STORMWATER MONITORING

CONTINUING EDUCATION PROFESSIONAL DEVELOPMENT COURSE

Technical Learning College

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http://www.abctlc.com/downloads/PDF/CEU%20State%20Approvals.pdf

You can obtain a printed version from TLC for an additional $129.95 plus shipping charges.

All downloads are electronically tracked and monitoring for security purposes.

Evidence that paint and chemicals were dumped to the storm water drain. Very common practice in the rear of strip malls. Photographs should be taken to back-up or support your Notice of Violations (NOVs) or citations.

Here is a revenue making technique to place advertisements on the storm drain covers as here in Germany.

Copyright Notice

Contributing Editors

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Joseph Camerata has a BS in Management with honors (magna cum laude). He retired as a Chemist in 2006 having worked in the field of chemical, environmental, and industrial hygiene sampling and analysis for 40 years.

James Bevan, Water Quality Inspector S.M.E. Twenty years of experience in the environmental field dealing with all aspects of water regulations on the federal, state, and local levels. Teacher and Proctor in Charge for Backflow Certification Testing at the ASETT Center in Tucson for the past 15 years and possess an Arizona Community College, Special Teaching Certificate in Environmental Studies.

Dr. Pete Greer S.M.E., Retired biology instructor, chemistry and biological review.

Jack White, Environmental, Health, Safety expert, City of Phoenix. Art Credits.

Some States and many employers require the final exam to be proctored.

Do not solely depend on TLC's Approval list for it may be outdated.

A second certificate of completion for a second State Agency $50 processing fee.

Most of our students prefer to do the assignment in Word and e-mail or fax the assignment back to us. We also teach this course in a conventional hands-on class. Call us and schedule a class today.

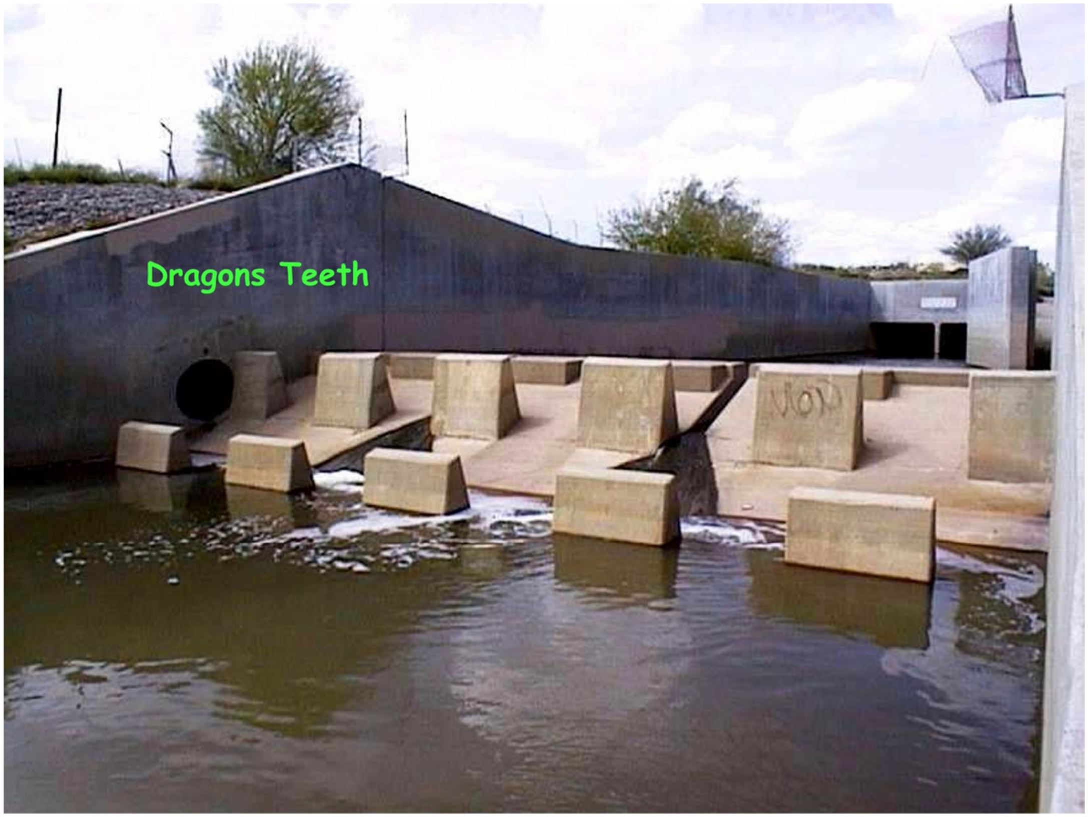
Responsibility

This course contains EPA's federal rule requirements. Please be aware that each state implements drinking water/wastewater/safety regulations that may be more stringent than EPA's or OSHA's regulations. Check with your state environmental agency for more information. You are solely responsible in ensuring that you abide with your jurisdiction or agency's rules and regulations.

Storm Drains have been around for thousands of years and are still working in most other countries. Most countries channel the storm water to cisterns or storage wells for an addition source of drinking water.

Florence, Italy

Milan, Italy



Dragon's Teeth
This engineered method is to *slow the flow* of stormwater

A sign commonly found throughout San Francisco. This city has one of the finest stormwater management programs.

Technical Learning College's Scope and Function

Welcome to the Program,

Technical Learning College (TLC) offers affordable continuing education for today's working professionals who need to maintain licenses or certifications. TLC holds several different governmental agency approvals for granting of continuing education credit.

TLC's delivery method of continuing education can include traditional types of classroom lectures and distance-based courses or independent study. TLC's distance-based or independent study courses are offered in a print - based distance educational format. We will beat any other training competitor's price for the same CEU material or classroom training.

Our courses are designed to be flexible and for you to finish the material at your convenience. Students can receive course materials through the mail or electronically. The CEU course or e-manual will contain all your lessons, activities and instruction to obtain the assignments. All of TLC's CEU courses allow students to submit assignments using e-mail or fax, or by postal mail. (See the course description for more information.)

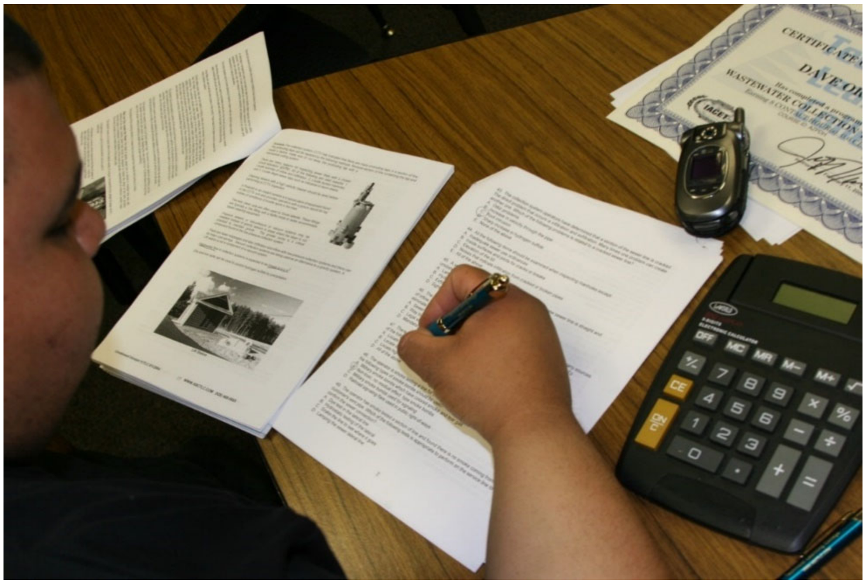
Students have direct contact with their instructor—primarily by e-mail or telephone. TLC's CEU courses may use such technologies as the World Wide Web, e-mail, CD-ROMs, videotapes and hard copies. (See the course description.) Make sure you have access to the necessary equipment before enrolling; i.e., printer, Microsoft Word and/or Adobe Acrobat Reader. Some courses may require proctored closed-book exams, depending upon your state or employer requirements.

Flexible Learning
At TLC, there are no scheduled online sessions or passwords you need contend with, nor are you required to participate in learning teams or groups designed for the "typical" younger campus - based student. You will work at your own pace, completing assignments in time frames that work best for you. TLC's method of flexible individualized instruction is designed to provide each student the guidance and support needed for successful course completion.

Course Structure
TLC's online courses combine the best of online delivery and traditional university textbooks. You can easily find the course syllabus, course content, assignments, and the post-exam (Assignment). This student-friendly course design allows you the most flexibility in choosing when and where you will study.

Classroom of One
TLC offers you the best of both worlds. You learn on your own terms, on your own time, but you are never on your own. Once enrolled, you will be assigned a personal Student Service Representative who works with you on an individualized basis throughout your program of study. Course specific faculty members (S.M.E.) are assigned at the beginning of each course providing the academic support you need to successfully complete each course. Please call or email us for assistance.

Satisfaction Guaranteed
We have many years of experience, dealing with thousands of students. We assure you, our customer satisfaction is second to none. This is one reason we have taught more than 20,000 students.



We welcome you to do the electronic version of the assignment and submit the answer key and registration to us either by fax or e-mail. If you need this assignment graded and a certificate of completion within a 48-hour turn around, prepare to pay an additional rush charge of $50.

Contact Numbers

Fax (928) 468-0675
Email Info@tlch2o.com
Telephone (866) 557-1746

Precept-Based Training CEU Course

This training course is made of “micro-content” or “precepts”– small chunks of information that can be easily digested. Using bite-size pieces of technical information is considered to be one of the most effective ways of teaching people new information because it helps the student to retain knowledge easier.

Micro-learning or precept-based training doesn’t rely on the student to process a large amount of information before breaking it down. Our method includes short modules with clearly defined learning goals for each section. This method allows a student to hone in on a particular skill, then demonstrate their knowledge in the final assessment.

Stormwater CEU Course Description

Stormwater Monitoring CEU Training Course

This CEU Course will review the Environmental Protection Agency's Rules and Regulation relating to storm water monitoring. This course will cover the purpose and basic requirements of the federal rule concerning storm water monitoring and general pollution prevention operations. Stormwater Inspectors, Wastewater Treatment Operators. Pretreatment and Industrial Waste Inspectors. The target audience for this course is the person interested in working in the stormwater/pretreatment field, wastewater treatment or pretreatment/ industrial wastewater facility and/or wishing to maintain CEUs for certification license or to learn how to do the job safely and effectively, and/or to meet education needs for promotion.

Final Examination for Credit

Opportunity to pass the final comprehensive examination is limited to three attempts per course enrollment.

Course Procedures for Registration and Support

All of Technical Learning College's correspondence courses have complete registration and support services offered. Delivery of services will include, e-mail, web site, telephone, fax and mail support. TLC will attempt immediate and prompt service.

When a student registers for a distance or correspondence course, he/she is assigned a start date and an end date. It is the student's responsibility to note dates for assignments and keep up with the course work. If a student falls behind, he/she must contact TLC and request an end date extension in order to complete the course. It is the prerogative of TLC to decide whether to grant the request. All students will be tracked by an unique number will be assigned to the student.

Instructions for Written Assignments

The Stormwater Monitoring CEU Training course uses a multiple-choice answer key, Scantron, or equivalent answer sheet. The students must use a number two pencil, make dark marks, and erase completely to change an answer.

Feedback Mechanism (examination procedures)

Each student will receive a feedback form as part of their study packet. You will find this form in the front of the course or lesson.

Security and Integrity

All students are required to do their own work. All lesson sheets and final exams are not returned to the student to discourage the sharing of answers. Any fraud or deceit and the student will forfeit all fees and the appropriate agency will be notified.

Required Texts

The Storm Water Monitoring CEU Training course comes complete with a copy of the EPA's 40 CFR 122.26 and all relevant information. No other materials are needed.

Recordkeeping and Reporting Practices

TLC will keep all student records for a minimum of seven years. It is the student's responsibility to give the completion certificate to the appropriate agencies. We will send the required information to Texas, Indiana and Pennsylvania for your certificate renewals.

ADA Compliance
TLC will make reasonable accommodations for persons with documented disabilities. Students should notify TLC and their instructors of any special needs. Course content may vary from this outline to meet the needs of this particular group.

Mission Statement
Our only product is educational service. Our goal is to provide you with the best possible education service possible. TLC will attempt to make your learning experience an enjoyable opportunity.

Educational Mission
The educational mission of TLC is:
To provide TLC students with comprehensive and ongoing training in the theory and skills needed for the environmental education field,

To provide TLC students with opportunities to apply and understand the theory and skills needed for operator certification,

To provide opportunities for TLC students to learn and practice environmental educational skills with members of the community for the purpose of sharing diverse perspectives and experience,

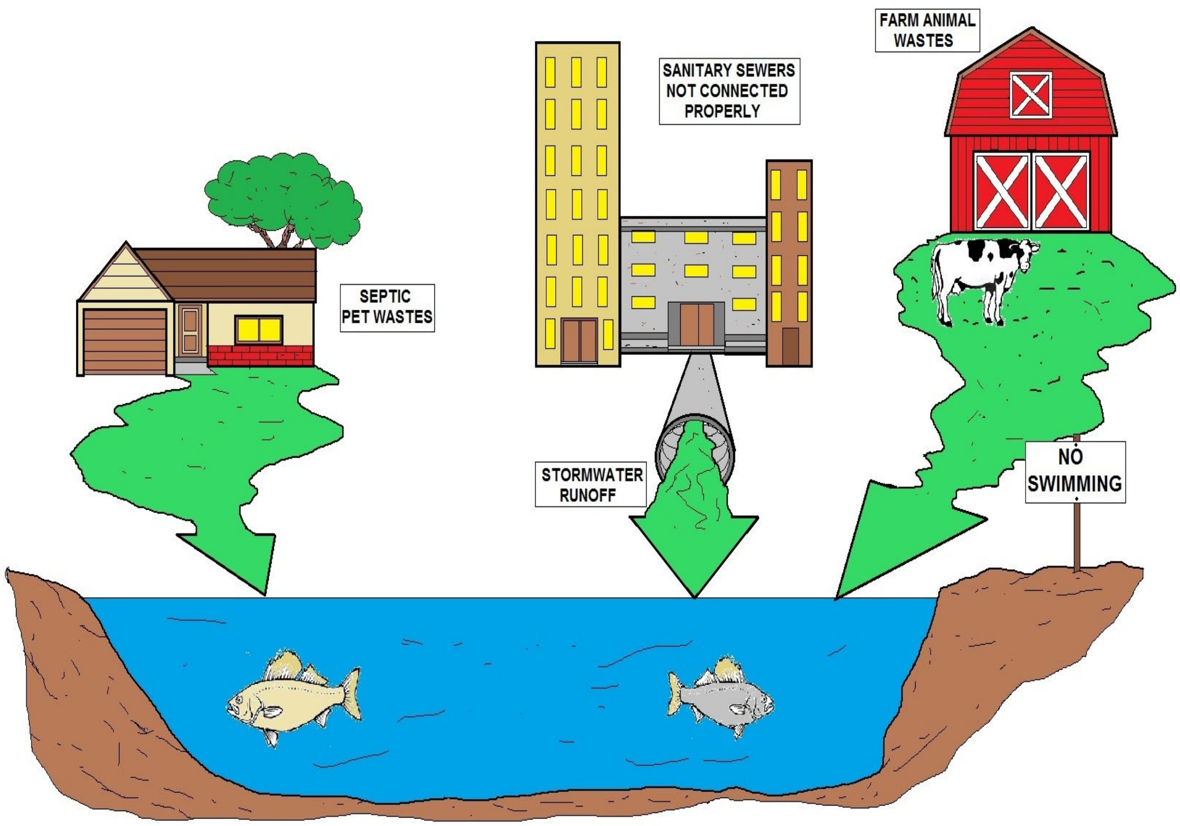
To provide a forum in which students can exchange experiences and ideas related to environmental education,

To provide a forum for the collection and dissemination of current information related to environmental education, and to maintain an environment that nurtures academic and personal growth.

Silt fences or Waddles are necessary to prevent soil erosion.

We welcome you to download the assignment in Microsoft Word and complete it and simply e-mail or fax the assignment back to us.

Table of Contents



SOURCES OF FECAL COLIFORM BACTERIA

This course contains EPA's federal rule requirements. Please be aware that each state implements wastewater/safety/environment regulations that may be more stringent than EPA's regulations. Check with your state environmental agency for more information.

Important Information about this Manual

This manual has been prepared to educate employees in the general awareness of dealing with the often-complex procedures and requirements of the Clean Water Act for safely handling or mitigating hazardous and toxic materials from entering national waterways by stormwater.

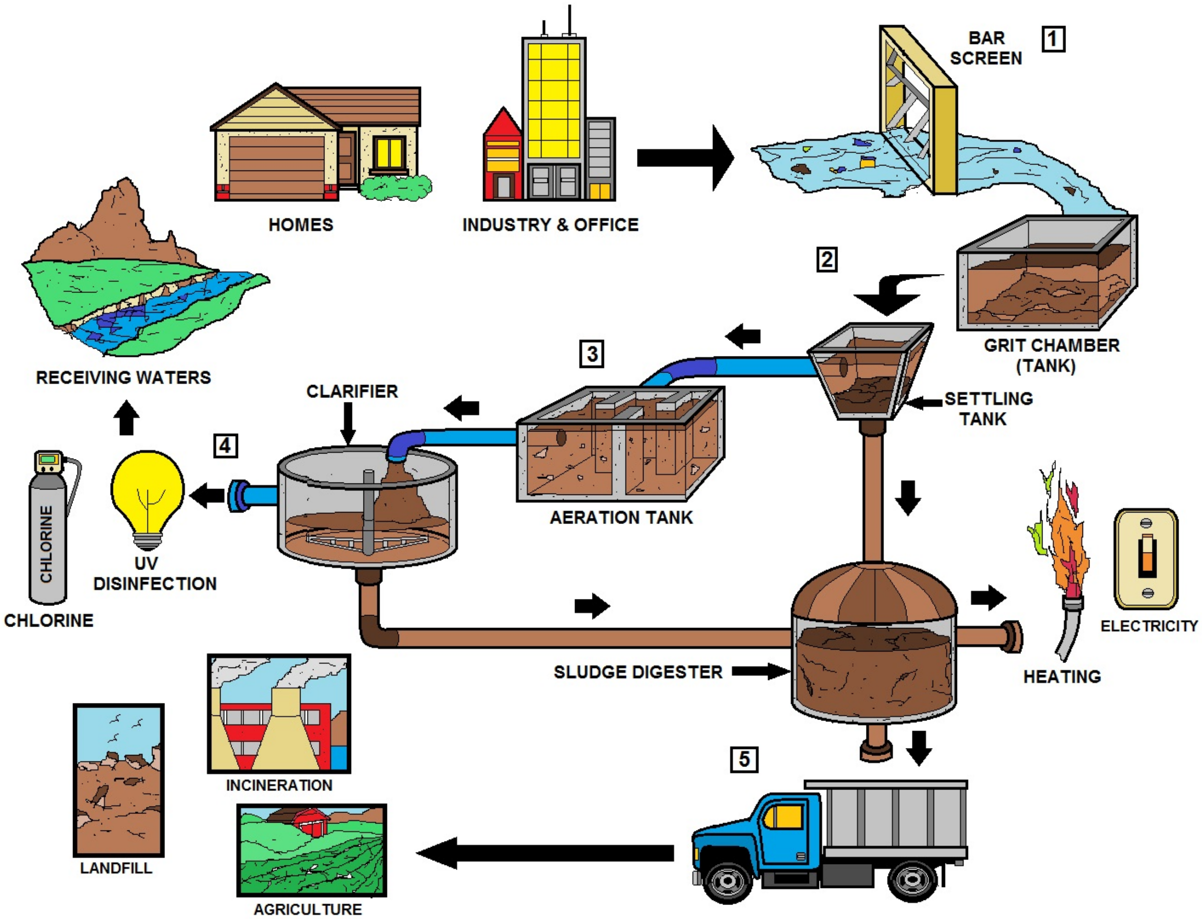
The scope of the problem is quite large, requiring a major effort to bring it under control. Employee health and safety, as well as that of the public, depend upon careful application of safe procedures. The manner in which we deal with such pollutional hazards will affect the earth and its inhabitants for many generations to come.

This manual will cover general laws, regulations, required procedures and work rules relating to pollution control and stormwater rules and regulations. It should be noted, however, that the regulation of pollution and stormwater is an ongoing process and subject to change over time. For this reason, a list of resources is provided to assist in obtaining the most up-to-date information on various subjects.

This manual is a not a guidance document for employees who are involved with pollution control or stormwater monitoring. It is not designed to meet the requirements of the United States Environmental Protection Agency (EPA), the Department of Labor-Occupational Safety and Health Administration (OSHA) or your state environmental protection or health departments. This course manual will provide general education awareness and should be not used as a preliminary basis for developing stormwater or pollution prevention plans. This document is not a detailed industrial hygiene textbook or a comprehensive source book on occupational safety and health.

Technical Learning College or Technical Learning Consultants, Inc. make no warranty, guarantee or representation as to the absolute correctness or appropriateness of the information in this manual and assumes no responsibility in connection with the implementation of this information. It cannot be assumed that this manual contains all measures and concepts required for specific conditions or circumstances. This document should be used for educational purposes only and is not considered a legal document.

Individuals who are responsible for pollution control programs or stormwater monitoring programs and the health and safety of workers at hazardous waste sites should obtain and comply with the most recent federal, state, and local regulations relevant to these sites and are urged to consult with OSHA, the EPA and other appropriate federal, state and local agencies.



WASTEWATER TREATMENT PROCESS

WASTEWATER CHARACTERISTICS & SPECIFIC SOURCES	
PHYSICAL	
SOLIDS	Domestic - Industrial Wastes / Soil Erosion / Inflow, etc.
COLOR	Industrial - Domestic Wastes / Natural Decaying of Organic Matter
ODOR	Industrial Wastes / Decomposition of Wastewater
CHEMICAL	
PHENOLS	Industrial Wastes
pH	Industrial Wastes
TOXIC COMPOUNDS	Industrial Wastes
HEAVY METALS	Industrial Wastes
PESTICIDES	Run-Off From Agriculture
BIOLOGICAL	/ Open Water Courses / Treatment Units, etc

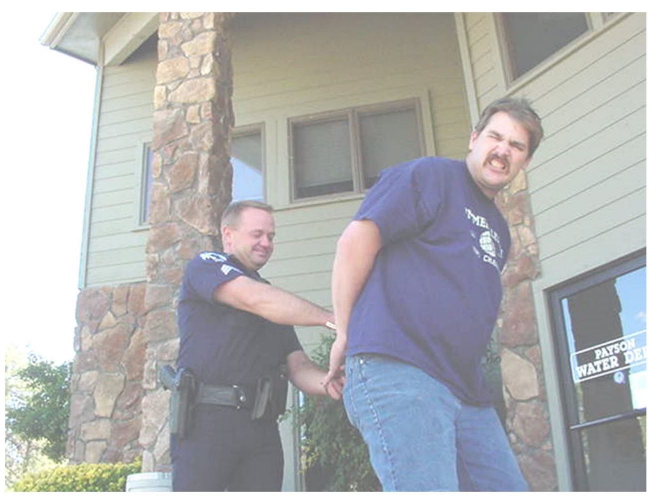
CHART IDENTIFYING BASIC SOURCES AND CHARACTERISTICS OF WASTEWATER

LIST OF STORMWATER AND PRETREATMENT ACRONYMS

Acronym	Full Phrase
AA	Approval Authority
AO	Administrative Order
BAT	Best Available Technology Economically Achievable
BCT	Best Conventional Pollutant Control Technology
BMP	Best Management Practices
BMR	Baseline Monitoring Report
BOD5	5-day Biochemical Oxygen Demand
BPJ	Best Professional Judgment
BPT	Best Practicable Control Technology Currently Available
CA	Control Authority
CFR	Code of Federal Regulations
CIU	Categorical Industrial User
CSO	Combined Sewer Overflow
CWA	Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Pub. L. 92-500, as amended by Pub. L. 95-217, Pub. L. 95-576, Pub. L. 96-483, Pub. L. 97-117, and Pub. L. 100-4, 33 U.S.C. 1251 et seq.
CWF	Combined Wastestream Formula
CWT	Centralized Waste Treater
DMR	Discharge Monitoring Report
DSE	Domestic Sewage Exclusion
DSS	Domestic Sewage Study
ELG	Effluent Limitations Guideline
EPA	Environmental Protection Agency
EPCRA	Emergency Preparedness and Community Right to Know Act
ERP	Enforcement Response Plan
FDF	Fundamentally Different Factors
FR	Federal Register
FWA	Flow Weighted Average
gpd	Gallons per Day
IU	Industrial User
LEL	Lower Explosive Limit
MAHL	Maximum Allowable Headworks Loading
MAIL	Maximum Allowable Industrial Loading
MGD	Million Gallons per Day
MSDS	Material Safety Data Sheet
NAICS	North American Industry Classification System (replaces SIC coding system in 1998)
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NRDC	Natural Resources Defense Council
NSPS	New Source Performance Standard
O&G	Oil and Grease
O&M	Operations and Maintenance

OCPSF	Organic Chemicals, Plastics, and Synthetic Fibers
P2	Pollution Prevention
PCI	Pretreatment Compliance Inspection
PCS	Permit Compliance System
PIRT	Pretreatment Implementation Review Task Force
POTW	Publicly Owned Treatment Works
PSES	Pretreatment Standards for Existing Sources
PSNS	Pretreatment Standards for New Sources
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
SIC	Standard Industrial Classification
SIU	Significant Industrial User
SPCC	Spill Prevention Control and Countermeasures
SNC	Significant Noncompliance
SSO	Sanitary Sewer Overflow
SUO	Sewer Use Ordinance
TCLP	Toxicity Characteristic Leaching Procedure
TIE	Toxicity Identification Evaluation
TOMP	Toxic Organic Management Program
TRE	Toxicity Reduction Evaluation
TRI	Toxic Release Inventory
TSS	Total Suspended Solids
TTO	Total Toxic Organics
USC	United States Code
UST	Underground Storage Tank
WET	Whole Effluent Toxicity
WWTP	Wastewater Treatment Plant

With any type of enforcement, be prepared for "Nut cases, 10-16 like this person below" and practice your emergency skills on how to handle people that are violent or mentally ill.



During enforcement actions, you will run in to violent and hostile customers.

Clean Water Act Summary

33 U.S.C. s/s 1251 et seq. (1977)

The Clean Water Act is a 1977 amendment to the Federal Water Pollution Control Act of 1972, which set the basic structure for regulating discharges of pollutants to waters of the United States.

The law gave the EPA the authority to set effluent standards on an industry basis (technology-based) and continued the requirements to set water quality standards for all contaminants in surface waters. The CWA makes it unlawful for any person to discharge any pollutant from a point source into navigable waters unless a permit (**NPDES**) is obtained under the Act. The 1977 amendments focused on toxic pollutants. In 1987, the CWA was reauthorized and again focused on toxic substances, authorized citizen suit provisions, and funded sewage treatment plants (**POTW's**) under the Construction Grants Program.

The CWA provides for the delegation by the EPA of many permitting, administrative, and enforcement aspects of the law to state governments. In states with the authority to implement CWA programs, the EPA still retains oversight responsibilities. In 1972, Congress enacted the first comprehensive national clean water legislation in response to growing public concern for serious and widespread water pollution. The Clean Water Act is the primary federal law that protects our nation's waters, including lakes, rivers, aquifers and coastal areas.

Lake Erie was dying. The Potomac River was clogged with blue-green algae blooms that were a nuisance and a threat to public health. Many of the nation's rivers were little more than open sewers and sewage frequently washed up on shore. Fish kills were a common sight. Wetlands were disappearing at a rapid rate.

Today, the quality of our waters has improved dramatically as a result of a cooperative effort by federal, state, tribal and local governments to implement the pollution control programs established in 1972 by the Clean Water Act.

The Clean Water Act's primary objective is to restore and maintain the integrity of the nation's waters. This objective translates into two fundamental national goals:

- eliminate the discharge of pollutants into the nation's waters, and
- achieve water quality levels that are fishable and swimmable.

The Clean Water Act focuses on improving the quality of the nation's waters. It provides a comprehensive framework of standards, technical tools 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.

For example, the Clean Water Act: requires major industries, to meet performance standards to ensure pollution control; charges states and tribes with setting specific water quality criteria appropriate for their waters and developing pollution control programs to meet them; provides funding to states and communities to help them meet their clean water infrastructure needs; protects valuable wetlands and other aquatic habitats through a permitting process that ensures development and other activities are conducted in an environmentally sound manner.

After 25 years, the Act continues to provide a clear path for clean water and a solid foundation for an effective national water program.

In 1972:
Only a third of the nation's waters were safe for fishing and swimming. Wetlands losses were estimated at about 460,000 acres annually.

Agricultural runoff resulted in the erosion of 2.25 billion tons of soil and the deposit of large amounts of phosphorus and nitrogen into many waters. Sewage treatment plants served only 85 million people.

Today:
Two-thirds of the nation's waters are safe for fishing and swimming.

The rate of annual wetlands losses is estimated at about 70,000-90,000 acres according to recent studies.

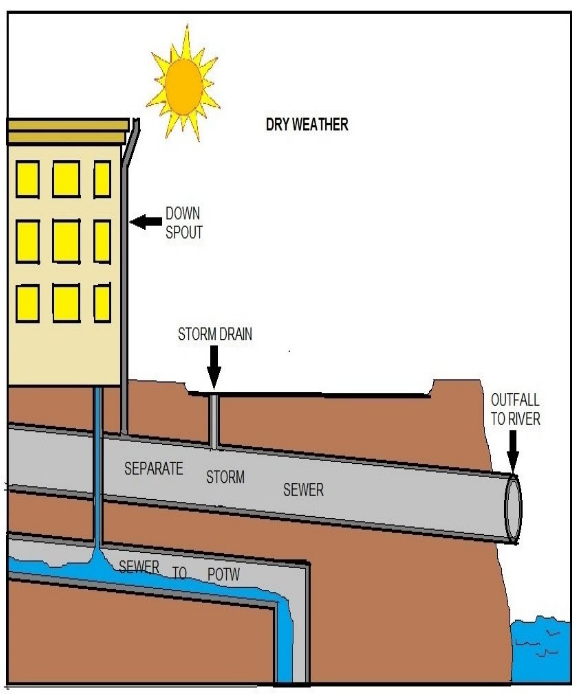
The amount of soil lost due to agricultural runoff has been cut by one billion tons annually, and phosphorus and nitrogen levels in water sources are down.

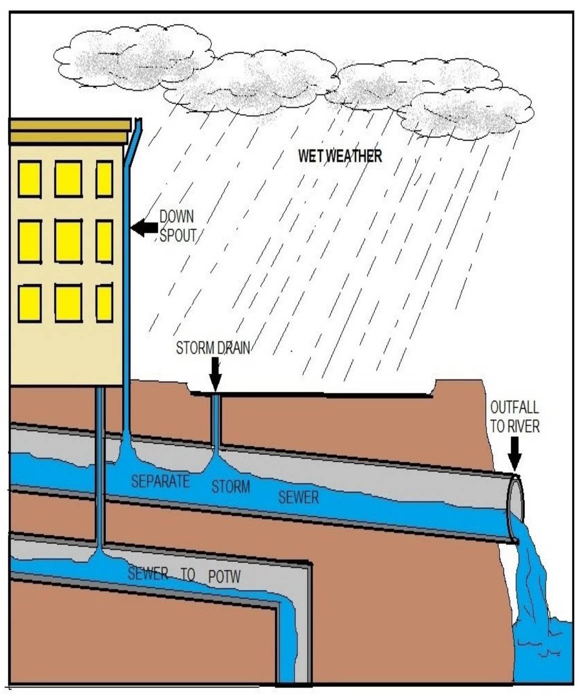
Modern wastewater treatment facilities serve 173 million people.

The Future:
All Americans will enjoy clean water that is safe for fishing and swimming.

We will achieve a net gain of wetlands by preventing additional losses and restoring hundreds of thousands of acres of wetlands.

Soil erosion and runoff of phosphorus and nitrogen into watersheds will be minimized, helping to sustain the nation's farming economy and aquatic systems. The nation's waters will be free of effects of sewage discharges.





Stormwater Introduction

Stormwater runoff is rainwater or melted snow which flows across the ground and eventually into lakes, streams, wetlands, underground water supplies, and the ocean.

The construction of pavement and buildings, and the clearing and flattening of fields increase the volume and speed of stormwater runoff. This contributes to flooding and damage to property and habitat (stormwater quantity impacts). It also contributes to lowering of water quality by increasing the flow of human pollutants such as oil, fertilizers and pesticides, and the flow of natural elements, such as phosphorus, into the water (stormwater quality impacts).

Degradation of lakes, streams and wetlands has economic effects: it reduces property values, raises bills from public water utilities, raises local property tax rates, and reduces tourism and related business income.

The U.S. Environmental Protection Agency (**EPA**) estimates that 60% of the water quality problems in the nation are caused by nonpoint sources. Stormwater runoff has quantity and quality impacts. When impervious or disturbed areas are created by construction activities and stormwater is not adequately managed, the environment may be adversely affected by: (1) changes in volume, timing, and location of the stormwater discharges, and (2) the movement of pollutants from the site to waterbodies. Stormwater runoff can cause flooding, undermine stream banks, and damage property and habitat, as well as carry contaminants that contribute to lower water quality.

Nonpoint source (**NPS**) pollution is water pollution that consists of contaminated runoff associated with agricultural, urban, and other sources. The term "***nonpoint source pollution***" was created under the federal Clean Water Act to distinguish it from "***point source***" discharges such as industrial waste water from pipes.

Nonpoint sources include many varied small sources of pollutants from activities. Every time it rains or the snow melts, pollutants such as dirt, nutrients, bacteria, oils and heavy metals are swept off from land surfaces and carried by runoff water into surface and groundwater. When people speak about "**stormwater quality control**", they are talking about reducing the pollutants from nonpoint sources that are carried by stormwater into our lakes, streams, groundwater, and coastal areas.

The Clean Water Act of 1972 (passed by the United States Congress and amended by the Water Quality Act of 1987), set in motion requirements and policy measures for the Environmental Protection Agency (**EPA**). The EPA therewith established regulatory components for Storm Water Discharges which were levied upon associated industries and municipalities with populations over 100,000.

The goal of National Pollutant Discharge Elimination System (**NPDES**), through permits and plans, is to reduce to the maximum extent practical the amount of pollution discharges from the municipal storm drainage systems. These municipal permits have several components, one being management programs. A term frequently used in this subject matter is - **Best Management Practices** (**BMP**).

BMP's are schedules of activities, prohibition of practices, maintenance procedures, and other recommended management practices that may be employed for a particular purpose - Storm Water Pollution Prevention and Reduction. Although the EPA / NPDES regulations seem complex, their goal is simple - ***"Improve water quality in waters of the United States".***

What is Nonpoint Source Pollution?

Nonpoint source (**NPS**) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground.

As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water. ***These pollutants include:***

- Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas;
- Oil, grease, and toxic chemicals from urban runoff and energy production;
- Sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks;
- Salt from irrigation practices and acid drainage from abandoned mines;
- Bacteria and nutrients from livestock, pet wastes, and faulty septic systems;

Atmospheric deposition and hydromodification are also sources of nonpoint source pollution.

What are the effects of these pollutants on our waters?

States report that nonpoint source pollution is the leading remaining cause of water quality problems. The effects of nonpoint source pollutants on specific waters vary and may not always be fully assessed. However, we know that these pollutants have harmful effects on drinking water supplies, recreation, fisheries, and wildlife.

What causes nonpoint source pollution?

Nonpoint source pollution results from a wide variety of human activities on the land. Each of us can contribute to the problem without even realizing it.

Leachate from a landfill

Leachates

Leachates are liquids that have dripped through the landfill and carry dissolved substances from the waste materials, containing such substances as heavy metals and organic decomposition products; salt; bacteria; and viruses.

Stormwater Program Requirements
Regulation: 40 CFR 122.26

Applicability
EPA's National Pollutant Discharge Elimination System (**NPDES**) stormwater discharge permit program was developed to regulate the runoff of stormwater from various types of facilities. Covered facilities are required to obtain NPDES permits, submit management plans to reduce runoff, and disconnect illegal connections to storm drains. A permittee is required to develop a pollution prevention plan that details the best management practices the facility will use to ensure that the stormwater from its site does not impact surface waters.
The permittee must also develop a training program that covers such topics as spill prevention and response, good housekeeping, and material management practices so that employees are aware of the goals of the stormwater pollution prevention plan (**SWPPP**) and have an overall understanding of its provisions.

Phase I of the NPDES stormwater discharge permit program regulates:
- Operators of medium and large municipal separate storm sewer systems that generally serve or are located in incorporated places and counties with populations of 100,000 or more.
- Operators of 11 categories of industrial activity—one of which is construction activity disturbing five or more acres of land—that discharge stormwater runoff to waters of the United States or into municipal separate storm sewer systems.

Phase II of the NPDES stormwater discharge permit program regulates two classes of stormwater dischargers on a nationwide basis:
- Operators of small municipal separate storm sewer systems located in urbanized areas
- Operators of construction activities that disturb equal to or greater than one acre of land but less than five acres

Training Requirements
An employee training program must inform personnel at all levels of responsibility of the components and goals of the facility stormwater pollution prevention plan (**SWPPP**). The training program should be an ongoing, yearly process.

Facilities are required to specify a schedule for periodic training activities in the SWPPP.

Best Management Practices
Good Housekeeping
Good housekeeping practices are designed to maintain a clean and orderly work environment. Often, the most effective first step towards preventing pollution in stormwater from industrial sites simply involves using good common sense to improve the facility's basic housekeeping methods. Poor housekeeping can result in more waste being generated than necessary and an increased potential for stormwater contamination. A clean and orderly work area reduces the possibility of accidental spills caused by mishandling of chemicals and equipment and should reduce safety hazards to plant personnel.

Well-maintained material and chemical storage will reduce the possibility of stormwater mixing with pollutants. Good housekeeping procedures may include:
- Improving operation and maintenance of machinery and processes
- Implementing careful storage practices
- Keeping an up-to-date inventory and labeling all containers
- Scheduling routine cleanup operations
- Training employees on good housekeeping techniques

Preventive Maintenance
Preventive maintenance involves the regular inspection and testing of plant equipment and operational systems. These inspections should uncover conditions, such as cracks or slow leaks, that could cause breakdowns or failures that result in discharges of chemicals to storm sewers and surface waters. The program should prevent breakdowns and failures through adjustment, repair, or replacement of equipment. An effective preventive maintenance program should include:
- Identification of equipment, systems, and facility areas that should be inspected
- Schedule for periodic inspections or tests of such equipment and systems
- Appropriate and timely adjustment, repair, or replacement of equipment and systems
- Maintenance of complete records on inspections, equipment, and systems

Examples of equipment to be inspected at a facility can include:
- Pipes
- Pumps
- Storage tanks and bins
- Pressure vessels
- Pressure release valves
- Process and material handling equipment
- Stormwater management devices (oil/water separators, catch basins, or other structural or treatment BMPs)

Spill Prevention and Response
Spills and leaks together account for one of the largest industrial sources of stormwater pollutants and are avoidable in most cases. Establishing standard operating procedures, such as safety and spill prevention procedures, along with proper employee training can reduce these accidental releases. The steps to take for spill prevention and response usually involve:
- Identify potential spill areas (such as loading and unloading areas, storage areas, process activities, dust or particulate generating processes, and waste disposal activities).
- Specify material handling procedures and storage requirements.
- Identify spill response procedures and equipment (such as spill response team; safety measures; notification of authorities; spill containment, diversion, isolation, and cleanup; and spill response equipment).

