day
$C_{dgstinhib}$ = Sludge digester inhibition criterion, mg/L
C_{dgstr} = Existing pollutant level in sludge, mg/L
Q_{dgstr} = Sludge flow rate to digester, MGD
R_{potw} = Plant removal efficiency from headworks to plant effluent, as decimal
8.34 = Unit conversion factor

Using the steady-state mass balance approach across the influent to the digester, Equation 5.12 calculates the AHL based on sludge digestion inhibition *(AHL_{dgstr})* for conservative pollutants such as metals. AHL_{dgstr} is calculated by dividing the pollutant loading at the inhibition criterion to the digester *($C_{dgstinhib}$ * Q_{dgstr})* by the removal efficiency across the entire POTW *(R_{potw})*. As shown in Equation 5.13, for non-conservative pollutants *(AHL_{dgstr})* is found by multiplying the POTW influent loading *(L_{infl})* by the ratio of the sludge digester inhibition criterion *($C_{dgstinhib}$)* and the level of the POC in the sludge *(C_{dgstr})*.

5.2.5 AIR-QUALITY BASED AHLS

In rare circumstances, POTWs that have been regulated as air pollution sources and have air emissions standards for specific toxics may need to consider calculating AHLs for those toxics (see Section 3.2.4). AHLs based on air emissions standards can be calculated using either Equation 5.14, which uses the air standard and removal efficiency by volatization, or Equation 5.15, which uses air standards and existing air emissions. The POTW can conduct air emissions sampling or conduct modeling to predict existing air emissions *(C_{air})*. The most widely used model, EPA's Water9 model for wastewater collection and treatment systems, is available at: http://www.epa.gov/ttn/chief/software/water/index.html.

POTWs can determine pollutant removal efficiency by volatilization *(R_{vol})* by examining sampling data of influent, effluent, sludge, and air and determining the portions of the total removal efficiency associated with adsorption to the sludge, biodegradation, and volatilization. In addition, POTWs can model the removal process to predict pollutant removal efficiency by volatilization.

Equation 5.14: AHLs Based On Air Criteria and Volatization Rates

$$AHL_{air} = \frac{0.0022(C_{airstnd})}{R_{vol}}$$

Equation 5.15: AHLs Based On Air Criteria and Existing Emissions

$$AHL_{air} = (L_{infl}) * \frac{C_{airstnd}}{C_{air}}$$

Where:

AHL_{air} = AHL based air emission standards, lb/day
L_{infl} = POTW influent loading, lb/day
$C_{airstnd}$ = Air emissions standard, grams/day
C_{air} = Existing air emissions, grams/day
R_{vol} = Pollutant removal efficiency by volatilization, as decimal
0.0022 = Unit conversion factor

5.3 AHLS FOR CONVENTIONAL AND NON-CONVENTIONAL POLLUTANTS

This section provides guidance on the development of AHLs for three conventional pollutants [BOD, Total Suspended Solids (TSS), oil and grease] and one non-conventional pollutant (ammonia), whose unique circumstances allow for special mechanisms for their AHL development.

5.3.1 BOD/TSS

One of the most commonly documented industry-related causes of POTW effluent violations is the discharge of excessive conventional pollutants, particularly BOD and TSS (see Exhibit 5-5). As stated earlier in the chapter on POC development, POTWs should develop MAHLs for all NPDES-permitted conventional pollutants and understand the degree to which the plant is loaded. In fact, some EPA regions require any wastewater treatment plant that operates at 80 percent of any NPDES permitted conventional pollutant MAHL for three months of the calendar year to calculate a MAIL and establish local limits for those pollutants. To establish MAHLs for BOD and TSS, EPA recommends the following:

> **Exhibit 5-5: Less BOD, More Ammonia and Phosphorous**
>
> In the late 1980s, the City of Trenton Wastewater Treatment Plant (WWTP) violated NPDES permits due to excessive BOD_5 loading. Today, BOD_5 loading has been cut in half after two industries that accounted for half of the BOD_5 loading upgraded their existing treatment facilities by including nutrient addition and longer retention times. However, the industries' nutrient addition led to problems with high amounts of Ammonia-N and Phosphorous discharged to the WWTP. The ratio of BOD to Ammonia-N to Phosphorous has increased from 100:5:1 to 100:11:2.

- The POTW's rated average design capacity, along with any improvements subsequent to construction that have increased plant capacity, should be used as a "monthly average"- based MAHL. The treatment works is designed to have the capacity to consistently treat a specified amount of conventional pollutants to acceptable levels for discharge. A copy of the approved design capacity may be available from the State as part of the design or operating manual for the POTW.

- The POTW's peak loading capacity should be used as the "daily maximum"- based MAHL. Based on a peaking factor, peak loading capacity reflects the plant's ability to handle diurnal, wet weather, or seasonal peaks.

EPA recognizes that sometimes average design capacity and the corresponding peak loading factor may be too conservative when considering the industrial allocation of conventional pollutants. Therefore, the POTW can provide a technically defensible argument for establishing a MAHL for the plant. These arguments could include the following:

- Performing mass balance calculations on the entire plant for the current condition, and scale up the plant loading until loading rates for individual processes exceed design guidelines, including solids handling facilities.

- Verifying capacity of hydraulic structures.

- Performing detailed modeling of biological process capacity under current loading conditions using software (e.g., BioWin by Envirosim). Calibrate the model to current conditions and then increase loading rates to estimate failure.

- Determining maximum biological process loading compared to typical design guidelines - including aeration equipment capacity, basin sizing, mixing energy, secondary clarifier sizing, return activated sludge/waste activated sludge capacity, nutrient removal capacity, winter and peak operation.

- Evaluating current operating conditions. For example, a plant with three activated sludge trains is operating reliably at 2/3 of its design loading with only one train in service.

- Stress testing of individual processes. Increase loading through a single process train until failure is recognized.

- Benchmarking against similar plants and processes.

- Pilot or bench-scale testing of unit operations that have been determined to possibly be a bottleneck for plant capacity.

Smaller plants should incorporate a safety factor in developing the BOD/TSS MAHL for the plant using these methods.

5.3.2 AMMONIA

Typical concentrations of ammonia in untreated domestic wastewater range from 10 to 50 mg/L. Therefore, significant non-domestic industrial sources of ammonia will be unusual and the result of industry-specific activities. If the POTW was designed to remove ammonia through specific processes such as nitrification and denitrification, breakpoint chlorination, or ammonia stripping, the engineering specifications that establish design loading rates should be used as the MAHL. However, for most conventional activated sludge and trickling filter plants, ammonia removal is incidental, and a study of the plant will have to be conducted to determine its removal efficiency. The AHL for ammonia can then be determined using Equation 5.5. When the AHL is determined using site-specific removal efficiencies and Equation 5.5, a safety factor of at least 20 percent should be applied. NPDES ammonia limits are often seasonal, with more stringent limits in place during warmer weather. This needs to be taken into consideration in the development of local limits. A seasonal limit for ammonia might be developed for IUs as well.

5.3.3 OIL AND GREASE

The term fats, oil, and grease (FOG) includes materials of vegetable, animal, and mineral origin. Mineral oils include petroleum, hydrocarbon, and or non-polar fats, oils, and grease. Petroleum-based oil and grease (non-polar concentrations) occur at businesses using oil and grease; and can usually be identified and regulated by municipalities through local limits and associated pretreatment permit conditions. Animal-based and vegetable-based oil and grease (polar concentrations) are more difficult to regulate when the major source is a large number of restaurants and fast-food outlets in the collection system. Collection system issues related to animal-based and vegetable-based oil and grease are addressed in Section 8.3 dealing with flow obstructions.

The pretreatment regulations 40 CFR 403.5(b)(6) prohibit the discharge of "petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through." Most POTWs have adopted 100 mg/L as their local limit for petroleum-based oil and grease because of its history of being protective of the treatment plant and receiving stream. Additionally, the limit of 100 mg/L is achievable with the application of best management practices (BMPs) or generally available pretreatment. The basis of the 100 mg/L limit is an April 1975 EPA document titled *Treatability of Oil and Grease Discharged to Publicly Owned Treatment Works*. This study found a dilution of at least two occurs in collection systems and that influent to biological treatment systems should contain less than 75 mg/L and preferably less than 50 mg/L oil and grease of mineral or petroleum origin to prevent interference. The 100 mg/L was recommended as the value that prevents interference based on the dilution. However, the basis for the 100 mg/L FOG limit is not site specific. The limit should be justified with additional information in order to be considered a technically based limit. See Exhibit 5-6 for a description of how the City of Richland, Washington addressed this limit.

Exhibit 5-6: City of Richland, Washington, POTW Evaluates FOG Removal Efficiency

The Richland POTW and the Washington Department of Ecology ("WDOE") sought to address a laundry's inability to meet its local limits permit limit of 100 mg/L FOG. During 1995, the laundry discharged to the POTW at an average of 200 mg/L FOG.

Monitoring of the POTW indicated average influent levels for FOG of 25 mg/L and effluent levels averaging less than 1 mg/L -- a FOG removal efficiency of 96 percent. Respirometer tests on samples of the laundry's wastewater indicated that the wastestream was a biodegradable food source and easily metabolized by the POTW's microorganisms.

Despite the relatively high concentration of FOG (200 mg/L) in the laundry's effluent, based on the results of this evaluation, the city eliminated the laundry's FOG effluent limit but continued a sampling schedule. Furthermore, the results support previous EPA findings that petroleum based oil and grease compounds "can be degraded to various degrees especially if the microorganisms are acclimated to use the compounds as a substrate", and that "[i]f oil and grease are biodegradable and in a physical state [i.e., emulsified] that does not cause clogging or undue maintenance problems in the wastewater facilities, the discharge of these substances can be accepted in a wastewater treatment system." (*EPA, Treatability of Oil and Grease Discharged to Publicly Owned Treatment Works* (April 1975), p. 11)

City of Richland POTW, *Richland Laundry & Dry Cleaning, Inc. Wastewater Discharge Permit CR-IU003*

Developing a technically based local limit for FOG requires an understanding of the unique manner in which oil and grease can cause interference or pass through. EPA recommends two different methods:

- With FOG limits often included in NPDES permits, POTWs could determine FOG removal efficiency using Equation 5.5 to develop an AHL based on the plant's numeric NPDES permit limits.

- Although animal- and vegetable-based FOG at reasonable concentrations are easily broken down, petroleum-based, non-polar FOG can interfere with both aerobic and anaerobic treatment. Petroleum-based oils can coat the organisms responsible for biological treatment and result in less effective oxygen transfer rates. In anaerobic processes, excessive concentrations of solid grease in digesters can reduce the effectiveness of the process, lead to structural damage to pipes and supports as a result of the weight of scum and grease, and present accumulation problems when supernatant is recycled. When digesters are well mixed and heated to minimize scum loads, reasonable FOG concentrations can be anaerobically digested. If these types of process inhibition are occurring, POTWs could calculate FOG primary and secondary removal efficiencies, determine FOG inhibition criteria, and use Equations 5.10 and 5.11 to determine AHLs based on inhibition. See Exhibit 5-7 for a description of how the City of Portland established an inhibition-based local limit for non-polar FOG.

5.4 Determination of the Maximum Allowable Headworks Loading

After calculating AHLs for each POC for a variety of environmental criteria, MAHL determination is simple. *The lowest (i.e., most stringent) of the AHLs for each POC is selected as the MAHL for that pollutant*. Influent loadings below the MAHL will lead to compliance with the AHLs based on all environmental and treatment plant criteria. The MAHL will be used for all further steps of local limits development and evaluation.

Exhibit 5-7: City of Portland, Oregon Uses Current Influent Loading to Develop Non-Polar FOG Local Limit

The City of Portland wanted to develop a local limit for non-polar FOG to avoid any potential for inhibition at its POTW. However, as often is the case in developing inhibition- based local limits, the MAHL was difficult to define (see Exhibit 5-3) because the plant had never experienced inhibition. The City determined that "the POTW had not experienced process inhibition from non-polar-FOG under these conditions. Therefore the development of a local limit based upon current loading will be protective against process inhibition." The current loading of 8.6 mg/L of non-polar FOG was used as the inhibition-based MAHL.

Although using current loading to establish an inhibition based MAHL is conservative, the methodology provides a scientific basis for the development of local oil and grease limits. Based on this MAHL, the City established a non-polar FOG local limit of 110 mg/L.

See Industrial Source Control Division, Bureau of Environmental Affairs, City of Portland, Final Report - Update of Local Discharge Standards (April 1996).

5.5 Sample MAHL Calculation

A POTW is attempting to determine the MAHL for copper. From its local limits sampling plan, the POTW has determined the following plant data:

- Plant removal efficiency from headworks to plant effluent, $R_{potw} = 0.85$
- Removal efficiency from headworks to primary treatment effluent, $R_{prim} = 0.65$
- Average plant flow rate, $Q_{potw} = 10$ MGD
- Percent solids in the sludge, $PS = 5$ percent
- Specific gravity of sludge, $G_{sludge} = 1$ kg/L
- Average sludge flow rate, $Q_{sludge} = 0.05$ MGD

For copper, the POTW determines that the suitable environmental criteria are the following:

- The POTW has a specific copper limit in its NPDES permit, $C_{npdes} = 1$ mg/L copper.

- With biosolids being used ultimately for lawn application, Federal Sludge Land Application Table 3 "Clean Sludge" Limits, $C_{slgstd} = 1{,}500$ mg/kg copper, are applicable.

- Although inhibition has never taken place at the plant's activated sludge secondary treatment unit, the POTW wants to develop an AHL based on activated sludge inhibition. Based upon the highest observed copper concentration in the secondary treatment unit that did not cause inhibition, the POTW sets the inhibition criterion for secondary treatment, $C_{inhib2} = 1$ mg/L copper.

The following equations for AHLs based on NPDES limits (Equation 5.5), sludge standards (Equation 5.9), and secondary treatment inhibition (Equation 5.10) are used.

$$AHL_{npdes} = \frac{(8.34)(C_{npdes})(Q_{potw})}{(1 - R_{potw})} = \frac{(8.34)(1 mg/L)(10 MGD)}{(1 - 0.85)} = 556 lb/day$$

$$AHL_{sldg} = \frac{(8.34)(C_{slgstd})(PS/100)(Q_{sldg})(G_{sldg})}{R_{potw}} = \frac{(8.34)(1{,}500 mg/kg)(5/100)(0.05 MGD)(1 kg/L))}{0.85} = 37 lb/day$$

$$AHL_{sec} = \frac{8.34(C_{inhib2})(Q_{potw})}{(1 - R_{prim})} = \frac{8.34(1 mg/L)(10 MGD)}{(1 - .65)} = 238 lb/day$$

From these three AHLs, the most stringent (lowest) AHL based on the sludge standard *(AHL_{sldg})* was chosen as the MAHL for copper at 37 lb/day.

5.6 SUMMARY

After reviewing Chapter 5, POTWs should be able to:

- Calculate POTW removal efficiencies for each POC
- Calculate AHLs for each environmental criteria
- Determine MAHL as the most stringent AHL for each POC

Chapter 6 describes how to assess the need for local limits, allocate the maximum allowable industrial loadings, and develop and implement final local limits and BMPs.

CHAPTER 6 -
DESIGNATING AND IMPLEMENTING LOCAL LIMITS

Chapter 6 provides guidance on how to:

- Determine the need for new local limits after establishing Maximum Allowable Headworks Loadings (MAHLs).
- Calculate Maximum Allowable Industrial Loadings (MAILs).
- Compare MAIL allocation and implementation methods.
- Allocate MAILs to controlled dischargers.
- Perform a common sense assessment of local limits.
- Use best management practices.
- Provide public participation.
- Gain Approval Authority approval.
- Conduct public outreach.
- Select the appropriate control mechanism to apply local limits.

6.1 DETERMINATION OF THE NEED FOR NEW LOCAL LIMITS

Once a POTW has calculated MAHLs for all of its pollutants of concern (POCs), it can determine for which pollutants it will require local limits. In making this pollutant-by-pollutant evaluation, the POTW will also want to consider historical issues and the degree to which current influent loadings approach calculated MAHLs. For example, the concentration of some pollutants in the POTW influent may be far below the calculated MAHLs. These pollutants are unlikely to cause problems for the POTW, so the treatment works may conclude that local limits for them are unnecessary. EPA recommends that the POTW document such decisions and discuss them with its Approval Authority, as needed.

Some Approval Authorities require that local limits be established for a specific set of pollutants regardless of the outcome of the headworks loading analysis. For example, some Approval Authorities specify that local limits be developed for arsenic, cadmium, chromium, copper, cyanide, lead, mercury, molybdenum, nickel, selenium, silver, and zinc regardless of whether they are in the POTW's influent. If such specific guidance is not available, EPA recommends that the POTW conduct evaluations for each POC.

No single approach applies for all pollutants at all POTWs. The approaches presented below are intended to determine which POCs deserve to be covered by new local limits. **In EPA's view, a POTW should not use the approaches below in deciding whether to continue to control a particular pollutant by a local limit because the enforcement of the local limit may be the reason that the pollutant loading has been reduced or is no longer causing problems**. If the local limit were removed, industrial users (IUs) may discontinue their use of wastewater pretreatment and POTW loadings may increase above the threshold in the criteria. Re-evaluation of existing local limits is discussed in Chapter 7.

6.1.1 ACTUAL LOADINGS VS. MAHL

Equation 6.1 compares actual POTW loadings to the calculated MAHLs for individual POCs. A POTW would use this equation to calculate the percentage of MAHL being received at the POTW. The *average* and *highest daily* influent loading should be calculated. EPA recommends that local limits are needed when:

- Average influent loading of a toxic pollutant exceeds 60 percent of the MAHL.
- Maximum daily influent loading of a toxic pollutant exceeds 80 percent of the MAHL any time in the 12-month period preceding the analysis.
- Monthly average influent loading reaches 80 percent of average design capacity for BOD, TSS, and ammonia during any one month in the 12-month period preceding the analysis.

Equation 6.1: Actual Loading vs. MAHL Calculation

$$L_{\%} = \frac{L_{INFL}}{MAHL} x100$$

Where:
$L_{\%}$ = Percentage of the MAHL
L_{INFL} = Current influent loading (average or highest daily), lb/day
$MAHL$ = Calculated MAHL lb/day

EPA recognizes that these percentages to trigger local limits development are default assumptions that can vary from plant to plant. The approach used for toxic pollutants is more conservative because most POTWs are not designed to treat toxic pollutants.

6.1.2 NONCOMPLIANCE DUE TO PASS THROUGH OR INTERFERENCE

The basic purpose of the pretreatment program is to prevent pass through and interference, and the General Pretreatment Regulations require that local limits be established to prevent them. EPA recommends that in the absence of strong evidence that the cause of pass through or interference has been eliminated, a POTW retain local limits for the pollutants causing historic violations. By reviewing past NPDES permit violations, sludge disposal restrictions, or inhibition incidents, the POTW can identify the pollutants for which it should set or maintain local limits.

6.1.3 ESTABLISHING LOCAL LIMITS FOR CONVENTIONAL POLLUTANTS

Conventional pollutants such as BOD, TSS and ammonia require additional evaluation before decisions are made to set a MAIL and put in place a local limit. Controlling conventional pollutants from IUs must be evaluated in a broader context, because the POTW was designed to treat conventional pollutants. A comprehensive evaluation of the POTW may be needed (see Section 5.3) and many alternatives in lieu of or in addition to local limits may be considered.

A POTW that is approaching its design capacity for BOD/TSS should begin planning to avoid future violations. NPDES permits sometimes include a reporting requirement when the POTW begins to operate at 80-90 percent of its original design capacity for 90-180 consecutive days. EPA recommends using a similar threshold as a basis for investigating alternatives for reducing or responding to future conventional loadings. If the rate of increase in influent conventional pollutants loadings suggests that the full capacity of the plant will be utilized within five to seven years, then planning may need to begin immediately. The planning need not automatically assume that local limits would be set for conventional pollutants. Several alternatives should be investigated in addition to local limits. These include:

- Minimizing growth of the community by controlling sewer connections.
- Initiating POTW modifications to optimize performance (through chemical additions, filtration, membrane filtration, and other methods).
- Modifying operation or flow configurations.
- Expanding POTW capacity via facilities planning.
- Reducing industrial sources of conventional pollutants through incentives and disincentives.

Each POTW has a unique, historical background of successful operation with respect to conventional pollutants, and whether each POTW can operate successfully at a given (elevated) loading will vary from plant to plant. Some of these concepts are reviewed in Section 5.3.

POTW expansions can take up to 5 years. Therefore, it is vitally important to monitor loadings to the plant against the POTW design capacity. Failure to plan in a timely manner can result in NPDES violations. With respect to nitrogen management, it is useful to note that nitrogen removal at the POTW typically requires four times the biological treatment volume needs of BOD, hence the need to quantify significant industrial sources of nitrogen to optimize control and treatment.

6.2 CALCULATION OF MAXIMUM ALLOWABLE INDUSTRIAL LOADING

MAHLs estimate the maximum combined loadings that can be received at the POTW's headworks from all sources. MAILs developed by the POTW represent the amount of pollutant loadings the POTW can receive from controlled sources (i.e., industrial users, some commercial sources[1], and some hauled waste) that the POTW chooses to control through local limits. As shown in Equation 6.2, the MAIL is calculated by subtracting estimates of:

- Loadings from uncontrolled sources *(L_{unc})*
- Hauled waste not regulated through local limits *(HW)*
- Growth allowance *(GA)*

Equation 6.2: MAIL Calculation

$$MAIL = MAHL(1 - SF) - (L_{UNC} + HW + GA)$$

Where:

MAIL = Maximum allowable industrial loading, lb/day
MAHL = Maximum allowable headworks loading, lb/day
SF = Safety factor, if desired
L_{UNC} = Loadings from uncontrolled sources (uncontrolled sources= domestic + some commercial + I&I)
HW = Loadings from hauled waste, if not regulated through the local limits
GA = Growth allowance.

from a MAHL adjusted with a safety factor *(SF)*. These four elements of the MAIL calculation– loadings from uncontrolled sources, hauled waste, growth allowance, and safety factor – are further explained in the next four subsections. Table 6-1 provides a summary on the information needed to calculate the MAIL.

Table 6-1: Data for Implementation of MAHLs

Parameter	Comments	Source of Data
IU and significant industrial user (SIU) flow	Total flow from all SIUs and IUs, plus any commercial dischargers that the POTW intends to control	POTW local use sampling program, periodic reports from SIUs
Uncontrolled Source Pollutant Concentrations	Levels of POCs in domestic and commercial discharges that the POTW does not intend to control with local limits	POTW local use sampling program
Uncontrolled Source Flow	Flow from all uncontrolled sources, either in total or divided by type of facility (domestic, commercial, I&I, storm water)	POTW local use sampling program
Hauled Waste Loadings	Based on volume and pollutant concentration data	POTW sampling of waste hauler loads
Safety Factor	Varies depending on quality and amount of data	POTW choice based on data analysis
Growth Allowance	Varies based on the projected growth for the area	POTW choice based on data analysis

[1] For example, a POTW may choose to regulate or limit the discharges from some or all of its commercial dischargers (e.g., dental offices, hospitals, and restaurants), in which case they would be considered controllable sources.

6.2.1 UNCONTROLLED SOURCES

As noted above, some sources of pollutant loadings to the POTW are considered uncontrolled. They include domestic users, inflow and infiltration (I&I), treatment chemicals added to sewers, storm water, and some or all of a POTW's commercial dischargers. Because the POTW does not control the loadings that these users discharge [except through the general and specific prohibitions in the POTW's sewer use ordinance (SUO)], the POTW needs to subtract these loadings from its MAHLs before it can determine the MAIL (see Equation 6.2). EPA recommends the following approach for calculating the contribution to the MAHL from these uncontrolled loadings: First, the POTW conducts site-specific monitoring of the uncontrolled discharges at sewer trunk lines that receive wastewater from only these sources (see Section 4.1.2). This activity will enable the POTW to develop data on average pollutant concentration levels. The POTW then multiplies the concentration loadings for each pollutant obtained from these locations (C_{UNC}) by the POTW's total uncontrolled flow rate (Q_{UNC}) to determine total loadings to the POTW for that specific pollutant from all uncontrolled sources (see Equation 6.3).

EPA strongly encourages POTWs to use site-specific data for uncontrolled loadings whenever possible. Appendix V includes data on pollutant concentrations found in typical domestic wastewater discharges, which can be used if site-specific data are not available. Because domestic wastewater values may not be representative of the uncontrolled discharges in their systems, POTWs should use care with these data.

A POTW may find that the total uncontrolled loadings of a particular pollutant approach or exceed the MAHL. In these cases, little or no pollutant loading is available for IUs. This situation may arise in part because some of the facilities considered uncontrolled are commercial facilities such as gas stations, radiator repair shops, car washes, or hospitals, which may discharge high levels of pollutants. These facilities may be grouped initially with uncontrolled sources because they are small or have low discharge flows. The POTW may need to carefully evaluate the sources it considers uncontrolled to see if some of them would be better classified as controlled sources with reducible pollutant loadings. Refer to the *Supplemental Manual on the Development and Implementation of Local Discharge Limitations under the Pretreatment Program* (EPA-W21-4002, May 1991) for typical pollutant loadings for selected commercial industries. This is recommended for POTWs whose allocations to uncontrolled sources consume most or all of its MAHLs for some pollutants. In addition, see Section 9.5 for additional guidance addressing this issue.

Equation 6.3: Uncontrolled Loading Calculation

$$L_{UNC} = (C_{UNC})(Q_{UNC})(8.34)$$

Where:
L_{UNC} = Uncontrolled loading, lb/day
C_{UNC} = Uncontrolled pollutant concentration, mg/L
Q_{UNC} = Uncontrolled flow rate, MGD
8.34 = Unit conversion factor.

If a POTW has considerable loadings from I&I and storm water (from combined sewer systems), it should try to estimate their loadings and include them in the uncontrolled loadings estimate. The POTW may be able to select sampling locations that include these flows, or it may be able to estimate them by analyzing the variations in flow between periods of wet and dry weather. In some cases, the POTW may be able to decrease the flows and loads from I&I and storm water through sewer system rehabilitation and pollution prevention programs so that loads from these sources do not consume a substantial portion of the POTW's MAHLs.

The POTW may be able to estimate loadings from uncontrolled sources by subtracting loadings of controlled sources from total influent loadings. This method may be useful when most or all of a POTW's data for uncontrolled sources are below detection levels for a pollutant. When the data are mostly below detection levels, the POTW should carefully evaluate how to handle these data because these decisions can greatly affect the loadings available for IUs. Additional guidance on setting local limits when uncontrolled source loading exceeds the MAHL has been developed by EPA Region 5 and can be found at: http://epa.gov/r5water/npdestek/npdprtg3.htm.

6.2.2 HAULED WASTE

As previously noted, POTWs that do not regulate waste haulers through local limits will want to determine the loads they receive from hauled waste and subtract these loads from their MAHLs before determining their MAILs. EPA recommends that POTWs base the allocations for hauled waste on actual data – pollutant concentrations and flows from waste haulers collected by sampling hauled waste brought to the treatment works. EPA further recommends that POTWs regularly sample these loads to ensure that they are not hazardous waste, do not contain toxic pollutants in amounts greater than expected or greater than local limits, and will not pose risks to the treatment plant or its workers. In addition, EPA reminds POTWs that hauled waste subject to categorical limitations must meet those limits when accepted at the POTW and that pretreatment standards apply to wastes hauled from IUs. Additional information on the acceptance and characterization of hauled wastes at POTWs is available in *Guidance Manual for the Control of Waste Hauled to Publicly Owned Treatment Works* (EPA/833-B98-003). The guidance discusses collection of information on waste haulers, characterization of hauled waste received, evaluation of potential impacts and development and implementation of controls.

Exhibit 6-1: Safety Factor Example

If a POTW's data for cadmium were all below detection and the POTW used literature data for cadmium removal efficiencies, the treatment works should consider using a safety factor for cadmium. At the same time, if the POTW's zinc data were mostly above detection and the daily removal efficiencies were all between 60 and 80 percent, the POTW may not need to use a safety factor for zinc. The decision to use a safety factor for zinc removal on pass through would depend on the quality of the data used to calculate the removal efficiency. In this example, assume that the removal efficiency is based on 12 months of paired influent and effluent samples that range from 60 and 80 percent and collected as hydraulically lagged pairs. Because this data set is of high quality, the POTW might not use a safety factor. If an ADRE is calculated, it will lie in the 60 to 80 percent range. If the ADRE is 72 percent, the POTW will want to consider the degree of safety that would exist should the actual removal efficiency be lower. This, along with the potential to violate water quality standards or NPDES effluent limits, also needs to be considered.

Note that the ADRE for pass through is the same value used for sludge quality protection calculations. The POTW should also examine the data set to determine the potential for removals to be higher than the ADRE leading to violations of sludge disposal quality criteria.

6.2.3 SAFETY FACTOR

Determining safety factors is an imprecise process, which has the potential to affect significantly the final local limits. A safety factor is site specific and depends on local conditions. The main purpose of a safety factor is to address data "uncertainties" that can affect the ability of the POTW to calculate accurate local limits. Some Approval Authorities may have mandatory safety factors. At a minimum, EPA generally recommends a 10 percent safety factor. The determination of whether a safety factor is needed and, if it is, how large the safety factor should be depends on the following elements:

- The variability of the POTW's data.

- The amount of data the POTW used to develop its MAHLs.

- The quality of the POTW's data.

- The amount of literature data the POTW used.

- The history of compliance with the parameter.

- The potential for IU slug loadings (e.g., as a result of chemical spills).

- The number and size of each IU with respect to the POTW's total flow rate.

The POTW may use different safety factors for different pollutants. The above elements may vary from pollutant to pollutant, making it appropriate for a POTW to use different safety factors (see Exhibit 6-1).

6.2.4 Expansion/Growth Allowance

A POTW that anticipates a significant amount of growth in the future can consider holding in reserve a portion of its MAHLs for this growth. This expansion/growth allowance is separate from the safety factor. Anticipated growth should be projected for known, planned expansions such as IUs moving into the POTW's service area or existing IUs expanding their operations, the development of a shopping mall or the opening of other commercial businesses in a new office park, or the construction of a new housing development. The expansion and growth allowance is most commonly justified for BOD, TSS, and other pollutants the POTW was designed to remove. By holding in reserve some of the MAHL, the POTW has a portion to allocate to the new discharges and may not need to revise its existing IU permits or SUO.

6.3 Comparison of MAIL Allocation and Implementation Methods

Uniform-concentration local discharge limitations have become synonymous in the Pretreatment Program with the term "local limits." However, local limits can take many forms based on how MAILs are allocated to IUs. The designation and implementation of these MAILs, including the allocation of loadings to IUs, are left to each POTW, as long as the implementation procedures do not allow the calculated MAHL to be exceeded and provide a reasonable method for making allocations to the IUs. This section describes some of the implementation decisions facing POTWs. The selection of an appropriate implementation approach is an integral aspect of a POTW's local limits process.

A POTW may select any allocation and implementation method that results in enforceable local limits to prevent pass through and interference and to comply with the prohibitions in the Federal regulations. The POTW should choose the allocation approach that best fits its own situation. It may choose one approach for some pollutants and another approach for other pollutants, depending on the amount of loading available to IUs and the number of IUs discharging a given pollutant. For example, if only three of a POTW's ten IUs discharge silver, the POTW may prefer to allocate its allowable industrial silver loading among the three IUs that discharge silver so that these IUs receive more achievable limits. At the same time, if all of the users discharge copper, the POTW may choose to allocate the MAIL for copper to all of the users on a uniform basis. All regulated IUs should receive at least a background allocation for copper and all other POCs.

Table 6-2 on the next page lists issues that POTWs will want to consider when determining how to allocate and implement its local limits. Ultimately, the POTW will want to allocate pollutant loadings in a fair and sensible way that does not favor any one industry or group of industries, considers the economic impacts, maintains compliance with the NPDES permit, and otherwise achieves the environmental goals of the program. The allocation method selected may be subject to State and local public participation requirements in order for the resulting local limits to become legally enforceable.

6.4 Allocation of MAILs Among Controlled Sources

A POTW can apply to its controllable sources concentration-based limits (typically in mg/L), or mass-based limits (typically in lb/day), or both. *The type of limit depends in part on the method chosen by the POTW to allocate its MAILs among the controlled dischargers*. For example, a POTW that uses the uniform concentration method based on total IU flow typically implements a pollutant limit as a single concentration (generally in its SUO) applicable to all controlled users. If the POTW allocates its MAILs on a case-by-case basis depending on an IU's need for a certain loading allocation, the POTW may find it easier to apply mass-based limits (in individual permits) that allow for the needed loading at the IU. The POTW needs to consider the ability to determine and enforce compliance. EPA recommends that the POTW consider the IU's sampling capabilities when determining the type of limits to apply to an IU. An IU may not have flow meters or sampling points necessary to determine mass-based limits. In these cases, the POTW may instead put concentration-based limits in the IU permits or, potentially, both types of limits in the permit. Thus, the POTW may first allocate its MAILs based on loadings, but then apply the allocations to IUs as concentration-based limits based on flow. EPA recommends that POTWs use mass-based limits only for users that have the capability (or are required to develop the capability) to accurately measure their flows at the designated sampling points. Mass-based limits have the added benefit of allowing IUs to reduce their water consumption through conservation or recycling without affecting their ability to meet local limits.

6.4.1 Limit Duration

When applying its local limits, a POTW needs to determine the appropriate limit duration. The POTW may establish limits that are daily maximums, monthly averages, or instantaneous maximums. In general, a POTW should base the limit duration on the type of criteria – long-term or short-term – used to develop the local limit. However, most local limits will be implemented as **daily maximums** based upon two main factors: 1) the short-term nature of the event that the local limit is protecting against; and 2) the infrequency of IU sampling. Scenarios illustrating this are presented below.

Table 6-2: Options for Allocating and Implementing Local Limits

Method	Pros	Cons
Allocate MAILs uniformly among all IUs and place uniform concentration limits in the local SUO	-Limits are clear to IUs -Requires little time to calculate limits -Easy to determine compliance	-Need to update SUO when limits change -Inflexible -Limits may be overly stringent because some IUs may get an allocation but do not discharge a pollutant
Place general language about complying with local limits in the local SUO and announce the actual uniform limits outside the SUO	-Do not have to revise the SUO every time local limits change -Easy to monitor for compliance -Relatively easy to calculate limits	-IUs may not be clear on the limits with which they must comply -Action may be overlooked by the general public and interested parties
Place general language about complying with local limits in the local SUO and place individual limits in IU permits	-Do not have to revise the SUO every time local limits change -Provides flexibility	-Requires issuing a permit to all IUs to which the POTW wants limits to apply -Action may be overlooked by the general public and interested parties
Put MAILs in SUO, allocate loadings on an IU contributory flow or mass proportion basis, and place limits in IU permits	-Only IUs that discharge a pollutant are given a full allocation so limits are more efficiently allocated -Helps avoid setting excessively stringent or unattainable limits	-Requires knowing more about IU discharges (need to know their pollutant content) -Requires updating the SUO when MAILs change -Requires issuing permits to all IUs with specific limits -May penalize IUs that are currently pretreating if others are not
Put MAILs in SUO, allocate loadings on a case-by-case basis to those IUs that need an allocation for a specific pollutant, and place limits in IU permits	-Only IUs that discharge a pollutant are given a full allocation so limits are more efficiently allocated -Helps avoid setting excessively stringent or unattainable limits -Provides flexibility	-Requires knowing more about IU discharges (need to know their pollutant content) and applicable pretreatment systems -More time-consuming to determine allocation -Can lead to an inequitable allocation among IUs -Requires updating SUO when MAILs change -Requires issuing permits to all IUs with individual limits

EPA recommends use of a daily maximum in the following circumstances:

- **A local limit based upon short-term criteria should be a daily maximum**. For example, local limits based upon NPDES permit limits expressed as daily maximums should be considered daily maximums.

- **A local limit based upon long-term criteria, BUT protecting against a short-term event, should be a daily maximum**. For example, a local limit based on chronic water quality criteria would appear to warrant assigning a long-term limit duration such as monthly average. However, the local limit should be considered a daily maximum because the MAHL calculation using water quality criteria is based on either the receiving stream's 1Q10 or 7Q10 flows, both of which are short-term phenomena (see Equation 5.6). Another short-term condition that leads to a daily maximum limit is biological inhibition for both secondary and tertiary treatment, both of which have short residence times.

- **A local limit based upon long-term criteria and protecting against a long-term event, BUT the sampling cannot generate a true monthly average, should be a daily maximum.** For example, monthly average "clean sludge" criteria, can be the basis of a local limit. Residence times in sludge digesters and storage facilities are commonly 20 to 30 days or more. Consequently, to change the concentration to any appreciable degree, any excessive loading would have to be maintained for three to four weeks – a long-term event. These two factors favor a monthly average type local limit. However, an IU will rarely sample for the metals that end up in the POTW sludge more than once a month. Therefore, local limits for sludge disposal, although based upon a long-term criteria and protecting against a long-term event, should be considered a daily maximum limit.

This means of assigning local limit duration is protective in that it leads to enforcing local limits based on monthly average criteria as daily maximums.

In terms of other duration types, EPA recommends that local limits should be **monthly averages** when the environmental criteria that they are based upon is long term, the protected event is long term, and frequent IU sampling can generate a true monthly average. EPA recommends that **instantaneous limits** be developed for pollutants that cannot be composited. A limit derived from a MAHL based on one-hour acute toxicity water quality criteria may not be protective if it is implemented as a daily maximum instead of as an instantaneous limit. However, if the instantaneous limit is converted to a daily maximum limit using a statistical procedure that accounts for the variation in concentrations over a 24-hour period, the daily maximum limit should be adequately protective. The EPA Technical Support Document (TSD) approach, described in the *Technical Support Document for Water Quality Based Toxics Control* (EPA, 1991a), accounts for these variations. Instantaneous limits may also be appropriate where Approval Authorities require IUs to accumulate all wastewater flows in batch tanks. Grab samples can then be collected to evaluate an instantaneous limit.

Exhibit 6-2: Background Allocation

When using the IU Contributory Flow Method or Mass Proportion method, any user that discharges at or below the background level is given a background allocation (unless a different allocation can be justified based on actual sample data). Please note that:

- Background loading can be calculated for each pollutant using the uncontrolled concentration for that pollutant and the flow of that pollutant from the "non-contributing" industries. (Background flow from non-contributing industries may be different for each pollutant.)
- These background "limits" are then applied to non-contributing industries.
- Similar to how estimated uncontrolled source loading can actually exceed the MAHL (see Section 6.2.1), estimated loadings from non-contributing IUs discharging the pollutant at background levels can result in an over-allocation of the MAIL. In other words, the estimated loading from IUs discharging at pollutant background levels plus the loading from IUs discharging the pollutant at local limit levels is greater than the MAIL. Generally, this occurs because background levels are set too high. POTWs should make sure that their determination of background levels is sound and check their allocation method. For instance, a uniform concentration specified in a Sewer Use Ordinance for a background concentration can lead to an over-allocation error (see Equation 6.7 on the next page).

6.4.2 ALLOCATION APPROACHES

A POTW can use several basic approaches to assign limits to its controlled dischargers. As noted above, the POTW can select different allocation methods for different pollutants. Several common approaches for allocating MAILs for conservative pollutants are described in this section. A POTW may choose to use another method, such as a statistical method, as long as it results in local limits that are enforceable and adequately protective.

Limits Based on IU Contributions of a Pollutant

Two allocation methods divide the MAILs among only the controlled dischargers that discharge a particular pollutant. These methods develop IU-specific discharge limits. Any user that discharges at or below the background level is given a background allocation unless a different allocation can be justified based on actual sample data (see Exhibit 6-2 on the previous page).

The IU Contributory Flow method is similar to the uniform method described below, except that the portion of MAILs above background $(MAIL - L_{BACK})$ is divided by the flow rate from controlled sources (Q_{CONTD}) discharging the pollutant above background. The concentration-based limits (C_{LIM}) apply only to those users (see Equation 6.4).

The Mass Proportion method allocates MAILs to each controlled discharger in proportion to the discharger's loading of that pollutant. To calculate the allowable loading for a user (L_{ALLx}) the portion of the MAIL above background $(MAIL - L_{BACK})$ is multiplied by the ratio of the current loading from user x (L_{CURRx}) to the current total loading of a pollutant from controlled sources (L_{CURRt}). The mass-based loading calculated using the mass proportion method can be converted to a concentration-based limit (see Equations 6.5 and 6.6).

Uniform Limits For All Controlled Dischargers

As illustrated in Equation 6.8 (on the following page), the uniform limits method of allocating MAILs for conservative pollutants yields one limit per pollutant (C_{LIM}) that applies to every controlled discharger. It requires that the *MAIL* for each pollutant be divided by the total flow rate from all controlled dischargers (Q_{CONT}),

Equation 6.4: IU Contributory Flow Calculation

$$C_{LIM} = \frac{MAIL - L_{BACK}}{(Q_{CONTD})(8.34)}$$

Equation 6.5: Mass Proportion Method for a Mass-Based Local Limit

$$L_{ALL_X} = \frac{L_{CURR_X}}{L_{CURR_t}} * (MAIL - L_{BACK})$$

Equation 6.6: Mass Proportion Method for a Concentration-Based Limit

$$C_{LIM_X} = \frac{L_{ALL_X}}{(Q_X)(8.34)}$$

Equation 6.7: Uniform Allocation of Background Loading

$$C_{BACK} = \frac{L_{BACK}}{(Q_{BACK})(8.34)}$$

Where:

- C_{LIM} = Concentration-based limit for all users discharging a pollutant, mg/L
- C_{BACK} = Concentration-based limit for all users discharging pollutant at or below background, mg/L
- $MAIL$ = Maximum allowable industrial loading, lb/day
- L_{BACK} = Total background loading allocation for all users for which no contributory flow limit is being established for that pollutant, lb/day
- Q_{CONTD} = Flow rate from all industrial and other controlled sources discharging the pollutant, MGD
- Q_{BACK} = Flow rate from all industrial and other controlled sources not discharging the pollutant at or below background, MGD
- L_{ALLx} = Allowable loading allocated to user x, lb/day
- L_{CURRx} = Current loading from user x, lb/day
- L_{CURRt} = Total current loading to POTW from controlled sources, lb/day
- C_{LIMx} = Discharge limit for user x, mg/L

even those that do not discharge the pollutant. This method can be overly stringent because some IUs that do not discharge the pollutant will be given an allocation of the MAIL that they may not need. Other IUs that do discharge that same pollutant may have to pretreat to comply with the local limit.

Basis of IU Needs for Discharge Loading/Case-by-Case Basis
A POTW may set IU-specific limits case by case. This type of allocation relies on the POTW's judgment to determine the amount of the MAIL to allocate to each controlled discharger. The limits can be based on the discharger's current loading, its need for a continued loading allocation, its ability to apply pretreatment to achieve certain discharge pollutant levels (i.e., treatability), or any other factor that the POTW determines is relevant. The POTW needs to ensure that the sum of the allocated loadings does not exceed the MAIL and that it provides for at least a background allocation for each pollutant for each user, unless a lower allocation can be justified by sampling data. To ensure that it does not allocate more than the MAIL, the POTW should develop a mechanism to track the loading allocated to each IU and compare the allocated total to the MAIL.

Creative Allocation Methods
In general, once the MAIL is calculated, the POTW has substantial flexibility in allocating the pollutant load among its IUs as long as a margin of safety is maintained, the POTW has carefully accounted for all allocations, and public notice of the allocation is properly issued and allocation is adopted. For example, the Hampton Roads Sanitation District (HRSD) has developed flow-based local limits. Industries are placed in one of the following flow categories:

Equation 6.8: Uniform Concentration Limit Calculation

$$C_{LIM} = \frac{MAIL}{(Q_{CONT})(8.34)}$$

Where:
C_{LIM} = Uniform concentration limit, mg/L
$MAIL$ = Maximum allowable industrial loading, lb/day
Q_{CONT} = Total flow rate from industrial and other controlled sources, MGD
8.34 = Unit conversion factor

- 0 to 9,999 gallons per day (gpd)
- 10,000 to 19,999 gpd
- 20,000 to 29,999 gpd
- 30,000 to 39,999 gpd
- 40,000 to 199,999 gpd
- 200,000 to 399,999 gpd
- Greater than 400,000 gpd

Uniform limits are applied to each industry within the same flow category. The local limits become progressively more stringent as the industry's discharge flow increases. IUs that discharge above 400,000 gpd are assigned specifically calculated local limits based on domestic loadings and the industrial processes from the specific facility. As an illustration, IUs with a flow rate of 0 to 10,000 gpd would have a nickel limit of 10.0 mg/L, while those with a rate of 200,000 to 400,000 gpd would have daily maximum nickel limit of 1.0 mg/L. HRSD uses this scheme for its local limits for the following parameters: arsenic, cadmium, chromium, copper, cyanide, lead, mercury, nickel , phenolic compounds, silver, zinc, and non-saponifiable oil and grease.

Another creative form of MAIL allocation that POTWs may consider is pretreatment trading or effluent trading. These programs allow one source to meet its regulatory obligations by using pollutant reductions created by another source that has lower pollution control costs. Trading capitalizes on economies of scale and the control cost differentials among and between sources. Trading policy is applicable to local limits, only. The policy does not apply to categorical standards. EPA supports a municipality or regional sewerage authority developing and implementing trading programs among industrial users that are consistent with the pretreatment regulatory requirements at 40 CFR Part 403 and the municipality's or authority's NPDES permit. See *Final Water Quality Trading Policy*, EPA, Office of Water, Water Quality Trading Policy, January 13, 2003. Available at:

http://www.epa.gov/owow/watershed/trading/finalpolicy2003.html.

6.5 COMMON SENSE ASSESSMENT

After developing and allocating local limits, POTWs should determine whether their local limits pass a "common sense test." An effective public participation process can help with this assessment. Some of the questions a POTW should ask to determine if its limits pass the "common sense" test are:

- **Are the limits technologically achievable?** Are IUs and other controlled dischargers likely to meet these limits with currently available forms of pretreatment and pollution prevention (e.g., process modifications)? Local limits are meant to protect the POTW and the environment and therefore are not specifically based on technological achievability.

- **Can the POTW and dischargers determine compliance with the local limits?** Are the limits above sampling method detection levels? If the limits are below the detection level of the most sensitive analytical method, neither the POTW nor the IUs will be able to definitively determine compliance.

- **Are the limits sensible in light of actual conditions at the treatment plant and past compliance experience?** For example, if the POTW is currently violating its NPDES limit for copper but the local limits analysis indicates that the POTW can accept its current influent loading and maintain compliance with that limit, the calculations and the past experience are in conflict. In this situation, the POTW should determine the reason(s) for the inconsistency.

If a POTW's calculated limits do not pass the "common sense test," the POTW may need to reassess its limits development process or investigate other options for reducing pollutant loads (e.g., source reduction measures). Besides the environmental criteria used in the calculations, the two pieces of data that can have the greatest impact on the local limits calculations are the removal rates and the uncontrolled pollutant concentrations. A reassessment of the limits development process may show that several of the limits are affected by a lack of data and the use of literature values. By conducting additional sampling (possibly using lower detection limits), a POTW may obtain better data and, thus, be able to calculate more appropriate limits.

Despite the POTW's efforts to obtain the best data available for the calculations, the local limit calculated for a specific pollutant may at times be unreasonable and warrant other actions to establish valid limits. Other options for reducing pollutant loads to the POTW include the following:

- Adding other commercial facilities to the set of controlled sources and requiring those facilities to reduce the pollutant load in their discharges. For example, a POTW's

MAHL for silver could be less than the uncontrolled loading resulting in a negative local limit. By adding other silver dischargers (e.g., photoprocessors) to the group of controlled IUs, the uncontrolled loading may be reduced significantly enough to calculate a reasonable limit.