Visual Inspections
Regular visual inspections are the means to ensure that all of the elements of the SWPPP are in place and working properly. They are routine look-overs of the facility to identify conditions that may give rise to contamination of stormwater runoff with pollutants from the facility.

Areas to be inspected should include:
- Areas around all equipment listed in the preventive maintenance box
- Areas where spills and leaks have occurred in the past
- Material storage areas

- Outdoor material processing areas
- Material handling areas
- Waste generation, storage, treatment, and disposal areas

All inspections must be documented, and the records must be kept with the SWPPP.

Sediment and Erosion Control

There may be certain areas on your site that, due to construction activities, steep slopes, sandy soils, or other reasons, are prone to soil erosion. Construction activities typically remove grass and other protective ground covers, resulting in the exposure of underlying soil to wind and rain. Similarly, steep slopes or sandy soils may not be capable of supporting plant life, leaving soils exposed. Because the soil surface is unprotected, dirt and sand particles are easily picked up by wind and/or washed away by rain. This process is called erosion.

Erosion can be controlled or prevented with the use of certain BMPs. ***It is important to:***

- Identify areas that, due to topography, activities, or other factors, have a high potential for significant soil erosion.
- Identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

Management of Runoff

Traditional stormwater management practices can be used to direct stormwater away from areas of exposed materials or potential pollutants. These management practices can also be used to direct stormwater that contains pollutants to natural or other types of treatment locations.

The potential of various sources at the facility to contribute pollutants to stormwater discharges associated with industrial activity must be considered when determining reasonable and appropriate measures.

Appropriate measures include:

- Vegetative swales and practices
- Reuse of collected stormwater
- Inlet controls (such as oil/water separators)
- Snow management activities
- Infiltration devices
- Wet detention/retention devices

Monitoring and Sampling

In addition to instituting BMPs, facilities may be required to implement a program of sampling and monitoring of their stormwater discharges. The terms of the permit will indicate the levels of sampling and monitoring required at a facility.

Stormwater Management Practices

A watershed manager needs to make careful choices about what stormwater management practices should be installed in the sub watershed to compensate for the hydrological changes caused by new and existing development. Stormwater management practices are used to delay, capture, store, treat, or infiltrate stormwater runoff.

A key choice is to determine the primary stormwater objectives for a sub watershed that will govern the selection, design, and location of stormwater management practices at individual sites.

While specific design objectives for stormwater management practices are often unique to each sub watershed, the general goals for stormwater management practices are often the same, and include:

- maintaining groundwater quality and recharge;
- reducing stormwater pollutant loads;
- protecting stream channels;
- preventing increased overbank flooding; and
- safely conveying extreme floods.

There are numerous structural stormwater management techniques for controlling stormwater quantity and quality. These five practices can be categorized into five broad groups, including:

- ponds
- wetlands
- infiltration
- filtering systems and
- grassed channels

While many advances have been made recently in innovative stormwater management designs, their ability to maintain resource quality in the absence of other watershed protection tools is limited. In fact, stormwater management practices designed or located improperly can sometimes cause more severe secondary environmental impacts than if they were not installed at all.

Basic Program Requirements

Stormwater Monitoring Program:
Objective: To obtain a baseline measurement of current water quality, discover and eliminate illicit connections to the system and, the development of watershed drainage runoff data to assist in engineering studies for future developments.

Industrial Monitoring Program:
Objective: To evaluate industrial storm water runoff locations and to perform physical site inspections and develop future pollution prevention plans.

Illicit Connection Program:
Objective: To discover and eliminate illicit connections to the storm sewer system.

In-Stream Monitoring Program:
Objective: To improve data collection and interpretation. Analysis of the monitoring sites with a full scan of pollutants as required by the NPDES permit.

Household Hazardous Waste Program:
Objective: To eliminate household hazardous waste from contaminating the storm water.

Public Educational Program:
Objective: Create a public awareness of the pollutional risk of misusing and improper disposal of chemicals. Recycling techniques and water conservation are also parts of an overall program.

Recycling Program:
Objective: To reduce the amount of household hazardous waste disposed of improperly as well as to recover recyclable materials from the waste stream thereby reducing the demand on the landfills and improving the environment.

Spill Response Program:
Objective: To prevent pollutants from entering the Storm Drainage System.

Storm Sewer Maintenance:
Objective: To prevent failure of the Storm Drainage System by performing preventative maintenance and repairs in a timely, cost-effective manner.

Street Cleaning Program:
Objective: To remove debris that has collected on the streets before it can enter the drainage system and contaminate the Storm water.

Overflow Elimination Program
Objective: To reduce the amount of overflows to the storm drain system, and increase the efficiency of expenditures by planning and coordinating all infrastructure type projects.

Clearing and Grading Permit Administration:
Objective: To allow local inspectors from the City to review construction drawings and field check compliance with such.

New and Redevelopment Program:
Objective: To reduce the discharge of pollutants to the Municipal Separate Storm Sewer System; minimize potential short and long term water quality impacts; establish inspection and enforcement procedures and appropriate control measures; develop appropriate education and training measures; and notification process for applicants of their potential responsibilities under the NPDES permitting program.

Categories of Activities that Impact Groundwater and Sources of Drinking Water

RUNOFF
Water washes away many substances which later seep into the ground and mixes with groundwater.

Examples of runoff include:
AGRICULTURAL
- Animal Wastes
- Fertilizers
- Pesticides
- Sediments

URBAN
- Chemicals
- Grease and Oils
- Solvents

LANDFILL
- Garbage
- Leachate

CONSTRUCTION
- Contaminated Soil
- Stormwater Runoff
- Waste and Trash

LEAKING STORAGE TANKS (ULST)
Fuels and chemicals stored in underground or above ground tanks can leak into groundwater.

***Examples of substances that are expensive and difficult to remove are*:**
- Chemicals
- Diesel Fuel
- Fertilizers
- Gasoline
- Heating Oil
- Pesticides
- Solvents

HOLDING PONDS
Surface ponds serve a number of purposes in rural or industrial areas but also threaten groundwater quality.

Some examples are:
ANIMAL WASTES
- Microbial Contaminants
- Toxic levels of Nitrogen and Phosphorus

MINE WASTES

- Acid Waters
- Heavy Metals, Arsenic, Lead, etc.
- Sediments

WASTEWATER LAGOONS

- Microbial Contaminants
- Toxic Levels of Nitrogen and Phosphorus

WASTES FROM HUMAN AND ANIMALS

Waste by-products from humans and animals can seep into the ground and stay in a concentrated form. Groundwater containing harmful waste by-products can not be used as drinking water.

Some examples of possible pollutant sources are:

- Animal Feeding Operations including Aqua-Culture
- Animal Waste Ponds
- Leaking Wastewater Lines
- Manure Spreading
- Septic Systems

WELLS

Wells are drilled into the ground for drinking water, irrigation water, to recharge (injection) the aquifer, and to dispose of low-concentrated wastes. Any of these wells can allow pollutants to reach groundwater. Wells not in use must be properly capped and sealed to prevent contamination to the groundwater.

COMMON SOURCES OF WELL POLLUTANTS

- Abandoned or improperly closed wells
- Injection wells
- Irrigation wells left uncapped when not in use

DRINKING WATER WELLS ARE SUSCEPTIBLE TO POLLUTANTS WHEN THE WELL:

- Has an improperly cased/grouted pipe
- Is too shallow
- Is located within 50 feet of septic or leach fields
- Is too close to chemical or biological contaminants

Why Is the Phase II Storm Water Program Necessary?

Since the passage of the Clean Water Act (**CWA**), the quality of our Nation's waters has improved dramatically. Despite this progress, however, degraded waterbodies still exist.

According to the 1996 National Water Quality Inventory (Inventory), a biennial summary of State surveys of water quality, approximately 40 percent of surveyed U.S. waterbodies are still impaired by pollution and do not meet water quality standards. A leading source of this impairment is polluted runoff. In fact, according to the Inventory, 13 percent of impaired rivers, 21 percent of impaired lake acres and 45 percent of impaired estuaries are affected by urban/suburban storm water runoff and 6 percent of impaired rivers, 11 percent of impaired lake acres and 11 percent of impaired estuaries are affected by construction site discharges.

Phase I of the U.S. Environmental Protection Agency's (**EPA**) storm water program was promulgated in 1990 under the CWA. Phase I relies on National Pollutant Discharge Elimination System (**NPDES**) permit coverage to address storm water runoff from:
(1) "**medium**" and "**large**" municipal separate storm sewer systems (**MS4s**) generally serving populations of 100,000 or greater, (2) construction activity disturbing 5 acres of land or greater, and (3) ten categories of industrial activity.

The Storm Water Phase II Final Rule is the next step in the EPA's effort to preserve, protect, and improve the Nation's water resources from polluted storm water runoff. The Phase II program expands the Phase I program by requiring additional operators of MS4s in urbanized areas and operators of small construction sites, through the use of NPDES permits, to implement programs and practices to control polluted storm water runoff.

Phase II is intended to further reduce adverse impacts to water quality and aquatic habitat by instituting the use of controls on the unregulated sources of storm water discharges that have the greatest likelihood of causing continued environmental degradation.

The environmental problems associated with discharges from MS4s in urbanized areas and discharges resulting from construction activity are outlined below.

MS4s in Urbanized Areas
Storm water discharges from MS4s in urbanized areas are a concern because of the high concentration of pollutants found in these discharges. Concentrated development in urbanized areas substantially increases impervious surfaces, such as city streets, driveways, parking lots, and sidewalks, on which pollutants from concentrated human activities settle and remain until a storm event washes them into nearby storm drains.

Common pollutants include pesticides, fertilizers, oils, salt, litter and other debris, and sediment. Another concern is the possible illicit connections of sanitary sewers, which can result in fecal coliform bacteria entering the storm sewer system.

Storm water runoff picks up and transports these and other harmful pollutants and then discharges them – untreated – to waterways via storm sewer systems. When left uncontrolled, these discharges can result in fish kills, the destruction of spawning and wildlife habitats, a loss in aesthetic value, and contamination of drinking water supplies and recreational waterways that can threaten public health.

All storm water discharges associated with industrial activity that discharge through a storm water discharge system that is not a municipal separate storm sewer must be covered by an individual permit, or a permit issued to the operator of the portion of the system that discharges to waters of the United States, with each discharger to the non-municipal conveyance a co-permittee to that permit.

Fact Sheet 1.0 – Storm Water Phase II Final Rule

Construction Activity
Uncontrolled runoff from construction sites is a water quality concern because of the devastating effects that sedimentation can have on local waterbodies, particularly small streams.

Numerous studies have shown that the amount of sediment transported by storm water runoff from construction sites with no controls is significantly greater than from sites with controls. In addition to sediment, construction activities yield pollutants such as pesticides, petroleum products, construction chemicals, solvents, asphalts, and acids that can contaminate storm water runoff.

During storms, construction sites may be the source of sediment-laden runoff, which can overwhelm a small stream channel's capacity, resulting in streambed scour, streambank erosion, and destruction of near stream vegetative cover. Where left uncontrolled, sediment laden runoff has been shown to result in the loss of in-stream habitats for fish and other aquatic species, an increased difficulty in filtering drinking water, the loss of drinking water reservoir storage capacity, and negative impacts on the navigational capacity of waterways.

Are Municipally Operated Sources Exempted by the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 Affected by the Final Rule?
Provisions within ISTEA temporarily delayed the deadline for Phase I industrial activities (with the exception of power plants, airports, and uncontrolled sanitary landfills) operated by municipalities with populations of less than 100,000 people to obtain an NPDES storm water discharge permit.

Congress delayed the permitting deadline for these facilities to allow small municipalities additional time to comply with NPDES requirements.

The Phase II Final Rule ended this temporary exemption from permitting and set a deadline of no later than March 10, 2003 for all ISTEA exempted municipally operated industrial activities to obtain permit coverage.

How Was the Phase II Final Rule Developed?
The EPA developed the Phase II Final Rule during extensive consultations with a cross-section of interested stakeholders brought together on a subcommittee chartered under the Federal Advisory Committee Act, and with representatives of small entities participating in an advisory process mandated under the Small Business Regulatory Enforcement Fairness Act.

In addition, the EPA considered comments submitted by over 500 individuals and organizations during a 90-day public comment period on the proposed rule.

Why Does Part of the Phase II Final Rule Use a Question and Answer Format?
The provisions pertaining to operators of small MS4s are written in a "***readable regulation***" form that uses the "***plain language***" method. Questions and answers are used to create more reader-friendly and understandable regulations.

The plain language method uses ***"must"*** instead of ***"shall"*** to indicate a requirement and words like ***"should," "could,"*** or "**encourage**" to indicate a recommendation or guidance.

Who Is Covered by the Phase II Final Rule? The final rule "***automatically***" covers two classes of storm water dischargers on a nationwide basis: (1) Operators of small MS4s located in "***urbanized areas***" as delineated by the Bureau of the Census.
A "***small***" MS4 is any MS4 not already covered by Phase I of the NPDES storm water program. See Fact Sheets 2.1 and 2.2 for more information on small MS4 coverage. (2) Operators of small construction activities that disturb equal to or greater than 1 (one) and less than 5 (five) acres of land. See Fact Sheet 3.0 for more information on small construction activity coverage.

Waivers
Permitting authorities may waive "***automatically designated***" Phase II dischargers if the dischargers meet the necessary criteria. See Fact Sheets 2.1 (small MS4 waivers overview), 3.0 (construction waivers overview) and 3.1 (construction rainfall erosivity waiver) for details.

Phased-in Permit Coverage
Permitting authorities may phase-in permit coverage for small MS4s serving jurisdictions with a population under 10,000 on a schedule consistent with a State watershed permitting approach.

Additional Designations by the Permitting Authority
Small MS4s located outside of urbanized areas, construction activity disturbing less than 1 acre, and any other storm water discharges can be designated for coverage if the NPDES permitting authority or the EPA determines that storm water controls are necessary. See Fact Sheet 2.1 for more information on the designation of small MS4s located outside of urbanized areas.

Fact Sheet 1.0 – Storm Water Phase II Final Rule

Small Construction Activity

What Does the Phase II Final Rule Require?

Operators of Phase II-designated small MS4s and small construction activity are required to apply for NPDES permit coverage, most likely under a general rather than individual permit, and to implement storm water discharge management controls (known as "***best management practices***" (**BMPs**)).

Specific requirements for each type of discharge are listed below. A regulated small MS4 operator must develop, implement, and enforce a storm water management program designed to reduce the discharge of pollutants from their MS4 to the "***maximum extent practicable***," to protect water quality, and to satisfy the appropriate water quality requirements of the CWA. The rule assumes the use of narrative, rather than numeric, effluent limitations requiring implementation of BMPs.

The small MS4 storm water management program must include the following six minimum control measures: public education and outreach; public participation/involvement; illicit discharge detection and elimination; construction site runoff control; post-construction runoff control; and pollution prevention/good housekeeping. See Fact Sheets 2.3 through 2.8 for more information on each measure, including BMPs and measurable goals.

A regulated small MS4 operator must identify its selection of BMPs and measurable goals for each minimum measure in the permit application. The evaluation and assessment of those chosen BMPs and measurable goals must be included in periodic reports to the NPDES permitting authority.

The specific requirements for storm water controls on small construction activity will be defined by the NPDES permitting authority on a State-by-State basis.

The EPA expects that the NPDES permitting authorities will use their existing Phase I general permits for large construction activity as a guide for their Phase II permits for small construction activity. If this occurs, a storm water pollution prevention plan will likely be required for small construction activity.

See Fact Sheet 3.0 for more information on potential program requirements and appropriate BMPs for small construction activity.

What Is the Phase II Program Approach?

The Phase II program, based on the use of federally enforceable NPDES permits:

- ✓ Encourages the use of general permits;
- ✓ Provides flexibility for regulated operators to determine the most appropriate storm water controls;
- ✓ Allows for the recognition and inclusion of existing NPDES and non-NPDES storm water programs in Phase II permits;
- ✓ Includes public education and participation efforts as primary elements of the small MS4 program;
- ✓ Attempts to facilitate and promote watershed planning and to implement the storm water program on a watershed basis; and
- ✓ Works toward a unified and comprehensive NPDES storm water program with Phase I of the program.

How Does the Phase II Final Rule Address the Phase I Industrial "No Exposure" Provision?

In addition to establishing a deadline for ISTEA facilities and designating two new classes of dischargers, the Phase II Final Rule revises the "***no exposure***" provision originally included in the 1990 regulations for Phase I of the NPDES storm water program. The provision was remanded to the EPA for further rulemaking and, subsequently, included in its revised form in the Phase II rule.

Under the Phase II Final Rule, a conditional no exposure exclusion is available to operators of *all* categories of Phase I regulated industrial activity (except category (x) construction activity) who can certify that all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff.

To obtain the no exposure exclusion, written certification must be submitted to the NPDES permitting authority. The final rule includes a ***No Exposure Certification*** form for use only by operators of industrial activity in areas where the EPA is the NPDES permitting authority.

See Fact Sheet 4.0 for more information on the conditional no exposure exclusion for industrial activity.

Where there is more than one operator of a single system of such conveyances, all operators of storm water discharges associated with industrial activity must submit applications. Any permit covering more than one operator shall identify the effluent limitations, or other permit conditions, if any, that apply to each operator.

Small MS4s

Fact Sheet 1.0 – Storm Water Phase II Final Rule
For Additional Information

Contacts
U.S. EPA Office of Wastewater Management
• Internet: www.epa.gov/npdes/stormwater
• Phone:2 202-564-9545
Your NPDES Permitting Authority. A list of names and telephone numbers for each EPA Region and State is located at: www.epa.gov/npdes/stormwater, then click on "Contacts."

Reference Documents
Storm Water Phase II Final Rule Fact Sheet Series
• Internet: cfpub.epa.gov/npdes/stormwater/swfinal.cfm
Storm Water Phase II Final Rule (64 *FR* 68722)
• Internet: www.epa.gov/npdes/regulations/phase2.pdf

What Is the Phase II Program Implementation "Tool Box?"
The EPA is committed to providing tools to facilitate implementation of the final Phase II storm water program in an effective and cost-efficient manner. The "***tool box***" will include the following components:

- ✓ Fact Sheets;
- ✓ Guidance Documents;
- ✓ Menu of BMPs;
- ✓ Information Clearinghouse/Web Site;
- ✓ Training and Outreach Efforts;
- ✓ Technical Research;
- ✓ Support for Demonstration Projects; and
- ✓ Compliance Monitoring/Assistance Tools.

A preliminary working toolbox is available on the EPA's web site at www.epa.gov/npdes/stormwater.

Three years after publication of the final rule, when the general permits are issued, a fully operational tool box is scheduled to be available.

What Is the Schedule for the Phase II Rule?

- ✓ The Phase II Final Rule was published in the *Federal Register* on December 8, 1999 (64 *FR* 68722).
- ✓ The Conditional No Exposure Exclusion option is available February 7, 2000, in States where the EPA is the permitting authority.
- ✓ The NPDES permitting authority will issue general permits for Phase II-designated small MS4s and small construction activity by December 9, 2002.
- ✓ Operators of Phase II *"automatically"* designated regulated small MS4s and small construction activity must obtain permit coverage within 90 days of permit issuance.
- ✓ The NPDES permitting authority may phase-in coverage for small MS4s serving jurisdictions with a population under 10,000 on a schedule consistent with a State watershed permitting approach.
- ✓ Operators of regulated small MS4s must fully implement their storm water management programs
- ✓ by the end of the first permit term, typically a 5-year period.

Polluted Storm Water Runoff

Polluted storm water runoff is often transported to municipal separate storm sewer systems (**MS4s**) and ultimately discharged into local rivers and streams without treatment. EPA's Storm Water Phase II Rule establishes an MS4 storm water management program that is intended to improve the Nation's waterways by reducing the quantity of pollutants that storm water picks up and carries into storm sewer systems during storm events.

Common pollutants include oil and grease from roadways, pesticides from lawns, sediment from construction sites, and carelessly discarded trash, such as cigarette butts, paper wrappers, and plastic bottles.

When deposited into nearby waterways through MS4 discharges, these pollutants can impair the waterways, thereby discouraging recreational use of the resource, contaminating drinking water supplies, and interfering with the habitat for fish, other aquatic organisms, and wildlife.

In 1990, the EPA promulgated rules establishing Phase I of the National Pollutant Discharge Elimination System (**NPDES**) storm water program. The Phase I program for MS4s requires operators of ***"medium"*** and ***"large"*** MS4s, that is, those that generally serve populations of 100,000 or greater, to implement a storm water management program as a means to control polluted discharges from these MS4s.

The Storm Water Phase II Rule extends coverage of the NPDES storm water program to certain "small" MS4s but takes a slightly different approach to how the storm water management program is developed and implemented.

What Is a Phase II Small MS4?
A small MS4 is any MS4 not already covered by the Phase I program as a medium or large MS4.

The Phase II Rule automatically covers on a nationwide basis all small MS4s located in "***urbanized areas***" (**UAs)** as defined by the Bureau of the Census (unless waived by the NPDES permitting authority), and on a case-by-case basis those small MS4s located outside of UAs that the NPDES permitting authority designates.

For more information on Phase II small MS4 coverage, see Fact Sheets 2.1 and 2.2.

What Are the Phase II Small MS4 Program Requirements?

Operators of regulated small MS4s are required to design their programs to:

- ✓ Reduce the discharge of pollutants to the *"maximum extent practicable"* (**MEP**);
- ✓ Protect water quality; and
- ✓ Satisfy the appropriate water quality requirements of the Clean Water Act.

Implementation of the MEP standard will typically require the development and implementation of BMPs and the achievement of measurable goals to satisfy each of the six minimum control measures.

The Phase II Rule defines a small MS4 storm water management program as a program comprising six elements that, when implemented in concert, are expected to result in significant reductions of pollutants discharged into receiving waterbodies.

Fact Sheet 2.0 – An Overview of the Small MS4 Storm Water Program
For Additional Information

Contact
U.S. EPA Office of Wastewater Management
• Internet: www.epa.gov/npdes/stormwater
• Phone: 202-564-9545

Reference Documents
Storm Water Phase II Final Rule Fact Sheet Series
• Internet: cfpub.epa.gov/npdes/stormwater/swfinal.cfm

Storm Water Phase II Final Rule (64 *FR* 68722)
• Internet: www.epa.gov/npdes/regulations/phase2.pdf
The six MS4 program elements, termed "***minimum control measures***," are outlined below. For more information on each of these required control measures, see Fact Sheets 2.3 – 2.8.

Public Education and Outreach
Distributing educational materials and performing outreach to inform citizens about the impacts polluted storm water runoff discharges can have on water quality.

Public Participation/Involvement
Providing opportunities for citizens to participate in program development and implementation, including effectively publicizing public hearings and/or encouraging citizen representatives on a storm water management panel.

Illicit Discharge Detection and Elimination
Developing and implementing a plan to detect and eliminate illicit discharges to the storm sewer system (includes developing a system map and informing the community about hazards associated with illegal discharges and improper disposal of waste).

Construction Site Runoff Control
Developing, implementing, and enforcing an erosion and sediment control program for construction activities that disturb 1 or more acres of land (controls could include silt fences and temporary storm water detention ponds).

Post-Construction Runoff Control
Developing, implementing, and enforcing a program to address discharges of post-construction storm water runoff from new development and redevelopment areas.

Applicable controls could include preventative actions such as protecting sensitive areas (e.g., wetlands) or the use of structural BMPs such as grassed swales or porous pavement.

Pollution Prevention/Good Housekeeping
Developing and implementing a program with the goal of preventing or reducing pollutant runoff from municipal operations. The program must include municipal staff training on pollution prevention measures and techniques (e.g., regular street sweeping, reduction in the use of pesticides or street salt, or frequent catch-basin cleaning).

What Information Must the NPDES Permit Application Include?
The Phase II program for MS4s is designed to accommodate a general permit approach using a Notice of Intent (**NOI**) as the permit application. The operator of a regulated small MS4 must include in its permit application, or NOI, its chosen BMPs and measurable goals for each minimum control measure.

To help permittees identify the most appropriate BMPs for their programs, the EPA will issue a "***menu***," of BMPs to serve as guidance. NPDES permitting authorities can modify the EPA menu or develop their own list. For more information on application requirements, see Fact Sheet 2.9.

What Are the Implementation Options?
The rule identifies a number of implementation options for regulated small MS4 operators. These include sharing responsibility for program development with a nearby regulated small MS4, taking advantage of existing local or State programs, or participating in the implementation of an existing Phase I MS4's storm water program as a co-permittee.

These options are intended to promote a regional approach to storm water management coordinated on a watershed basis.

What Kind of Program Evaluation/Assessment Is Required?
Permittees need to evaluate the effectiveness of their chosen BMPs to determine whether the BMPs are reducing the discharge of pollutants from their systems to the "***maximum extent practicable***" and to determine if the BMP mix is satisfying the water quality requirements of the Clean Water Act.

Permittees also are required to assess their progress in achieving their program's measurable goals. While monitoring is not required under the rule, the NPDES permitting authority has the discretion to require monitoring if deemed necessary. If there is an indication of a need for improved controls, permittees can revise their mix of BMPs to create a more effective program.

For more information on program evaluation/assessment, see Fact Sheet 2.9.

Industrial "No Exposure"
4.0 – Conditional No Exposure Exclusion for Industrial Activity

According to 40 CFR 122.26(b)(8), "***municipal separate storm sewer*** means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law)...including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges into waters of the United States.
(ii) Designed or used for collecting or conveying storm water;
(iii) Which is not a combined sewer; and
(iv) Which is not part of a Publicly Owned Treatment Works
(POTW) as defined at 40 CFR 122.2."

Who Is Affected by the Phase II Small MS4 Program?

The Storm Water Phase II Final Rule applies to operators of *regulated small* municipal separate storm sewer systems **(MS4s)**, which are designated based on the criteria discussed in this fact sheet. In this fact sheet, the definition of an MS4 and the distinction between small, medium, and large MS4s is reviewed.

Conditions under which a small MS4 may be designated as a *regulated* small MS4, as well as the conditions for a waiver from the Phase II program requirements, are outlined.

This fact sheet also attempts to clarify possible implementation issues related to determining one's status as an operator of a regulated small MS4.

What Is a Municipal Separate Storm Sewer System (MS4)?
What constitutes an MS4 is often misinterpreted and misunderstood. The term MS4 does not solely refer to municipally-owned storm sewer systems, but rather is a term of art with a much broader application that can include, in addition to local jurisdictions, state departments of transportation, universities, local sewer districts, hospitals, military bases, and prisons. An MS4 also is not always just a system of underground pipes – it can include roads with drainage systems, gutters, and ditches.

The regulatory definition of an MS4 is provided below.

Fact Sheet 2.1 – Who's Covered? Designation and Waivers of Regulated Small MS4s

What Is a Small, Medium, or Large MS4?

- ✓ The EPA's NPDES (National Pollutant Discharge Elimination System) storm water permitting program labels MS4s as either "small," "medium," or "large" for the purposes of regulation.
- ✓ A ***small*** **MS4** is any MS4 that is not already covered by the Phase I storm water program. Small MS4s include Federally-owned systems, such as military bases.
- ✓ The Phase I storm water program covers *medium* and *large* MS4s. Phase I MS4s were automatically designated nationwide as ***medium*** **MS4s** if they were located in an incorporated place or county with a population between 100,000 - 249,999 or as ***large*** **MS4s** if located in an incorporated place or county with a population of 250,000 or greater.

Many MS4s in areas below 100,000 in population, however, have been individually brought into the Phase I program by NPDES permitting authorities. Such already regulated MS4s do not have to develop a Phase II program.

Are All Small MS4s Covered by the Phase II Final Rule?
No. The universe of small MS4s is quite large since it includes every MS4 except for the approximately 900 medium and large MS4s already regulated under the Phase I storm water program.

Only a select sub-set of small MS4s, referred to as ***regulated*** **small MS4s**, are covered by the Phase II Final Rule, either through automatic nationwide designation or designation on a case-by-case basis by the NPDES permitting authority.

Discharges from storm drain outfalls can be a combination of dry-weather base flows; stormwater runoff; snowmelt water; intermittent discharges of debris, wash-waters, and other waste materials into storm drains; and the relatively continuous discharges of sanitary and industrial cross-connected wastes. These discharges include stormwater that contains the washoff of pollutants from all land surfaces during rains, including washoff of pollutants from areas such as industrial material and waste storage areas, gas station service areas, parking lots, and other industrial and commercial areas, etc. Therefore, the quality of urban runoff can vary greatly with time (dry versus wet-weather, cold versus warm weather, etc.) and location.

How Is A Small MS4 Designated as a Regulated Small MS4?

A small MS4 can be designated by the permitting authority as a *regulated* small MS4 in one of three ways:

Automatic Nationwide Designation

The Phase II Final Rule requires nationwide coverage of all operators of small MS4s that are located within the boundaries of a Bureau of the Census-defined "***urbanized area"*** (**UA**) based on the latest decennial Census. Once a small MS4 is designated into the program based on the UA boundaries, it cannot be waived from the program if in a subsequent UA calculation the small MS4 is no longer within the UA boundaries. An automatically designated small MS4 remains regulated unless, or until, it meets the criteria for a waiver.

Urbanized Areas

Before the time of permit issuance (which must be by December 9, 2002), UA calculations based on the 2000 Census should be published. The regulated universe then will be based on these new calculations. For more information on UAs, see Fact Sheet 2.2.

Preamble of the Phase II Final Rule: Appendix 6

A listing of governmental entities that are located either fully or partially within a UA according to the 1990 Census can be found in Appendix 6 to the Preamble. The list is a general geographic reference intended to help operators of small MS4s determine whether or not they are located in a UA and, consequently, required to comply with the regulation; it is not a list of all Phase II regulated MS4s.

For example, the list does not include small MS4 operators such as colleges and universities, Federal prison complexes, and State highway departments located within a UA. See Fact Sheet 2.2 for more information on how to determine potential coverage under the Phase II program.

Appendix 6 can be obtained from the EPA Office of Wastewater Management (**OWM**) or downloaded from the OWM web site.

Potential Designation by the NPDES Permitting Authority – Required Evaluation

An operator of small MS4 located outside of a UA may be designated as a regulated small MS4 if the NPDES permitting authority determines that its discharges cause, or have the potential to cause, an adverse impact on water quality.

The Phase II Final Rule requires the NPDES permitting authority to develop a set of designation criteria and apply them, ***at a minimum***, to all small MS4s located outside of a UA serving a jurisdiction with a population of at least 10,000 and a population density of at least 1,000 people/square mile.

An ***urbanized area*** (**UA**) is a land area comprising one or more places – central place(s) and the adjacent densely settled surrounding area – urban fringe – that together have a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile.

It is a calculation used by the Bureau of the Census to determine the geographic boundaries of the most heavily developed and dense urban areas.

The discharge of sanitary and industrial wastes into storm drainage can lead to serious water pollution problems. In many cases, urban receiving waters are badly polluted by stormwater alone, without additional pollutant loadings associated with sanitary or industrial non-stormwater discharges into the storm drainage system. The addition of sanitary wastes increases the concentrations of oxygen-demanding organic solids and nutrients, and increases the number of pathogenic microorganisms in the storm-induced discharge. Industrial wastes can be highly variable, but can substantially increase the concentrations of many filterable heavy metals in runoff, as an example. In many cases, annual discharge loadings from stormwater outfalls can be greatly affected by dry-weather discharges.

Fact Sheet 2.1 – Who's Covered?
Designation and Waivers of Regulated Small MS4s

Physically interconnected means that one MS4 is connected to a second MS4 in such a way that it allows for *direct* discharges into the second system.

TMDLs are water quality assessments that determine the source or sources of pollutants of concern for a particular waterbody, consider the maximum amount of pollutants the waterbody can assimilate, and then allocate to each source a set level of pollutants that it is allowed to discharge (i.e., a "***wasteload allocation***").

Small MS4s that are not given a wasteload allocation would meet the third criterion above.

Pollutants of Concern include biochemical oxygen demand (**BOD**), sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation), pathogens, oil and grease, and any pollutant that has been identified as a cause of impairment in any water body to which the MS4 discharges.

Designation Criteria
The EPA recommends that the NPDES permitting authority use a balanced consideration of the following designation criteria on a watershed or other local basis:

- ✓ Discharge to sensitive waters;
- ✓ High population density;
- ✓ High growth or growth potential;
- ✓ Contiguity to a UA;
- ✓ Significant contributor of pollutants to waters of the United States; and
- ✓ Ineffective protection of water quality concerns by other programs.

Preamble of the Phase II Final Rule: Appendix 7
A listing of governmental entities located outside of a UA, that have a population of at least 10,000 and a population density of at least 1,000 people per square mile can be found in Appendix 7 to the Preamble of the Phase II Final Rule. Similar to Appendix 6, the list is a geographic reference only –it is not a list of regulated entities.

Operators of small MS4s located within a listed area could be examined by their NPDES permitting authority for potential designation into the Phase II program. Furthermore, the NPDES permitting authority reserves the right to designate for regulation any small MS4 that is contributing pollutants to waters of the United States, whether or not its jurisdiction is found in Appendix 7.

Appendix 7 can be obtained from the EPA Office of Wastewater Management or downloaded from the OWM web site.

Deadline for Designation
The NPDES permitting authority is required to designate small MS4s meeting the designation criteria by December 9, 2002 or by December 8, 2004 if a watershed plan is in place.

Potential Designation by the NPDES Permitting Authority Physically Interconnected
Under the final rule, the NPDES permitting authority is required to designate any small MS4 located outside of a UA that contributes substantially to the pollutant loadings of a ***physically interconnected*** MS4 regulated by the NPDES storm water program. The final rule does not set a deadline for designation of small MS4s meeting this criterion.

Are Waivers from the Phase II Permit/Program Requirements Possible?
Yes, two waiver options are available to operators of automatically designated small MS4s if discharges do not cause, or have the potential to cause, water quality impairment.

The first applies where:
(1) the jurisdiction served by the system is less than 1,000 people;
(2) the system is not contributing substantially to the pollutant loadings of a physically interconnected regulated MS4; and
(3) if the small MS4 discharges any pollutants identified as a cause of impairment of any water body to which it discharges, storm water controls are not needed based on wasteload allocations that are part of an EPA approved or established "***total maximum daily load***" (**TMDL**) that addresses the pollutant(s) of concern.

Fact Sheet 2.1 – Who's Covered? Designation and Waivers of Regulated Small For Additional Information

Contact

U.S. EPA Office of Wastewater Management
• Phone: (202) 564-9545
• Internet: www.epa.gov/npdes/stormwater

Reference Documents
Storm Water Phase II Final Rule Fact Sheet Series
• Internet: cfpub.epa.gov/npdes/stormwater/swfinal.cfm
Storm Water Phase II Final Rule (64 *FR* 68722)
• Internet: www.epa.gov/npdes/regulations/phase2.pdf
The second applies where:
(1) the jurisdiction served by the system is less than 10,000 people;
(2) an evaluation of all waters of the U.S. that receive a discharge from the system shows that storm water controls are not needed based on wasteload allocations that are part of an EPA approved or established TMDL that addresses the pollutant(s) of concern or an equivalent analysis; and
(3) it is determined that future discharges from the small MS4 do not have the potential to result in exceedances of water quality standards. The NPDES permitting authority is required to periodically review any waivers granted to MS4 operators to determine whether any information required for granting the waiver has changed. Minimally, such a review needs to be conducted once every five years.

Are There Allowances for Phasing-in Permit Coverage?
Yes. Small MS4s serving a jurisdiction with a population under 10,000 can be phased-in for permit coverage, following establishment of a State watershed permitting approach. NPDES permitting authorities that choose this option must establish a schedule to phase-in permit coverage annually for approximately 20 percent of all small MS4s that qualify for such phased-in coverage. Where this option is followed, all regulated small MS4s are required to have permit coverage no later than March 8, 2007.

Can More than One MS4 in the Same Political Jurisdiction Be Automatically Designated?
Yes. Since the final rule provides automatic coverage of all small MS4s within a UA, the result would likely be coverage of several governments and agencies with multiple, perhaps overlapping, jurisdictions. For example, a city that is located within a UA and operates its own small MS4 could be designated alongside the State's department of transportation (**DOT**) and the county's DOT if the State and county operate roads that are within the borders of the city.

All three entities would be responsible for developing a storm water management program for the portion of their respective MS4s within the city limits. In such a case, the permittees are strongly encouraged to work together to form a unified storm water management program.

Who Is Responsible if the Small MS4 Operator Lacks the Necessary Legal Authority?
Some regulated small MS4s may lack the necessary legal authority to implement one or more of the required minimum control measures that comprise the Phase II storm water management program.

For example, a local government that is a small MS4 operator may be in a State that does not have an enabling statute that allows local regulatory control of construction site runoff into the sewer system.

Another example is a State DOT that may not have the legal authority to require and enforce controls on illicit discharges into its system. In these situations, the small MS4 is encouraged to work with the neighboring regulated small MS4s. As co-permittees, they could form a shared storm water management program in which each permittee is responsible for activities that are within their individual legal authorities and abilities.

Fact Sheet 2.2 What Is an Urbanized Area (UA)?

The Bureau of the Census determines UAs by applying a detailed set of published UA criteria (see 55 *FR* 42592, October 22, 1990) to the latest decennial census data. Although the full UA definition is complex, the Bureau of the Census' general definition of a UA, based on population and population density.

The basic unit for delineating the UA boundary is the census block. Census blocks are based on visible physical boundaries, such as the city block, when possible, or on invisible political boundaries, when not. An urbanized area can comprise places, counties, Federal Indian Reservations, and minor civil divisions (MCDs - towns and townships).

Central Place
Incorporated Place
Federal Indian Reservation (**FIR**)
Unincorporated "Urbanized Area" Portion of a Town
(**MCD**) or County
Urbanized Area
Town or Township as a functioning Minor Civil Division (**MCD**). An MCD is the primary subdivision of a County.
County

Figure 1
Operators of small MS4s can determine if they are located within a UA, and therefore covered by the Phase II stormwater program, through the following two steps:
— STEP 1 —
Refer to a listing of incorporated places, MCDs, and counties that are located entirely or partially within a UA. Such a listing, based on the 1990 Census, can be found in Appendix 6 to the Preamble of the Phase II Final Rule; it does not include governmental entities already permitted under Phase I.

If a small MS4 is located in a listed incorporated place, MCD, or county, then the operator of the small MS4 should follow step (2) below. (Note: Appendix 6 can be obtained from the EPA Office of Wastewater Management (**OWM**) or downloaded from the OWM web site.)

— STEP 2 —
Some operators of small MS4s may find that they are located within an entity listed in Appendix 6 but not know if their systems are within the urbanized portion of the listed entity.

In such a case, they should contact one or more of the following institutions for more detailed information on the location of the UA boundary:

The State or NPDES Permitting Authority (may be the State or the U.S. EPA Region)
Storm Water Coordinators**:** The NPDES permitting authority may be the State or the U.S. EPA Region.

The Storm Water Coordinators for each U.S. EPA Region are listed in the *For Additional Information* section in Fact Sheet 2.9. These regional contacts can assist with UA information and provide the names of State storm water contacts. Regional and State contact information can also be obtained from OWM.

State Data Centers: Each State's Data Center receives listings of all entities that are located in UAs, as well as detailed maps and electronic files of UA boundaries. The Bureau of the Census web site includes a list of contact names and phone numbers for the data in each State at www.census.gov/sdc/www.

State Planning/Economic/Transportation Agencies:
These agencies typically use UAs to assess current development and forecast future growth trends and, therefore, should have detailed UA information readily available to help determine the UA boundaries in any given area.

County or Regional Planning Commissions/Boards
As with State agencies, these entities are likely to have detailed UA data and maps to help determine UA boundaries.