- Instituting a public education program to reduce problem discharges from domestic and other non-industrial (e.g., dental offices) sources. Some POTWs have worked with area dental associations to help educate dentists about proper disposal practices for mercury amalgam. Other POTWs have held hazardous waste disposal days to reduce the amount of household hazardous wastes discharged into sewers. See more on working with industry on Best Management Practices (BMPs) in Section 6.6.

- Limiting acceptance of hauled waste to fewer loads, smaller loads, or lower pollutant levels. If hauled wastes contribute significantly to uncontrolled loadings, the POTW may need to stop accepting some hauled waste.

- Conducting an I&I reduction program. Although I&I will generally contain lower concentrations of most pollutants than typical domestic sewage, it may contribute loadings that can increase problems with limits calculations.

- Encouraging the replacement of piping that contributes significant loads of copper and lead.

- Examining impurities, such as mercury, in chemicals used by industry, POTWs and water suppliers. Additionally, POTWs should be aware that the chemicals used in potable water treatment, such as fluoride (hydrofluorosilicic acid additive to prevent tooth decay) and zinc (zinc orthophosphate for corrosion control), can contribute to POTW pollutant loads.

A POTW that cannot develop reasonable local limits may need to consider changing sludge disposal methods (if sludge is the limiting factor) or, in the long term, expanding the capacity of its treatment plant (especially for pollutants such as BOD, TSS, or ammonia). In any event, a POTW that is experiencing difficulty developing reasonable limits should contact its Approval Authority to discuss possible solutions.

6.6 BEST MANAGEMENT PRACTICES

The General Pretreatment Regulations do not specifically address the use of BMPs. The regulations at 40 CFR 403.5(c) require the POTW only to develop "specific limits" for prohibited discharges. The current regulatory language is ambiguous as to whether BMPs may serve in lieu of numeric limits. *However, the proposed Pretreatment Streamlining Rule (40 CFR Part 403, Streamlining the General Pretreatment Regulations for Existing and New Sources of Pollution, July 22, 1999) states that BMPs may be enforceable as local limits as an alternative to numerical limits or may supplement local limits. BMPs would need to be included in the technical evaluation of local limits.* BMPs are defined in the NPDES regulations (40 CFR 122.2) as scheduled activities, prohibitions of practices, maintenance procedures and other management practices to prevent or reduce pollution. Some recently developed Effluent Limitation Guidelines, such as those for Pulp, Paper and Paperboard (40 CFR 430), Transportation Equipment Cleaning (40 CFR 442) and Pesticide Formulating, Packaging and

Repackaging (40 CFR 455), allow for use of BMPs in meeting prescribed limits. BMPs also include treatment requirements, operating procedures, sludge or waste disposal, or drainage from raw material storage, and practices to control plant site runoff, spillage or leaks.

Some commercial establishments may discharge pollutants in quantities that can be controlled either by local limits or by BMPs. A photofinisher that discharges to a POTW that is critically loaded with silver is one example. The POTW might elect to require silver BMPs in lieu of a permit and account for this allocation and anticipated reduction in silver in coordination with more traditional permits issued to IUs with mass-based or concentration-based local limits. However, to the extent that BMPs are used as an alternative or supplement to technically based local limits, the technical evaluation will need to assign an allocation to the pollutants and users covered by the BMP. A series of BMP mini-case studies is presented in Appendix W.

EPA suggests the following resources in POTW development of BMPs:

- Pollution Prevention Information Clearinghouse Resource List: This comprehensive Web site has sector-specific guidelines on pollution prevention. http://www.epa.gov/opptintr/library/ppicdist.htm

- *Guides to Pollution Prevention: Municipal Pretreatment Program*, (EPA 625/R-93/006 October 1993)

- *Guidance Manual for Developing Best Management Practices*, (EPA 833/B-93/004 October 1993)

- *Pollution Prevention (P2) Guidance Manual for the Pesticide Formulating, Packaging, and Repackaging Industry: Implementing the P2 Alternative*, (EPA 821-B-98-017 June 1998)

- The Massachusetts Water Resources Authority (MWRA) currently prohibits the discharge of mercury by industrial facilities to its sewer system. Additionally, MWRA imposes an effective discharge limitation for mercury of 1.0 part per billion (ppb) from its regulated sources, including hospitals and institutions. To address this complex issue, the MWRA established a Mercury Products Work Group to examine the problem and develop strategies to reduce the amount of mercury being discharged. Read about this effort at: http://www.masco.org/mercury/index.htm.

6.7 APPROVAL AUTHORITY AND ADOPTION PROCESS

A Control Authority's legal authority to impose local limits on industrial and commercial users derives from State law. Therefore, State law must confer the minimum Federal legal authority on a Control Authority. Where deficient, State law must be modified to grant the minimum requirements. In order to apply regulatory authority provided by State law, the Control Authority generally must establish local regulations to legally implement and enforce pretreatment requirements. If the Control Authority is a municipality, legal authority is detailed in a Sewer Use Ordinance (SUO),[2] which is usually part of a city or county code. Regional Control Authorities frequently adopt similar provisions in the form of "rules and regulations." Likewise, State agencies implementing a State-wide program under 40 CFR 403.10(e) set out pretreatment requirements as State regulations, rather than as a SUO. However, local regulations cannot give the Control Authority greater authority than that provided by State law.

Establishing or revising local limits is considered to be a modification of the POTW's pretreatment program. Therefore, the new or changed local limits must be submitted to the Approval Authority for its review and approval. The POTW must submit a notice to the Approval Authority that states the basis for the modification and must provide a modified program description and other documentation requested by the Approval Authority. After a modification is approved by the Approval Authority, it will be incorporated into the POTW's NPDES permit [40 CFR 403.18(e) and 40 CFR122.62].

In most instances, the initial adoption of a MAIL or BMP will be a substantial modification where it replaces a different form of local limits. Unless the mass-based limit or BMP is specifically tied to an existing concentration limit, the switch to mass-based limits or to BMPs will likely result in less stringent local limits for at least some group of industrial users. As specified at 40 CFR 403.18(b)(2), making a local limit less stringent is considered a substantial modification of a POTW's pretreatment program. Not only is the relaxation of a uniform concentration limit considered a substantial modification, but if a POTW calculates a less stringent concentration limit, the MAHL or MAIL also becomes less stringent. If this is the case, the Approval Authority may be required to process any new local limits as a substantial modification as well. For substantial modifications, the Approval Authority must issue a public notice of the request for approval and must provide an opportunity for interested parties to comment or request a public hearing. After deciding whether to approve the modification, the Approval Authority must issue a public notice of approval or disapproval, unless certain conditions are met [40 CFR 403.18(c)(3)].

Non-substantial modifications may be implemented after 45 days, unless the Approval Authority notifies the POTW that a modification is disapproved or determines that the modification is substantial (e.g., would result in an increase in pollutant loadings at the POTW) [40 CFR 403.18(d)]. To be approved by the Approval Authority, local limits must first be made legally enforceable by the POTW. This is generally done by incorporating them in the local SUO by following local public noticing procedures. The SUO need not contain local limits already allocated to industries. However, at a minimum, the SUO should authorize the POTW to establish individual limits through the permits based on the MAIL.

The activities described above are regulatory requirements that must be met by all Approval Authorities and POTWs. Approval Authorities may have different procedures for implementing these requirements, and POTWs should check with their Approval Authority for details. In general, however, the approval and adoption process includes the following steps:

[2] Consult *Model Pretreatment Ordinance, (EPA 833-B-92-003, June 1992)* for recommended formats for a Sewer Use Ordinance.

(1) The POTW develops or recalculates draft local limits.

(2) The POTW submits the draft new or revised local limits and supporting documentation to the Approval Authority for review,[3] makes the proposed new or revised limits available to the public for comment, and provides individual notice to the affected parties.

(3) The Approval Authority notifies the POTW of the adequacy of its submission. The submission may be:

- **Not accepted**. The Approval Authority provides comments to the POTW, the POTW addresses the issues raised in the comments and repeats Step 2.

- **Accepted**. The Approval Authority notifies the POTW that its proposed limits have been accepted.

(4) Once accepted by the Approval Authority, the POTW adopts the new or revised limits, which also are adopted by all the contributing jurisdictions (i.e., all municipalities in the service area). Note that the public must be given the opportunity to review and comment according State and local law (see Section 6.8 for a discussion on public participation).

(5) Once approved and adopted by the control authority (and thereby enforceable), the proposed changes to local limits become a formal pretreatment program modification and need to be publicly noticed and approved (as noted in the above discussion of regulatory requirements) by the Approval Authority. (The specific procedures for review and final approval may vary among Approval Authorities. POTWs should check with their Approval Authority.)

6.8 PUBLIC PARTICIPATION

Section 101(e) of the CWA establishes public participation as one of the goals in the development, revision, and enforcement of any regulation, standard, effluent limitation, plan, or program established by EPA or any State. The General Pretreatment Regulations encourage public participation by requiring public notices or hearings for program approval, removal credits, program modifications, local limits development and modifications, and IUs in significant non-compliance.

POTW pretreatment program approval requests require the Approval Authority (a State or EPA) to publish a notice (including a notice for a public hearing) in a newspaper of general circulation within the jurisdiction served by the POTW. All comments regarding the request as well as any request for a public hearing must be filed with the Approval Authority within the specified comment period, which generally lasts 30 days. The Approval Authority is required to account for all comments received when deciding to

[3] Although not required, POTWs are encouraged to submit draft local limits to their Approval Authority for review prior to formal submission. This step can be helpful in identifying revisions necessary to make limits approvable and can save the POTW (and any contributing jurisdictions) from having to re-adopt revised limits after addressing Approval Authority comments.

approve or deny the submission. The decision is then provided to the POTW and other interested parties, and published in the newspaper. All comments received are made available to the public for inspection and copying.

Once a local pretreatment program is approved, the Control Authority (usually the POTW) must implement that program as approved. Before there is a significant change in the operation of a POTW pretreatment program, a program modification must be initiated. For a substantial program modification, such as the development of new or less stringent local limits, the Control Authority is required to notify the Approval Authority of the desire to modify its program and the basis for the change. Approval Authorities (or POTWs) also are required to issue public notice of the request for a modification, but are not required to issue public notice of the decision if no comments are received and the request is approved without changes. These changes become effective upon approval by the Approval Authority.

Exhibit 6-3: Local Limits Documentation

Among the items a POTW should keep to document its local limits development process are:

- All data used for determining pollutants of concern and performing calculations.
- Rationale for choosing pollutants of concern.
- Record of calculations (formulas used) and related assumptions.
- Printouts from any spreadsheets or computer programs used.
- Rationale for choosing local limits (comparison of maximum allowable headworks loadings for all applicable criteria, allocation methods and calculations).
- Reasons for not setting limits for particular pollutants or deleting any existing limits.

Federal regulations also require POTWs to notify affected persons and groups and give them an opportunity to respond before final promulgation of a local limit [40 CFR 403.5(c)(3)]. While the regulations do not specify the exact public notice process that a POTW should follow, EPA recommends that the POTW conduct public participation in the local limits process as openly as possible. This process would include notifying affected users and other parties that the POTW knows are interested that the POTW is beginning a detailed reevaluation of its local limits. When new limits are drafted, EPA recommends notifying the IUs and other interested parties, individually, of the proposed limits and announce a public comment period in the local newspaper. This public comment period can be open while the proposed limits are submitted to the Approval Authority for initial review, or the POTW can wait until it receives comments from the Approval Authority. In EPA's view, POTWs should allow sufficient time in their limits development process to provide for public participation. A POTW that plans to establish individual limits through the permits issued to users also should provide for public comments in the permit issuance process. During the comment period, the public may present technical challenges to the rationale for a particular local limit. To be adequately prepared to address such challenges, the POTW needs to thoroughly document its local limits development process. Similar issues need to be addressed during the re-evaluation process as well (see Exhibit 6-3).

6.9 CONTROL MECHANISMS

POTWs have discretion in selecting the control mechanism through which they will apply local limits to IUs and thereby making them enforceable. Examples of control mechanisms may include a SUO, individual permits, and orders. A POTW's choice of control mechanism may depend on the type of user (SIU or non-SIU) and on the method the POTW uses to allocate its MAHLs among its IUs. A POTW should consider the following:

- An SUO alone may not be adequate with any allocation method other than the uniform concentration method.

- The POTW does not need to allocate its local limits in an SUO. It may instead include MAILs in the SUO, then allocate the loadings in individual control mechanisms. Again, care must be taken to ensure that the sum of each pollutant allocation does not exceed the MAIL.

- Limits based on the contributory flow method may result in over-allocation of the MAIL when uniform concentration values are specified in the SUO for "background concentrations" for SIUs that do not discharge the pollutant. POTWs should ensure that the implementation of the allocation scheme into a control mechanism does not result in an over-allocation of the MAIL.

- An individual control mechanism (such as a permit) is necessary for most POTW-IU relationships. Even if one uniform set of local limits were applicable for all IUs, an individual control mechanism may be desirable to specify monitoring locations and frequency, special conditions such as solvent management or spill prevention plans, applicable categorical standards, and reporting requirements, and to provide clear notification to IUs (as required by 40 CFR 403.8). Note that 40 CFR 403.8(f)(1)(iii) requires a POTW to control the contribution of SIUs through individual control mechanisms (e.g., permits). The development of IU permits is discussed in detail in EPA's *Industrial User Permitting Guidance Manual* (EPA, 1989a).

6.10 SUMMARY

After reviewing Chapter 6, POTWs should understand how to:

- Determine the need for new local limits after establishing MAHLs.

- Calculate MAILs.

- Compare MAIL allocation and implementation methods.

- Allocate MAILs to controlled dischargers.

- Perform a common sense assessment of local limits.

- Use best management practices.

- Provide public participation.

- Gain Approval Authority approval.

- Select the appropriate control mechanism to apply local limits.

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CHAPTER 7- LOCAL LIMITS REVIEWS AND DETAILED RE-EVALUATIONS

According to 40 CFR 122.44(j)(2)(ii), POTWs must "provide a written technical evaluation of the need to revise local limits under 40 CFR 403.5(c)(1), following permit issuance or reissuance." EPA recommends that a periodic evaluation of local limits be tied to the permit cycle and that more detailed evaluations be conducted on an "as needed" basis. Chapter 7 provides guidance on two means to meet this requirement – local limits reviews and detailed re-evaluations –depending on the conditions at the POTW. Reviews compare current headworks loadings with the maximum allowable headworks loading (MAHL) and examine any recent violations. When plant conditions have changed, EPA suggests a detailed re-evaluation be conducted that includes an in-depth look at all the data, criteria, and assumptions on which local limits are based to determine whether any changes affecting the local limits have occurred.

7.1 REVIEWS

For POTWs with past performance problems (pass through, interferences, or collection system issues), EPA suggests performing reviews annually as part of its preparation of the Annual Pretreatment Report. Reviews are intended as a quick check for any obvious signs that local limits may not be adequately protective of its treatment works, its workers, and the environment. This review will help ensure that any changes made during the previous year have not weakened the local limits' effectiveness in protecting the POTW from pass through and interference. Presented below is a suggested methodology for performing reviews.

7.1.1 COMPARISON OF CURRENT LOADINGS WITH MAHLS

During a local limits review, EPA recommends that a POTW identify its maximum daily and maximum monthly average headworks loadings during the previous year for each pollutant of concern (POC) for which it calculated a MAHL—regardless of whether a local limit for each POC was adopted. Similar to the calculations made to determine the need for local limits in Section 6.1, comparisons of the MAHL to the headworks loadings will determine if local limits need to be recalculated, or established for additional POCs. The comparisons also may indicate if there is a need for an investigation into the cause of increased loadings, possibly due to noncompliant industrial users (IUs).

As previously explained, dividing the headworks loading of all POCs by their respective MAHL will yield a "percentage of MAHL" represented by the POC headworks loading (see Equation 6.1). If a POC headworks loading is a high percentage of the MAHL, the POTW may choose to revise the local limit for that pollutant or develop a local limit for it if none exists. For example, a POTW may decide to develop a local limit for any pollutant whose headworks loading is above a "threshold value" of 50 percent of the MAHL. EPA recommends maximum threshold values of 60 percent for metals and toxic organics and 80 percent for non-toxic organics, and conventional pollutants. However, in most circumstances, a POTW will use threshold values that are consistent with the criteria it used to determine if a local limit was needed for a POC. EPA offers the following guidance on this comparison between MAHLs and POCs for which local limits were not established:

1. **If the current POC headworks loading exceeds the MAHL**, EPA recommends that the POTW establish a local limit for the pollutant, investigate the cause of elevated loading, increase its IU monitoring, identify any noncomplying industries, and consider undertaking pollution prevention efforts.

2. **If the current POC headworks loading exceeds the established threshold value for the first time (i.e., the loading was below the threshold value during the year before)**, EPA recommends the POTW increase monitoring for the POC, or establish a local limit for it.

3. **If the current POC headworks loading exceeds the established threshold value for the second time,** EPA recommends establishing a local limit and increasing POC monitoring.

4. **If the current loading is below the established threshold,** EPA recommends that the POTW review the pollutant's loading as part of its preparation of next year's annual report.

Similarly, EPA recommends that the POTW prepare to address situations involving POCs for which local limits have already been established in the follow circumstances:

- **If the current POC loading exceeds the MAHL,** EPA recommends revising the local limit (unless an investigation reveals that the elevated loading is due to an unusual, one-time event), investigating the cause of the high loading, identifying any noncomplying industries, increasing monitoring of IUs, and considering adopting pollution prevention efforts.

- **If the current POC loading has increased significantly from the previous year (e.g., from 55 percent to 75 percent of the MAHL)**, EPA recommends that the POTW investigate the cause of the increased loading, increase its monitoring for the POC, or revise the local limit.

- **If the current POC loading is below the established threshold,** EPA recommends that the POTW review the POC's loading when it prepares next year's report.

As part of its investigation into the cause of an elevated loading, the POTW will investigate whether the loading is an aberration. If the high loading resulted from an unusual, or one-time, occurrence, the POTW may not need to establish or recalculate the local limit for the POC. For example, if the POC load increased as a result of an IU oil spill, the POTW may better address the situation by ensuring that the IU properly implements a spill control plan, rather than by setting or revising a local limit. In addition, the POTW should also look at whether any sampling or analytical problems caused the aberration.

When the current loading of one or more POCs approaches the MAHL, the POTW can respond in several ways. It can compare current IU loadings with the MAILs. If the comparison shows that the increased loadings come from domestic or commercial sources, the POTW can educate these sources about pollution prevention, or it can impose local limits on the commercial sources rather than change the IU local limits. If the IU loadings exceed the MAILs, one or more IU may be violating local limits. Such violations should be found during the POTW's regular review of IU monitoring data. Another response is to review the data used to set the local limits in the first place. If changing conditions have affected the removal efficiencies, flow rate, or other criteria on which the MAHLs were based, the POTW should recalculate the MAHLs.

7.1.2 Review of Compliance History

If a review is performed, the POTW will also want to consider its compliance record over the previous year to determine whether the local limits it has set provide sufficient protection from pass through and interference. If the POTW has violated its NPDES permit or sludge disposal standards, has caused or contributed to violations of water quality standards in its receiving waters, or has experienced interference of its treatment processes, the POTW's local limits may not be adequately protective. Unless it has identified as the cause of the violation a specific, unusual incident that is unlikely to recur, the POTW is required to investigate the violation's cause and take appropriate enforcement action against any noncomplying IUs. Alternatively, the POTW may revise the local limit, or establish a local limit if none exists for the pollutants that caused the violations.

7.1.3 Next Steps

POTWs that find further action is necessary after conducting reviews outlined above can turn to the earlier chapters of this document for guidance on ensuring that local limits remain protective. Chapter 4 has information about sampling issues; Chapter 5 covers the calculation or recalculation of MAHLs; and Chapter 6 discusses the reallocation of existing MAHLs and other implementation issues, such as control mechanisms and revisions to the POTW's sewer use ordinance.

7.2 Detailed Local Limits Re-Evaluation

Periodically, POTWs need to re-evaluate their local limits to ensure that they remain protective, or to determine whether they should be revised, reallocated, or developed for additional pollutants (see Exhibit 7-1). As discussed above, POTWs may wish to review their local limits when preparing their annual Pretreatment Program Reports. However, the annual review may not have addressed conditions that can change over time and undermine the effectiveness of local limits. When a POTW needs to address changes in its operating conditions or environmental criteria, the data or assumptions used to establish local limits in the first place may no longer be appropriate (see Exhibit 7-2).

> **Exhibit 7-1: Why Local Limits Should Be Re-evaluated**
>
> Conditions change over time, and these changes may make it necessary to revise some or all of a POTW's local limits. Periodic re-evaluation of local limits will help the POTW ensure that the limits are effective in protecting the treatment works, its workers, the local collection system, and the environment from the effects of interference and pass through.

As these and other changes occur, the POTW will need periodically to undertake a more detailed re-evaluation of its local limits. In addition, if a POTW violates its NPDES permit or sludge requirements, but all of its regulated sources have been maintaining compliance, the POTW will need to evaluate the adequacy of its local limits to protect the treatment works, its workers, and the environment.

POTWs can avoid having to re-evaluate local limits for some of the events described in Exhibit 7-2 if adequate growth allowances (covered in Section 6.2.4) were used during local limits development. In addition, if IU's have stopped discharging a pollutant, or reduced their discharge of a pollutant, POTWs should place the load formerly contributed by those IUs into a reserve account to accommodate future growth. If local limits are developed with flexibility, POTWs can respond to changes in IU loadings without a complete recalculation and approval of their local limits.

The detailed re-evaluation of local limits is a four-step process:

1. Assess current conditions to determine whether existing MAHLs should be recalculated or reallocated, or additional local limits should be developed. Also determine which pollutants need to be further evaluated and for which criteria. (If only re-allocation of existing MAHLs is needed, skip to step 4.)

2. Based on the pollutants and criteria identified in step 1, determine whether existing data are sufficient. If not, develop and implement a local limits sampling plan, then analyze the data collected.

3. Recalculate the MAHLs of pollutants for which local limits have been developed, and determine MAHLs for new pollutants.

4. Implement the local limits. This step may include the reallocation of existing MAILs, if required.

Exhibit 7-2: When to Recalculate or Develop Local Limits

A POTW that answers "yes" to any of these questions should re-evaluate its local limits:

- Has the treatment plant been modified, or has a new treatment plant been brought on line?
- Have the treatment plant processes or operation changed in a way that affected the removal efficiencies?
- Has the flow to the treatment plant changed significantly?
- Is the POTW subject to new or revised NPDES limits?
- Have the State water quality standards changed for the receiving water?
- Has the POTW changed, or intend to change, its sludge disposal method? If yes, will this change affect the sludge quality standards that the POTW must meet?
- Have loadings been affected by new IUs discharging to the POTW?
- Have loadings been affected by IUs that have stopped discharging to the POTW?
- Have loadings been affected by changes in discharges from current IUs?
- Are new data available about the POTW or the IUs that invalidate assumptions made during the last local limits development effort?

The following sections describe these four steps in more detail.

7.2.1 Step 1: Assess Current Conditions

To determine whether MAHLs should be recalculated, MAILs reallocated, or additional local limits developed, the POTW first will need to compare its current conditions and requirements with those that existed when the local limits were last developed. In this process, EPA suggests that the POTW also evaluate whether a new MAHL is required for a POC, or if the previously determined MAHL remains valid, but needs to be reallocated. To determine which response is appropriate, the POTW will want to consider the change that led it to re-evaluate its local limits in detail.

Usually, a POTW will undertake a detailed re-evaluation of its local limits in response to one or more significant changes at the treatment works or in the discharges it receives. Recalculating existing MAHLs or determining MAHLs for new POCs is generally an appropriate response to changes in:

- Removal efficiencies
- Total POTW or IU loading
- Limiting criteria (NPDES permits, water quality standards, sludge criteria)
- Sludge characteristics or method of disposal (e.g., percent solids, disposal site life)
- Background concentrations of pollutants in receiving water

Simply reallocating existing MAHLs may be appropriate when:

- Some IUs need a larger loading allocation and other IUs are not using all of their allocations.

- Total POTW flow is unchanged, but the amount of uncontrollable loading relative to the IU loading has changed.

- Total POTW flow has not changed but new IUs have come on line while existing IUs have stopped discharging.

In these cases the current MAHLs are usually still appropriate, and the POTW can **skip to step 4.**

Some Approval Authorities have worksheets that POTWs can use to determine whether existing local limits need to be recalculated. The worksheets help POTWs compare existing local limits and the data on which they are based with current conditions and applicable environmental and treatment plant criteria. They consider such parameters as POTW and SIU flows; sludge disposal method and associated disposal criteria; occurrence of violations, upsets, and interference; current influent and effluent loadings; water quality criteria; and NPDES permits. A copy of one of these worksheets and instructions for its use can be found in Appendix X.

On occasion, a relaxation of local limits may be appropriate. However, in EPA's view, the POTW first should demonstrate that the revised local limits will satisfy all of the minimum Federal and State requirements and will adequately protect in-stream water quality and sludge quality. If its analysis shows that local limits can be relaxed, the POTW would next determine whether their relaxation will result in new or increased IU discharges that will affect the volume or character of POTW influent or effluent. Relaxation of local limits would likely result in a major modification that must be approved by the Approval Authority in accordance with 40 CFR 403.18(b)(2).

7.2.2 STEP 2: COLLECT AND ANALYZE DATA

Properly re-evaluating local limits requires representative sampling data. If sufficient data are not available, the POTW obviously will want to develop and implement a sampling plan to provide additional data on relevant POCs. The availability of accurate site-specific data is critical to the development of sound, technically based local limits. Local limits developed using data from the literature are often conservative.

The data necessary to calculate a MAHL for a new POC may not be available if that pollutant was not part of the POTW's local limits monitoring. Similarly, data collected to support development of a current MAHL may not be valid for recalculating the MAHL if the data were collected before any changes occurred. For example, upgrading a treatment unit may increase removal efficiencies beyond the levels when the POTW conducted most of the sampling for local limits. Consequently, the POTW may need to collect new samples to obtain sufficient data that represent current conditions in order to support the MAHL's recalculation. Chapter 4 covers the data needed to develop local limits.

7.2.3 Step 3: Recalculate Existing, or Determine New, MAHLs

If the results of the analyses conducted in Steps 1 and 2 warrant, the POTW will next recalculate existing MAHLs or determine MAHLs for new POCs. Chapter 5 of this guidance covers MAHL calculations. The POTW will want to ensure that current data are used for all the variables in the equations for calculating MAHLs.

7.2.4 Step 4: Implement the Local Limits

The evaluation conducted in Step 1 may indicate that the MAHL for a POC need not be recalculated, but rather should be reallocated among the sources of pollutant loadings (IUs, domestic and commercial sources, hauled waste, and any reserve for future growth). In such cases, the POTW will go directly from step 1 to this step.

Implementing local limits may involve:

- Allocating or reallocating MAHLs (between the group of IUs and uncontrollable sources, as well as to individual non-domestic sources).
- Public participation.
- Approval of revised local limits considered either a "non-substantial" or "substantial" modification as defined in 40 CFR 403.18(b).
- Adoption of local limits and revision of the SUO.
- Revisions of control mechanisms or IU permits.

Implementing new and revised local limits is covered in Chapter 6 of this guidance. Although most of the information presented in Chapter 6 applies to both new and revised local limits, the POTW may have to take additional considerations into account when implementing revised local limits. For example, the POTW may want to use the same allocation method it used previously but may have a different number of IUs to consider. Or the POTW may want to use a new allocation method (see Exhibit 7-3). In addition, the POTW does not have to use the same allocation method for every POC, but it should document which method is used for which pollutant and why. If a POTW wants to change its allocation method, it should consider how the change may affect its existing users. If some IUs become subject to more stringent limits, they may need to install pretreatment equipment to remain in compliance with local limits.

Exhibit 7-3: An Example of Changing the Method for Allocating Local Limits

Using the uniform allocation method, a POTW gave all of its IUs the same local limit for cadmium through its sewer use ordinance. Since then, an IU changed its operating process and now generates a significant amount of cadmium. If the POTW reallocates cadmium using the same method, the IU may be subject to a local limit that will be difficult for it to meet.

The POTW can change its local limits implementation method by including the MAILs for cadmium in its SUO and allocating cadmium loadings to IUs through individual permits. The new allocations would be based on how much loading each IU discharger needs. In this way, the POTW can provide the IU that changed its operating process with a cadmium allocation sufficient for its needs. This would be considered a "substantial" modification as defined in 40 CFR 403.18(b).

7.3 SUMMARY

Chapter 7 provides the tools for POTWs to evaluate the circumstances that would lead it to conduct a review or re-evaluation of the local limits program.

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CHAPTER 8- LOCAL LIMITS TO ADDRESS CONCERNS ABOUT COLLECTION SYSTEMS

POTWs may need to develop local limits to address concerns about their collection systems and meet the requirements found at 40 CFR 403.5(b), which include protecting the health and safety of workers at the POTW. Chapter 8 describes methods to address the following collection system concerns:

- Fires and explosions [40 CFR 403.5(b)(1)]
- Corrosion [40 CFR 403.5(b)(2)]
- Flow obstructions [40 CFR 403.5(b)(3)]
- Temperature [40 CFR 403.5(b)(5)]
- Toxic gases, vapors, or fumes [40 CFR 403.5(b)(7)]

POTWs should address each of these potential problems through their local limits development and re-evaluation processes.

8.1 FIRES AND EXPLOSIONS

The General Pretreatment Regulations prohibit the discharge of pollutants that will create a fire or explosion hazard in the POTW. This prohibition includes wastestreams shown to have a closed cup flashpoint of less than 140 degrees Fahrenheit (60 degrees Celsius) using the test methods specified at 40 CFR 261.21. This provision is intended to protect POTW workers and the POTW collection system. To comply, a POTW can establish a local limit equal to the flashpoint provision, or opt to develop other protection methods. The flashpoint provision and three common alternatives are described below.

8.1.1 FLASHPOINT LIMIT

The flashpoint is the lowest temperature at which vapor combustion will propagate away from its source of ignition. At temperatures below the flashpoint, vapor combustion immediately above the liquid either will not occur, or will occur only at the exact point of ignition. Temperatures above the flashpoint are required for combustion to spread. **If a POTW prohibits discharges, typically volatile organic compounds, that have a closed cup flashpoint of less than 140°F, it will protect against fires and explosions**. (A flashpoint limit applies to the entire wastestream, not to a specific pollutant.)

A flashpoint limit ensures that discharges to a POTW will not combust. It is important to note that a flashpoint prohibition does not necessarily account for the flammability of mixtures from more than one discharger. Dilution effects in sewer systems, however, generally prevent the creation of explosive conditions.

The closed cup is used because this test simulates the confinement of vapors in a sewer. EPA requires a flashpoint of less than 140°F [see 40 CFR 403.5(b)]for several reasons:

- Ambient temperatures in a sewer are not expected to exceed 140°F.

- Typical industrial discharges of wastewater are cooler than 140°F.

- The specified flashpoint is consistent with hazardous waste regulations, which will help ensure that POTWs do not face increased hazardous waste liabilities.

Regulations require that the flashpoint be determined by a Pensky-Martens Closed-Cup Tester, using the test method specified in ASTM Standard D-93-79 or D-93-80, or by a Setaflash Closed-Cup Tester, using the test method specified in ASTM Standard D-3278-78, or as determined by an equivalent test method approved by the EPA Administrator under specified procedures. Appendix H lists closed cup flashpoints for select organic compounds.

8.1.2 Lower Explosive Limit Monitoring

Another way to protect POTW workers is to monitor the collection system for combustible gases. A combustible gas detector measures the concentration of these gases and vapors in the air as a percentage of the lower explosive limit (LEL). The LEL is the minimum concentration in air at which a gas or vapor will explode or burn in the presence of an ignition source.

LEL monitoring measures pollutant concentrations in the headspace above the wastewater, rather than in the wastewater itself. This method makes setting local limits difficult. Consequently, POTWs often use LEL monitoring to identify potentially problematic discharges, rather than as a numerical limitation to implement and enforce against IUs. LEL monitoring is also an important way to protect POTW workers who enter the collection system.

One approach to monitoring explosion potential is to measure LEL levels at key locations in the collection system. Continuous monitoring at pump stations or key manholes can provide a constant source of data on the potential for an explosion. **Many POTWs establish a percentage of the LEL, often 10 to 30 percent, as the level of concern.** This ensures that discharges are safely below an explosive level. The entire LEL should not be used to establish the level of concern.

8.1.3 Sample Headspace Monitoring

Sample headspace monitoring is a discharge screening technique to detect the presence of explosive compounds and toxic gases and vapors. Initial screening using this method can identify discharges that warrant detailed chemical-specific screening.

Sample headspace monitoring involves collecting a wastewater sample using proper volatile organic sampling techniques (i.e., zero headspace), withdrawing a set percentage of the sample, injecting nitrogen gas into the sample container (to maintain a total pressure of one atmosphere), and performing a gas chromatography analysis of the sample headspace gas.

Volatile organic concentrations of the sample headspace gas are converted to an equivalent concentration of hexane and compared to a set hexane limit (usually 300 parts per million of hexane). Concentrations below the limit are usually deemed sufficient to protect the collection system from fires and explosions and to provide minimal protection from toxic gases and vapors. Details of this method are available in *Guidance to Protect POTW Workers from Toxic and Reactive Gases and Vapors* (EPA/812-B-92-001).

8.1.4 FLAMMABILITY AND EXPLOSIVITY DISCHARGE SCREENING LEVELS

Discharge screening levels can be used to set local limits on the discharge of pollutants that can create flammable or explosive conditions in sewers. This approach requires converting the LELs of individual compounds into corresponding IU discharge screening levels. These levels are then compared with actual IU discharge concentrations. Appendix I contains a table of discharge screening levels based on explosivity. A variety of screening levels have been developed for limiting flammable and explosive discharges, including the four-step approach summarized here:

1. Identify the LEL for each POC.

2. Use the following equation to convert the compound's LEL concentration to a vapor phase concentration (C_{VAP}) expressed as moles per cubic meter (mol/m^3). (Ten percent of the LEL often is used in this equation, instead of the full LEL.)

   $$C_{VAP} = LEL \times P/RT \times 1000 = LEL \times 40.87 \text{ (at 1 atm and 25°C)}$$

   Where:
   P = total pressure, 1 atmosphere (assumed)
   R = ideal gas constant, 0.08206 atm L/mol °K
   T = absolute temperature, 298.15°K (equal to 25°C) (assumed)

3. Determine the Henry's Law Constant (H) for the POC. This constant converts LEL air phase values to corresponding water phase discharge levels. Note that H is presented in a variety of units [e.g., (atm m^3)/(mol), (mol/m^3)/(mg/L), and (mg/m^3)/(mg/L)] and may require converting H into the appropriate units of (mol/m^3)/(mg/L). Appendix I contains a listing of Henry's Law constants in various units and provides the appropriate conversions.

4. Calculate the IU discharge screening level (C_{LVL}) using the Henry's Law expression:

   $$C_{LVL} = C_{VAP}/H$$

   Where C_{LVL} is the discharge screening level in mg/L.

Screening levels derived by this method should be compared directly with the actual IU discharge concentrations. Some of the assumptions made using this method are:

- Although temperature dependent, H typically is reported at 25°C (77°F), which is a reasonable estimated temperature of discharges to POTWs. Warmer wastewaters will exhibit higher concentrations in the vapor phase, while cooler wastewaters will exhibit more of the pollutant in the liquid phase.

- The pollutant instantly volatizes to the sewer atmosphere. Although this is a conservative assumption, the more turbulence in the sewer, the closer the assumption is to actual conditions. In addition, air flow through the sewers prevents the reaching of equilibrium, thereby acting to reduce concentrations below threshold levels in the vapor phase.

- The equation does not take into account the solubility effects that result from organic contaminants in the wastewater, thereby limiting volatilization into the atmosphere.

For details of this method, see *Guidance to Protect POTW Workers from Toxic and Reactive Gases and Vapors (EPA 812-B-92-001)*.

8.2 CORROSION

The General Pretreatment Regulations prohibit discharges of pollutants that will cause corrosive structural damage to a POTW. The regulations also prohibit discharges with a pH lower than 5.0 unless the POTW is specifically designed to accommodate such discharges.

8.2.1 PH

Besides the low-end pH limit specified in the General Pretreatment Regulations, EPA recommends POTWs evaluate the need to set upper pH limits or more stringent low-end pH limits. A POTW should set an upper pH limit if corrosion damage attributable to high-pH discharges is identified. An upper limit pH of up to 12.5 may be an appropriate upper limit in lieu of any identified high pH corrosion concerns. However, because wastewater of pH 12.5 or higher is considered a hazardous waste (exhibiting the characteristic of corrosivity) under 40 CFR 261.22(a)(1), additional reporting and liability results when hazardous waste is discharged to a sanitary sewer. The POTW needs to set an upper pH limit that is protective of the POTW, but also allows for some margin of safety to avoid characterization as hazardous waste.

EPA acknowledges that there are advantages to accepting high pH industrial wastewater. These include:

- Reducing odor emissions from the collection system and plant processes due to a reduction in the amount of aqueous hydrogen sulfide.

- Aiding the nitrification process (which often requires an external source of alkalinity).

- Improving precipitation and removal of toxic heavy metals by primary clarification.

- Limiting IU use of acids to neutralize high pH effluent and thus minimizing chloride and sulfate ions detrimental to POTW operation.

8.2.2 CORROSIVE POLLUTANTS

In addition to discharges whose pH is high or low, the following pollutants can contribute to the corrosive properties of wastewater:

- **Sulfide and sulfate**. Much of the sulfide in collection systems is present as hydrogen sulfide due to the anaerobic degradation of sulfate. This degradation occurs where oxygen is absent and organic matter is present. Collection systems are particularly conducive to this reaction if wastewater is allowed to stagnate. The formation of hydrogen sulfide is primarily a function of the collection system's design, however, and not a function of the characteristics of industrial discharges. Hydrogen sulfide corrodes metals such as iron, copper, lead, and zinc. It is also a precursor to sulfuric acid, which corrodes concrete and metals. Sulfate causes corrosion by reacting with the calcium in concrete to form calcium sulfate, which can cause concrete to crack. For more information, see *Detection, Control, and Correction of Hydrogen Sulfide Corrosion in Existing Wastewater System*, (EPA-832-R92-001, September 1992).

- **Chloride**. This pollutant can adversely affect inorganic films and precipitates that form on sewer wall and provide a physical barrier that protects from chemical corrosion. Not only can chloride decay and penetrate these coatings, it can also prevent them from developing by forming more soluble metal chloride instead.

- **Chlorine**. By reacting to form hydrochloric (HCl) and hypochlorous (HOCl) acids that decrease the pH of wastewater, chlorine can increase the rate at which iron and steel corrode.

- **Nitrate and nitrite**. They can contribute to iron and steel corrosion.

- **Dissolved salts**. The electrolytic action of dissolved salts on the base material can corrode concrete, asbestos-cement, and cement mortar.

- **Suspended solids**. The abrasive and erosive contact of suspended solids with sewer pipes and pumps can cause corrosion, particularly at joints, elbows, bends, and other non-uniform areas.

- **Organic compounds**. If present in excessive concentrations, organic compounds such as solvents will promote the dissolution of gaskets and rubber and plastic linings.

8.3 FLOW OBSTRUCTIONS

The discharge of solid or viscous pollutants in amounts that will obstruct flows to POTWs and result in interference is prohibited by the General Pretreatment Regulations. *The greatest threat of obstruction in POTWs comes from polar fats, oils, and greases (FOG) of animal and vegetable origin*. Typical sources include restaurants, residences, food processors, and food-based industries. Certain polar FOGs, such as non-ionic surfactants, do not contribute to flow obstruction. Additional discussions on the potential for interference and pass through due to FOG are provided in Section 5.3.3.

Although more compatible with wastewater treatment operations than non-polar mineral oil or petroleum-based oil and grease, polar FOG can accumulate and congeal in collection systems, pumping stations, and treatment plants. By obstructing influent flows, polar FOG reduces the capacity of pipes and pumps, interferes with POTW instruments (such as flow meters and probes), reduces treatment efficiency, and increases POTW operation and maintenance costs. Polar FOG can interfere with the

POTW's collection system through blockages when the wastewater cools sufficiently to allow the suspended fat, oil, or grease to congeal. This condition is a function primarily of interceptor size, length, and slope; ambient temperature; wastewater temperature; and concentration of FOG. These factors vary throughout the collection system. To develop a technically based FOG limit for protecting the collection system, empirical data (observations and measurements) are needed to document problems and contributing factors. The empirical data along with generally available pretreatment and control measures for FOG become the technical basis for the proposed local limit.

To collect data, the POTW first identifies collection system sections that have a critical low slope (i.e., relatively flat) profile and may be subject to low temperatures. Data are collected that identify FOG levels corresponding to deposition rates of solidified oil and grease. The level of oil and grease at which deposition is negligible would be the basis for the collection system MAHL.

Local limits on FOG may require POTWs to investigate and monitor the activities of non-SIUs that are the sources of FOG. The use of controls other than numerical limitations may be a more appropriate way to address the problem of FOG from non-SIUs. These controls can include:

- Requirements to install and maintain grease traps
- Pretreatment requirements
- Best management practices
- Prohibitions of specific materials, such as free-floating FOG
- Prohibitions of FOG that are in a solid or semisolid form
- Surcharge programs
- Cost recovery efforts to defray the expenses associated with cleaning sewers
- Pollution prevention measures

Many POTWs have oil and grease control programs. The Oregon Association of Clean Water Agencies has authored *Fats, Oil, and Grease Best Management Practices Manual: Information, Pollution Prevention, and Compliance Information for Publicly Owned Treatment Plants*. The manual provides municipal pretreatment staff, along with restaurant and fast food business managers and owners, with information about animal and vegetable-based oil and grease pollution prevention techniques focused on their businesses. The techniques are effective in both reducing maintenance costs for business owners, and preventing oil and grease discharges to the sewer system. Go to:
http://www.oracwa.org/Pages/intro.htm to review the manual.

8.4 TEMPERATURE

The General Pretreatment Regulations prohibit heat discharges that will inhibit biological activity in a POTW and result in interference. **And in no case can discharges increase the temperature at the POTW headworks above 40°C (104°F) unless the Approval Authority, upon request of the POTW, approves alternative temperature limits.**

The dilution of heated industrial wastewaters in the collection system typically ensures compliance with this prohibition. Temperature is generally more of a hazard to workers who must enter the sewer system than it is to POTW treatment operations. A POTW that encounters IU discharges hot enough to prevent or restrict sewer entry should require the IU to reduce the temperature of its discharge. The installation of heat exchangers on high-temperature discharges may help the IU save on heating costs for its facility or its process streams.

8.5 TOXIC GASES, VAPORS, AND FUMES

The General Pretreatment Regulations prohibit the discharge of pollutants that lead to the accumulation of toxic gases, vapors, or fumes in the POTW in sufficient quantity to cause acute worker health and safety problems.

Discharge screening levels can be developed to identify IU discharges that have the potential to generate toxic gases or vapors in the sewer. A common approach is to convert gas and vapor toxicity criteria for individual compounds into corresponding IU discharge screening levels using Henry's Law Constants. These constants relate the concentration of a constituent in the air to the corresponding equilibrium concentration in the water. The screening levels should be compared to the actual pollutant concentrations in the IU discharge. Calculating these wastewater screening levels is a three-step process:

- Identify the toxicity criteria, also known as the threshold concentration (C_{VAP}, in mg/m^3), for the POC. Typical threshold values are available from the National Institute for Occupational Safety and Health's (NIOSH's) Recommended Exposure Limits (RELs), the Occupational Safety and Health Administration's (OSHA's) Permissible Exposure Limits (PELs), and the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs). Each organization can provide chronic and acute exposure thresholds that can be used to develop screening levels. See Appendix J for a listing of some of these threshold concentrations. Consistent with the specific prohibitions for toxic gases, vapors, and fumes, screening levels may be based most appropriately on acute worker health and safety levels (i.e., short-term exposure levels or ceiling concentrations).

- Identify the Henry's Law Constant (H) for the POC and convert the constant to the appropriate units of $(mg/m^3)/(mg/L)$. Appendix I contains a listing of Henry's Law constants in various units and the appropriate conversions.

- Calculate the IU discharge screening level (C_{LVL}) from the Henry's Law expression:

$$C_{LVL} = C_{VAP}/H$$

Where:
C_{LVL} = IU discharge screening level (in mg/L)
C_{VAP} = Threshold concentration (in mg/m^3)

As with the flammability and explosivity screening level, this screening method assumes instantaneous volatilization of the pollutants to the atmosphere and does not consider the dilution of IU wastewater in the collection system. Therefore, these screening levels will in many cases be more conservative than necessary to protect POTW workers.

These screening levels address only the toxicities of individual compounds, but mixtures of toxic compounds can be evaluated against an adjusted threshold value of the mixture of all the toxic compounds. Appendix I contains a table of discharge screening levels based on fume toxicity. Details on the specifics of using the discharge screening level method, including evaluating mixtures of toxic gases, vapors, or fumes, is available in EPA's *Guidance to Protect POTW Workers from Toxic and Reactive Gases and Vapors (EPA 812-B-92-001)*.

8.6 SUMMARY

After reviewing Chapter 8, POTWs should be able to address collection system concerns: fire and explosions, corrosion, flow obstructions, temperature, and toxic gas, vapors and fumes.

CHAPTER 9 - QUESTIONS AND ANSWERS

This chapter presents EPA's responses to many commonly asked questions about local limits development and implementation. The questions and answers are grouped by topic for ease of finding subjects of interest.

9.1 GENERAL

Q: Once I establish a local limit, will I ever be able to drop it?

A: *As emphasized throughout this guidance, development of local limits is a continuing, dynamic process. EPA recommends a re-evaluation of specific local limits whenever there are significant changes in the overall program as a step that every prudent Control Authority should do on a regular basis. If changes in IU discharge conditions or installed treatment technologies at the POTW dictate that some pollutants of concern (POCs) are no longer present or are present only in concentrations that will not cause pass through, interference, or degradation of sludge quality, then the local limits for those pollutants may be dropped after appropriate procedures are taken. However, POTWs should be cautioned that dropping a particular local limit completely may motivate IUs to discontinue a treatment process designed to remove or recycle that particular pollutant. POTWs should have a complete understanding of the makeup of untreated IU wastestreams before dropping a local limit completely. The regulations at 40 CFR 403.18(c) specify that eliminating or changing a local limit to make it less stringent requires notification of the Approval Authority and appropriate public notice because such actions are considered substantial program modifications.*

Q: How do multi-jurisdictional systems affect local limit requirements?

A: *For multi-jurisdictional systems in which one Control Authority accepts industrial wastes from one or more other, independent municipalities, EPA strongly recommends that all contributing jurisdictions adopt a set of local limits that are at least as stringent as those of the Control Authority that maintains the collection system and operates the receiving POTW. If this policy is impractical, then the contributing jurisdictions should agree to a maximum total mass loading of pollutants that would be discharged to the primary collection system and POTW. As an alternative, the contributing jurisdiction may adopt two sets of local limits and apply to each IU the limit appropriate to the treatment works to which the user discharges. Consult EPA's* Multijurisdictional Pretreatment Programs Guidance Manual *(EPA 833-B-94-005, June 1994) for additional information.*

Q: Do a minimum number of parameters need to be evaluated?

A: *There is no minimum number of parameters required by regulation. EPA* recommends *that the need for local limits be evaluated for a list of specific pollutants. EPA recommends that technical evaluations for POCs by every POTW should include a determination of the need for* *limits for arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc, and cyanide. This Guidance adds total suspended solids, 5-day biochemical oxygen demand, ammonia, molybdenum and selenium to the list of recommended minimum pollutants to be considered as POCs.*

Q: Do local limits have to be developed individually for multiple treatment works? Is it necessary that identical numeric local limits be established?

A: There is no regulatory requirement that a Control Authority develop local limits that are specific to a single treatment works. However, EPA recommends that the Control Authority perform a separate evaluation for each works to determine if each plant is being protected and not subject to pass through or interference problems. After completing these independent evaluations, the Control Authority can determine whether individual local limits should be provided to the IUs that discharge into the parts of the system served by a particular treatment works. The only regulatory requirement is that there be local limits developed that prevent pass through and interference and are enforceable on a technical basis. The preferred method is to establish MAILs individually for the treatment plants, but if that is politically infeasible, then set a single, conservative local limit (i.e., the lowest limit developed in the assessment for the individual treatment works) for a POC. The limit should then apply to all IUs that discharge to the POTW, without regard as to which works actually treats the wastewater discharged by a particular IU.

Q: Can best management practices (BMPs) and best professional judgment (BPJ) limits be applied in lieu of the traditionally derived numeric local limits?

A: The General Pretreatment Regulations do not specifically address the use of BMPs and BPJ as local limits. The regulations at 40 CFR 403.5 (c) require the POTW only to develop "specific limits" for prohibited discharges. The current regulatory language is ambiguous as to whether BMPs could serve in lieu of numeric limits. BMPs may reduce the amount of the POC at the headworks thus leaving more pollutant loading to be distributed as numerical limits to facilities that cannot control their discharge through BMPs. If adopted, the proposed Pretreatment Streamlining Rule would specify that BMPs could be considered as local limits and also fulfill the statutory requirements of Section 307 (d) of the Clean Water Act. As with BMPs, using BPJ to develop local limits is not specifically prohibited. If adopted following the process in 40 CFR 403.5, BPJs are enforceable.

Q: Can local limits evaluation and development be contracted out?

A: In EPA's view, the optimum process is for the Control Authority to evaluate and develop the appropriate local limits because it provides the Control Authority with a better understanding of limit development and the importance of compliance. However, recognizing the fact that some Control Authorities may be severely constrained by an overextended workforce, or require access to technical expertise that is not internally available, the Control Authority may secure the necessary manpower and expertise through an outside consultant or engineering firm. However, the Control Authority should be aware that any mistakes or improper determinations would be its legal responsibility if the Approval Authority, an IU, or any outside party challenges the POTW on the assignment of the limits.

9.2 POTENTIAL POLLUTANTS OF CONCERN

Q: If a pollutant is below the detection level in influent, effluent, and sludge, may a POTW exclude it as a POC (and not develop a MAHL), even if it is one of EPA's 15 pollutants?

A: Yes, it may. If a POC is not detected in the influent, effluent, or sludge during the POTW 's assessment of the need for local limits, an accurate calculation of the MAHL for that particular pollutant is not possible. The goal of setting stringent local limits is to protect the POTW and avoid violations of NPDES permit. However, if no MAHL is established for a "potential" POC, there is always the possibility that a new industrial user (or users) of the system will discharge wastes that are in excess of the POTW's ability or capacity to treat such wastes. Therefore, EPA recommends that MAHLs be developed for all 15 EPA-designated POCs even if local limits are not adopted. Of course, POTWs should assess a new user's impact on local limits before granting authorization to discharge.

Q: Should local limits be developed as dissolved metals, total metals, or both? How does hexavalent chromium relate to total chromium, and which should be used for local limits development?

A: While it may be desirable to develop local limits for both dissolved and total metals, in reality it may be impractical because of cost. POTW data are developed almost exclusively in terms of "total" because of NPDES requirements and the fact that Categorical Pretreatment Standards are always expressed as total. Because the POTW should be able to apply the more stringent of either the local limit or the Categorical Standard, it makes sense to develop the local limits as "total" values. Although the dissolved form of metals is usually more toxic, POTWs need to control the total metal entering the treatment works because particulate metal or metal compounds may exert some toxicity or may later be resolubilized. A large percentage of the toxic metals present in aeration basins at some treatment works has come from recycled solids handling sidestreams. These contributions can continue to exert a toxic effect long after the source has been controlled. Although most heavy metals "passing through" a treatment works are discharged into receiving waters in the dissolved form, significant concentrations of heavy metals may accumulate as fine particulates in the sludge produced at the POTW. By implementing local limits to control <u>total</u> metal concentrations, a POTW will reduce the chances for pass through and ensure that the quality of the sludge is not degraded. Local limits should be developed for total chromium. Hexavalent chromium is the more toxic of the two forms of the metal, but it can be converted to a total chromium value by using proper mathematical equations. If a POTW has contributions of hexavalent chromium, EPA recommends it develop local limits for both hexavalent chromium and total chromium. The basis of the limits will likely be different because the allowable holding time for hexavalent chromium samples is less than 24 hours.

9.3 SAMPLING AND ANALYSIS

Q: What analytical requirements and quality assurance/quality control procedures apply to local limits evaluation sampling?

A: There are no different or "special" quality assurance/quality control procedures that apply strictly to local limits sampling. EPA recommends that all wastewater sampling for POCs follow *prescribed protocols found in 40 CFR Part 136 (*Guidelines for Establishing Test Procedures for the Analysis of Pollutants*) and information provided in EPA-issued technical guidance. When sampling sludge for metals and total solids, however, the requirements in the sludge regulations at 40 CFR Part 503 apply. Therefore, EPA recommends that the analysis of sludge for the presence of metals be performed according to EPA test method SW-846 and for total solids according to Part 2540 G of the Standard Methods for the Examination of Water and Wastewater, 18th Edition.*

Q: Are there minimum analytical detection levels that should be achieved when analyzing samples for local limits?

A: As discussed in Chapter 3, a POTW's NPDES permit conditions, sludge disposal practices, and State and local requirements need to be addressed through local limits. Therefore, the analytical techniques for detecting POCs need to be able to identify and quantify concentration levels that are at least as stringent as the prescribed maximum concentrations for conventional and non-conventional pollutant effluent limitations, water quality-based toxic pollutant limitations, whole effluent toxicity (WET) requirements, and any numeric criteria for sludge use and disposal practices. In addition, POTWs will want to specify the lowest reasonable detection limit for a local limit monitoring to minimize the possibility of a POC being reported as"non-detectable."

Q: Is it necessary to account for hydraulic detention time through the treatment works when conducting sampling?

A: Treatment works sampling should account for hydraulic detention times within the plant whenever possible. Developing relevant removal efficiencies depends in part on accounting for hydraulic detention times. For some systems, such as lagoon systems, hydraulic detention times may be lengthy (e.g., 21 days). If it is not feasible to account for detention times, local limits can still be developed, but the options for determining removal rates will be reduced. Various methods for determining removal efficiencies are reviewed in Chapter 5.

Q: Do I have to outline a sampling plan for the local limits evaluation?

A: Outlining a sampling plan for local limits evaluation is not required by 403 regulations, although some Approval Authorities may require submission of such a plan. However, EPA highly recommends that a POTW develop a sampling program to ensure that it has adequate data for developing local limits that have sound technical bases. A sampling program can also enable a POTW to use fewer resources for evaluating local limits by providing the data necessary to determine and justify that local limits are not necessary for some pollutants and by enabling the POTW to manage its data and ensure that unnecessary sampling is not performed. Information regarding local limits data collection is reviewed in Chapter 4.

Q: Is sampling and analysis of the receiving stream necessary?

A: Receiving stream data (flow and ambient background concentrations of pollutants) provide key input parameters for allowable headworks loading (AHL) calculations when NPDES permit limits do not exist and the POTW needs to evaluate for pass through based on water quality standards. These data may already be available from sources such as the U.S. Geological Survey, State environmental agencies, and the POTW's NPDES permit. Therefore, a POTW may *not need to conduct sampling and analysis of the receiving stream to gather these values. However, if these data are not available, the POTW will want to consider sampling the receiving water so that AHLs can be calculated based on applicable values. The Approval Authority may require this information on a case-by-case basis for individual IUs. Other dischargers to the same portion of the receiving stream may already have performed sampling and may be willing to share the data or the costs of new monitoring.*

9.4 DETERMINING MAHLS

Q: Water quality standards have been established for our treatment works' receiving waters, but no water quality-based effluent limitations are included in our permit. Is it necessary to include the analysis for an allowable headworks loading (AHL) based on water quality standards in this case?

A: Yes, it is. If a POC loading measured at the headworks exceeds a MAHL that was set by the AHL for a water quality standard, there may be pass through of the pollutant, thereby causing a violation of the water quality standard and (consequently) of the Clean Water Act. In general, POTWs will not have NPDES permit limits for all of the POCs established during the local limits analysis. In such cases, a POTW may base its effluent-quality-based AHL on State Water Quality Standards (WQS) or Federal Water Quality Criteria (WQC). State environmental agencies have developed WQS that set maximum allowable pollutant levels for their water bodies, specific to the receiving stream reach's designated uses. Even though the POTW's NPDES permit may not contain a numeric effluent limit for a POC, the permit probably will contain narrative provisions requiring compliance with State WQS and prohibiting the discharge of any toxic pollutants in toxic amounts. A local limit based on a State WQS fulfills the narrative permit requirement specifying "no discharge of toxics in toxic amounts." See Section 3.2.2 and the associated footnotes for additional information.

Q: How much literature data are acceptable in deriving MAHLs? How much site-specific data are sufficient? How recent must data be for deriving MAHLs?

A: The answers to these questions will vary significantly from facility to facility. Depending on the POC and on the type and accuracy of the data available, a considerable range of techniques are acceptable for deriving the MAHL. EPA recommends that the Control Authority make a case-by-case determination about type and age of data that are sufficient to calculate accurate, technically defensible MAHLs. For example, data collected prior to major construction should not be used. However, the most accurate and technically defensible limits are the result of using site-specific data, rather than "generic" removal efficiency data derived from average, national-level treatment works "literature" data.

Q: We do not have NPDES or sludge limits for all of the POCs required to be evaluated; further, there are no State WQS for these pollutants. What criteria are we supposed to use in our evaluation?

A: Sludge, NPDES, or water quality criteria may not exist for all POCs. In these instances, the POTW may want to develop MAHLs based on system design criteria, air quality standards, inhibition criteria, or worker health and safety standards. In addition, the POTW will want to *determine the original purpose for adding a POC (e.g., WET test failure) and establish criteria through researching other applicable standards and guidelines.*

Q: How does a POTW develop local limits based on a NPDES WET limit?

A: Nothing in the pretreatment regulations prohibits using Whole Effluent Toxicity (WET) test data as the basis for developing a local limit. WET tests are primarily designed to protect the receiving waters from the aggregate toxic effect of a mixture of pollutants in the effluent. The WET approach is most useful for complex effluents where it may be infeasible to identify and regulate all toxic pollutants in the discharge, or where chemical-specific pollutants are set, but synergistic effects are a problem. However, unless you can identify each compound in the effluent that produces measurable acute or chronic toxicity concentrations, WET testing cannot be used to set local limits for a particular POC. If the toxic pollutant or pollutant parameter cannot be identified, then a POTW will want to evaluate all of the possible POCs present in the mixture. In this situation, WET test data may not be a cost-effective methodology for identifying POCs for evaluation in the local limits development process. The guidance Toxicity Reduction Evaluation Guidance for Municipal Wastewater Treatment Plants *(EPA/833-B-99-002, August 1999) provides further information on conducting a Toxicity Identification Evaluation.*

Q: Influent and effluent pollutant concentrations are below quantifiable levels yet the pollutant is detected in the sludge. What removal rate should I use?

A: EPA recommends that a POTW first evaluate those levels below the minimum level of quantitation (ML) as outlined in Section 5.1.3. If the methodologies outlined in Section 5.1.3 do not allow the calculation of a removal rate, a POTW then may selectively use removal efficiencies reported by other POTWs or by studies that have been published in professional journals or by EPA. Appendix R provides a list of removal efficiency data for priority pollutants gathered from other POTWs.

Q: Why should POTWs use the Table 3 Land Application Part 503 sludge standards when the POTW's sludge is disposed in a landfill?

A: *POTWs are encouraged to use the Table 3 standards because the Pretreatment Regulations list recycling of sludge as one of the goals of the program. Land application standards help meet this goal and also allow for more sludge disposal options, because the Table 3 standards are the most stringent. EPA recommends that POTWs consider the attainment of EPA "clean sludge" standards, that are delineated in Table 3 of 40 CFR 503.13, and provide the broadest choice of beneficial use options for sludge disposal. Further achievement of these standards is consistent with the objectives of the National Pretreatment Program, which are listed at 40 CFR 403.2. Additionally, until a sludge landfill is properly closed and abandoned there is always a potential for the leachate to affect groundwater. See Appendix K for landfill leachate loadings. In some cases, collected leachate can be trucked (as hauled waste) to a POTW and treated to non-toxic concentration levels. For this option to be viable, the metals content of the sludge should be limited to concentrations that will not cause potential pass through or interference problems for the POTW. Table 3 sludge standards for land application cover all nine toxic metals, while the surface disposal sludge standards specify limits only for arsenic, chromium and nickel. Imposing land application standards on sludge increases the probability that the leachate can be successfully treated in the future at a POTW. Nevertheless, if a POTW has a choice of disposal* *options, EPA recommends that it use land application disposal techniques because they are generally more controllable and have less potential for serious environmental degradation of surface water and groundwater.*

9.5 ESTABLISHING LOCAL LIMITS

Q: All of my influent, effluent, and sludge concentration data for a specific pollutant are below the method detection limit. Can the pollutant still be considered a POC and local limits established?

A: Yes. The Control Authority (generally, the POTW) has the authority to consider any chemical compound or pollutant as a potential POC and establish a local limit for that pollutant. If your POTW serves a high-growth municipality or incorporated area where the number and type of non-domestic users change frequently, it may be prudent to establish a MAHL limit in your ordinances for any pollutant that could potentially cause interference, pass through, or degrade your sludge quality—even if the concentration of that pollutant is currently below detection levels. Several statistical approaches to evaluating "below detection level" or below quantitation level data are discussed in Section 5.1.3 and Appendix Q.

Q: If a POTW's local limits evaluation indicates that its sludge disposal method (e.g., land application) is the most limiting factor, may the POTW pursue a less stringent sludge disposal method (e.g., landfill)?

A: The determination of the manner in which the sewage sludge is used or disposed of is a local determination. As long as a POTW adheres to all of the regulatory requirements specified in 40 CFR Part 503, it may select the optimum method of sludge disposal. EPA recommends that POTWs consider the attainment of EPA "clean sludge" standards, that are delineated in Table 3 of 40 CFR 503.13, and provide the broadest choice of beneficial use options for sludge disposal. Further, achievement of these standards is consistent with the objectives of the National Pretreatment Program, which are listed at 40 CFR 403.2.

Q: What do I do when my total domestic/background loading of a pollutant is equal to or greater than my MAHL, so I have no allowable loading for IUs?

A: The POTW may wish to consider a program that involves short-term, intermediate, and long-term measures. Short-term measures include evaluating the data and calculations used to develop the local limits to assess the validity of results. Intermediate measures include establishing interim local limits, looking into other possible sources of pollutants (including expansion of your list of IUs), and determining how to manage these sources. Long-term measures involve evaluating controls for users not already covered by your pretreatment program. If the short-term measures do not take care of the problem and provide loadings to allocate to IUs, the POTW would proceed to intermediate measures, and then, if necessary, to long-term measures. Examples of activities for each of the steps are listed below:

Short-term

- *Ensure that all significant industrial and commercial dischargers of the pollutants have been identified.*

- *Evaluate all sampling sites that have been used to estimate background concentration to ensure that commercial facilities were not missed and are not contributing pollutants of concern to the sampling location.*

- *Use actual sewer trunk line monitoring data in place of any literature data used in determining total domestic pollutant loadings to the POTW.*

- *Use removal efficiencies based on in-plant monitoring in place of any literature removal efficiencies used in determining MAHLs.*

- *Verify the applicability of criteria (e.g., sludge disposal standards, and water quality criteria) used as the basis for AHL calculations.*

- *Verify that appropriate sampling locations have been used, and that samples are representative (i.e., do not reflect peak loading periods only).*

- *Check the accuracy of all calculations made and the reliability of data used.*

- *Evaluate the method for handling non-detect monitoring results (e.g., equal to the detection level was used) and consider using other conventions (e.g., half the detection level).*

- *If the MAHL is based on inhibition criteria, current headworks loadings are greater than the inhibition criteria and the POTW has not experienced inhibition, the current loadings may be a more appropriate basis for inhibition values.*

Intermediate

- *Verify the sampling frequency through statistical methods.*

. - *Collect additional sampling data to refine values used (e.g., for removal efficiencies) or replace literature values.*

- *If hauled waste is being accepted, consider discontinuing this practice or instituting a program to determine individual wastewater components versus those contained in the septage.*

- *If chemicals are added in the plant or sewer system (e.g., to control root growth), consider alternatives that do not introduce POCs.*

- *Calculate a mass balance for the collection system (i.e., check if the sum of industrial plus domestic/commercial plus any hauled waste loadings are between 80 percent and 120 percent of the total influent loading). If not, one or more sources may not be accounted for or data may be invalid.*

- *Establish interim local limits such as a local limit equal to the POTW's NPDES permit limit, to the NPDES limit adjusted for the POTW removal efficiency for a* particular *pollutant, or to the lowest achievable method detection level (so that IU compliance with the limit can be determined). If the POTW is not experiencing pass through or interference for a given pollutant (e.g., no NPDES limit or sludge disposal criterion violations, no collection system problems), consider substituting the current influent loading for the MAHL and recalculate the allowable industrial loading. The interim limits should be replaced as long-term measures take effect.*

Long-term

- *Require industries to perform pollutant minimization/prevention evaluations.*

- *Consider implementing measures to address or regulate elevated loadings from non-industrial sources. These non-industrial sources include nonpoint sources (e.g., runoff) discharging to combined sewers, elevated pollutant levels in water supplies, household disposal of chemicals into sanitary sewers, and toxic pollutant discharges from commercial sources (e.g., photo labs or dry cleaners).*

Pollution prevention/minimization programs can address each of these sources. Nonpoint sources of pollutants may be addressed through combined sewer overflow control programs and urban and agricultural chemical management programs. The POTW may be able to reduce elevated pollutant levels in water supplies by working with the local water department. For example, elevated levels of metals in water supplies often arise from corrosion in water distribution pipes. The local water department may be able to reduce corrosion by adjusting the pH of the water supply. The POTW may be able to assist the water company in developing a program to optimize the use of chemical additives in lieu of making simple adjustments to the pH by using acidic or caustic chemical agents. The POTW can make efforts to educate the public on proper disposal of household chemicals and to provide chemical and used-oil recovery facilities. Each of these efforts is not directly part of the local limits process.

Reducing toxic pollutant discharges from commercial facilities is generally most effectively addressed through local limits. Commercial sources of pollutants, such as radiator shops, car washes, hospitals, laundries and photo processors, are often not considered significant sources of toxics because they typically have relatively low flows or are assumed to have insignificant pollutant levels in their discharges. However, these commercial sources may discharge at surprisingly high pollutant loading levels and are potential IUs that should be considered for control during local limits development. In some cases, the POTW may best address these sources through pollution prevention/minimization efforts, such as providing guidance to small commercial dischargers (e.g., informing dentists about how they can reduce mercury discharges to sewers).

Q: How useful are priority pollutant data in determining the need for and in setting local limits?

A: The "best case scenario" is that a POTW knows everything about each of its IUs, including the manufacturing processes involved and the types and amounts of pollutants discharged into the collection system by a particular facility. However, despite the requirements to notify the POTW of any changed discharges, some facilities might install new process technology, change to the *production of new chemical compounds, or use new or substitute chemicals in their processes. In these cases, new POCs might be introduced into the POTW. Use of priority pollutant scan data would provide added insurance that none of the 126 priority pollutants are being introduced (inadvertently or otherwise) into a POTW before problems with pass through, interference or sludge quality are detected by other analytical means.*

Q: Do local limits apply to all IUs? Do they have to be included in all permits issued by the POTW?

A: The assignment of local limits depends on how the MAIL calculations were performed and how the sewer use ordinance requires the local limits to be implemented. There is no regulatory requirement that "all limits" be included in every permit. However, the regulations at 40 CFR 403.8(f)(1) require that the contribution to the POTW by each Industrial User be 'controlled' through permit, order, or similar means, to ensure compliance with applicable Pretreatment Standards and Requirements. The regulations also specify that permits issued to Significant Industrial Users (SIUs) must contain certain minimum conditions, which include: "Effluent limits based on applicable general pretreatment standards in part 403 of this chapter, categorical pretreatment standards, local limits, and State and local law." [40 CFR 403.8(f)(1)(iii)(C)]

The applicability issue is determined by the local limit allocation method (i.e., uniform concentration, mass proportion, industrial contributory) that the POTW chooses when developing the local limits and how the POTW expressly states the applicability of the local limits within its sewer use ordinance (SUO). The Control Authority may elect to codify local limits in the local SUO or place general enabling authority language about local limits in the SUO and announce the actual limits by another mechanism (e.g., as a technical directive, etc.). Including the limits in the SIU permit provides individual notice to a permittee of the pollutant limits that are applicable to that particular SIU.

Q: My local limits re-evaluation indicates that a less stringent local limit than the one currently in the ordinance can be applied. Is this allowed in light of EPA's anti-backsliding policy?

A: First, you need to consider the full meaning of the "anti-backsliding" policy. The "anti-backsliding" concept associated with NPDES permit limits does not apply to local limits. Local limits apply to a particular IU and can be raised or lowered based on the periodic re-evaluation of the need for those limits. Second, a POTW may need to modify its SUO before it may impose a less stringent limit. Otherwise, the permit may conflict with the POTW's authority. Third, in the case of a Categorical Industrial User discharge regulated by a categorical effluent standard, the more stringent limit (either the local limit or the categorical standard) must be applied—regardless of the local limit established for that pollutant. Though rare, some categorical standards may be made less stringent as a result of removal credits (40 CFR 403.7). Also, because any less stringent change in prescribed local limits would be a significant program modification, you must notify and seek the approval of the Approval Authority prior to making such a change.

Q: Is effluent trading of local limits allowed?

A: Yes. A POTW may decide to negotiate with its IUs in allocating its calculated allowable industrial loadings. However, the POTW needs to ensure that no more than the total MAHL is allocated among domestic/background sources, IUs, commercial sources not considered IUs by the POTW, and other sources of loadings such as hauled waste. Effluent trading, which must be authorized in the POTW's sewer use ordinance, may result in a program modification, as defined in 40 CFR 403.18 and results of the trades should be incorporated into any control mechanisms (see Section 6.4.2).

Q: If a calculated local limit is excessive (i.e., a large number), should the POTW implement this limit?

A: The POTW should consider the potential IU discharge for the particular pollutant and the possibility that a high limit might encourage increased discharges to the system. Of course, the POTW must receive Approval Authority concurrence on the local limit.

Q: How do I develop local limits for other pollutants (e.g., BTEX compounds) that may be specific to certain users?

A: For BTEX, some options to consider for determining if pass through or interference will occur include:

- *Fume toxicity criteria.*
- *Aquatic life protection criteria.*
- *Worker safety and health criteria. Consult the* Guidance to Protect POTW Workers from Toxic and Reactive Gases and Vapors *(EPA, 1992).*

Once the most stringent criteria are determined, POTWs may want to compare the proposed local limit with BTEX treatment technology. The Model NPDES Permit for Discharges Resulting from the Cleanup of Gasoline Released from Underground Storage Tanks *(EPA, 1989) contains two sets of effluent limits: 1) BTEX of 100 µg/L and benzene of 5 µg/L (assumes approximately 15 mg/L of dissolved product is treated to a removal efficiency of 99.5 percent, which can be achieved with a commercially available stripper unit), and 2) BTEX of 750 µg/L and benzene of 50 µg/L (assumes approximately 15 mg/L of dissolved product is treated to a removal efficiency of 95 percent, using equipment that a small business is more likely to purchase).*

Q: How should IU-specific limits be developed for "atypical"dischargers (i.e., groundwater cleanups, hauled waste, landfill leachate, and underground storage tank cleanups) containing pollutants for which no local limits or MAHLs are established and which cannot be measured at the headworks?

A: First, EPA recommends you ensure that your local ordinance gives you the authority to impose limits for pollutants that are not specifically listed in your ordinance limits or other document *pertaining to local limits adoption policy. Second, EPA suggests that you review the* Supplemental Manual on the Development and Implementation of Local Discharge Limitations under the Pretreatment Program *(EPA-W21-4002, May 1991) and relevant RCRA site remediation guidelines (for underground storage tanks and groundwater contamination) to determine what types and concentrations of pollutants are typically discharged by these wastewater sources. The POTW next may determine (on a site-specific basis) which of these sources are likely to be a problem and establish a sampling program for the sewer trunk lines into which the wastewater is discharged. If this sampling program identifies the potential for an adverse impact on the POTW, then specific local limits can be developed and incorporated into the discharge permit of the IU(s) that are problematic. The* Guidance to Protect POTW Workers from Toxic and Reactive Gases and Vapors *(EPA, 1992) provides additional data relating to health and safety concerns.*

9.6 OVERSIGHT AND PUBLIC PARTICIPATION

Q: What kind of public participation should I expect during the local limits development process?

A: Although the public does not usually become actively involved in the development process, the CWA established public participation as an integral part of developing any regulatory program, including standards and effluent limitations associated with the pretreatment program. Obviously, "public" participation includes all affected entities. The IUs are critically important participants in the whole local limits development process. The General Pretreatment Regulations encourage public participation by requiring public notices or hearings on local limits development. Federal regulations require POTWs to notify affected persons and groups and give them an opportunity to respond before final promulgation of a local limit [40 CFR 403.5(c)(3)]. Any subsequent modifications that are deemed significant modifications (as defined in 40 CFR 403.18 (b)) must be publicly noticed. Minor modifications, such as the adoption of a more stringent local limit for a POC, do not require public notice. However, the POTW must ensure that it has the authority to impose more stringent limits. Modifications to local limits for pH and reallocation of the MAIL are considered to be minor program modifications and do not require public notice (see Sections 6.7 - 6.9).

Q: Do I need Approval Authority approval to implement and enforce local limits?

A: No, you do not unless you are making changes to your legal authority or amending your local limits to make them less stringent than those currently incorporated in your approved pretreatment program. In accordance with 40 CFR 403.18, changes to legal authority or making local limits less stringent is considered a significant modification to the approved pretreatment program and must therefore be approved by the Approval Authority. However, modifications to local limits for pH and reallocation of the MAIL are considered to be minor program modifications and do not require Approval Authority approval or public noticing. As prescribed in 40 CFR Part 403, the authority to develop and enforce local limits needs to be incorporated into a POTW's pretreatment program at the time of program approval (see Sections 6.7 - 6.9).

9.7 IMPLEMENTATION AND ENFORCEMENT OF LOCAL LIMITS

Q: Are local limits enforceable if not contained in a sewer use ordinance (SUO)?

A: Local limits are enforceable if included in a valid user permit or similar enforceable control mechanism. From a notification standpoint, local limits may be more difficult to enforce if the SUO does not specifically reference them so that IUs know what is expected of them. Even if the limits are not in the SUO, the Control Authority must ensure that it has the legal authority to enforce limits or procedures in documents other than the SUO and that all required public participation procedures are conducted. The Control Authority will need to evaluate the availability of resources and the respective burden of enforcing local limits before deciding whether to use general language about complying with local limits versus putting specific MAIL values in its SUO (see Sections 6.7 - 6.9).

Q: Can my State or EPA take enforcement action against IUs in my jurisdiction for violations of local limits?

A: All local limits developed in accordance with the provisions stated in 40 CFR 403.5(c) are deemed to be Pretreatment Standards for the purposes of Section 307(d) of the Clean Water Act. Consequently, EPA or the State Approval Authority may take enforcement action against any industrial user for a violation of a local limit. The CWA also provides that affected third parties may bring "citizen suits" against users for violations of these local limits.

Q: How can a POTW justify imposing stringent local limits on IUs when the POTW is not subject to an NPDES permit limit or sludge standards for the same pollutant?

A: If a POTW believes that one or more POCs may cause or have the potential to cause damage to the system infrastructure (i.e., corrosion, erosion, disruption of plant treatment efficiencies), affect worker safety and health, or negatively impact water quality, it must impose a local limit for these POCs. The use of site-specific data (rather than less precise"literature" data) for local limits calculations will always produce better, more technically defensible limits. In addition, POTWs have the ability to establish land application of its sludge as the goal of its pretreatment program and to use sludge land application criteria (as opposed to sludge surface disposal criteria) in the development of the limits.

Q: Can a POTW allocate local limits to non-categorical SIUs only and require CIUs to comply with the categorical standards only?

A: This is an allocation method issue. As long as the appropriate categorical standards are imposed on the CIUs and the sum of the loadings allocated to all IUs does not exceed the total MAIL, the POTW may assign MAILs as it sees fit (i.e., each IU need not be given the identical limit for a particular POC). Note that if the POTW establishes a MAIL for a pollutant, then EPA recommends that CIUs receive an allocation for that pollutant even if the categorical standard does not regulate that pollutant. Also, note that local limits based on the general prohibitions (e.g., corrosion, flammability, etc.) would still need to be applied to categorical industries.

9.8 POTW OPERATIONS

Q: Our POTW consists of multiple treatment plants. Wastewater flow and sludges can be diverted between them. How does this affect local limits evaluation and development?

A: To ensure that all treatment plants are protected from pass through, interference, and sludge degradation, each treatment plant should calculate allowable headworks loadings. The MAHL can then be selected from the most stringent AHL. This practice will effectively impose a safety factor on all of the treatment plants in the POTW and avoid any disruption of the plant treatment process or violation of the POTW's NPDES discharge permit.

Q: Is expansion of my POTW's service area cause for me to re-evaluate local limits?

A: EPA recommends that a POTW evaluate the characteristics of its "new" service area to determine how the POTW's current local limits requirements would be affected. Although not an absolute requirement (due to presumed safety factors built into a POTW's local limits determination), it is always prudent to re-evaluate the local limits calculations if the expansion will add a number of SIUs to the POTW's collection system. The decision about what triggers the need for a re-evaluation is left to the POTW. However, as has been previously noted, EPA recommends that local limits be re-evaluated periodically whenever there are significant changes in the mix of IUs or in the total daily flow through the system (see Exhibit 7-2).

Q: How do contract operations or privatization affect local limits evaluations and development?

A: A POTW's type of management should have no impact on the evaluation and development of local limits. Local limits are designed to protect the POTW from pass through, interference, or degradation of sewage sludge. As long as the public has some fiduciary interest in the POTW the need for local limits should be assessed on a routine basis. If the POTW is sold to a private entity, then the 403 regulations regarding local limits would no longer apply upon reissuance of the permit. The new owner of the treatment plant is not required to develop or implement local limits unless it is made a management practice requirement in its new NPDES permit.

Q: Is it possible to develop local limits for a wastewater treatment lagoon where sludge is dredged only every 20 years?

A: The POTW can always develop local limits based on water quality. A lagoon system would not be significantly different than any other type of system in that respect. For sludge, the POTW should ensure that the sludge, when dredged, will meet the standards for its chosen sludge disposal option by establishing local limits protective of that option.

9.9 INDUSTRIAL USERS

Q: If a new significant industrial user/categorical industrial user (SIU/CIU) commences its process discharge, or if an existing SIU/CIU ceases its process discharge, is a local limits re-evaluation necessary?

A: It depends. If the SIU/CIU contributes a "significant percentage" (as determined by the POTW based on total design flow or number of IUs contributing a particular POC) of the total loading *for a particular pollutant or pollutants, then EPA recommends that the POTW recalculate the local limits. However, if the SIU/CIU in question does not have the capability of adversely affecting the entire POTW, then (depending upon the allocation method, SUO language, or applicable categorical standards) the local limits can be specified in the IU's discharge permit.*

Q: If I have CIUs with specific, numeric categorical pretreatment standards, is it necessary for me to apply local limits to these CIUs for these pollutants?

A: No, it is not necessary unless the numeric categorical standards for a specific POC covered by local limits are less stringent than the values specified in the local limits. In this case, the more stringent local limits must prevail (see Section 1.5).

Q: Does promulgation of new categorical pretreatment standards affect local limits evaluation?

A: The promulgation of a new categorical standard should have no effect on local limits requirements. All industrial users subject to the categorical standard(s) will have to meet that discharge standard. However, if the categorical standard for a particular POC is less stringent than the local limit set for that pollutant, the more stringent local limit must be met by the IUs subject to the categorical pretreatment standard. In addition, if the new categorical standard is more stringent than the local limit, the"freed up" loading could be reallocated to the other IUs.

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United States
Environmental Protection
Agency

Office of Wastewater
Management 4203

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Local Limits Development Guidance Appendices

APPENDICES

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APPENDIX A - LIST OF SUPPLEMENTAL DOCUMENTS

GENERAL GUIDANCE ON PRETREATMENT				
TITLE	**DATE**	**EPA Number**	**NTIS Number**	**ERIC Number**
CERCLA Site Discharges to POTWs Guidance Manual	August 1990	540-G-90-005	PB90-274531	W150
Control Authority Pretreatment Audit Checklist and Instructions	May 1992	--	--	--
Control of Slug Loadings To POTWs: Guidance Manual	February 1991	21W-4001	--	--
Environmental Regulations and Technology: The National Pretreatment Program	July 1986	625-10-86-005	PB90-246521	W350
Guidance for Conducting a Pretreatment Compliance Inspection	September 1991	300-R-92-009	PB94-120631	W273
Guidance For Developing Control Authority Enforcement Response Plans	September 1989	--	PB90-185083/AS	--
Guidance for Reporting and Evaluating POTW Noncompliance with Pretreatment Implementation Requirements	September 1987	--	PB95-157764	W304
Guidance Manual for POTW Pretreatment Program Development	October 1983	--	PB93-186112	W639
Guidance Manual for POTWs to Calculate the Economic Benefit of Noncompliance	September 1990	833-B-93-007	--	--
Guidance Manual for Preparation and Review of Removal Credit Applications	July 1985	833-B-85-200	--	--
Guidance Manual for Preventing Interference at POTWs	September 1987	833-B-87-201	PB92-117969	W106
Guidance Manual for the Control of Wastes Hauled to Publicly Owned Treatment Works	September 1999	833-B-98-003	--	--
Guidance Manual for the Identification of Hazardous Wastes Delivered to Publicly Owned Treatment Works by Truck, Rail, or Dedicated Pipe	June 1987	--	PB92-149251	W202
Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula	September 1985	833-B-85-201	PB92-232024	U095
Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program	December 1987	833-B-87-202	PB92-129188	W107
Guidance on Evaluation, Resolution, and Documentation of Analytical Problems Associated with Compliance Monitoring	June 1993	821-B-93-001	--	--
Guidance on the Privatization of Federally Funded Wastewater Treatment Works	August 2000	832-B-00-002	--	--
Guidance to Protect POTW Workers From Toxic And Reactive Gases And Vapors	June 1992	812-B-92-001	PB92-173236	W115

GENERAL GUIDANCE ON PRETREATMENT				
TITLE	**DATE**	**EPA Number**	**NTIS Number**	**ERIC Number**
Guides to Pollution Prevention: Municipal Pretreatment Programs	October 1993	625-R-93-006	--	--
Industrial User Inspection and Sampling Manual For POTWs	April 1994	831-B-94-001	PB94-170271	W305
Industrial User Permitting Guidance Manual	September 1989	833-B-89-001	PB92-123017	W109
Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion	June 1996	823-B-96-007	--	--
Model Pretreatment Ordinance	June 1992	833-B-92-003	PB93-122414	W108
Multijurisdictional Pretreatment Programs: Guidance Manual	June 1994	833-B-94-005	PB94-203544	W607
National Pretreatment Program: Report to Congress	July 1991	21-W-4004	PB91-228726	W694
NPDES Compliance Inspection Manual	September 1994	300-B-94-014	--	--
Pollution Prevention (P2) Guidance Manual for the Pesticide Formulating, Packaging, and Repackaging Industry: Implementing the P2 Alternative	June 1998	821-B-98-017	--	--
POTW Sludge Sampling and Analysis Guidance Document	August 1989	833-B-89-100	--	--
Prelim User's Guide, Documentation for the EPA Computer Program/Model for Developing Local Limits for Industrial Pretreatment Programs at Publicly Owned Treatment Works, Version 5.0	January 1997	--	--	--
Pretreatment Compliance Inspection and Audit Manual For Approval Authorities	July 1986	833-B-86-100	PB90-183625	W277
Pretreatment Compliance Monitoring and Enforcement Guidance and Software (Version 3.0)	(Manual) September 1986 (Software) September 1992	(Software) 831-F-92-001	(Software) PB94-118577	(Software) W269
Procedures Manual for Reviewing a POTW Pretreatment Program Submission	October 1983	833-B-83-200	PB93-209880	W137
Procuring Analytical Services: Guidance for Industrial Pretreatment Programs	October 1998	833-B-98-004	--	--
Region III Guidance for Setting Local Limits for a Pollutant Where the Domestic Loading Exceeds the Maximum Allowable Headworks Loading	June 1994	--	--	--
Protecting the Nation's Waters Through Effective NPDES Permits: A Strategic Plan FY 2001 and Beyond	June 2001	833-R-01-001	--	--
RCRA Information on Hazardous Wastes for Publicly Owned Treatment Works	September 1985	833-B-85-202	PB92-114396	W351
Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works	February 1986	530-SW-86-004	PB86-184017 & PB95-157228	W922 & W692

GENERAL GUIDANCE ON PRETREATMENT				
TITLE	**DATE**	**EPA Number**	**NTIS Number**	**ERIC Number**
Supplemental Manual On the Development And Implementation of Local Discharge Limitations Under The Pretreatment Program	May 1991	21W-4002	PB93-209872	W113

Source: Updated, originally part of U.S. EPA's *Introduction to the National Pretreatment Program*, EPA-833-B-98-002, February 1999, pp. 51-52

GUIDANCE ON INDUSTRY PRETREATMENT STANDARDS				
TITLE	**DATE**	**EPA Number**	**NTIS Number**	**ERIC Number**
Aluminum, Copper, And Nonferrous Metals Forming And Metal Powders Pretreatment Standards: A Guidance Manual	December 1989	800-B-89-001	PB91-145441	W119
Guidance Manual For Battery Manufacturing Pretreatment Standards	August 1987	440-1-87-014	PB92-117951	W195
Guidance Manual for Electroplating and Metal Finishing Pretreatment Standard	February 1984	440-1-84-091-G	PB87-192597	W118
Guidance Manual For Implementing Total Toxic Organics (TTO) Pretreatment Standards	September 1985	440-1-85-009-T	PB93-167005	W339
Guidance Manual For Iron And Steel Manufacturing Pretreatment Standards	September 1985	821-B-85-001	PB92-114388	W103
Guidance Manual for Leather Tanning and Finishing Pretreatment Standards	September 1986	800-R-86-001	PB92-232024	W117
Guidance Manual for Pulp, Paper, and Paperboard and Builders' Paper and Board Mills Pretreatment Standards	July 1984	--	PB92-231638	W196
Guidance Manual for the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula	September 1985	833-B-85-201	PB92-232024	U095
Permit Guidance Document: Pulp, Paper, and Paperboard Manufacturing Point Source Category (40 CFR Section 430)	May 2000	821-B-00-003	PB2002-106590	--
Permit Guidance Document: Transportation Equipment Cleaning Point Source Category (40 CFR 422)	March 2001	821-R-01-021	--	--
Small Entity Compliance Guide: Centralized Waste Treatment Guidelines and Pretreatment Standards (40 CFR 437)	June 2001	821-B-01-003	--	--

Source: Updated, originally part of U.S. EPA's *Introduction to the National Pretreatment Program*, EPA-833-B-98-002, February 1999, pp. 51-52

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APPENDIX B - INDUSTRIAL CATEGORIES WITH PRETREATMENT STANDARDS

Source: U.S. EPA's *Introduction to the National Pretreatment Program*, EPA-833-B-98-002, February 1999, Figure 13, p. 14. (Updated)

Category (SIC Codes)* [NAICS Codes]**	40 CFR Part (Sub-parts)	Type of Standard***	Overview of Pretreatment Standards
Aluminum Forming (3353, 3354, 3355, 3357, 3363) [331315, 331316, 331319, 331521]	467(A-F)	PSES PSNS	Limits are production-based, daily maximums and monthly averages. Subpart C prohibits discharges from certain operations.
Battery Manufacturing (3691, 3692) [335911, 335912]	461(A-G)	PSES PSNS	Limits are production-based, daily maximums and monthly averages. No discharge is allowed from any process not specifically identified in the regulations.
Carbon Black Manufacturing (2895) [325182]	458 (A-D)	PSNS	Limits are for Oil & Grease only (no limit duration specified).
Centralized Waste Treatment (4953) [562211, 562219]	437 (A-D)	PSES PSNS	Limits are concentration-based, daily maximums and monthly averages.
Coil Coating (3411, 3479, 3492) [332431, 332812]	465 (A-D)	PSES PSNS	Limits are production-based, daily maximums and monthly averages.
Commercial Hazardous Waste Combustors (4953, 2819, 2869, 3241, 1422, 1429, 1459) [562213, 212312, 325188, 325199, 327310]	444 (A)	PSES PSNS	Limits are concentration-based daily maximums or maximum monthly averages.
Concentrated Animal Feeding Operations (0211, 0213, 0214, 0241, 0251, 0252, 0253, 0254, 0259, 0272) [112112, 11221, 11241, 11242, 112111, 11212, 11232, 11231, 11233, 11234, 11239, 11292]	412 (B)	PSNS	Discharge of process wastewater is prohibited, except when there is an overflow resulting from a chronic or catastrophic rainfall event.
Copper Forming (3351, 3357, 3463) [331421, 331422, 332112]	468 (A)	PSES PSNS	Limits are production-based, daily maximums and monthly averages.
Electrical and Electronic Components (3671, 3674, 3679) [334411, 334413, 334419]	469 (A-D)	PSES PSNS	Limits are concentration-based, daily maximums and 30-day averages or monthly averages (varies per subpart and pollutant parameter). Certification is allowed in lieu of monitoring for certain pollutants when a management plan is approved and implemented.

Category (SIC Codes)* [NAICS Codes]**	40 CFR Part (Subparts)	Type of Standard***	Overview of Pretreatment Standards
Electroplating (3471, 3672) [332813, 334412]	413 (A-B, D-H)	PSES	Limits are concentration-based (or alternative mass-based equivalents), daily maximums and four consecutive monitoring days averages. Two sets of limits exist, depending on if facility discharges more or less than 10,000 gallons per day of process wastewater. Certification is allowed in lieu of monitoring for certain pollutants when a management plan is approved and implemented.
Fertilizer Manufacturing (2873, 2874, 2875) [325311, 325312, 325314]	418 (A-G)	PSNS	Limits may specify zero discharge of wastewater pollutants (Subpart A), production-based daily maximums and 30-day averages (Subparts B-E) or concentration-based (Subparts F-G) with no limit duration specified.
Glass Manufacturing (3211, 3221, 3296) [327211, 327212, 327993]	426 (H, K-M)	PSNS	Limits are either concentration- or production-based, daily maximums and monthly averages.
Grain Mills (2041, 2043, 2044, 2045, 2046, 2047) [311111, 311211, 311212, 311213, 311221, 311230]	406 (A)	PSNS	Discharge of process wastewater is prohibited at a flow rate or mass loading rate which is excessive over any time period during the peak load at a POTW.
Ink Formulating (2893) [325910]	447 (A)	PSNS	Regulations specify no discharge of process wastewater pollutants to the POTW.
Inorganic Chemicals Manufacturing (2812, 2813, 2816, 2819) [325120, 325131, 325181, 325188]	415 (A-BO)	PSES PSNS	Limits vary for each subpart with a majority of the limits concentration-based, daily maximums and 30-day averages, or may specify no discharge of wastewater pollutants. Numerous subparts have no pretreatment standards.
Iron and Steel Manufacturing (3312, 3315, 3316, 3317, 3479) [331111, 331210, 331221, 331222, 332812]	420 (A-F, H-J, L, M)	PSES PSNS	Limits are production-based, daily maximums and 30 day averages, or may specify no discharge of wastewater pollutants.
Leather Tanning and Finishing (3111) [316110]	425 (A-I)	PSES PSNS	Limits are concentration-based, daily maximums and monthly averages. In certain instances, production volume dictates applicable pretreatment standards.
Metal Finishing (Industry groups: 34, 35, 36, 37, 38) [Industry Subsectors: 332, 333, 334, 336]	433 (A)	PSES PSNS	Limits are concentration-based, daily maximums and monthly averages. Certification is allowed for certain pollutants where a management plan is approved and implemented.
Metal Molding and Casting (3321, 3322, 3324, 3325, 3365, 3366, 3369) [331511, 331512, 331513, 331524, 331525, 331528]	464 (A-D)	PSES PSNS	Limits are primarily production-based, daily maximums and monthly averages. Discharges from certain processes are prohibited (Subparts A-C).
Nonferrous Metals Forming and Metal Powders (3356, 3357, 3363, 3497, 3499) [331491, 331422, 331521, 332117, 332999]	471 (A-J)	PSES PSNS	Limits are production-based, daily maximums and monthly averages. In some instances, the regulations prohibit the discharge of wastewater pollutants.

Category (SIC Codes)* [NAICS Codes]**	40 CFR Part (Sub-parts)	Type of Standard***	Overview of Pretreatment Standards
Nonferrous Metals Manufacturing (2819, 3331, 3334, 3339, 3341) [331311, 331312, 331314, 331411, 331419, 331423, 331492]	421 (B-AE)	PSES PSNS	Limits are production-based, daily maximums and monthly averages. The majority of the Subparts have both existing and new source limits, with others having solely new source requirements. In some instances, the regulations prohibit the discharge of wastewater pollutants.
Oil and Gas Extraction (1311) [211111]	435 (D)	PSES PSNS	Regulations specify no discharge of process wastewater (drilling fluieds, deck drainage, etc.) pollutants to the POTW.
Organic Chemicals, Plastics, and Synthetic Fibers (2821, 2823, 2824, 2865, 2869) [325211, 325221, 325222, 32511, 325132, 325192, 325188]]	414 (B-H, K)	PSES PSNS	Limits are mass-based (concentration-based standards multiplied by process flow), daily maximums and monthly averages. Standards for metals and cyanide apply only to metal- or cyanide-bearing wastestreams.
Paint Formulating (2851) [325510]	446 (A)	PSNS	Regulations specify no discharge of process wastewater pollutants to the POTW.
Paving and Roofing Materials (Tars and Asphalt) (2951, 2952, 3996) [324121, 324122, 326192]	443 (A-D)	PSNS	Limits are for Oil & Grease only (no limit duration specified).
Pesticide Chemicals (2879) [325320]	455 (A, C, E)	PSES PSNS	Limits are mass-based (concentration-based standards multiplied by process flow), daily maximums and monthly averages. Subpart C specifies no discharge of process wastewater pollutants but provides for pollution prevention alternatives. Subpart E specifies no discharge of process wastewater pollutants.
Petroleum Refining (2911) [324110]	419 (A-E)	PSES PSNS	Limits are concentration-based (or mass-based equivalent), daily maximums.
Pharmaceutical Manufacturing (2833, 2834) [325411, 325412]	439 (A-D)	PSES PSNS	Limits are concentration-based, daily maximums and monthly averages. Subpart A and C facilities may certify they do not use or generate cyanide in lieu of performing monitoring to demonstrate compliance.
Porcelain Enameling (3431, 3469, 3479, 3631, 3632, 3633, 3639) [332116, 332812, 332998, 335221, 335222, 335224, 335228]	466 (A-D)	PSES PSNS	Limits are concentration-based (or alternative production-based), daily maximums and monthly averages. Subpart B prohibits discharges certain operations.
Pulp, Paper, and Paperboard (2611, 2621, 2631) [322110, 322121, 322122, 322130]	430 (A-G, I-L)	PSES PSNS	Limits are production-based or concentration-based (or alternative production-based) daily maximums and monthly averages. These facilities may certify they do not use certain compounds in lieu of performing monitoring to demonstrate compliance. Facilities subject to Subparts B and E must also implement Best Management Practices as identified.
Rubber Manufacturing (2822) [325212]	428 (E-K)	PSNS	Limits are concentration- or production-based, daily maximums and monthly averages.