Fact Sheet 2.2 — Urbanized Areas: Definition and Description For Additional Information
Contact
U.S. EPA Office of Wastewater Management
• Phone: (202) 564-9545
• Internet: www.epa.gov/npdes/stormwater

Reference Documents
Storm Water Phase II Final Rule Fact Sheet Series
• Internet: cfpub.epa.gov/npdes/stormwater/swfinal.cfm
Storm Water Phase II Final Rule (64 *FR* 68722)
• Internet: www.epa.gov/npdes/regulations/phase2.pdf

The Bureau of the Census
Urbanized Areas Staff: 301 457-1099
Web Site: www.census.gov
The site provides information on purchasing UA maps and electronic files for use with computerized mapping systems. Obtain free UA cartographic boundary files (Arc/Info export format) for Geographical Information System (GIS) use at:www.census.gov:80/geo/www/cob/ua.html.

UA Maps: Detailed UA maps are available for purchase with a $25 minimum order ($5 per map sheet). Each map sheet measures 36 by 42 inches.

For prices and a listing of UAs, visit www.census.gov/mp/www/geo/msgeo12.html. Order from the Department of Commerce, Bureau of the Census (MS 1921), P.O. Box 277943, Atlanta, GA 30384-7943 (Phone: 301 457-4100; Toll-free fax:1-888-249-7295).

U.S. EPA

The EPA is modifying a web-based geographic program called *Enviromapper*. This will allow MS4 operators to enter a location and see a detailed map of the UA boundary. Information about *Enviromapper* will be available at www.epa.gov/owm/phase2.

How Will the Year 2000 Census Affect the Determination of Status as a Regulated Small MS4?

The listing of incorporated places, MCDs, and counties located within UAs in the United States and Puerto Rico, found in Appendix 6, is based on the 1990 Census.

New listings for UAs based on the 2000 Census are scheduled to be available by July or August of 2001. Once the official 2000 Census listings are published by the Bureau of the Census, operators of small MS4s located within the revised boundaries of former 1990 UAs, or in any newly defined 2000 UAs, become regulated small MS4s and must develop a storm water management program.

Any additional automatic designations of small MS4s based on subsequent census years is governed by the Bureau of the Census' definition of a UA in effect for that year and the UA boundaries determined as a result of the definition.

Once a small MS4 is designated into the Phase II storm water program based on the UA boundaries, it cannot be waived from the program, even if in a subsequent UA calculation, the small MS4 is no longer within the UA boundaries. An automatically designated small MS4 will remain regulated unless, or until, it meets the criteria for a waiver (see Fact Sheet 2.1 for more information on the regulated small MS4 waiver option).

Pretreatment sampling for BOD, COD and Heavy metals from a Significant Industrial User (SIU) using an automatic sampler. Here we see the Inspector shaking the pickle jar which contains several timed grab samples making a composite sample. Notice the ice chest which is filled with ice as is the bottom half of the automatic sampler.

Signage is a major part of the public awareness program. Most cities have implemented small placards or have spray painted "Do Not Dump" on every storm drain in their system to prevent contaminants from entering the system.

Fact Sheet 2.3 – Public Education and Outreach

This fact sheet profiles the Public Education and Outreach minimum control measure, one of six measures an operator of a Phase II-regulated small municipal separate storm sewer system (**MS4**) is required to include in its storm water management program to meet the conditions of its National Pollutant Discharge Elimination System (**NPDES**) storm water permit.

This fact sheet outlines the Phase II Final Rule requirements and offers some general guidance on how to satisfy them. It is important to keep in mind that the regulated small MS4 operator has a great deal of flexibility in choosing exactly how to satisfy the minimum control measure requirements.

Why Is Public Education and Outreach Necessary?
An informed and knowledgeable community is crucial to the success of a storm water management program since it helps to ensure the following:

- ***Greater support*** for the program as the public gains a greater understanding of the reasons why it is necessary and important. Public support is particularly beneficial when operators of small MS4s attempt to institute new funding initiatives for the program or seek volunteers to help implement the program; and
- ***Greater compliance*** with the program as the public becomes aware of the personal responsibilities expected of them and others in the community, including the individual actions they can take to protect or improve the quality of area waters**.**

What Is Required?
To satisfy this minimum control measure, the operator of a regulated small MS4 needs to:

- ✓ Implement a public education program to distribute educational materials to the community, or conduct equivalent outreach activities about the impacts of storm water discharges on local waterbodies and the steps that can be taken to reduce storm water pollution; and
- ✓ Determine the appropriate best management practices (**BMPs**) and measurable goals for this minimum control measure. Some program implementation approaches, BMPs (i.e., the program actions/activities), and measurable goals are suggested below.

What Are Some Guidelines for Developing and Implementing This Measure?
Three main action areas are important for successful implementation of a public education and outreach program:

Fact Sheet 2.3 – Public Education and Outreach Minimum Control Measure
For Additional Information
Contact
U.S. EPA Office of Wastewater Management
• Internet: www.epa.gov/npdes/stormwater
• Phone: 202-564-9545

Reference Documents
Storm Water Phase II Final Rule Fact Sheet Series
• Internet: cfpub.epa.gov/npdes/stormwater/swfinal.cfm
Storm Water Phase II Final Rule (64 *FR* 68722)
• Internet: www.epa.gov/npdes/regulations/phase2.pdf

Forming Partnerships
Operators of regulated small MS4s are encouraged to enter into partnerships with other governmental entities to fulfill this minimum control measure's requirements. It is generally more cost-effective to use an existing program, or to develop a new regional or state-wide education program, than to have numerous operators developing their own local programs. Operators also are encouraged to seek assistance from nongovernmental organizations (e.g., environmental, civic, and industrial organizations), since many already have educational materials and perform outreach activities.

Using Educational Materials and Strategies
Operators of regulated small MS4s may use storm water educational information provided by their State, Tribe, EPA Region, or environmental, public interest, or trade organizations instead of developing their own materials. Operators should strive to make their materials and activities relevant to local situations and issues, and incorporate a variety of strategies to ensure maximum coverage. Some examples include:
• ***Brochures or fact sheets*** for general public and specific audiences;
• ***Recreational guides*** to educate groups such as golfers, hikers, paddlers, climbers, fishermen, and campers;
• ***Alternative information sources,*** such as web sites, bumper stickers, refrigerator magnets, posters for bus and subway stops, and restaurant placemats;
• ***A library of educational materials*** for community and school groups;
• ***Volunteer citizen educators*** to staff a ***public education task force;***
• ***Event participation*** with educational displays at home shows and community festivals;
• ***Educational programs*** for school-age children;
• ***Storm drain stenciling*** with messages such as "Do Not Dump - Drains Directly to Lake;"
• ***Storm water hotlines*** for information and for citizen reporting of polluters;
• ***Economic incentives*** to citizens and businesses (e.g., rebates to homeowners purchasing mulching lawnmowers or biodegradable lawn products); and
• ***Tributary signage*** to increase public awareness of local water resources.

Reaching Diverse Audiences
The public education program should use a mix of appropriate local strategies to address the viewpoints and concerns of a variety of audiences and communities, including minority and disadvantaged communities, as well as children. Printing posters and brochures in more than one language or posting large warning signs (e.g., cautioning against fishing or swimming) near storm sewer outfalls are methods that can be used to reach audiences less likely to read standard materials.

Directing materials or outreach programs toward specific groups of commercial, industrial, and institutional entities likely to have significant storm water impacts is also recommended. For example, information could be provided to restaurants on the effects of grease clogging storm drains and to auto garages on the effects of dumping used oil into storm drains.

What Are Appropriate Measurable Goals?
Measurable goals, which are required for each minimum control measure, are intended to gauge permit compliance and program effectiveness. The measurable goals, as well as the BMPs, should reflect the needs and characteristics of the operator and the area served by its small MS4.

Furthermore, they should be chosen using an integrated approach that fully addresses the requirements and intent of the minimum control measure. An integrated approach for this minimum measure could include the following measurable goals:

Target Date Activity

1 year.......... Brochures developed (bilingual, if appropriate) and distributed in water utility bills; a storm water hotline in place; volunteer educators trained.

2 years......... A web site created; school curricula developed; storm drains stenciled.

3 years......... A certain percentage of restaurants no longer dumping grease and other pollutants down storm sewer drains.

4 years......... A certain percentage reduction in litter or animal waste detected in discharges.

Fact Sheet 2.4 – Public Participation/ Involvement

This fact sheet profiles the Public Participation/Involvement minimum control measure, one of six measures the operator of a Phase II regulated small municipal separate storm sewer system (**MS4**) is required to include in its storm water management program to meet the conditions of its National Pollutant Discharge Elimination System (**NPDES**) permit. This fact sheet outlines the Phase II Final Rule requirements and offers some general guidance on how to satisfy them. It is important to keep in mind that the small MS4 operator has a great deal of flexibility in determining how to satisfy the minimum control measure requirements.

Why Is Public Participation and Involvement Necessary?

The EPA believes that the public can provide valuable input and assistance to a regulated small MS4's municipal storm water management program and, therefore, suggests that the public be given opportunities to play an active role in both the development and implementation of the program. An active and involved community is crucial to the success of a storm water management program because it allows for:

- ***Broader public support*** since citizens who participate in the development and decision making process are partially responsible for the program and, therefore, may be less likely to raise legal challenges to the program and more likely to take an active role in its implementation;
- ***Shorter implementation schedules*** due to fewer obstacles in the form of public and legal challenges and increased sources in the form of citizen volunteers;
- ***A broader base of expertise*** and ***economic benefits*** since the community can be a valuable, and free, intellectual resource; and
- ***A conduit to other programs*** as citizens involved in the storm water program development process provide important cross-connections and relationships with other community and government programs. This benefit is particularly valuable when trying to implement a storm water program on a watershed basis, as encouraged by the EPA.

What Is Required?

To satisfy this minimum control measure, the operator of a regulated small MS4 must:

- ✓ Comply with applicable State, Tribal, and local public notice requirements; and
- ✓ Determine the appropriate best management practices (**BMPs**) and measurable goals for this minimum control measure. Possible implementation approaches, BMPs (i.e., the program actions and activities), and measurable goals are described below.

Fact Sheet 2.4 – Public Participation/Involvement Minimum Control Measure
For Additional Information

Contact

U.S. EPA Office of Wastewater Management

- Phone: (202) 564-9545
- Internet: www.epa.gov/npdes/stormwater

Reference Documents
Storm Water Phase II Final Rule Fact Sheet Series
• Internet: cfpub.epa.gov/npdes/stormwater/swfinal.cfm
Storm Water Phase II Final Rule (64 *FR* 68722)
• Internet: www.epa.gov/npdes/regulations/phase2.pdf

What Are Some Guidelines for Developing and Implementing This Measure?
Operators of regulated small MS4s should include the public in developing, implementing, and reviewing their storm water management programs. The public participation process should make every effort to reach out and engage all economic and ethnic groups. The EPA recognizes that there are challenges associated with public involvement.

Nevertheless, the EPA strongly believes that these challenges can be addressed through an aggressive and inclusive program. Challenges and example practices that can help ensure successful participation are discussed below.

Implementation Challenges
The best way to handle common notification and recruitment challenges is to know the audience and think creatively about how to gain its attention and interest. Traditional methods of soliciting public input are not always successful in generating interest, and subsequent involvement, in all sectors of the community.

For example, municipalities often rely solely on advertising in local newspapers to announce public meetings and other opportunities for public involvement. Since there may be large sectors of the population who do not read the local press, the audience reached may be limited.

Therefore, alternative advertising methods should be used whenever possible, including radio or television spots, postings at bus or subway stops, announcements in neighborhood newsletters, announcements at civic organization meetings, distribution of flyers, mass mailings, door-to-door visits, telephone notifications, and multilingual announcements.

These efforts, of course, are tied closely to the efforts for the public education and outreach minimum control measure (see Fact Sheet 2.3). In addition, advertising and soliciting for help should be targeted at specific population sectors, including ethnic, minority, and low-income communities; academia and educational institutions; neighborhood and community groups; outdoor recreation groups; and business and industry. The goal is to involve a diverse cross-section of people who can offer a multitude of concerns, ideas, and connections during the program development process.

Possible Practices (BMPs)
There are a variety of practices that could be incorporated into a public participation and involvement program, such as:
• ***Public meetings/citizen panels*** allow citizens to discuss various viewpoints and provide input concerning appropriate storm water management policies and BMPs;
• ***Volunteer water quality monitoring*** gives citizens' firsthand knowledge of the quality of local water bodies and provides a cost-effective means of collecting water quality data;
• ***Volunteer educators/speakers*** who can conduct workshops, encourage public participation, and staff special events;
• ***Storm drain stenciling*** is an important and simple activity that concerned citizens, especially students, can do;
• ***Community clean-ups*** along local waterways, beaches, and around storm drains;

• ***Citizen watch groups*** can aid local enforcement authorities in the identification of polluters; and
• ***"Adopt A Storm Drain" programs*** encourage individuals or groups to keep storm drains free of debris and to monitor what is entering local waterways through storm drains.

What Are Appropriate Measurable Goals?
Measurable goals, which are required for each minimum control measure, are intended to gauge permit compliance and program effectiveness. The measurable goals, as well as the BMPs, greatly depend on the needs and characteristics of the operator and the area served by the small MS4.

Furthermore, they should be chosen using an integrated approach that fully addresses the requirements and intent of the minimum control measure. An integrated approach for this minimum measure could include the following measurable goals:

Target Date Activity
1 year............ Notice of a public meeting in several different print media and bilingual flyers; citizen panel established; volunteers organized to locate outfalls/illicit discharges and stencil drains.
2 years.......... Final recommendations of the citizen panel; radio spots promoting program and participation.
3 years.......... A certain percentage of the community participating in community clean-ups.
4 years.......... Citizen watch groups established in a certain percentage of neighborhoods; outreach to every different population sector completed.

Common Wastewater/Stormwater Sample Collection Bottles

On the left hand side, 625/608, 1657, TTO/Organics, TPH/Oil/Grease, Smaller bottles TOCs, VOCs, 601/602 and 502.2 On the right hand side photograph, NO^2/NO^3, Flouride, Sulfide, Metals, BOD-TDS-TSS Wide-mouth Sludge/Metals bottle

Direct Connections to Storm Drains
Direct connections refer to physical connections of sanitary, commercial, or industrial piping carrying untreated or partially treated wastewaters to a separate storm drainage system. These connections are usually unauthorized. They may be intentional, or may be accidental due to mistaken identification of sanitary sewerlines.

They represent the most common source of entries to storm drains by industry. Direct connections can result in continuous or intermittent dry-weather entries of contaminants into the storm drain. Some common situations are:

- Sanitary sewers that tie into a storm drain.
- Foundation drains or residential sump-pump discharges that are frequently connected to storm drains. While this practice may be quite appropriate in many cases, it can be a source of contamination when the local groundwater is contaminated, as for example by septic tank failures.
- Commercial laundries and car wash establishments that may route process wastewaters to storm drains rather than sanitary sewers.

Fact Sheet 2.5 – Illicit Discharge Detection and Elimination

This fact sheet profiles the Illicit Discharge Detection and Elimination minimum control measure, one of six measures the operator of a Phase II regulated small municipal separate storm sewer system (**MS4**) is required to include in its storm water management program to meet the conditions of its National Pollutant Discharge Elimination System (**NPDES**) permit.

This fact sheet outlines the Phase II Final Rule requirements and offers some general guidance on how to satisfy them. It is important to keep in mind that the small MS4 operator has a great deal of flexibility in choosing exactly how to satisfy the minimum control measure requirements.

What Is An "Illicit Discharge"?
Federal regulations define an illicit discharge as "...any discharge to an MS4 that is not composed entirely of storm water..." with some exceptions. These exceptions include discharges from NPDES-permitted industrial sources and discharges from fire-fighting activities. Illicit discharges (see Table 1) are considered "illicit" because MS4s are not designed to accept, process, or discharge such non-storm water wastes.

Why Are Illicit Discharge Detection and Elimination Efforts Necessary?
Discharges from MS4s often include wastes and wastewater from non-storm water sources. A study conducted in 1987 in Sacramento, California, found that almost one-half of the water discharged from a local MS4 was not directly attributable to precipitation runoff. A significant portion of these dry weather flows were from illicit and/or inappropriate discharges and connections to the MS4.

Illicit discharges enter the system through either direct connections (e.g., wastewater piping either mistakenly or deliberately connected to the storm drains) or indirect connections (e.g., infiltration into the MS4 from cracked sanitary systems, spills collected by drain outlets, or paint or used oil dumped directly into a drain). The result is untreated discharges that contribute high levels of pollutants, including heavy metals, toxins, oil and grease, solvents, nutrients, viruses, and bacteria to receiving waterbodies. Pollutant levels from these illicit discharges have been shown in EPA studies to be high enough to significantly degrade receiving water quality and threaten aquatic, wildlife, and human health.

Fact Sheet 2.5 – Illicit Discharge Detection and Elimination Minimum Control Measure

What Is Required?
Recognizing the adverse effects illicit discharges can have on receiving waters, the final rule requires an operator of a regulated small MS4 to develop, implement and enforce an illicit discharge detection and elimination program. This program must include the following:

- ✓ A storm sewer system map, showing the location of all outfalls and the names and location of all waters of the United States that receive discharges from those outfalls;
- ✓ Through an ordinance, or other regulatory mechanism, a prohibition (to the extent allowable under State, Tribal, or local law) on non-storm water discharges into the MS4, and appropriate enforcement procedures and actions;
- ✓ A plan to detect and address non-storm water discharges, including illegal dumping, into the MS4;
- ✓ The education of public employees, businesses, and the general public about the hazards associated with illegal discharges and improper disposal of waste; and
- ✓ The determination of appropriate best management practices (**BMPs**) and measurable goals for this minimum control measure. Some program implementation approaches,

BMPs (i.e., the program actions/activities), and measurable goals are suggested below.

Does This Measure Need to Address All Illicit Discharges?
No. The illicit discharge detection and elimination program does not need to address the following categories of non-storm water discharges or flows unless the operator of the regulated small MS4 identifies them as significant contributors of pollutants to its MS4:

- Water line flushing;
- Landscape irrigation;
- Diverted stream flows;
- Rising ground waters;
- Uncontaminated ground water infiltration;
- Uncontaminated pumped ground water;
- Discharges from potable water sources;
- Foundation drains;
- Air conditioning condensation;
- Irrigation water;
- Springs;
- Water from crawl space pumps;
- Footing drains;
- Lawn watering;
- Individual residential car washing;
- Flows from riparian habitats and wetlands;
- Dechlorinated swimming pool discharges; and
- Street wash water.

What Are Some Guidelines for Developing and Implementing This Measure?
The objective of the illicit discharge detection and elimination minimum control measure is to have regulated small MS4 operators gain a thorough awareness of their systems. This awareness allows them to determine the types and sources of illicit discharges entering their system; and establish the legal, technical, and educational means needed to eliminate these discharges. Permittees could meet these objectives in a variety of ways depending on their individual needs and abilities, but some general guidance for each requirement is provided below.

The Map
The storm sewer system map is meant to demonstrate a basic awareness of the intake and discharge areas of the system. It is needed to help determine the extent of discharged dry weather flows, the possible sources of the dry weather flows, and the particular waterbodies these flows may be affecting.

An existing map, such as a topographical map, on which the location of major pipes and outfalls can be clearly presented demonstrates such awareness.

The EPA recommends collecting all existing information on outfall locations (e.g., review city records, drainage maps, storm drain maps), and then conducting field surveys to verify locations. It probably will be necessary to walk (i.e., wade through small receiving waters or use a boat for larger waters) the streambanks and shorelines for visual observation. More than one trip may be needed to locate all outfalls.

Legal Prohibition and Enforcement
The EPA recognizes that some permittees may have limited authority under State, Tribal or local law to establish and enforce an ordinance or other regulatory mechanism prohibiting illicit discharges. In such a case, the permittee is encouraged to obtain the necessary authority, if possible.

The Plan
The plan to detect and address illicit discharges is the central component of this minimum control measure. The plan is dependant upon several factors, including the permittee's available resources, size of staff, and degree and character of its illicit discharges. The EPA envisions a plan similar to the one Michigan recommends for use in meeting their NPDES stormwater discharge requirements.

Locate Problem Areas
The EPA recommends that priority areas be identified for detailed screening of the system based on the likelihood of illicit connections (e.g., areas with older sanitary sewer lines). Methods that can locate problem areas include: public complaints; visual screening; water sampling from manholes and outfalls during dry weather; and use of infrared and thermal photography.

Find the Source
Once a problem area or discharge is found, additional efforts usually are necessary to determine the source of the problem. Methods that can find the source of the illicit discharge include: dye-testing buildings in problem areas; dye- or smoke-testing buildings at the time of sale; tracing the discharge upstream in the storm sewer; employing a certification program that shows that buildings have been checked for illicit connections; implementing an inspection program of existing septic systems; and using video to inspect the storm sewers.

Remove/Correct Illicit Connections
Once the source is identified, the offending discharger should be notified and directed to correct the problem. Education efforts and working with the discharger can be effective in resolving the problem before taking legal action.

Document Actions Taken
As a final step, all actions taken under the plan should be documented. This illustrates that progress is being made to eliminate illicit connections and discharges.

Documented actions should be included in annual reports and include information such as: the number of outfalls screened; any complaints received and corrected; the number of discharges and quantities of flow eliminated; and the number of dye or smoke tests conducted.

Educational Outreach
Outreach to public employees, businesses, property owners, the general community, and elected officials regarding ways to detect and eliminate illicit discharges is an integral part of this minimum measure that will help gain support for the permittee's storm water program. Suggested educational outreach efforts include:
• Developing ***informative brochures, and guidances*** for specific audiences (e.g., carpet cleaning businesses) and school curricula;
• Designing a program to ***publicize and facilitate public reporting*** of illicit discharges;
• ***Coordinating volunteers*** for locating, and visually inspecting, outfalls or to stencil storm drains; and

• Initiating ***recycling programs*** for commonly dumped wastes, such as motor oil, antifreeze, and pesticides.

What Are Appropriate Measurable Goals?
Measurable goals, which are required for each minimum control measure, are intended to gauge permit compliance and program effectiveness. The measurable goals, as well as the BMPs, should reflect the needs and characteristics of the operator and the area served by its small MS4. Furthermore, they should be chosen using an integrated approach that fully addresses the requirements and intent of the minimum control measure. An integrated approach for this minimum measure could include the following measurable goals:

Target Date Activity
1 year............ Sewer system map completed; recycling program for household hazardous waste in place.
2 years.......... Ordinance in place; training for public employees completed; a certain percentage of sources of illicit discharges determined.
3 years.......... A certain percentage of illicit discharges detected; illicit discharges eliminated; and households participating in quarterly household hazardous waste special collection days.
4 years.......... Most illicit discharge sources detected and eliminated.

The educational outreach measurable goals for this minimum control measure could be combined with the measurable goals for the Public Education and Outreach minimum control measure (see Fact Sheet 2.3).

For Additional Information
Contact
U.S. EPA Office of Wastewater Management
• Phone: (202) 564-9545
• Internet: www.epa.gov/npdes/stormwater

Reference Documents
Storm Water Phase II Final Rule Fact Sheet Series
• Internet: cfpub.epa.gov/npdes/stormwater/swfinal.cfm
Storm Water Phase II Final Rule (64 *FR* 68722)
• Internet: www.epa.gov/npdes/regulations/phase2.pdf

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U.S. EPA Office of Water. 1993. *Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems: A User's Guide*. EPA/600/R-92/238. Washington, D.C.

Wayne County Rouge River National Wet Weather Demonstration Project. 1997. *Guidance for Preparing a Program for the Elimination of Illicit Discharges*. Wayne County, Michigan.

Fact Sheet 2.6 – Construction Site Runoff Control

This fact sheet profiles the Construction Site Runoff Control minimum control measure, one of six measures that the operator of a Phase II regulated small municipal separate storm sewer system (**MS4**) is required to include in its storm water management program to meet the conditions of its National Pollutant Discharge Elimination System (**NPDES**) permit. This fact sheet outlines the Phase II Final Rule requirements and offers some general guidance on how to satisfy them. It is important to keep in mind that the small MS4 operator has a great deal of flexibility in choosing exactly how to satisfy the minimum control measure requirements.

Why Is the Control of Construction Site Runoff Necessary?

Polluted storm water runoff from construction sites often flows to MS4s and ultimately is discharged into local rivers and streams. Of the pollutants listed in Table 1, sediment is usually the main pollutant of concern. Sediment runoff rates from construction sites are typically 10 to 20 times greater than those of agricultural lands, and 1,000 to 2,000 times greater than those of forest lands.

During a short period of time, construction sites can contribute more sediment to streams than can be deposited naturally during several decades. The resulting siltation, and the contribution of other pollutants from construction sites, can cause physical, chemical, and biological harm to our nation's waters. For example, excess sediment can quickly fill rivers and lakes, requiring dredging and destroying aquatic habitats.

What Is Required?

The Phase II Final Rule requires an operator of a regulated small MS4 to develop, implement, and enforce a program to reduce pollutants in storm water runoff to their MS4 from construction activities that result in a land disturbance of greater than or equal to one acre.

The small MS4 operator is required to:

- ✓ Have an ordinance or other regulatory mechanism requiring the implementation of proper erosion and sediment controls, and controls for other wastes, on applicable construction sites;
- ✓ Have procedures for site plan review of construction plans that consider potential water quality impacts;
- ✓ Have procedures for site inspection and enforcement of control measures;
- ✓ Have sanctions to ensure compliance (established in the ordinance or other regulatory mechanism);
- ✓ Establish procedures for the receipt and consideration of information submitted by the public; and
- ✓ Determine the appropriate best management practices (**BMPs**) and measurable goals for this minimum control measure. Suggested BMPs (i.e., the program actions/activities) and measurable goals are presented below.

What Are Some Guidelines for Developing and Implementing This Measure?

Further explanation and guidance for each component of a regulated small MS4's construction program is provided below.

Regulatory Mechanism

Through the development of an ordinance or other regulatory mechanism, the small MS4 operator must establish a construction program that controls polluted runoff from construction sites with a land disturbance of greater than or equal to one acre. Because there may be limitations on regulatory legal authority, the small MS4 operator is required to satisfy this minimum control measure only to the maximum extent practicable and allowable under State, Tribal, or local law.

Site Plan Review

The small MS4 operator must include in its construction program requirements the implementation of appropriate BMPs on construction sites to control erosion and sediment and other waste at the site. To determine if a construction site is in compliance with such provisions, the small MS4 operator should review the site plans submitted by the construction site operator before ground is broken.

Site plan review aids in compliance and enforcement efforts since it alerts the small MS4 operator early in the process to the planned use or non-use of proper BMPs and provides a way to track new construction activities. The tracking of sites is useful not only for the small MS4 operator's recordkeeping and reporting purposes, which are required under their NPDES storm water permit (see Fact Sheet 2.9), but also for members of the public interested in ensuring that the sites are in compliance.

Inspections and Penalties

Once construction commences, BMPs should be in place and the small MS4 operator's enforcement activities should begin. To ensure that the BMPs are properly installed, the small MS4 operator is required to develop procedures for site inspection and enforcement of control measures to deter infractions.

Procedures could include steps to identify priority sites for inspection and enforcement based on the nature and extent of the construction activity, topography, and the characteristics of soils and receiving water quality. Inspections give the MS4 operator an opportunity to provide additional guidance and education, issue warnings, or assess penalties.

To conserve staff resources, one possible option for small MS4 operators is to have these inspections performed by the same inspector that visits the sites to check compliance with health and safety building codes.

Information Submitted by the Public

A final requirement of the small MS4 program for construction activity is the development of procedures for the receipt and consideration of public inquiries, concerns, and information submitted regarding local construction activities. This provision is intended to further reinforce the public participation component of the regulated small MS4 storm water program (see Fact Sheet 2.4) and to recognize the crucial role that the public can play in identifying instances of noncompliance.

The small MS4 operator is required only to *consider* the information submitted, and may not need to follow-up and respond to every complaint or concern. Although some form of enforcement action or reply is not required, the small MS4 operator is required to demonstrate acknowledgment and consideration of the information submitted. A simple tracking process in which submitted public information, both written and verbal, is recorded and then given to the construction site inspector for possible follow-up will suffice.

What Are Appropriate Measurable Goals?

Measurable goals, which are required for each minimum control measure, are intended to gauge permit compliance and program effectiveness. The measurable goals, as well as the BMPs, should reflect the needs and characteristics of the operator and the area served by its small MS4.

Furthermore, they should be chosen using an integrated approach that fully addresses the requirements and intent of the minimum control measure. An integrated approach for this minimum measure could include the following measurable goals:

Target Date Activity
1 year............ Ordinance or other regulatory mechanism in place; procedures for information submitted by the public in place.
2 years.......... Procedures for site inspections implemented; a certain percentage rate of compliance achieved by construction operators.
3 years.......... Maximum compliance with ordinance; improved clarity and reduced sedimentation of local waterbodies.
4 years.......... Increased numbers of sensitive aquatic organisms in local waterbodies.

For Additional Information
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Are Construction Sites Already Covered Under the NPDES Storm Water Program?
Yes. EPA's Phase I NPDES storm water program requires operators of construction activities that disturb five or more acres to obtain a NPDES construction storm water permit. General permit requirements include the submission of a Notice of Intent and the development of a storm water pollution prevention plan (**SWPPP**).

The SWPPP must include a site description and measures and controls to prevent or minimize pollutants in storm water discharges. The Phase II Final Rule similarly regulates discharges from smaller construction sites disturbing equal to or greater than one acre and less than five acres (see Fact Sheet 3.0 for information on the Phase II construction program).

Even though all construction sites that disturb more than one acre are covered nationally by an NPDES storm water permit, the construction site runoff control minimum measure for the small MS4 program is needed to induce more localized site regulation and enforcement efforts, and to enable operators of regulated small MS4s to more effectively control construction site discharges into their MS4s.

To aid operators of regulated construction sites in their efforts to comply with both local requirements and their NPDES permit, the Phase II Final Rule includes a provision that allows the NPDES permitting authority to reference a "***qualifying State, Tribal or local program"*** in the NPDES general permit for construction. This means that if a construction site is located in an area covered by a qualifying local program, then the construction site operator's compliance with the local program constitutes compliance with their NPDES permit.

A regulated small MS4's storm water program for construction could be a "***qualifying program***" if the MS4 operator requires a SWPPP, in addition to the requirements summarized in this fact sheet.

The ability to reference other programs in the NPDES permit is intended to reduce confusion between overlapping and similar requirements, while still providing for both local and national regulatory coverage of the construction site.

The provision allowing NPDES permitting authorities to reference other programs has no impact on, or direct relation to, the small MS4 operator's responsibilities under the construction site runoff control minimum measure profiled here.

Is a Small MS4 Required to Regulate Construction Sites that the Permitting Authority has Waived from the NPDES Construction Program?
No. If the NPDES permitting authority waives requirements for storm water discharges associated with small construction activity (see 122.26(b)(15)(i)), the small MS4 operator is not required to develop, implement, and/or enforce a program to reduce pollutant discharges from such construction sites.

2.7 – Post-Construction Runoff Control

This fact sheet profiles the Post-Construction Runoff Control minimum control measure, one of six measures that the operator of a Phase II regulated small municipal separate storm sewer system (**MS4**) is required to include in its storm water management program in order to meet the conditions of its National Pollutant Discharge Elimination System (**NPDES**) permit.

This fact sheet outlines the Phase II Final Rule requirements for post-construction runoff control and offers some general guidance on how to satisfy those requirements. It is important to keep in mind that the small MS4 operator has a great deal of flexibility in choosing exactly how to satisfy the minimum control measure requirements.

Why Is the Control of Post-Construction Runoff Necessary?
Post-construction storm water management in areas undergoing new development or redevelopment is necessary because runoff from these areas has been shown to significantly effect receiving waterbodies. Many studies indicate that prior planning and design for the minimization of pollutants in post-construction storm water discharges is the most cost-effective approach to storm water quality management.

There are generally two forms of substantial impacts of post-construction runoff. The first is caused by an increase in the type and quantity of pollutants in storm water runoff. As runoff flows over areas altered by development, it picks up harmful sediment and chemicals such as oil and grease, pesticides, heavy metals, and nutrients (e.g., nitrogen and phosphorus). These pollutants often become suspended in runoff and are carried to receiving waters, such as lakes, ponds, and streams. Once deposited, these pollutants can enter the food chain through small aquatic life, eventually entering the tissues of fish and humans.

The second kind of post construction runoff impact occurs by increasing the quantity of water delivered to the waterbody during storms. Increased impervious surfaces interrupt the natural cycle of gradual percolation of water through vegetation and soil. Instead, water is collected from surfaces such as asphalt and concrete and routed to drainage systems where large volumes of runoff quickly flow to the nearest receiving water.

The effects of this process include streambank scouring and downstream flooding, which often lead to a loss of aquatic life and damage to property.

What Is Required?
The Phase II Final Rule requires an operator of a regulated small MS4 to develop, implement, and enforce a program to reduce pollutants in post-construction runoff to their MS4 from new development and redevelopment projects that result in the land disturbance of greater than or equal to 1 acre.

The small MS4 operator is required to:

- ✓ Develop and implement strategies which include a combination of structural and/or nonstructural best management practices (**BMPs**);
- ✓ Have an ordinance or other regulatory mechanism requiring the implementation of post construction runoff controls to the extent allowable under State, Tribal or local law,

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Ensure adequate long-term operation and maintenance of controls;
Determine the appropriate best management practices (**BMPs**) and measurable goals for this minimum control measure.

What Is Considered a *"Redevelopment"* Project?
The term "redevelopment" refers to alterations of a property that change the "***footprint***" of a site or building in such a way that there is a disturbance of equal to or greater than 1 acre of land. The term does not include such activities as exterior remodeling. Because redevelopment projects may have site constraints not found on new development sites, the rule provides flexibility for implementing post-construction controls on redevelopment sites that consider these constraints.

What Are Some Guidelines for Developing and Implementing This Measure?
This section includes some sample non-structural and structural BMPs that could be used to satisfy the requirements of the post-construction runoff control minimum measure. It is important to recognize that many BMPs are climate-specific, and not all BMPs are appropriate in every geographic area.

Because the requirements of this measure are closely tied to the requirements of the construction site runoff control minimum measure (see Fact Sheet 2.6), the EPA recommends that small MS4 operators develop and implement these two measures in tandem. Sample BMPs follow.

Non-Structural BMPs
• **Planning and Procedures**. Runoff problems can be addressed efficiently with sound planning procedures. Master Plans, Comprehensive Plans, and zoning ordinances can promote improved water quality by guiding the growth of a community away from sensitive areas and by restricting certain types of growth (industrial, for example) to areas that can support it without compromising water quality.
• **Site-Based Local Controls**. These controls can include buffer strip and riparian zone preservation, minimization of disturbance and imperviousness, and maximization of open space.

Structural BMPs
• **Storage Practices**. Storage or detention BMPs control storm water by gathering runoff in wet ponds, dry basins, or multichamber catch basins and slowly releasing it to receiving waters or drainage systems. These practices both control storm water volume and settle out particulates for pollutant removal.
• **Infiltration Practices**. Infiltration BMPs are designed to facilitate the percolation of runoff through the soil to ground water, and, thereby, result in reduced storm water quantity and reduced mobilization of pollutants. Examples include infiltration basins/trenches, dry wells,
and porous pavement.

• **Vegetative Practices**. Vegetative BMPs are landscaping features that, with optimal design and good soil conditions, enhance pollutant removal, maintain/improve natural site hydrology, promote healthier habitats, and increase aesthetic appeal.

Examples include grassy swales, filter strips, artificial wetlands, and rain gardens.

What Are Appropriate Measurable Goals?
Measurable goals, which are required for each minimum control measure, are intended to gauge permit compliance and program effectiveness. The measurable goals, as well as the BMPs, should reflect the needs and characteristics of the operator and the area served by its small MS4.

Furthermore, the measurable goals should be chosen using an integrated approach that fully addresses the requirements and intent of the minimum control measure. An integrated approach for this minimum measure could include the following goals:

Target Date Activity
1 year............. Strategies developed that include structural and/or non-structural BMPs.
2 years........... Strategies codified by use of ordinance or other regulatory mechanism.
3 years..........Reduced percent of new impervious surfaces associated with new development projects.
4 years........... Improved clarity and reduced sedimentation of local waterbodies.

Infiltration to Storm Drains

Continuous dry weather flows may be caused by groundwater infiltration into storm drains when the storm sewers are located below the local groundwater table. These continuous discharges generally are not a pollution threat to surface waters, since most ground waters which infiltrate into storm sewers are not contaminated, but these flows will have variable flow rates due to fluctuations in the level of the water table and percolation from rainfall events. Underground potable water main breaks are a potential clean source of releases to storm drains. While such occurrences are not a direct pollution source, they should obviously be corrected.

However, when groundwater pollution does occur, such as from leaky underground storage tanks, storm drains may become a method of conveyance for these contaminants to the surface waters. Infiltration into storm drains most commonly occurs through leaking pipe joints and poor connections to catch basins, but can also be due to other causes, such as damaged pipes and subsidence. Storm drains, as well as natural drainage channels, can therefore intercept and convey subsurface groundwater and percolating waters.

2.8 – Pollution Prevention/Good Housekeeping

This fact sheet profiles the Pollution Prevention/Good Housekeeping for Municipal Operations minimum control measure, one of six measures the operator of a Phase II regulated small municipal separate storm sewer system (**MS4**) is required to include in its storm water management program to meet the conditions of its National Pollutant Discharge Elimination System (**NPDES**) permit. This fact sheet outlines the Phase II Final Rule requirements and offers some general guidance on how to satisfy them. It is important to keep in mind that the small MS4 operator has a great deal of flexibility in choosing exactly how to satisfy the minimum control measure requirements.

Why Is Pollution Prevention/Good Housekeeping Necessary?
The Pollution Prevention/Good Housekeeping for municipal operations minimum control measure is a key element of the small MS4 storm water management program. This measure requires the small MS4 operator to examine and subsequently alter their own actions to help ensure a reduction in the amount and type of pollution that: (1) collects on streets, parking lots, open spaces, and storage and vehicle maintenance areas and is discharged into local waterways; and (2) results from actions such as environmentally damaging land development and flood management practices or poor maintenance of storm sewer systems.

While this measure is meant primarily to improve or protect receiving water quality by altering municipal or facility operations, it also can result in a cost savings for the small MS4 operator, since proper and timely maintenance of storm sewer systems can help avoid repair costs from damage caused by age and neglect.

What Is Required?

- ✓ Recognizing the benefits of pollution prevention practices, the rule requires an operator of a regulated small MS4 to:
- ✓ Develop and implement an operation and maintenance program with the ultimate goal of preventing or reducing pollutant runoff from municipal operations into the storm sewer system;
- ✓ Include employee training on how to incorporate pollution prevention/good housekeeping techniques into municipal operations such as park and open space maintenance, fleet and building maintenance, new construction and land disturbances, and storm water system maintenance. To minimize duplication of effort and conserve resources, the MS4 operator can use training materials that are available from the EPA, their State or Tribe, or relevant organizations;
- ✓ Determine the appropriate best management practices (**BMPs**) and measurable goals for this minimum control measure. Some program implementation approaches, BMPs (i.e., the program actions/activities), and measurable goals are suggested below.

For Additional Information
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• Internet: www.epa.gov/npdes/regulations/phase2.pdf

What Are Some Guidelines for Developing and Implementing This Measure?

The intent of this control measure is to ensure that existing municipal, State or Federal operations. The EPA encourages the small MS4 operator to consider the following components when developing their program for this measure:

• ***Maintenance activities, maintenance schedules, and long-term inspection procedures*** for structural and non-structural controls to reduce floatables and other pollutants discharged from the separate storm sewers;

• ***Controls for reducing or eliminating the discharge of pollutants*** from areas such as roads and parking lots, maintenance and storage yards (including salt/sand storage and snow disposal areas), and waste transfer stations. These controls could include programs that promote recycling (to reduce litter), minimize pesticide use, and ensure the proper disposal of animal waste;

• ***Procedures for the proper disposal of waste*** removed from separate storm sewer systems and areas listed in the bullet above, including dredge spoil, accumulated sediments, floatables, and other debris; and

• ***Ways to ensure that new flood management projects assess the impacts on water quality*** and examine existing projects for incorporation of additional water quality protection devices or practices. The EPA encourages coordination with flood control managers for the purpose of identifying and addressing environmental impacts from such projects. The effective performance of this control measure hinges on the proper maintenance of the BMPs used, particularly for the first two bullets above. For example, structural controls, such as grates on outfalls to capture floatables, typically need regular cleaning, while non-structural controls, such as training materials and recycling programs, need periodic updating.

What Are Appropriate Measurable Goals?

Measurable goals, which are required for each minimum control measure, are meant to gauge permit compliance and program effectiveness. The measurable goals, as well as the BMPs, should consider the needs and characteristics of the operator and the area served by its small MS4.

The measurable goals should be chosen using an integrated approach that fully addresses the requirements and intent of the minimum control measure.

An integrated approach for this minimum measure could include the following measurable goals:

Target Date Activity

1 year........... Pollution prevention plan (the new BMPs and revised procedures) completed; employee training materials gathered or developed; procedures in place for catch basin cleaning after each storm and regular street sweeping.

2 years......... Training for appropriate employees completed; recycling program fully implemented.

3 years......... Some pollution prevention BMPs incorporated into master plan; a certain percentage reduction in pesticide and sand/salt use; maintenance schedule for
BMPs established.

4 years......... A certain percentage reduction in floatables discharged; a certain compliance rate with maintenance schedules for BMPs; controls in place for all areas of concern.

Fact Sheet 2.9 – Permitting and Reporting: The Process and Requirements

The Storm Water Phase II Final Rule requires operators of certain small municipal separate storm sewer systems (**MS4s**) to obtain National Pollutant Discharge Elimination System (**NPDES**) permit coverage because their storm water discharges are considered "***point sources***" of pollution.

All point source discharges, unlike nonpoint sources such as agricultural runoff, are required under the Clean Water Act (**CWA**) to be covered by federally enforceable NPDES permits. Those systems already permitted under the NPDES Phase I storm water program, even systems serving less than 100,000 people, are not required to be permitted under the Phase II storm water program.

NPDES storm water permits are issued by an NPDES permitting authority, which may be NPDES authorized State or a U.S. EPA Region in non-authorized States (see the *For Additional Information* section for a list of U.S. EPA regional contacts). Once a permit application is submitted by the operator of a regulated small MS4 and a permit is obtained, the conditions of the permit must be satisfied (i.e., development and implementation of a storm water management program) and periodic reports must be submitted on the status and effectiveness of the program.

This fact sheet explains the various permit options that are available for operators of regulated small MS4s and details the permit application and reporting requirements. Important compliance deadlines also are highlighted. Program coverage and requirements for regulated small MS4s are explained in Fact Sheets 2.0 through 2.8.

What Permitting Options Are Available to Operators of Regulated Small MS4s?
Unlike the Phase I program that primarily utilizes individual permits for medium and large MS4s, the Phase II approach allows operators of regulated small MS4s to choose from as many as three permitting options as listed below. The NPDES permitting authority reserves the authority to determine, however, which options are available to the regulated small MS4s.

General Permits
• General permits are strongly encouraged by the EPA. The Phase II program has been designed specifically to accommodate a general permit approach.
• General permits prescribe one set of requirements for all applicable permittees. General permits are drafted by the NPDES permitting authority, then published for public comment before being finalized and issued.
• A Notice of Intent (**NOI**) serves as the application for the general permit. The permittee complies with the permit requirements by submitting an NOI to the NPDES permitting authority that describes the storm water management plan, including best management practices (**BMPs**) and measurable goals. A Phase II permittee has the flexibility to develop an individualized storm water program that addresses the particular characteristics and needs of its system, provided the basic requirements of the general permit are satisfied.
• Permittees also can choose to share responsibilities for meeting the Phase II program requirements. Those entities choosing to do so may submit jointly with the other municipalities or governmental entities an NOI that identifies who will implement which minimum measures within the area served by the MS4.
• The permittee then follows the Phase II permit application requirements (see discussion in next question below).

Minimize Duplication of Effort
Two permitting options tailored to minimize duplication of effort can be incorporated into the general permit by the NPDES permitting authority. First, the permitting authority can recognize in the permit that another governmental entity is responsible under an NPDES permit for implementing any or all minimum measures. Responsibility for implementation of the measure(s) would rest with the other governmental entity, thereby relieving the permittee of its responsibility to implement that particular measure(s).

For example, the NPDES permitting authority could recognize a county erosion and sediment control program for construction sites that was developed to comply with a Phase I permit. As long as the Phase II MS4s in the county comply with the county's construction program, they would not need to develop and implement their own construction programs because such activity would already be addressed by the county.

Second, the NPDES permitting authority can include conditions in a general permit that direct a permittee to follow the requirements of an existing qualifying local program rather than the requirements of a minimum measure. A qualifying local program is defined as a local, State or Tribal municipal storm water program that imposes requirements that are equivalent to those of the Phase II MS4 minimum measures.

The permittee remains responsible for the implementation of the minimum measure through compliance with the qualifying local program.

Individual Permits
• Individual permits are required for Phase I "medium" and "large" MS4s, but not recommended by the EPA for Phase II program implementation.
• The permittee can either submit an individual application for coverage by the Phase II MS4 program (see §122.34) or the Phase I MS4 program (see §122.26(d)).
• For individual coverage under Phase II, the permittee must follow Phase II permit application requirements and provide an estimate of square mileage served by the system and any additional information requested by the NPDES permitting authority. A permittee electing to apply for coverage under the Phase I program must follow the permit application requirements detailed at §122.26(d).
• The NPDES permitting authority may allow more than one regulated entity to jointly apply for an individual permit.
• The NPDES permitting authority could incorporate in the individual permit either of the two permitting options explained above in the *Minimize Duplication of Effort* section.

Modification of a Phase I Individual Permit –A Co-Permittee Option
• The operator of a regulated small MS4 could participate as a limited co-permittee in a neighboring Phase I MS4's storm water management program by seeking a modification of the existing Phase I individual permit. A list of Phase I medium and large MS4s can be obtained from the EPA Office of Wastewater Management (**OWM**) or downloaded from the OWM web site.
• The permittee must follow Phase I permit application requirements (with some exclusions).
• The permittee must comply with the applicable terms of the Phase I individual permit rather than the minimum control measures in the Phase II Final Rule.

What Does the Permit Application Require?
Operators of regulated small MS4s are required to submit in their NOI or individual permit application the following information:
_ Best management practices (**BMPs**) are required for each of the six minimum control measures:
_ Public education and outreach on storm water impacts
_ Public participation/involvement
_ Illicit discharge detection and elimination
_ Construction site storm water runoff control
_ Post-construction storm water management in new development/redevelopment
_ Pollution prevention/good housekeeping for municipal operations
(See Fact Sheets 2.3 through 2.8 for full descriptions of each measure, including examples of BMPs and measurable goals)
_ Measurable goals for each minimum control measure (i.e., narrative or numeric standards used to gauge program effectiveness);
_ Estimated months and years in which actions to implement each measure will be undertaken, including interim milestones and frequency; and
_ The person or persons responsible for implementing or coordinating the storm water program.

Relying on Another Entity
The Phase II permittee has the option of relying on other entities already performing one or more of the minimum control measures, provided that the existing control measure, or component thereof, is at least as stringent as the Phase II rule requirements.

For example, a county already may have an illicit discharge detection and elimination program in place and may allow an operator of a regulated small MS4 within the county's jurisdiction to rely on the county program instead of formulating and implementing a new program. In such a case, the permittee would not need to implement the particular measure, but would still be ultimately responsible for its effective implementation.

For this reason, the EPA recommends that the permittee enter into a legally binding agreement with the other entity. If the permittee chooses to rely on another entity, they must note this in their permit application and subsequent reports.

A Phase II permittee may even rely on another governmental entity regulated under the NPDES storm water program to satisfy all of the permittee's permit obligations. Should this option be chosen, the permittee must note this in its NOI, but does not need to file periodic reports.

What Does the Permit Require?
The operator of a regulated small MS4 has the flexibility to determine the BMPs and measurable goals, for each minimum control measure, that are most appropriate for the system. The chosen BMPs and measurable goals, submitted in the permit application, become the required storm water management program; however, the NPDES permitting authority can require changes in the mix of chosen BMPs and measurable goals if all or some of them are found to be inconsistent with the provisions of the Phase II Final Rule.

Likewise, the permittee can change its mix of BMPs if it determines that the program is not as effective as it could be. Fact Sheets 2.3 through 2.8 further describe each of the minimum control measures, while the permit requirements for evaluation/assessment and recordkeeping activities are described in separate sections below.

Menu of BMPs
The BMPs for minimum measures 3 through 6 (as listed in the permit application requirements section, above) are not enforceable until the NPDES permitting authority provides a list, or "menu," of BMPs to assist permittees in the design and implementation of their storm water management programs.

The NPDES permitting authority is required to provide this menu as an aid for those operators that are unsure of the most appropriate and effective BMPs to use. Since the menu is intended to serve as guidance only, the operators can either select from the menu or identify other BMPs to meet the permit requirements.

What Standards Apply?

A Phase II small MS4 operator is required to design its program so that it:

- ✓ Reduces the discharge of pollutants to the "***maximum extent practicable***" (**MEP**);
- ✓ Protects water quality; and
- ✓ Satisfies the appropriate water quality requirements of the Clean Water Act.

Compliance with the technical standard of MEP requires the successful implementation of approved BMPs. The Phase II Final Rule considers narrative effluent limitations that require the implementation of BMPs and the achievement of measurable goals as the most appropriate form of effluent limitations to achieve the protection of water quality, rather than requiring that storm water discharges meet numeric effluent limitations.

The EPA intends to issue Phase II NPDES permits consistent with its August 1, 1996, Interim Permitting Approach policy, which calls for BMPs in first-round storm water permits and expanded or better tailored BMPs in subsequent permits, where necessary, to provide for the attainment of water quality standards.

In cases where information exists to develop more specific conditions or limitations to meet water quality standards, these conditions or limitations should be incorporated into the storm water permit. Monitoring is not required under the Phase II Rule, but the NPDES permitting authority has the discretion to require monitoring if deemed necessary.

What Evaluation/Reporting Efforts Are Required?
Frequency of Reports
Reports must be submitted annually during the first permit term. For subsequent permit terms, reports must be submitted in years 2 and 4 only, unless the NPDES permitting authority requests more frequent reports.

For Additional Information

Contacts

U.S. EPA Regional Storm Water Coordinators1
Region 1 {ME2, NH2, VT, MA2, RI, CT}: Thelma Murphy 617 918-1615
Region 2 {NY, NJ, PR2, VI}: Karen O'Brien 212 637-3717
Region 3 {PA, DE, DC2, MD, VA, WV}: Mary Letzkus 215 814-2087
Region 4 {KY, TN, NC, SC, MS, AL, GA, FL}: Michael Mitchell 404 562-9303
Region 5 {MN, WI, IL, MI, IN, OH}: Peter Swenson 312 886-0236
Region 6 {NM2, TX, OK, AR, LA}: Brent Larsen 214 665-7523
Region 7 {NE, KS, IA, MO}: Ralph Summers 913 551-7416
Region 8 {MT, ND, WY, SD, UT, CO}: Vernon Berry 303 312-6234
Region 9 {CA, NV, AZ2, HI}: Eugene Bromley 415 744-1906
Region 10 {WA, OR, ID2, AK2}: Bob Robichaud 206 553-1448
1 The U.S. EPA is the NPDES permitting authority for all federally recognized Indian Country Lands, and for Federal facilities in AK, American Samoa, AZ, CO, DE, DC, FL, Guam, ID, Johnston Atoll, ME, MA, Midway & Wake Islands, NH, NM, PR, VT, VI, and WA.
2 Denotes a non-authorized State for the NPDES storm water program. For these States only, the U.S. EPA Region is the NPDES permitting authority. All other States serve as NPDES permitting authorities for the storm water program.

U.S. EPA Office of Wastewater Management
• Phone: (202) 564-9545 • Internet: www.epa.gov/npdes/stormwater

Required Report Content

The reports must include the following:

- ✓ The status of compliance with permit conditions, including an assessment of the appropriateness of the selected BMPs and progress toward achieving the selected measurable goals for each minimum measure;
- ✓ Results of any information collected and analyzed, including monitoring data, if any;
- ✓ A summary of the storm water activities planned for the next reporting cycle;
- ✓ A change in any identified best management practices or measurable goals for any minimum measure; and
- ✓ Notice of relying on another governmental entity to satisfy some of the permit obligations (if applicable).

A Change in Selected BMPs

If, upon evaluation of the program, improved controls are identified as necessary, permittees should revise their mix of BMPs to provide for a more effective program. Such a change, and an explanation of the change, must be noted in a report to the NPDES permitting authority.

What are the Recordkeeping Requirements?

Records required by the NPDES permitting authority must be kept for at least 3 years and made accessible to the public at reasonable times during regular business hours.

Records need not be submitted to the NPDES permitting authority unless the permittee is requested to do so.

What Are the Deadlines for Compliance?

- ✓ The NPDES permitting authority issues general permits for regulated small MS4s by December 9, 2002.
- ✓ Operators of "automatically designated" regulated small MS4s in urbanized areas submit their permit applications within 90 days of permit issuance, no later than March 10, 2003.
- ✓ Operators of regulated small MS4s designated by the permitting authority submit their permit applications within 180 days of notice.
- ✓ Regulated small MS4 storm water management programs fully developed and implemented by the end of the first permit term, typically a 5-year period.

What are the Penalties for Noncompliance?

The NPDES permit that the operator of a regulated small MS4 is required to obtain is federally enforceable, thus subjecting the permittee to potential enforcement actions and penalties by the NPDES permitting authority if the permittee does not fully comply with application or permit requirements.

This federal enforceability also includes the right for interested parties to sue under the citizen suit provision (section 405) of the CWA.

2.10 – Federal and State-Operated MS4s: Program Implementation

The program for small municipal separate storm sewer systems (**MS4s**) under the Storm Water Phase II Final Rule includes, in addition to local government jurisdictions, certain Federal and State-operated small MS4s. Federal facilities were not designated for regulation by the NPDES Phase I storm water program for MS4s.

The Phase II Final Rule, however, includes the "***United States***" in the definition of a small MS4, thereby including Federal MS4 operators in the NPDES Phase II storm water program. Federal and State-operated small MS4s can include universities, prisons, hospitals, roads (i.e., departments of transportation), military bases (e.g., State Army National Guard barracks), parks, and office buildings/complexes.

The small MS4 program, largely designed with municipally-operated small MS4s in mind, raises a number of implementation issues for Federal and State operators of regulated small MS4s who must obtain an NPDES permit that requires the development and implementation of a storm water management program which includes the following six minimum control measures: public education and outreach, public participation/involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and good housekeeping/pollution prevention for municipal operations (for more information on each measure, see Fact Sheets 2.3 through 2.8). This fact sheet highlights potential implementation issues related to the minimum control measures, then discusses the implementation options included in the rule that may resolve these issues.

What Are Some Implementation Concerns?
This section profiles the three most common implementation issues raised in the public comments submitted regarding Federal/State implementation of the small MS4 program.

How Does the Final Rule Account for Unique Characteristics?
Federal and State small MS4s possess a number of characteristics that set them apart from their municipal counterparts. For example, whereas municipally-operated MS4s largely serve resident populations, many Federal or State-operated MS4s, such as medical clinics and departments of transportation (**DOTs**), do not.

Other types of Federal and State MS4s, such as military bases, prisons, and State universities, serve populations that are different from a typical municipal population. Their unique characteristics might lead Federal or State MS4 operators to question either the need to implement the entire suite of minimum control measures or their ability to comply fully with their Phase II storm water permit. Responsibility for developing a storm water program that comprises the minimum measures lies with the operator of the Federal or State MS4.

What If the Operator Lacks Legal Authority?
Three of the minimum control measures (illicit discharge detection and elimination, and the two construction-related measures) require enforceable controls on third party activities to ensure successful implementation of the measure. Some Federal and State operators, however, may not have the necessary legal regulatory authority to adopt these enforceable controls in the same manner as do local governments. For example, a State DOT that is responsible for the portions of its roads running through urbanized areas may not have the legal authority to impose restrictions on, and penalties against, illicit (i.e., non-storm water) discharges into its MS4 if the source of the discharge is outside the DOT's right-of-way or jurisdiction.

As in the case of local governments that lack such authority, State and Federal MS4s are expected to utilize the authority they do possess and to seek cooperative arrangements.

How Can the Program Be Implemented in Areas Where There Are Multiple Regulated Entities?

Since the final rule provides automatic coverage of all small MS4s within an urbanized area, regardless of political boundaries, coverage of multiple governments and agencies in a single area is likely.

For example, a city government that operates a small MS4 within an urbanized area must obtain permit coverage alongside the county, State, and Federal DOTs if they all operate a portion of the roads (i.e., MS4s) in the city. All four entities are responsible for developing a storm water management program for their MS4s (or portions thereof) within the urbanized area. The EPA encourages State and Federal small MS4 operators to establish cooperative agreements with cities and counties in implementing their storm water programs.

Are There Implementation Strategies that Help Facilitate Program Implementation?

This section offers two hypothetical strategies for resolving the implementation issues raised above. The best solution may include a creative combination of strategies.

STRATEGY #1

A Focus on Choosing Appropriate BMPs

The final rule requires the permittee to choose *appropriate* best management practices (**BMPs**) for each minimum control measure. In other words, the EPA expects Phase II permittees to tailor their storm water management plans and their BMPs to fit the particular characteristics and needs of the permittee and the area served by its MS4.

Therefore, the Federal or State operator of a regulated storm sewer system can take advantage of the flexibility provided by the rule to utilize the most suitable minimum control measures for its MS4.

Below is an example of tailored activities and BMPs that Federal or State operators can implement for each measure:

Public Education and Outreach. Distribute brochures and post fliers to educate employees of a Federal hospital about the problems associated with storm water runoff and the steps they can take to reduce pollutants in storm water discharges. For example, employees could be advised against carelessly discarding trash on the ground or allowing their cars to leak oil/fluids in the parking lot.

Public Participation/Involvement. Provide notice of storm water management plan development and hold meetings at which employees of a Federal office complex are encouraged to voice their ideas and opinions about the effort. Request volunteers to help develop the plan.

Illicit Discharge Detection and Elimination.

Develop a map of the storm sewer system on a military base. Perform visual dry weather monitoring of any outfalls to determine whether the storm sewer system is receiving any non-storm water discharges from the base. If a dry weather flow is found, trace it back to the source and stop the discharge.

Should a Federal military base identify an illicit discharge, the source of which is traced to the boundary of its system, the Federal operator should refer the discharge to the adjoining regulated MS4 for further action.

Construction Site Runoff Control. Require the implementation of erosion and sediment controls, and control of waste, for any Federal or State DOT road construction. The DOT would review site plans for proper controls, perform inspections, and establish penalties in the construction contract if controls are not implemented. If construction is done directly by the regulated DOT instead of a private contractor, the DOT could be penalized by the NPDES permitting authority for non-compliance with its small MS4 permit in the event that controls are not properly implemented.

Post-Construction Runoff Control. Require the implementation of post-construction storm water controls for any new construction on the grounds of a prison. This can be required as part of a construction contract, instituted as internal policy, and considered during site plan review.

Pollution Prevention/Good Housekeeping for Municipal Operations. Train maintenance staff at a State university to employ pollution prevention techniques whenever possible. For example, routinely pick up trash/litter from the university grounds, use less salt on the parking lots and access roads in the winter, perform any maintenance of university vehicles under shelter only, limit pesticide use to the minimum needed, use vegetative buffer strips in the parking lots to filter runoff, and keep dumpster lids closed.

For Additional Information
Contact
U.S. EPA Office of Wastewater Management
• Phone: (202) 564-9545
• Internet: www.epa.gov/npdes/stormwater

Reference Documents
Storm Water Phase II Final Rule Fact Sheet Series
• Internet: cfpub.epa.gov/npdes/stormwater/swfinal.cfm
Storm Water Phase II Final Rule (64 *FR* 68722)
• Internet: www.epa.gov/npdes/regulations/phase2.pdf

STRATEGY #2
Working with Other Entities
There may be instances when the Federal or State permittee has limited capabilities to satisfy one or more of the minimum control measures.

As discussed above, the permittee may lack the proper legal authority to enforce controls (although it should try to obtain the necessary legal authority if at all possible).

In the case of limited capabilities, the permittee can work with neighboring operators of regulated small MS4s, preferably on a watershed basis, to form a shared storm water management program in which each permittee is responsible for activities that are within individual legal authorities and abilities.

The final rule allows the permittee to rely on other entities, with their permission, to implement those minimum measures that the permittee is otherwise unable to implement.

Three examples are:

- ✓ A State DOT with limited regulatory legal authority can reference a local sewer district's illicit detection and elimination program in its permit application, provided the program sufficiently addresses illicit discharges into the DOT's storm sewer system.

- ✓ The permittee or NPDES permitting authority can reference such programs as coastal nonpoint pollution control programs, State or local watershed programs, State or local construction programs, and environmental education efforts by public or private entities.

- ✓ The permittee can become a co-permittee with a neighboring Phase I MS4 through a modification of the Phase I MS4's individual permit. This may be the most logical and preferable option for those Federal and State entities located in close proximity to Phase I MS4s.

Choosing to work with other governmental entities as a co-permittee, or referencing parts of each other's plans, can help resolve issues that may arise where multiple regulated jurisdictions exist in the same area. Permittees can avoid duplicative efforts, as well as territorial or regulatory disputes, by working together to implement the storm water program. See Fact Sheet 2.9 for more information on permitting options for regulated small MS4s.

Suggested Steps for Working with Other Entities

(1) Identify the boundaries of the urbanized area (see Fact Sheet 2.2 for more information on urbanized areas)

(2) Identify the operators of storm sewer systems or portions of the systems within the urbanized area such as local, State, Tribal or Federal governments or other entities.

(3) In seeking permit coverage:

(A) Identify where another entity's program may satisfy one or more minimum control measure.

If a program has requirements that are equivalent to a minimum control measure's required elements, the operator of the regulated small MS4 may reference the program in its permit application, provided the other entity gives it permission to do so.

While such an arrangement relieves the operator from performing the minimum measure itself, the operator remains ultimately responsible for the measure's effective implementation (see Fact Sheet 2.9 for more information on this option)

OR

(B) Team with an operator of a Phase I MS4 and become a co-permittee on its existing Phase I individual permit (see Fact Sheet 2.9 for more information on this option)

3.0 – Construction Program Overview

The 1972 amendments to the Federal Water Pollution Control Act, later referred to as the Clean Water Act (**CWA**), prohibit the discharge of any pollutant to navigable waters of the United States from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (**NPDES**) permit.

Efforts to improve water quality under the NPDES program traditionally have focused on reducing pollutants in industrial process wastewater and municipal sewage treatment plant discharges. Over time, it has become evident that more diffuse sources of water pollution, such as storm water runoff from construction sites, are also significant contributors to water quality problems.

Sediment runoff rates from construction sites are typically 10 to 20 times greater than those from agricultural lands, and 1,000 to 2,000 times greater than those of forest lands. During a short period of time, construction activity can contribute more sediment to streams than can be deposited over several decades, causing physical and biological harm to our Nation's waters.

In 1990, EPA promulgated rules establishing Phase I of the NPDES storm water program.

Phase I addresses, among other discharges, discharges from large construction activities disturbing 5 acres or more of land. Phase II of the NPDES storm water program covers small construction activities disturbing between 1 and 5 acres. Phase II became final on December 8, 1999 with small construction permit applications due by March 10, 2003 (specific compliance dates will be set by the NPDES permitting authority in each State). This fact sheet outlines the construction activities covered by Phase I and Phase II, including possible waiver options from Phase II coverage, and the Phase II construction program requirements.

Who Is Covered Under the Phase I Rule?
Sites Five Acres and Greater
The Phase I NPDES storm water rule identifies eleven categories of industrial activity in the definition of "***storm water discharges associated with industrial activity***" that must obtain an NPDES permit. Category (x) of this definition is construction activity, commonly referred to as "large" construction activity. Under category (x), the Phase I rule requires all ***operators*** of construction activity ***disturbing 5 acres or greater of land*** to apply for an NPDES storm water permit.

Operators of sites disturbing less than 5 acres are also required to obtain a permit if their activity is part of a "***larger common plan of development or sale***" with a planned disturbance of 5 acres or greater. "***Disturbance***" refers to exposed soil resulting from activities such as clearing, grading, and excavating. Construction activities can include road building, construction of residential houses, office buildings, industrial sites, or demolition.

What Is Meant by a "Larger Common Plan of Development or Sale"?
As defined in the EPA's NPDES storm water general permit for large construction activity, a "***larger common plan of development or sale***" means a contiguous area where multiple separate and distinct construction activities are occurring under one plan (e.g., the operator is building on three half-acre lots in a 6-acre development).

The "***plan***" in a common plan of development or sale is broadly defined as any announcement or piece of documentation (including a sign, public notice or hearing, sales pitch, advertisement, drawing, permit application, zoning request, computer design, etc.) or physical demarcation (including boundary signs, lot stakes, surveyor markings, etc.) indicating that construction activities may occur on a specific plot.

What Is the Definition of an "Operator" of a Construction Site?
As defined in the EPA's storm water general permit for large construction activity, an ***"operator"*** is the party or parties that has:

- ✓ Operational control of construction project plans and specifications, including the ability to make modifications to those plans and specifications; *or*
- ✓ Day-to-day operational control of those activities that are necessary to ensure compliance with a storm water pollution prevention plan (**SWPPP**) for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWPPP or comply with other permit conditions).

There may be more than one party at a site performing the tasks related to "***operational control***" as defined above.

Depending on the site and the relationship between the parties (e.g., owner, developer, contractor), there can either be a single party acting as site operator and consequently be responsible for obtaining permit coverage, or there can be two or more operators, all obligated to seek permit coverage.

It is important to note that NPDES-authorized States may use a different definition of "***operator***" than the one above.

How Is the Phase II Construction Rule Related to the Phase I Construction Rule?
In 1992, the Ninth Circuit court remanded for further proceedings portions of the EPA's existing Phase I storm water regulation related to the category (x) discharges from large construction activity (NRDC v. EPA, 966 F.2d at 1292).

The EPA responded to the court's decision by designating under Phase II storm water discharges from construction activity disturbing less than 5 acres as sources that should be regulated to protect water quality. The Phase II Rule designates these sources as "***storm water discharges associated with small construction activity***," rather than as another category under "***storm water associated with industrial activity***."

Who Is Covered Under the Phase II Construction Rule?
Sites Between One and Five Acres
The Storm Water Phase II Rule automatically designates, as small construction activity under the NPDES storm water permitting program, all operators of construction site activities that result in a ***land disturbance of equal to or greater than 1 and less than 5 acres***.

Sites Less Than One Acre
Site activities disturbing less than 1 acre are also regulated as small construction activity if they are part of a larger common plan of development or sale with a planned disturbance of equal to or greater than 1 acre and less than 5 acres, or if they are designated by the NPDES permitting authority. The NPDES permitting authority or EPA Region may designate construction activities disturbing less than 1 acre based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants to waters of the United States.

Are Waivers Available for Operators of Regulated Construction Activity?
Yes, but only for small, not large, construction activity.

Under the Phase II Rule, NPDES permitting authorities have the option of providing a waiver from the requirements to operators of small construction activity who certify to either one of two conditions:

_ Low predicted rainfall potential (i.e., activity occurs during a negligible rainfall period), where the rainfall erosivity factor ("R" in the Revised Universal Soil Loss Equation [**RUSLE**]) is less than 5 during the period of construction activity; *or*
_ A determination that storm water controls are not necessary based on either:

(A) A "total maximum daily load" (TMDL) that address the pollutant(s) of concern for construction activities; **OR**
(B) An equivalent analysis that determines allocations are not needed to protect water quality based on consideration of in stream concentrations, expected growth in pollutant concentrations from all sources, and a margin of safety.

The intent of the waiver provision is to waive only those sites that are highly unlikely to have a negative effect on water quality. Therefore, before applying for a waiver, operators of small construction activity are encouraged to consider the potential water quality impacts that may result from their project and to carefully examine such factors as proximity to water resources and sensitivity of receiving waters.

a. *What is the Rainfall Erosivity Factor in Waiver?*
Waiver uses the Rainfall Erosivity Factor to determine whether the potential for polluted discharge is low enough to justify a waiver from the requirements. It is one of six variables used by the Revised Universal Soil Loss Equation (**RUSLE**)—a predictive tool originally used to measure soil loss from agricultural lands at various times of the year on a regional basis—to predict soil loss from construction sites.

The Rainfall Erosivity Factor waiver is time-sensitive and is dependent on when during the year a construction activity takes place, how long it lasts, and the expected rainfall and intensity during that time. For information about the rainfall erosivity waiver, see Fact Sheet 3.1. Charts detailing the value of the Rainfall Erosivity Factor by particular regions can be found in Chapter 2 of the RUSLE user's guide, which can be downloaded at: http://www.epa.gov/owm/sw/phase2.

b. *What is a "TMDL" in Waiver?*
For impaired waters where technology-based controls required by NPDES permits are not achieving State water quality standards, the CWA requires implementation of the TMDL process.

The TMDL process establishes the maximum amount of pollutants a waterbody can assimilate before water quality is impaired, then requires that this maximum level not be exceeded. A TMDL is done for each pollutant that is found to be contributing to the impairment of a waterbody or a segment of a waterbody. To allow a waiver for construction activities, a TMDL would need to address sediment, or a parameter that addresses sediment such as total suspended solids, turbidity, or siltation.

Additional TMDLs addressing common pollutants from construction sites such as nitrogen, phosphorus, and oil and grease also may be necessary to ensure water quality protection and allow a waiver from the NPDES storm water program.

A TMDL assessment determines the source or sources of a pollutant of concern, considers the maximum allowable level of that pollutant for the waterbody, then allocates to each source or category of sources a set level of the pollutant that it is allowed to discharge into the waterbody.

Allocations to point sources are called wasteload allocations.

How Would an Operator Qualify for, and Certify to, Waiver?

The EPA expects that when TMDLs, or equivalent analyses are completed, there may be a determination that certain classes of sources, such as small construction activity, would not have to control their contribution of pollutants of concern to the waterbody in order for the waterbody to be in attainment with water quality standards (i.e., these sources were not assigned wasteload allocations).

In such a case, to qualify for waiver, the operator of the construction site would need to certify that its construction activity will take place, and the storm water discharges will occur, within the area covered either by the TMDLs or equivalent analysis. A certification form would likely be provided by the NPDES permitting authority for this purpose.

What Does the Phase II Construction Program Require?

The Phase II Final Rule requires operators of Phase II small construction sites, nationally, to obtain an NPDES permit and implement practices to minimize pollutant runoff.

It is important to note that, locally, these same sites also may be covered by State, Tribal, or local construction runoff control programs (see Fact Sheets 2.6 and 2.7 for information on the Phase II small MS4's construction program).

For the Phase II small construction program, the EPA has taken an approach similar to Phase I where the program requirements are not fully defined in the rule but rather in the NPDES permit issued by the NPDES permitting authority.

The EPA recommends that the NPDES permitting authorities use their existing Phase I large construction general permits as a guide to developing their Phase II small construction permits.

In doing so, the Phase II requirements would be similar to the three general Phase I requirements summarized below.

Submission of a ***Notice of Intent*** (NOI) that includes general information and a certification that the activity will not impact endangered or threatened species. This certification is unique to the EPA's NOI and is not a requirement of most NPDES-delegated State's NOIs;

The development and implementation of a ***Storm Water Pollution Prevention Plan*** (**SWPPP**) with appropriate BMPs to minimize the discharge of pollutants from the site; and ***Pollutants of concern*** include sediment or a parameter that addresses sediment (such as total suspended solids, turbidity, or siltation) and any other pollutant that has been identified as a cause of Submission of a ***Notice of Termination*** (**NOT**) when final stabilization of the site has been achieved as defined in the permit or when another operator has assumed control of the site.

Can the Permitting Authority Reference a Qualifying Erosion and Sediment Control Program in NPDES Construction Permits?

Yes. The Phase II Rule allows the NPDES permitting authority to include in its NPDES permits for large and for small construction activity conditions that incorporate by reference qualifying State, Tribal, or local erosion and sediment control program requirements. A qualifying program must include the following requirements:

- ✓ Requirements for construction site operators to implement appropriate erosion and sediment control best management practices;
- ✓ Requirements for construction site operators to control waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste that may cause adverse impacts to water quality;
- ✓ Requirements for construction site operators to develop and implement a storm water pollution prevention plan; and
- ✓ Requirements to submit a site plan for review that incorporates consideration of potential water quality impacts.

In addition to the four elements above, a qualifying program for large construction activities must also include any additional requirements necessary to achieve the applicable technology-based standards of "***Best Available Technology***" (**BAT**) and "***Best Conventional Technology***" (**BCT**) based on the best professional judgment of the permit writer.

Should a State, Tribal, or local program include one or more, but not all, of the elements listed above, the permitting authority can reference the program in the permit, provided it also lists the missing element(s) as a condition in the permit.

What are Some Recommended BMPs for Small Construction Sites?

The approach and BMPs used for controlling pollutants in storm water discharges from small construction sites may vary from those used for large sites since their characteristics can differ in many ways.

For example, operators of small sites may have more limited access to qualified design personnel and technical information. Also, small sites may have less space for installing and maintaining certain BMPs.

As is the case with all construction sites, erosion and sediment control at small construction sites is best accomplished with proper planning, installation, and maintenance of controls. The following practices have shown to be efficient, cost effective, and versatile for small construction site operators to implement.

The practices are divided into two categories: non-structural and structural.

Non-Structural BMPs

- Minimizing Disturbance
- Preserving Natural Vegetation
- Good Housekeeping

Structural BMPs

Erosion Controls

- Mulch
- Grass
- Stockpile Covers

Sediment Controls
• Silt Fence
• Inlet Protection
• Check Dams
• Stabilized Construction Entrances
• Sediment Traps

Most erosion and sediment controls require regular maintenance to operate correctly.

Accumulated sediments should be removed frequently and materials should be checked periodically for wear. Regular inspections by qualified personnel, which can allow problem areas to be addressed, should be performed after major rain events.

For Additional Information

Contact
U.S. EPA Office of Wastewater Management
• Internet: www.epa.gov/npdes/stormwater
• Phone: (202)-564-9545
Your local soil conservation district office. They can provide assistance with RUSLE and other conservation related issues.
• A list of conservation district contacts is available at:
www.nacdnet.org/resources/cdsonweb.html

Reference Documents
Storm Water Phase II Final Rule Fact Sheet Series

• Internet: cfpub.epa.gov/npdes/stormwater/swfinal.cfm
Storm Water Phase II Final Rule (64 *FR* 68722)

• Internet: www.epa.gov/npdes/regulations/phase2.pdf
Agricultural Handbook Number 703, Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE), Chapter 2, pp. 21-64, January 1997.

• Internet: www.epa.gov/npdes/pubs/ruslech2.pdf
Guidance for Water Quality Based Decisions: The TMDL Process. April 1991. U.S. EPA Office of Water. EPA 440/4-91-001.

• Internet: www.epa.gov/OWOW/tmdl
NPDES General Permit for Storm Water Discharges from Construction Activities (63 FR 7857).

• Internet: www.epa.gov/npdes/pubs/cgp-nat.pdf
www.epa.gov/npdes/pubs/cgp-nat2.pdf
www.epa.gov/npdes/pubs/cgp-nat3.pdf
www.epa.gov/npdes/pubs/cgp-nat4.pdf

Fact Sheet 3.1 – Construction Rainfall Erosivity Waiver

Construction Rainfall Erosivity Waiver

The 1972 amendments to the Federal Water Pollution Control Act, later referred to as the Clean Water Act (**CWA**), prohibit the discharge of any pollutant to navigable waters of the United States unless the discharge is authorized by a National Pollutant Discharge Elimination System (**NPDES**) permit.

Because construction site storm water runoff can contribute significantly to water quality problems, the Phase I Storm Water Rule imposed a requirement that all construction sites with a planned land disturbance of 5 acres or more obtain an NPDES permit and implement storm water runoff control plans. Phase II extends the requirements of the storm water program to sites of between 1 and 5 acres.

The Rainfall erosivity waiver, along with the water quality waiver, allows permitting authorities to waive those sites that do not have adverse water quality impacts.

What is Erosivity?

Erosivity is the term used to describe the potential for soil to wash off disturbed, devegetated earth into waterways during storms. The potential for erosion is in part determined by the soil type and geology of the site. For instance, dense, clay-like soils on a glacial plain will erode less readily when it rains than will sandy soils on the side of a hill. Another important factor is the amount and force of precipitation expected during the time the earth will be exposed.

While it is impossible to predict the weather several months in advance of construction, for many areas of the country, there are definite optimal periods, such as a dry season when rain tends to fall less frequently and with less force. When feasible, this is the time to disturb the earth, so that the site is stabilized by the time the seasonal wet weather returns. There are many other important factors to consider in determining erosivity, such as freeze/thaw cycles and snow pack.

How Is Site Erosivity Determined?

The method for determining if a site qualifies for the erosivity waiver is based on the Universal Soil Loss Equation (**USLE**) developed by the U.S. Department of Agriculture (**USDA**) in the 1950s to help farmers conserve their valuable topsoil. The USLE has been updated to the Revised USLE (**RUSLE**). Using a computer model supported by decades worth of soil and rainfall data, the USDA established estimates of annual erosivity values (**R**) for sites throughout the country.

These R factors are used as surrogate measures of the impact that rainfall had on erosion from a particular site. They have been mapped using isoerodent contours, as shown in Figures 2 through 5.

The USDA developed the Erosivity Index Table (EI Table, provided here in Table 1), to show how the annual erosivity factor is distributed throughout the year in two-week increments. Table 1 is based on 120 rainfall distribution zones for the continental U.S. Detailed instructions for calculating a project R Factor are provided later in this fact sheet.

The Storm Water Phase II rule allows permitting authorities to waive NPDES requirements for small construction sites if the value of the rainfall erosivity factor is less than 5 during the period of construction activity (see § 122.26(b)(15)(i)(A)). Note that the permitting authority has the option to not allow waivers for small construction activity. If the permitting authority in a State chooses to use the rainfall erosivity waiver, it will not become effective until permits are required from small construction activity.

If the R Factor for the period of construction calculates to 5 or lower, and the permitting authority allows the use of the waiver, the site owner may apply for a waiver under the low rainfall erosivity provision of the applicable NPDES Construction General Permit.

When applying, owners are encouraged to consider other site-specific factors, such as proximity to water resources and the sensitivity of receiving waters to sedimentation impacts. The small construction operator must certify to the permitting authority that the construction activity will take place during a period when the rainfall erosivity factor is less than 5.

The start and end dates used for the construction activity will be the initial date of disturbance and the anticipated date when the site will have achieved final stabilization as defined by the permit. If the construction continues beyond this period, the operator will need to recalculate the EI for the site based on this new ending date (but keeping the old start date) and either resubmit the certification form or apply for NPDES permit coverage.

What Other Factors Can Affect Waiver Availability and Eligibility?
The EPA has established the R Factor of 5 or lower as the criteria for determining waiver eligibility. However, since the intent is to waive only those construction activities that will not adversely impact water quality, State and Tribal permitting authorities have considerable discretion in determining where, when, and how to offer it.