Category (SIC Codes)* [NAICS Codes]**	40 CFR Part (Sub-parts)	Type of Standard***	Overview of Pretreatment Standards
Soap and Detergent Manufacturing (2841) [325611]	417 (O-R)	PSNS	Regulations specify no discharge of process wastewater pollutants to the POTW.
Steam Electric Power Generating (4911) [221112]	423	PSES PSNS	Limits are either concentration-based, daily maximums, or "maximums for any time," or compliance can be demonstrated through engineering calculations. In some instances, the regulations prohibit the discharge of wastewater pollutants.
Timber Products Processing (2421, 2435, 2436, 2491, 2493, 2499) [321114, 321219, 321211, 321212]	429 (F-H)	PSES PSNS	All PSNS (and PSES for Subpart F) prohibit the discharge of wastewater pollutants. PSES for Subparts G and H are concentration-based, daily maximums (with production-based alternatives).
Transportation Equipment Cleaning (4491, 4499, 4741, 7699) [484230, 488320, 488390, 488210]	442 (A-C)	PSES PSNS	Limits are concentration-based daily maximums. Subpart A and B allow for a pollutant as an alternative to achieving PSES or PSNS.

* SIC = Standard Industrial Classification, 1987 SIC Manual
** NAICS = North American Industry Classification System, 1997 NAICS Manual.
*** PSNS = Pretreatment Standard New Source; PSES = Pretreatment Standard Existing Source

APPENDIX C - POLLUTANTS REGULATED BY CATEGORICAL PRETREATMENT STANDARDS

	Aluminum Forming	Battery Manufacturing	Carbon Black Manufacturing	Centralized Waste Treatment	Coil Coating	Copper Forming	Electrical and Electronic Components	Electroplating	Feedlots	Fertilizer Manufacturing	Glass Manufacturing	Grain Mills	Ink Formulating	Inorganic Chemicals Manufacturing	Iron and Steel Manufacturing	Leather Tanning and Finishing	Metal Finishing	Metal Molding and Casting	Nonferrous Metals Form./Metal Powders	Nonferrous Metals Manufacturing	Oil and Gas	Organic Chems., Plastics, and Syn. Fibers	Paint Formulating	Paving and Roofing Materials	Pesticide Chemicals	Petroleum Refining	Pharmaceutical Manufacturing	Porcelain Enameling	Pulp, Paper, and Paperboard	Rubber Manufacturing	Soap and Detergent Manufacturing	Steam Electric Power Generating	Timber Products Processing	Transportation Equip. Cleaning	Waste Combustors
Flow Restrictions Only									X				X								X		X								X				
Ammonia (as N)										X					X				X	X						X	X								
BOD												X																							
COD														X																X					
Fluoride					X		X				X			X					X	X															
Nitrate (as N)										X																									
Oil and Grease	X		X		X	X												X						X		X				X			X		
Oil (mineral)											X																								
Organic Nitrogen (as N)										X																									
pH										X				X		X																			
Phenols															X			X		X															
Phosphorus					X					X																									
Sulfide																X																			
TSS												X																							X
1,1-Dichloroethane					X			X									X					X										X			
1,1-Dichloroethylene					X		X	X									X					X			X							X			
1,1,1-Trichloroethane					X	X	X	X									X	X				X			X							X			
1,1,2-Trichloroethane							X	X									X					X										X			
1,1,2,2-Tetra-chloroethane					X			X									X															X			
1,2-Dichlorobenzene							X	X									X					X			X		X					X			
1,2-Dichloroethane							X	X									X					X			X		X					X			
1,2-Dichloropropane								X									X					X			X							X			
1,2-Diphenyl-hydrazine	X						X	X									X															X			
1,2-trans-Dichloroethylene								X									X					X			X							X			

	Aluminum Forming	Battery Manufacturing	Carbon Black Manufacturing	Centralized Waste Treatment	Coil Coating	Copper Forming	Electrical and Electronic Components	Electroplating	Feedlots	Fertilizer Manufacturing	Glass Manufacturing	Grain Mills	Ink Formulating	Inorganic Chemicals Manufacturing	Iron and Steel Manufacturing	Leather Tanning and Finishing	Metal Finishing	Metal Molding and Casting	Nonferrous Metals Form./Metal Powders	Nonferrous Metals Manufacturing	Oil and Gas	Organic Chems., Plastics, and Syn. Fibers	Paint Formulating	Paving and Roofing Materials	Pesticide Chemicals	Petroleum Refining	Pharmaceutical Manufacturing	Porcelain Enameling	Pulp, Paper, and Paperboard	Rubber Manufacturing	Soap and Detergent Manufacturing	Steam Electric Power Generating	Timber Products Processing	Transportation Equip. Cleaning	Waste Combustors
1,2,4-Trichloro-benzene							X	X									X					X										X			
1,3-Dichloro-benzene							X	X									X					X										X			
1,3-Dichloro-propene								X									X					X			X							X			
1,4-Dichloro-benzene							X	X									X					X			X							X			
2-Chloroethyl vinyl ether (mixed)								X									X															X			
2-Chloro-naphthalene								X									X															X			
2-Chlorophenol	X						X	X									X	X														X			
2-Nitrophenol							X	X									X					X										X			
2,3-Dichloro-aniline				X																															
2,3,4,6-Tetra-chlorophenol																													X						
2,4-Dichlorophenol							X	X									X	X														X			
2,4-Dimethyl-phenol								X									X	X														X			
2,4-Dinitrophenol								X									X															X			
2,4-Dinitro-toluene	X							X									X															X			
2,4,5-Trichloro-phenol																													X						
2,4,6-Trichloro-phenol				X			X	X									X	X											X			X			
2,6-Dinitro-toluene						X		X									X															X			
3,3-Dichloro-benzidine								X									X															X			
3,4,5-Trichloro-catechol																													X						
3,4,5-Trichloro-guaiacol																													X						
3,4,6-Trichloro-catechol																													X						
3,4,6-Trichloro-guaiacol																													X						
4-Bromophenyl phenyl ether								X									X															X			

	Aluminum Forming	Battery Manufacturing	Carbon Black Manufacturing	Centralized Waste Treatment	Coil Coating	Copper Forming	Electrical and Electronic Components	Electroplating	Feedlots	Fertilizer Manufacturing	Glass Manufacturing	Grain Mills	Ink Formulating	Inorganic Chemicals Manufacturing	Iron and Steel Manufacturing	Leather Tanning and Finishing	Metal Finishing	Metal Molding and Casting	Nonferrous Metals Form./Metal Powders	Nonferrous Metals Manufacturing	Oil and Gas	Organic Chems., Plastics, and Syn. Fibers	Paint Formulating	Paving and Roofing Materials	Pesticide Chemicals	Petroleum Refining	Pharmaceutical Manufacturing	Porcelain Enameling	Pulp, Paper, and Paperboard	Rubber Manufacturing	Soap and Detergent Manufacturing	Steam Electric Power Generating	Timber Products Processing	Transportation Equip. Cleaning	Waste Combustors
4-Chlorophenyl phenyl ether								X									X															X			
4-Nitrophenol							X	X									X	X				X										X			
4,4-DDD								X									X															X			
4,4-DDE								X									X															X			
4,4-DDT								X									X															X			
4,5,6-Trichloro-quaiacol																													X						
4,6-Dinitro-o-cresol								X									X					X										X			
Acenaphthene	X							X									X	X				X										X			
Acenaphthylene	X							X									X	X														X			
Acetone																											X								
Acrolein								X									X															X			
Acrylonitrile								X									X															X			
Aldrin								X									X															X			
Alpha-BHC								X									X															X			
Alpha-endosulfan								X									X															X			
Anthracene	X					X	X	X									X	X				X										X			
Benzene						X		X									X	X				X			X		X					X			
Benzidine								X									X															X			
Benzo (b) fluoranthene	X							X									X	X														X			
Benzo (a) anthracene								X									X	X														X			
Benzo (ghi) perylene	X							X									X															X			
Benzo (a) pyrene	X							X									X	X		X												X			
Benzo (k) fluoranthene								X									X	X														X			
Beta-BHC								X									X															X			
Beta-endosulfan								X									X															X			
Bis (2-chloro-ethoxy) methane								X									X															X			
Bis (2-chloro-isopropyl) ether								X									X															X			
Bis (2-chloro-ethyl) ether					X			X									X															X			
Bis (2-ethyl-hexyl) phthalate	X			X	X		X	X									X	X				X										X			
Bromoform								X									X								X							X			

	Aluminum Forming	Battery Manufacturing	Carbon Black Manufacturing	Centralized Waste Treatment	Coil Coating	Copper Forming	Electrical and Electronic Components	Electroplating	Feedlots	Fertilizer Manufacturing	Glass Manufacturing	Grain Mills	Ink Formulating	Inorganic Chemicals Manufacturing	Iron and Steel Manufacturing	Leather Tanning and Finishing	Metal Finishing	Metal Molding and Casting	Nonferrous Metals Form./Metal Powders	Nonferrous Metals Manufacturing	Oil and Gas	Organic Chems., Plastics, and Syn. Fibers	Paint Formulating	Paving and Roofing Materials	Pesticide Chemicals	Petroleum Refining	Pharmaceutical Manufacturing	Porcelain Enameling	Pulp, Paper, and Paperboard	Rubber Manufacturing	Soap and Detergent Manufacturing	Steam Electric Power Generating	Timber Products Processing	Transportation Equip. Cleaning	Waste Combustors
Butyl benzyl phthalate					X		X	X									X	X														X			
Carbon tetrachloride							X	X									X					X			X							X			
Carbazole				X																															
Chlordane (tech. mix. & metabolites)								X									X															X			
Chlorobenzene								X									X	X				X			X		X					X			
Chlorodibromo-methane								X									X								X							X			
Chloroethane								X									X					X										X			
Chloroform					X	X	X	X									X	X				X			X		X		X			X			
Chrysene	X							X									X	X														X			
Cresol				X																															
Delta-BHC								X									X															X			
Di-n-butyl phthalate	X				X		X	X									X	X														X			
Di-n-octyl phthalate								X									X															X			
Dibenzo (a,h) anthracene	X							X									X															X			
Dichlorobromo-methane							X	X									X								X							X			
Dieldrin								X									X															X			
Diethyl phthalate	X							X									X	X				X										X			
Diethylamine																											X								
Dimethyl phthalate								X									X	X				X										X			
Endosulfan sulfate	X							X									X															X			
Endrin	X							X									X															X			
Endrin aldehyde	X							X									X															X			
Ethyl acetate																											X								
Ethylbenzene	X					X	X	X									X					X			X							X			
Fluoranthene	X			X				X									X	X				X										X		X	
Fluorene	X							X									X	X				X										X			
Gamma-BHC								X									X															X			
Heptachlor epoxide								X									X															X			
Heptachlor								X									X															X			

	Aluminum Forming	Battery Manufacturing	Carbon Black Manufacturing	Centralized Waste Treatment	Coil Coating	Copper Forming	Electrical and Electronic Components	Electroplating	Feedlots	Fertilizer Manufacturing	Glass Manufacturing	Grain Mills	Ink Formulating	Inorganic Chemicals Manufacturing	Iron and Steel Manufacturing	Leather Tanning and Finishing	Metal Finishing	Metal Molding and Casting	Nonferrous Metals Form./Metal Powders	Nonferrous Metals Manufacturing	Oil and Gas	Organic Chems., Plastics, and Syn. Fibers	Paint Formulating	Paving and Roofing Materials	Pesticide Chemicals	Petroleum Refining	Pharmaceutical Manufacturing	Porcelain Enameling	Pulp, Paper, and Paperboard	Rubber Manufacturing	Soap and Detergent Manufacturing	Steam Electric Power Generating	Timber Products Processing	Transportation Equip. Cleaning	Waste Combustors
Hexachloro-benzene								X									X			X		X										X			
Hexachlorobuta-diene								X									X															X			
Hexachlorocyclo pentadiene								X									X					X										X			
Hexachloro-ethane								X									X					X										X			
Indeno (1,2,3-cd)pyrene	X							X									X															X			
Isobutylaldehyde																											X								
Isophorone	X						X	X									X															X			
Isopropyl acetate																											X								
Isopropyl ether																											X								
Methyl formate																											X								
Methyl bromide								X									X								X							X			
Methyl cellosolve																											X								
Methyl Isobutyl Ketone																											X								
Methyl chloride								X									X					X			X							X			
Methylene chloride					X	X	X	X									X	X				X			X		X					X			
n-Amyl acetate																											X								
n-Butyl acetate																											X								
n-Decane				X																															
n-Heptane																											X								
n-Hexane																											X								
N-nitrosodi-n-propylamine								X									X		X										X			X			
N-nitrosodi-methylamine								X									X		X													X			
N-nitrosodi-phenylamine	X					X		X									X		X													X			
n-Octadecane				X																															
Naphthalene	X					X	X	X							X		X	X				X			X							X			
Nitrobenzene								X									X					X										X			
Non-polar material (SGT-HEM)																																		X	
Parachloro-metacresol	X							X									X	X														X			
PCB–1016	X							X									X															X			

	Aluminum Forming	Battery Manufacturing	Carbon Black Manufacturing	Centralized Waste Treatment	Coil Coating	Copper Forming	Electrical and Electronic Components	Electroplating	Feedlots	Fertilizer Manufacturing	Glass Manufacturing	Grain Mills	Ink Formulating	Inorganic Chemicals Manufacturing	Iron and Steel Manufacturing	Leather Tanning and Finishing	Metal Finishing	Metal Molding and Casting	Nonferrous Metals Form./Metal Powders	Nonferrous Metals Manufacturing	Oil and Gas	Organic Chems., Plastics, and Syn. Fibers	Paint Formulating	Paving and Roofing Materials	Pesticide Chemicals	Petroleum Refining	Pharmaceutical Manufacturing	Porcelain Enameling	Pulp, Paper, and Paperboard	Rubber Manufacturing	Soap and Detergent Manufacturing	Steam Electric Power Generating	Timber Products Processing	Transportation Equip. Cleaning	Waste Combustors
PCB–1221	X							X									X															X			
PCB–1232	X							X									X															X			
PCB–1242	X							X									X															X			
PCB–1248	X							X									X															X			
PCB–1254	X							X									X															X			
PCB–1260	X							X									X															X			
Pentachloro-phenol					X		X	X									X	X														X			
Phenanthrene	X				X	X		X									X	X				X										X		X	
Phenol	X						X	X									X	X														X			
Pyrene	X							X									X	X				X										X			
TCDF																													X						
Tetrachloro-catechol																													X						
Tetrachloro-ethylene	X				X		X	X							X		X	X				X			X							X			
Tetrachloro-guaiacol																													X						
Tetrahydrofuran																											X								
Toluene	X				X	X	X	X									X	X				X			X		X					X			
Toxaphene								X									X															X			
Trichloro-ethylene	X					X	X	X									X	X				X										X			
Trichlorosyringol																													X						
Triethylamine																											X								
Vinyl chloride								X									X					X										X			
Xylenes																											X								
2,3,7,8-tetrachloro-dibenzo-p-dioxin								X									X												X			X			
Organic Pesticide Active Ingredients																									X										
Antimony				X			X							X					X	X												X			
Arsenic				X			X							X						X												X	X		X
Asbestos																																X			
Barium				X																															
Beryllium																				X												X			
Cadmium		X		X			X	X						X			X		X	X												X		X	X
Chromium, Total	X	X		X	X	X	X	X						X	X	X	X		X	X						X		X		X		X	X	X	X

	Aluminum Forming	Battery Manufacturing	Carbon Black Manufacturing	Centralized Waste Treatment	Coil Coating	Copper Forming	Electrical and Electronic Components	Electroplating	Feedlots	Fertilizer Manufacturing	Glass Manufacturing	Grain Mills	Ink Formulating	Inorganic Chemicals Manufacturing	Iron and Steel Manufacturing	Leather Tanning and Finishing	Metal Finishing	Metal Molding and Casting	Nonferrous Metals Form./Metal Powders	Nonferrous Metals Manufacturing	Oil and Gas	Organic Chems., Plastics, and Syn. Fibers	Paint Formulating	Paving and Roofing Materials	Pesticide Chemicals	Petroleum Refining	Pharmaceutical Manufacturing	Porcelain Enameling	Pulp, Paper, and Paperboard	Rubber Manufacturing	Soap and Detergent Manufacturing	Steam Electric Power Generating	Timber Products Processing	Transportation Equip. Cleaning	Waste Combustors
Chromium, Hexavalent														X	X																				
Cobalt		X		X										X						X															
Copper		X		X	X	X		X						X			X	X	X	X												X	X	X	X
Cyanide, Total	X	X		X	X			X						X	X		X		X	X		X			X		X					X			
Cyanide, Amenable														X			X																		
Gold																				X															
Indium																				X															
Iron														X						X															
Lead		X		X		X	X	X						X	X		X	X	X	X		X			X			X		X		X		X	X
Manganese		X			X																														
Mercury		X		X										X						X												X		X	X
Molybdenum				X															X	X															
Nickel		X		X		X		X						X	X		X		X	X								X				X		X	
Palladium																				X															
Platinum																				X															
Selenium				X										X						X												X			
Silver		X		X				X						X			X		X	X												X			X
Tantalum																				X															
Thallium																																X			
Tin				X																X															
Titanium				X																X															X
Tungsten																				X															
Vanadium				X																															
Zinc	X	X		X	X	X	X	X						X	X		X	X	X	X		X						X	X	X		X		X	X

Source: Updated from the 1991 *National Pretreatment Program Report to Congress*, pp. 5-6.

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APPENDIX D - CLEAN WATER ACT PRIORITY POLLUTANTS AND THE FEDERAL WATER QUALITY CRITERIA

The appendix below lists, in three tables, the National Recommended Water Quality Criteria for:

- Specific chemical compounds that are identified by unique Chemical Abstract Service (CAS) registry numbers;
- Priority pollutants in the form of the Criteria Maximum Concentration (CMC) and Criterion Continuous Concentration (CCC);
- Non-priority pollutants in the form of the Criteria Maximum Concentration (CMC) and Criterion Continuous Concentration (CCC) for non-priority pollutants;
- Organoleptic effects in the form of Organoleptic Effect Criteria.

Please see page D-16 for further discussion and definitions of these criteria.

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR PRIORITY POLLUTANTS

	Priority Pollutant	CAS Number	Freshwater CMC (µg/L)	Freshwater CCC (µg/L)	Saltwater CMC (µg/L)	Saltwater CCC (µg/L)	Human Health For Consumption of: Water + Organism (µg/L)	Human Health For Consumption of: Organism Only (µg/L)	FR Cite/Source
1	Antimony	7440360					14 B,Z	4300 B	57FR60848
2	Arsenic	7440382	340 A,D,K	150 A,D,K	69 A,D,bb	36 A,D,bb	0.018 C,M,S	0.14 C,M,S	62FR42160 57FR60848
3	Beryllium	7440417					J,Z	J	62FR42160
4	Cadmium	7440439	4.3 D,E,K	2.2 D,E,K	42 D,bb	9.3 D,bb	J,Z	J	62FR42160
5a	Chromium III	16065831	570 D,E,K	74 D,E,K			J,Z Total	J	EPA820/B-96 -001 62FR42160
5b	Chromium VI	18540299	16 D,K	11 D,K	1,100 D,bb	50 D,bb	J,Z Total	J	62FR42160
6	Copper	7440508	13 D,E,K,cc	9.0 D,E,K,cc	4.8 D,cc,ff	3.1 D,cc,ff	1,300 U		62FR42160
7	Lead	7439921	65 D,E,bb,gg	2.5 D,E,bb,gg	210 D,bb	8.1 D,bb	J	J	62FR42160
8	Mercury	7439976	1.4 D,K,hh	0.77 D,K,hh	1.8 D,ee,hh	0.94 D,ee,hh	0.050 B	0.051 B	62FR42160
9	Nickel	7440020	470 D,E,K	52 D,E,K	74 D,bb	8.2 D,bb	610 B	4,600 B	62FR42160
10	Selenium	7782492	L,R,T	5.0 T	290 D,bb,dd	71 D,bb,dd	170Z	11,000	62FR42160 IRIS 09/01/91
11	Silver	7440224	3.4 D,E,G		1.9 D,G				62FR42160
12	Thallium	7440280					1.7 B	6.3 B	57FR60848
13	Zinc	7440666	120 D,E,K	120 D,E,K	90 D,bb	81 D,bb	9,100 U	69,000 U	62FR42160 IRIS 10/01/92

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR PRIORITY POLLUTANTS

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health For Consumption of:		FR Cite/Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
14	Cyanide	57125	22 K,Q	5.2 K,Q	1 Q,bb	1 Q,bb	700 B,Z	220,000 B,H	EPA820/B-96-001 57FR60848
15	Asbestos	1332214					7 million fibers/L I		57FR60848
16	2,3,7,8-TCDD (Dioxin)	1746016					1.3E-8 C	1.4E-8 C	62FR42160
17	Acrolein	107028					320	780	57FR60848
18	Acrylonitrile	107131					0.059 B,C	0.66 B,C	57FR60848
19	Benzene	71432					1.2 B,C	71 B,C	62FR42160
20	Bromoform	75252					4.3 B,C	360 B,C	62FR42160
21	Carbon Tetrachloride	56235					0.25 B,C	4.4 B,C	57FR60848
22	Chlorobenzene	108907					680 B,Z	21,000 B,H	57FR60848
23	Chlorodibromomethane	124481					0.41 B,C	34 B,C	62FR42160
24	Chloroethane	75003							
25	2-Chloroethylvinyl Ether	110758							
26	Chloroform	67663					5.7 B,C	470 B,C	62FR42160
27	Dichlorobromomethane	75274					0.56 B,C	46 B,C	62FR42160
28	1,1-Dichloroethane	75343							
29	1,2-Dichloroethane	107062					0.38 B,C	99 B,C	57FR60848
30	1,1-Dichloroethylene	75354					0.057 B,C	3.2 B,C	57FR60848

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR PRIORITY POLLUTANTS

			Freshwater		Saltwater		Human Health For Consumption of:		
	Priority Pollutant	CAS Number	CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	FR Cite/Source
31	1,2-Dichloropropane	78875					0.52 B,C	39 B,C	62FR42160
32	1,3-Dichloropropene	542756					10 B	1,700 B	57FR60848
33	Ethylbenzene	100414					3,100 B,Z	29,000 B	62FR42160
34	Methyl Bromide	74839					48 B	4000 B	62FR42160
35	Methyl Chloride	74873					J	J	62FR42160
36	Methylene Chloride	75092					4.7 B,C	1600 B,C	62FR42160
37	1,1,2,2-Tetrachloroethane	79345					0.17 B,C	11 B,C	57FR60848
38	Tetrachloroethylene	127184					0.8 C	8.85 C	57FR60848
39	Toluene	108883					6,800 B,Z	200,000 B	62FR42160
40	1,2-Trans-Dichloroethylene	156605					700 B,Z	140,000 B	62FR42160
41	1,1,1-Trichloroethane	71556					J,Z	J	62FR42160
42	1,1,2-Trichloroethane	79005					0.60 B,C	42 B,C	57FR60848
43	Trichloroethylene	79016					2.7 C	81 C	57FR60848
44	Vinyl Chloride	75014					2.0 C	525 C	57FR60848
45	2-Chlorophenol	95578					120 B,U	400 B,U	62FR42160
46	2,4-Dichlorophenol	120832					93 B,U	790 B,U	57FR60848
47	2,4-Dimethylphenol	105679					540 B,U	2,300 B,U	62FR42160
48	2-Methyl-4,6-Dinitrophenol	534521					13.4	765	57FR60848
49	2,4-Dinitrophenol	51285					70 B	14,000 B	57FR60848
50	2-Nitrophenol	88755							
51	4-Nitrophenol	100027							
52	3-Methyl-4-Chlorophenol	59507					U	U	

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR PRIORITY POLLUTANTS

			Freshwater		Saltwater		Human Health For Consumption of:		
	Priority Pollutant	CAS Number	CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	FR Cite/Source
53	Pentachlorophenol	87865	19F,K	15F,K	13bb	7.9bb	0.28 B,C	8.2 B,C,H	62FR42160
54	Phenol	108952					21,000 B,U	4,600,000 B,H,U	62FR42160 57FR60848
55	2,4,6-Trichlorophenol	88062					2.1 B,C,U	6.5 B,C	62FR42160
56	Acenaphthene	83329					1,200 B,U	2,700 B,U	62FR42160
57	Acenaphthylene	208968							
58	Anthracene	120127					9,600 B	110,000 B	62FR42160
59	Benzidine	92875					0.00012 B,C	0.00054 B,C	57FR60848
60	Benzo (a) Anthracene	56553					0.0044 B,C	0.049 B,C	62FR42160
61	Benzo (a) Pyrene	50328					0.0044 B,C	0.049 B,C	62FR42160
62	Benzo (b) Fluoranthene	205992					0.0044 B,C	0.049 B,C	62FR42160
63	Benzo (ghi) Perylene	191242							
64	Benzo (k) Fluoranthene	207089					0.0044 B,C	0.049 B,C	62FR42160
65	Bis 2-Chloroethoxy Methane	111911							
66	Bis 2-Chloroethyl Ether	111444					0.031 B,C	1.4 B,C	57FR60848
67	Bis 2-Chloroisopropyl Ether	39638329					1,400 B	170,000 B	62FR42160 57FR60848
68	Bis 2-Ethylhexyl Phthalate [X]	117817					1.8 B,C	5.9 B,C	57FR60848
69	4-Bromophenyl Phenyl Ether	101553							
70	Butylbenzyl Phthalate [W]	85687					3,000 B	5,200 B	62FR42160
71	2-Chloronaphthalene	91587					1,700 B	4,300 B	62FR42160

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR PRIORITY POLLUTANTS

			Freshwater		Saltwater		Human Health For Consumption of:		
	Priority Pollutant	CAS Number	CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	FR Cite/Source
72	4-Chlorophenyl Phenyl Ether	7005723							
73	Chrysene	218019					0.0044 B,C	0.049 B,C	62FR42160
74	Dibenzo (a,h) Anthracene	53703					0.0044 B,C	0.049 B,C	62FR42160
75	1,2-Dichlorobenzene	95501					2,700 B,Z	17,000 B	62FR42160
76	1,3-Dichlorobenzene	541731					400	2,600	62FR42160
77	1,4-Dichlorobenzene	106467					400 Z	2600	62FR42160
78	3,3'-Dichlorobenzidine	91941					0.04 B,C	0.077 B,C	57FR60848
79	Diethyl Phthalate [W]	84662					23,000 B	120,000 B	57FR60848
80	Dimethyl Phthalate [W]	131113					313,000	2,900,000	57FR60848
81	Di-n-Butyl Phthalate [W]	84742					2,700 B	12,000 B	57FR60848
82	2,4-Dinitrotoluene	121142					0.11 C	9.1 C	57FR60848
83	2,6-Dinitrotoluene	606202							
84	Di-n-Octyl Phthalate	117840							
85	1,2-Diphenylhydrazine	122667					0.040 B,C	0.54 B,C	57FR60848
86	Fluoranthene	206440					300 B	370 B	62FR42160
87	Fluorene	86737					1,300 B	14,000 B	62FR42160
88	Hexachlorobenzene	118741					0.00075 B,C	0.00077 B,C	62FR42160
89	Hexachlorobutadiene	87683					0.44 B,C	50 B,C	57FR60848
90	Hexachlorocyclopentadiene	77474					240 B,U,Z	17,000 B,H,U	57FR60848
91	Hexachloroethane	67721					1.9 B,C	8.9 B,C	57FR60848

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR PRIORITY POLLUTANTS

			Freshwater		Saltwater		Human Health For Consumption of:		
	Priority Pollutant	CAS Number	CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	FR Cite/Source
92	Indeno (1,2,3-cd) Pyrene	193395					0.0044 B,C	0.049 B,C	62FR42160
93	Isophorone	78591					36 B,C	2,600 B,C	IRIS 11/01/97
94	Naphthalene	91203							
95	Nitrobenzene	98953					17 B	1,900 B,H,U	57FR60848
96	N-Nitrosodimethylamine	62759					0.00069 B,C	8.1 B,C	57FR60848
97	N-Nitrosodi-n-Propylamine	621647					0.005 B,C	1.4 B,C	62FR42160
98	N-Nitrosodiphenylamine	86306					5.0 B,C	16 B,C	57FR60848
99	Phenanthrene	85018							
100	Pyrene	129000					960 B	11,000 B	62FR42160
101	1,2,4-Trichlorobenzene	120821					260 Z	940	IRIS 11/01/96
102	Aldrin	309002	3.0 G		1.3 G		0.00013 B,C	0.00014 B,C	62FR42160
103	alpha-BHC	319846					0.0039 B,C	0.013 B,C	62FR42160
104	beta-BHC	319857					0.014 B,C	0.046 B,C	62FR42160
105	gamma-BHC (Lindane)	58899	0.95 K		0.16 G		0.019 C	0.063 C	62FR42160
106	delta-BHC	319868							
107	Chlordane	57749	2.4G	0.0043G,aa	0.09G	0.004G,aa	0.0021 B,C	0.0022 B,C	62FR42160 IRIS 02/07/98
108	4,4-DDT	50293	1.1G	0.001G,aa	0.13G	0.001G,aa	0.00059 B,C	0.00059 B,C	62FR42160
109	4,4-DDE	72559					0.00059 B,C	0.00059 B,C	62FR42160
110	4,4-DDD	72548					0.00083 B,C	0.00084 B,C	62FR42160

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR PRIORITY POLLUTANTS

			Freshwater		Saltwater		Human Health For Consumption of:		
	Priority Pollutant	CAS Number	CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	FR Cite/Source
111	Dieldrin	60571	0.24K	0.056K,O	0.71G	0.0019G,aa	0.00014 B,C	0.00014 B,C	62FR42160
112	alpha-Endosulfan	959988	0.22G,Y	0.056G,Y	0.034G,Y	0.0087G,Y	110 B	240 B	62FR42160
113	beta-Endosulfan	33213659	0.22G,Y	0.056G,Y	0.034G,Y	0.0087G,Y	110 B	240 B	62FR42160
114	Endosulfan Sulfate	1031078					110 B	240 B	62FR42160
115	Endrin	72208	0.086K	0.036K,O	0.037G	0.0023G,aa	0.76 B	0.81 B,H	62FR42160
116	Endrin Aldehyde	7421934					0.76 B	0.81 B,H	62FR42160
117	Heptachlor	76448	0.52G	0.0038G,aa	0.053G	0.0036G,aa	0.00021 B,C	0.00021 B,C	62FR42160
118	Heptachlor Epoxide	1024573	0.52G,V	0.0038G,V, aa	0.053G,V	0.0036G,V, aa	0.00010 B,C	0.00011 B,C	62FR42160
119	Polychlorinated Biphenyls PCBs:			0.014 N,aa		0.03 N,aa	0.00017 B,C,P	0.00017 B,C,P	62FR42160 63FR16182
120	Toxaphene	8001352	0.73	0.0002aa	0.21	0.0002aa	0.00073B,C	0.00075B,C	62FR42160

Footnotes:

A This recommended water quality criterion was derived from data for arsenic (III), but is applied here to total arsenic, which might imply that arsenic (III) and arsenic (V) are equally toxic to aquatic life and that their toxicities are additive. In the arsenic criteria document (EPA 440/5-84-033, January 1985), Species Mean Acute Values are given for both arsenic (III) and arsenic (V) for five species and the ratios of the SMAVs for each species range from 0.6 to 1.7. Chronic values are available for both arsenic (III) and arsenic (V) for one species; for the fathead minnow, the chronic value for arsenic (V) is 0.29 times the chronic value for arsenic (III). No data are known to be available concerning whether the toxicities of the forms of arsenic to aquatic organisms are additive.

B This criterion has been revised to reflect The Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of April 8, 1998. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.

C This criterion is based on carcinogenicity of 10^{-6} risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10^{-5} , move the decimal point in the recommended criterion one place to the right).

D Freshwater and saltwater criteria for metals are expressed in terms of the dissolved metal in the water column. The recommended water quality criteria value was calculated by using the previous 304(a) aquatic life criteria expressed in terms of total recoverable metal, and multiplying it by a conversion factor (CF). The term "Conversion Factor" (CF) represents the recommended conversion factor for converting a metal criterion expressed as the total recoverable fraction in the water column to a criterion expressed as the dissolved fraction in the water column. (Conversion Factors for saltwater CCCs are not currently available. Conversion factors derived for saltwater CMCs have been used for both saltwater CMCs and CCCs). See "Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria," October 1, 1993, by Martha G. Prothro, Acting Assistant Administrator for Water, available from the Water Resource Center, USEPA, 401 M St., SW, mail code RC4100, Washington, DC 20460; and 40CFR§131.36(b)(1). Conversion Factors applied in the table can be found in Appendix A to the Preamble- Conversion Factors for Dissolved Metals.

E The freshwater criterion for this metal is expressed as a function of hardness (mg/L) in the water column. The value given here corresponds to a hardness of 100 mg/L. Criteria values for other hardness may be calculated from the following: CMC (dissolved) = exp{mA [ln(hardness)]+ b_A} (CF), or CCC (dissolved) = exp{m_C [ln (hardness)]+ b_C} (CF) and the parameters specified in Appendix B to the Preamble- Parameters for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent.

F Freshwater aquatic life values for pentachlorophenol are expressed as a function of pH, and are calculated as follows: CMC = exp(1.005(pH)-4.869); CCC = exp(1.005(pH)-5.134). Values displayed in table correspond to a pH of 7.8.

G This Criterion is based on 304(a) aquatic life criterion issued in 1980, and was issued in one of the following documents: Aldrin/Dieldrin (EPA 440/5-80-019), Chlordane (EPA 440/5-80-027), DDT (EPA 440/5-80-038), Endosulfan (EPA 440/5-80-046), Endrin (EPA 440/5-80-047), Heptachlor (440/5-80-052), Hexachlorocyclohexane (EPA 440/5-80-054), Silver (EPA 440/5-80-071). The Minimum Data Requirements and derivation procedures were different in the 1980 Guidelines than in the 1985 Guidelines. For example, a "CMC" derived using the 1980 Guidelines was derived to be used as an instantaneous maximum. If assessment is to be done using an averaging period, the values given should be divided by 2 to obtain a value that is more comparable to a CMC derived using the 1985 Guidelines.

H No criterion for protection of human health from consumption of aquatic organisms excluding water was presented in the 1980 criteria document or in the *1986 Quality Criteria for Water*. Nevertheless, sufficient information was presented in the 1980 document to allow the calculation of a criterion, even though the results of such a calculation were not shown in the document.

I This criterion for asbestos is the Maximum Contaminant Level (MCL) developed under the Safe Drinking Water Act (SDWA).

J EPA has not calculated human health criterion for this contaminant. However, permit authorities should address this contaminant in NPDES permit actions using the State's existing narrative criteria for toxics.

K This recommended criterion is based on a 304(a) aquatic life criterion that was issued in the *1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water,* (EPA-820-B-96-001, September 1996). This value was derived using the GLI Guidelines (60FR15393-15399, March 23, 1995; 40CFR132 Appendix A); the difference between the 1985 Guidelines and the GLI Guidelines are explained on page iv of the 1995 Updates. None of the decisions concerning the derivation of this criterion were affected by any considerations that are specific to the Great Lakes.

L The CMC = 1/[(f1/CMC1) + (f2/CMC2)] where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively, and CMC1 and CMC2 are 185.9 µg/L and 12.83 µg/L, respectively.

M EPA is currently reassessing the criteria for arsenic. Upon completion of the reassessment the Agency will publish revised criteria as appropriate.

N PCBs are a class of chemicals which include aroclors, 1242, 1254, 1221, 1232, 1248, 1260, and 1016, CAS numbers 53469219, 11097691, 11104282, 11141165, 12672296, 11096825 and 12674112 respectively. The aquatic life criteria apply to this set of PCBs.

O The derivation of the CCC for this pollutant did not consider exposure through the diet, which is probably important for aquatic life occupying upper trophic levels.

P This criterion applies to total pcbs, i.e., the sum of all congener or all isomer analyses.

Q This recommended water quality criterion is expressed as µg free cyanide (as CN)/L.

R This value was announced (61FR58444-58449, November 14, 1996) as a proposed GLI 303(c) aquatic life criterion. EPA is currently working on this criterion and so this value might change substantially in the near future.

S This recommended water quality criterion refers to the inorganic form only.

T This recommended water quality criterion is expressed in terms of total recoverable metal in the water column. It is scientifically acceptable to use the conversion factor of 0.922 that was used in the GLI to convert this to a value that is expressed in terms of dissolved metal.

V This value was derived from data for heptachlor and the criteria document provides insufficient data to estimate the relative toxicities of heptachlor and heptachlor epoxide.

W Although EPA has not published a final criteria document for this compound it is EPA's understanding that sufficient data exist to allow calculation of aquatic criteria. It is anticipated that industry intends to publish in the peer reviewed literature draft aquatic life criteria generated in accordance with EPA Guidelines. EPA will review such criteria for possible issuance as national WQC.

X There is a full set of aquatic life toxicity data that show that DEHP is not toxic to aquatic organisms at or below its solubility limit.

Y This value was derived from data for endosulfan and is most appropriately applied to the sum of alpha-endosulfan and beta-endosulfan.

Z A more stringent MCL has been issued by EPA. Refer to drinking water regulations (40 CFR 141) or Safe Drinking Water Hotline (1-800-426-4791) for values.

aa This CCC is based on the Final Residue Value procedure in the 1985 Guidelines. Since the publication of the *Great Lakes Aquatic Life Criteria Guidelines* in 1995 (60FR15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.

bb This water quality criterion is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985) and was issued in one of the following criteria documents: Arsenic (EPA 440/5-84-033), Cadmium (EPA 440/5-84-032), Chromium (EPA 440/5-84-029), Copper (EPA 440/5-84-031), Cyanide (EPA 440/5-84-028), Lead (EPA 440/5-84-027), Nickel (EPA 440/5-86-004), Pentachlorophenol (EPA 440/5-86-009), Toxaphene, (EPA 440/5-86-006), Zinc (EPA 440/5-87- 003).

cc When the concentration of dissolved organic carbon is elevated, copper is substantially less toxic and use of Water-Effect Ratios might be appropriate.

dd The selenium criteria document (EPA 440/5-87-006, September 1987) provides that if selenium is as toxic to saltwater fishes in the field as it is to freshwater fishes in the field, the status of the fish community should be monitored whenever the concentration of selenium exceeds 5.0 µg/L in salt water because the saltwater CCC does not take into account uptake via the food chain.

ee This recommended water quality criterion was derived on page 43 of the mercury criteria document (EPA 440/5-84-026, January 1985). The saltwater CCC of 0.025 µg/L given on page 23 of the criteria document is based on the Final Residue Value procedure in the 1985 Guidelines. Since the publication of the *Great Lakes Aquatic Life Criteria Guidelines* in 1995 (60FR15393-15399, March 23, 1995), the Agency no longer uses the Final Residue Value procedure for deriving CCCs for new or revised 304(a) aquatic life criteria.

ff This recommended water quality criterion was derived in *Ambient Water Quality Criteria Saltwater Copper Addendum* (Draft, April 14, 1995) and was promulgated in the Interim final National Toxics Rule (60FR22228-222237, May 4, 1995).

gg EPA is actively working on this criterion and so this recommended water quality criterion may change substantially in the near future.

hh This recommended water quality criterion was derived from data for inorganic mercury (II), but is applied here to total mercury. If a substantial portion of the mercury in the water column is methylmercury, this criterion will probably be under protective. In addition, even though inorganic mercury is converted to methylmercury and methylmercury bioaccumulates to a great extent, this criterion does not account for uptake via the food chain because sufficient data were not available when the criterion was derived.

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR NON-PRIORITY POLLUTANTS

	Priority Pollutant	CAS Number	Freshwater		Saltwater		Human Health For Consumption of:		FR Cite/Source
			CMC (µg/L)	CCC (µg/L)	CMC (µg/L)	CCC (µg/L)	Water + Organism (µg/L)	Organism Only (µg/L)	
1	Alkalinity	--	*	20000 F	*	*	*	*	Gold Book
2	Aluminum pH 6.5 - 9.0	7429905	750 G,I	87 G,I,L	*	*	*	*	53FR33178
3	Ammonia	7664417	FRESHWATER CRITERIA ARE pH DEPENDENT -- SEE DOCUMENT D SALTWATER CRITERIA ARE pH AND TEMPERATURE DEPENDENT						EPA822-R-98-008 EPA440/5-88-004
4	Aesthetic Qualities	--	NARRATIVE STATEMENT -- SEE DOCUMENT						Gold Book
5	Bacteria	--	FOR PRIMARY RECREATION AND SHELLFISH USES -- SEE DOCUMENT						Gold Book
6	Barium	7440393					1,000 A		Gold Book
7	Boron	--	NARRATIVE STATEMENT -- SEE DOCUMENT						Gold Book
8	Chloride	16887006	860000 G	230000 G					53FR19028
9	Chlorine	7782505	19	11	13	7.5	C		Gold Book
10	Chlorophenoxy Herbicide 2,4,5,-TP	93721					10 A		Gold Book
11	Chlorophenoxy Herbicide 2,4-D	94757					100 A,C		Gold Book
12	Chlorpyrifos	2921882	0.083 G	0.041 G	0.011 G	0.0056 G			Gold Book
13	Color	--	NARRATIVE STATEMENT -- SEE DOCUMENT F						Gold Book
14	Demeton	8065483		0.1 F		0.1 F			Gold Book
15	Ether, Bis Chloromethyl	542881					0.00013 E	0.00078 E	IRIS 01/01/91
16	Gases, Total Dissolved	--	NARRATIVE STATEMENT -- SEE DOCUMENT F						Gold Book
17	Guthion	86500		0.01 F		0.01 F			Gold Book
18	Hardness	--	NARRATIVE STATEMENT -- SEE DOCUMENT						Gold Book

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR NON-PRIORITY POLLUTANTS

Priority Pollutant	CAS Number	Freshwater CMC (µg/L)	Freshwater CCC (µg/L)	Saltwater CMC (µg/L)	Saltwater CCC (µg/L)	Human Health For Consumption of: Water + Organism (µg/L)	Human Health For Consumption of: Organism Only (µg/L)	FR Cite/Source
19 Hexachlorocyclo-hexane-Technical	319868					0.0123	0.0414	Gold Book
20 Iron	7439896		1000 F			300 A		Gold Book
21 Malathion	121755		0.1 F		0.1 F			Gold Book
22 Manganese	7439965					50 A	100 A	Gold Book
23 Methoxychlor	72435		0.03 F		0.03 F	100 A,C		Gold Book
24 Mirex	2385855		0.001 F		0.001 F			Gold Book
25 Nitrates	14797558					10,000 A		Gold Book
26 Nitrosamines	--					0.0008	1.24	
27 Dinitrophenols	25550587					70	14,000	Gold Book
28 Nitrosodibutylamine,N	924163					0.0064 A	0.587 A	Gold Book
29 Nitrosodiethylamine,N	55185					0.0008 A	1.24 A	Gold Book
30 Nitrosopyrrolidine,N	930552					0.016	91.9	Gold Book
31 Oil and Grease	--	NARRATIVE STATEMENT -- SEE DOCUMENT F						Gold Book
32 Oxygen, Dissolved	7782447	WARMWATER AND COLDWATER MATRIX -- SEE DOCUMENT O						Gold Book
33 Parathion	56382	0.065 J	0.013 J					Gold Book
34 Pentachlorobenzene	608935					3.5 E	4.1 E	IRIS 03/01/88
35 pH	--		6.5 - 9 F		6.5 - 8.5 F,K	5 - 9		Gold Book
36 Phosphorus Elemental	7723140				0.1 F,K			Gold Book
37 Phosphate Phosphorus	--	NARRATIVE STATEMENT -- SEE DOCUMENT						Gold Book

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR NON-PRIORITY POLLUTANTS

	Priority Pollutant	CAS Number	Freshwater CMC (µg/L)	Freshwater CCC (µg/L)	Saltwater CMC (µg/L)	Saltwater CCC (µg/L)	Human Health For Consumption of: Water + Organism (µg/L)	Human Health For Consumption of: Organism Only (µg/L)	FR Cite/Source
38	Solids Dissolved and Salinity	--					250,000 A		Gold Book
39	Solids Suspended and Turbidity	--	NARRATIVE STATEMENT -- SEE DOCUMENT F						Gold Book
40	Sulfide-Hydrogen Sulfide	7783064		2.0 F		2.0 F			Gold Book
41	Tainting Substances	--	NARRATIVE STATEMENT -- SEE DOCUMENT						Gold Book
42	Temperature	--	SPECIES DEPENDENT CRITERIA -- SEE DOCUMENT M						Gold Book
43	Tetrachlorobenzene,1,2,4,5-	95943					2.3 E	2.9 E	IRIS03/01/91
44	Tributyltin TBT	--	0.46 N	0.063 N	0.37 N	0.010 N			62FR42554
45	Trichlorophenol,2,4,5-	95954					2,600 B,E	9800 B,E	IRIS 03/01/88

Footnotes:

A This human health criterion is the same as originally published in the Red Book which predates the 1980 methodology and did not utilize the fish ingestion BCF approach. This same criterion value is now published in the Gold Book.

B The organoleptic effect criterion is more stringent than the value presented in the non priority pollutants table.

C A more stringent Maximum Contaminant Level (MCL) has been issued by EPA under the Safe Drinking Water Act. Refer to drinking water regulations 40CFR141 or Safe Drinking Water Hotline (1-800-426-4791) for values.

D According to the procedures described in the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, except possibly where a very sensitive species is important at a site, freshwater aquatic life should be protected if both conditions specified in Appendix C to the Preamble--Calculation of Freshwater Ammonia Criterion are satisfied.

E This criterion has been revised to reflect The Environmental Protection Agency's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of April 8, 1998. The fish tissue bioconcentration factor (BCF) used to derive the original criterion was retained in each case.

F The derivation of this value is presented in the Red Book (EPA 440/9-76-023, July, 1976).

G This value is based on a 304(a) aquatic life criterion that was derived using the 1985 Guidelines (*Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses*, PB85-227049, January 1985) and was issued in one of the following criteria documents: Aluminum (EPA 440/5-86-008); Chloride (EPA 440/5-88-001); Chlorpyrifos (EPA 440/5-86-005).

I This value is expressed in terms of total recoverable metal in the water column.

J This value is based on a 304(a) aquatic life criterion that was issued in the *1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water* (EPA-820-B-96-001). This value was derived using the GLI Guidelines (60FR15393-15399, March 23, 1995; 40CFR132 Appendix A); the differences between the 1985 Guidelines and the GLI Guidelines are explained on page iv of the 1995 Updates. No decision concerning this criterion was affected by any considerations that are specific to the Great Lakes.

K According to page 181 of the Red Book:

> For open ocean waters where the depth is substantially greater than the euphotic zone, the pH should not be changed more than 0.2 units from the naturally occurring variation or any case outside the range of 6.5 to 8.5. For shallow, highly productive coastal and estuarine areas where naturally occurring pH variations approach the lethal limits of some species, changes in pH should be avoided but in any case should not exceed the limits established for fresh water, i.e., 6.5-9.0.