They can establish an R Factor threshold lower than 5, or they can suspend the waiver within an area where watersheds are known to be heavily impacted by, or sensitive to, sedimentation. They can also suspend the waiver during certain periods of the year. They may opt not to offer the waiver at all. **NOTE**: This waiver is not available to sites that will disturb more than 5 acres of land (large construction).

What if My Site Is Not Eligible?
If your site is not eligible for a waiver, you must submit a Notice of Intent under the NPDES General Permit, and comply with its requirements. These requirements are described in more detail in Storm Water Phase II Fact Sheet 3.0.

How Do I Compute the R Factor for My Project?
1. Estimate the construction start date. This is the day you expect to begin disturbing soils, including grubbing, stockpiling, excavating, and grading activities. Pick the 15-day period for your start date (e.g., June 1-15.)
2. Estimate the day you expect to have a permanent vegetative cover of at least 70%, or as defined by your permitting authority, over all previously disturbed areas. Round to the nearest 15-day period.
3. Refer to Figure 1 to find your Erosivity Index (EI) Zone based on your geographic location.
4. Refer to Table 1, the Erosivity Index (EI) Table. Find the number of your EI Zone in the left column. Locate the EI values for the 15-day periods that correspond to the project start and end periods you identified in Steps 1 and 2.
Subtract the start value from the end value to find the % EI for your site. The maximum annual EI value for a project is 100%.
5. Refer to the appropriate Isoerodent Map (Figures 2 through 5). Interpolate the annual isoerodent value for your area. This is the annual R Factor for your site.

6. Multiply the percent value obtained in Step 4 by the annual isoerodent value obtained in Step 5. This is the R Factor for your scheduled project.

Examples

1. Construction started and completed in one calendar year.

Find the R value of a construction site in Denver, Colorado. Assume the site will be disturbed from March 1 to May 15.

The EI distribution zone is 84 (Figure 1). Referring to Table 1, the project period will span from March 1 to May 15. The difference in values between these two periods is 4.7 % (4.9-0.2 =4.7). Since the annual erosion index for this location is about 45 (interpolated from Figure 2), the R Factor for the scheduled construction project is 4.7% of 45, or 2.1.

Because 2.1 is less than 5, the operator of this site would be able to seek a waiver under the low rainfall erosivity provision.

2. Construction spanning two calendar years.

Find the R value for a construction site in Pittsburgh, Pennsylvania. Assume the site will be disturbed from August 1 to April 15.

The EI distribution zone is 111 (Figure 1). Referring to Table 1, the project will span from August 1 to April 15. The difference in values between August 1 and December 30 is 35% (100- 65.0 = 35.0). The difference between January 1 and April 15 is 8%. The total percentage EI for this project is 43% (35 +8).

Since the annual erosion index for this location is 112 (interpolated from Figure 2), the R Factor for the scheduled construction is 43% of 112, or 48.

Since 48 is greater than 5, the operator of this site would not be able to seek a waiver under the low rainfall erosivity provision.

Can I Use A Personal Computer to Calculate the R Factor?

The computer program used by the USDA to develop the current R Factor maps and table is called the Revised Universal Soil Loss Equation, or RUSLE. The current version of RUSLE (v. 1.60) will calculate the R factor for the entire year for a limited number of cities in the U.S., but does not allow the R factor to be easily adjusted based on a shorter period of construction. If you are interested in using RUSLE; Version 1.06 for Mined Lands, Construction Sites, and Reclaimed Lands, it is downloadable free of charge from the Internet at http://www.sedlab.olemiss.edu/rusle.

Where Can I Get Help?

A copy of "Chapter 2, Rainfall-Runoff Erosivity Factor (R)" from the *USDA Handbook 703 - Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (**RUSLE**)*, January 1997, is available on the EPA's web site at http://www.epa.gov/npdes/stormwater.

Your local soil conservation district office can provide assistance with R Factors and other conservation-related issues. To find the office nearest you, look in the government section of the phone book under soil conservation district, conservation district, natural resource conservation district, etc.

Phone: (202) 564-9545

Groundwater may be contaminated, either in localized areas or on a relatively widespread basis. In cases where infiltration into the storm drains occurs, it can be a source of excessive contaminant levels in the storm drains. Potential sources of groundwater contamination include, but are not limited to:

- Failing or nearby septic tank systems.
- Exfiltration from sanitary sewers in poor repair.
- Leaking underground storage tanks and pipes.
- Landfill seepage.
- Hazardous waste disposal sites.
- Naturally occurring toxicants and pollutants due to surrounding geological or natural environment.

Leaks from underground storage tanks and pipes are a common source of soil and groundwater pollution and may lead to continuously contaminated dry-weather entries. These situations are usually found in commercial operations, such as gasoline service stations, or industries involving the piped transfer of process liquids over long distances and the storage of large quantities of fuel, e.g., petroleum refineries. Pipes that are plugged or collapsed as well, as leaking storage tanks, may cause pollution when they release contaminants underground which can infiltrate through the soil into stormwater pipes.

Fact Sheet 4.0 – Conditional No Exposure

Exclusion for Industrial Activity
No exposure means all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff. Industrial materials or activities include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products.

Why Is the Phase I No Exposure Exclusion Addressed in the Phase II Final Rule?
The 1990 storm water regulations for Phase I of the federal storm water program identify eleven categories of industrial activities that must obtain a National Pollutant Discharge Elimination System (**NPDES**) permit. Operators of certain facilities within category eleven (xi), commonly referred to as "***light industry***," were exempted from the definition of "storm water discharge associated with industrial activity," and the subsequent requirement to obtain an NPDES permit, provided their industrial materials or activities were not "***exposed***" to storm water. This Phase I exemption from permitting was limited to those facilities identified in category (xi), and did not require category (xi) facility operators to submit any information supporting their no exposure claim.

In 1992, the Ninth Circuit court remanded to the EPA for further rulemaking the no exposure exemption for light industry after making a determination that the exemption was arbitrary and capricious for two reasons. First, the court found that the EPA had not established a record to support its assumption that light industrial activity that is not exposed to storm water (as opposed to all other regulated industrial activity not exposed) is not a "***storm water discharge associated with industrial activity***."

Second, the court concluded that the exemption impermissibly relied on the unsubstantiated judgment of the light industrial facility operator to determine the applicability of the exemption. This fact sheet describes the revised conditional no exposure exclusion as presented in the Phase II Final Rule.

Who is Eligible to Claim No Exposure?
As revised in the Phase II Final Rule, the conditional no exposure exclusion applies to ALL industrial categories listed in the 1990 storm water regulations, except for construction activities disturbing 5 or more acres (category (x)).

What Is the Regulatory Definition of "No Exposure"?
The intent of the no exposure provision is to provide facilities with industrial materials and activities that are entirely sheltered from storm water a simplified way of complying with the storm water permitting provisions of the Clean Water Act (**CWA**). This includes facilities that are located within a larger office building, or facilities at which the only items permanently exposed to precipitation are roofs, parking lots, vegetated areas, and other non-industrial areas or activities. The Phase II regulatory definition of "***no exposure***" follows.

A storm resistant shelter is not required for the following industrial materials and activities:
Drums, barrels, tanks, and similar containers that are tightly sealed, provided those containers are not deteriorated and do not leak. "***Sealed***" means banded or otherwise secured and without operational taps or valves;

Adequately maintained vehicles used in materials handling; and Final products, other than products that would be mobilized in storm water discharges (e.g., rock salt).

The term "***storm-resistant shelter***," as used in the no exposure definition, includes completely roofed and walled buildings or structures, as well as structures with only a top cover but no side coverings, provided material under the structure is not otherwise subject to any run-on and subsequent runoff of storm water.

While the intent of the no exposure provision is to promote a condition of permanent no exposure, the EPA understands certain vehicles could become temporarily exposed to rain and snow while passing between buildings.

Adequately maintained mobile equipment (e.g., trucks, automobiles, forklifts, trailers, or other such general purpose vehicles found at the industrial site that are not industrial machinery, and that are not leaking contaminants or are not otherwise a source of industrial pollutants) can be exposed to precipitation or runoff. Such activities alone would not prevent a facility from certifying to no exposure.

Similarly, trucks or other vehicles awaiting maintenance at vehicle maintenance facilities that are not leaking contaminants or are not otherwise a source of industrial pollutants, are not considered "***exposed***."

In addition, the EPA recognizes that there are circumstances where permanent no exposure of industrial activities or materials is not possible and, therefore, under such conditions, materials and activities can be sheltered with temporary covers (e.g., tarps) between periods of permanent enclosure.

The no exposure provision does not specify every such situation, but NPDES permitting authorities can address this issue on a case-by-case basis.

The Phase II Final Rule also addresses particulate matter emissions from roof stacks/vents that are regulated by, and in compliance with, other environmental protection programs (i.e., air quality control programs) and that do not cause storm water contamination are considered not exposed. Particulate matter or visible deposits of residuals from roof stacks and/or vents not otherwise regulated (i.e., under an air quality control program) and evident in storm water outflow are considered exposed.

Likewise, visible "***track out***" (i.e., pollutants carried on the tires of vehicles) or windblown raw materials is considered exposed. Leaking pipes containing contaminants exposed to storm water are deemed exposed, as are past sources of storm water contamination that remain onsite.

General refuse and trash, not of an industrial nature, is not considered exposed as long as the container is completely covered and nothing can drain out holes in the bottom, or is lost in loading onto a garbage truck. Industrial refuse and trash that is left uncovered, however, is considered exposed.

What is Required Under the No Exposure Provision?
The Phase II Final Rule represents a significant expansion in the scope of the original no exposure provision in terms of eligibility (as noted above) and responsibilities for facilities claiming the exclusion.

Under the original no exposure provision, a light industry operator was expected to make an independent determination of whether there was "***exposure***" of industrial materials and activities to storm water and, if not, simply not submit a permit application.

An operator seeking to qualify for the revised conditional no exposure exclusion, including light industry operators (i.e., category (xi) facilities), must:

- ✓ Submit written certification that the facility meets the definition of "no exposure" to the NPDES permitting authority once every 5 years.

The Phase II Final Rule includes a four-page *No Exposure Certification* form that uses a series of yes/no questions to aid facility operators in determining whether they have a condition of no exposure. It also serves as the necessary certification of no exposure provided the operator is able to answer all the questions in the negative.

The EPA's *Certification* is for use only by operators of industrial activity located in areas where the EPA is the NPDES permitting authority.

- ✓ A copy of the *Certification* can be obtained from the U.S. EPA Office of Wastewater Management (**OWM**) web site, the Storm Water Phase II Final Rule published in the *Federal Register* (Appendix 4), or by contacting OWM.
- ✓ Submit a copy, upon request, of the *Certification* to the municipality in which the facility is located.
- ✓ Allow the NPDES permitting authority or, if discharging into a municipal separate storm sewer system, the operator of the system, to: (1) inspect the facility; and (2) make such inspection reports publicly available upon request.
- ✓ Regulated industrial operators need to either apply for a permit or submit a no exposure certification form in order to be in compliance with the NPDES storm water regulations.
- ✓ Any permit held becomes null and void once a certification form is submitted.

For Additional Information

Contact

U.S. EPA Office of Wastewater Management
• Phone: (202) 564-9545
• Internet: www.epa.gov/npdes/stormwater
Your NPDES Permitting Authority. (A list of names and phone numbers for each U.S. EPA Region is included in Fact Sheet 2.9. Additional contact names, addresses, and numbers for each State can be obtained from the U.S. EPA Office of Wastewater Management)

Reference Documents

Storm Water Phase II Final Rule Fact Sheet Series
• Internet: cfpub.epa.gov/npdes/stormwater/swfinal.cfm
Storm Water Phase II Final Rule (64 *FR* 68722)
• Internet: www.epa.gov/npdes/regulations/phase2.pdf
• Contact the U.S. EPA Water Resource Center
Phone: (202) 260-7786
Even when an industrial operator certifies to no exposure, the NPDES permitting authority still retains the authority to require the operator to apply for an individual or general permit if the NPDES permitting authority has determined that the discharge is contributing to the violation of, or interfering with the attainment or maintenance of, water quality standards, including designated uses.

Are There Any Concerns Related to Water Quality Standards?
Yes. An operator certifying that its facility qualifies for the conditional no exposure exclusion may, nonetheless, be required by the NPDES permitting authority to obtain permit authorization. Such a requirement would follow the permitting authority's determination that the discharge causes, has a reasonable potential to cause, or contributes to a violation of an applicable water quality standard, including designated uses. Designated uses can include use as a drinking water supply or for recreational purposes.

Many efforts to achieve no exposure can employ simple good housekeeping and contaminant cleanup activities such as moving materials and activities indoors into existing buildings or structures. In limited cases, however, industrial operators may make major changes at a site to achieve no exposure. These efforts may include constructing a new building or cover to eliminate exposure or constructing structures to prevent run-on and storm water contact with industrial materials and activities.

Major changes undertaken to achieve no exposure, however, can increase the impervious area of the site, such as when a building with a smooth roof is placed in a formerly vegetated area. Increased impervious area can lead to an increase in the volume and velocity of storm water runoff, which, in turn, can result in a higher concentration of pollutants in the discharge, since fewer pollutants are naturally filtered out.

The concern of increased impervious area is addressed in one of the questions on the *Certification* form, which asks, ***"Have you paved or roofed over a formerly exposed, pervious area in order to qualify for the no exposure exclusion? If yes, please indicate approximately how much area was paved or roofed over***."

This question has no affect on an operator's eligibility for the exclusion. It is intended only to aid the NPDES permitting authority in assessing the likelihood of such actions interfering with water quality standards.

Where this is a concern, the facility operator and its NPDES permitting authority should take appropriate actions to ensure that water quality standards can be achieved.

What Happens if the Condition of No Exposure Is Not Maintained?
Under the Phase II Final Rule, the no exposure exclusion is conditional and not an outright exemption. Therefore, if there is a change in circumstances that causes exposure of industrial activities or materials to storm water, the operator is required to comply immediately with all the requirements of the NPDES Storm Water Program, including applying for and obtaining a permit.

Failure to maintain the condition of no exposure or obtain coverage under an NPDES storm water permit can lead to the unauthorized discharge of pollutants to waters of the United States, resulting in penalties under the CWA.

Where a facility operator determines that exposure is likely to occur in the future due to some anticipated change at the facility, the operator should submit an application and acquire stormwater permit coverage prior to the exposed discharge to avoid such penalties.

Required Containers, Preservation Techniques, and Holding Times 40 CFR 136.3

Parameter No./name Container Preservation Maximum holding time

Table IA--Bacteria Tests:
1-4 Coliform, fecal and total. P,G............. Cool, 4C, 0.008% $Na_2S_2O_3$...... 6 hours.
5 Fecal streptococci.......... P,G............. Cool, 4C, 0.008% $Na_2S_2O_3$ ...... 6 hours.
Table IA--Aquatic Toxicity
Tests:
6-10 Toxicity, acute and P,G........... Cool, 4 deg.C .... 36 hours. chronic.

Table IB--Inorganic Tests:
1. Acidity.................... P, G............ Cool, 4 deg.C.................. 14 days.
2. Alkalinity................. P, G............ Cool, 4 deg.C.................. 14 days.
4. Ammonia.................... P, G............ Cool, 4 deg.C, H_2SO_4 to pH< 2..... 28 days.
9. Biochemical oxygen demand.. P, G............ Cool, 4 deg.C.................. 48 hours.
10. Boron..................... P, PFTE, or Quartz. HNO_3 TO pH2.................... 6 months.
11. Bromide................... P, G............ None required.................. 28 days.
14. Biochemical oxygen demand, P, G............ Cool, 4 deg.C.................. 48 hours. carbonaceous.
15. Chemical oxygen demand.... P, G............ Cool, 4 deg.C, H_2SO_4 to pH<2..... 28 days.
16. Chloride.................. P, G............ None required.................. 28 days.
17. Chlorine, total residual.. P, G............ None required .... Analyze immediately.
21. Color..................... P, G............ Cool, 4 deg.C.................. 48 hours.
23-24. Cyanide, total and amenable to chlorination. P, G............ Cool, 4 deg.C, NaOH to pH>12, 0.6g Ascorbic acid 14 days.
25. Fluoride.................. P................ None required.................. 28 days.
27. Hardness.................. P, G............ HNO_3 to pH<2, H_2SO_4 to pH <2....... 6 months.
28. Hydrogen ion (pH)......... P, G............ None required.................. Analyze immediately.
31, 43. Kjeldahl and organic nitrogen. P, G............ Cool, 4 deg.C, H_2SO_4 to pH <2..... 28 days.

Metals:
18. Chromium VI............... P, G............ Cool, 4 deg.C.................. 24 hours.
35. Mercury................... P, G............ HNO_3 to pH<2................. 28 days.
3, 5-8, 12, 13, 19, 20, 22, P, G............ ......do........................ 6 months.
26, 29, 30, 32-34, 36, 37, 45, 47, 51, 52, 58-60, 62,
63, 70-72, 74, 75. Metals, except boron, chromium VI and mercury.

38. Nitrate................... P, G............ Cool, 4 deg.C.................. 48 hours.
39. Nitrate-nitrite........... P, G............ Cool, 4 deg.C, H_2SO_4 to pH <2..... 28 days.
40. Nitrite................... P, G............ Cool, 4 deg.C.................. 48 hours.
41. Oil and grease............ G............... Cool to 4 deg.C, HCl or H_2SO_4 to pH <2 to 28 days.
42. Organic Carbon............ P, G............ Cool to 4 deg.C HC1 or H_2SO_4 to pH <2 or 28 days.
44. Orthophosphate............ P, G............ Filter immediately, Cool, 4 deg.C. .... 48 hours.
46. Oxygen, Dissolved Probe... G Bottle and top. None required................. Analyze immediately.
47. Winkler.................. .... G Bottle and top. Fix on site and store in dark... 8 hours.
48. Phenols.................. G only........... Cool, 4 deg.C,..... H_2SO_4 to pH <2 28 days.
49. Phosphorus (elemental).... G................ Cool, 4 deg.C.................. 48 hours.
50. Phosphorus, total......... P, G............ Cool, 4 deg.C, H_2SO_4 to pH <2…………..28 days.
53. Residue, total............ P, G............ Cool, 4 deg.C.................. 7 days.
54. Residue, Filterable....... P, G............ Cool, 4 deg.C.................. 7 days.
55. Residue, Nonfilterable P, G............ Cool, 4 deg.C........................ 7 days.(TSS).
56. Residue, Settleable....... P, G............ Cool, 4 deg.C........................ 48 hours.
57. Residue, volatile......... P, G............ Cool, 4 deg.C....................... 7 days.
61. Silica.................... P, PFTE, or Quartz…….. Cool, 4 deg.C................. 28 days.

64. Specific conductance...... P, G.......... . Cool, 4 deg.C....................... 28 days.
65. Sulfate.................. P, G............ ...... Cool, 4 deg.C .... 28 days.
66. Sulfide...... P, G............. Cool, 4 deg.C add zinc acetate plus sodium hydroxide to pH>9. 7 days.
67. Sulfite.................. P, G............ None required.................. Analyze immediately.
68. Surfactants............... P ,G............. Cool, 4 deg.C.................. 48 hours.
69. Temperature............... P, G............ None required.................. Analyze.
73. Turbidity................. P, G............ Cool, 4 deg.C.................. 48 hours.

Table IC--Organic Tests
13, 18-20, 22, 24-28, 34-37, G, Teflon-lined septum Cool, 4 deg.C, 0.008% $NA_2S_2O_3$ 14 days.
39-43, 45-47, 56, 76, 104, 105, 108-111, 113.
Purgeable Halocarbons. 6, 57, 106.
Purgeable aromatic hydrocarbons G, Teflon-lined septum Cool, 4 deg.C, 0.008% $NA_2S_2O_3$ 14 days.
3, 4. Acrolein and acrylonitrile G, Teflon-lined septum Cool, 4 deg.C, 0.008% $NA_2S_2O_3$ pH 4-5 14 days.
23, 30, 44, 49, 53, 77, 80, 81, 98, 100, 112. G, Teflon-lined Cool, 4 deg.C, 0.008% $NA_2S_2O_3$ 14 days.
Phenols G, Teflon-lined septum Cool, 4 deg.C, 0.008% $NA_2S_2O_3$ pH 4-5 7 days until extraction; 40 days after extraction.
7, 38. Benzidines G, Teflon-lined septum………… Cool, 4 deg.C, 0.008% $NA_2S_2O_3$ 7 days until extraction.
14, 17, 48, 50-52. Phthalate G, Teflon-lined septum Cool, 4 deg.C.................. 7 days until extraction; esters 40 days after extraction.
82-84. Nitrosamines G, Teflon-lined septum ……Cool, 4 deg.C, 0.008% $NA_2S_2O_3$......Store in dark
88-94. PCBs G, Teflon-lined septum Cool, 4 deg.C .... 7 days until extraction; 40 days after extraction.
54, 55, 75, 79. Nitroaromatics ...... G, Teflon-lined septum………….Cool, 4 deg.C, 0.008% $NA_2S_2O_3$ and isophorone

1, 2, 5, 8-12, 32, 33, 58, 59, 74, 78, 99, 101. Polynuclear aromatic hydrocarbons. Cool, 4 deg.C, 0.008% $NA_2S_2O_3$......Store in dark
15, 16, 21, 31, 87. Haloethers .... G, Teflon-lined septum....... Cool, 4 deg.C, 0.008% $NA_2S_2O_3$ 7 days until extraction; 40 days after extraction.
29, 35-37, 63-65, 73, 107. Chlorinated hydrocarbons G, Teflon-lined septum………….Cool, 4 deg.C, 7 days until extraction; 40 days after extraction.
60-62, 66-72, 85, 86, 95-97,
102, 103. CDDs/CDFs aqueous: field and lab G........... Cool, 0-4 deg.C, pH9, 0.008% $NA_2S_2O_3$ 1 year.
preservation.
Solids, mixed phase, and ......do......... Cool, 4 deg.C................. 7 days. tissue: field preservation.
Solids, mixed phase, and ......do......... Freeze, -10 deg.C............. 1 year. tissue: lab preservation.
Table ID--Pesticides Tests:
1-70. Pesticides \11\......... ......do......... Cool, 4 deg.C, pH 5-9 .... Do.
Table IE--Radiological Tests:
1-5. Alpha, beta and radium... P, G............ HNO_3 to pH2.................... 6 months.

Polyethylene (P) or glass (G). For microbiology, plastic sample containers must be made of sterilizable materials (polypropylene or other autoclavable plastic).

Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4 deg.C until compositing and sample splitting is completed.

When any sample is to be shipped by common carrier or sent through the United States Mails, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR part 172). The person offering such material for transportation is responsible for ensuring such compliance.

For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO_3in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under Sec. 136.**3**(e). Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show that this is necessary to maintain sample stability. See Sec. 136.**3**(e) for details. The term``analyze immediately'' usually means within 15 minutes or less of sample collection.

Should only be used in the presence of residual chlorine.

Maximum holding time is 24 hours when sulfide is present. Optionally all samples may be tested with lead acetate paper before pH adjustments in order to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

Samples should be filtered immediately on-site before adding preservative for dissolved metals.

Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

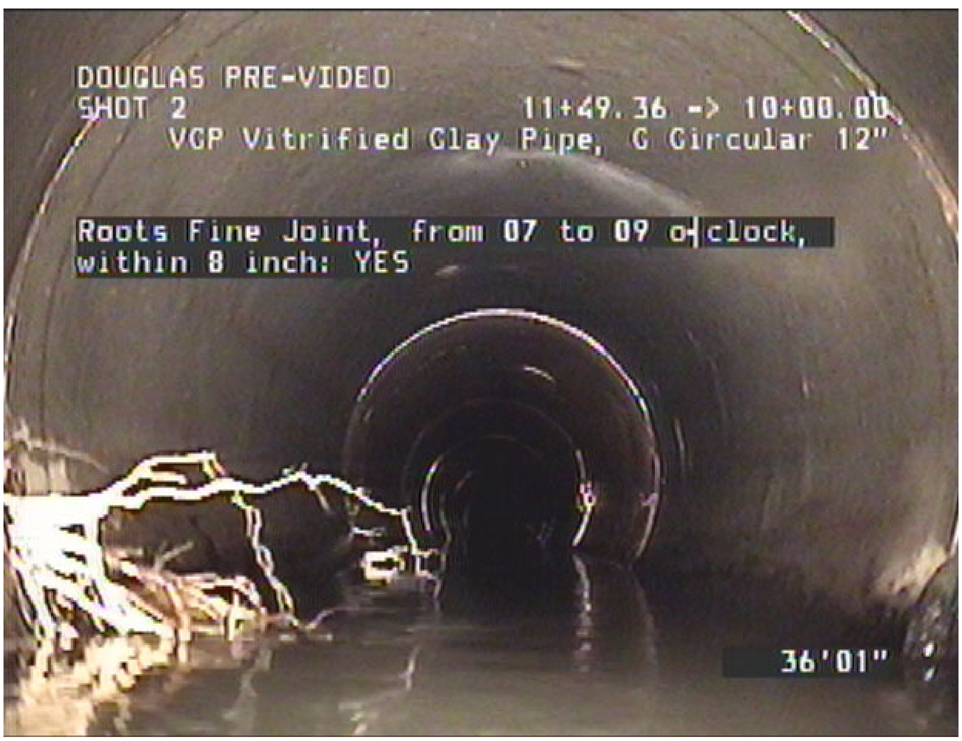
Sample receiving no pH adjustment must be analyzed within seven days of sampling.

The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within **3** days of sampling.

When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4 deg.C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re the requirement for thiosulfate reduction of residual chlorine), and footnotes 12, 13 (re the analysis of benzidine).

If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0<plus-minus>0.2 to prevent rearrangement to benzidine. Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere. For the analysis of diphenylnitrosamine, add 0.008% $NA_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.

Various sewer related problems.



CMOM - "Capacity, Management, Operation and Maintenance"

Proper function of sanitary sewer systems is vital to protect public health, property, and waterways in the surrounding area. Most utilities have a management, operation, and maintenance (MOM) plan to ensure their system is in working order.

However, more than 40,000 sanitary sewage overflows SSOs occur every year, causing huge monetary losses, damage to fish/shellfish beds, polluting groundwater, and decreased tourism. Sanitary sewage overflows (SSOs) release raw sewage from the collection system before it can reach a treatment facility. Sewage may flow out of manholes, into businesses and homes, and eventually ends up in local waterways.

Many factors are involved in SSOs. Many municipalities started constructing sewer systems over 100 years ago. Some of these have not been adequately maintained, improved, or repaired over the last century. Cities have used a wide variety of building materials, designs, and installation techniques, which aren't durable enough to withstand heavy, continuous use. Problems can be especially bad where an older system is attached to a new system or an older system has fallen into disrepair.

The Management, Operation and Maintenance (MOM) Programs Project is a pilot enforcement approach developed by EPA Region 4 to bring municipal sewer systems into full compliance with the Clean Water Act by eliminating sanitary sewer overflows (SSOs) from municipal sewer systems. A SSO is a release of untreated wastewater before the flow reaches a treatment plant. SSOs pose a significant threat to public health and water quality.

Treatment Balance and the Effects of Undesirable Solids

For any wastewater treatment plant to operate properly, the operator has to maintain a skillfully balanced mixture of microorganisms which contact and digest the organics in the wastewater, and bacteria then grows on this media to treat the wastewater. When a plant is properly maintained these bacteria or bugs eat the dissolved organics in the water, thus removing BOD, Ammonia, Nitrates, and Phosphorus. All of these constituents must be treated and removed from the water. When this is accomplished you achieve a low turbidity and clean decantible water which is then filtered and chlorinated to kill all the remaining bacteria. This incredible process leaves extremely clean and reusable water that can be injected back into the ground, sent to ponds or used for irrigation.

Certain compounds and undesirable solids, like grease and grass clippings, can disturb this delicate balance and necessary process at the wastewater treatment facility. There are compounds and mixtures that should never be introduced into a sanitary sewer system. These destructive compounds include but are not limited to: cleaning solvents, grease (both household and commercial), oils (both household and commercial), pesticides, herbicides, antifreeze and other automotive products.

The solids include but are not limited to: plastics, rubber goods, grass clippings, metal products such as aluminum foil, beer or soda cans, wood products, glass, paper products such as disposable diapers and sanitary napkins. Items such as these disturb or even kill the delicate balance of microorganisms and bacteria that are needed to treat the wastewater. These will also clog the sanitary sewer causing backups and sewer overflows. First, we will examine the damage to equipment and we will finish with resolution methods.

Costly Maintenance
These harmful compounds and solids can also cause equipment damage and create costly and unnecessary repairs, as well as frequent and costly maintenance. Repairs include but are not limited to: SBR Motive Pumps--these should last at least 5 years but are failing after only 2 or 3 years because of material that was placed in the sewer system. In a recent 2007 study, the cost of repairing these pumps was around $30,000.00. The replacement of the influent grinder or, “Muffin Monster” after only 3 years of service was nearly $7,000.00. The cost of frequent maintenance consists of, but is not limited to: the extensive amounts of damaging solids that clog lift stations and damage lift station pumps.

To properly clean a lift station may cost around $3,000.00 for each time that common problems like grass clippings from a golf course, overflowing grease from improperly maintained grease traps from a casino, hotel or golf course and improperly maintained grease and oil interceptors. These costs do not touch the cost of cleaning the sewer mains and manholes. In most cases, no serious damage will occur to the sewer main or manhole, but the chance of overflowing sewage or untreated wastewater getting to the street is greatly increased and does happen in most communities. Most of us know about it and accept it as part of our jobs. But time and rules have changed. We must work harder and be smarter to stop these problems before the damage and overflow occurs.

Municipality Self-Assessment
Under the MOM Programs Project, Region 4 invites municipalities to undertake a detailed self-assessment of their MOM programs. The municipalities submit this self-assessment along with recommendations for improvements to the MOM programs and/or remedial measures to correct sewer infrastructure problems.

In consideration for undertaking the self-assessment, the municipality is able to establish its own reasonable goals and schedules, and the Region may use its discretion to significantly reduce penalties related to SSOs. Where an enforcement action is necessary, the Region works with the municipality to identify necessary remedial measures and to establish schedules. The Region will likely defer any penalty decision until after the completion of the necessary improvements.

Project Initiation
In 1998, Region 4 began the MOM Programs Project by identifying priority watersheds and geographical areas in each of the eight States in the Region. These included areas where SSOs could cause significant public health concerns, such as beaches, shellfish harvesting areas and drinking water supplies. In addition, watersheds already listed as impaired by collection system overflows or bacterial contamination were identified.

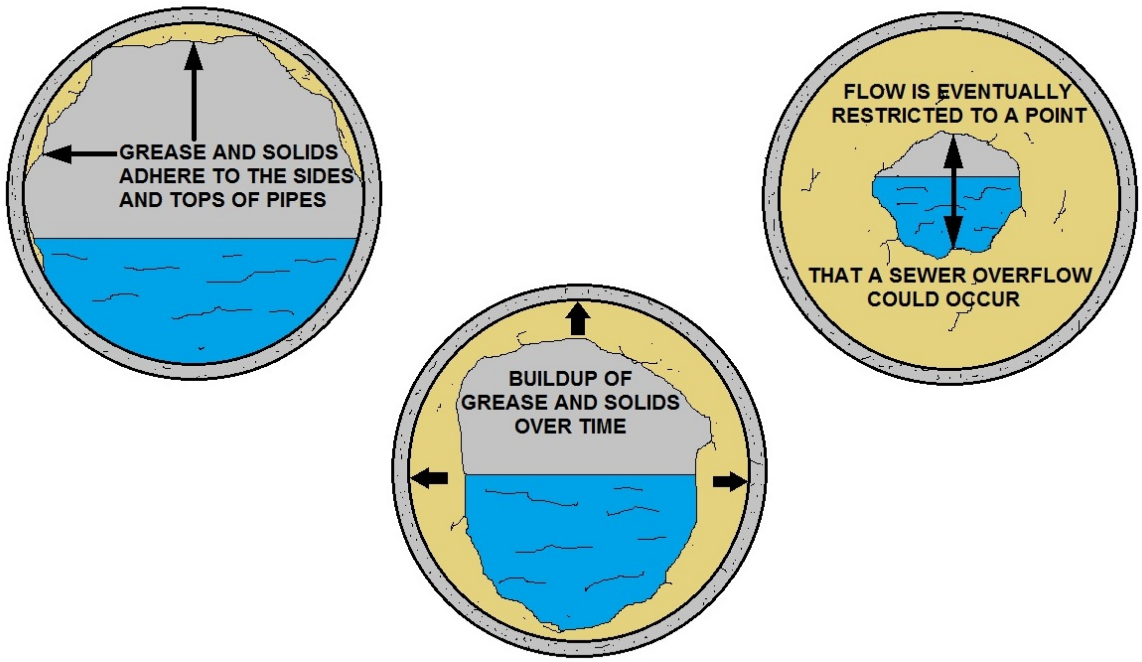
Region 4, working with the States, selected a watershed (or geographical area) in each State. All municipal sewer systems in each watershed were identified and invited to participate in the Project and to attend a kickoff meeting held at a location in the watershed.

Those municipalities wanting to participate in the MOM Project undertake the self-assessment using the guidance materials provided and submit the self-assessment to the Region within seven months of the kickoff. Municipalities that don’t participate are inspected by the Region and/or State and are subject to traditional enforcement actions, including penalties where appropriate. Improper management and maintenance cause a majority of avoidable SSOs.

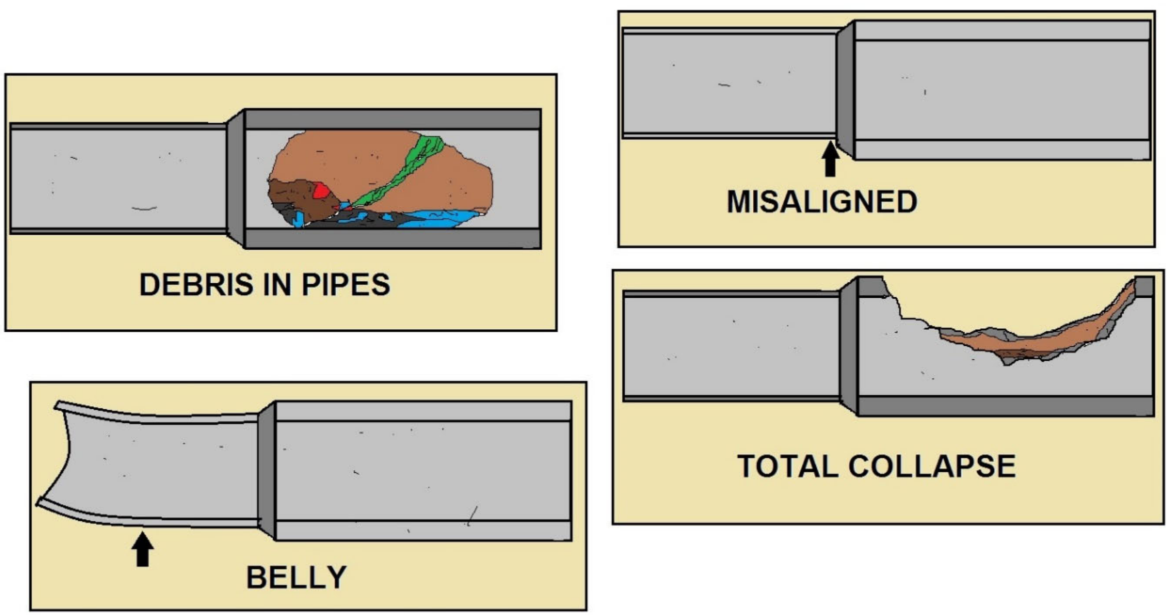
Leading Causes of SSOs

Problem/Cause	% of SSOs	Description
Blockages	43%	Blockages may be caused by tree roots or a build-up of sediment and other materials (i.e., grease, grit, debris). Structural defects and a flat slope can also cause excessive deposits of material. Build-ups can cause pipes to break or collapse.
Infiltration and Inflow (I/I)	27%	Infiltration and inflow occurs when rain or snowmelt enters the ground and seeps into leaky sanitation sewers, which were not designed to carry rainfall or drain property. Inflow can also occur when excess waters from roof drains, broken pipes and bad connections at sewer service lines infiltrates the sanitary sewer.
Structural Failures	12%	Line/main breaks are a major result of structural failure. Undersized systems do not have large enough pumps or lines to carry all the sewage generated by the buildings attached to them. This is especially true for new subdivisions or commercial areas. SSOs can occur at sewer service connections to houses or buildings. Some cities estimate that up to 60% of SSOs come from service lines.
Power Failure	11%	Stops pump operation, interrupting sewage flow
Other	7%	Scheduling, vandalism

Above, a cracked sewer main, a SSO waiting to happen. Below, a sewer manhole with a history of overflowing.



EFFECTS OF GREASE AND SOLIDS ON SEWER FLOW



DAMAGED SEWER PIPE EXAMPLES

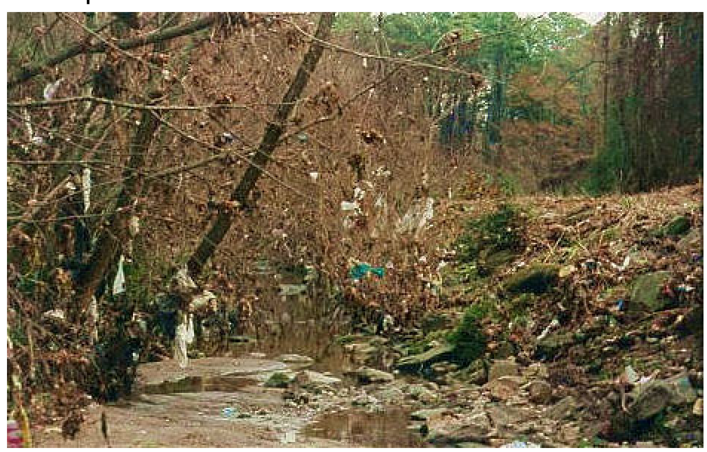
What are Sanitary Sewer Overflows?

Sanitary Sewer Overflows (**SSOs**) are discharges of raw sewage from municipal sanitary sewer systems. SSOs can release untreated sewage into basements or out of manholes and onto city streets, playgrounds, and into streams before it can reach a treatment facility. SSOs are often caused by blockages and breaks in the sewer lines.

Why do Sewers Overflow?
SSOs occasionally occur in almost every sewer system, even though systems are intended to collect and contain all the sewage that flows into them. When SSOs happen frequently, it means something is wrong with the system.

Problems that Can Cause Chronic SSOs Include:

- Infiltration and Inflow (I&I): too much rainfall or snowmelt infiltrating through the ground into leaky sanitary sewers not designed to hold rainfall or to drain property, and excess water inflowing through roof drains connected to sewers, broken pipes, and badly connected sewer service lines.
- Undersized Systems: Sewers and pumps are too small to carry sewage from newly-developed subdivisions or commercial areas.
- Pipe Failures: blocked, broken or cracked pipes, tree roots grow into the sewer, sections of pipe settle or shift so that pipe joints no longer match, and sediment and other material builds up causing pipes to break or collapse.
- Equipment Failures: pump failures, power failures.
- Sewer Service Connections: discharges occur at sewer service connections to houses and other buildings; some cities estimate that as much as 60% of overflows comes from the service lines.
- Deteriorating Sewer System: improper installation, improper maintenance; widespread problems that can be expensive to fix develop over time, some municipalities have found severe problems necessitating billion-dollar correction programs, often communities have to curtail new development until problems are corrected or system capacity is increased.