L There are three major reasons why the use of Water-Effect Ratios might be appropriate. (1) The value of 87 µg/L is based on a toxicity test with the striped bass in water with pH= 6.5-6.6 and hardness <10 mg/L. Data in "Aluminum Water-Effect Ratio for the 3M Plant Effluent Discharge, Middleway, West Virginia" (May 1994) indicate that aluminum is substantially less toxic at higher pH and hardness, but the effects of pH and hardness are not well quantified at this time. (2) In tests with the brook trout at low pH and hardness, effects increased with increasing concentrations of total aluminum even though the concentration of dissolved aluminum was constant, indicating that total recoverable is a more appropriate measurement than dissolved, at least when particulate aluminum is primarily aluminum hydroxide particles. In surface waters, however, the total recoverable procedure might measure aluminum associated with clay particles, which might be less toxic than aluminum associated with aluminum hydroxide. (3) EPA is aware of field data indicating that many high quality waters in the U.S. contain more than 87 µg aluminum/L, when either total recoverable or dissolved is measured.

M U.S. EPA. 1973. *Water Quality Criteria 1972*. EPA-R3-73-033. National Technical Information Service, Springfield, VA.; U.S. EPA. 1977. *Temperature Criteria for Freshwater Fish: Protocol and Procedures*. EPA-600/3-77-061. National Technical Information Service, Springfield, VA.

N This value was announced (62FR42554, August 7, 1997) as a proposed 304(a) aquatic life criterion. Although EPA has not responded to public comment, EPA is publishing this as a 304(a) criterion in today's notice as guidance for States and Tribes to consider when adopting water quality criteria.

O U.S. EPA. 1986. *Ambient Water Quality Criteria for Dissolved Oxygen*. EPA 440/5-86-003. National Technical Information Service, Springfield, VA.

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR ORGANOLEPTIC EFFECTS

	Pollutant	CAS Number	Organoleptic Effect Criteria (µg/L)	FR Cite/Source
1	Acenaphthene	83329	20	Gold Book
2	Monochlorobenzene	108907	20	Gold Book
3	3-Chlorophenol	--	0.1	Gold Book
4	4-Chlorophenol	106489	0.1	Gold Book
5	2,3-Dichlorophenol	--	0.04	Gold Book
6	2,5-Dichlorophenol	--	0.5	Gold Book
7	2,6-Dichlorophenol	--	0.2	Gold Book
8	3,4-Dichlorophenol	--	0.3	Gold Book
9	2,4,5-Trichlorophenol	95954	1	Gold Book
10	2,4,6-Trichloropehnol	88062	2	Gold Book
11	2,3,4,6-Tetrachlorophenol	--	1	Gold Book
12	2-Methyl-4-Chlorophenol	--	1800	Gold Book
13	3-Methyl-4-Chlorophenol	59507	3000	Gold Book
14	3-Methyl-6-Chlorophenol	--	20	Gold Book
15	2-Chlorophenol	95578	0.1	Gold Book
16	Copper	7440508	1000	Gold Book
17	2,4-Dichlorophenol	120832	0.3	Gold Book
18	2,4-Dimethylphenol	105679	400	Gold Book
19	Hexachlorocyclopentadiene	77474	1	Gold Book
20	Nitrobenzene	98953	30	Gold Book

NATIONAL RECOMMENDED WATER QUALITY CRITERIA FOR ORGANOLEPTIC EFFECTS

	Pollutant	CAS Number	Organoleptic Effect Criteria (µg/L)	FR Cite/Source
21	Pentachlorophenol	87865	30	Gold Book
22	Phenol	108952	300	Gold Book
23	Zinc	7440666	5000	45FR79341

General Notes:

1. These criteria are based on organoleptic (taste and odor) effects. Because of variations in chemical nomenclature systems, this listing of pollutants does not duplicate the listing in Appendix A of 40 CFR Part 423. Also listed are the Chemical Abstracts Service (CAS) registry numbers, which provide a unique identification for each chemical.

NATIONAL RECOMMENDED WATER QUALITY CRITERIA

Additional Notes:

1. Criteria Maximum Concentration and Criterion Continuous Concentration

The Criteria Maximum Concentration (CMC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect. The Criterion Continuous Concentration (CCC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect. The CMC and CCC are just two of the six parts of a aquatic life criterion; the other four parts are the acute averaging period, chronic averaging period, acute frequency of allowed exceedence, and chronic frequency of allowed exceedence. Because 304(a) aquatic life criteria are national guidance, they are intended to be protective of the vast majority of the aquatic communities in the United States.

2. Criteria Recommendations for Priority Pollutants, Non Priority Pollutants and Organoleptic Effects

This compilation lists all priority toxic pollutants and some non priority toxic pollutants, and both human health effect and organoleptic effect criteria issued pursuant to CWA §304(a). Blank spaces indicate that EPA has no CWA §304(a) criteria recommendations. For a number of non-priority toxic pollutants not listed, CWA §304(a) "water + organism" human health criteria are not available, but, EPA has published MCLs under the SDWA that may be used in establishing water quality standards to protect water supply designated uses. Because of variations in chemical nomenclature systems, this listing of toxic pollutants does not duplicate the listing in Appendix A of 40 CFR Part 423. Also listed are the Chemical Abstracts Service CAS registry numbers, which provide a unique identification for each chemical.

3. Human Health Risk

The human health criteria for the priority and non priority pollutants are based on carcinogenicity of 10 -6 risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10 -5 , move the decimal point in the recommended criterion one place to the right).

4. Water Quality Criteria published pursuant to Section 304(a) or Section 303(c) of the CWA

Many of the values in the compilation were published in the proposed California Toxics Rule (CTR, 62FR42160). Although such values were published pursuant to Section 303(c) of the CWA, they represent the Agency's most recent calculation of water quality criteria and thus are published today as the Agency's 304(a) criteria. Water quality criteria published in the proposed CTR may be revised when EPA takes final action on the CTR.

5. Calculation of Dissolved Metals Criteria

The 304(a) criteria for metals, shown as dissolved metals, are calculated in one of two ways. For freshwater metals criteria that are hardness-dependent, the dissolved metal criteria were calculated using a hardness of 100 mg/L as CaCO3 for illustrative purposes only. Saltwater and freshwater metals' criteria that are not hardness-dependent are calculated by multiplying the total recoverable criteria before rounding by the appropriate conversion factors. The final dissolved metals' criteria in the table are rounded to two significant figures. Information regarding the calculation of hardness dependent conversion factors are included in the footnotes.

6. Correction of Chemical Abstract Services Number

The Chemical Abstract Services number (CAS) for Bis(2-Chloroisopropyl) Ether, has been corrected in the table. The correct CAS number for this chemical is 39638-32-9. Previous publications listed 108-60-1 as the CAS number for this chemical.

7. Maximum Contaminant Levels

The compilation includes footnotes for pollutants with Maximum Contaminant Levels (MCLs) more stringent than the recommended water quality criteria in the compilation. MCLs for these pollutants are not included in the compilation, but can be found in the appropriate drinking water regulations (40 CFR 141.11-16 and 141.60-63), or can be accessed through the Safe Drinking Water Hotline (800-426-4791) or the Internet (http://www.epa.gov/ost/tools/dwstds-s.html).

8. Organoleptic Effects

The compilation contains 304(a) criteria for pollutants with toxicity-based criteria as well as non-toxicity based criteria. The basis for the non-toxicity based criteria are organoleptic effects (e.g., taste and odor) which would make water and edible aquatic life unpalatable but not toxic to humans. The table includes criteria for organoleptic effects for 23 pollutants. Pollutants with organoleptic effect criteria more stringent than the criteria based on toxicity (e.g., included in both the priority and non-priority pollutant tables) are footnoted as such.

9. Category Criteria

In the 1980 criteria documents, certain recommended water quality criteria were published for categories of pollutants rather than for individual pollutants within that category. Subsequently, in a series of separate actions, the Agency derived criteria for specific pollutants within a category. Therefore, in this compilation EPA is replacing criteria representing categories with individual pollutant criteria (e.g., 1,3-dichlorobenzene, 1,4-dichlorobenzene and 1,2-dichlorobenzene).

10. Specific Chemical Calculations

A. Selenium

(1) Human Health

In the 1980 Selenium document, a criterion for the protection of human health from consumption of water and organisms was calculated based on a BCF of 6.0 L/kg and a maximum water-related contribution of 35 mg Se/day. Subsequently, the EPA Office of Health and Environmental Assessment issued an errata notice (February 23, 1982), revising the BCF for selenium to 4.8 L/kg. In 1988, EPA issued an addendum (ECAO-CIN-668) revising the human health criteria for selenium. Later in the final National Toxic Rule (NTR, 57 FR 60848), EPA withdrew previously published selenium human health criteria, pending Agency review of new epidemiological data.

This compilation includes human health criteria for selenium, calculated using a BCF of 4.8 L/kg along with the current IRIS RfD of 0.005 mg/kg/day. EPA included these recommended water quality criteria in the compilation because the data necessary for calculating a criteria in accordance with EPA's 1980 human health methodology are available.

(2) Aquatic Life

This compilation contains aquatic life criteria for selenium that are the same as those published in the proposed CTR. In the CTR, EPA proposed an acute criterion for selenium based on the criterion proposed for selenium in the Water Quality Guidance for the Great Lakes System (61 FR 58444). The GLI and CTR proposals take into account data showing that selenium's two most prevalent oxidation states, selenite and selenate, present differing potentials for aquatic toxicity, as well as new data indicating that various forms of selenium are additive. The new approach produces a different selenium acute criterion concentration, or CMC, depending upon the relative proportions of selenite, selenate, and other forms of selenium that are present.

EPA notes it is currently undertaking a reassessment of selenium, and expects the 304(a) criteria for selenium will be revised based on the final reassessment (63FR26186). However, until such time as revised water quality criteria for selenium are published by the Agency, the recommended water quality criteria in this compilation are EPA's current 304(a) criteria.

B. 1,2,4-Trichlorobenzene and Zinc

Human health criteria for 1,2,4-trichlorobenzene and zinc have not been previously published. Sufficient information is now available for calculating water quality criteria for the protection of human health from the consumption of aquatic organisms and the consumption of aquatic organisms and water for both these compounds. Therefore, EPA is publishing criteria for these pollutants in this compilation.

C. Chromium (III)

The recommended aquatic life water quality criteria for chromium (III) included in the compilation are based on the values presented in the document titled: *1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water*, however, this document contains criteria based on the total recoverable fraction. The chromium (III) criteria in this compilation were calculated by applying the conversion factors used in the Final Water Quality Guidance for the Great Lakes System (60 FR 15366) to the 1995 Update document values.

D. Ether, Bis (Chloromethyl), Pentachlorobenzene, Tetrachlorobenzene 1,2,4,5-, Trichlorphenol

Human health criteria for these pollutants were last published in EPA's Quality Criteria for Water 1986 or "Gold Book". Some of these criteria were calculated using Acceptable Daily Intake (ADIs) rather than RfDs. Updated q1*s and RfDs are now available in IRIS for ether, bis (chloromethyl), pentachlorobenzene, tetrachlorobenzene 1,2,4,5-, and trichlorophenol, and were used to revise the water quality criteria for these compounds. The recommended water quality criteria for ether, bis (chloromethyl) were revised using an updated q1*, while criteria for pentachlorobenzene, and tetrachlorobenzene 1,2,4,5-, and trichlorophenol were derived using an updated RfD value.

E. PCBs

In this compilation EPA is publishing aquatic life and human health criteria based on total PCBs rather than individual arochlors. These criteria replace the previous criteria for the seven individual arochlors. Thus, there are criteria for a total of 102 of the 126 priority pollutants.

Conversion Factors for Dissolved Metals

Metal	Conversion Factor freshwater CMC	Conversion Factor freshwater CCC	Conversion Factor saltwater CMC	Conversion Factor saltwater CCC[1]
Arsenic	1.000	1.000	1.000	1.000
Cadmium	1.136672-[(ln hardness)(0.041838)]	1.101672-[(ln hardness)(0.041838)]	0.994	0.994
Chromium III	0.316	0.860	--	--
Chromium VI	0.982	0.962	0.993	0.993
Copper	0.960	0.960	0.83	0.83
Lead	1.46203-[(ln hardness)(0.145712)]	1.46203-[(ln hardness)(0.145712)]	0.951	0.951
Mercury	0.85	0.85	0.85	0.85
Nickel	0.998	0.997	0.990	0.990
Selenium	--	--	0.998	0.998
Silver	0.85	--	0.85	--
Zinc	0.978	0.986	0.946	0.946

Parameters* for Calculating Freshwater Dissolved Metals Criteria That Are Hardness-Dependent

Chemical	m_A	b_A	m_C	b_C	Freshwater Conversion Factors (CF)	
					Acute	Chronic
Cadmium	1.128	-3.6867	0.7852	-2.715	1.136672-[ln (hardness)(0.041838)]	1.101672-[ln (hardness)(0.041838)]
Chromium III	0.8190	3.7256	0.8190	0.6848	0.316	0.860
Copper	0.9422	-1.700	0.8545	-1.702	0.960	0.960
Lead	1.273	-1.460	1.273	-4.705	1.46203-[ln (hardness)(0.145712)]	1.46203-[ln (hardness)(0.145712)]
Nickel	0.8460	2.255	0.8460	0.0584	0.998	0.997
Silver	1.72	-6.52	--	--	0.85	--
Zinc	0.8473	0.884	0.8473	0.884	0.978	0.986

* Where m_A and b_A are conversion factors to calculate CMC and m_C and b_C are conversion factors necessary to calculate CCC

Appendix C - Calculation of Freshwater Ammonia Criterion

1. The one-hour average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CMC calculated using the following equation:

$$\text{CMC} = \frac{0.275}{1 + 10^{7.204-\text{pH}}} + \frac{39.0}{1 + 10^{\text{pH}-7.204}}$$

In situations where salmonids do not occur, the CMC may be calculated using the following equation:

$$\text{CMC} = \frac{0.411}{1 + 10^{7.204-\text{pH}}} + \frac{58.4}{1 + 10^{\text{pH}-7.204}}$$

2. The thirty-day average concentration of total ammonia nitrogen (in mg N/L) does not exceed, more than once every three years on the average, the CCC calculated using the following equation:

$$\text{CCC} = \frac{0.0858}{1 + 10^{7.688-\text{pH}}} + \frac{3.70}{1 + 10^{\text{pH}-7.688}}$$

and the highest four-day average within the 30-day period does not exceed twice the CCC.

Source: U.S. EPA's *National Recommended Water Quality Criteria-Correction*, EPA-822-Z-99-001, April 1999, pp. 7-25; http://www.epa.gov/OST/standards/wqcriteria.html

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APPENDIX E -
FEDERAL SEWAGE SLUDGE STANDARDS

Biosolids Land Application Limitations

Pollutant	**Ceiling Concentration*** (Table 1, 40 CFR 503.13)		**Monthly Average Pollutant Concentration*** (Table 3, 40 CFR 503.13)		**Cumulative Pollutant Loading Rates*** (Table 2, 40 CFR 503.13)		**Annual Pollutant Loading Rate*** (Table 4, 40 CFR 503.13)	
	mg/kg	lbs/1000 lbs	mg/kg	lbs/1000 lbs	kg/hectare	lbs/acre**	kg/hectare/ 365-day period	lbs/acre/ 365-day period**
Arsenic	75	75	41	41	41	37	2	1.8
Cadmium	85	85	39	39	39	35	1.9	1.7
Copper	4,300	4,300	1,500	1,500	1,500	1,338	75	67
Lead	840	840	300	300	300	268	15	13
Mercury	57	57	17	17	17	15	0.85	0.76
Molybdenum	75	75	-	-	-	-	-	-
Nickel	420	420	420	420	420	375	21	19
Selenium	100	100	100	100	100	89	5	4.5
Zinc	7,500	7,500	2,800	2,800	2,800	2,498	140	125

* Dry weight.

** Calculated using metric standards specified in 40 CFR 503.13 multiplied by the conversion factor of 0.8922.

Source: 40 CFR §503.13, Tables 1-4, October 25, 1995

Surface Disposal

Distance from the Boundary of Active Biosolids Unit to Surface Disposal Site Property Line (meters)	Pollutant Concentration*		
	Arsenic (mg/kg)	Chromium (mg/kg)	Nickel (mg/kg)
0 to less than 25	30	200	210
25 to less than 50	34	220	240
50 to less than 75	39	260	270
75 to less than 100	46	300	320
100 to less than 125	53	360	390
125 to less than 150	62	450	420
Equal to or greater than 150	73	600	420

* Dry-weight.

Source: 40 CFR Part 503.23 Table 1 and 2.

Conversion Factors

pounds per acre (lbs/ac) x 1.121 = kilograms per hectare (kg/ha)

kilograms per hectare (kg/ha) x 0.8922 = pounds per acre (lbs/ac)

pound (lb) = 0.4536 kilogram (kg)

kilogram (kg) = 2.205 pounds (lbs)

English ton = 0.9072 metric tonne

metric tonne = 1.102 English ton

APPENDIX F - TOXICITY CHARACTERISTIC LEACHATE PROCEDURE LIMITATIONS

EPA Hazardous Waste No.	Contaminant	CAS No.[1]	Regulatory Level (mg/L)
D004	Arsenic	7440–38–2	5.0
D005	Barium	7440–39–3	100.0
D018	Benzene	71–43–2	0.5
D006	Cadmium	7440–43–9	1.0
D019	Carbon tetrachloride	56–23–5	0.5
D020	Chlordane	57–74–9	0.03
D021	Chlorobenzene	108–90–7	100.0
D022	Chloroform	67–66–3	6.0
D007	Chromium	7440–47–3	5.0
D024	o-Cresol	95-48-7	200.0 [2]
D024	m-Cresol	108–39–4	200.0 [2]
D025	p-Cresol	106–44–5	200.0 [2]
D026	Cresols		200.0 [2]
D016	2,4-D	94–75–7	10.0
D027	1,4-Dichlorobenzene	106–46–7	7.5
D028	1,2-Dichloroethane	107–06–2	0.5
D029	1,1-Dichloroethylene	75–35–4	0.7
D030	2,4-Dinitrotoluene	121–14–2	0.13 [3]
D012	Endrin	72–20–8	0.02
D031	Heptachlor (and its epoxide)	76–44–8	0.008
D032	Hexachlorobenzene	118–74–1	0.13 [3]
D033	Hexachlorobutadiene	87–68–3	0.5
D034	Hexachloroethane	67–72–1	3.0
D008	Lead	7439–92–1	5.0
D013	Lindane	58–89–9	0.4
D009	Mercury	7439–97–6	0.2
D014	Methoxychlor	72–43–5	10.0
D035	Methyl ethyl ketone	78–93–3	200.0
D036	Nitrobenzene	98–95–3	2.0
D037	Pentachlorophenol	87–86–5	100.0
D038	Pyridine	110–86–1	5.0 [3]
D010	Selenium	7782–49–2	1.0
D011	Silver	7440–22–4	5.0
D039	Tetrachloroethylene	127–18–4	0.7
D015	Toxaphene	8001–35–2	0.5
D040	Trichloroethylene	79–01–6	0.5

EPA Hazardous Waste No.	Contaminant	CAS No.[1]	Regulatory Level (mg/L)
D041	2,4,5-Trichlorophenol	95–95–4	400.0
D042	2,4,6-Trichlorophenol	88–06–2	2.0
D017	2,4,5-TP (Silvex)	93–72–1	1.0
D043	Vinyl chloride	75–01–4	0.2

1 Chemical Abstracts Service number.

2 If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/L.

3 Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.

Source: 40 CFR 261.24

APPENDIX G - LITERATURE INHIBITION VALUES

Pollutant	Reported Range of Activated Sludge Inhibition Threshold Levels, mg/L	References*
METALS/NONMETAL INORGANICS		
Ammonia	480	(4)
Arsenic	0.1	(1), (2), (3)
Cadmium	1 - 10	(2), (3)
Chromium (VI)	1	(2), (3)
Chromium (III)	10 - 50	(2), (3)
Chromium (Total)	1 - 100	(1)
Copper	1	(2), (1), (3)
Cyanide	0.1 - 5 5	(1), (2), (3) (1)
Iodine	10	(4)
Lead	1.0 - 5.0 10 - 100	(3) (1)
Mercury	0.1 - 1 2.5 as Hg (II)	(2), (3) (1)
Nickel	1.0 - 2.5 5	(2), (3) (1)
Sulfide	25 -30	(4)
Zinc	0.3 - 5 5 - 10	(3) (1)
ORGANICS		
Anthracene	500	(1)
Benzene	100 - 500 125 - 500	(3) (1)
2-Chlorophenol	5 20 - 200	(2) (3)
1,2 Dichlorobenzene	5	(2)
1,3 Dichlorobenzene	5	(2)
1,4 Dichlorobenzene	5	(2)
2,4-Dichlorophenol	64	(3)
2,4 Dimethylphenol	40 - 200	(3)
2,4 Dinitrotoluene	5	(2)
1,2-Diphenylhydrazine	5	(2)
Ethylbenzene	200	(3)
Hexachlorobenzene	5	(2)
Naphthalene	500 500 500	(1) (2) (3)
Nitrobenzene	30 - 500 500 500	(3) (1) (2)

Pollutant	Reported Range of Activated Sludge Inhibition Threshold Levels, mg/L	References*
Pentachlorophenol	0.95 50 75 - 150	(2) (3) (1)
Phenanthrene	500 500	(1) (2)
Phenol	50 - 200 200 200	(3) (2) (1)
Toluene	200	(3)
2,4,6 Trichlorophenol	50 - 100	(1)
Surfactants	100 - 500	(4)

Pollutant	Reported Range of Trickling Filter Inhibition Threshold Levels, mg/L	References*
Chromium (III)	3.5 - 67.6	(1)
Cyanide	30	(1)

Pollutant	Reported Range of Nitrification Inhibition Threshold Levels, mg/L	References*
METALS/NONMETAL INORGANICS		
Arsenic	1.5	(2)
Cadmium	5.2	(1), (2)
Chloride	180	(4)
Chromium (VI)	1 - 10 [as $(CrO_4)^{2-}$]	(1)
Chromium (T)	0.25 - 1.9 1 - 100 (trickling filter)	(1), (2), (3) (1)
Copper	0.05 - 0.48	(2), (3)
Cyanide	0.34 - 0.5	(2), (3)
Lead	0.5	(2), (3)
Nickel	0.25 - 0.5 5	(2), (3) (1)
Zinc	0.08 - 0.5	(2), (3)
ORGANICS		
Chloroform	10	(2)
2,4-Dichlorophenol	64	(3)
2,4-Dinitrophenol	150	(2)
Phenol	4 4 - 10	(2) (3)

Pollutant	Reported Range of Anaerobic Digestion Inhibition Threshold Levels, mg/L	References*
METALS/NONMETAL INORGANICS		
Ammonia	1500 - 8000	(4)
Arsenic	1.6	(1)
Cadmium	20	(3)
Chromium (III)	130	(3)
Chromium (VI)	110	(3)
Copper	40	(3)
Cyanide	4 - 100 1 - 4	(1) (2), (3)
Lead	340	(3)
Nickel	10 136	(2), (3) (1)
Silver	13 - 65**	(3)
Sulfate	500 - 1000	(4)
Sulfide	50 - 100	(4)
Zinc	400	(3)
ORGANICS		
Acrylonitrile	5 5	(3) (2)
Carbon Tetrachloride	2.9 - 159.4 10 - 20 2.0	(1) (3) (2)
Chlorobenzene	0.96 - 3 0.96	(1) (2)
Chloroform	1 5 - 16 10 - 16	(2) (1) (3)
1,2-Dichlorobenzene	0.23 - 3.8 0.23	(1) (2)
1,4-Dichlorobenzene	1.4 - 5.3 1.4	(1) (2)
Methyl chloride	3.3 - 536.4 100	(1) (2)
Pentachlorophenol	0.2 0.2 - 1.8	(2) (1)
Tetrachloroethylene	20	(2)
Trichloroethylene	1 - 20 20 20	(1) (2) (3)
Trichlorofluoromethane	-	(2)

* Total pollutant inhibition levels, unless otherwise indicated.
** Dissolved metal inhibition levels.

(1) Jenkins, D.I., and Associates. 1984. *Impact of Toxics on Treatment Literature Review*.

(2) Russell, L. L., C. B. Cain, and D.I. Jenkins. 1984. *Impacts of Priority Pollutants on Publicly Owned Treated Works Processes: A Literature Review*. 1984 Purdue Industrial Waste Conference.

(3) Anthony, R. M., and L. H. Briemburst. 1981. *Determining Maximum Influent Concentrations of Priority Pollutants for Treatment Plants*. Journal Water Pollution Control Federation 53(10):1457-1468.

(4) U.S. EPA. 1986, *Working Document; Interferences at Publicly Owned Treatment Works*. September 1986.

Source: *EPA's Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program*, December 1987, pp. 3-44 to 3-49.

APPENDIX H - CLOSED-CUP FLASHPOINTS FOR SELECT ORGANIC COMPOUNDS

Pollutant	Closed Cup Flashpoint (˚F)
Acrolein	-15
Acrylonitrile	30
Benzene	12
Chlorobenzene	82
Chloroethane (Ethyl chloride)	-58
1,1-Dichloroethane	2
1,2-Dichloroethane (Ethylene dichloride)	56
1,1-Dichloroethylene (Vinylidene chloride)	-2
Trans-1,2-Dichloroethylene, (1,2-Dichloroethylene)	36-39
1,2-Dichloropropane (Propylene dichloride)	60
Ethylbenzene	55
Toluene	40

Source: Online *NIOSH Pocket Guide to Chemical Hazards* at http://www.cdc.gov/niosh/npg/npg.html.

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APPENDIX I - DISCHARGE SCREENING LEVELS AND HENRY'S LAW CONSTANTS FOR ORGANIC COMPOUNDS

Discharge Screening Levels Based on Explosivity

Pollutant	LELs(1) % volume / volume	LELs (mol/m^3)	Henry's Law Constant (mol/m^3)/(mg/L)	MW (g/mol)	Discharge Screening Level (mg/L)
Acrolein	2.8	1.15	8.7E-05	56.1	13163
Acrylonitrile	3.0	1.23	8.4E-05	53.1	14586
Benzene	1.2	0.49	2.9E-03	78.1	169
Chlorobenzene	1.3	0.53	1.3E-03	112.6	395
Chloroethane	3.8	1.55	7.0E-03	65.5	222
1,1-Dichloroethane	5.4	2.21	2.4E-03	99	909
1,2-Dichloroethane	6.2	2.54	4.9E-04	99	5221
1,1-Dichloroethylene	6.5	2.66	1.2E-02	97	215
Trans-1,2-Dichloroethylene	5.6	2.29	4.0E-03	97	571
1,2-Dichloropropane	3.4	1.39	1.0E-03	113	1326
Ethyl benzene	0.8	0.33	3.1E-03	106.2	106
Hydrogen Cyanide	5.6	2.30	1.7E-4	27	13529
Hydrogen Sulfide	4.0	1.64	1.7E-2	34	96
Methyl bromide	10.0	4.09	2.7E-03	95	1521
Methyl chloride	8.1	3.31	7.4E-03	50.5	450
Methylene Chloride	13.0	5.32	1.2E-03	84.9	4307
Toluene	1.1	0.45	3.0E-03	92.1	152
1,1,2-Trichloroethane	6.0	2.45	2.6E-04	133.4	9611
1,1,1-Trichloroethane	7.5	3.07	5.2E-03	133.4	591
Trichloroethylene	8.0 (F)	3.20	3.1E-03	131.4	1029
Vinyl Chloride	3.6	1.47	1.7E-02	62.5	88

Lower Explosive Limits (LELs) assumed for 25°C unless noted otherwise.
MW = molecular weight

Source: Updated in 2002 via the online *NIOSH Pocket Guide to Chemical Hazards* at http://www.cdc.gov/niosh/npg/npg.html

Discharge Screening Levels Based upon Fume Toxicity

Pollutant	Exposure Limit* (mg/m^3)	Henry's Law Constant (mg/m^3/ mg/L)	Discharge Screening Level (mg/L)	Source
Acrolein	0.23	4.9	0.047	TLV-STEL
Acrylonitrile	21.70	4.5	4.822	PEL-Ceiling, REL- Ceiling
Benzene	3.19	228.0	0.014	REL-STEL
Bromoform	5.17	22.8	0.227	PEL-TWA, TLV-TWA, REL-TWA
Carbon Tetrachloride	12.58	1185.0	0.011	REL-STEL
Chlorobenzene	345.75	151.0	2.290	PEL-TWA
Chloroethane	2,640.00	449.0	5.880	PEL-TWA
Chloroform	9.76	163.5	0.060	REL-STEL
Dichloroethane, 1,1-	405.00	240.4	1.685	PEL-TWA, TLV-TWA, REL-TWA
Dichloroethane,1,2-	8.10	48.1	0.168	REL-STEL
Dichloroethylene, 1,1-	19.80	1202.1	0.016	TLV-TWA
Trans-Dichloroethylene,1,2-	794.00	389.3	2.040	PEL-TWA, TLV-TWA, REL-TWA
Dichloropropane,1,2	508.20	118.5	4.289	TLV-STEL
Ethyl benzene	542.50	327.0	1.659	TLV-STEL, REL-STEL
Hydrogen Cyanide	5.17	4.5	1.149	TLV-Ceiling, REL-STEL
Hydrogen Sulfide	14.00	414.4	0.034	REL-Ceiling
Methyl bromide	77.80	255.5	0.305	PEL-Ceiling
Methyl chloride	207.00	371.6	0.557	TLV-STEL
Methylene Chloride	433.75	104.8	4.139	PEL-STEL
Tetrachlorethane, 1,1,2,2-	34.35	18.6	1.847	PEL-TWA
Tetrachloroethylene	678.00	717.1	0.945	TLV-STEL
Toluene	565.50	272.5	2.075	REL-STEL
Trichloroethane, 1,1,2-	54.60	34.1	1.601	PEL-TWA, TLV-TWA, REL-TWA
Trichloroethane, 1,1,1	1,911.00	692.7	2.759	REL-Ceiling
Trichloroethylene	10.74	408.7	0.026	REL-Ceiling
Vinyl Chloride	12.80	1048.0	0.012	PEL Ceiling

*Exposure limits are lowest of acute toxicity data (NIOSH REL-STEL, ACGIH TLV-STEL, OSHA PEL-STEL, NIOSH REL-Ceiling, ACGIH TLV-Ceiling, OSHA PEL-Ceiling) converted from ppm to mg/m^3 through conversion factor. If acute toxicity data were not available, the highest chronic exposure limit (NIOSH REL-TWA, ACGIH TLV-TWA, OSHA PEL-TWA) was used. See Appendix J of this manual for full list of acute and chronic exposure data.

Discharge Screening Level = Exposure Limit / Henry's Law Constant.

Henry's Law Constants Expressed in Alternate Units

Pollutant	Henry's Law Constant(2) M/atm @ 298 K (25°C)	Henry's Law Constant (atm m^3 / mol)	Henry's Law Constant (mol/m^3 / mg/L)	Henry's Law Constant (mg/m^3 / mg/L)
Acrolein	8.2	0.00012	0.000087	4.9
Acrylonitrile	9.15	0.00011	0.000084	4.5
Benzene	0.18	0.0056	0.0029	228
Bromoform	1.8	0.00056	0.000091	23
Carbon Tetrachloride	0.034	0.029	0.0077	1185
Chlorobenzene	0.27	0.0037	0.0013	151
Chloroethane	0.089	0.011	0.007	449
Chloroform	0.25	0.004	0.00137	164
1,1-Dichloroethane	0.17	0.0059	0.0024	240
1,2-Dichloroethane	0.85	0.0012	0.00049	48
1,1-Dichloroethylene	0.034	0.029	0.012	1202
Trans-1,2-Dichloroethylene	0.105	0.0095	0.004	389
1,2-Dichloropropane	0.345	0.0029	0.001	119
Ethyl benzene	0.125	0.008	0.0031	327
Hydrogen Cyanide	9.3	0.00011	0.00017	4.5
Hydrogen Sulfide	0.1	0.01	0.017	414.4
Methyl bromide	0.16	0.0063	0.0027	256
Methyl chloride	0.11	0.0091	0.0074	372
Methylene Chloride	0.39	0.0026	0.0012	105
1,1,2,2,-Tetrachlorethane	2.2	0.00045	0.00011	19
Tetrachloroethylene	0.057	0.018	0.00432	717
Toluene	0.15	0.0067	0.003	273
1,1,2-Trichloroethane	1.2	0.00083	0.00026	34
1,1,1-Trichloroethane	0.059	0.017	0.0052	693
Trichloroethylene	0.1	0.01	0.0031	409
Vinyl Chloride	0.039	0.026	0.017	1048

Source: *Compilation of Henry's Law Constants for Inorganic and Organic Species of Potential Importance in Environmental Chemistry*, R. Sanders 1999 (version 3).

H (atm m^3/mol) = [986.9 * H (M/atm)]-1

H (mg/m^3 / mg/L) = 40,893 * H(atm m^3 / mol)

H (mol/m^3 mg/L) = H (mg/m^3 / mg/L) / (1000 * MW)

MW = molecular weight in grams per mole

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APPENDIX J -
OSHA, ACGIH AND NIOSH EXPOSURE LEVELS

EXPOSURE LIMITS FROM VARIOUS AGENCIES FOR VOLATILE ORGANIC PRIORITY POLLUTANTS							
		OSHA Permissible Exposure Limits		ACGIH Threshold Limit Values		NIOSH Recommended Exposure Limits	
Volatile Organic Compounds	**mg/m^3 per ppm**	**TWA ppm**	**STEL ppm**	**TVA ppm**	**STEL ppm**	**TWA ppm**	**STEL ppm**
Acrolein	*2.29*	0.1			C 0.1	0.1	0.3
Acrylonitrile	*2.17*	2	C 10	2		1	C 10
Benzene	*3.19*	1	5	.5	2.5	0.1	1
Bromoform	*10.34*	0.5		0.5		0.5	
Carbon Tetrachloride	*6.29*	10	C 25	5	10		2
Chlorobenzene	*4.61*	75		10			
Chloroethane (Ethyl chloride)	*2.64*	1000		100			
Chloroform	*4.88*		C 50	10			2
Dichloroethane, 1,1-	*4.05*	100		100		100	
Dichloroethane,1,2- (Ethylene dichloride)	*4.05*	50	C 100	10		1	2
Dichloroethylene, 1,1- (Vinylidene chloride)	*3.96*			5			
trans-Dichloroethylene,1,2- (1,2-Dichloroethylene)	*3.97*	200		200		200	
Dichloropropane,1,2- (Propylene dichloride)	*4.62*	75		75	110		
Ethyl benzene	*4.34*	100		100	125	100	125
Hydrogen Cyanide	*1.10*	10			C 4.7		4.7
Hydrogen Sulfide	*1.40*		C 20	10	15		C 10
Methyl bromide	*3.89*		C 20	1			
Methyl chloride	*2.07*	100	C 200	50	100		
Methylene Chloride (Dichloromethane)	*3.47*	25	125	50			
Tetrachlorethane, 1,1,2,2-	*6.87*	5				1	
Tetrachloroethylene (Perchloroethylene)	*6.78*	100	C 200	25	100		
Toluene	*3.77*	200	C 300	50		100	150
Trichloroethane, 1,1,2-	*5.46*	10		10		10	
Trichloroethane, 1,1,1 (Methyl Chloroform)	*5.46*	350		350	450		C 350
Trichloroethylene	*5.37*	100	C 200	50	100	25	C 2
Vinyl Chloride	*2.56*	1	C 5	5			

Occupational Safety and Health Administration Permissible Exposure Limits (PELs) (29 CFR 1910.1000)
PEL time-weighted average (TWA) concentrations must not be exceeded during any 8-hour workshift of a 40-hour workweek. PEL short-term exposure limit (STEL) must not be exceeded over a 15-minute period unless noted otherwise. PEL ceiling concentrations (designated by "C" preceding the value in the STEL column) must not be exceeded during any part of the workday; if instantaneous monitoring is not feasible, the ceiling must be assessed as a 15-minute TWA exposure. OSHA values were updated in 2002 via the online *NIOSH Pocket Guide to Chemical Hazards*. http://www.cdc.gov/niosh/npg/npg.html.

American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs)
TLV Time-weighted average (TVA) concentrations are for a conventional 8-hour workday and a 40-hour workweek for which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. TLV short-term exposure limit (STEL) concentrations are the 15-minute TWA exposure which should not be exceeded at any time during a workday even if the 8-hour TWA is within the TLV-TWA. TLV ceiling concentrations (designated by a "C" preceding the value in the STEL column) should not be exceeded during any part of the working exposure. ACGIH values found in the *ACGIH 2002 TLVs and BEIs.*

National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (RELs)
REL time-weighted average (TWA) concentrations must not be exceeded over a 10-hour workday during a 40-hour workweek. REL short-term exposure limits (STELs) are a 15-minute TWA exposure that should not be exceeded at any time during a workday. A ceiling REL, designated by "C" preceding the value in the STEL column, should not be exceeded at any time. NIIOSH values updated in 2003 via the online *NIOSH Pocket Guide to Chemical Hazards* at http://www.cdc.gov/niosh/npg/npg.html.

APPENDIX K - LANDFILL LEACHATE LOADINGS

Landfill Leachate Monitoring Data*

Pollutant	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)	Average Concentration (mg/L)
INORGANICS			
Antimony	0.008	0.3	0.142
Arsenic	0.002	0.13	0.042
Barium	<0.1	0.55	0.201
Cadmium	< 0.001	1.25	0.03
Chromium (T)	0.007	12.1	0.633
Copper	0.007	10.87	0.395
Cyanide	0.04	0.05	0.029
Iron	1.5	4500	33.8
Lead	0.005	9.8	0.156
Manganese	0.63	73.2	13.224
Mercury	< 0002	0.002	0.002
Nickel	0.003	12.09	0.55
Selenium	< 002	0.02	0.01
Silver	< 0.01	0.05	0.019
Zinc	< 01	58	12.006
ORGANICS			
Acetone	2.8	2.8	2.8
Benzene	< 0.002	0.031	0.025
Benzoic Acid	0.02	< 0.4	0.19
Chlorobenzene	0.011	0.011	0.011
Chloroethane	< 0.001	< 0.1	0.021
p-chloro-m-Cresol	0.018	0.018	0.018
1,4-Dichlorobenzene	< 0.005	< 0.4	0.101
1,1-Dichloroethane	< 0.001	0.052	0.002
1,2-Dichloroethane	< 0.005	6.8	1.136
Ethylbenzene	0.017	0.54	0.171
Methyl Butyl Ketone	0.028	0.16	0.094
Methyl Ethyl Ketone	5.3	29	13.633
4-Methylphenol	0.065	0.065	0.065
Naphthalene	< 0.01	<0.4	0.113
N-Nitrosodiphenylamine	0.011	0.011	0.011
Pentachlorophenol	0.016	0.016	0.016
Phenol	0.008	2.9	1.06

Pollutant	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)	Average Concentration (mg/L)
Toluene	0.0082	1.6	0.735
Trichloroethene	< 0.001	< 0.1	0.025
1,1,1-Trichloroethane	0.011	0.022	0.019
2,4-Dimethyl Phenol	0.005	< 0.4	0.107
Diethyl Phthalate	0.11	0.11	0.11
Dimethyl Phthalate	0.0049	0.0049	0.0049
Di-N-Butyl Phthalate	0.0044	0.0044	0.0044
Vinyl Acetate	0.25	0.25	0.25
Vinyl Chloride	< 0.002	0.21	0.067

* Number of detections/number of observations could not be determined from data provided.

Source: U.S. EPA's *Supplemental Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Programs*, May 1991, pp. 1-30 and 1-31. "Pollutant levels reported below specified detection limit were considered in the data analysis and, for the purpose of statistical analysis, were considered to be equal to the detection limit."

Most Common Landfill Leachates*

Pollutant	Concentration Range (parts per million)
INORGANICS**	
Arsenic	0.0002 - 0.982
Barium	0.11 - 5
Cadmium	0.007 - 0.15
Chloride	31 - 5,475
Chromium (Total)	0.0005 - 1.9
Copper	0.03 - 2.8
Iron	0.22 - 2,280
Lead	0.005 - 1.6
Manganese	0.03 - 79
Nickel	0.02 - 2.2
Nitrate	0.01 - 51
Sodium	12 - 2,574
Sulfate	8 - 1,400
ORGANICS***	
1,1-Dichloroethane	0.004 - 44
Trans-1,2-Dichloroethylene	0.002 - 4.8
Ethylbenzene	0.006 - 4.9
Methylene Chloride	0.002 - 220
Phenol	0.007 - 28.8
Toluene	0.006 - 18

*	Leachate data is compiled from a database of 70 MSWLFs [U.S. EPA 1988. *Summary of Data on Municipal Solid Waste Landfill Leachate Characteristics-Criteria for Municipal Solid Waste Landfills (40 CFR Part 258) - Subtitle D of Resource Conservation and Recovery Act* (Background Document)]. Washington, DC: Office of Solid Waste.

**	Leachate data from 62 landfills.

***	Leachate data from 53 landfills.

Source: U.S. EPA's *National Pretreatment Program Report to Congress*, July 1991, p. 3-81.

Contaminant Concentration Ranges in Municipal Leachate

Pollutant Parameter	George (1972)	Chain /DeWalle (1977)	Metry/ Cross (1977)	Cameron (1978)	Wisconsin Report (20 Sites)	Sobotka Report (44 Sites)
CONVENTIONAL						
BOD	9 - 54,610	81 - 33,360	2,200 - 720,000	9 - 55,000	ND - 195,000	7 - 21,600
pH	3.7 - 8.5	3.7 - 8.5	3.7 - 8.5	3.7 - 8.5	5 - 8.9	5.4 - 8.0
TSS	6 - 2,685	10 - 700	13 - 26,500		2 - 140,900	28 - 2,835
NON-CONVENTIONAL						
Alkalinity	0 - 20,850	0 - 20,850	310 - 9,500	0 - 20,900	ND - 15,050	0 - 7,375
Bicarbonate			3,260 - 5,730			
Chlorides	34 - 2,800	4.7 - 2,467	47 - 2,350	34 - 2,800	2 - 11,375	120 - 5,475
COD	0 - 89,520	40 - 89,520	800 - 750,000	0 - 9,000	6.6 - 97,900	440 - 50,450
Fluorides				0 - 2.13	0 - 0.74	0.12 - 0.790
Hardness	0 - 22,800	0 - 22,800	35 - 8,700	0 - 22,800	52 - 225,000	0.8 - 9,380
NH_3-Nitrogen	0 - 1,106	0 - 1,106	0.2 - 845	0 - 1,106		11.3 - 1,200
NO -Nitrogen	0 - 1,300	0.2 - 1,0.29	4.5 - 18			0 - 5,0.95
Organic Nitrogen			2.4 - 550			4.5 - 78.2
Ortho-Phosphorus		6.5 - 85	0.3 - 136	0 - 154		
Sulfates	1 - 1,826	1 - 1,558	20 - 1,370	0 - 1,826	ND - 1,850	8 - 500
Sulfide				0 - 0.13		
TOC		256 - 28,000			ND - 30,500	5 - 6,884
TDS	0 - 42,276	584 - 44,900	100 - 51,000	0 - 42,300	584 - 50,430	1,400 - 16,120
Total-K-Nitrogen	0 - 1,416				2 - 3,320	47.3 - 938
Total Phosphorus	1 - 154	0 - 130			ND - 234	
Total Solids		0 - 59,200				1,900 - 25,873
METALS						
Aluminum				0 - 122	ND - 85	0.010 - 5.07
Arsenic				0 - 11.6	ND - 70.2	0 - 0.08
Barium				0 - 5.4	ND - 12.5	0.01 - 10
Beryllium				0 - 0.3	ND - 0.36	0.001 - 0.01

Pollutant Parameter	George (1972)	Chain /DeWalle (1977)	Metry/ Cross (1977)	Cameron (1978)	Wisconsin Report (20 Sites)	Sobotka Report (44 Sites)
Boron				0.3 - 73	0.867 - 13	
Cadmium		0.03 - 17		0 - 0.19	ND - 0.04	0 - 0.1
Calcium	5 - 4,080	60 - 7,200	240 - 2,570	5 - 4,000	200 - 2,500	95.5 - 2,100
Total Chromium				0 - 33.4	ND - 5.6	0.001 - 1.0
Copper	0 - 9.9	0 - 9.9		0 - 10	ND - 4.06	0.003 - 0.32
Cyanide				0 - 0.11	ND - 6	0 - 4.0
Iron	0.2 - 5,500	0 - 2,820	0.12 - 1,700	0.2 - 5,500	ND - 1,500	0.22 - 1,400
Lead	0 - 0.5	<0.10 - 2.0		0 - 5.0	0 - 14.2	0.001 - 1.11
Magnesium	16.5 - 15,600	17 - 15,600	64 - 547	16.5 - 15,600	ND - 780	76 - 927
Manganese	0.06 - 1,400	0.09 - 125	13	0.06 - 1,400	ND - 31.1	0.03 - 43
Mercury				0 - 0.064	ND - 0.01	0 - 0.02
Molybdenum				0 - 0.52	0.01 - 1.43	
Nickel				0.01 - 0.8	ND - 7.5	0.01 - 1.25
Potassium	2.8 - 3,770	28 - 3,770	28 - 3,800	2.8 - 3,770	ND - 2,800	30 - 1,375
Sodium	0 - 7,700	0 - 7,700	85 - 3,800	0 - 7,700	12 - 6,010	
Titanium				0 - 5.0	<0.01	
Vanadium				0 - 1.4	0.01	
Zinc	0 - 1,000	0 - 370	0.03 - 135	0 - 1,000	ND - 731	0.01 - 67

All concentrations in mg/L, except pH (standard units).
ND = Non-detect

Source: U*.S. EPA's Technical Development Document for Proposed Effluent Limitations Guidelines and Standards for the Landfills Point Source Category*, EPA 821-R-97-022, January 1998, Table 6-3.

* Literature sources were:

George, J. A., *Sanitary Landfill-Gas and Leachate Control, the National Perspective*, Office of Solid Waste Management Programs, U.S. EPA, 1972.

Chian, E. S., and F. B. DeWalle, *Evaluation of Leachate Treatment, Volume I, Characterization of Leachate*, EPA-600/2-77-186a.

Metry, A. A., and F. L. Cross, *Leachate Control and Treatment*, Volume 7, Environmental Monograph Series, Technomic Publishing Co., Westport, CT, 1977.

Cameron, R. D., *The Effect of Solid Waste Landfill Leachates on Receiving Waters*, Journal AWWA, March 1978.

McGinley, Paul M., and Peter Met. *Formation, Characteristics, Treatment and Disposal of Leachate from Municipal Solid Waste Landfills*, Wisconsin Department of Natural Resources Special Report, August 1, 1984.

Sobotka & Co., Inc., Case History Data Compiled and Reported to the U.S. Environmental Protection Agency Economic Analysis Branch, Office of Solid Waste, 1986.

APPENDIX L -
HAULED WASTE LOADINGS

Septage Hauler Monitoring Data

Pollutant	Number of Detections	Number of Samples	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)	Average Concentration (mg/L)
INORGANICS					
Arsenic	144	145	0	3.5	0.141
Barium	128	128	0.002	202	5.758
Cadmium	825	1097	0.005	8.1	0.097
Chromium (T)	931	1019	0.01	34	0.49
Cobalt	16	32	< 0.003	3.45	0.406
Copper	963	971	0.01	260.9	4.835
Cyanide	575	577	0.001	1.53	0.469
Iron	464	464	0.2	2740	39.287
Lead	962	1067	< 0.025	118	1.21
Manganese	5	5	0.55	17.05	6.088
Mercury	582	703	0.0001	0.742	0.005
Nickel	813	1030	0.01	37	0.526
Silver	237	272	< 0.003	5	0.099
Tin	11	25	< 015	1	0.076
Zinc	959	967	< 0.001	444	9.971
NONCONVENTIONALS					
COD	183	183	510	117500	21247.951
ORGANICS					
Acetone	118	118	0	210	10.588
Benzene	112	112	0.005	3.1	0.062
Ethylbenzene	115	115	0.005	1.7	0.067
Isopropyl Alcohol	117	117	1	391	14.055
Methyl Alcohol	117	117	1	396	15.84
Methyl Ethyl Ketone	115	115	1	240	3.65
Methylene Chloride	115	115	0.005	2.2	0.101
Toluene	113	113	0.005	1.95	0.17
Xylene	87	87	0.005	0.72	0.051

Source: U.S. EPA's *Supplemental Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Programs*, 21W-4002, May 1991, pp. 1-27 and 1-28. "Pollutant levels reported below specified detection limit were considered in the data analysis and, for the purpose of statistical analysis, were considered equal to the detection limit."

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APPENDIX M -
HAZARDOUS WASTE CONSTITUENTS - RCRA APPENDIX VIII

Constituent	CAS No.	Hazardous Waste No.
A2213	30558-43-1	U394
Acetonitrile	75-05-8	U003
Acetophenone	98-86-2	U004
2-Acetylaminefluarone	53-96-3	U005
Acetyl chloride	75-36-5	U006
1-Acetyl-2-thiourea	591-08-2	P002
Acrolein	107-02-8	P003
Acrylamide	79-06-1	U007
Acrylonitrile	107-13-1	U009
Aflatoxins	1402-68-2	-
Aldicarb	116-06-3	P070
Aldicarb sulfone	1646-88-4	P203
Aldrin	309-00-2	P004
Allyl alcohol	107-18-6	P005
Allyl chloride	107-18-6	-
Aluminum phosphide	20859-73-8	P006
4-Aminobiphenyl	92-67-1	-
5-(Aminomethyl)-3-isoxazolol	2763-96-4	P007
4-Aminopyridine	504-24-5	P008
Amitrole	61-82-5	U011
Ammonium vanadate	7803-55-6	P119
Aniline	62-53-3	U012
Antimony	7440-36-0	-
Antimony compounds, N.O.S.	-	-
Aramite	140-57-8	-
Arsenic	7440-38-2	-
Arsenic compounds, N.O.S.	-	-
Arsenic acid	7778-39-4	P010
Arsenic pentoxide	1303-28-2	P011
Arsenic trioxide	1327-53-3	P012
Auramine	492-80-8	U014
Azaserine	115-02-6	U015
Barban	101-27-9	U280
Barium	7440-39-3	-
Barium compounds, N.O.S.	-	-
Barium cyanide	542-62-1	P013
Bendiocarb	22781-23-3	U278
Bendiocarb phenol	22961-82-6	U364
Benomyl	17804-35-2	U271
Benz[c]acridine	225-51-4	U016
Benz[a]anthracene	56-55-3	U018
Benzal chloride	98-87-3	U017
Benzene	71-43-2	U019
Benzenearsonic acid	98-05-5	-
Benzidine	92-87-5	U021
Benzo[b]fluoranthene	205-99-2	-
Benzo[j]fluoranthene	205-82-3	-
Benzo(k)fluoranthene	207-08-9	-
Benzo[a]pyrene	50-32-8	U022
p-Benzoquinone	106-51-4	U197
Benzotrichloride	98-07-7	U023
Benzyl chloride	100-44-7	P028
Beryllium powder	7440-41-7	P015
Beryllium compounds, not otherwise specified (NOS)	-	-

Constituent	CAS No.	Hazardous Waste No.
Bis(pentamethylene)-thiuram tetrasulfide	120-54-7	-
Bromoacetone	598-31-2	P017
Bromoform	75-25-2	U225
4-Bromophenyl phenyl ether	101-55-3	U030
Brucine	357-57-3	P018
Butyl benzyl phthalate	85-68-7	-
Butylate	2008-41-5	-
Cacodylic acid	75-60-5	U136
Cadmium	7440-43-9	-
Cadmium compounds, NOS	-	-
Calcium chromate	13765-19-0	U032
Calcium cyanide	592-01-8	P021
Carbaryl	63-25-2	U279
Carbendazim	10605-21-7	U372
Carbofuran	1563-66-2	P127
Carbofuran phenol	1563-38-8	U367
Carbon disulfide	75-15-0	P022
Carbon oxyfluoride	353-50-4	U033
Carbon tetrachloride	56-23-5	U211
Carbosulfan	55285-14-8	P189
Chloral	75-87-6	U034
Chlorambucil	305-03-3	U035
Chlordane	57-74-9	U036
Chlordane (alpha and gamma isomers)	-	U036
Chlorinated benzenes, NOS	-	-
Chlorinated ethane, NOS	-	-
Chlorinated fluorocarbons, NOS	-	-
Chlorinated naphthalene, NOS	-	-
Chlorinated phenol, NOS	-	-
Chlornaphazin	494-03-1	U026
Chloroacetaldehyde	107-20-0	P023
Chloroalkyl ethers, NOS	-	-
p-Chloroaniline	106-47-8	P024
Chlorobenzene	108-90-7	U037
Chlorobenzilate	510-15-6	U038
p-Chloro-m-cresol	59-50-7	U039
2-Chloroethyl vinyl ether	110-75-8	U042
Chloroform	67-66-3	U044
Chloromethyl methyl ether	107-30-2	U046
beta-Chloronaphthalene	91-58-7	U047
o-Chlorophenol	95-57-8	U048
1-(o-Chlorophenyl)thiourea	5344-82-1	P026
Chloroprene	126-99-8	-
3-Chloropropionitrile	542-76-7	P027
Chromium	7440-47-3	-
Chromium compounds, NOS	-	-
Chrysene	218-01-9	U050
Citrus red No. 2	6358-53-8	-
Coal tar creosote	8007-45-2	-
Copper cyanide	544-92-3	P029
Copper dimethyldithiocarbamate	137-29-1	-
Creosote	-	U051
Cresol (Cresylic acid)	1319-77-3	U052
Crotonaldehyde	4170-30-3	U053
m-Cumenyl methylcarbamate	64-00-6	P202
Cyanides (soluble salts and complexes), NOS	-	P030
Cyanogen	460-19-5	P031
Cyanogen bromide	506-68-3	U246
Cyanogen chloride	506-77-4	P033

Constituent	CAS No.	Hazardous Waste No.
Cycasin	14901-08-7	-
Cycloate	1134-23-2	-
2-Cyclohexyl-4,6-dinitrophenol	131-89-5	P034
Cyclophosphamide	50-18-0	U058
2,4-D	94-75-7	U240
2,4-D, salts, esters	-	U240
Daunomycin	20830-81-3	U059
Dazomet	533-74-4	-
DDD	72-54-8	U060
DDE	72-55-9	-
DDT	50-29-3	U061
Diallate	2303-16-4	U062
Dibenz[a,h]acridine	226-36-8	-
Dibenz[a,j]acridine	224-42-0	-
Dibenz[a,h]anthracene	53-70-3	U063
7H-Dibenzo[c,g]carbazole	194-59-2	-
Dibenzo[a,e]pyrene	192-65-4	-
Dibenzo[a,h]pyrene	189-64-0	-
Dibenzo[a,i]pyrene	189-55-9	U064
1,2-Dibromo-3-chloropropane	96-12-8	U066
Dibutyl phthalate	84-74-2	U069
o-Dichlorobenzene	95-50-1	U070
m-Dichlorobenzene	541-73-1	U071
p-Dichlorobenzene	106-46-7	U072
Dichlorobenzene, NOS	25321-22-6	-
3,3’-Dichlorobenzidine	91-94-1	U073
1,4-Dichloro-2-butene	764-41-0	U074
Dichlorodifluoromethane	75-71-8	U075
Dichloroethylene, NOS	25323-30-2	-
1,1-Dichloroethylene	75-35-4	U078
1,2-Dichloroethylene	156-60-5	U079
Dichloroethyl ether	111-44-4	U025
Dichloroisopropyl ether	108-60-1	U027
Dichloromethoxy ethane	111-91-1	U024
Dichloromethyl ether	542-88-1	P016
2,4-Dichlorophenol	120-83-2	U081
2,6-Dichlorophenol	87-65-0	U082
Dichlorophenylarsine	696-28-6	P036
Dichloropropane, NOS	26638-19-7	-
Dichloropropanol, NOS	26545-73-3	-
Dichloropropene, NOS	26952-23-8	-
1,3-Dichloropropene	542-75-6	U084
Dieldrin	60-57-1	P037
1,2:3,4-Diepoxybutane	1464-53-5	U085
Diethylarsine	692-42-2	P038
Diethylene glycol, dicarbamate	5952-26-1	U395
1,4-Diethyleneoxide	123-91-1	U108
Diethylhexyl phthalate	117-81-7	U028
N,N'-Diethylhydrazine	1615-80-1	U086
O,O-Diethyl S-methyl dithiophosphate	3288-58-2	U087
Diethyl-p-nitrophenyl phosphate	311-45-5	P041
Diethyl phthalate	84-66-2	U088
O,O-Diethyl O-pyrazinyl phosphoro- thioate	297-97-2	P040
Diethylstilbesterol	56-53-1	U089
Dihydrosafrole	94-58-6	U090
Diisopropylfluorophosphate (DFP)	55-91-4	P043
Dimethoate	60-51-5	P044
3,3'-Dimethoxybenzidine	119-90-4	U091
p-Dimethylaminoazobenzene	60-11-7	U093

Constituent	CAS No.	Hazardous Waste No.
7,12-Dimethylbenz[a]anthracene	57-97-6	U094
3,3'-Dimethylbenzidine	119-93-7	U095
Dimethylcarbamoyl chloride	79-44-7	U097
1,1-Dimethylhydrazine	57-14-7	U098
1,2-Dimethylhydrazine	540-73-8	U099
alpha,alpha-Dimethylphenethylamine	122-09-8	P046
2,4-Dimethylphenol	105-67-9	U101
Dimethyl phthalate	131-11-3	U102
Dimethyl sulfate	77-78-1	U103
Dimetilan	644-64-4	P191
Dinitrobenzene, NOS	25154-54-5	-
4,6-Dinitro-o-cresol	534-52-1	P047
4,6-Dinitro-o-cresol salts	-	P047
2,4-Dinitrophenol	51-28-5	P048
2,4-Dinitrotoluene	121-14-2	U105
2,6-Dinitrotoluene	606-20-2	U106
Dinoseb	88-85-7	P020
Di-n-octyl phthalate	117-84-0	U017
Diphenylamine	122-39-4	-
1,2-Diphenylhydrazine	122-66-7	U109
Di-n-propylnitrosamine	621-64-7	U111
Disulfiram	97-77-8	-
Disulfoton	298-04-4	P039
Dithiobiuret	541-53-7	P049
Endosulfan	115-29-7	P050
Endothall	145-73-3	P088
Endrin	72-20-8	P051
Endrin metabolites	-	P051
Epichlorohydrin	106-89-8	U041
Epinephrine	51-43-4	P042
EPTC	759-94-4	-
Ethyl carbamate (urethane)	51-79-6	U238
Ethyl cyanide	107-12-0	P101
Ethyl Ziram	14324-55-1	-
Ethylenebisdithiocarbamic acid	111-54-6	U114
Ethylenebisdithiocarbamic acid, salts and esters	-	U114
Ethylene dibromide	106-93-4	U067
Ethylene dichloride	107-06-2	U077
Ethylene glycol monoethyl ether	110-80-5	U359
Ethyleneimine	151-56-4	P054
Ethylene oxide	75-21-8	U115
Ethylenethiourea	96-45-7	U116
Ethylidene dichloride	75-34-3	U076
Ethyl methacrylate	97-63-2	U118
Ethyl methanesulfonate	62-50-0	U119
Famphur	52-85-7	P097
Ferbam	14484-64-1	-
Fluoranthene	206-44-0	U120
Fluorine	7782-41-4	P056
Fluoroacetamide	640-19-7	P057
Fluoroacetic acid, sodium salt	62-74-8	P058
Formaldehyde	50-00-0	U122
Formetanate hydrochloride	23422-53-9	P198
Formic acid	64-18-6	U123
Formparanate	17702-57-7	P197
Glycidylaldehyde	765-34-4	U126

Constituent	CAS No.	Hazardous Waste No.
Halomethanes, NOS	-	-
Heptachlor	76-44-8	P059
Heptachlor epoxide	1024-57-3	-
Heptachlor epoxide (alpha, beta, and gamma isomers)	-	-
Heptachlorodibenzofurans	-	-
Heptachlorodibenzo-p-dioxins	-	-
Hexachlorobenzene	118-74-1	U127
Hexachlorobutadiene	87-68-3	U128
Hexachlorocyclopentadiene	77-47-4	U130
Hexachlorodibenzo-p-dioxins	-	-
Hexachlorodibenzofurans	-	-
Hexachloroethane	67-72-1	U131
Hexachlorophene	70-30-4	U132
Hexachloropropene	1888-71-7	U243
Hexaethyl tetraphosphate	757-58-4	P062
Hydrazine	302-01-2	U133
Hydrogen cyanide	74-90-8	P063
Hydrogen fluoride	7664-39-3	U134
Hydrogen sulfide	7783-06-4	U135
Indeno[1,2,3-cd]pyrene	193-39-5	U137
3-Iodo-2-propynyl n-butylcarbamate	55406-53-6	-
Isobutyl alcohol	78-83-1	U140
Isodrin	465-73-6	P060
Isolan	119-38-0	P192
Isosafrole	120-58-1	U141
Kepone	143-50-0	U142
Lasiocarpine	303-34-1	U143
Lead	7439-92-1	-
Lead compounds, NOS	-	-
Lead acetate	301-04-2	U144
Lead phosphate	7446-27-7	U145
Lead subacetate	1335-32-6	U146
Lindane	58-89-9	U129
Maleic anhydride	108-31-6	U147
Maleic hydrazide	123-33-1	U148
Malononitrile	109-77-3	U149
Manganese dimethyldithiocarbamate	15339-36-3	P196
Melphalan	148-82-3	U150
Mercury	7439-97-6	U151
Mercury compounds, NOS	-	-
Mercury fulminate	628-86-4	P065
Metam Sodium	137-42-8	-
Methacrylonitrile	126-98-7	U152
Methapyrilene	91-80-5	U155
Methiocarb	2032-65-7	P199
Methomyl	16752-77-5	P066
Methoxychlor	72-43-5	U247
Methyl bromide	74-83-9	U029
Methyl chloride	74-87-3	U045
Methyl chlorocarbonate	79-22-1	U156
Methyl chloroform	71-55-6	U226
3-Methylcholanthrene	56-49-5	U157
4,4'-Methylenebis(2-chloroaniline)	101-14-4	U158
Methylene bromide	74-95-3	U068
Methylene chloride	75-09-2	U080
Methyl ethyl ketone (MEK)	78-93-3	U159
Methyl ethyl ketone peroxide	1338-23-4	U160
Methyl hydrazine	60-34-4	P068
Methyl iodide	74-88-4	U138

Constituent	CAS No.	Hazardous Waste No.
Methyl isocyanate	624-83-9	P064
2-Methyllactonitrile	75-86-5	P069
Methyl methacrylate	80-62-6	U162
Methyl methanesulfonate	66-27-3	-
Methyl parathion	298-00-0	P071
Methylthiouracil	56-04-2	U164
Metolcarb	1129-41-5	P190
Mexacarbate	315-18-4	P128
Mitomycin C	50-07-7	U010
MNNG	70-25-7	U163
Molinate	2212-67-1	-
Mustard gas	505-60-2	-
Naphthalene	91-20-3	U165
1,4-Naphthoquinone	130-15-4	U166
alpha-Naphthylamine	134-32-7	U167
beta-Naphthylamine	91-59-8	U168
alpha-Naphthylthiourea	86-88-4	P072
Nickel	7440-02-0	-
Nickel compounds, NOS	-	-
Nickel carbonyl	13463-39-3	P073
Nickel cyanide	557-19-7	P074
Nicotine	54-11-5	P075
Nicotine salts	-	P075
Nitric oxide	10102-43-9	P076
p-Nitroaniline	100-01-6	P077
Nitrobenzene	98-95-3	U169
Nitrogen dioxide	10102-44-0	P078
Nitrogen mustard	51-75-2	-
Nitrogen mustard, hydrochloride salt	-	-
Nitrogen mustard N-oxide	126-85-2	-
Nitrogen mustard, N-oxide, hydro- chloride salt	-	-
Nitroglycerin	55-63-0	P081
p-Nitrophenol	100-02-7	U170
2-Nitropropane	79-46-9	U171
Nitrosamines, NOS	35576-91-1D	-
N-Nitrosodi-n-butylamine	924-16-3	U172
N-Nitrosodiethanolamine	1116-54-7	U173
N-Nitrosodiethylamine	55-18-5	U174
N-Nitrosodimethylamine	62-75-9	P082
N-Nitroso-N-ethylurea	759-73-9	U176
N-Nitrosomethylethylamine	10595-95-6	-
N-Nitroso-N-methylurea	684-93-5	U177
N-Nitroso-N-methylurethane	615-53-2	U178
N-Nitrosomethylvinylamine	4549-40-0	P084
N-Nitrosomorpholine	59-89-2	-
N-Nitrosonornicotine	16543-55-8	-
N-Nitrosopiperidine	100-75-4	U179
N-Nitrosopyrrolidine	930-55-2	U180
N-Nitrososarcosine	13256-22-9	-
5-Nitro-o-toluidine	99-55-8	U181
Octamethylpyrophosphoramide	152-16-9	P085
Osmium tetroxide	20816-12-0	P087
Oxamyl	23135-22-0	P194
Paraldehyde	123-63-7	U182
Parathion	56-38-2	P089
Pebulate	1114-71-2	-
Pentachlorobenzene	608-93-5	U183
Pentachlorodibenzo-p-dioxins	-	-
Pentachlorodibenzofurans	-	-

Constituent	CAS No.	Hazardous Waste No.
Pentachloroethane	76-01-7	U184
Pentachloronitrobenzene (PCNB)	82-68-8	U185
Pentachlorophenol	87-86-5	F027
Phenacetin	62-44-2	U187
Phenol	108-95-2	U188
Phenylenediamine	25265-76-3	-
Phenylmercury acetate	62-38-4	P092
Phenylthiourea	103-85-5	P093
Phosgene	75-44-5	P095
Phosphine	7803-51-2	P096
Phorate	298-02-2	P094
Phthalic acid esters, NOS	-	-
Phthalic anhydride	85-44-9	U190
Physostigmine	57-47-6	P204
Physostigmine salicylate	57-64-7	P188
2-Picoline	109-06-8	U191
Polychlorinated biphenyls, NOS		-
Potassium cyanide	151-50-8	P098
Potassium dimethyldithiocarbamate	128-03-0	-
Potassium n-hydroxymethyl-n-methyl-dithiocarbamate	51026-28-9	-
Potassium n-methyldithiocarbamate	137-41-7	-
Potassium pentachlorophenate	7778736	-
Potassium silver cyanide	506-61-6	P099
Promecarb	2631-37-0	P201
Pronamide	23950-58-5	U192
1,3-Propane sultone	1120-71-4	U193
n-Propylamine	107-10-8	U194
Propargyl alcohol	107-19-7	P102
Propham	122-42-9	U373
Propoxur	114-26-1	U411
Propylene dichloride	78-87-5	U083
1,2-Propylenimine	75-55-8	P067
Propylthiouracil	51-52-5	-
Prosulfocarb	52888-80-9	U387
Pyridine	110-86-1	U196
Reserpine	50-55-5	U200
Resorcinol	108-46-3	U201
Saccharin	81-07-2	U202
Saccharin salts	-	U202
Safrole	94-59-7	U203
Selenium	7782-49-2	-
Selenium compounds, NOS	-	-
Selenium dioxide	7783-00-8	U204
Selenium sulfide	7488-56-4	U205
Selenium, tetrakis(dimethyl-dithiocarbamate)	144-34-3	-
Selenourea	630-10-4	P103
Silver	7440-22-4	-
Silver compounds, NOS	-	-
Silver cyanide	506-64-9	P104
Silvex (2,4,5-TP)	93-72-1	F027
Sodium cyanide	143-33-9	P106
Sodium dibutyldithiocarbamate	136-30-1	-
Sodium diethyldithiocarbamate	148-18-5	-
Sodium dimethyldithiocarbamate	128-04-1	-
Sodium pentachlorophenate	131522	None
Streptozotocin	18883-66-4	U206
Strychnine	57-24-9	P108
Strychnine salts	-	P108
Sulfallate	95-06-7	-

Constituent	CAS No.	Hazardous Waste No.
TCDD	1746-01-6	-
Tetrabutylthiuram disulfide	1634-02-2	-
1,2,4,5-Tetrachlorobenzene	95-94-3	U207
Tetrachlorodibenzo-p-dioxins	-	-
Tetrachlorodibenzofurans	-	-
Tetrachloroethane, NOS	25322-20-7	-
1,1,1,2-Tetrachloroethane	630-20-6	U208
1,1,2,2-Tetrachloroethane	79-34-5	U209
Tetrachloroethylene	127-18-4	U210
2,3,4,6-Tetrachlorophenol	58-90-2	F027
2,3,4,6-tetrachlorophenol, potassium salt	53535276	-
2,3,4,6-tetrachlorophenol, sodium salt	25567559	-
Tetraethyldithiopyrophosphate	3689-24-5	P109
Tetraethyl lead	78-00-2	P110
Tetraethyl pyrophosphate	107-49-3	P111
Tetramethylthiuram monosulfide	97-74-5	-
Tetranitromethane	509-14-8	P112
Thallium	7440-28-0	-
Thallium compounds, NOS	-	-
Thallic oxide	1314-32-5	P113
Thallium(I) acetate	563-68-8	U214
Thallium(I) carbonate	6533-73-9	U215
Thallium(I) chloride	7791-12-0	U216
Thallium(I) nitrate	10102-45-1	U217
Thallium selenite	12039-52-0	P114
Thallium(I) sulfate	7446-18-6	P115
Thioacetamide	62-55-5	U218
Thiodicarb	59669-26-0	U410
Thiofanox	39196-18-4	P045
Thiomethanol	74-93-1	U153
Thiophanate-methyl	23564-05-8	U409
Thiophenol	108-98-5	P014
Thiosemicarbazide	79-19-6	P116
Thiourea	62-56-6	U219
Thiram	137-26-8	U244
Tirpate	26419-73-8	P185
Toluene	108-88-3	U220
Toluenediamine	25376-45-8	U221
Toluene-2,4-diamine	95-80-7	-
Toluene-2,6-diamine	823-40-5	-
Toluene-3,4-diamine	496-72-0	-
Toluene diisocyanate	26471-62-5	U223
o-Toluidine	95-53-4	U328
o-Toluidine hydrochloride	636-21-5	U222
p-Toluidine	106-49-0	U353
Toxaphene	8001-35-2	P123
Triallate	2303-17-5	U389
2,4,6-Tribromophenol	118-79-6	U408
1,2,4-Trichlorobenzene	120-82-1	-
1,1,2-Trichloroethane	79-00-5	U227
Trichloroethylene	79-01-6	U228
Trichloromethanethiol	75-70-7	P118
Trichloromonofluoromethane	75-69-4	U121
2,4,5-Trichlorophenol	95-95-4	F027
2,4,6-Trichlorophenol	88-06-2	F027
2,4,5-T	93-76-5	F027

Constituent	CAS No.	Hazardous Waste No.
Trichloropropane, NOS	25735-29-9	-
1,2,3-Trichloropropane	96-18-4	-
Triethylamine	121-44-8	U404
O,O,O-Triethyl phosphorothioate	126-68-1	-
1,3,5-Trinitrobenzene	99-35-4	U234
Tris(1-aziridinyl)phosphine sulfide	52-24-4	-
Tris(2,3-dibromopropyl) phosphate	126-72-7	U235
Trypan blue	72-57-1	U236
Uracil mustard	66-75-1	U237
Vanadium pentoxide	1314-62-1	P120
Vernolate	1929-77-7	-
Vinyl chloride	75-01-4	U043
Warfarin, concentrations less than 0.3%	81-81-2	U248
Warfarin, concentrations greater than 0.3%	81-81-2	P001
Warfarin salts, when present at concentrations less than 0.3%.	-	U248
Warfarin salts, when present at concentrations greater than 0.3%.	-	P001
Zinc cyanide	557-21-1	P121
Zinc phosphide, when present at concentrations greater than 10%.	1314-84-7	P122
Zinc phosphide, when present at concentrations of 10% or less.	1314-84-7	U249
Ziram	137-30-4	P205

Source: 40 CFR Part 261, Subpart D and Appendix VIII - Hazardous Constituents.

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APPENDIX N - STATISTICAL APPROACH TO DETERMINING SAMPLING FREQUENCY

The use of statistical analyses can help establish an acceptable minimum number of samples needed to adequately represent a population of pollutants influent and effluent at an acceptable confidence level.

The procedure for establishing an acceptable minimum number of samples is calculated using the technique described in: *Statistical Methods for Environmental Pollution Monitoring* (Gilbert, 1987). This text is frequently cited in environmentally related statistical work. The method utilizes Equation 1 to calculate the sample size required to estimate the true mean of a population, based on the coefficient of variation, a confidence level, and a relative error. The method assumes a normal distribution of samples.

$$n = (Z_{1-\alpha/2}\eta/d_r)^2 \qquad \text{Eq. 1}$$

Where:

n	=	Sample size required for estimating the true mean, μ
$Z_{1-\alpha/2}$	=	Normal deviate of desired confidence level
η	=	Coefficient of variation
d_r	=	Relative error

The coefficient of variation is determined by Equation 2.

$$\eta = s / \overline{X} \qquad \text{Eq. 2}$$

Where:

s	=	Standard deviation
$\overline{X}$	=	Mean

The sample standard deviation is determined by Equation 3.

$$s = \left[\frac{1}{n-1} \cdot \sum_{i=1}^{n} (X_i - \overline{X})^2 \right]^{1/2}$$

Eq. 3

The mean and standard deviation used above should be taken from an acceptable past available sample. Both an acceptable confidence level and an acceptable relative error must be selected, each of which will vary depending on the type of pollutant being measured. Selection of both levels should be determined by the POTW based on the situation. The confidence level expresses the certainty of the estimated mean while the relative error indicates the accuracy of the estimated mean compared to the true mean.

Table 1-1 is an example matrix which applies Equation 1 to calculate sample size.

Table 1-1. Sample Sizes Required for Estimating the True Mean

Confidence Level (1-α)	Relative Error (d_r)	Coefficient of Variation (η) 0.10	0.30	0.50	1.00	1.50	2.00
0.80 ($Z_{0.90}$ = 1.28)	0.10	2	15	41	164	369	656
	0.25	-	3	7	27	59	105
	0.50	-	1	2	7	15	27
	1	-	-	-	2	4	7
0.90 ($Z_{0.975}$ = 1.645)	0.10	3	25	68	271	609	1083
	0.25	-	4	11	44	98	174
	0.50	-	1	3	11	25	44
	1	-	-	1	3	7	11

As shown in Table 1-1, establishing the number of samples needed to estimate the true mean is critically dependent on a data set's coefficient of variation (CV).

For example, a past, reliable sample produced a data set with standard deviation of 2 mg/L and a mean of 2 mg/L, resulting in CV equal to one. If a confidence level of 0.80 (with a corresponding $Z_{1-\alpha/2}$ = 1.28) and a relative error of 0.25 are determined to be adequate, then Equation 1 is used as follows:

$$n = (1.28 * 1 / .25)^2 = 26.21$$

The sample size must then be rounded to the next whole number, in this case, 27. The 27 samples may be taken throughout the year if desired, or as determined by the POTW. In the case of taking the samples throughout the year, the POTW might take two samples per month and an additional three samples at random times during the year. One sample may be evaluated for multiple contaminants; however, each location would need to be sampled independently.

Under these conditions, there would be 80% confidence that the estimated mean from 27 samples (as illustrated in Table 1-1) would be within ± 25% of the true mean. Therefore, if the estimated mean is 4 mg/L, there would be 80% confidence that the true mean is within the interval of 3 to 5 (*i.e.*, 4 ± 1). If a confidence level of 0.90 and relative error of 0.10 were desired, the number of samples would increase substantially. Under these conditions, there would be 90% confidence that the estimated mean from 271 samples (as illustrated in Table 1-1) would be within ± 10% of the true mean. Therefore, if the estimated mean was 2 mg/L, there would be 90% confidence that the true mean was within the interval of 1.8 to 2.2 (*i.e.*, 2 ± 0.2).

Source: SAIC. 1998. POTW Metals Analysis Project, Task 3 Deliverable to U.S. EPA Region VIII, EPA, Contract No. 68-C4-0068; Work Assignment Number PS-3-1, SAIC Project Number 01-0833-08-2696-800, August 25, 1998.

APPENDIX O - MINIMIZING CONTAMINATION IN SAMPLES

Some of the data reported as below the detection level (BDL) may be the result of the POTW sampling techniques and chosen analytical methods. With the need to accurately detect trace levels of pollutants, POTWs should thoroughly examine potential sources of gross and trace contamination and select analytical methods that can detect very low levels of pollutants. EPA has established new performance based[1] sampling and analysis methods (1600 series) for measuring 13 toxic metals in the low ppt to ppb range. While these methods were developed for ambient water quality monitoring, POTWs may apply some of the concepts in Method 1669, *Sampling Ambient Water for Determination of Metals at EPA Water Quality Criteria Levels*, to improve the reliability of data collected, potentially even utilizing analytical methods 1631, 1632, 1636-40.

Excerpts from Section 4.2.2 of Method 1669 are provided below.

Minimizing Contamination: Sampling Location, Sampling Equipment and Materials, and Chemicals:

- *Where possible, limit exposure of the sample and equipment in areas of higher contamination, e.g., downwind from the sludge beds.*
- *Minimize contact with airborne dust, dirt, particulate matter, or vapors from automobile exhaust; cigarette smoke; nearby corroded or rusted bridges, pipes, poles, or wires; nearby roads; and even human breath. Areas where nearby soil is bare and subject to wind erosion should be avoided.*
- *Clean the sampling equipment and minimize the time between cleaning of equipment and use.*
- *Use metal-free equipment, i.e., equipment should be nonmetallic and free of material that may contain metals of interest. When it is not possible to obtain equipment that is completely free of the metal(s) of interest, the sample should not come into direct contact with the equipment.*
- *Do not use sampling equipment where there are indications that it may not be clean, e.g., sampler tubing or collection bottle is stained, has not been changed out in some time, was used to collected a sample of a slug load that hit the WWTP, etc.*
- *Avoid contamination by carryover. Contamination may occur when a sample containing low concentrations of metals is processed immediately after a sample containing relatively high concentrations of these metals.*
- *Where possible, do not collect, process, or ship samples containing high concentrations of metals (e.g., untreated effluents, in-process waters, landfill leachates) at the same time as samples being collected for trace metals determinations.*
- *Wear clean, non-talc dusted gloves during all operations involving handling of equipment, samples, and blanks. Change gloves once they have become contaminated.*

[1] An alternate procedure or technique may be used so long as neither samples nor blanks are contaminated when following alternate procedures.

- *Fluoropolymer (FEP, PTFE), conventional or linear polyethylene, polycarbonate, polysulfone, polypropylene, or ultrapure quartz are the preferred materials for coming in contact with samples. Fluoropolymer or glass containers are preferred for samples that will be analyzed for mercury because mercury vapors can diffuse in or out of other materials, resulting either in contamination or low-biased results.*

Lot Analyses of Metals in Different Grades of Nitric Acid (SOURCE-FISHER-INTERNET)

	Highest Grade	Higher Grade	High Grade
Antimony	<0.01 ppb	<0.1 ppb	
Arsenic	<0.1 ppb	<0.3 ppb	≤4 ppb
Cadmium	<0.005 ppb	<0.1 ppb	
Chromium	<0.03 ppb	≤9 ppb	≤100 ppb
Copper	≤0.05 ppb	<1 ppb	≤50 ppb
Lead	≤0.01 ppb	<0.3 ppb	≤100 ppb
Mercury	<0.1 ppb	<0.5 ppb	
Nickel	≤0.1 ppb	<1 ppb	≤50 ppb
Selenium		<0.5 ppb	
Silver	<0.005 ppb	<0.1 ppb	

- *The following materials have been found to contain trace metals: Pyrex, Kimax, methacrylate, polyvinyl chloride, nylon, Vycor, highly colored plastics, paper cap liners, pigments used to mark increments on plastics, and rubber. It is recommended that these materials not be used to hold liquids that come in contact with the sample or must not contact the sample.*

- *Use an appropriate grade of chemicals when prepping equipment/materials and chemically preserving samples.*

Quality Control:

- *Serial numbers should be indelibly marked or etched on each piece of Apparatus so that contamination can be traced, and logbooks should be maintained to track the sample from the container through the sampling process to shipment to the laboratory. Chain-of-custody procedures should be used so that contamination can be traced to particular handling procedures or lab personnel.*

- *Equipment blanks should be periodically generated and analyzed to identify contamination that may result from improper preparation or handling of sampling equipment and bottles in the laboratory. Equipment blanks include processing reagent water (i.e., water known not to contain pollutants at detectable levels) through sampling equipment and sample bottle(s) prior to taking the equipment or bottle(s) to the field.*

- *A trip blank should be periodically generated and analyzed to identify incidental contamination that may occur to sampling equipment/bottles while in transit to and from the sampling location. Essential, reagent water is place in a sample bottle prior to going to the field.*

- *Field blanks should be periodically generated and analyzed to identify contamination that may occur to sampling equipment/bottles while in the field. Like equipment blanks, it involves process reagent water through the sampling equipment/bottle.*

APPENDIX P - METHODS FOR CALCULATING REMOVAL EFFICIENCY

There are three methods of calculating removal efficiencies: average daily removal efficiency (ADRE) method, mean removal efficiency (MRE) method, and the decile approach. As defined in Equation 5.1, the ADRE across a plant is defined as:

$$R_{potw} = \frac{\Sigma (I_n - E_{potw,n})/I_n}{N}$$

Where:

R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
I_n	=	POTW influent pollutant concentration at headworks , mg/L
$E_{potw,\,n}$	=	POTW effluent pollutant concentration
n	=	Paired observations, numbered 1 to N

As defined in Equation 5.2, the MRE across a plant is defined as:

$$R_{potw} = \frac{\overline{I_r} - \overline{E_{potw,t}}}{\overline{I_r}}$$

Where:

R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
I_r	=	POTW influent pollutant concentration at headworks, mg/L
$E_{potw,\,t}$	=	POTW effluent pollutant concentration, mg/L
t	=	Plant effluent samples, numbered 1 to T
r	=	Plant influent samples, numbered 1 to R

It is important to realize that the portion of the pollutant removed through a treatment process is transferred to another wastestream, typically the sludge. For conservative pollutants, such as metals, all the pollutant from the influent ends up in either the effluent or the sludge. For example, a 93% overall plant removal means that 93% of the cadmium in the influent is transferred to the sludge, while 7% remains in the effluent wastewater.

1. REVIEW OF THE DATA SET AND EXCLUSION OF CERTAIN DATA

A good first step in determining removal efficiencies is to review the data set. This review can identify any data values that are extremely high or low. If there are isolated extreme values, there are formal statistical procedures that can be applied to evaluate whether a value can be classified as an "outlier" relative to the rest of the data set. Two methods most widely used to make this determination are described in the following two paragraphs.

If the data is known to closely follow a normal distribution, then any data point that lies more than two standard deviations from the mean is considered an outlier. Consider, for example, the DRE data values located in Table 1 of this appendix, and assume that this data is from a normal distribution. The 15 observations have a mean of 52.69 and a standard deviation of 34.65. Using this method, any data point that lies outside of the range -16.61 to 121.99, or 52.69 ± 2*34.65, can be considered an outlier. In this case, one value, -20.25, falls outside of the range and can be determined to be an outlier.

However, the DRE data values do not approximate a "bell-shaped" normal distribution. In this case, outliers can be determined based on the interquartile range (IQR) of the data set. First, order the data from smallest to largest and locate the data points that fall at the 25th percentile (also referred to as the first quartile or Q1), and the 75th percentile (also referred to as the third quartile or Q3). The IQR is equal to the value of the observation at Q3 minus the value of the observation at Q1. Any data point that lies more than 1.5 times this IQR below Q1, or above Q3, is considered an outlier. Again, consider the data in Table 1, but now make no assumptions about the distribution of the population from which the sample was taken. The Q1 and Q3 of this data set are located at 38.04 and 78.5 respectively. Based on these values, the IQR is equal to 40.46 (78.5 - 38.04). Any value that falls below -22.65 (38.04 - 1.5*40.46), or above 139.19 (78.5 + 1.5*40.46), can be considered an outlier. In this case, there are no values that fall outside of the range and, consequently, no values should be determined to be outliers.

Both of these methods are meant to determine any values that may be candidates for exclusion from the data set. Data exclusion should be performed only if technical justification exists to support such action (e.g., poor removals due to temporary maintenance or operational problems or known sampling problems). For example, if an examination of the data set shows that an unusually high influent value is from the same sampling day/event as an unusually high effluent value, this occurrence of corresponding extreme values should be investigated to determine if the data values can be explained by technical or operational problems not related to treatment system performance (e.g., maintenance, repair, or sampling problems). If this is the case, dropping the data pair from the data set may be appropriate.

Review of the data may also show patterns such as increasing effluent values over time. If a similar pattern is not observed for the influent values, this will generate a pattern of decreasing DREs over time. A graph or plot of DRE against sampling day/event (in order from first to most recent sample) can help identify such trends. This may alert the POTW to operational problems that should be investigated. A plot can also highlight unusually low DREs that call for further review, such as checking laboratory quality control samples to determine if blank or duplicate samples indicate anything out of the ordinary. If abnormalities are found in laboratory QA/QC (quality assurance/quality control) data, the POTW may consider excluding the affected values from the data set.

Table 1 contains an example data set of 15 influent and effluent sample pairs for zinc. The influent and effluent concentrations have been converted to loadings using the POTW flows for the sample days. The influent and effluent concentrations may be used instead of converting to loadings. Whether loadings or concentrations are used will likely have little impact on the results of the ADRE and decile approaches.

Influent and effluent flows are probably similar (if not the same) for a data pair and therefore will have little effect on the relative size of the influent and effluent values, so DREs will change little. However, converting to loadings may have a noticeable impact on the MRE method if a POTW has high variability in its flows. Because influent and effluent loadings for high flow days will increase more relative to influent and effluent loadings for low flow days, the net effect is to give greater weight to the removal rates on those days with high flows. If the POTW has high variability in its flows, it should evaluate whether its removal rates tend to go up and down in relation to flow. If so, the POTW should consider calculating an MRE using both concentrations and loadings and evaluating which is more appropriate.

Table 1. Removal Efficiency Example

Sample Day	Date	Influent Load (lbs/day)	Effluent Load (lbs/day)	DRE (%)
1	3/4/99	518.22	111.41	78.50
2	3/5/99	163.98	173.99	-6.10
3	3/6/99	110.15	97.64	11.36
4	3/7/99	1739.93	474.41	72.73
5	3/8/99	266.48	320.45	-20.25
6	4/15/99	170.48	105.15	38.32
7	5/11/99	473.16	132.67	71.96
8	5/12/99	314.19	148.96	52.59
9	5/13/99	306.68	132.69	56.73
10	5/14/99	232.57	92.63	60.17
11	5/15/99	226.52	72.60	67.95
12	6/15/99	533.25	98.87	81.46
13	7/1/99	141.43	87.63	38.04
14	7/15/99	1166.77	103.90	91.10
15	8/1/99	2301.00	97.88	95.75
Average		577.65	150.06	52.69

Review of the data shows that:

- The data set does not require removal of outliers.
- The three particularly high influent values (sample days 4, 14, and 15) all have DREs of more than 70%, so the high influent values do not appear to make the data candidates for elimination.
- There are two effluent values (sample days 4 and 5) that are significantly higher than the others. For one, the corresponding influent value is also high and the DRE is 73%. For the other day, the DRE is negative (-20%) because the influent value is relatively low. These results are from samples taken on two consecutive days (March 7 and March 8), which may indicate that the POTW treatment system was experiencing some operational difficulties or interference at the time. The POTW should investigate the matter to determine if there are valid reasons for dropping these data from the removal calculations data set.
- There are two negative DREs (one for March 8) calculated from the influent and effluent data pairs. They occurred three days apart and may indicate temporary operational problems, so the POTW should investigate the matter (as noted above).

A plot of the data may help the POTW identify any data concerns that should be investigated. Based on the review of data for this example, it was determined that no justification exists for excluding any of the data from the data set.

2. Calculation of Removal Efficiencies

Once the data set has been reviewed, the POTW can proceed to calculating removal efficiencies. The following sections describe each of the methods for calculating removal efficiencies and perform the calculations using the example data set in Table 1.

2.1 Average Daily Removal Efficiency (ADRE)

The ADRE is calculated by first calculating a DRE for each pair of influent and effluent values (i.e., an influent value and an effluent value from the same sampling day/event are used to calculate a DRE). This set of DREs is then averaged to determine the ADRE for a pollutant. Use of the ADRE method requires that a POTW only use data for the sampling days/events for which it has both an influent and an effluent value, and the influent value is greater than zero.

Example

For the example data set in Table 1, the ADRE is calculated as:

ADRE = [78.5+(-6.1)+11.36+72.73+(-20.25)+38.32+71.96+52.59+56.73+60.17+67.95+81.46+38.04 +91.10+95.75)]/15 = 52.69%

2.2 Mean Removal Efficiency (MRE)

The MRE is calculated by using the same formula as for the DRE (shown at the beginning of the Appendix), but instead of using individual influent and effluent values from sampling days/events, the set of influent values is first averaged to determine the average influent value and the same is done for the set of effluent values (either concentrations or loadings). These average values are then used in the DRE equation to result in the MRE for a pollutant. Unlike the ADRE method, the MRE method does not require paired influent and effluent values from the same sampling days/events. The MRE can be based on influent and effluent sample values that are not always paired (e.g., one effluent sample is lost or destroyed, so the influent average is based on one more value than the effluent average). However, the POTW should use caution in building the data sets for calculating influent and effluent averages because if too many unpaired values are used the removal efficiencies may be meaningless because the influent data and effluent data may represent different time periods, and treatment plant conditions do vary over time.

Example

For the example data set in Table 1, the MRE is calculated as:

Average of the *influent* values = 577.65 lbs/day
Average of the *effluent* values = 150.06 lbs/day
MRE = 100*(577.65-150.06)/577.65 = 74.02%

2.3 Comparison of Results from ADRE and MRE Methods

Note that the MRE (74.02%) is higher than the ADRE (52.69%). The three days with the highest influent loadings have relatively high DREs and the two negative DREs (Day 2 and Day 5) occur on days with values that are not significantly greater than the other days. In the ADRE calculation, each day/DRE is given the same weight as the others, while the MRE method gives greater weight to the days with greater loadings. This means that the high removals on the days with high influent loadings affect the MRE more than the other days do, leading to a higher MRE, while the negative values do not have as great an impact because they occur on days with less elevated influent and effluent values If each DRE were to be weighted by its proportion of the total loading, the result would be the same as with the MRE method.

Usually, the MRE and ADRE are slightly different from each other, and can be quite different (as in the example presented here). The POTW can calculate both and decide if one of the estimates is the most appropriate for use in AHL calculations. The POTW can also use the decile approach to determine representative removal efficiencies.

2.4 Decile Approach

The decile approach, unlike the above methods, considers how often the actual DRE will be above or below a specified removal rate, thereby taking into account the variability of POTW removal efficiencies over time. The decile approach involves putting the set of DREs (calculated using the formula presented at the beginning of this appendix) in order from least to greatest and then determining nine decile values. Each decile is the value below which a certain percentage of the DREs fall. For example, the first decile is the value below which 10% of the DREs fall. Similarly, the second decile is the value below which 20% of the DREs fall, on up to the ninth decile, which is the value below which 90% of the DREs fall. The fifth decile is the median and half of the DREs fall below this number. To apply the decile approach, a minimum of nine DREs are required. If exactly nine DREs are available, the nine estimated deciles are simply the nine DREs. If more then nine DREs are used, the POTW needs to calculate the nine decile estimates.

Tables 2 and 3 below illustrate use of the decile approach for the example zinc data set. The steps are:

- ***Step 1:*** Take the set of DREs and put the values in order from smallest to largest (see Table 2).
- ***Step 2:*** The entries for Column 1 are obtained by performing the two calculations. First, define the location for the first decile and then calculate the next eight multiples of that location value to determine the location for the second through ninth deciles. The first location is determined by the equation: (N+1)/10, where N = the number of data pairs/DREs used. For the example data set, N=15, so the location for the first decile is (15+1)/10 = 1.6. The location for the second decile is 2 x 1.6 = 3.2, the location for the third decile is 3 x 1.6 = 4.8, and so on up to the ninth decile of 9 x 1.6 = 14.4. (Column 1 in Table 3)
- ***Step 3:*** For each decile, take the whole number part of the value in Column 1 and place it in Column 2 (e.g., the first decile is 1.6, so the whole number part is 1; the fourth decile is 6.4, so the whole number part is 6).
- ***Step 4:*** The entries in Column 3 of Table 3 are taken from the ordered list of DREs in Table 2. The whole number values in Column 2 correspond to the entry in the ordered list in Table 2 [e.g., the whole number part for the first decile is 1, so entry 1 (-20.25%) from Table 2 is the correct value and is placed in Column 3 of Table 3; similarly, the fourth decile whole number part is 6, so value 6 (52.59%) is placed in Column 3 of Table 3 for the fourth decile].
- ***Step 5:*** Following a similar procedure as in Step 4, values for Column 4 are taken from Table 2 and place in Table 3, except that this time the values taken from Table 2 are the ones that immediately follow the Column 3 entries [e.g., for the first decile, the value placed in Column 4 is -6.10, which is value 2 (the value immediately after value 1) from Table 2; for the fourth decile, the value placed in Column 4 is 56.73, which is value 7 from Table 2].
- ***Step 6:*** Fill in Column 5 by subtracting Column 3 from Column 4 and entering the result.
- ***Step 7:*** Similar to the process for filling Column 2 (explained in Step 3) of Table 3, place the decimal part of the Column 1 entries in Column 6 of Table 3 (e.g., for the first decile, use 0.6; for the fourth decile, use 0.4).

- ***Step 8:*** Fill in Column 7 by multiplying the values in Column 5 by the values in Column 6 and entering the result.

- ***Step 9:*** Add Column 3 and Column 7 and enter the result in Column 8 of Table 3. These values are the estimated deciles.

Table 2. Set of DREs Sorted in Ascending Order

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
-20.25	-6.1	11.36	38.04	38.32	52.59	56.73	60.17	67.95	71.96	72.73	78.50	81.46	91.10	95.75

Table 3. Decile Approach for Zinc Example

Deciles	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
1st	1.6	1	-20.25	-6.10	14.15	0.6	8.490	-11.76
2nd	3.2	3	11.36	38.04	26.68	0.2	5.336	16.70
3rd	4.8	4	38.04	38.32	0.28	0.8	0.224	38.26
4th	6.4	6	52.59	56.73	4.14	0.4	1.656	54.25
5th	8.0	8	60.17	67.95	7.78	0	0.000	60.17
6th	9.6	9	67.95	71.96	4.01	0.6	2.406	70.36
7th	11.2	11	72.73	78.50	5.77	0.2	1.154	73.88
8th	12.8	12	78.50	81.46	2.96	0.8	2.368	80.87
9th	14.4	14	91.10	95.75	4.65	0.4	1.860	92.96

The main value of the decile approach is that it provides an estimate of how often a POTW is expected to exceed certain removal values, such as the ADRE and MRE. For the example, the ADRE is 53% and the MRE is calculated as 74%. If the POTW uses either one of these values, what amount of the time will its removal efficiency exceed those values? This can be estimated using the decile approach. The ADRE of 53% falls between the third and fourth deciles (38.26% and 54.25%, respectively), meaning that the actual removal efficiency is estimated to exceed the ADRE 60% to 70% of the time [(e.g., the third decile means that 30% of the time values will fall below that value (38.26% in this case)]. The MRE of 74% lies between the seventh and eight deciles (73.88% and 80.87%, respectively), so the POTW is estimated to exceed the MRE 20% to 30% of the time.