Why are SSOs a Problem?
The EPA has found that SSOs caused by poor sewer collection system management pose a substantial health and environmental challenge. The response to this challenge varies considerably from state to state. Many municipalities have asked for national consistency in the way permits are considered for wastewater discharges, including SSOs, and in enforcement of the law prohibiting unpermitted discharges. In response, the EPA has convened representatives of states, municipalities, health agencies, and environmental advocacy groups to advise the Agency on how to best meet this challenge. This SSO Federal Advisory Subcommittee examines the need for national consistency in permitting and enforcement, effective sewer operation and maintenance principles, public notification for SSOs with potential health or environmental dangers, and other public policy issues. The EPA carefully considers the Subcommittee's recommendations for regulatory and nonregulatory actions to reduce SSOs nationally.

How Big is the SSO Problem?

The total number of SSOs that occur nationwide each year is not known. In some areas, they might not be reported or are underreported to the EPA and state environmental agencies. Two surveys, however, help to define the size of the problem:

- In a 1994 survey of 79 members of the Association of Metropolitan Sewerage Agencies, 65 percent of the respondents reported wet weather SSOs. They reported that between 15 and 35 percent of their sewers were filled above capacity and/or overflowed during wet weather. However, municipal respondents with SSOs had only limited information about them. Only 60 percent had estimated the annual number. Half of those had estimated the amount of sewerage discharged, and 17 percent had determined what pollutants were in their overflows.
- A 1981 survey conducted by the National Urban Institute indicated an average of 827 backups and 143 breaks per 1,000 miles of sewer pipe (about 1,000 miles of sewer pipe are needed to serve 250,000 people.) per year. Breaks occurred most often in the young, growing cities of the South and West.

Downstream of a nonfunctional Combined Sewer Overflow (CSO) Control Facility.

Combined Sewer Overflows

Combined sewer systems are sewers that are designed to collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. Most of the time, combined sewer systems transport all of their wastewater to a sewage treatment plant, where it is treated and then discharged to a water body. During periods of heavy rainfall or snowmelt, however, the wastewater volume in a combined sewer system can exceed the capacity of the sewer system or treatment plant. For this reason, combined sewer systems are designed to overflow occasionally and discharge excess wastewater directly to nearby streams, rivers, or other water bodies. These overflows, called combined sewer overflows (CSOs), contain not only storm water but also untreated human and industrial waste, toxic materials, and debris. They are a major water pollution concern for the approximately 772 cities in the U.S. that have combined sewer systems. CSOs may be thought of as a type of "urban wet weather" discharge. This means that, like sanitary sewer overflows (SSOs) and storm water discharges, they are discharges from a municipality's wastewater conveyance infrastructure that are caused by precipitation events such as rainfall or heavy snowmelt. The EPA's CSO Control Policy, published April 19, 1994, is the national framework for control of CSOs. The Policy provides guidance on how communities with combined sewer systems can meet Clean Water Act goals in as flexible and cost-effective a manner as possible. EPA's Report to Congress on implementation of the CSO Control Policy assesses the progress made by EPA, states, and municipalities in implementing and enforcing the CSO Control Policy.

The Elements of a Proper CMOM Program

Utility Specific
The complexity and expense associated with a utility's CMOM or MOM programs is specific to the size and complexity of the Publicly Owned Treatment Works (POTW) and related infrastructure. Factors such as population growth rate and soil/groundwater conditions also dictate the level of investment which should be made.

Purposeful
When MOM programs are present and properly maintained, they support customer service and protect system assets, public health, and water quality.

Goal-Oriented
Proper MOM programs have goals directed toward their individual purposes. Progress toward these goals is measurable, and the goals are attainable.

Uses Performance Measures
Performance measures should be established for each MOM program in conjunction with the program goal. These measures are quantifiable, and used in determining progress to, or beyond, the program goal.

Periodically Evaluated
An evaluation of the progress toward reaching the goals, or a reassessment of the goals, should be made periodically and based upon the quantified performance measures.

Available In Writing
The effectiveness of a MOM program quickly breaks down unless it is available in writing. Personnel turnover and lapses in communication between staff and management can change otherwise proper MOM programs to improper ones. Written MOM programs are useful only if they are made readily available to all personnel and clearly documented.

Implemented by Trained Personnel
Appropriate safety, equipment, technical, and program training is essential for implementing MOM programs properly.

What MOM programs should be audited?
MOM activity at a utility involves its entire wastewater infrastructure. Common utility management activities and operations and maintenance activities associated with sewer systems and pretreatment are listed in the Self-Audit Review Document.

If a utility owns treatment works or a pond system, then activities associated with the management, operation, and maintenance of these facilities should also be included in the audit. A helpful guide for this part is the NPDES Compliance Inspection Manual. Instruction for obtaining this manual is provided in a list of references.

What are the elements of a proper Self-Audit?
Initial Assessment
Begin by performing a general assessment of the utility, and prioritizing the order of programs to be audited. The NPDES Compliance Inspection Manual and Guidance may be useful references in making this assessment.

Develop the Audit Plan
Identify the MOM programs present and/or needed at the utility, establish performance measures, and develop a schedule for auditing the programs.

Conduct the Audit
Evaluate each MOM program against the defined elements of a proper program. This can be accomplished by reviewing the program's records and resources, conducting a field evaluation, and comparing the program understanding of both personnel and management.

Identify Deficiencies
Define any programs needed, or improvements to programs needed, and any infrastructure deficiencies found. Identify any unpermitted discharges which have occurred in the past five years.

Develop Improvement Plan
Define the utility's plan/schedule to remediate the necessary improvements. This plan should include any short-term or long-term program improvements, and any short-term or long-term capital improvements which need addressing.

Prepare the Self-Audit Report
Generate a report of the audit results, including any deficiencies found and the corresponding improvement plan, which is useful for the utility. This report should be capable of serving the utility as a reference when conducting any needed remedial measures, and as a reference to compare current performance with future self-audit results.

Are there federal grants or other compliance assistance resources available to conduct a Self-Audit?
Currently, there are no funds available for the specific purpose of conducting a MOM Programs Self-Audit. However, the Office of Wastewater Management offers a number of financial resources to assist qualified utilities in making improvements to their programs.

Small publicly-owned wastewater treatment plants which discharge less than 5 million gallons per day are also eligible for the Wastewater Treatment Plant Operator On-Site Assistance Training Program. The program provides on-site operator training, financial management, troubleshooting, and other operation and maintenance assistance. A network of operator training personnel, EPA Regional Office Coordinators and States and State Training Centers work in the field with small under-served communities to help solve their operation and maintenance problems. There is no cost incurred by the facility in need of assistance. The only requirement of the program is the willingness to work with a trainer to correct the facility's problems.

What Health Risks do SSOs present?
Because SSOs contain raw sewage they can carry bacteria, viruses, protozoa (parasitic organisms), helminths (intestinal worms), and borroughs (inhaled molds and fungi). The diseases they may cause range in severity from mild gastroenteritis (causing stomach cramps and diarrhea) to life-threatening ailments such as cholera, dysentery, infectious hepatitis, and severe gastroenteritis.

People can be Exposed Through:

- Sewage in drinking water sources.
- Direct contact in areas of high public access such as basements, lawns or streets, or waters used for recreation. At least one study has estimated a direct relationship between gastrointestinal illness contracted while swimming and bacteria levels in the water.
- Shellfish harvested from areas contaminated by raw sewage. One study indicates that an average of nearly 700 cases of illness per year were reported in the 1980s from eating shellfish contaminated by sewage and other sources. The number of unreported cases is estimated to be 20 times that.
- Some cases of disease contracted through inhalation and skin absorption have also been documented.

What other Damage can SSOs do?

SSOs also damage property and the environment. When basements flood, the damaged area must be thoroughly cleaned and disinfected to reduce the risk of disease. Cleanup can be expensive for homeowners and municipalities. Rugs, curtains, flooring, wallboard panels, and upholstered furniture usually must be replaced. A key concern with SSOs that enter oceans, bays, estuaries, rivers, lakes, streams, or brackish waters is their effect on water quality. When bodies of water cannot be used for drinking water, fishing, or recreation, society experiences an economic loss. Tourism and waterfront home values may fall. Fishing and shellfish harvesting may be restricted or halted. SSOs can also close beaches. One 1994 study claims that SSOs closed beaches across the nation that year for a total of more than 300 days.

How can SSOs be Reduced or Eliminated?

Many avoidable SSOs are caused by inadequate or negligent operation or maintenance, inadequate system capacity, and improper system design and construction. These SSOs can be reduced or eliminated by:

- Sewer system cleaning and maintenance
- Reducing infiltration and inflow through system rehabilitation and repairing broken or leaking service lines.
- Enlarging or upgrading sewer, pump station, or sewage treatment plant capacity and/or reliability.
- Construction of wet weather storage and treatment facilities to treat excess flows.

Communities also should address SSOs during sewer system master planning and facilities planning, or while extending the sewer system into previously unsewered areas.

A few SSOs may be unavoidable. Unavoidable SSOs include those occurring from unpreventable vandalism, some types of blockages, extreme rainstorms, and acts of nature such as earthquakes or floods.

What Costs are Involved with Reducing or Eliminating SSOs?

Sanitary sewer collection systems are a valuable part of the nation's infrastructure. The EPA estimates that our nation's sewers are worth a total of more than $1 trillion. The collection system of a single large municipality is an asset worth billions of dollars and that of a smaller city could cost many millions to replace. Sewer rehabilitation to reduce or eliminate SSOs can be expensive, but the cost must be weighed against the value of the collection system asset and the added costs if this asset is allowed to further deteriorate. Ongoing maintenance and rehabilitation adds value to the original investment by maintaining the system's capacity and extending its life.

The costs of rehabilitation and other measures to correct SSOs can vary widely by community size and sewer system type. Those being equal, however, costs will be highest and ratepayers will pay more in communities that have not put together regular preventive maintenance or asset protection programs.

Assistance is available through the Clean Water Act State Revolving Fund for capital projects to control SSOs. State Revolving Funds in each state and Puerto Rico can help arrange low-interest loans. For the name of your State Revolving Fund contact, please call the EPA Office of Water Resource Center, (202) 566-1729.

To reduce sanitary sewer overflows (SSOs), the EPA is proposing to clarify and expand permit regulations that are already in force under the Clean Water Act. This will affect over 19,000 municipal sanitary sewer systems, including 4800 satellite collection systems that will be regulated for the first time. It will allow streamlined CMOM requirements for small communities, and permit them to skip self-audits and annual reports if an SSO hasn't occurred.

The proposed rule would establish:

- Three standard permit conditions for inclusion in NPDES permits for publicly owned treatment works (POTWs) and municipal sanitary sewer collection systems
- A framework under the NPDES permit program for regulating municipal satellite collection systems.

The EPA would like to establish three standard permit conditions that will be included as part of NPDES permits for publicly owned treatment works (POTWs) and municipal sanitary sewer collection systems.

The proposed standard permit conditions:

- Address capacity, management, operation, and maintenance requirements for municipal sanitary sewer collection systems (proposed 40 CFR 122.42(e))
- Prohibit discharges to waters of the United States that occur before the discharge reaches a (POTW) treatment facility (includes a framework for defense for unavoidable discharges) (proposed 40 CFR 122.42(f))
- Establish requirements for reporting, public notification, and record keeping for discharges from municipal sanitary sewer system (proposed 40 CFR 122.42(g)).

These proposed standard permit rules are based on the Clean Water Act, sections 304(i), 308, and 402(a). The rules were developed from existing permit conditions to specifically address municipal systems and discharges.

The proposed rules will help cities upgrade wastewater collection systems across the nation, protecting one of the nation's most valuable assets. Under these proposed rules, facilities will be required to implement new programs for:

- Capacity assurance, managing, operating, and maintaining systems (CMOM) - These programs will help communities provide adequate wastewater collection and treatment facilities. It will include many standard operation and maintenance activities to ensure good system performance.
- Public notification – cities and local interests will establish a custom program to notify the public of overflows according to the risk they pose. The EPA is also proposing that yearly summaries of SSOs be made public. In addition, this proposal will clarify existing requirements for keeping records and requirements for reporting to the state.

More Specifically, CMOM will Require Facilities to:

- Establish general performance standards.
- Have a management program.
- Create an overflow response plan.
- Ensure system evaluations.
- Verify capacity assurance.
- Submit to periodic audits of the CMOM program.
- Notify the public and regulatory agencies of SSOs.

General Performance Standards

A CMOM program will ensure:

- There is enough capacity to handle base and peek flows.
- The use of all reasonable measure to stop SSOs.
- Proper collection, management, operation and maintenance of the system.
- Prompt notification of all parties that may be exposed to an SSO.

Management Programs

Management program documents must include:

- The goals of the CMOM program (may differ depending on the facility.)
- Legal authorities that will help implement CMOM.
- The "chain of command" for implementing CMOM and reporting SSOs.
- Design and performance requirements.
- Measures that will be taken to help implement CMOM.
- Monitoring/performance measures to how effective the CMOM program is.
- Communication plan.

Overflow Response Plan

The overflow response plan should be designed provide a quick response to SSOs. Rapid response to an SSO can mitigate structural damage, pollution of waterways, and the public health risk. The plan must include the following:

- SSO response procedures.
- Immediate notification of health officials.
- Public notification.
- Plan made available to the public.
- Distribution to all appropriate personnel.
- Revision and maintenance of the plan by appropriate personnel.

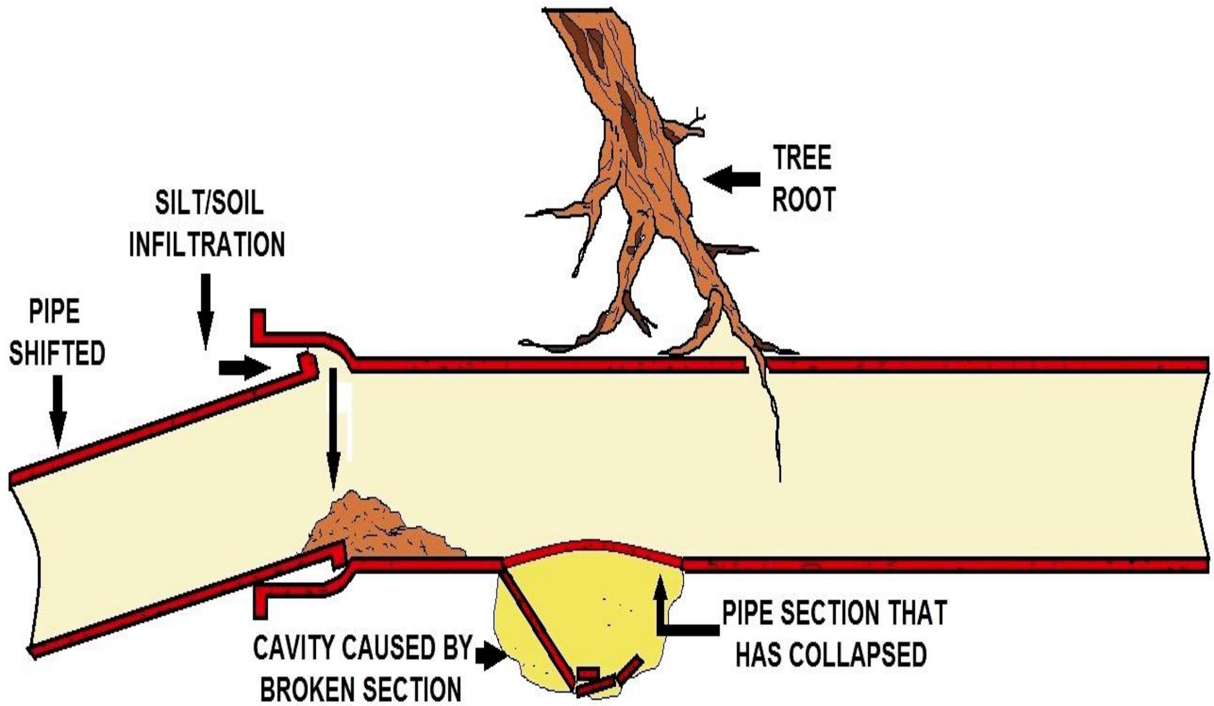
System Evaluation and Capacity Assurance Plan

These two activities work hand-in-hand to detect and address deficiencies and scheduling. These will provide:

- An evaluation of parts of the collection system that have substandard performance.
- Capacity assurance measures to address substandard performance.
- Explanation of prioritization and scheduling.

Performance measures and indicators are important in evaluating collection system performance and implementing capacity management, operation and maintenance programs.

Possible performance measures and indicators for sanitary sewer collection systems are shown below:



BROKEN SEWER PIPE DIAGRAM

CMOM Audits Potential Performance Indicators

Input measures	Per capita costs Number of employee hours
Output measures	Length of pipe maintained Number of service calls completed Percentage of length maintained repaired this year Percentage of length maintained needing repair Length of new sewer constructed Number of new services connected
Outcomes	Number of stoppages per 100 miles of pipe Average service response time Number of complaints
Ecological/Human health/ Resource use	Shellfish bed closures Benthic Organism index Biological diversity index Beach closures Recreational activities Commercial activities

CMOM Audits
CMOM will require regular, comprehensive audits, done by each facility. These audits will help identify non-conformance to CMOM regulations so problems can be addressed quickly. All findings, proposed corrective actions and upcoming improvements should be documented in the audit report.

Communication/Notification
If an SSO occurs, sanitary sewer facilities will be required to immediately notify the NPDES permit authority, appropriate health agencies, state authorities, drinking water suppliers, and, if necessary, the general public in the risk area. This rule will also require an annual report of all overflows, including minor SSOs such as building backups. Facilities must post locations of recurrent SSOs and let the public know that the annual report is available to them. The record keeping provisions mandate that facilities must maintain records for three years about all overflows, complaints, work orders on the system, and implementation measures.

According to the EPA, an effective CMOM program would help NPDES permitees to:

- Develop/revise routine preventive maintenance activities that prevent service interruption and protect capital investments.
- Create an inspection schedule and respond to the inspection results.
- Investigate the causes of SSOs and take corrective measures.
- Respond quickly to SSOs to minimize impacts to human health and the environment.
- Identify and evaluate SSO trends.
- Develop budgets and identify staffing needs.
- Plan for future growth to ensure adequate capacity is available when it’s needed.
- Identify hydraulic (capacity) and physical deficiencies and prioritize responses, including capital investments.
- Identify and develop appropriate responses to program deficiencies (e.g., lack of legal authority, inadequate funding, and inadequate preventive maintenance).

- Keep parts and tools inventories updated and equipment in working order.
- Report and investigate safety incidents and take steps to prevent their recurrence.

Implementation

The EPA estimates that implementing this rule will impose an additional $93.5 to $126.5 million every year on municipalities (includes planning and permitting costs). A system serving 7,500 people may need to spend an average of $6,000 every year to comply with the rule.

CMOM regulations will be added to the permit when facilities need to have a permit re-issued. Although a compliance deadline has not been set, the EPA recommends that facilities begin to implement "SSO Standard Conditions" right after the proposed rule is published. Considering the time and costs associated with compliance, this may be good advice.

Proposed Deadlines for CMOM Documentation After Permit Issuance

Avg. Daily Flow	Summary of CMOM program	Overflow Emergency Response Plan	Completion of Program Audit Report	Submission of Program Audit Report	System Evaluation and Capacity Assurance Plan
>=5 mgd	Within 18 mos.	Within 1 year	Within 18 mos.	Within 18 mos.	Initial sub-basins: 3 yrs.; All sub-basins: 5 yrs.
>1 but <5 mgd	Within 2 yrs	Within 1 yr.	Within 2 yrs.	With permit renewal application	Initial sub-basins: 3 yrs.; All sub-basins: 5 yrs.
<= 1 mgd	Within 3.5 yrs.	Within 1 yr.	Within 3.5 yrs.	With permit renewal application	Within 5 yrs.

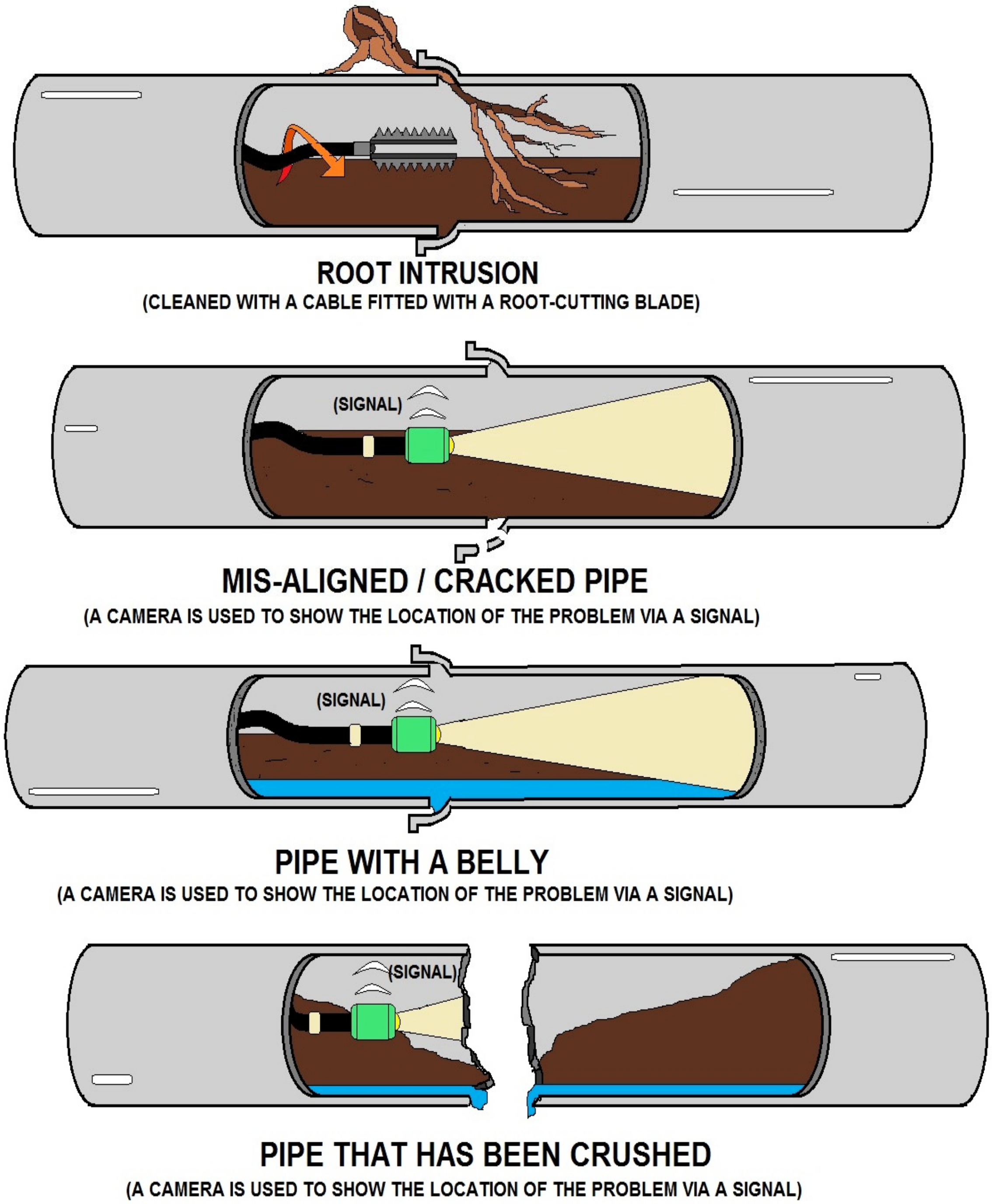
Continuous Training

Procedures for emergency response plans should be understood and practiced by all personnel in order to ensure safety of the public and the collection system personnel responding. Procedures should be specific to the type of emergency that could occur. It is important to keep detailed records of all past emergencies in order to constantly improve response training, as well as the method and timing of future responses. The ability to deal with emergencies depends on the knowledge and skill of the responding crews, in addition to availability of equipment. The crew should be able to rapidly diagnose problems in the field under stress and select the right equipment needed to correct the problem. If resources are limited, consideration should be given to contracting other departments or private industries to respond to some emergency situations, for example, those rare emergencies that would exceed the capacity of staff.

Routine Preventative O&M Activities – Wastewater Collection Lines

Routine preventative operations and maintenance activities for wastewater collection lines shall be performed by the system's personnel and outside contractors. A qualified outside contractor can also be utilized to perform hydraulic cleaning using a jet hydro-vac combination truck and mechanical cleaning using a rodding machine. Routine operations and maintenance activities including cleaning and removing roots from small and large diameter lines. The system's goal should be a minimum of cleaning between 20-30% of the sewers every year.

Closed-circuit **television (CCTV) is used** to assess the condition of the sewers. There are four types of activities that the system or a CCTV contractor can also perform: 1) inspect new work, 2) inspect condition of older portions of the wastewater collection system, 3) routine inspection of approximately 10% of the wastewater collection, and 4) problem identification to determine the cause of selected overflow events. Manhole inspection, manhole coating (to prevent concrete deterioration) and manhole painting (for roach control) are also routinely performed.



COMMON PROBLEMS IN SEWER PIPING

Stormwater and Wastewater Treatment Components

Biochemical Oxygen Demand

Biochemical Oxygen Demand (**BOD or BOD5**) is an indirect measure of biodegradable organic compounds in water, and is determined by measuring the dissolved oxygen decrease in a controlled water sample over a five-day period.

During this five-day period, aerobic (oxygen-consuming) bacteria decompose organic matter in the sample and consume dissolved oxygen in proportion to the amount of organic material that is present. In general, a high BOD reflects high concentrations of substances that can be biologically degraded, thereby consuming oxygen and potentially resulting in low dissolved oxygen in the receiving water. The BOD test was developed for samples dominated by oxygen-demanding pollutants like sewage. While its merit as a pollution parameter continues to be debated, BOD has the advantage of a long period of record.

Background Information

Microorganisms such as bacteria are responsible for decomposing organic waste. When organic matter such as dead plants, sewage, or even food waste is present in a water supply, the bacteria will begin the process of breaking down this waste. In this case, much of the available dissolved oxygen is consumed by aerobic bacteria, robbing other aquatic organisms of the oxygen they need to live. Biological Oxygen Demand (**BOD**) is a measure of the oxygen used by microorganisms to decompose this waste. If there is a large quantity of organic waste in the water supply, there will also be a lot of bacteria present working to decompose this waste. In this case, the demand for oxygen will be high (due to all the bacteria) and, subsequently, the dissolved oxygen levels in the water may begin to decline.

Test Procedure

The BOD test takes 5 days to complete and is performed using a dissolved oxygen test kit (from LaMotte or other supplier). Record the dissolved oxygen level (in ppm) on the first day using the method described in the dissolved oxygen test. Then place the water sample in an incubator at 20°C for 5 days. If you don't have an incubator, wrap the water sample bottle in aluminum foil or black electrical tape and store in a dark place at room temperature (20°C or 68°F). On day 5, take another dissolved oxygen reading (in ppm) using the dissolved oxygen test kit. The BOD level is determined by subtracting the Day 5 reading from the Day 1 reading. Record your final BOD result in ppm.

What to Expect

A BOD level of 1-2 ppm is considered very good. There will not be much organic waste present in the water supply. A water supply with a BOD level of 3-5 ppm is considered moderately clean. In water with a BOD level of 6-9 ppm, the water is considered somewhat polluted because there is usually organic matter present and bacteria are decomposing this waste. At BOD levels of 10 ppm or greater, the water supply is considered very polluted with organic waste.

Generally, as BOD levels increase there is a corresponding decrease in DO levels. This is because the demand for oxygen by the bacteria is high and they are taking that oxygen from the oxygen dissolved in the water. If there is no organic waste present in the water, there won't be as many bacteria present to decompose it and thus the BOD will tend to be lower and the DO level will tend to be higher.

At high BOD levels, organisms that are more tolerant of lower dissolved oxygen (i.e. leeches and sludge worms) may appear and become numerous. Organisms that need higher oxygen levels (i.e. caddis fly larvae and mayfly nymphs) will not survive.

Nutrients
Nutrients are chemical elements or compounds essential for plant and animal growth. Nutrient parameters include ammonia, organic nitrogen, Kjeldahl nitrogen, nitrate nitrogen (for water only) and total phosphorus. High amounts of nutrients have been associated with eutrophication, or overfertilization of a water body, while low levels of nutrients can reduce plant growth and (for example) starve higher level organisms that consume phytoplankton.

Organic Carbon
Most organic carbon in water occurs as partly degraded plant and animal materials, some of which are resistant to microbial degradation. Organic carbon is important in the estuarine food web and is incorporated into the ecosystem by photosynthesis of green plants, then consumed as carbohydrates and other organic compounds by higher animals. In another process, formerly living tissue containing carbon is decomposed as detritus by bacteria and other microbes.

Total Organic Carbon
TOC bears a direct relationship with biological and chemical oxygen demand; high levels of TOC can result from human sources, the high oxygen demand being the main concern.

Priority Pollutants
Priority Pollutants refer to a list of 126 specific pollutants that includes heavy metals and specific organic chemicals. The priority pollutants are a subset of ***"toxic pollutants"*** as defined in the Clean Water Act. These 126 pollutants were assigned a high priority for development of water quality criteria and effluent limitation guidelines because they are frequently found in wastewater. Many of the heavy metals, pesticides, and other chemicals listed below are on the priority pollutant list.

Heavy Metals (Total and Dissolved)
Heavy metals are elements from a variety of natural and human sources. Some key metals of concern and their primary sources are listed below:

- **Arsenic** from fossil fuel combustion and industrial discharges;
- **Cadmium** from corrosion of alloys and plated surfaces, electroplating wastes, and industrial discharges;
- **Chromium** from corrosion of alloys and plated surfaces, electroplating wastes, exterior paints and stains, and industrial discharges;
- **Copper** from corrosion of copper plumbing, anti-fouling paints, and electroplating wastes;
- **Lead** from leaded gasoline, batteries, and exterior paints and stains;
- **Mercury** from natural erosion and industrial discharges;
  and
- **Zinc** from tires, galvanized metal, and exterior paints and stains.

High levels of mercury, copper, and cadmium have been proven to cause serious environmental and human health problems in some bays around the world. Some of the sources listed above, such as lead in gasoline and heavy metals in some paints, are now being phased out by environmental regulations issued in the past ten years.

Pesticides
Typical pesticides and herbicides include DDT, Aldrin, Chlordane, Endosulfan, Endrin, Heptachlor, and Diazinon. Some of the more persistent compounds including DDT and dioxin (not a pesticide) are subject to stringent regulation including outright bans.

Polycyclic Aromatic Hydrocarbons (PAHs)
Polycyclic Aromatic Hydrocarbons include a family of semi-volatile organic pollutants such as naphthalene, anthracene, pyrene, and benzo(a)pyrene.

Polychlorinated biphenyls (PCBs)
Polychlorinated biphenyls are organic chemicals that formerly had widespread use in electrical transformers and hydraulic equipment. This class of chemicals is extremely persistent in the environment and has been proven to **bioconcentrate** in the food chain, thereby leading to environmental and human health concerns in areas such as the Great Lakes.

Because of the potential to accumulate in the food chain, PCBs were intensely regulated and subsequently prohibited from manufacture by the Toxic Substances Control Act (**TSCA**) of 1976. Disposal of PCBs is tightly restricted by TSCA.

Pretreatment Program

The term "**pretreatment**" refers to the requirement that non-domestic sources discharging wastewater to POTWs control their discharges, and meet limits established by the EPA, and/or your state or the local municipality (**Control Authority**) on the amount of pollutants allowed to be discharged. The control of the pollutants may necessitate treatment prior to discharge to the POTW (therefore the term "**pretreatment**").

Limits may often be met by the non-domestic source through pollution prevention techniques (product substitution, recycle and reuse of materials, more efficient production practices, improved environmental management systems, etc.), pretreatment of wastewater, or implementation of best management practices.

The National Pretreatment Program is a cooperative effort of federal, state, and local regulatory environmental agencies established to protect water quality. The program is designed to reduce the level of pollutants discharged by industry and other non-domestic wastewater sources into municipal sewer systems, and thereby reduce the amount of pollutants released into the environment from these sources.

The national pretreatment program was established by Congress under authority of the Federal Water Pollution Control Act of 1972 (Pub. L. 92-500) as amended by the Clean Water Act of 1977 (Pub. L. 95-217). Implementation requirements of the pretreatment portions of these laws were first codified into 40 Code of Federal Regulations (**CFR**) Part 403 in 1978.

Objectives of the pretreatment program:

1. Protect publicly owned treatment works (POTW) from pollutants that may cause interference with sewage treatment plant operations.
2. Prevent introducing pollutants into a POTW that could cause pass through of untreated pollutants to receiving waters.
3. Manage pollutant discharges into a POTW to improve opportunities for reuse of POTW wastewater and residuals (sewage sludge).
4. Prevent introducing pollutants into a POTW that could cause worker health or safety concerns, or that could pose a potential endangerment to the public or to the environment.

POTWs

Publicly owned treatment works (**POTWs**) collect wastewater from homes, commercial buildings, and industrial facilities and transport it via a series of pipes, known as a collection system, to the treatment plant. Here, the POTW removes harmful organisms and other contaminants from the sewage so it can be discharged safely into the receiving stream. Generally, POTWs are designed to treat domestic sewage only.

However, POTWs also receive wastewater from industrial (non-domestic) users. The General Pretreatment Regulations establish responsibilities of Federal, State, and local government, industry and the public to implement Pretreatment Standards to control pollutants from the industrial users which may pass through or interfere with POTW treatment processes or which may contaminate sewage sludge.

National Pretreatment Program

The National Pretreatment Program identifies specific requirements that apply to all IUs, additional requirements that apply to all SIUs, and certain requirements that only apply to CIUs. The objectives of the National Pretreatment Program are achieved by applying and enforcing three types of discharge standards:

*** prohibited discharge standards**

*** categorical Pretreatment standards**

*** local limits**

Prohibited discharge standards are somewhat general, national standards and are applicable to all industrial users to a POTW, regardless of whether or not the POTW has an approved pretreatment program or the industrial user has been issued a permit. These standards are designed to protect against pass through and interference, protect the POTW collection system, and to promote worker safety and beneficial biosolids use. These standards are listed in 40 CFR 403.5. For Final Regulations pertaining to the Pretreatment Program, refer to: 40 CFR Part 403 (general pretreatment regulations.

CONVENTIONAL POLLUTANTS

POTWs are designed to treat typical household wastes and biodegradable commercial and biodegradable industrial wastes. The Clean Water Act defines the contaminants from these sources as **conventional pollutants**. **Conventional pollutants** are biological oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH.

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Categorical Pretreatment Standards

Categorical Pretreatment Standards are limitations on pollutant discharges to publicly owned treatment works (POTWs), promulgated by the EPA in accordance with Section 307 of the Clean Water Act that apply to specific process wastewaters of particular industrial categories.

These are national, technology-based standards that apply regardless of whether or not the POTW has an approved pretreatment program or the industrial user has been issued a permit. Such industries are called Categorical Industrial Users. The standards applicable to industrial discharges to a POTW collection system are designated in the Effluent Guidelines & Limitations [Parts 405-471] by the terms ***"Pretreatment Standards for Existing Sources"*** (or "**PSES**") and ***"Pretreatment Standards for New Sources"*** (or "**PSNS**").

Note: The Effluent Guidelines & Limitations designated by the terms ***"Best Practicable Control Technology Currently Available*** (**BPT**)", ***"Best Available Technology Economically Achievable*** (**BAT**)", ***"Best Conventional Pollutant Control Technology*** (**BCT**)", and ***"New Source Performance Standards*** (**NSPS**)" apply to industries that discharge process wastewater to waters of the U.S. and should have an National Pollutant Discharge Elimination System (**NPDES**) Permit.

CATEGORICAL STANDARDS

Categorical standards are technology-based limitations on pollutant discharges to POTWs, which have been promulgated by U.S. EPA in accordance with Section 307 of the Clean Water Act, and apply to specific process wastewater discharges for thirty-two (32) different industrial categories. (Categorical standards can be found in 40 CFR Parts 405-471.) Categorical standards are similar to federal effluent guidelines (FEGs), with two important distinctions:

- **categorical standards** apply to indirect discharges while FEGs apply only to direct discharges to surface waters; and
- **categorical standards** are developed with the assumption that the POTW will remove at least small amounts of a pollutant, therefore the categorical standard for the pollutant will be less stringent than the corresponding best available technology (BAT) limits for the FEG applied to a direct discharger

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STORMWATER/ WASTEWATER/ PRETREATMENT SAMPLING EXAMPLES, ACTIVITIES AND OTHER RELATED INFORMATION

In accordance with the Clean Water Act and General Pretreatment Program Regulations, the POTW conducts a variety of sampling activities which must be closely coordinated. Each of these activities is briefly described below.

Pretreatment Permit Application

All industrial users that require a permit must be sampled to determine the characteristics of the wastes to be discharged into the sewer system. Prior to the issuance of a permit for existing industrial users, the POTW samples the user's effluent, and performs the analyses required by the applicable discharge standards (i.e., Categorical standards or local limits).

For new industrial users, estimates of the wastes to be discharged into the POTW's sewer system must be submitted along with the permit application. No sampling would be performed at these new facilities, since they do not presently discharge wastes into the sewer system.

A four-day sampling program is usually conducted at each site to collect both composite and grab (for pollutants not amenable to composite sampling) samples as needed.

Sewer System Evaluation Example

On a regular basis, selected locations in the sewer system are sampled to develop background data for purposes of updating the local limits, and to screen areas for higher than "***background***" pollutant levels.

In addition, problem areas are sampled on an as needed basis to determine potential sources of POTW's Code violations that either occur on a frequent basis, or are the result of a slug load to the sewer system.

To monitor sewers for background information, the sampling program would typically be conducted over a four-day period. In instances where the intent is to determine sources of pollutants and/or slug loads, the length of the program would vary.

Multi-City Users (Metering Stations) Example

All wastewater, which is transported to the POTW Treatment Plant from the Multi-City users, is analyzed for pollutants of concern to the Industrial Pretreatment Program.

The sampling program is conducted over a five-day period to obtain four days of sampling data at each sewer location (i.e., a metering station) on a quarterly basis.

Once the sampling dates have been determined, the Water Quality Inspector will notify, in writing, the Subregional Organizational Group (**SROG**) or equivalent agency representative for that City of the dates when the sampling will be conducted.

Upon arrival at the site, safety is the priority. A visual inspection must be completed prior to any entry. The site must be free of any obstructions or hazards which may cause injury when entering sampling area. If there are any problems detected, the SROG or equivalent agency representative and the Water Quality Inspector should be notified, and no entry should be attempted until the problem has been corrected.

Storm Drain, Metering and Sampling Stations Qualify As Confined Spaces
If all safety criteria have been met, prepare equipment for the site. Check the assignment sheet to determine what parameters are required to be sampled, which in turn determines the type of tubing to be used, (i.e. Tygon or Teflon).

The sampler must be completely assembled before performing Quality Assurance/Quality Control **(QA/QC)** procedures. After QA/QC is complete, a sufficient amount of weight must be attached to the tubing to keep the strainer submerged in the effluent for proper siphoning of the sample, without allowing the strainer to hit the bottom of the flume.

Make sure the intake tubing does not kink.

If the metering station has a flow meter, you may connect either their cable or a POTW cable to the sampler from the flow meter.

Occasionally, you will set up a flow meter to have a comparison reading. Determine the pulse rate and proper setting from the flow, and program the sampler. After entering the data into the sampler, wait to make sure the equipment is pulling samples.

After the initial set-up of the sampling equipment, samples will be collected during the remainder of the sampling period. Split samples may be requested by the SROG or equivalent agency representative. If the volume of the sample is adequate, these may be given, provided the representative supplies the containers and allows the POTW's Inspector to pour off the samples. **No grab samples will be collected by POTW Inspectors for any SROG representatives.**

Upon exiting the confined space, continue to follow the confined space entry procedures as outlined by OSHA Standards. When you return to the sampling vehicle, you must immediately perform field tests and preserve the samples according to the techniques set forth in by Standard Methods or the State/Federal Rule.