In developing local limits, appropriate removal efficiencies must be selected for calculation of AHLs for each pollutant. POTWs have often selected a pollutant's ADRE for local limits calculations. EPA recommends that POTWs consider using the decile approach or the MRE method because they better account for variabilities in removal efficiencies over time. For example, because a higher removal efficiency means more pollutant is removed to the sludge, if the POTW used the ADRE from the above example (which is likely exceeded 60% to 70% of the time) to calculate an AHL to protect sludge quality, the resulting AHL may not be adequately protective. More pollutant will likely be removed to the sludge 60% to 70% of the time, so loadings in the sludge will higher than was estimated in the AHL calculations and may lead to exceedances of sludge disposal standards.

A different approach that may address this concern is to use one decile for AHL calculations to protect sludge quality (for sludge disposal and for sludge digester inhibition for conservative pollutants) and a different decile for AHL calculations for protection against Pass Through concerns (e.g., NPDES permit limits). For example, a POTW can base its sludge quality-based AHLs on the seventh decile removal which means that greater removals to sludge and hence greater sludge loadings would be estimated to occur 30% of the time.

Similarly, the POTW can use the third decile for calculating its water quality-based AHLs because lower removals (and hence higher effluent loadings) would be estimated to occur about 30% of the time. Although use of these deciles estimates that AHLs would be exceeded 30% of the time, in reality this is not highly likely. If the entire AHL is allocated to IUs, all IUs would have to discharge at their maximum allowed level to reach the AHL. Then if the removal achieved is greater than the seventh decile, more loading would go to the sludge than is provided for with the AHL. If some IUs discharge at below their allocated loadings, which is very likely at any given time, the likelihood of exceeding the allowed loading to the sludge is much lower.

3. NON-CONSERVATIVE POLLUTANTS

The above discussion of removal efficiency calculations applies to conservative pollutants (e.g., metals). However removal efficiencies for non-conservative pollutants can be used to calculate AHLs based on Pass Through criteria (e.g., biological process inhibition data, NPDES permit limits) and the guidance above can be used for non-conservative pollutants only in these cases. Conservative pollutant removal efficiencies are determined by pollutant concentrations in the POTW influent and effluent streams. The presumption applied to conservative pollutants (that removed pollutants are exclusively transferred to the POTW's sludge streams) cannot be extended to non-conservative pollutants because losses through degradation and volatilization do not contribute to pollutant loadings in sludge. Therefore, non-conservative pollutant removal efficiencies cannot be used in deriving AHLs from criteria/standards applicable to the POTW's sludge streams (e.g., digester inhibition, sludge disposal).

Equation 5.13, for calculating AHLs for non-conservative pollutants, based on criteria for sludge digester inhibition, is:

$$AHL_{dgstr} = (L_{infl}) * \frac{C_{dgstinhib}}{C_{dgstr}}$$

Where:

AHL_{dgstr}	=	AHL based on sludge digestion inhibition, lb/day
L_{infl}	=	POTW influent loading, lb/day
$C_{dgstinhib}$	=	Sludge digester inhibition criterion, mg/L
C_{dgstr}	=	Existing pollutant level in sludge, mg/L

The equation can be rewritten as:

$$AHL_{dgstr} = \frac{C_{dgstinhib}}{\frac{C_{dgstr}}{L_{infl}}}$$

Where the factor C_{dgstr}/L_{infl} is a partitioning factor that relates the pollutant level in the POTW sludge, C_{dgstr}, to the headworks loading of the pollutant, L_{infl}. The partitioning factor enables calculation of an allowable loading based upon sludge digestion inhibition, AHL_{dgstr}, from a sludge digester inhibition criteria, $C_{dgstinhib}$, for a non-conservative pollutant. To determine the partitioning factor for a particular pollutant, the POTW's influent and sludge must be routinely sampled for that pollutant.

The factor C_{dgstr}/L_{infl} expresses non-conservative pollutant removals to sludge. Non-conservative pollutant removals to sludge are highly variable, and are dependent on such factors as wastewater temperature, ambient air temperature, biodegradation rates (which are temperature dependent), aeration rates, and POTW influent flow. Because non-conservative pollutant removals to sludge are highly variable, the variability in non-conservative pollutant sludge partitioning factors should be addressed in the local limits development process. The procedures and recommendations presented in this manual for addressing removal efficiency variability for conservative pollutants (e.g., the calculation of mean removals and the decile approach) can be extended to addressing variability in non-conservative pollutant sludge partitioning factors. In calculating sludge AHLs, the sludge partitioning factor should be used in place of the removal efficiency for non-conservative pollutants.

APPENDIX Q - METHODS FOR HANDLING DATA BELOW DETECTION LEVEL

The occurrence of values below the detection limit (DL) in environmental data sets is a major statistical complication. Uncertainty about the actual wastewater treatment plant influent and effluent values below the DL can bias subsequent statistical analyses to determine the removal efficiencies.

The various approaches to handling below detection level (BDL) data can be broken into three main categories:

- Regression order statistic (ROS) and probability plotting (MR) methods
- Maximum likelihood estimation (MLE) methods
- Simple replacement of a single value (e.g., detection limit or one half detection limit).

Although this discussion focuses on handling data below the detection limit, the same techniques can be applied to those data below the minimum level of quantitation (ML) as well. These methods can be applied by those without a background in statistics. However, EPA strongly recommends a statistician perform these data manipulations.

REGRESSION ORDER STATISTIC (ROS) AND PROBABILITY PLOTTING (MR) METHODS

Both the original ROS and the MR methods are based on ordered statistics of observed data and the assumption that data come from a normal or log-normal distribution. If Y is from a normal distribution with mean μ and standard deviation σ ($Y \sim N(\mu,\sigma)$) and Z is from a normal distribution with mean 0 and standard deviation 1 ($Z \sim N(0, 1)$), statistical theories show that $Y = \mu + \sigma Z$ when Y and Z are at the same percentiles in their respective distributions. For a given observation (sampling result) Y that is above the detection limit, we can calculate the "order statistic", i.e., the proportion of observations that are less than Y. This order statistic of Y is an estimate of the percentile. The corresponding Z value is available by either using existing computer program or checking the normal distribution table. In other words, we have a list of observations that are above the detection limit (Y_1, Y_2, ..., Y_m) and a list of Z values (Z_1, Z_2, ..., Z_m) that are of the same percentiles as the respective Y values. By performing a regression analysis of Y against Z, the resulting intercept and slope are estimates of the mean and standard deviation of the distribution of Y.

When the data are from a log-normal[2] distribution, a log transformation is needed before the regression. The estimated mean and standard deviation is for the log-transformed variable. To convert the estimates to the original metric, the standard log-normal distribution results should be used. For example, if Y is from a log-normal distribution, and estimated mean and variance for log(Y) are μ and σ, the mean of Y is and the variance of Y is $e^{2\mu+\sigma^2}\left(e^{\sigma^2}-1\right)$.

Alternatively, one may use the regression equation to "fill in" the missing (BDL) values. This is possible because we can calculate the order statistics for all BDL values. For example, suppose we have 20 out of 100 observations are BDL. The order statistics for the 20 BDL values are 0.01, 0.02, ..., 0.20. Using these order statistics, we can get the corresponding Z values Z_1, Z_2, ..., Z_{20}. Substitute these Z values into the regression model, we have the 20 fill-in Y values.

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[2] Log-normal distributions are probability distributions which are closely related to normal distributions: if X is a normally distributed random variable, then exp(X) has a log-normal distribution. In other words: the natural logarithm of a log-normally distributed variable is normally distributed.

To recap, we first define the variables used in this method:

n = Total number of observations
k = Number of BDL observations
Y_i= Value of the ith ranked observation

To utilize the ROS method, data are first ranked from smallest to largest so that Y_n is the largest data value and Y_1 through Y_k are the unknown BDL values. If an approximately normal distribution is expected, each Y_i is plotted on the y-axis against the expected normal order statistic Z_i for each rank i. The following linear regression is used to obtain μ and σ, using only the points above the DL (i.e., $i = k+1,...,n$).

$$Y_i = \mu + \sigma \ Z_i$$

One may use the estimated intercept and slope as the mean and standard deviation. Alternatively, one may use the above equation to obtain appropriate "fill-in" values for each of the k BDLs using the Z-statistic. The mean and standard deviation are then calculated using traditional formulas applied to both the observed and filled-in data. Thus, the estimated data are based on the assumption of normality, while the observed data are used directly with no assumption about their distribution. This method is relatively robust to departures from normality or lognormality (Gilliom and Helsel 1986).

If a distribution is expected to be skewed, then $\log(Y_i)$ is plotted against Z_i and the fitted data and the observed data are transformed back to original units from which the mean and standard deviation are calculated (Gilliom and Helsel 1986). Transformation of the data, rather than the summary statistics, avoids inherent transformation bias (Helsel 1990).

MR METHOD

The MR method, an extension of the ROS method, accounts for multiple detection limits. When there is only one detection limit, the k-BDL values are assigned order statistics of 1 through k. When there are multiple detection limits, it is not obvious how to assign the order statistic for some of the data, both below or above some detection limits. For example, suppose we have the following five observations: <100, 110, <200, 250, and 300. It is obvious that the two largest observations, 250 and 300 should receive order statistics of 4 and 5. But the rest is not clear, because the value labeled as <200 can be 199 or 9. Helsel and Cohn (1988) developed a plotting position method for assigning order statistics when there are multiple detection limits. The idea is that although we don't know exactly where the value, say <200, should fall, we can lay out all possible positions for this particular value and take the average rank of all possible ranks. For example, the value labeled as <200 can be the smallest (rank 1), the second smallest (rank 2), or the third smallest (rank 3), the average rank is (1+2+3)/3 = 2. The value 110 can be the second smallest or the third smallest, therefore a rank of (2+3)/2 = 2.5. Finally, the observation <100 receives a rank of (1+2)/2=1.5. Once the order statistics are assigned, one may use the same regression analysis method in the ROS method. When there is only one detection limit, the MR method is the same as the ROS method.

Helsel and Cohn (1988) found that if a single estimating method for several descriptive statistics is desired and the sampling distribution of a data set is unknown, the MR method should be utilized. The actual plotting procedure for the MR method is detailed in Appendix B of *Estimation of Descriptive Statistics for Multiple Censored Water Quality Data* (Helsel and Cohn, 1988).

MAXIMUM LIKELIHOOD ESTIMATION (MLE) METHOD

The MLE method is based on a specific probabilistic assumption about the observations. For example, suppose the data we observed (Y_1, Y_2, ..., Y_n) are from a normal distribution with unknown mean and standard deviation. The likelihood of observing a specific value, say Y_i, is calculated by the normal distribution density function:

$$L(Y_i) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(Y_i-\mu)^2}{2\sigma^2}}$$

The likelihood for a BDL value is:

$$L(Y_k) = \int_{-\infty}^{DL} \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(X-\mu)^2}{2\sigma^2}} dX$$

The likelihood of observing all the data (Y_1, Y_2, ..., Y_n), both below and above the detection limit is the product of all individual likelihoods. The likelihood of observing all data is a very complicated function of μ and σ. A different set of μ and σ values will lead to a different likelihood value. The maximum likelihood estimator is the pair of μ and σ values that maximize the likelihood function. Because the likelihood function is often very complicated, computation of the MLE method is difficult.

Gilliom and Helsel (1986) found that the ROS and the MR methods appear to be more robust to departures from distributional assumptions.

MLE methods have been shown to have the smallest mean-squared error (i.e., higher accuracy) of available techniques when the data distribution is exactly normal or lognormal (Harter and Moore 1966). However, simulation results indicate that ROS and MR methods are superior when distribution shape population is unknown (Gilliom and Helsel 1986).

In a simulation study by Newman et al. (1989) comparing mean and standard deviation estimates between MLE and ROS, the results were similar. However, the MLE method provided slightly more accurate results when BDL values comprised less than 30 percent of the data set, while ROS methods provided slightly more accurate results when BDL values represented 30 percent or more.

SIMPLE SUBSTITUTION METHODS

Simple substitution methods simply replace the below detection value with another value, such as zero, the detection limit, or one-half the detection limit. Both ROS and MLE methods offer substantial advantages over most simple replacement methods (Gilbert 1987, Gleit 1985, Helsel and Gilliom 1986, Newman et al.1989).

In general, replacement methods result in a greater bias when calculating the mean or standard deviation. Additionally, their relative performance worsens as the proportion of BDLs increases (Gilliom and Helsel 1986). Helsel (1989) reasons that because large differences may occur in the resulting estimates for any given population, and because the choice of the replacement value is essentially arbitrary without some knowledge of instrument readings below the reporting limit, estimates resulting from simple substitution are not defensible.

CONCLUSION

The MR method is most applicable for use in local limits development because of the data set's multiple detection limits and unknown parent distribution. Additionally, the MR method is recommended when the data set contains a relatively high percentage of BDL values.

Further information on statistical methods can be found in the literature listed below.

LITERATURE REVIEW LIST/REFERENCES

Gilliom and Helsel 1986. *Estimation of distribution parameters for censored trace level water quality data: 1 Estimation techniques*. Water Resources Research 22:135-146.

Gleit 1985. *Estimation for small normal data sets with detection limits. Environmental Science Technology* 19:1201-1206.

Harter and Moore 1966. *Local-Maximum-Likelihood estimation of the parameters of three-parameter lognormal populations from complete and censored samples.* Journal of American Statistical Association 61:842-851.

Helsel, D. R. 1990. *Less Than Obvious: Statistical treatment of data below the detection limit.* Environmental Science and Technology 24:1766-1774.

Helsel and Cohn 1988. *Estimation of Descriptive Statistics for Multiple Censored Water Quality Data.* Water Resources Research 24:1997-2004.

Newman, Dixon, Looney, and Pinder 1989. *Estimating the mean and variance for environmental samples with below detection limit observations.* Water Resources Bulletin 25:905-916.

Porter, Ward, and Bell 1988. *The Detection Limit: Water quality monitoring data are plagued with levels of chemicals that are too low to be measured precisely*. Environmental Science Technology Vol. 22, No. 8.

Travis and Land. 1990. *Estimating the Mean of Data Sets with Nondetectable Values*. Environmental Science Technology Vol. 24, No. 7.

ATTACHMENT - DESCRIPTION OF THE MR METHOD

Method:

(1) If an analytical result is reported as ND (to be referred to as a nondetect), set the result $c_i = 1$. Annotate the result with a "<" and consider this observation to be "< a detection limit."

(2) Divide the observations into two groups: Nondetects, those observations annotated with a "<" sign, and detects.

(3) Let m = number of distinct detection limits.

(4) Let A_j = number of detected observations at or above the jth detection limit (j = 1,...,m) and below the next highest detection limit.

(5) Let B_j = number of detected and nondetected observations below the jth detection limit (j = 1,...,m).

(6) Let $p_{e,j} = p_{e,j+1} + (A_j/[A_j + B_j])(1 - p_{e,j+1})$, and solve iteratively for j = m,m-1,...,2,1. By convention, $p_{e,m+1} = 0$.

(7) Determine plotting positions, p(i), for detected observations as:

$p(i) = (1 - p_{e,j}) + (p_{e,j} - p_{e,j+1})\cdot r/(A_j + 1)$, where r is the rank of the ith observation above the jth detection limit. If detected observations are "tied," arbitrarily order the "tied" observations before assigning ranks. Whether the "tied" observations are arbitrarily ordered or assigned the same mid-rank (average of the corresponding ranks) is expected to be of negligible importance. If detected observations are present below the lowest detection limit, assume the "0th detection limit" is 0, and consequently $p_{e,0} = 1$.

(8) Assign plotting positions, pc(i), for nondetected observations as:

$pc(i) = (1- p_{e,j})\cdot r/(C_j + 1)$, $r = 1,...,C_j$. C_j is the number of nondetected values known only to be less than the jth detection limit (j = 1,...m). The formula for C_j is: $C_j = B_j - (A_{j-1} + B_{j-1})$, where $A_0 = B_0 = 0$. Plotting positions are therefore assigned separately within the j groups of nondetects (j=1,...,m).

(9) Perform a simple linear regression using only the detected observations. The natural logarithm of the detected observations ($z_i = \ln(y_i)$) is the dependent variable, and the normal quantile associated with the corresponding plotting position ($\Phi^{-1}(p(i))$) is the independent variable, where $\Phi^{-1}(\cdot)$ is the normal quantile.

(10) Use the estimated regression line ($\hat{z}_i = \hat{b}_0 + \hat{b}_1\cdot\Phi^{-1}(pc(i))$) to "fill in" (using the terminology of Helsel and Cohn) estimated natural logarithm values for nondetected observations, based on the normal quantile associated with the calculated plotting position (pc(i)).

(11) Calculate a natural log mean ($\hat{\mu}$) and log standard deviation ($\hat{\sigma}$) of the detected and "filled in" observations using the formulas below. Assume $z_i = \ln(y_i)$, where z_i represents the natural logarithm of detected observations where available, and "filled in" estimated natural logarithm values where nondetects were observed.

$$\hat{\mu} = \frac{\sum_{i=1}^{n} z_i}{n} \qquad \textbf{(1)}$$

$$\hat{\sigma} = \sqrt{\frac{\sum_{i=1}^{n} (z_i - \bar{z})^2}{n-1}} \qquad \textbf{(2)}$$

(12) Use the values of $\hat{\mu}$ and $\hat{\sigma}$ to estimate a 90th percentile using a lognormal distribution: $P_{90} = \exp(\hat{\mu} + 1.282 \cdot \hat{\sigma})$.

An example of the MR method is given below.

Comments:

Although the algorithm for determining plotting positions when multiple detection limits are present appears rather cumbersome, as described in the 12-step process above, the process of fitting a regression line to order statistics is well-established as a method for determining parameters of a distribution. The ROS method utilizes plotting positions to "spread" nondetected observations along a continuum, rather than simply substituting an arbitrary value for each nondetected measurement. In practice, one would expect nondetected values to be "spread out" rather than all fixed at a single point, as would be the case with simple substitution methods.

The MR method described above directly mimics the methods of Helsel and Cohn. However, the article by Helsel and Cohn contains an inaccurate formula for C_j, which has been revised above. In addition, the article did not address ties in detected observations and detected observations below the lowest detection limit. These questions have been addressed in Steps 7 and 9 above.

At least two detected observations are necessary to estimate a regression line. Consequently, this procedure is not useful when 0 or only 1 detected observation is present.

Software which utilizes the MR method to compute summary statistics is available. The feasibility of utilizing the software available at this site for implementation among numerous POTWs must be explored further. For example, the software is restrictive in some ways, such as the format of data which can be processed.

Reference:

Helsel, D.R., and T.A. Cohn. 1988. *Estimation of Descriptive Statistics for Multiple Censored Water Quality Data.* Water Resources Research 24:1997-2004.

EXAMPLE OF THE MR METHOD

Suppose we have a set of data from multiple sources with varying detection limits. When combined, the data set is ordered as follow:

Data Summary

<50	<200	<400	100	300	500	
<50	<200	<400	100	300	500	
<50	<200	<400			700	
						1000
						1200

In order to provide estimates of the mean and standard deviation, it is necessary to fill-in the non-detected values. Once the non-detected values are filled-in, sample mean and standard deviation can be estimated. The following are the MR steps for filling in the nondetected values.

1. Summary statistics:

$n = 18$
$m = 3$ (1st detection limit = 50, 2nd detection limit = 200, 3rd detection limit = 400)

$A_1 = 2$ (2 detects $\geq$50 but <200)
$A_2 = 2$ (2 detects $\geq$200 but <400)
$A_3 = 5$ (5 detects $\geq$400)

$B_1 = 3$ (3 nondetects <50)
$B_2 = 8$ (3 nondetects <50, 3 nondetects <200, and 2 detects <200)
$B_3 = 13$ (3 nondetects <50, 3 nondetects <200, 3 nondetects <400, 2 detects <200, and 2 detects <400)

$C_1 = 3$ (3 nondetects <50)
$C_2 = 3$ (3 nondetects <200)
$C_3 = 3$ (3 nondetects <400)

$p_{e,3} = p_{e,4} + (A_3/[A_3 + B_3])(1 - p_{e,4}) = 0 + (5/[5+13])\cdot 1 = 0.278$
$p_{e,2} = p_{e,3} + (A_2/[A_2 + B_2])(1 - p_{e,3}) = 0.278 + (2/[2+8])\cdot(1-0.278) = 0.422$
$p_{e,1} = p_{e,2} + (A_1/[A_1 + B_1])(1 - p_{e,2}) = 0.422 + (2/[2+3])\cdot(1 - 0.422) = 0.653$

2. Determination of plotting positions:

Nondetected observations:

x_i	j	r	$p_{e,j}$	C_j	Plotting Position $pc(i) = (1- p_{e,j})\cdot r/(C_j + 1)$
<50	1	1	0.653	3	0.087
<50	1	2	0.653	3	0.173
<50	1	3	0.653	3	0.260
<200	2	1	0.422	3	0.144
<200	2	2	0.422	3	0.289
<200	2	3	0.422	3	0.433
<400	3	1	0.278	3	0.181
<400	3	2	0.278	3	0.361
<400	3	3	0.278	3	0.542

Detected observations:

x_i	j	r	$p_{e,j}$	$p_{e,j+1}$	A_j	Plotting Position $p(i) = (1 - p_{e,j}) + (p_{e,j} - p_{e,j+1})\cdot r/(A_j + 1)$
100	1	1	0.653	0.422	2	0.424
100	1	2	0.653	0.422	2	0.500
300	2	1	0.422	0.278	2	0.626
300	2	2	0.422	0.278	2	0.674
500	3	1	0.278	0	5	0.769
500	3	2	0.278	0	5	0.815
700	3	3	0.278	0	5	0.861
1000	3	4	0.278	0	5	0.907
1200	3	5	0.278	0	5	0.954

3. Linear regression

A simple linear regression is then performed using the following detected observations and their associated plotting points. The regression is based on z_i as the dependent variable and p(i) as the independent variable.

x_i	$z_i = \ln(x_i)$	p(i)	$\Phi^{-1}(p(i))$
100	4.605	0.424	-0.192
100	4.605	0.500	0.000
300	5.704	0.626	0.321
300	5.704	0.674	0.451
500	6.215	0.769	0.736
500	6.215	0.815	0.896
700	6.551	0.861	1.085
1000	6.908	0.907	1.323
1200	7.090	0.954	1.685

The regression equation based on these nine detected observations is:

$$\hat{z}_i = 4.9614 + 1.4186 \cdot \Phi^{-1}(p(i))$$

4. Fill-in

This equation is used to "fill in" estimated nondetect values for the nine nondetects above. The results of the calculation are shown below:

x_i	pc(i)	$\Phi^{-1}(pc(i))$	$\hat{z}_i$
<50	0.087	-1.360	3.032
<50	0.173	-0.942	3.625
<50	0.260	-0.643	4.049
<200	0.144	-1.063	3.453
<200	0.289	-0.556	4.173
<200	0.433	-0.169	4.722
<400	0.181	-0.912	3.668
<400	0.361	-0.356	4.456
<400	0.542	0.106	5.112

The z_i and the $\hat{z}_i$ from the two tables above are then combined to estimate a natural log mean and a log standard deviation. The data and calculated values for $\hat{\mu}$ and $\hat{\sigma}^2$ are shown below:

4.605	5.704	6.551	3.032	3.453	3.668
4.605	6.215	6.908	3.625	4.173	4.456
5.704	6.215	7.090	4.049	4.722	5.112

$$\hat{\mu} = 4.9937$$
$$\hat{\sigma}^2 = 1.5632 \quad (\hat{\sigma} = 1.2503)$$

The calculated values for $\hat{\mu}$ and $\hat{\sigma}$ can then be used for estimating the arithmetic mean of the sample: $m = \exp(\hat{\mu} + 0.5\,\hat{\sigma}^2) = 322.241$ and sample standard deviation $s = m\sqrt{e^{\hat{\sigma}^2} - 1} = 626.168$. In some instances, one may be interested in the 90th percentile of the data, which can be estimated as $P_{90} = \exp(\hat{\mu} + 1.282 \cdot \hat{\sigma}) = 732.585$. It is worthwhile to note that these calculations are based on the assumption that the data follow a log-normal distribution. For most water quality related variables, such as BOD concentration, the log-normal distribution is appropriate. However, when percent removal is the variable of concern, log-normal is no longer an appropriate probability distribution. Instead, one may apply the MR method to the concentration variables first and calculate the percent removal after the non-detected concentration values have been filled-in.

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APPENDIX R - PRIORITY POLLUTANT REMOVAL EFFICIENCIES

Priority Pollutant Removal Efficiencies (%) Through Primary Treatment*

Priority Pollutant	Median	Number of POTWs with Removal Data**
METAL/NONMETAL INORGANICS		
Cadmium	15	6 of 40
Chromium	27	12 of 40
Copper	22	12 of 40
Cyanide	27	12 of 40
Lead	57	1 of 40
Mercury	10	8 of 40
Nickel	14	9 of 40
Silver	20	4 of 40
Zinc	27	12 of 40
ORGANICS		
Benzene	25	8 of 40
Chloroform	14	11 of 40
1,2-trans-Dichloroethylene	36	9 of 40
Ethylbenzene	13	12 of 40
Naphthalene	44	4 of 40
Phenol	8	11 of 40
Butyl benzyl phthalate	62	4 of 40
Di-n-butyl phthalate	36	3 of 40
Diethyl phthalate	56	1 of 40
Tetrachloroethylene	4	12 of 40
1,1,1-Trichloroethane	40	10 of 40
Trichloroethylene	20	12 of 40

* Pollutant removals between POTW influent and primary effluent. From *Fate of Priority Pollutants in Publicly Owned Treatment Works, Volume I* (EPA 440/1-82/303), U.S. Environmental Protection Agency, Washington, D.C., September 1982, p. 61.

** Median removal efficiencies from a data base of removal efficiencies for 40 POTWs. Only POTWs with average influent concentrations exceeding three times each pollutant's detection limit were considered.

Source: U.S. EPA's *Guidance Manual on the Development and Implementation of Local Discharger Limitations Under the Pretreatment Program*, December 1987, p. 3-55.

Priority Pollutant Percent Removal Efficiencies (%) Through Activated Sludge Treatment*

Priority Pollutant	Range	Second Decile	Median	Eight Decile	Number of POTWs with Removal Data
METALS/NONMETAL INORGANICS**					
Arsenic	11-78	31	45	53	5 of 26
Cadmium	25-99	33	67	91	19 of 26
Chromium	25-97	68	82	91	25 of 26
Copper	2-99	67	86	95	26 of 26
Cyanide	3-99	41	69	84	25 of 26
Lead	1-92	39	61	76	23 of 26
Mercury	1-95	50	60	79	20 of 26
Nickel	2-99	25	42	62	23 of 26
Selenium	25-89	33	50	67	4 of 26
Silver	17-95	50	75	88	24 of 26
Zinc	23-99	64	79	88	26 of 26
ORGANICS**					
Anthracene	29-99	44	67	91	5 of 26
Benzene	25-99	50	80	96	18 of 26
Chloroform	17-99	50	67	83	24 of 26
1,2-trans-Dichloroethylene	17-99	50	67	91	17 of 26
Ethylbenzene	25-99	67	86	97	25 of 26
Methylene chloride	2-99	36	62	77	26 of 26
Naphthalene	25-98	40	78	90	16 of 26
Phenanthrene	29-99	37	68	86	6 of 26
Phenol	3-99	75	90	98	19 of 26
Bis (2-ethylhexyl) phthalate	17-99	47	72	87	25 of 26
Butyl benzyl phthalate	25-99	50	67	92	16 of 26
Di-n-butyl phthalate	11-97	39	64	87	19 of 26
Diethyl phthalate	17-98	39	62	90	15 of 26
Pyrene	73-95	76	86	95	2 of 26
Tetrachloroethylene	15-99	50	80	93	26 of 26
Toluene	25-99	80	93	98	26 of 26
1,1,1-Trichloroethane	18-99	75	85	94	23 of 26
Trichloroethylene	20-99	75	89	98	25 of 26

* Pollutant removals between POTW influent and secondary effluent (including secondary clarification). Based on a computer analysis of POTW removal efficiency data (derived from actual POTW influent and effluent sampling data) provided in U.S. EPA's *Fate of Priority Pollutants in Publicly Owned Treatment Works, Volume II* (EPA 440/1-82/303), September 1982.

** For the purpose of deriving removal efficiencies, effluent levels reported as below detection were set equal to the reported detection limits. All secondary activated sludge treatment plants sampled as part of the study were considered.

Source: U.S. EPA's *Guidance Manual on the Development and Implementation of Local Discharger Limitations Under the Pretreatment Program*, December 1987, p. 3-56.

Priority Pollutant Removal Efficiencies (%) Through Trickling Filter Treatment*

Priority Pollutant	Range	Second Decile	Median	Eighth Decile	Number of POTWs with Removal Data
METALS/NONMETAL INORGANICS**					
Cadmium	33-96	33	68	93	6 of 11
Chromium	5-92	34	55	71	9 of 11
Copper	12-97	32	61	89	9 of 11
Cyanide	7-88	33	59	79	8 of 11
Lead	4-84	25	55	70	6 of 11
Mercury	14-80	33	50	62	9 of 11
Nickel	7-72	11	29	57	9 of 11
Silver	11-93	38	66	86	8 of 11
Zinc	14-90	34	67	81	9 of 11
ORGANICS**					
Benzene	5-98	50	75	93	7 of 11
Chloroform	21-94	50	73	84	9 of 11
1,2-trans-Dichloroethylene	14-99	50	50	96	7 of 11
Ethylbenzene	45-97	50	80	91	10 of 11
Methylene chloride	5-98	28	70	85	10 of 11
Naphthalene	33-93	40	71	87	6 of 11
Phenol	50-99	75	84	96	8 of 11
Bis (2-ethylhexyl) phthalate	4-98	21	58	81	10 of 11
Butyl benzyl phthalate	25-90	37	60	77	9 of 11
Di-n-butyl phthalate	29-97	41	60	82	10 of 11
Diethyl phthalate	17-75	40	57	67	8 of 11
Tetrachloroethylene	26-99	53	80	93	10 of 11
Toluene	17-99	80	93	97	10 of 11
1,1,1-Trichloroethane	23-99	75	89	97	10 of 11
Trichloroethylene	50-99	67	94	98	10 of 11

* Pollutant removals between POTW influent and secondary effluent (including secondary clarification). Based on a computer analysis of POTW removal efficiency data (derived from actual POTW influent and effluent sampling data) provided in U.S EPA's *Fate of Priority Pollutants in Publicly Owned Treatment Works, Volume II*, (EPA 440/182/303), September 1982.

** For the purpose of deriving removal efficiencies, effluent levels reported as below detection were set equal to the reported detection limits. All secondary trickling filter plants sampled as part of the study were considered.

Source: U.S. EPA's *Guidance Manual on the Development and Implementation of Local Discharger Limitations Under the Pretreatment Program*, December 1987, p. 3-57.

Priority Pollutant Removal Efficiencies (%) Through Tertiary Treatment*

Priority Pollutant	Range	Second Decile	Median	Eighth Decile	Number of POTWs with Removal Data
METALS/NONMETAL INORGANICS**					
Cadmium	33-81	50	50	73	3 of 4
Chromium	22-93	62	72	89	4 of 4
Copper	8-99	58	85	98	4 of 4
Cyanide	20-93	32	66	83	4 of 4
Lead	4-86	9	52	77	3 of 4
Mercury	33-79	43	67	75	4 of 4
Nickel	4-78	17	17	57	3 of 4
Silver	27-87	55	62	82	3 of 4
Zinc	1-90	50	78	88	4 of 4
ORGANICS**					
Benzene	5-67	40	50	54	2 of 4
Chloroform	16-75	32	53	64	3 of 4
1,2-trans-Dichloroethylene	50-96	50	83	93	2 of 4
Ethylbenzene	65-95	80	89	94	3 of 4
Methylene Chloride	11-96	31	57	78	4 of 4
Naphthalene	25-94	33	73	86	3 of 4
Phenol	33-98	80	88	96	4 of 4
Bis (2-ethylhexyl) phthalate	45-98	59	76	94	4 of 4
Butyl benzyl phthalate	25-94	50	63	85	4 of 4
Di-n-butyl phthalate	14-84	27	50	70	4 of 4
Diethyl phthalate	20-57	29	38	50	3 of 4
Tetrachloroethylene	67-98	80	91	97	4 of 4
Toluene	50-99	83	94	97	4 of 4
1,1,1-Trichloroethane	50-98	79	94	97	4 of 4
Trichloroethylene	50-99	62	93	98	4 of 4

* Pollutant removals between POTW influent and tertiary effluent (including final clarification). Based on a computer analysis of POTW removal efficiency data (derived from actual POTW influent and effluent sampling data) provided in U.S. EPA's *Fate of Priority Pollutants in Publicly Owned Treatment Works, Volume II* (EPA 440/1-82/303), September 1982. Tertiary treatment was taken to include POTWs with effluent microscreening, mixed media filtration, post aeration, and/or nitrification/denitrification.

** For the purpose of deriving removal efficiencies, effluent levels reported as below detection were set equal to the reported detection limits. All tertiary treatment plants sampled as part of the study were considered.

Source: U.S. EPA's *Guidance Manual on the Development and Implementation of Local Discharger Limitations Under the Pretreatment Program*, December 1987, p. 3-58.

APPENDIX S -
SPECIFIC GRAVITY OF SLUDGE

The allowable headworks loading (AHL) equations presented in Chapter 5 for sewage sludge disposal contain a factor for the specific gravity of sludge (sludge density). This factor accounts for differences in the density of sludge based on the percent solids of sludge to disposal. The unit conversion factor (8.34) in the same equations converts the overall units into pounds per day (lbs/day), using a specific gravity or density of sludge equal to 1 kg/L, which assumes that sludge has the same density as water. If the dewatered sludge density is different from the density of water, the unit conversion factor is not fully accurate. As the percent solids of a sludge increases, the density of the sludge increases and therefore the error introduced by the inaccurate unit conversion factor increases. To correct this inaccuracy, the numerator of the AHL equation should be multiplied by the specific gravity of the dewatered sludge (as noted in Chapter 6). If a sludge is not dewatered before disposal, the inaccuracy produced by using the unit conversion factor (8.34) without a specific gravity factor would probably not be significant.

The POTW can determine the specific gravity (density) of its sludge prior to disposal through a simple laboratory measurement. The POTW should take this measurement as part of its local limits monitoring program and average the resulting data set (e.g., 7-10 data points) to determine a representative sludge specific gravity (density) factor for use in local limits calculations. The POTW can also estimate the specific gravity of its sludge using the equations below and information on the percent solids.

For a typical wet sludge at 10% solids, the approximate density is 1.03 kg/L. For a typical dewatered sludge at 30% solids, the approximate density is 1.11 kg/L. A sludge at 50% solids may reach a density of 1.2 to 1.3 kg/L, which would result in a 20% to 30% conservative error in the calculation of an AHL if a specific gravity factor is not used. All of these values depend on the amount of volatile solids in the sludge in comparison with the amount of fixed mineral solids, which vary with percent solids, and the densities of each of these types of solids.

$$\frac{M_{WS}}{S_{WS}} = \frac{M_S}{S_S} + \frac{M_W}{S_W}$$

Equation to determine specific gravity of wet sludge

Where:

M_{WS}	=	Mass of wet sludge (kg)
S_{WS}	=	Specific gravity of wet sludge (kg/L)
M_S	=	Mass of dry sludge solids (kg)
S_S	=	Specific gravity of sludge solids (kg/L)
M_W	=	Mass of water (kg)
S_W	=	Specific gravity of water (kg/L)

$$\frac{M_S}{S_S} = \frac{M_F}{S_F} + \frac{M_V}{S_V}$$

Equation to determine specific gravity of dry sludge solids

Where:

M_F	=	Mass of fixed solids (kg)
S_F	=	Specific gravity of fixed solids (kg/L)
M_V	=	Mass of volatile solids (kg)
S_V	=	Specific gravity of volatile solids (kg/L)

The result from the second equation is used in the first equation.

Example

Sludge is 10% solids:

Assume solids consist of 33% fixed mineral solids with a specific gravity of 2.5 kg/L and 67% volatile solids with a specific gravity of 1.2 kg/L.

To determine the specific gravity of the dry sludge solids, use the second equation:

$$\frac{M_S}{S_S} = [(0.33)x\frac{M_S}{2.5}] + [(0.67)x\frac{M_S}{1.2}]$$

which results in S_s = 1.45 kg/L. Using this value in the first equation:

$$\frac{M_{WS}}{S_{WS}} = [(0.10)x\frac{M_{WS}}{1.45}] + [(0.90)x\frac{M_{WS}}{1}]$$

yields S_{WS} = 1.03 kg/L.

APPENDIX T - SLUDGE AHL EQUATIONS USING FLOW (IN METRIC UNITS)

Some POTWs may have sludge flow data available in dry metric tons per day, rather than MGD. The AHL equations for sludge disposal in Chapter 6 can be converted to use sludge flow data in these units. Some of the equations in Chapter 6 are presented below using flows in dry metric tons per day. Use of these "dry flows" eliminates the need for the specific gravity factor in the equations.

GENERAL SLUDGE EQUATION FOR CONSERVATIVE POLLUTANTS

$$L_{INFL} = \frac{(C_{CRIT})(Q_{SLDG})(0.0022)}{R_{POTW}}$$

Where:

L_{INFL}	=	Allowable influent loading, lbs/day
C_{CRIT}	=	Sludge criteria, mg/kg dry sludge
Q_{SLDG}	=	Total sludge flow to disposal, dry metric tons per day
R_{POTW}	=	Removal efficiency across POTW (as decimal)
0.0022	=	Unit conversion factor

LAND APPLICATION

As explained in Chapter 6, determining the land application sludge criteria for use in the general sludge equation requires that the POTW first convert 40 CFR §503 Table 2 and Table 4 sludge criteria into values in mg/kg of dry sludge units. Because Table 2 and Table 4 criteria are in metric units (kg/ha), they must be converted into English units (lbs/acre) so that they can be used with the equations in Chapter 6 which use other English units (e.g., flow in MGD, area in acres). Table 2 and Table 4 criteria are provided in both metric and English units in Appendix E.

Another option is for POTWs to use the land application criteria equations in metric units (e.g., area in hectares, flow in dry metric tons per day), thus eliminating the need to convert Table 2 and Table 4 values to English units. These equations are provided below. These equations avoid the need for a specific gravity factor because they use also use a "dry flow" for sludge.

$$C_{CRIT} = \frac{(C_{CUM})(SA)}{(SL)(Q_{LA})(0.365)}$$

Where:

C_{CRIT}	=	Sludge criteria, mg/kg dry sludge
C_{CUM}	=	Federal (Table 2 of 40 CFR 503.13) or State land application cumulative pollutant loading rate, kg/ha
SA	=	Site area, hectares
SL	=	Site life, years
Q_{LA}	=	Sludge flow to bulk land application at an agricultural, forest, public contact, or reclamation site, dry metric tons per day
0.365	=	Unit conversion factor

$$C_{CRIT} = \frac{C_{ANN}}{(AWSAR)(0.001)}$$

Where:

C_{CRIT}	=	Sludge criteria, mg/kg dry sludge
C_{ANN}	=	Federal (Table 4 of 40 CFR 503.13) or State land application annual pollutant loading rate, kg/ha
AWSAR	=	Annual whole sludge application rate, metric tons per hectare per year dry weight basis
0.001	=	Unit conversion factor

INCINERATION

Sludge standards for maximum pollutant concentrations in sludge feed to the incinerator need to be in mg/kg dry sludge to be used in the equations at the beginning of Section 6.2.3 to calculate AHLs. A POTW disposing of sludge through incineration may already have sludge standards in mg/kg dry sludge, such as through a waste disposal agreement with the operator of a sludge incincerator. As noted in Chapter 6, if no sludge standards have been calculated for the sludge feed to the incinerator, POTWs should use the Part 503 equations (provided below) to determine the maximum pollutant concentrations for the incinerator feed. These maximum concentrations are then used in the equations at the beginning of Section 6.2.3 to calculate AHLs.

$$C_{CRIT} = \frac{(RSC)(86{,}400)}{(DF)(1-CE)(Q_{INC})}$$

Arsenic, Cadmium, Chromium, Nickel

$$C_{CRIT} = \frac{(0.1)(NAAQS)(86{,}400)}{(DF)(1-CE)(Q_{INC})}$$

Lead

$$C_{CRIT} = \frac{NESHAP}{(1-CE)(Q_{INC})}$$

Beryllium, Mercury, pollutants with State limits

Where:

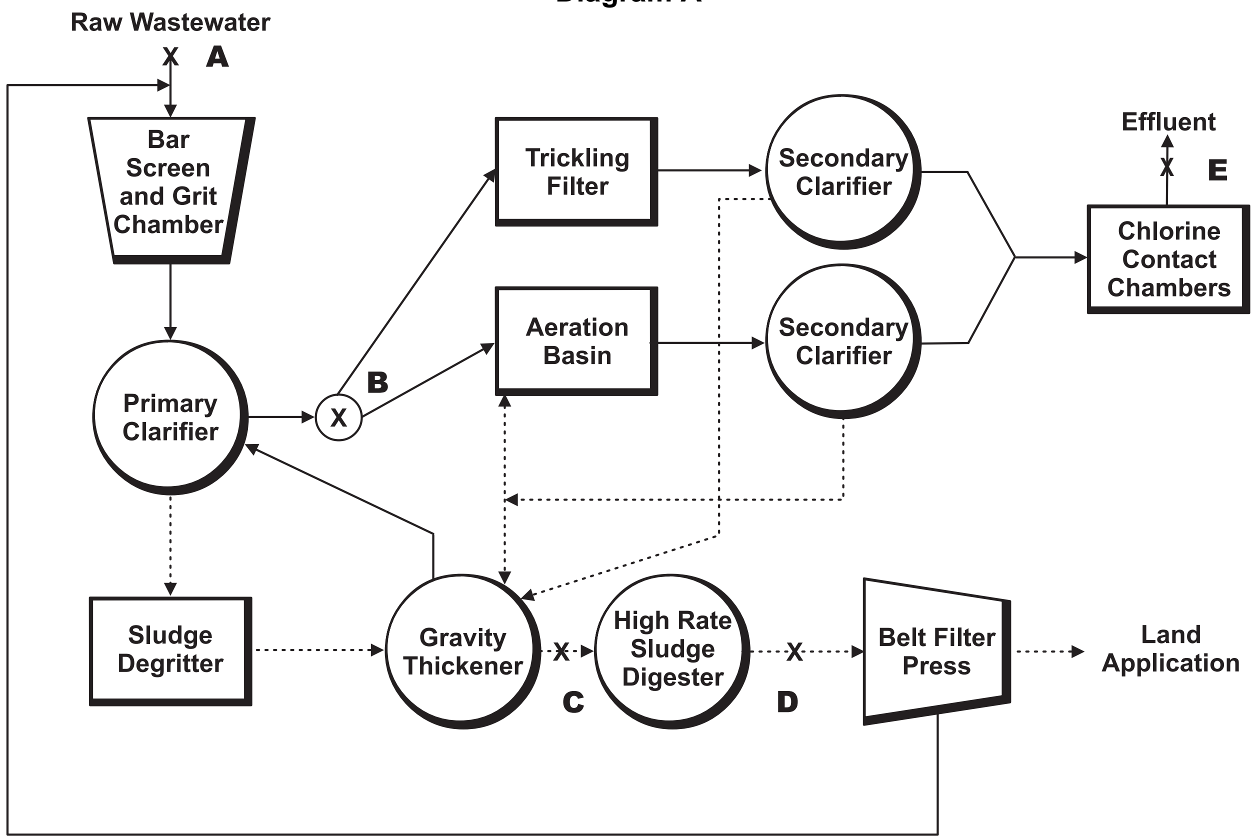
C_{CRIT}	=	Sludge criteria, mg/kg dry sludge
NESHAP	=	National emission standard for beryllium or mercury from 40 CFR Part 61, g/day
NAAQS	=	National Ambient Air Quality Standard for lead, ug/m^3
RSC	=	Federal risk specific concentration limit for arsenic, cadmium, chromium, or nickel from 40 CFR 503.43, ug/m^3
CE	=	Control efficiency (removal efficiency) for sewage sludge incinerator for the given pollutant (as a decimal)
Q_{INC}	=	Sludge flow to incinerator (i.e., sewage sludge feed rate), dry metric tons per day
DF	=	Dispersion factor, ug/m^3/g/sec
0.1 and 86,400	=	Unit conversion factors

For pollutants with State incinerator emissions standards, limits should be entered in g/day in place of the NESHAPs limits in the first equation above.

APPENDIX U -
POTW CONFIGURATIONS

The diagrams and discussions below demonstrate sampling locations to develop allowable headworks loadings (AHLs). For illustrative purposes, in this appendix all three plants must determine the AHLs based upon effluent limitations, secondary treatment inhibition, sludge digester inhibition, and sludge land application. Three different plants, with very different secondary treatment trains, are diagramed below along with sampling points for the AHL calculations.

Diagram A



AHL FOR SECONDARY TREATMENT INHIBITION

At this POTW a trickling filter and an activated sludge system (aeration basin) operated in parallel provide secondary treatment of the raw wastewater. The concentration of a pollutant that could cause inhibition at the trickling filter may be different than the pollutant concentration that causes inhibition (known as the inhibition threshold level) at the aeration basin. The plant must determine a headworks loading protective of these two secondary treatment units. Using Equation 5.10, an AHL based on secondary treatment inhibition can be calculated.

$$AHL_{inhtf} = \frac{(C_{inhtf})(Q_{potw})(8.34)}{(1 - R_{prim})} \qquad \text{Trickling Filter}$$

$$AHL_{inhab} = \frac{(C_{inhab})(Q_{potw})(8.34)}{(1 - R_{prim})} \qquad \text{Aeration Basin}$$

Where:

AHL_{inhab}	=	AHL based on aeration basin inhibition, lbs/day
AHL_{inhtf}	=	AHL based on trickling filter inhibition, lbs/day
C_{inhab}	=	Inhibition criteria for aeration basin, mg/L
C_{inhtf}	=	Inhibition criteria for trickling filter, mg/L
Q_{potw}	=	Total POTW flow, MGD
R_{prim}	=	Removal efficiency from headworks to primary treatment effluent as a decimal (See Section 5.1.1 for calculating removal efficiencies)
8.34	=	Unit conversion factor

The equations to calculate the AHL based on trickling filter and aeration basin inhibition includes an inhibition criteria for the trickling filter, C_{inhtf}, and aeration basin, C_{inhab}, respectively. Both equations use the same removal rate, R_{prim}, from the headworks to the primary treatment effluent. R_{prim} can be determined by sampling loading at point "A," the headworks, and point "B," primary clarifier effluent (See Section 5.1 for these calculations). Q_{potw} can be determined through flow sampling at point "A" as well. AHL_{ab} and the AHL_{tf} would be calculated, compared and the more stringent selected.