All paper work must be filled out completely before the sampling crew's departure.

This paperwork includes the chain of custody which is turned in to the laboratory with the samples, "**Metering Station Field Observation Form**" or equivalent that remains with the sampling site file, and the Multi-City Metering Station Sample Record of which the original is given to the Water Quality Inspector and the copy is given to the SROG or equivalent agency representative.

If there is not an SROG representative or equivalent at the site, these copies will be turned over to the Water Quality Inspector with the originals at the end of the week.

Remember, all paperwork must be completed prior to leaving site.

Stormwater, Wastewater and Pretreatment Compliance
Monitoring Examples

There are two types of sampling activities that are performed as part of compliance monitoring for permitted industries: unscheduled and demand.

Unscheduled sampling is used to determine the compliance status of the user. Instances of noncompliance are often identified during unannounced monitoring visits. No notice is given for this type of sampling. This type of sampling is performed two to four times a year, at each industrial user site, over a two to five-day period to obtain sampling data

Demand sampling is usually initiated in response to a known or suspected violation, discovered as a result of a self-monitoring report, routine sampling visit, public complaint, unusual influent condition at the wastewater treatment plant, or emergency situations (e.g., plant upsets, sewer line blockages, fires, explosions, etc.). Most often, this type of sampling is conducted to support enforcement actions against an industrial user. This type of sampling activity is performed on an as needed basis.

The length of the sampling program depends on the flow, nature of the wastes, and type of samples (i.e., grab or composite) to be collected.

Typically, composite and grab samples are collected at each user site.

Wastewater Treatment Plant Sampling

POTW samples are collected in accordance with the National Pollutant Discharge Elimination System (**NPDES**) permit which sets discharge limits for certain pollutants and specifies sampling frequencies and sample types.

The POTW is responsible for coordinating the plant sampling activity with laboratory personnel who prepare any special sampling bottles and laboratory appurtenances necessary (i.e. trip blanks, etc.) to complete the sampling objectives.

Pre-Treatment Monitoring Locations Should:

- be appropriate for waste stream conditions;
- be representative of the discharge;
- have no bypass capabilities; and
- allow for unrestricted access at all times.

Control Authorities should measure flow to allow for collection of flow-proportioned composite samples, which are required, unless flow-proportional sampling is not feasible. Flow-proportional composite samples are preferred over time composite samples particularly where the monitored discharge is intermittent or variable.

Desired analyses dictate the preparation protocols, equipment, and collection bottles to use to avoid contamination of samples or loss of pollutants through improper collection. Sampling for such pollutants as pH, cyanide, oil and grease, flashpoint, and volatile organic compounds require manual collection of grab samples.

Similar to composite samples, grab samples must be representative of the monitored discharge and are to be collected from actively flowing wastestreams. Fluctuations in flow or the nature of the discharge may require collection of and hand-compositing of more than one grab sample to accurately assess compliance.

To ensure defensibility of data, Control Authorities should develop and implement standard operating procedures and policies detailing sample collection and handling protocols in accordance with 40 CFR Part 136.

Adherence to proper sample collection and handling protocols, 40 CFR Part 136 approved analytical methodologies, and record-keeping requirements [40 CFR §403.12(o) (1)] can be verified through review of field measurement records, chain of custodies, and lab reports. Field measurement records may require information regarding sample location, condition of and programmed settings for sampling equipment, wastewater meter readings, and information for such parameters as pH and temperature which require analysis in the field.

Chain of custody forms serve as a link between field personnel and the laboratory and contain information regarding sample matrix, type, and handling. Lab reports should contain the minimum information specified in 40 CFR §403.12(o)(1)(ii-iv) as well as any additional information necessary to demonstrate compliance with 40 CFR Part 136 requirements (e.g., analytical methodology, sample preparation date and time, time of analysis).

Use of standardized forms which prompt recording of information necessary for demonstrating compliance with applicable requirements will aid in ensuring it can be used as admissible evidence in enforcement proceedings or in judicial actions.

Wastewater Plant Sampling Procedure Example

Set up two samplers at the plant influent channel and two samplers at the plant effluent channel. Two samplers are used to provide sufficient sample quantity and to minimize sampler failure. All sampling equipment must be prepared and cleaned as established in your POTW's procedures. Teflon hose is required. Sampling sites are specified in each plant's NPDES permit.

Collect the following composite samples at both sites.

(1) Metals Sample - (one 2-liter plastic bottle)

Preserve with 1:1 nitric acid to a pH < 2. Store sample on ice to 4°C.

(2) Cyanide Sample - one (2-liter plastic bottle)

Collect the cyanide sample as a composite in accordance with NPDES permit. Check the sample for chlorine. If Cl_2 is present, use ascorbic acid to eliminate chlorine. Add NaOH to a pH > 12. Store samples on ice to 4°C.

(3) EPA Test Method 608 and 625 samples are informational samples only. These results are used for local limits data.

608 and 625 samples are collected as composite samples. At the influent channel: Collect one 1-liter amber glass bottle of each sample (608, 625). Check samples for chlorine. At the effluent channel: Collect one 4-liter amber glass bottle of each sample (608, 625). Check samples for chlorine. If Cl_2 is present in the samples, use sodium thiosulfate ($Na_2S_20_3$) to eliminate chlorine. Store samples on ice to 4°C.

(4) **625/Phenols** are collected as a grab sample. Collect one 4-liter amber glass bottle at the effluent channel only. Check the sample for chlorine. If Cl_2 is present, use sodium thiosulfate ($Na_2S_20_3$) to eliminate chlorine. Store sample on ice to four degrees Centigrade.

Bio-Solids Sampling Example
Bio-solids (dried sludge) samples are collected at POTWs.

Normally, bio-solid samples will be collected from the final storage area for dry sludge. The location of the dried bio-solids may vary based on the individual plants. Sampling frequency will be determined on an as needed basis and to comply with EPA requirements.

All samples collected are grabs. All samples are collected using a sterile plastic scoop in order to avoid any contamination.

The following is a list of samples to be collected:

PARAMETER	CONTAINER
Helminth Ova & Enteric Virus	1 Qt Plastic Bag (Ziploc)
Metals +	500 ml Plastic Bottle
Nitrogen (total)	4 oz Glass Bottle
TOC (Total Organic Carbon)	4 oz Glass Bottle
Fecal Coliform	(autoclaved from lab)
6 hr hold time	500 ml Plastic Bottle

Sample Scheduling Example
An active file is maintained on each sampling location which contains historical data which includes past process discharge flow readings, water meter readings, sampling dates, and conditions of sampling site.

River Sampling Activities Examples
When developing a sampling plan for river sampling, the following considerations must be observed:

(1) Sampling sites must meet the objectives of the program or study.

(2) At the sampling sites the river must be flowing freely and the sample must be as representative as possible of river flow at that site. Consideration of all safety factors must be observed.

(3) Sample must be collected at midstream of the main channel at approximately two-thirds of the depth unless specific depths have been requested.

(4) All safety precautions must be observed during sampling which includes the use of harnesses, waterproof boots and other equipment.

Samples from Sewers Example

Sewer system and user rate sampling are conducted in manholes. General guidelines for selection of sampling locations include the following:

(1) Samples should be taken at points of high turbulent flow to ensure good mixing and prevent the deposition of solids.

(2) The sample location should be easily accessible and free of any major safety hazards.

(3) Sample lines should not be located where there is surface scum.

(4) If a flow study or a flow/proportional sampling event is required, make sure that the sewer pipe does not have a curve, a drop in the line or any obstructions. These would cause false readings.

Types of Samples

General *Example*
There are four types of samples that are collected by the POTW's Sampling Section or equivalent agency: grab, time proportional composites, flow proportional composites, and hand composites. The sampling method used depends largely on the types of analyses to be run, and the nature of the wastestream being sampled. Each sampling method is described in this section.

Most POTW's will define the sampling methods which must be used by industrial users (IUs) to obtain representative samples to show compliance with their permits: ***Example***

(1) A grab sample is an individual sample collected in less than 15 minutes without regard for flow or time of day. pH, cyanide, oil and grease, sulfide, and volatile organics must be collected as grab samples.

(2) 24-hour flow proportional composite samples where feasible. The POTW may waive this requirement if the IU demonstrates that this method is not feasible. Samples would then be taken by means of time proportional composite sampling methods, or by hand composite where the IU can demonstrate that this will provide a representative sample of the effluent being discharged.

The volume of sample to be collected by any of these methods is dependent on the number and types of analyses that must be performed.

Wastewater Grab Samples
Grab samples are individual samples collected in less than 15 minutes without regard to flow or time of day. Grab samples are normally taken manually, but can be pumped. Oil and grease samples and purgeable organics are exceptions and must be taken manually.

A grab sample is usually taken when a sample is needed to:

(1) Provide information about an instantaneous concentration of pollutants at a specific time.

(2) Quantify the pollutants in a non-continuous discharge (e.g., batch discharge).

(3) Corroborate composite samples if the waste is not highly variable.

(4) Monitor parameters not amenable to compositing such as pH, temperature, dissolved oxygen, chlorine, purgeable organics and sulfides, oil and grease, coliform bacteria, and sulfites.

Collecting Procedure for Water/Wastewater Grab Samples Example
Lower dipper or mouth of the bottle into water just below surface. Some cases, you will need to rinse the bottle or dipper three times in the sample before obtaining the sample.

Retrieve collected sample to clean processing area.

Rinse the outside of the bottle 3 times to remove contamination.

Pour the sample into the required laboratory bottle.

You may need to filter the sample; this is true with some water and wastewater samples. Filtering (for ortho-P and NOx samples--some Surface water virus samples need to be filtered.

Secure caps tightly.

Label the sample containers before placing them in an iced cooler for storage.

Bottles preservation is performed in the truck or lab before sampling.

Secure sample container caps tightly.

Label the sample containers and place them in an iced cooler before storage.

Timed Composites
Timed samples are usually taken in instances where the intention is to characterize the wastes over a period of time without regard to flow, or where the flow is fairly constant.

Timed composite samples consist of a series of equal volume grab samples taken at regular intervals. Usually the interval is 15 minutes, with a maximum sampling duration of 24 hours. However, other intervals can be used and may be more appropriate under some circumstances.

Samplers are available which can take up to 10 discreet samples per bottle, for a total of 240 discreet samples. The sampler may be programmed to take any number of samples into one composite bottle which has a 2.5-gallon capacity.

Flow Proportional Composites
Flow proportional composite samples consist of: a series of grab samples whose volumes are equal in size and proportion to the flow at the time of sampling. Samples are taken at varying time intervals, or continuous samples taken over a period of time based on the flow.

Wherever possible, flow proportional sampling is recommended because it most accurately reflects the nature of the wastestream. Equal volume samples taken at varying time intervals are most often collected by the sampling inspectors. A flow measuring device must be used in conjunction with the automatic sampler.

This sampling method is used for all sampling activities except for instances where grab samples are required or time proportional sampling is more expedient and can provide the same accuracy as flow proportional sampling (i.e., constant flow levels).

Hand Compositing
Hand compositing is a series of time proportional grab samples which are collected and composited by hand. Provided the sample volumes are equal and are collected at even intervals, the results should be the same as if done by an automatic sampler (i.e., flow proportional composite sampling).

A specific instance where this sampling method may be used is in metal plating shops which have batch discharges from the treatment tank. Provided the tank contains a homogeneous mixture, a minimum of four grab samples are taken of equal amounts and at evenly spaced intervals of time during discharge, to accurately represent the entire tank.

This should represent the waste characteristics of the entire batch discharge to the sewer. One hand composite per batch discharge would be equivalent to a 24-hour composite sample taken at other types of facilities. The sampling data would be compared with the average daily categorical standards or local limits where applicable.

Presampling Procedures Example

To ensure acceptable analytical results, numerous steps must be followed before a sampling program can be initiated:

(1) Sampling equipment must be clean and be in good working order.
(2) Sampling site must be selected.
(3) Types of analyses must be determined.
(4) Proper sample containers must be selected and prepared.

Wastewater Sampling Equipment Examples

The POTW or equivalent agency may use one of the following portable samplers, ISCO Ultra-Sonic flow meters, SIGMA Depth Sensor samplers, and SIGMA pH Probe samplers. Safety equipment and other necessary equipment are also used.

The equipment that is kept in the sampling vehicle is dependent on the types of sampling activities planned each week, while the equipment stored in the storeroom is for back-up needs and future sampling demands.

Each sampling vehicle should be equipped with at least one sampler and one flow meter more than is needed for the particular sampling period. For example, three scheduled flow proportionate sampling sites would require a vehicle to be equipped with four samplers and four flow meters. At least one spare battery for each type of equipment taken into the field should also be placed in the sampling vehicle.

Ancillary equipment, such as supports, harnesses, blowers, etc., that must be carried in each vehicle will depend on the nature of the sampling location.

In order to keep the equipment in good working order, the equipment should be maintained and cleaned on a regular basis. Routine maintenance and cleaning procedures should be written into procedures.

Sampling Equipment Maintenance

Basic maintenance for samplers includes: periodic calibration and general equipment checking, and replacement of the internal desiccant and fuses. Routine cleaning should be done as covered in SOP.

Basic maintenance of the flow meters includes: periodic replacement of the internal desiccant, plotter paper, ribbon, fuses, and any broken re-roll spool assemblies.

Note: on this assembly there are two tabs on the sides of this piece which are extremely thin and easily broken.

The NiCad and Gel Cell batteries need to be recharged on a regular basis. Any battery that reads less than 12.50 when checked should not be installed or left on any of the sampling equipment. At the battery charging station, areas are set aside for batteries that need to be charged and batteries already charged.

To prolong battery life, batteries should be charged for a maximum of 24 hours, in accordance with the procedures described in the manufacturer's operations and maintenance manuals.

It is important to note that charged NiCad batteries, if left unused for a long time, are nevertheless slowly discharging. Gel cell batteries are generally more stable. Voltage readings should be taken **before** the charged batteries are taken into the field to be sure that they still have a full charge.

When a sampler, flow meter, or ancillary equipment needs more specific repairs, the manufacturer representative should be contacted and arrangements made for repair or replacement of the equipment.

Cleaning Automatic Samplers

Samplers, sample jars, grab beakers, and all other equipment used in collecting samples must be cleaned between their use at each site, to avoid the possibility of cross contamination. Latex or nitrile gloves should be worn to protect against infections and acid burns. The following steps should be taken to ensure the proper cleaning of the sampling equipment.

(1) Break down the sampler and lay out the three components in a row.

(2) Place the strainers and weights in a plastic bucket.

(3) Set the glass composite jars and Teflon caps off to the side, to be cleaned separately from the samplers.

(4) Pour a small amount of diluted (1:128) O-Syl disinfectant and MICRO soap into each sampler component, the bucket containing the strainers and weights, and the composite jars.

(5) To clean the sampler components:

  (a) Partially fill the sampler bases and cover with water.

  (b) Use a brush to scrub the inside and outside of each sampling component. Using a small bottle brush, thoroughly scrub the inside of the intake tube and the float housing of the sampler head (these are critical areas since they come in contact with the sample).

  (c) Rinse off the soap with fresh water.

  (d) Stack each component so that it will dry quickly and thoroughly.

  (e) Reassemble the sampler after the components are dry, and store it in the proper compartment of the sampling van. Leave the sampler lid loose so moisture won't be trapped.

  (f) Clean the strainers and weights in the bucket. Empty the contents of the bucket and rinse the bucket, strainers, and weights. After they have dried, place them in the proper storage areas of the sampling van.

  (g) Drain the wastewater tank of the sampling van into the sewer drain.

  (h) Refill the fresh-water tank on the sampling van with potable water.

Sampler Bottle Cleaning and Preparation Examples

(1) Fill each jar with O-Syl (same dilution as used in the sampler disinfection), MICRO soap, and fresh water.

(2) Thoroughly scrub the inside and outside of the jars until they are sparkling clean. Make sure that all oil and grease are removed.

(3) Triple rinse the jars with fresh water.

(4) Pour a small amount of 1:1 nitric acid into one jar, and securely place the proper Teflon cap on the jar. Swirl the nitric acid throughout the jar, remove the lid, and pour the nitric acid into the next jar. Repeat this procedure until all the bottles have been treated. Rinse bottles with water after the acid wash. **NOTE:** Wear safety glasses or a full-face shield to protect your eyes.

(5) Place jars in the drying oven. If jars are to air dry, use Acetone to clean the bottles the same way as stated in (4) above. Let the jars and caps dry completely.

(6) Place the jars, with their caps on loosely, in their respective places on the sampling van.

Selection of Pretreatment Sampling Site
In order to ensure the collection of valid samples, a representative sampling site must be selected. For industrial sampling, the sites are designated in the permit.

Industrial Users - Permitted/Nonpermitted
The sampling points within an industry variy with each industry, depending on the nature of the process and location of pretreatment facilities. Therefore, exact locations must be identified on a case by case basis. However, the following general principles apply in all cases:

(1) A permanent sampling location(s) must be identified for use by the POTW and the IU.

All permitted industries are required to install a sampling vault. The location of the vault is designated by the enforcement inspector. The enforcement inspector responsible for an individual company or site is responsible for providing directions (**maps**) to the specific sampling points, as well as current copies of permits and the name of the contact person and phone number. This information needs to be kept current in the sampling file.

Locations of sampling points need to be compared to what is listed on the currant permit. If sampling points that the POTW is using do not agree with permit location, do not sample -refer to Chief Inspector or Supervisor or equivalent agency.

(2) The sampling location should be easily accessible and relatively free of safety hazards.

(3) For categorical industries, there should be, if possible, no discharge present other than that from the regulated process. If other wastestreams are combined with the regulated wastestream prior to the sampling location, the combined wastestream formula will need to be utilized. The sampling crew must be aware of lower limits to correctly show analysis on chain of custody.

(4) If the rate of industrial process discharge flow is needed (i.e., where mass limitations are applied), the sampling location will need to be located where the flow of the wastestream is known or can be measured or estimated and flow rates for the other wastestreams obtained.

(5) In instances where sampling must be performed in the sewer outside of the building, the IU must install a sampling vault in accordance with your Code.

Sample Type and Analyses Example

Typical sample volumes required for various analyses. In addition, the laboratory has developed standard volumes for routine analyses performed on industrial waste samples as follows:

(1) BOD/COD/TSS (1000-2000 ml, plastic)
(2) Heavy metals (500-2000 ml, plastic)
(3) Cyanide (2000 ml, plastic)
(4) Oil and grease (1000 ml, level-one glass)

Selection and Preparation of Sample Containers
The selection of a sample container is based on the parameter to be measured. The inspector should be familiar with the type of sampling containers and preservatives that are needed. It is essential that the sample containers be made of chemically resistant material, and do not affect the concentrations of the pollutants to be measured.

In addition, sample containers should have a closure (i.e., leak proof/resistant, Teflon lined) that protects the sample from contamination and should be properly labeled before leaving the sampling site.

Wastewater Sample Preservation
Wastewater usually contains one or more unstable pollutants that require immediate analysis or preservation until an analysis can be made.

Sample preservation is needed for composite samples, for example, which may be stored for as long as 24 hours prior to transferring them to the laboratory. Recommended preservatives and holding times that should be used for specific pollutants are presented in the front of this section.

Proper Sample Handling- *Example*

The proper handling of water quality samples also includes wearing gloves. Gloves not only protect field personnel, but also prevent potential contamination to the water sample. Always wear powderless, disposable gloves. When sampling for inorganics, wear latex gloves. Nitrile gloves are appropriate for organics.

The following sections provide a field reference for chain of custody procedures, sampling surface water and ground water, and further provides procedures for measuring field parameters and handling water-quality samples.

Use chain-of-custody procedures when coolers and containers are prepared, sealed and shipped. They will remain sealed until used in the field. When making arrangements with the laboratory, make sure you request enough containers, including those for blank and duplicate samples. Order extra sample bottles to allow for breakage or contamination in the field.

Some samples require low-temperature storage and/or preservation with chemicals to maintain their integrity during shipment and before analysis in the laboratory. The most common preservatives are hydrochloric, nitric, sulfuric and ascorbic acids, sodium hydroxide, sodium thiosulfate, and biocides.

Many laboratories provide pre-preserved bottles filled with measured amounts of preservatives. Although most federal and state agencies allow the use of pre-preserved sample containers, some may require either cool temperatures or added preservatives in the field.

When the containers and preservatives are received from the laboratory, check to see that none have leaked. Be aware that many preservatives can burn eyes and skin, and must be handled carefully. Sampling bottles should be labeled with type of preservative used, type of analysis to be done and be accompanied by a Safety Data Sheet (**SDS**).

Make sure you can tell which containers are pre-preserved, because extra care must be taken not to overfill them when collecting samples in the field. Check with the laboratory about quality control procedures when using pre-preserved bottles. Coolers used for sample shipment must be large enough to store containers, packing materials and ice. Obtain extra coolers, if necessary. Never store coolers and containers near solvents, fuels or other sources of contamination or combustion. In warm weather, keep coolers and samples in the shade.

Field Parameters
Measure and record the field parameters of temperature, electrical conductivity, pH and dissolved oxygen in an undisturbed section of stream flow. Other parameters may be measured, if desired.

Quality Assurance/Quality Control Example

Quality Assurance/Quality Control (**QA/QC**) measures taken by the sampling crew include equipment blanks, trip blanks, split samples and duplicate samples. Equipment blanks and trip blanks are routine QA/QC measures.

Split samples are taken for Local Limits(pretreatment) sampling and when requested by an industry or laboratory. Split samples requested by an industry are analyzed by their lab at their expense. Duplicate samples are run when requested by a Supervisor or Project Leader or equivalent agency.

The laboratory prepares all trip blanks/travel blanks used by the sampling crews. This is performed in the laboratory rather than in the field in order to assure that there is no field contamination in the blanks. Any contamination detected in the blanks would result from field exposure which could in turn affect collected samples.

Chain of Custody
Documentation of all pertinent data concerning the collection, preservation and transportation of samples is critical to the overall success of the Sampling Program. If sampling is performed for the Pretreatment program, any sampling data may be used as evidence in court proceedings against a noncompliant industrial user. In this case documentation becomes critical. This form is a legal document and is of major importance in a court hearing.

Specific procedures with regard to chain of custody are outlined below:

(1) The sampling crew takes a sufficient supply of pre-numbered Industrial Waste Lab Reports, (custody forms) and sample containers into the field.

(2) The sampling crew fills in the sampling form at the time of sample collection, and returns the form to the lab along with the collected sample. Specific information to be completed on the form includes:

(a) **CODE**: The company ID number assigned by supervisor.

(b) **SITE No.:** The sampling point ID number assigned by supervisor.

(c) **DATE SAMPLED**: From - Date sampling began To - Date sample is pulled. If it is a grab sample, only the date the sample was taken will be entered with the other line crossed out.

(d) **SUBMITTED BY**: This will have a preprinted truck number. The sampling crew will write in their initials on the blank line which follows.

(e) **LABEL:** A letter is checked and the type of analysis to be performed.

(f) **PRESERVATIVE:** The method of preservation used. See Table 8-5 to see which preservatives to use.

(g) **TYPE SAMPLE:** Check off whether flow proportional, timed composite, hand composite, or grab sample.

(h) **TIME:** The time frame needed for collection of the sample. A starting time for sample collection, an ending time, and a total time in hours and quarter hours is recorded, such as 23.25 hours. On a grab sample only, the end time, which is the time the sample was taken, will be entered and the other two lines will be crossed out.

(i) **RELINQUISHED BY**: This is the signature of person that relinquishes sample to lab personnel, or to any other person taking custody of the sample.

(j) **DATE**: Date sample is submitted to the laboratory or relinquished to another person.

(k) **NOTES TO LAB:** Includes any special notes to the lab, such as special analysis required of the sample, a letter code which is assigned to the entity being tested, the amount of flow if sample is flow proportional, grab sample pH and temperature, and/or actual sample temperature.

(l) **FIELD TEST**: Results of any field tests including sample pH, hexavalent chromium, dissolved sulfides, copper, and residual chlorine.

(m) **RESULTS**: The appropriate box(es) need to be checked to correspond to the label designation chosen above.

(3) When the sampling is completed at a site, the sampling crew labels the bottles with the label letter designation. The samples are sealed with chain of custody seals and placed in an ice chest for transportation to the lab.

(4) The sampling crew submits the samples and the chain of custody form to the laboratory.

(5) The laboratory logs the samples and assigns a Lab Reference Number to the sample. The sample is tracked by means of this number.

(6) Laboratory personnel sign and date the form, and return it to the sampling crew who makes two copies of the form. One copy is for the sampling crew files and the other is for data entry. The original form is returned to the laboratory. It is also important to note that the sampling vehicle should be kept locked at all times when the sampling crew is not in the vehicle, or in full view of the vehicle.

QA/QC FIELD PROCEDURES FOR SAMPLING *EXAMPLE*

DUPLICATE SAMPLING PROCEDURE

The purpose of Duplicate Samples is to check the laboratory's ability to reproduce analytical results. Duplicate Samples are to be collected using these steps:

1. Determine amount of sample needed. If a flow proportion sample is required, then base the amount of sample needed on the current flow reading. If a flow-proportion sample is not required, then use the predetermined amount for the sampling site.
2. Collect sample using a grab type sampler or a sampling head.
3. Measure the amount determined in Step 1 using a graduated cylinder or other accurate measuring device.
4. Pour measured sample into sample container that is not marked as the Duplicate Sample.
5. Measure same amount as in Step 1
6. Pour second measured quantity into sample container marked for Duplicate Sample.
7. Process both samples using standard procedures and submit both samples to laboratory.

SPLIT SAMPLING PROCEDURE *EXAMPLE*

The purpose of Split Samples is to check analytical procedures by having the samples analyzed by two different laboratories. Split Samples are to be collected using these steps:

1. Determine amount of sample needed. If a flow proportion sample is required, then base the amount of sample needed on the current flow reading. If a flow-proportion sample is not required, then use the predetermined amount for the sampling site.
2. Collect sample using a grab type sampler or a sampling head.
3. Measure the amount determined in Step 1 using a graduated cylinder or other accurate measuring device.
4. Pour measured sample into sample container that is not marked as the Split Sample.
5. Measure same amount as in Step 1
6. Pour second measured quantity into sample container marked for Split Sample.
7. Process both samples using standard procedures and submit both samples to the laboratory. The laboratory will be responsible for submitting the samples to the outside laboratory that will be analyzing the Split Sample.

TRIP BLANK PROCEDURE *EXAMPLE*

The purpose of Trip Blanks is to determine if the sample bottles have been adequately cleaned, and if sample contamination occurs between the time sample bottles leave the laboratory to the time that samples are returned to the lab.

Trip blanks are prepared by the laboratory using bottles supplied by the sampler. They are picked up by the person who begins the sampling day. Trip blanks are placed in the cooler which contains the other samples, and remain there until the samples are turned into the laboratory.

FIELD EQUIPMENT BLANK PROCEDURE *EXAMPLE*

The purpose of Field Equipment Blanks is to test the procedure for cleaning the sample measuring container to determine if cross contamination between sample sites has occurred. These Blanks are needed only at sites where flow-proportion samples are taken. Follow these steps when collecting a Field Equipment Blank:

1. Collect Field Equipment Blank **AFTER** collecting a sample and **BEFORE** moving to the next sampling location.
2. After collecting sample, triple rinse sample measuring container, usually a graduated cylinder, using High Purity water.
3. Open a sealed bottle of High Purity Water.
4. Pour the High Purity Water into the sample measuring container that was just rinsed.
5. Pour the High Purity water from sample measuring device into sample bottles labeled for the Field Equipment Blanks.
6. Repeat Steps 3 through 5 until all Field Equipment Blank sample bottles have been filled.
7. Process samples using standard procedures and submit to laboratory.

An equipment blank is high purity water which has been collected in a composite sample bottle or a series of discrete bottles from an automatic sampler. Equipment blanks are used to evaluate the reliability of composite samples collected in the field.

The data produced from the equipment blank indicates the performance of the sample collection system, which involves the cleaning of sampling equipment, and accessories, preservation techniques, and handling of samples. The objective is to demonstrate that the samples are not contaminated by inadequate cleaning of equipment, contaminated preservation additives or sample collection techniques, and to provide documented records on Quality Assurance Practices.

Procedures to be followed in collecting the equipment blanks are outlined below. (Also see QA/QC check list, example.

(1) The sampler is to be assembled completely in the manner determined by the parameters the crew will be sampling (i.e. if sampling for organics, Teflon suction tubing must be used at that site). The composite jar inside the sampler must always be rinsed out thoroughly with high purity water.

(2) Program the sampler to collect the proper amount of high purity water that is representative of the sample parameters that will be collected at that site. Grab samples are excluded. Pump high purity water through the strainer and intake tubing prior to filling the sampler bottle. Then, place the strainer into as many fresh, uncontaminated bottles of high purity water as needed to collect the necessary volume of sample.

(3) If the sampler is set up in the discrete mode, the crew must then transfer the collected samples into the field composite bottle and shake to mix thoroughly.

(4) Transfer the sample from the field composite bottle into its respective lab sample bottles. Test and preserve the samples as appropriate for the parameters being analyzed.

(5) Follow the chain of custody procedures outlined in SOP for turning the samples in to the laboratory. All paperwork must be completed at this time, and all bottles must be marked accordingly. Custody seals must be used.

Sampling Technique/Procedure Examples

General Guidelines
In general, the following guidelines should be observed in conducting sampling activities:

(1) Samples being collected must be representative of the wastestream being tested.

(2) Samples shall be collected in uncontaminated containers and preserved properly.

(3) Samples should be of sufficient volume for the required analyses.

(4) Samples should be stored in a manner which does not alter the properties of the sample prior to chain of custody transfer.

(5) Samples should be properly and completely identified by marking them with the proper information.

(6) Sample lines should be as short as possible and the smallest practical diameter to facilitate purging, reduce lag time, and give adequate consideration to maximum transport velocity. Also, they should have sufficient strength to prevent structural failure.

(7) Sample lines should be pitched downward at least 10 percent to prevent settling or separation of solids contained by the sample.

(8) Samples should be delivered as quickly as possible to the laboratory.

Specific Sampling Techniques
Sampling techniques in addition to the above general guidelines must also recognize differences in sampling methodology, preservation, and analytical methods.

The following sections specify techniques that differ by pollutant group and discuss such factors as sampling methodology (e.g., composite, grab, etc.), type of container, preservation and holding time.

Sampling Techniques for Volatile Organics
Volatile organics are analyzed in accordance with EPA methods 601, 602, and 603.

Due to the volatility of these compounds, only grab samples can be taken. If a composite sample is needed, individual grab samples must be collected and composited in the laboratory prior to analysis.

The procedures that must be followed in taking these samples are outlined below.

NOTE: Gloves, clothing, face, and eye protection must be worn when handling volatile organics. In addition, the sampling crew must thoroughly clean those parts of the body that have been exposed to these materials.

(1) For each sampling date, the lab will also provide two additional bottles to be used as a backup in case of breakage. These sampling

vials are only good for one week. If any are unused, they must be returned to the lab for disposal.

(2) The lab will provide one sample trip blank per sampling date. This bottle is to be kept on ice until the samples are submitted to the lab. At least one day prior to sampling, go to the lab and request the sample bottles (40 ml vials) for the specific sampling site, as indicated by the sampling plan. The laboratory will arrange to have the appropriate number of sample bottles prepared, based on the number of analyses to be performed. The sampling crew should make sure that all bottles are provided for these samples by the lab technicians.

(3) Collect the sample in a clean glass beaker. Test for chlorine with the Hach test kit. If there is any chlorine residual, neutralize the chlorine with sodium thiosulfate ($Na_2S_2O_3$) and retest for chlorine. Repeat until there is no chlorine residual. Make notes on chain of custody sheet if extra amounts of sodium thiosulfate are required for neutralization.

(4) Remove the vials from the ice. There will be two empty vials for the 601 sample and two vials with HCl for the 602. The HCl will already have been measured into the vials by the lab personnel.

(5) Fill the vial to just overflowing in such a manner that no air bubbles pass through the sample as the vial is being filled. This is accomplished by pouring the sample from the beaker into the vial along the side of the vial to minimize the possibility of entrapping air in the sample. Do not rinse out or overfill the vials, this will wash out the preservative in the vial.

(6) Seal the vial so that no air bubbles are entrapped in it. Remember to put the Teflon side of the cap facing down onto the vial.

(7) To be sure there are no air bubbles, turn the vial upside down and tap it against the palm of the hand. Check to see if there are air bubbles along the sides or bottom of the vial. If there are bubbles, unseal the vial, top off the vial, and reseal. Check the vial again for the presence of bubbles.

(8) All samples must be maintained at 4°C from the time of collection until the time of extraction. Custody seals must be placed on all samples, and all paper work must be filled out properly.

(9) Return the sample bottles and QA/QC bottles to the laboratory the same day the sample is collected.

Acid/Base/Neutral Extractable Organics and Pesticides

Acid extractable organics are analyzed in accordance with EPA methods 604 and 625. Base/neutral extractable organics are analyzed in accordance with EPA method 625, or individual methods for various groups of compounds including EPA methods 605, 606, 607, 609, 611, and 612. Pesticides are analyzed in accordance with EPA method 608.

The procedures that must be followed in taking these samples are outlined below.

(1) Samples must be collected in certified clean one-gallon amber glass bottles with Teflon lids.

(2) Travel blanks or QA/QC bottles may not be required with the samples.

(3) Grab samples must be collected in amber glass bottles. They do not have to be completely filled, but must be a minimum of 1/3 to 1/2 full. Bottles should not be prewashed with samples prior to filling.

(4) For composite sampling, glass composite bottles must be used and pre-cleaned. Teflon tubing must be used for the suction piping. The pump tubing must be medium grade silicone rubber.

(5) The composite bottle in the sampler must be kept refrigerated (putting ice in the sampler) at 4°C. If amber glass is not used (i.e. 2 1/2-gallon clear composite sampler bottle), the sample must be protected from the light during collection and compositing. The compositing must be done in the field (i.e. when discrete sampling has been used).

(6) All samples must be iced at 4°C from the time of collection until extraction.

(7) The sample should be checked for the presence of chlorine using field test kits that provide results in accordance with EPA methods 330.4 and 330.5. If chlorine is determined to be present, 80 mg of sodium thiosulfate should be added to each bottle. The sample must be retested for chlorine. This procedure must be repeated until there is no residual of chlorine shown. The amount of sodium thiosulfate added must be noted on the chain of custody if in excess of 80 mg.

(8) All necessary paperwork must be completed at sampling site. All bottles must be properly labeled, and have custody seals.

Sampling Techniques for Heavy Metals

(1) Generally, all metal samples collected are to be composite samples, i.e., flow/composite, time/composite, or hand composite.

(2) For composite sampling, place the lid on the bottle and agitate the bottle to completely mix the composite sample.

(3) Transfer the required amount from the composite container to either a 500 ml or 2000 ml clean plastic bottle. Check the pH of the sample.

Note: For inductively coupled plasma (**ICP**) metal analysis, a 500 ml clean plastic bottle is required. For extra metals or metals by furnace, a 2000 ml clean plastic bottle is required.

(4) Add nitric acid (1:1 solution) to the sample to reduce the pH to below 2.0. Usually, 2 ml/500 ml is sufficient. Recheck the pH to be sure it is below 2.0. Make a note on the lab sheet if more than two ml of acid is required to bring the pH below 2.0.

(5) Label the sample bottle with the corresponding IW number and proper analysis code letter. Attach the custody seal to the sample, then store in the ice chest until transferred to the laboratory. Fill out the IW lab sheet with all the pertinent information, being careful to include all required parameters and the type of analysis required, e.g., ICP/furnace.

(6) When a grab sample is necessary, rinse out the receiving sample bottle with an aliquot of the sample stream at least three times. Then fill the sample bottle and proceed with steps two through four described above.

(7) When a split sample is requested (i.e., one for the samplers and one for the user), the composite sample is prepared as described in item one. Providing there is sufficient sample, a portion is transferred into the bottle provided by the user.

(8) If more than one site is sampled per day, a clean composite container (i.e., two and one half-gallon glass jar), must be used at each site.

(9) If a discrete sampler is being used, at the time of collection combine all the samples that have been collected into a single clean composite bottle. Then follow the preceding steps one through four, and refer to step six if a split is requested.

Cyanide Example

To assure that the sample can be analyzed for cyanide, no chlorine can be present in the sample. Procedures for taking cyanide samples are as follows:

(1) This sample is normally a grab sample. The cyanide sample is a composite sample when collected as part of Priority Pollutants or Plant Sampling at the waste treatment plants.

(a) In the sampling file, check the industries' wastewater discharge permit and locate all cyanide (CN) sampling sites. If the sampling sites are located in a confined space, follow Confined Space procedures before collecting the sample or samples.

(b) Collect 2000 ml (maximum), 1000 ml (minimum), of CN sample into a type C plastic bottle.

NOTE: 2000 ml is the standard, but for batch dischargers 1000 ml is adequate.

(c) Test the cyanide sample for pH and temperature with the pH meter. Record the results on the custody sheet (Industrial Waste (IW) lab sheet).

(d) Test for chlorine with **Hach Total Chlorine Test Kit** (the instructions ate located in the kit)

(e) If chlorine is present in the CN sample, neutralize it with Ascorbic Acid ($C_6H_8O_6$). For ascorbic acid neutralization, add $C_6H_8O_6$, a few crystals at a time, until five mls of sample in the test tube produces no color. Then add an additional 0.06 g of $C_6H_8O_6$ for each liter of sample volume.

(f) Once all Cl_2 has been neutralized, preserve the sample with Sodium Hydroxide (NaOH) and raise the pH to >12. Verify the >12 pH with a pH meter or pH test strips.

(g) Mark on the side of the CN sample bottle the IW Lab sheet number (using a water proof marker), and place a corresponding custody seal across the sample bottle tightened cap. Place a Cyanide label on the bottle if cyanide is suspected of being present in the sample.

(h) Store the CN sample in the ice at 4°C and transport it to the laboratory.

Total Sulfides Example

(1) The Total Sulfide sample is collected as a grab sample only. Use a clean 500 ml plastic bottle to collect the sample. This sample may be pumped into the sample container or collected directly from the discharge side of the sampling device.

(2) Preserve the sample with 1 ml of 2N Zinc Acetate ($C_4H_6O_4Zn$) and then add Sodium Hydroxide (NaOH) to raise the pH > 9.

(3) Label and seal the sample with a custody seal. Cool to 4°C.

Oil and Grease/TPH Example

Oil and grease samples are collected as two separate samples:

METHOD 413.1 (Oil and Grease). Non-volatile hydrocarbons: vegetable oils, animal fats, waxes, soaps, and related matters.

METHOD 418.1 (TPH). Extractable petroleum hydrocarbons: light fuels and mineral oils.

(1) This is a grab sample only. The bottle used to take the sample must be the same bottle given to the laboratory for analysis. Do not pump or transfer the wastewater sample into the bottle. Obtain a level one clean 1000 ml glass bottle, do not use a pre-preserved bottle because you will lose the preservative when collecting the sample.

(2) Collect the sample by placing the bottle neck down (up-side down) into the effluent stream below the surface. This should be as close to the discharge pipe or point as physically possible. Turn the bottle, allowing the bottle to fill, while keeping the bottle below the surface. Remove the filled bottle and cap it. Never skim the surface of the effluent stream.