AHL FOR SLUDGE DIGESTER INHIBITION

This plant must determine a headworks loading protecting the high-rate sludge digester from inhibition. Using Equation 5.12, an AHL based on sludge digester inhibition can be calculated.

$$AHL_{inhhrsd} = \frac{8.34(C_{inbhrsd})(Q_{hrsd})}{R_{potw}}$$

Where:

$AHL_{inhhrsd}$	=	AHL based on high-rate sludge digester inhibition, lbs/day
$C_{inbhrsd}$	=	High-rate sludge digester inhibition criteria, mg/L
Q_{hrsd}	=	Sludge flow to high-rate sludge digester, MGD
R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
8.34	=	Unit conversion factor

The equation to calculate the AHL based on high-rate sludge digester inhibition includes an inhibition criteria for the digester, $C_{inbhrsd}$, sludge flow to the digester, Q_{hrsd} , and an overall plant removal rate from headworks to plant effluent, R_{potw}. Q_{hrsd} can be determined by sampling flow at point "C," the sludge wastestream from gravity thickener to digester. R_{potw} can be determined by sampling at point "A," the headworks before the bar screen and grit chamber, and at point "E," the effluent after the chlorine contact chambers.

AHL FOR EFFLUENT LIMITS

The plant must determine headworks loading that would lead to effluent from its chlorine contact chambers (CCC) comply with NPDES Permit limits. Using Equation 5.5, the AHL based on NPDES Permit limit can be calculated.

$$AHL_{effccc} = \frac{(8.34)(C_{npdes})(Q_{potw})}{(1 - R_{potw})}$$

Where:

AHL_{effccc}	=	AHL based on CCC effluent compliance with NPDES, lbs/day
C_{npdes}	=	NPDES permit limit, mg/L
Q_{potw}	=	POTW flow, average, MGD
R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
8.34	=	Conversion factor

The equation to calculate the AHL based on CCC effluent compliance with NPDES includes the NPDES permit limit, C_{npdes}, total POTW flow, Q_{potw}, and an overall plant removal rate from headworks to plant effluent, R_{potw}. R_{potw} can be determined by sampling loading at point "A," the headworks before the bar screen and grit chamber, and at point "E," the effluent after the chlorine contact chambers. Q_{potw} can be determined through sampling flow at point "A" as well.

AHL FOR SLUDGE APPLICATION

The plant must determine a headworks that would lead to sludge from the belt filter press suitable for land application. Using equation 5.9 an AHL based on sludge land application can be calculated.

$$AHL_{sabfp} = \frac{(8.34)(C_{slgstd})(PS/100)(Q_{bpf})(G_{sldg})}{R_{potw}}$$

Where:

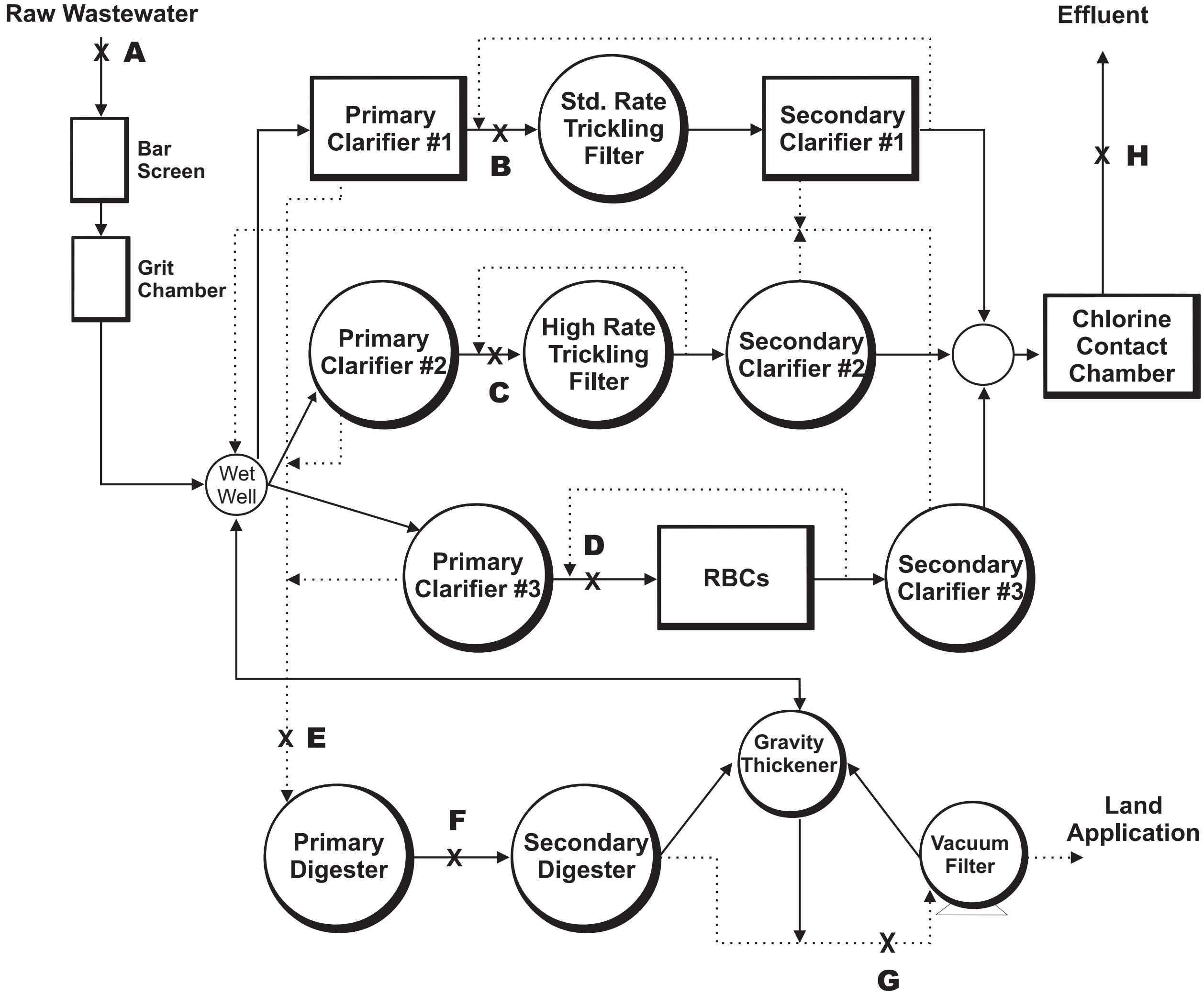
AHL_{sabfp}	=	AHL based on compliance with sludge application standards, lbs/day
C_{slgstd}	=	Sludge standard, mg/kg dry sludge
PS	=	Percent solids of sludge leading to belt filter press
Q_{bfp}	=	Total sludge flow to belt filter press, MGD
R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
G_{sldg}	=	Specific gravity of sludge leading to filter press, kg/L
8.34	=	Unit conversion factor

The equation to calculate the AHL based on belt filter press sludge compliance with sludge standards includes the sludge limit, C_{slgstd}; the flow, percent solids and specific gravity of sludge leading to the belt filter press, Q_{bfp}, PS, and G_{sldg}, respectively; and the overall plant removal rate from headworks to plant effluent, R_{potw}. R_{potw} can be determined by sampling loading at point "A," the headworks before the bar screen and grit chamber, and at point "E," the effluent after the chlorine contact chambers. Q_{bfp}, PS, and G_{sldg}, can be determined through sampling point "D" the sludge waste stream to the belt filter press.

AHL FOR SECONDARY TREATMENT INHIBITION

At this POTW a standard rate trickling filter, a high rate trickling filter, and rotating biological contactors (RBCs) operated in parallel provide secondary treatment of the raw wastewater. Each of these biological units is preceded by a different primary clarifier. An AHL (to prevent inhibition) should be determined for each of these biological unit processes because:

Diagram B



- The concentration of a pollutant that could cause inhibition at the standard rate trickling filter, high rate trickling filter, and RBCs are different.
- The design and operational loadings to each of the secondary treatment units are different and therefore loading is different.
- The primary clarifiers may have different removal efficiencies and therefore the pollutant concentrations to each of the secondary treatment unit may be different.

The three equations listed below can be used to calculate secondary treatment inhibition.

$$AHL_{inhstf} = \frac{(C_{inhstf})(Q_{potw})(8.34)}{(1 - R_{prim1})}$$ Standard Trickling Filter

$$AHL_{inhhrtf} = \frac{(C_{inhhrtf})(Q_{potw})(8.34)}{(1 - R_{prim2})}$$ High-Rate Trickling Filter

$$AHL_{inhrbc} = \frac{(C_{inhrbc})(Q_{potw})(8.34)}{(1 - R_{prim3})}$$ RBCs

Where:

AHL_{inhstf}	=	AHL based on standard trickling filter inhibition, lbs/day
$AHL_{inhhrtf}$	=	AHL based on high-rate trickling filter inhibition, lbs/day
AHL_{inhrbc}	=	AHL based on RBC inhibition, lbs/day
C_{inhstf}	=	Inhibition criteria for standard trickling filter, mg/L
$C_{inhhrtf}$	=	Inhibition criteria for high-rate trickling filter, mg/L
C_{inhrbc}	=	Inhibition criteria for RBC, mg/L
Q_{potw}	=	Total POTW flow, MGD
R_{prim1}	=	Removal efficiency from headworks to primary clarifier #1 effluent as a decimal (See Section 5.1.1 for calculating removal efficiencies)
R_{prim2}	=	Removal efficiency from headworks to primary clarifier #2 effluent as a decimal
R_{prim3}	=	Removal efficiency from headworks to primary clarifier #3 effluent as a decimal
8.34	=	Unit conversion factor

Each of the AHL equations has an inhibition criteria for each secondary treatment unit, C_{inhstf} , $C_{inhhrtf}$, and C_{inhrbc} and removal rates from the headworks to corresponding primary clarifier unit effluent, R_{prim1}, R_{prim2}, and R_{prim3}. Data from sampling locations "A" and "B" is used to calculate the removal efficiency from headworks to the primary clarifier #1 effluent, R_{prim1}. Data from sampling locations "A"and "C" is used to calculate the removal efficiency from headworks to primary clarifier #2 effluent, R_{prim2}. Data from sampling locations "A" and "D" is used to calculate the removal efficiency from headworks to primary clarifier #3 effluent, R_{prim3}. Q_{potw} can be determined at sampling point "A." The AHL_{inhstf}, $AHL_{inhhrtf}$, and AHL_{inhrbc} should be calculated, compared, and the most stringent (smallest) selected.

AHL FOR SLUDGE DIGESTER INHIBITION

This plant must determine a headworks loading protecting both the primary and secondary sludge digesters from inhibition. Using Equation 5.12, an AHL based on sludge digester inhibition can be calculated.

$$AHL_{inbpd} = \frac{8.34(C_{inbpd})(Q_{pd})}{R_{potw}}$$ Primary Digester

$$AHL_{inbsd} = \frac{8.34(C_{inbsd})(Q_{sd})}{R_{potw}}$$ Secondary Digester

Where:

AHL_{inbpd}	=	AHL based on primary digester inhibition, lbs/day
AHL_{inbsd}	=	AHL based on secondary digester inhibition, lbs/day
C_{inbpd}	=	Primary digester inhibition criteria, mg/L
C_{inbsd}	=	Primary digester inhibition criteria, mg/L
Q_{pd}	=	Sludge flow to primary digester, MGD
Q_{sd}	=	Sludge flow to secondary digester, MGD
R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
8.34	=	Unit conversion factor

The equations to calculate the AHL based on sludge digester inhibition include primary and secondary inhibition criteria, C_{inbpd} and C_{inbsd}, sludge flow to the primary and secondary digesters, Q_{pd} and Q_{sd}, and an overall plant removal rate from headworks to plant effluent, R_{potw}. Q_{pd} can be determined by sampling flow at point "E," the sludge wastestream to the primary digester. Q_{sd} can be determined by sampling flow at point "F," the sludge wastestream from the primary digester to the secondary digester. R_{potw} can be determined by sampling loading at point "A," the headworks before the bar screen and grit chamber, and at point "H," the effluent after the chlorine contact chambers. AHL_{inbpd} and AHL_{inbsd} should be calculated, compared and the more stringent selected.

AHL FOR EFFLUENT LIMITS

The plant must determine headworks loading that would lead to effluent from its chlorine contact chambers (CCC) comply with NPDES Permit limits. Using Equation 5.5, the AHL based on NPDES Permit limit can be calculated.

$$AHL_{effccc} = \frac{(8.34)(C_{npdes})(Q_{potw})}{(1 - R_{potw})}$$

Where:

AHL_{effccc}	=	AHL based on CCC effluent compliance with NPDES, lbs/day
C_{npdes}	=	NPDES permit limit, mg/L
Q_{potw}	=	POTW flow, average, MGD
R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
8.34	=	Conversion factor

The equation to calculate the AHL based on CCC effluent compliance with NPDES includes the NPDES permit limit, C_{npdes}, total POTW flow, Q_{potw}, and an overall plant removal rate from headworks to plant effluent, R_{potw}. R_{potw} can be determined by sampling at point "A," the headworks before the bar screen and grit chamber, and at point "H," the effluent after the chlorine contact chambers. Q_{potw} can be determined through sampling flow at point "A" as well.

AHL FOR SLUDGE APPLICATION

The plant must determine a headworks that would lead to sludge from the vacuum filter suitable for land application. Using equation 5.9 an AHL based on sludge land application can be calculated.

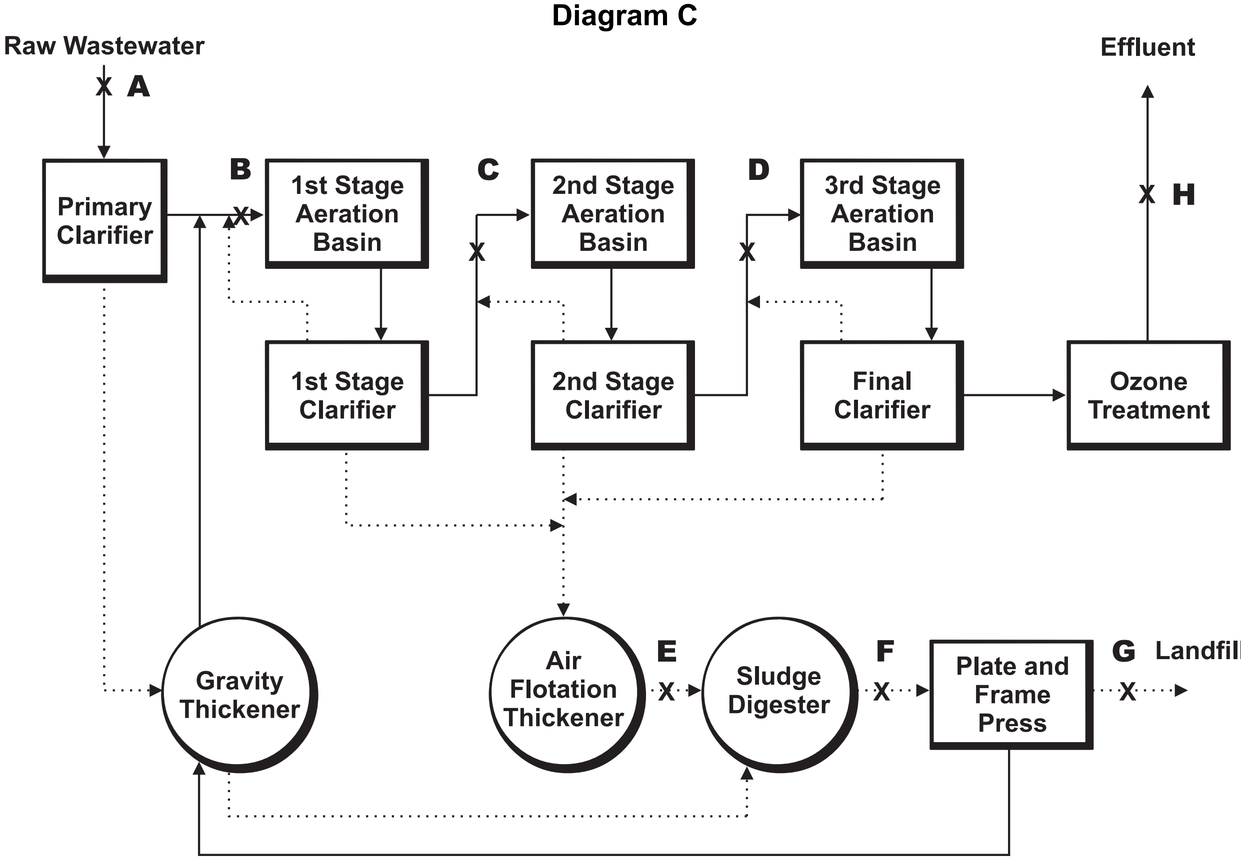
$$AHL_{savf} = \frac{(8.34)(C_{slgstd})(PS/100)(Q_{vf})(G_{sldg})}{R_{potw}}$$

Where:

AHL_{savf}	=	AHL based on compliance with sludge application standards, lbs/day
C_{slgstd}	=	Sludge standard, mg/kg dry sludge
PS	=	Percent solids of sludge leading to vacuum filter
Q_{vf}	=	Total sludge flow to vacuum filter, MGD
R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
G_{sldg}	=	Specific gravity of sludge leading to vacuum filter, kg/L
8.34	=	Unit conversion factor

The equation to calculate the AHL based on vacuum filter sludge compliance with sludge standards includes the sludge limit, C_{slgstd}; the flow, percent solids and specific gravity of sludge leading to the belt filter press, Q_{vf}, *PS,* and G_{sldg}, respectively; and the overall plant removal rate from headworks to plant effluent, R_{potw}. R_{potw} can be determined by sampling at point "A," the headworks before the bar screen and grit chamber, and at point "H," the effluent after the chlorine contact chambers. Q_{vf}, *PS,* and G_{sldg}, can be determined through sampling at point "G" the sludge waste stream to the vacuum filter.

Diagram C



AHL FOR SECONDARY TREATMENT INHIBITION

At this POTW three activated sludge units (aeration basins) operated in series provide secondary treatment of the raw wastewater. The concentration of a pollutant entering the First Stage Aeration Basin would be different from the concentration of that pollutant entering the Second Stage Aeration Basin and the Third Stage Aeration Basin because of the removal occurring in each unit. An AHL (to prevent inhibition) should be determined for each of these secondary treatment units.

$$AHL_{inhab1} = \frac{(C_{inhab1})(Q_{potw})(8.34)}{(1 - R_{prim})} \quad \text{1}^{st} \text{ Stage Aeration Basin}$$

$$AHL_{inhab2} = \frac{(C_{inhab2})(Q_{potw})(8.34)}{(1 - R_{ab1})} \quad \text{2}^{nd} \text{ Stage Aeration Basin}$$

$$AHL_{inhab3} = \frac{(C_{inhab3})(Q_{potw})(8.34)}{(1 - R_{ab2})} \quad \text{3}^{rd} \text{ Stage Aeration Basin}$$

Where:

AHL_{inhab1}	=	AHL based on 1st Stage Aeration Basin inhibition, lbs/day
AHL_{inhab2}	=	AHL based on 2nd Stage Aeration Basin inhibition, lbs/day
AHL_{inhab3}	=	AHL based on 3rd Stage Aeration Basin inhibition, lbs/day
C_{inhab1}	=	Inhibition criteria for 1st Stage Aeration Basin, mg/L
C_{inhab2}	=	Inhibition criteria for 2nd Stage Aeration Basin, mg/L
C_{inhab3}	=	Inhibition criteria for 3rd Stage Aeration Basin, mg/L
Q_{potw}	=	Total POTW flow, MGD
R_{prim}	=	Removal efficiency from headworks to primary treatment effluent as a decimal (See Section 5.1.1 for calculating removal efficiencies)
R_{ab1}	=	Removal efficiency from headworks to 1st Stage Aeration Basin effluent as a decimal
R_{ab2}	=	Removal efficiency from headworks to 2nd Stage Aeration Basin effluent as a decimal
8.34	=	Unit conversion factor

Each of the equations to calculate AHLs for secondary treatment has it own inhibition criteria for each basin, C_{inhab1}, C_{inhab2}, and C_{inhab3} and corresponding removal rate, R_{prim}, R_{ab1}, and R_{ab2}, respectively, for the 1st, 2nd, and 3rd stage aeration basins. Data from sampling locations "A" and "B" is used to determine the removal efficiency from headworks to primary clarifier effluent, R_{prim}. Data from sampling locations "A" and "C" is used to determine the removal efficiency from headworks to 1st stage clarifier effluent, $R_{ab1.}$ Data from sampling locations "A" and "D" is used to determine the removal efficiency from headworks to 2nd stage clarifier effluent, R_{ab2}. Q_{potw} can be determined by sampling at location "A." The AHL_{inhab1}, AHL_{inhab2}, and AHL_{inhab3} should be calculated, compared, and the most stringent (smallest) selected.

AHL FOR SLUDGE DIGESTER INHIBITION

This plant must determine a headworks loading protecting the sludge digester from inhibition. Using Equation 5.12, an AHL based on sludge digester inhibition can be calculated.

$$AHL_{inhsd} = \frac{8.34(C_{inhsd})(Q_{sd})}{R_{potw}}$$

Where:

AHL_{inhsd}	=	AHL based on sludge digester inhibition, lbs/day
C_{inhsd}	=	Sludge digester inhibition criteria, mg/L
Q_{sd}	=	Sludge flow to sludge digester, MGD
R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
8.34	=	Unit conversion factor

The equation to calculate the AHL based on high-rate sludge digester inhibition includes an inhibition criteria for the digester, C_{inhsd}, sludge flow to the digester, Q_{sd} , and an overall plant removal rate from headworks to plant effluent, R_{potw}. Q_{sd} can be determined by sampling flow at point "E," the sludge wastestream from air flotation thickener to the digester. R_{potw} can be determined by sampling loading at point "A," the headworks before the bar screen and grit chamber, and at point "H," the effluent after the ozone treatment unit.

AHL FOR EFFLUENT LIMITS

The plant must determine headworks loading that would lead to effluent from its ozone treatment unit (OTU) comply with NPDES Permit limits. Using Equation 5.5, the AHL based on NPDES Permit limit can be calculated.

$$AHL_{effotu} = \frac{(8.34)(C_{npdes})(Q_{potw})}{(1 - R_{potw})}$$

Where:

AHL_{effotu}	=	AHL based on OTU effluent compliance with NPDES, lbs/day
C_{npdes}	=	NPDES permit limit, mg/L
Q_{potw}	=	POTW flow, average, MGD
R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
8.34	=	Conversion factor

The equation to calculate the AHL based on OTU effluent compliance with NPDES includes the NPDES permit limit, C_{npdes}, total POTW flow, Q_{potw}, and an overall plant removal rate from headworks to plant effluent, R_{potw}. R_{potw} can be determined by sampling loading at point "A," the headworks before the bar screen and grit chamber, and at point "H," the effluent after the OTU. Q_{potw} can be determined through sampling flow at point "A" as well.

AHL FOR SLUDGE APPLICATION

The plant must determine a headworks that would lead to sludge from the plate and frame press (PFP) suitable for land application. Using equation 5.9 an AHL based on sludge land application can be calculated.

$$AHL_{sapfp} = \frac{(8.34)(C_{slgstd})(PS/100)(Q_{sldg})(G_{sldg})}{R_{potw}}$$

Where:

AHL_{sapfp}	=	AHL based on compliance with sludge application standards, lbs/day
C_{slgstd}	=	Sludge standard, mg/kg dry sludge
PS	=	Percent solids of sludge leading to PFP
Q_{pfp}	=	Total sludge flow to PFP, MGD
R_{potw}	=	Plant removal efficiency from headworks to plant effluent (as decimal)
G_{sldg}	=	Specific gravity of sludge leading to PFP, kg/L
8.34	=	Unit conversion factor

The equation to calculate the AHL based on PFP sludge compliance with sludge standards includes the sludge limit, C_{slgstd}; the flow, percent solids and specific gravity of sludge leading to the PFP, Q_{pfp}, *PS,* and G_{sldg}, respectively; and the overall plant removal rate from headworks to plant effluent, R_{potw}. R_{potw} can be determined by sampling loading at point "A," the headworks before the bar screen and grit chamber, and at point "H," the effluent after the OTU. Q_{pfp}, *PS,* and G_{sldg}, can be determined through sampling flow at point "E" the sludge waste stream to the PFP.

APPENDIX V -
DOMESTIC POLLUTANT LOADINGS

Residential/Commercial Trunkline Monitoring Data

Pollutant	Number of Detections	Number of Samples	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)	Average Concentration (mg/L)
INORGANICS					
Arsenic	140	205	0.0004	0.088	0.007
Barium	3	3	0.04	0.216	0.115
Boron	4	4	0.1	0.42	0.3
Cadmium	361	538	0.00076	0.11	0.008
Chromium (III)	1	2	< 0.005	0.007	0.006
Chromium (T)	311	522	< 0.001	1.2	0.034
Copper	603	607	0.005	0.74	0.14
Cyanide	7	7	0.01	0.37	0.082
Fluoride	2	2	0.24	0.27	0.255
Iron	18	18	0.0002	3.4	0.989
Lead	433	540	0.001	2.04	0.058
Lithium	2	2	0.03	0.031	0.031
Manganese	3	3	0.04	0.161	0.087
Mercury	218	235	< 0.0001	0.054	0.002
Nickel	313	540	< 0.001	1.6	0.047
Phosphate	2	2	27.4	30.2	28.8
Total Phosphorous	1	1	0.7	0.7	0.7
Silver	181	224	0.0007	1.052	0.019
Zinc	636	638	0.01	1.28	0.231
ORGANICS					
Chloroform	21	30	<0.002	0.069	0.009
1,1-Dichloroethene	2	29	0.005	0.008	0.007
1,1-Dichloroethane	1	28	0.026	0.026	0.026
Trans-1,2-Dichloroethene	1	28	0.013	0.013	0.013
Fluoranthene	2	5	0.00001	<0.001	0.001
Methylene Chloride	7	30	0.00008	0.055	0.027
Phenols	2	2	0.00002	0.00003	0.000025
Bis (2-ethylhexyl) Phthalate	5	5	0.00002	0.022	0.006
Pyrene	2	3	0.00001	<0.005	0.0002
Tetrachloroethene	5	29	0.00001	0.037	0.014
1,2,4-Trichlorobenzene	1	3	<0.002	0.035	0.013
PESTICIDES					
Total BHC	3	3	0.001	0.001	0.001
4,4-DDD	3	3	0.00026	0.0004	0.0003
Total Endosulfan	3	3	0.002	0.002	0.002

Source: U.S. EPA's *Supplemental Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Programs*, May 1991. "Pollutant levels reported below specified detection limit were considered in the data analysis and, for the purpose of statistical analysis, were considered equal to the detection limit."

APPENDIX W - BEST MANAGEMENT PRACTICES MINI-CASE STUDIES

POTWs can implement best management practice (BMP) programs to gain control over wastewater discharges from commercial sources. By developing a less formal source control program with emphasis on source control, education, BMPs, as-needed inspections, and individual or "general" permits, POTWs can gain additional control over uncontrolled wastewater discharges from commercial sources. Source control programs should place emphasis on certain specific pollutants of concern. For example, silver and mercury are often of great concern to POTWs because of NPDES permit requirements.

The commercial sources of wastewater that are addressed by BMP-based source control tend to have lower pollutant concentrations and loadings than other more traditional industrial facilities regulated by the traditional pretreatment program. Taken as a group, however, numerous uncontrolled commercial establishments may represent a significant source control opportunity that can lead to measurable improvement in environmental quality. Several pretreatment programs have documented pollutant reductions after the implementation of BMP and source reduction programs.

Several BMP/source control programs implemented at several POTWs are summarized in the following paragraphs to illustrate a variety of approaches that have been taken to utilize BMPs for the control of commercial sources of wastewater. Programs reviewed include: East Bay Municipal Utility District (EBMUD) in Oakland, California; Metropolitan Wastewater in San Diego, California; Seattle Metropolitan/King County in Washington State; Western Lake Superior Sanitary District, Duluth, Minnesota; and the Connecticut Department of Environmental Protection (CT DEP), Hartford, Connecticut.

EAST BAY MUNICIPAL DISTRICT (EBMUD), OAKLAND, CA

EBMUD has been issuing pollution prevention permits (PPPs) since 1988. EBMUD began their PPP program in response to tighter air emission standards and more stringent NPDES permit requirements. As a result, EBMUD had to augment headworks sampling and analysis programs for the development and local limits. Based on attentive tracking of regulatory requirements over the past 10 years, EBMUD has sequentially identified POCs, identified commercial users contributing those pollutants, and developed PPPs with best management practice requirements.

When EBMUD recognizes a pollutant of concern, they follow step-wise procedures. First, information on businesses and commercial activities that may be contributing the targeted POC is collected and refined. Next, EBMUD engages in an outreach program and works with the businesses to define BMPs. Finally, EBMUD issues the PPP and evaluates compliance. Generally, there is one sector of business activity that is responsible for the specific pollutant. For example, silver is linked to the photo finishers. EBMUD works with representatives of the commercial sector to research and develop BMPs that will effectively minimize the pollutant in effluent wastewater.

EBMUD believes that the most important aspect of a successful PPP program is education, outreach, and user awareness combined with an enforceable permit. When conducting outreach, EBMUD gets in touch with each user to confirm the nature of their business and the processes they use at the business that can contribute wastewater and pollutants of concern. The establishment is asked to participate in educational workshops to review EBMUD's concerns, review and refine preliminary methods to prevent pollutant releases and lay the groundwork for successful communications and understanding of the problem and the solution. Users are introduced to the permitting and enforcement process in a non-threatening forum. EBMUD's inventory of users is based on water supply account information. Whenever a user opens a water account, it is automatically characterized for wastewater and source control purposes. A revenue collection system ($3.25 per commercial account per month) assures adequate funding for the PPP program.

EBMUD staff researches ideas for generalized BMPs through discussions with the business sector and State trade group associations. Each of the EBMUD staff tracks one or more business sectors and are responsible for knowing current pollution control measures and trends. During the research phase of BMP development, each user that is a potential contributor of a POC is sent a letter to notify them that EBMUD is working on a PPP and reviewing the anticipated time frame for permit issuance.

The PPP includes similar BMPs for each permittee. Some examples include silver recovery canisters connected in series to optimize removal of silver with a required logging procedure that assures canisters are changed at the appropriate frequency to eliminate break through. EBMUD PPPs vary in length from two to 8 pages and are issued in industry group batches for a duration of 5 years. In the administration of their PPP program, EBMUD conducts visits/inspections of the permittees, provides follow up education, distributes fact sheets, procedures and posters illustrating acceptable waste and wastewater disposal procedures. During the life of a 5-year permit, EBMUD tries to inspect the permittee at least once or twice. Based on the findings of the initial visit, and the degree to which the permittee is implementing the prescribed BMPs, the follow up frequency is set. When EBMUD fails to get cooperation from businesses, they initiate enforcement actions. As an example, EBMUD sought and obtained a $27,000 penalty from a dry cleaner.

A partial list of the businesses for which EBMUD has developed BMPs and PPP permits includes:

- Photofinishers
- Boat Yards
- Dry Cleaners
- Auto Repairs
- Print Shop
- Radiator Repair Shops
- Furniture Stripping

METROPOLITAN WASTEWATER, SAN DIEGO, CA

Metropolitan Wastewater issues sector-specific BMP discharge authorizations to commercial customers. These authorizations require:

- Specific pollution prevention measures.
- An initial certification of compliance.
- On-going semi-annual “reminder” certifications for businesses to demonstrate familiarity with their pollution prevention measures.

Metropolitan Wastewater covers a variety of sectors with this program. General permits are issued to film processing and dry cleaners. The photo processing BMPs are based on the Code of Management Practice for Silver Dischargers (AMSA 1996) developed by the Silver Council in concert with the Association of Metropolitan Sewerage Agencies and EPA. Metropolitan Wastewater conducted workshops to review silver control BMPs with their users. Boat repair yards or dry docks are required to submit their own customized BMPs which are incorporated into a permit. Food establishment discharge permits are also issued and require grease removal equipment, operation and maintenance, and compliance with general and specific discharge prohibitions. Auto repair shops that have steam-cleaning operations are required to have a sump for all O&G

wastewater from steam cleaning operations. San Diego has initiated a more aggressive program to enforce grease trap cleaning particularly at food establishments. They have discovered that excessive amounts of grease buildup contribute to dry weather flows into San Diego and Mission Bay. Analytical/Research Labs are required to implement a solvent certification program that is very similar to the total toxic organic (TTO) certification program for metal finishers and electroplaters.

San Diego has a 301(h) waiver for their wastewater treatment facility, allowing conditional discharge of wastewater without full secondary treatment. One condition of the waiver requires the City to reexamine their local limits every year and reassess loadings from all sources (domestic, SIU, and non-SIU contributions). The IU is considered a "contributor" of a pollutant of concern (presently one of six heavy metals) if the user has one of the six metals in its effluent at a concentration that is two standard deviations above the average domestic concentration. Once the IU is deemed to be a “contributor” of a pollutant of concern, wastewater flow is evaluated to determine whether the load is significant enough to be assigned to the “allocated” versus “non-allocated” load for their local limits accounting procedures. When the load is significant, the user is included in the allocated portion of headworks load calculations and the user is required to comply with local limits. Users with minor concentrations or loadings of pollutants of concern are not required to comply with local limits. However, they may still be required to comply with BMPs and general permit requirements.

SEATTLE METROPOLITAN/KING COUNTY, WASHINGTON

Seattle Metropolitan /King County (Seattle Metro) has a very large and active pollution prevention program that has acquired a great deal of information on dental mercury source control. Dental facilities in the Seattle Metro collection system are subject to the mercury local limits. After strong lobbying by the Dental Association against mandatory BMPs, dental facilities currently have latitude in controlling mercury through BMPs. Seattle Metro has developed a variety of tools to control mercury, including:

- A certified list of the vendors and technologies that are able to achieve a 90% reduction in metals.
- Videotape on mercury and silver source control from dental offices entitled “Amalgam Waste Conference.”
- A dental facility waste management poster and a booklet entitled, “Waste Management Guidelines for Dental Facilities.”
- Records on the amount of amalgam that is being reclaimed by recyclers as a means of tracking the success of their education efforts.
- Voucher program that gives $500 to dental offices to obtain one of the approved metal removal units identified in the list above.
- Educational materials (posters, videos, booklets).

WESTERN LAKE SUPERIOR SANITARY DISTRICT (WLSSD), DULUTH, MINNESOTA

With support from the Great Lakes Protection Fund, the WLSSD conducted a two-year Mercury Zero Discharge Project to examine the sources of mercury to its wastewater treatment plant and to determine how to reduce or eliminate those sources. This project included cooperative initiatives with industries known to be discharging mercury, programs aimed at specific uses of mercury, a monitoring program to identify additional sources and a public awareness campaign. In addition to these external programs, WLSSD also examined its own facilities and practices.

WLSSD has authored the *Blueprint for Mercury Elimination, Mercury Reduction Project Guidance for Wastewater Treatment Plants*, March, 1997. Selected for an AMSA National Environmental Achievement Award for excellence in Public Information & Education, the document examines sources of mercury in the environment, reviews contributions to the wastewater collection system, and gives examples of success stories on mercury source reduction. Appendices to the document provide useful "how to" references for implementing a source reduction program, such as a sample news release for a mercury reduction project, sample letters to mercury contributors, telephone survey forms to interview possible contributors, survey forms for hospitals and dental offices.

CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION (CT DEP), HARTFORD, CONNECTICUT

In 1992, CT DEP began a Statewide general permit program. The program established requirements for industries that were not SIUs, regulated by CT DEP's State-run pretreatment permitting program, but were a potential source of concern for POTWs. The general permitting program is "self implementing" and expects commercial establishments to be made aware of general permit program requirements by the local Town officials, the State, or through consultants. Thus, the general permitting program avoids the resource intensive individual permitting of traditional programs.

The program works in the following manner. An IU assesses their eligibility for a general permit (versus a traditional pretreatment permit). CT DEP encourages industries to determine eligibility for a general permit, as the permitting process is quicker and less costly for the IU and CT DEP. Each general permit identifies BMPs that must be followed by each permit holder. CT DEP conducts selective auditing and enforcement of general permit holders, and facilities that may have failed to register for a general permit. By publicizing the enforcement actions and penalties, industries are made aware of their duties to have a permit and comply with the BMPs, record keeping, monitoring, and where applicable, effluent limits. General permits developed by CT DEP include the following sectors:

1. Constructions and Operation of Certain Recycling Facilities
2. Car Wash Wastewater
3. Domestic Sewage of 50,000 gallons per day or 5% of the POTW Design Flow
4. Groundwater Contamination Recovery Systems
5. Hydrostatic Pressure Testing
6. Minor Boiler Blowdown
7. Minor Non-Contact Cooling Water
8. Minor Photographic Processing
9. Minor Tumbling and Cleaning of Parts Wastewater
10. Storm Water Associated with Industrial Activities
11. Storm Water and Dewatering Wastewaters - Construction Activities
12. Vehicle Service Floor Drain and Car Wash Wastewater
13. Storm Water Associated with Commercial Activities
14. Minor Printing and Publishing Wastewater
15. Water Treatment Wastewater - Commercial
16. Food Processing Wastewater
17. Public Swimming Pool Backwash
18. Water Softening/Treatment Unit Wastewater-Individual Homes (under development)

APPENDIX X - REGION 1, REASSESSMENT OF TECHNICALLY BASED INDUSTRIAL DISCHARGE LIMITS CHECKLIST

Attachment A.

EPA - New England

<u>Reassessment of Technically Based Industrial Discharge Limits</u>

Under 40 CFR 122.21(j)(4), all Publicly Owned Treatment Works (POTWs) with approved Industrial Pretreatment Programs (IPPs) shall provide the following information to the Director: a written evaluation of the need to revise local industrial discharge limits under 40 CFR 403.5(c)(1).

Below is a form designed by the U.S. Environmental Protection Agency (EPA - New England) to assist POTWs with approved IPPs in evaluating whether their existing Technically Based Local Limits (TBLLs) need to be recalculated. The form allows the permittee and EPA to evaluate and compare pertinent information used in previous TBLLs calculations against present conditions at the POTW.

Please read direction below before filling out form.

ITEM I.

* In Column (1), list what your POTW's influent flow rate was when your existing TBLLs were calculated. In Column (2), list your POTW's present influent flow rate. Your current flow rate should be calculated using the POTW's average daily flow rate from the previous 12 months.

* In Column (1) list what your POTW's SIU flow rate was when your existing TBLLs were calculated. In Column (2), list your POTW's present SIU flow rate.

* In Column (1), list what dilution ratio and/or 7Q10 value was used in your old/expired NPDES permit. In Column (2), list what dilution ratio and/or 7Q10 value is presently being used in your new/reissued NPDES permit.

  The 7Q10 value is the lowest seven day average flow rate, in the river, over a ten-year period. The 7Q10 value and/or dilution ratio used by EPA in your new NPDES permit can be found in your NPDES permit "Fact Sheet."

* In Column (1), list the safety factor, if any, that was used when your existing TBLLs were calculated.

* In Column (1), note how your biosolids were managed when your existing TBLLs were calculated. In Column (2), note how your POTW is presently disposing of its biosolids and how your POTW will be disposing of its biosolids in the future.

ITEM II.

* List what your existing TBLLs are - as they appear in your current Sewer Use Ordinance (SUO).

ITEM III.

* Identify how your existing TBLLs are allocated out to your industrial community. Some pollutants may be allocated differently than others, if so please explain.

ITEM IV.

* Since your existing TBLLs were calculated, identify the following in detail:

  (1) if your POTW has experienced any upsets, inhibition, interference or pass-through as a result of an industrial discharge.

  (2) if your POTW is presently violating any of its current NPDES permit limitations - include toxicity.

ITEM V.

* Using current sampling data, list in Column (1) the average and maximum amount of pollutants (in pounds per day) received in the POTW's influent. Current sampling data is defined as data obtained over the last 24 month period.

  All influent data collected and analyzed must be in accordance with 40 CFR 136. Sampling data collected should be analyzed using the lowest possible detection method(s), e.g., graphite furnace.

* Based on your existing TBLLs, as presented in Item II., list in Column (2), for each pollutant the Maximum Allowable Industrial Headwork Loading (MAIHL) values derived from an applicable environmental criteria or standard, e.g., water quality, sludge, NPDES, inhibition, etc. For each pollutant, the MAIHL equals the calculated Maximum Allowable Headwork Loading (MAHL) minus the POTW's domestic loading source(s). For more information, please see p. 3-28 in EPA's *Guidance Manual on the Development and Implementation of Local Limits Under the Pretreatment Program, 12/87*.

ITEM VI.

* Using current sampling data, list in Column (1) the average and maximum amount of pollutants (in micrograms per liter) present in your POTW's effluent. Current sampling data is defined as data obtained during the last 24-month period.

  All effluent data collected and analyzed must be in accordance with 40 CFR 136. Sampling data collected should be analyzed using the lowest possible detection method(s), e.g., graphite furnace.

* List in Column (2A) what the Water Quality Standards (WQS) were (in micrograms per liter) when your TBLLs were calculated, please note what hardness value was used at that time. Hardness should be expressed in milligram per liter of calcium carbonate.

  List in Column (2B) the current WQSs or "Chronic Gold Book" values for each pollutant multiplied by the dilution ratio used in your new/reissued NPDES permit. For example, with a dilution ratio of 25:1 at a hardness of 25 mg/L - calcium carbonate (copper's chronic WQS equals 6.54 ug/L) the chronic NPDES permit limit for copper would equal 156.25 ug/L.

ITEM VII.

* In Column (1), list all pollutants (in micrograms per liter) limited in your new/reissued NPDES permit. In Column (2), list all pollutants limited in your old/expired NPDES permit.

ITEM VIII.

* Using current sampling data, list in Column (1) the average and maximum amount of pollutants in your POTW's biosolids. Current data is defined as data obtained during the last 24 month period. Results are to be expressed as total dry weight.

  All biosolids data collected and analyzed must be in accordance with 40 CFR 136.

  In Column (2A), list current State and/or Federal sludge standards that your facility's biosolids must comply with. Also note how your POTW currently manages the disposal of its biosolids. If your POTW is planing on managing its biosolids differently, list in Column (2B) what your new biosolids criteria will be and method of disposal.

In general, please be sure the units reported are correct and all pertinent information is included in your evaluation. If you have any questions, please contact your pretreatment representative at EPA - New England.

REASSESSMENT OF TECHNICALLY BASED LOCAL LIMITS (TBLLs)

POTW Name & Address : ____

NPDES PERMIT # : ____

Date EPA approved current TBLLs : ________________________________

Date EPA approved current Sewer Use Ordinance : __________________

ITEM I.

In Column (1), list the conditions that existed when your current TBLLs were calculated. In Column (2), list current conditions or expected conditions at your POTW.

	Column (1) EXISTING TBLLs	Column (2) PRESENT CONDITIONS
POTW Flow (MGD)		
SIU Flow (MGD)		
Dilution Ratio or 7Q10 (from NPDES Permit)		
Safety Factor		N/A
Biosolids Disposal Method(s)		

ITEM II.

EXISTING TBLLs

POLLUTANT	NUMERICAL LIMIT (mg/L) or (lb/day)	POLLUTANT	NUMERICAL LIMIT (mg/L) or (lb/day)
---------	-----------	---------	-----------
---------	-----------	---------	-----------
---------	-----------	---------	-----------
---------	-----------	---------	-----------
---------	-----------	---------	-----------
---------	-----------	---------	-----------
---------	-----------	---------	-----------

ITEM III.

Note how your existing TBLLs, listed in Item II., are allocated to your Significant Industrial Users (SIUs), i.e., uniform concentration, contributory flow, mass proportioning, other. Please specify by circling.

ITEM IV.

Has your POTW experienced any upsets, inhibition, interference or pass-through from industrial sources since your existing TBLLs were calculated?

If yes, explain.

____

____

Has your POTW violated any of its NPDES permit limits and/or toxicity test requirements?

If yes, explain.

____

____

ITEM V.

Using current POTW influent sampling data fill in Column (1). In Column (2), list your Maximum Allowable Headwork Loading (MAHL) values used to derive your TBLLs listed in Item II. In addition, please note the Environmental Criteria for which each MAHL value was established, i.e., water quality, sludge, NPDES, etc.

Pollutant	Column (1) Influent Data Analyses Maximum (lb/day)	Column (1) Influent Data Analyses Average (lb/day)	Column (2) MAHL Values (lb/day)	Criteria
Arsenic	-------------------	------------------		
Cadmium	-------------------	------------------		
Chromium	-------------------	------------------		
Copper	-------------------	------------------		
Cyanide	-------------------	------------------		
Lead	-------------------	------------------		
Mercury	-------------------	------------------		
Nickel	-------------------	------------------		
Silver	-------------------	------------------		
Zinc	-------------------	------------------		
Other (List)				
-------	-------------------	------------------		
-------	-------------------	------------------		
-------	-------------------	------------------		

ITEM VI.

Using current POTW effluent sampling data, fill in Column (1). In Column (2A) list what the Water Quality Standards (Gold Book Criteria) were at the time your existing TBLLs were developed. List in Column (2B) current Gold Book values multiplied by the dilution ratio used in your new/reissued NPDES permit.

Pollutant	Column (1) Effluent Data Analyses Maximum (ug/L)	Column (1) Effluent Data Analyses Average (ug/L)	Columns (2A) Water Quality Criteria (Gold Book) From TBLLs (ug/L)	Columns (2B) Water Quality Criteria (Gold Book) Today (ug/L)
Arsenic	---------------------------------------		---------	---------
*Cadmium	---------------------------------------		---------	---------
*Chromium	---------------------------------------		---------	---------
*Copper	---------------------------------------		---------	---------
Cyanide	---------------------------------------		---------	---------
*Lead	---------------------------------------		---------	---------
Mercury	---------------------------------------		---------	---------
*Nickel	---------------------------------------		---------	---------
Silver	---------------------------------------		---------	---------
*Zinc	---------------------------------------		---------	---------
Other (List)				
-------	---------------------------------------		---------	---------
-------	---------------------------------------		---------	---------
-------	---------------------------------------		---------	---------

*Hardness Dependent (mg/L - CaCO3)

ITEM VII.

In Column (1), identify all pollutants limited in your new/reissued NPDES permit. In Column (2), identify all pollutants that were limited in your old/expired NPDES permit.

Column (1) NEW PERMIT Pollutants	Column (1) NEW PERMIT Limitations (ug/L)	Column (2) OLD PERMIT Pollutants	Column (2) OLD PERMIT Limitations (ug/L)
----------	----------	----------	----------
----------	----------	----------	----------
----------	----------	----------	----------
----------	----------	----------	----------
----------	----------	----------	----------
----------	----------	----------	----------
----------	----------	----------	----------
----------	----------	----------	----------

ITEM VIII.

Using current POTW biosolids data, fill in Column (1). In Column (2A), list the biosolids criteria that was used at the time your existing TBLLs were calculated. If your POTW is planing on managing its biosolids differently, list in Column (2B) what your new biosolids criteria would be and method of disposal.

Pollutant	Column (1) Biosolids Data Analyses Average (mg/kg)	Columns (2A) Biosolids Criteria From TBLLs (mg/kg)	Columns (2B) Biosolids Criteria New (mg/kg)
Arsenic	---------	---------	---------
Cadmium	---------	---------	---------
Chromium	---------	---------	---------
Copper	---------	---------	---------
Cyanide	---------	---------	---------
Lead	---------	---------	---------
Mercury	---------	---------	---------
Nickel	---------	---------	---------
Silver	---------	---------	---------
Zinc	---------	---------	---------
Molybdenum	---------	---------	---------
Selenium	---------	---------	---------
Other (List)	---------	---------	---------
	---------	---------	---------