(3) Preserve the sample using five ml of sulfuric acid (H_2SO_4) for method 413.1 or hydrochloric acid (HCL) for method 418.1 (6:1 Ratio) to a pH of less than two. Reference 42 of methods 418.1 and 41 of methods 413.1.
When more than five ml of HCL is used to lower the pH to less than two, make note of how much additional acid is used, and record this on the lab sheet. Also indicate required analyses method on lab sheet.

(4) After making sure the sample is well mixed and preserved, seal and attach the proper identification (custody) label to the bottle. Then attach a custody seal across the lid. Store all samples at 4°C.

(5) Under no circumstances are Inspectors to collect an oil and grease sample or any other grab sample for IUs.

(6) All samples must be taken from a good representative flow. If there is any question as to whether there is sufficient flow for a representative sample, do not collect any sample. Make the necessary notes in the file report as to why no sample was obtained.

BOD/COD/SS Example

(1) 24-hour composite sampling is always used for this test. Agitate the bottle to completely mix the composite sample. Do not allow the solids to settle out before you pour off the sample.

(2) When more than one sample is being taken from a composite bottle, the BOD/COD/SS is taken first. The lab needs 1000 ml if the sample is cloudy or has solids. If the sample is clear, you must collect 2000 ml. Transfer the appropriate volume to the sample bottle.

(3) Take the pH/temperature of the sample with either pH paper and a thermometer, or the pH meter carried on the sampling trucks.

(4) Label the sample bottle and place a custody seal over the lid. Store on ice at 4°C.

(5) Should split samples be requested, they are given when it is sure there is enough sample for POTW's requirements. Users must provide their own sample containers and allow POTW's staff to pour off samples.

Virus Sampling Procedure Example

Viruses are microbiological organisms which can cause infectious diseases. Wastewater recharge, sewage disposal and stormwater drainage into the environment may contribute to the occurrence of viruses in surface water and groundwater.

Viruses are the most mobile and infectious of the waterborne pathogens. Large volumes of water must be filtered to detect viruses. This involves passing the water samples through a cartridge filter by use of a gasoline driven pump.

(1) **Equipment Needed**

Most of the equipment required for virus sampling should be readily available on your sampling trucks. However, some equipment is virus sampling specific. The needed equipment is as follows:

(a) Gasoline/oil powered water pump
(b) Hoses - intake (supplied with pump) and discharge (garden type, with female connectors at both ends)
(c) Two 55-gallon plastic containers
(d) Filter apparatus
(e) Cartridge filters
(f) Sodium thiosulfate (two 500 gram bottles/site)
(g) Gasoline can with gas/oil mixture
(h) Hach total chlorine test kit
(i) Large plastic Zip-lock bags (supplied with cartridges)
(j) Chain of custody sheets
(k) Thermometer
(l) Water-proof marker
(m) Latex gloves
(n) Liquid bleach
(o) Cooler with blue ice
(p) pH meter

(2) **Sampling Procedure Example**

Check the pump for gas/oil prior to starting (**Note**: do not fill while it is running). Make sure the gas/oil mixture is correct by checking the mixing instructions on the side of the two-cycle pump oil can. Latex gloves should be worn for protection, and to prevent contamination of the filters.

Connect the hoses and filter housing (with no filter) to the pump, and run the effluent through it for one to two minutes to flush the system. Next, pump effluent into the two 55-gallon drums and rinse them out. (**Note**: If disinfection was not possible after the last sampling, then 50-100 gallons of effluent should be pumped through the entire equipment set up prior to placing the filter in the housing.)

Pump effluent almost to the top (just above the handles) of both containers. While the drums are filling, check the water in the drums for chlorine using the Hach test kit and record the results and the temperature on the custody sheet. If chlorine is present and needs to be eliminated, add 500 grams of sodium thiosulfate to each container to eliminate it.

After visual observation has determined that all the sodium thiosulfate has dissolved, retest to make sure there is a <0.1 ppm chlorine residual. If chlorine was removed, take the hose from the channel, allow it to drain, and re-prime the pump with the de-chlorinated water.

Pump this water through the system to flush it, and adjust the flow to fill a one-gallon jug in about 15-20 seconds. Don't waste too much water, as the flow can be adjusted after the filter is inserted. Install the filter into the blue holder, being very careful not to touch it with your hands (wear clean latex gloves). There are two black washers that go with the filter, one on the bottom and the other on the top. Make sure these are aligned with the filter housing to prevent leaking. Screw the holder and filter onto the apparatus.

Refuel the pump, restart it, and adjust the water flow so that it is close to 15-20 seconds per gallon. Make sure the housing doesn't leak. Try to keep this amount of flow, since too great a flow will cause pass-through in the filter. Pump the water from both containers until they are empty.

Stop the pump, remove the filter (wear clean latex gloves), and place it in its original zip-lock bag. The washers do not need to go with the filter, but if they fall into the bag it is better to leave them than take the chance of contaminating the filter trying to remove them.

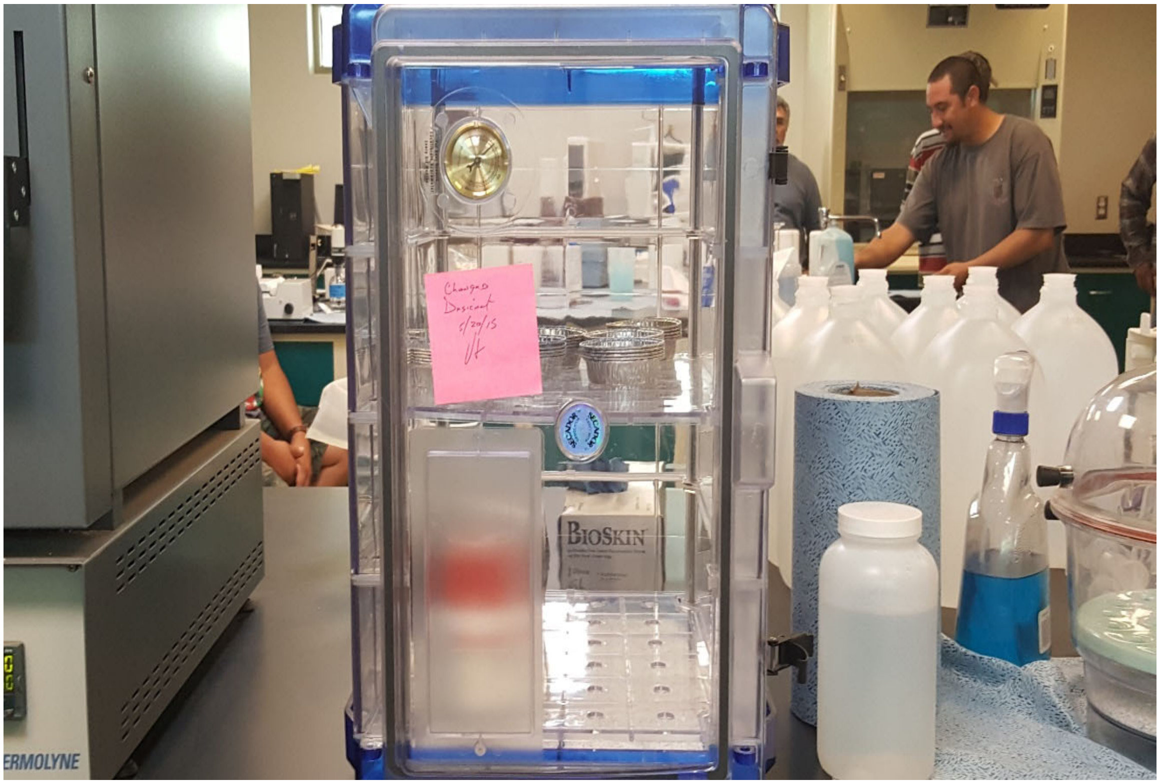
Fill in the information area on the zip-lock bag with a marker, indicating the plant being sampled and the date, and put it in the cooler with the blue ice provided. The blue ice keeps the temperature at 4°C to prevent significant die-off of the viruses.

While at the site, or later at the plant, mix a half-gallon of bleach to 10 gallons of clean water. Pump it through the flow system and the containers. Rinse everything with fresh water and drain it so it is ready for the next time. Let the pump cool before storing it. Store the gas/oil mixture in the warehouse flammable storage cabinet.

Parasitological Sampling

Parasitological sampling utilizes the same equipment and techniques as in the virus sampling described above. However, a different type of filter, which is normally provided by your laboratory is used.

Laboratory Analysis Section



Wastewater treatment operators run laboratory tests and analysis to monitor the treatment plant operation. These analyses are for testing the process control and indicate how well a particular process is working. Operators will analyze the results and if needed, will make operational adjustments.

In a typical wastewater treatment plant, there are several locations to sample. As wastewater flows through the treatment plant, including the collection system, its characteristics frequently change. By taking samples at different locations throughout the process, the operator has a better understanding of how to treat the flow.

Laboratory duties include some of the following:

- Collect and preserve samples
- Prepare samples for analysis
- Analyze samples and interpret results
- Operate and maintain equipment and instruments
- Handle chemicals and wastes (PPE)
- Quality assurance/quality control (Engineering and Administrative controls)
- Manage laboratory
- Laboratory safety (OSHA)

SAMPLING PLAN

Prior to laboratory analysis a sampling plan should consider the following:

1. Why is the sample being collected?
2. What tests need to be performed?
3. At what location will the sample be taken?
4. Will the sample be analyzed at the location?
5. When and how often must the sample be analyzed?
6. Is it a grab or composite sample?
7. Is it for process control or compliance?

Technical Learning College

Grab Samples (Snapshot)
A grab sample consists of a single container or large bucket of wastewater analyzed at one specific time. Grab samples indicate the condition of the wastewater at that specific time and may or may not represent the normal conditions. Grab samples are required when the analysis change rapidly. For instance, grab samples are required for certain tests such as temperature, pH, D.O. (dissolved oxygen), and bacteriological analysis.

Composite Samples
A composite sample consists of several grab samples collected from the same spot over a specific period of time and merged into a single sample. A composite sample is more arduous, complicated and usually inconvenient than a simple grab sample. Collecting a sample every few minutes and adding it to a single bottle is tedious, boring, and costly. To help solve this problem, a 24-hour automatic sampler is often used. The automatic sampler consists of a battery pack, a programmable timer, a pump, and as many as 24 bottles.

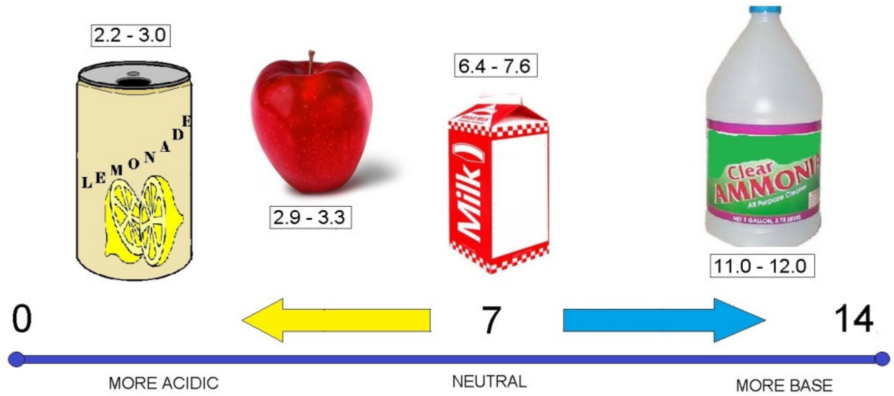
The automatic sampler has the capability to be programmed to draw a certain volume of sample every few minutes and deposit each sample into one bottles that are preserved or refrigerated. At the end of the sampling period, the operator can retrieve the bottles, bring them back to the lab and create a single composite sample. Analysis can now be performed on a single composite sample that is more representative of the wastewater quality than a grab sample.

Unweighted Composite
An unweighted composite collects the same sample volume at a constant time interval. For example, the operator collects 100 ml every hour for 6 hours. At the end of the time period, there will be 12 individual bottles representing the wastewater quality over the 6 hour time period. The operator now composites the samples by pouring from each bottle into a large bottle and mixes the composite.

Flow Weighted Composite
A flow meter is connected to the composite sampler and the sampler is programed to draw at different flow intervals. As the flow increases so does the number of samples.

The refrigerated automatic WWT sampler will have a Data programmer that will allow you to set the time to collect the sample or samples. This machine can also measure the amount of the sample. These can devices also be used for the collection of composite samples. Sometimes you will see a pH probe with real-time readings sent to the Operator's Command Center. These are a common sight at most wastewater plants and SIUs.

pH Testing Section



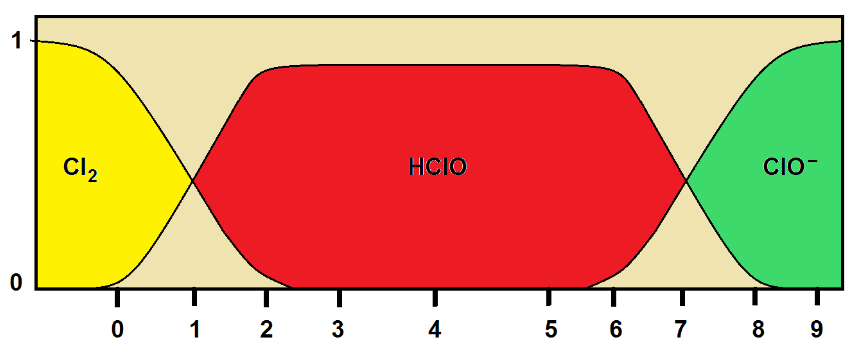
pH SCALE

In water and wastewater processes, **pH** is a measure of the acidity or basicity of an aqueous solution. Solutions with a pH greater than 7 are basic or alkaline and solution or samples with a pH less than 7 are said to be acidic. Pure water has a pH very close to 7.

Primary pH standard values are determined using a concentration cell with transference, by measuring the potential difference between a hydrogen electrode and a standard electrode such as the silver chloride electrode. The pH scale is traceable to a set of standard solutions whose pH is established by international agreement.

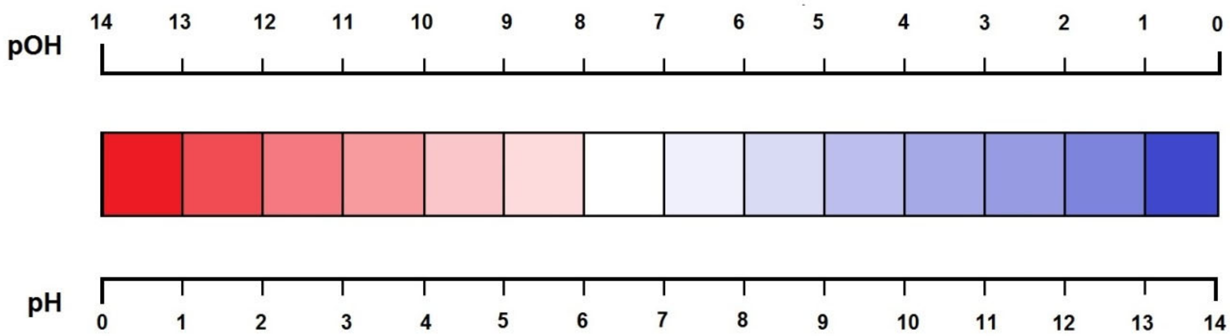
Measurement of pH for aqueous solutions can be done with a glass electrode and a pH meter, or using indicators like strip test paper.

pH measurements are important in water and wastewater processes (sampling) but also in medicine, biology, chemistry, agriculture, forestry, food science, environmental science, oceanography, civil engineering, chemical engineering, nutrition, water treatment & water purification, and many other applications.



pH - VALUE

Mathematically, pH is the measurement of hydroxyl ion activity and expressed as the negative logarithm of the activity of the (solvated) hydronium ion, more often expressed as the measure of the hydronium ion concentration.



IN RELATION BETWEEN p(OH) AND p(H) (red= ACIDIC / blue= BASIC)

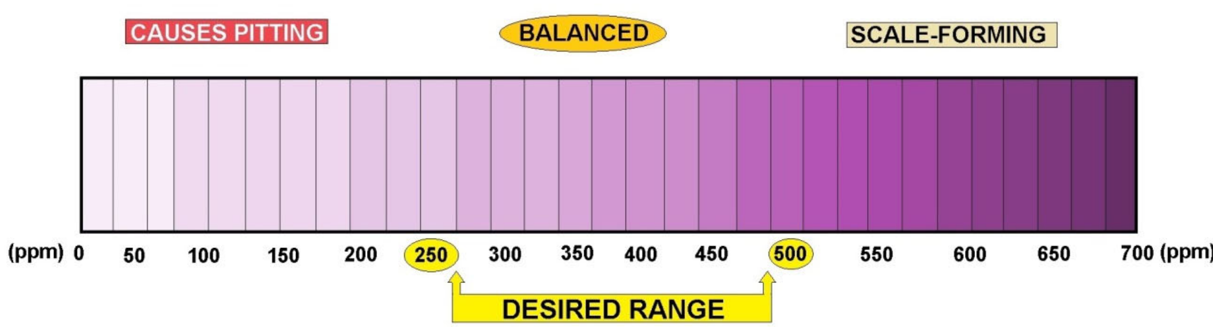
Contents

History

The scientific discovery of the p[H] concept of was first introduced by Danish chemist Søren Peder Lauritz Sørensen at the Carlsberg Laboratory back in 1909 and revised to the modern pH in 1924 to accommodate definitions and measurements in terms of electrochemical cells. In the first papers, the notation had the "H" as a subscript to the lowercase "p", as so: pH.

Alkalinity

Alkalinity is the quantitative capacity of an aqueous solution to neutralize an acid. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It is one of the best measures of the sensitivity of the stream to acid inputs. There can be long-term changes in the alkalinity of rivers and streams in response to human disturbances.



CALCIUM HARDNESS MEASUREMENT

Reference. Bates, Roger G. Determination of pH: theory and practice. Wiley, 1973.

pH Definition and Measurement

CONCENTRATION OF HYDROGEN IONS COMPARED TO DISTILLED H2O		EXAMPLES OF SOLUTIONS AND THEIR RESPECTIVE pH
1/10,000,000	14	LIQUID DRAIN CLEANER CAUSTIC SODA
1/1,000,000	13	BLEACHES OVEN CLEANERS
1/100,000	12	SOAPY WATER
1/10,000	11	HOUSEHOLD AMMONIA (11.9)
1/1,000	10	MILK OF MAGNESIUM (10.5)
1/100	9	TOOTHPASTE (9.9)
1/10	8	BAKING SODA (8.4) / SEA WATER EGGS
0	7	"PURE" WATER (7)
10	6	URINE (6) / MILK (6.6)
100	5	ACID RAIN (5.6) BLACK COFFEE (5)
1000	4	TOMATO JUICE (4.1)
10,000	3	GRAPEFRUIT & ORANGE JUICE SOFT DRINK
100,000	2	LEMON JUICE (2.3) VINEGAR (2.9)
1,000,000	1	HYDROCHLORIC ACID SECRETED FROM STOMACH LINING (1)
10,000,000	0	BATTERY ACID

pH Scale

Technical Definition of pH
In technical terms, pH is defined as the decimal logarithm of the reciprocal of the hydrogen ion activity, *a*H+, in a solution.

$$pH = -\log_{10}(a_H+) = \log_{10}\left(\frac{1}{aH+}\right)$$

Ion-selective electrodes are often used to measure pH, respond to activity.

In this calculation of electrode potential, *E*, follows the Nernst equation, which, for the hydrogen ion can be written as

$$E = E^0 + \frac{RT}{F} \ln(a_H+) = E^0 - \frac{2.303RT}{F} pH$$

where *E* is a measured potential, E^0 is the standard electrode potential, *R* is the gas constant, *T* is the temperature in kelvin, *F* is the Faraday constant. For H^+ number of electrons transferred is one. It follows that electrode potential is proportional to pH when pH is defined in terms of activity.

International Standard ISO 31-8 is the standard for the precise measurement of pH as follows: A galvanic cell is set up to measure the electromotive force (EMF) between a reference electrode and an electrode sensitive to the hydrogen ion activity when they are both immersed in the same aqueous solution.

The reference electrode may be a silver chloride electrode or a calomel electrode. The hydrogen-ion selective electrode is a standard hydrogen electrode.

Reference electrode | concentrated solution of KCl || test solution | H_2 | Pt

Firstly, the cell is filled with a solution of known hydrogen ion activity and the emf, E_S, is measured. Then the emf, E_X, of the same cell containing the solution of unknown pH is measured.

$$pH(X) = pH(S) + \frac{E_s - E_x}{z}$$

The difference between the two measured emf values is proportional to pH. This method of calibration avoids the need to know the standard electrode potential. The proportionality constant, *1/z* is ideally equal to $\frac{1}{2.303RT/F}$ the "Nernstian slope".

If you were to apply this practice the above calculation, a glass electrode is used rather than the cumbersome hydrogen electrode. A combined glass electrode has an in-built reference electrode. It is calibrated against buffer solutions of known hydrogen ion activity. IUPAC has proposed the use of a set of buffer solutions of known H^+ activity.

Two or more buffer solutions should be used in order to accommodate the fact that the "slope" may differ slightly from ideal.

The electrode is first immersed in a standard solution and the reading on a pH meter is adjusted to be equal to the standard buffer's value, to implement the proper calibration. The reading from a second standard buffer solution is then adjusted, using the "slope" control, to be equal to the pH for that solution. Further details, are given in the IUPAC recommendations.

When more than two buffer solutions are used the electrode is calibrated by fitting observed pH values to a straight line with respect to standard buffer values. Commercial standard buffer solutions usually come with information on the value at 25 °C and a correction factor to be applied for other temperatures. The pH scale is logarithmic and pH is a dimensionless quantity.

pH Indicators

Visual comparison of the color of a test solution with a standard color chart provides a means to measure pH accurate to the nearest whole number. Indicators may be used to measure pH, by making use of the fact that their color changes with pH. More precise measurements are possible if the color is measured spectrophotometrically, using a colorimeter of spectrophotometer. Universal indicator consists of a mixture of indicators such that there is a continuous color change from about pH 2 to pH 10. Universal indicator paper is made from absorbent paper that has been impregnated with universal indicator.

pOH

pOH is sometimes used as a measure of the concentration of hydroxide ions, OH^-, or alkalinity. pOH values are derived from pH measurements. The concentration of hydroxide ions in water is related to the concentration of hydrogen ions by

$$[\mathrm{OH^-}] = \frac{K_W}{[\mathrm{H^+}]}$$

where K_W is the self-ionization constant of water. Taking logarithms

$$\mathrm{pOH} = \mathrm{pK_W} - \mathrm{pH}$$

So, at room temperature pOH ≈ 14 − pH. However this relationship is not strictly valid in other circumstances, such as in measurements of soil alkalinity.

Extremes of pH

Measurement of pH below about 2.5 (ca. 0.003 mol dm^{-3} acid) and above about 10.5 (ca. 0.0003 mol dm^{-3} alkali) requires special procedures because, when using the glass electrode, the Nernst law breaks down under those conditions.

Extreme pH measurements imply that the solution may be concentrated, so electrode potentials are affected by ionic strength variation. At high pH the glass electrode may be affected by "alkaline error", because the electrode becomes sensitive to the concentration of cations such as Na^+ and K^+ in the solution. Specially constructed electrodes are available which partly overcome these problems. Runoff from industrial outfalls, restaurant grease, mines or mine tailings can produce some very low pH values.

Non-aqueous Solutions

Hydrogen ion concentrations (activities) can be measured in non-aqueous solvents. pH values based on these measurements belong to a different scale from aqueous pH values, because activities relate to different standard states. Hydrogen ion activity, a_{H^+}, can be defined as:

$$a_{H+} = \exp\left(\frac{\mu_{H+} - \mu^{\ominus}_{H+}}{RT}\right)$$

where μ_{H^+} is the chemical potential of the hydrogen ion, $\mu^{\ominus}_{H^+}$ is its chemical potential in the chosen standard state, R is the gas constant and T is the thermodynamic temperature. Therefore pH values on the different scales cannot be compared directly, requiring an intersolvent scale which involves the transfer activity coefficient of hydrolyonium ion.

pH is an example of an acidity function. Other acidity functions can be defined. For example, the Hammett acidity function, H_0, has been developed in connection with superacids.

The concept of "Unified pH scale" has been developed on the basis of the absolute chemical potential of the proton. This scale applies to liquids, gases and even solids.

Applications
Water has a pH of $pK_w/2$, so the pH of pure water is about 7 at 25 °C; this value varies with temperature. When an acid is dissolved in water, the pH will be less than that of pure water. When a base, or alkali, is dissolved in water, the pH will be greater than that of pure water.

A solution of a strong acid, such as hydrochloric acid, at concentration 1 mol dm^{-3} has a pH of 0. A solution of a strong alkali, such as sodium hydroxide, at concentration 1 mol dm^{-3}, has a pH of 14. Thus, measured pH values will lie mostly in the range 0 to 14, though negative pH values and values above 14 are entirely possible.

Since pH is a logarithmic scale, a difference of one pH unit is equivalent to a tenfold difference in hydrogen ion concentration.

The pH of an aqueous solution of pure water is slightly different from that of, a salt such as sodium chloride even though the salt is neither acidic nor basic. In this case, the hydrogen and hydroxide ions' activity is dependent on ionic strength, so K_w varies with ionic strength. The pH of pure water decreases with increasing temperatures. One example is the pH of pure water at 50 °C is 6.55.

Seawater
The pH of seawater plays an important role in the ocean's carbon cycle, and there is evidence of ongoing ocean acidification caused by carbon dioxide emissions. pH measurement can be complicated by the chemical properties of seawater, and several distinct pH scales exist in chemical oceanography.

As part of its operational definition of the pH scale, the IUPAC defines a series of buffer solutions across a range of pH values (often denoted with NBS or NIST designation).

These solutions have a relatively low ionic strength (~0.1) compared to that of seawater (~0.7), and, as a consequence, are not recommended for use in characterizing the pH of seawater, since the ionic strength differences cause changes in electrode potential.

To resolve this problem, an alternative series of buffers based on artificial seawater was developed. This new series resolves the problem of ionic strength differences between samples and the buffers. The newest pH scale is referred to as the **total scale**, often denoted as **pH_T**.

Calculations of pH

The calculation of the pH of a solution containing acids and/or bases is an example of a chemical speciation calculation, that is, a mathematical procedure for calculating the concentrations of all chemical species that are present in the solution.

The complexity of the procedure depends on the nature of the solution.

If the pH of a solution contains a weak acid requires the solution of a quadratic equation.

If the pH of a solution contains a weak base may require the solution of a cubic equation.

For strong acids and bases no calculations are necessary except in extreme situations.

The general case requires the solution of a set of non-linear simultaneous equations.

A complicating factor is that water itself is a weak acid and a weak base. It dissociates according to the equilibrium

$$2H_2O \rightleftharpoons H_3O^+(aq) + OH^-(aq)$$

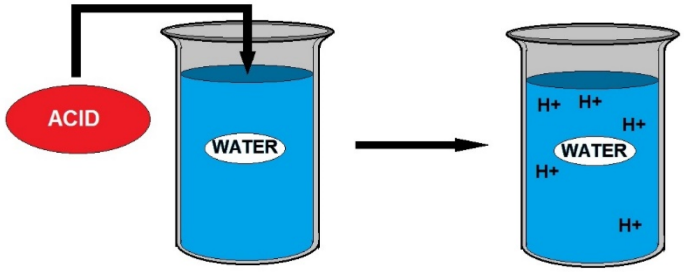
with a dissociation constant, K_w defined as

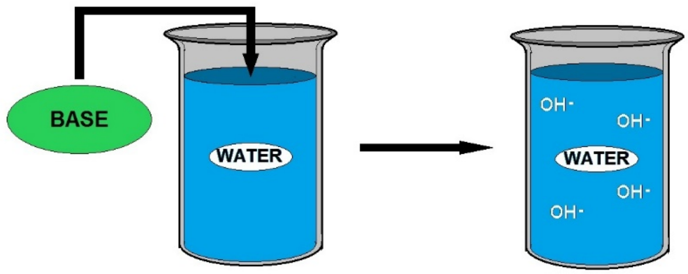
$$K_w = [H^+][OH^-]$$

where $[H^+]$ represents for the concentration of the aquated hydronium ion and $[OH^-]$ stands for the concentration of the hydroxide ion. K_w has a value of about 10^{-14} at 25 °C, so pure water has a pH of approximately 7.

This equilibrium needs to be considered at high pH and when the solute concentration is extremely low.

Strong Acids and Bases





Strong Acids and Bases
Strong acids and bases are compounds that, for practical purposes, are completely dissociated in water. Under normal circumstances this means that the concentration of hydrogen ions in acidic solution can be taken to be equal to the concentration of the acid. The pH is then equal to minus the logarithm of the concentration value.

Hydrochloric acid (HCl) is an example of a strong acid. The pH of a 0.01M solution of HCl is equal to $-\log_{10}(0.01)$, that is, pH = 2.

Sodium hydroxide, NaOH, is an example of a strong base. The p[OH] value of a 0.01M solution of NaOH is equal to $-\log_{10}(0.01)$, that is, p[OH] = 2.

From the definition of p[OH] above, this means that the pH is equal to about 12. For solutions of sodium hydroxide at higher concentrations the self-ionization equilibrium must be taken into account.

Weak Acids and Bases
A weak acid or the conjugate acid of a weak base can be treated using the same formalism.

Acid: $HA \rightleftharpoons H^+ + A^-$
Base: $HA^+ \rightleftharpoons H^+ + A$

First, an acid dissociation constant is defined as follows. Electrical charges are omitted from subsequent equations for the sake of generality

$$K_a = \frac{[H][A]}{[HA]}$$

and its value is assumed to have been determined by experiment. This being so, there are three unknown concentrations, [HA], $[H^+]$ and $[A^-]$ to determine by calculation. Two additional equations are needed.

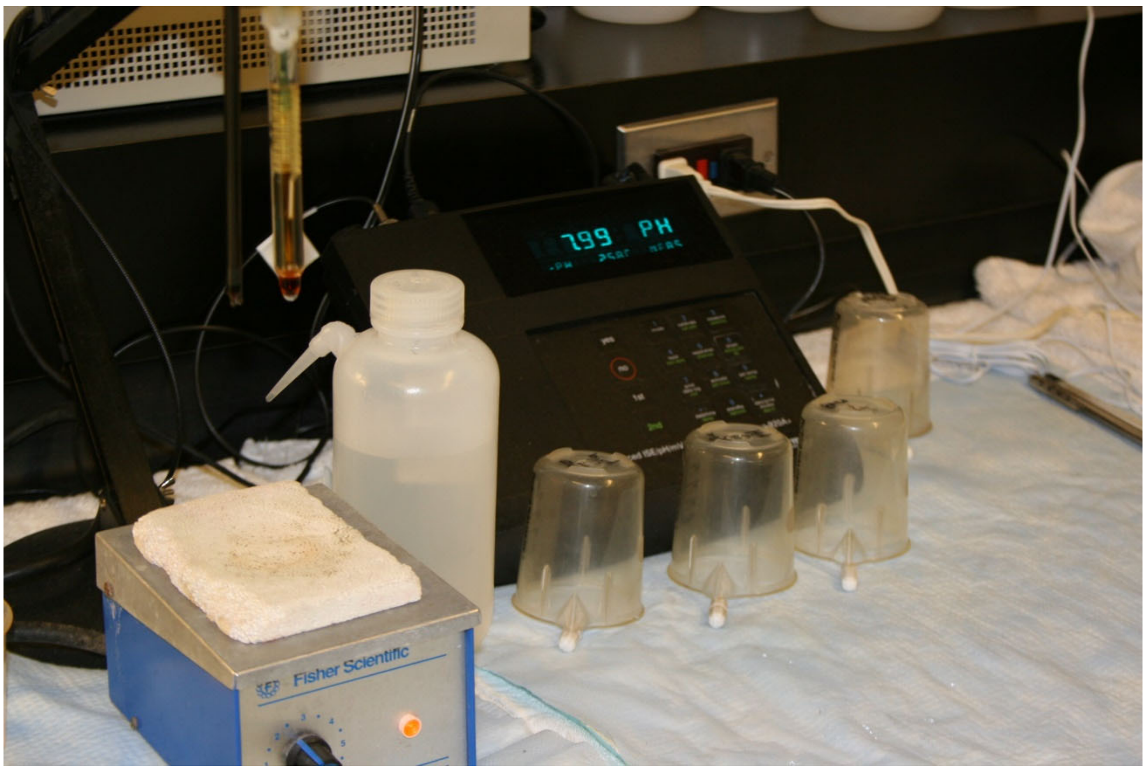
One way to provide them is to apply the law of mass conservation in terms of the two "reagents" H and A.

$$C_A = [A] + [HA]$$
$$C_H = [H] + [HA]$$

C stands for analytical concentration. In some texts one mass balance equation is replaced by an equation of charge balance. This is satisfactory for simple cases like this one, but is more difficult to apply to more complicated cases as those below.

Together with the equation defining K_a, there are now three equations in three unknowns. When an acid is dissolved in water $C_A = C_H = C_a$, the concentration of the acid, so [A] = [H]. After some further algebraic manipulation an equation in the hydrogen ion concentration may be obtained.

$$[H]^2 + K_a[H] - K_aC_a = 0$$



Dissolved Oxygen

Dissolved oxygen (**DO**) in water is not considered a contaminant. However, the (DO) level is important because too much or not enough dissolved oxygen can create unfavorable conditions. Generally, a lack of (DO) in natural waters creates anaerobic conditions. Anaerobic means without air. Certain bacteria thrive under these conditions and utilize the nutrients and chemicals available to exist. *Under anaerobic conditions the reaction is:*

Anaerobic:

$$\textbf{Organics} \rightarrow \textbf{intermediates} + CO_2 + H_2O + \textbf{energy}$$

Where the intermediates are butyric acid, mercaptans and hydrogen sulfide gas. At least two general forms of bacteria act in balance in a wastewater digester: Saprophytic organisms and Methane Fermenters. The saprophytes exist on dead or decaying materials. The methane fermenters live on the volatile acids produced by these saprophytes. The methane fermenting bacteria require a pH range of 6.6 to 7.6 to be able to live and reproduce. Aerobic conditions indicate that dissolved oxygen is present. Aerobic bacteria require oxygen to live and thrive. When aerobes decompose organics in the water, the result is carbon dioxide and water.

Aerobic:

$$\textbf{Organics} + \textbf{Oxygen} \rightarrow CO_2 + H_2O + \textbf{energy}$$

Dissolved Oxygen in a water sample can be detrimental to metal pipes in high concentrations because oxygen helps accelerate corrosion. Oxygen is an important component in water plant operations. Its primary value is to oxidize iron and manganese into forms that will precipitate out of the water. It also removes excess carbon dioxide. The amount of dissolved oxygen in a water sample will affect the taste of drinking water also.

Methods of Determination

There are two methods that we will be using in the lab. The membrane electrode method procedure is based on the rate of diffusion of molecular oxygen across a membrane. The other is a titrimetric procedure (Winkler Method) based on the oxidizing property of the (DO). Many factors determine the solubility of oxygen in a water sample. Temperature, atmospheric pressure, salinity, biological activity and pH all have an effect on the (DO) content.

Iodometric Test

The iodometric (titration) test is very precise and reliable for (DO) analysis of samples free from particulate matter, color and chemical interferences. Reactions take place with the addition of certain chemicals that liberate iodine equivalent to the original (DO) content. The iodine is then measured to the starch iodine endpoint. We then calculate the dissolved oxygen from how much titrate we use. Certain oxidizing agents can liberate iodine from iodides (positive interference), and some reducing agents reduce iodine to iodide (negative interferences). The alkaline Iodide-Azide reagent effectively removes interference caused by nitrates in the water sample, so a more accurate determination of (DO) can be made.

Methods of analysis are highly dependent on the source and characteristics of the sample. The membrane electrode method involves an oxygen permeable plastic membrane that serves as a diffusion barrier against impurities. Only molecular oxygen passes through the membrane and is measured by the meter. This method is excellent for field testing and continuous monitoring. Membrane electrodes provide an excellent method for (DO) analysis in polluted, highly colored turbid waters and strong waste effluents.

These interferences could cause serious errors in other procedures. Prolonged usage in waters containing such gases as H_2S tends to lower cell sensitivity. Frequent changing and calibrating of the electrode will eliminate this interference.

Samples are taken in BOD bottles where agitation or contact with air is at a minimum. Either condition can cause a change in the gaseous content. Samples must be determined immediately for accurate results.

The dissolved oxygen test is the one of the most important analyses in determining the quality of natural waters. The effect of oxidation wastes on streams, the suitability of water for fish and other organisms and the progress of self-purification can all be measured or estimated from the dissolved oxygen content. In aerobic sewage treatment units, the minimum objectionable odor potential, maximum treatment efficiency and stabilization of wastewater are dependent on maintenance of adequate dissolved oxygen. Frequent dissolved oxygen measurement is essential for adequate process control.

Terms Review

Aerobic (AIR-O-bick) - a condition in which free or dissolved oxygen is present in the aquatic environment.

Aerobic Bacteria (aerobes) – bacteria which will live and reproduce only in an environment containing oxygen. Oxygen combined chemically, such as in water molecules (H_2O), cannot be used for respiration by aerobes.

Anaerobic (AN-air O-bick) - a condition in which ***"free"*** or dissolved oxygen is not present in the aquatic environment.

Anaerobic Bacteria (anaerobes) – bacteria that thrive without the presence of oxygen.

Saprophytic Bacteria – bacteria that break down complex solids to volatile acids.

Methane Fermenters – bacteria that break down the volatile acids to methane (CH_4) carbon dioxide (CO_2) and water (H_2O).

Oxidation – the addition of oxygen to an element or compound, or removal of hydrogen or an electron from an element or compound in a chemical reaction. The opposite of reduction.

Reduction – the addition of hydrogen, removal of oxygen or addition of electrons to an element or compound. Under anaerobic conditions in wastewater, sulfur or compounds elemental sulfur are reduced to H_2S or sulfide ions.

This course contains general EPA's CWA federal rule requirements. Please be aware that each state implements wastewater/safety/environment regulations that may be more stringent than EPA's regulations. Check with your state environmental agency for more information.

Procedure for Dissolved Oxygen Determination

METER-PROBE METHOD

1. Collect a water sample in the clean 300-ml glass stoppered BOD bottle for two or three minutes to make sure there are no air bubbles trapped in the bottle. Do one Tap water sample and one DI water sample. Mark the BOD bottles.

2. Insert the DO probe from the meter into your BOD bottles. Record the DO for Tap and DI water. Now continue with the Winkler Burette method.

PROCEDURES FOR WINKLER BURET METHOD

1. Add the contents of one MANGANESE SULFATE powder pillow and one ALKALINE IODIDE-AZIDE reagent powder pillow to each of your BOD bottles (TAP and DI)

2. Immediately insert the stoppers so that no air is trapped in the bottles and invert several times to mix. A flocculent precipitate will form. It will be brownish-orange if dissolved oxygen is present or white if oxygen is absent.

3. Allow the samples to stand until the floc has settled and leaves the solution clear (about 10 minutes). Again invert the bottles several times to mix and let stand until the solution is clear.

4. Remove the stoppers and add the contents of one SULFAMIC ACID powder pillow to each bottle. Replace the stoppers, being careful not to trap any air bubbles in the bottles, and invert several times to mix. The floc will dissolve and leave a yellow color if dissolved oxygen is present.

5. Measure 200 ml of the prepared solution by filling a clean 250-ml graduated cylinder to the 200-ml mark. Pour the solutions into clean 250-ml Erlenmeyer flasks. Save the last 100 mls for a duplicate.

6. Titrate the prepared solutions with PAO Titrant, 0.025N, to a pale yellow color. Use a white paper under the flask.

7. Add two droppers full of Starch Indicator Solution and swirl to mix. A dark blue color will develop.

8. Continue the titration until the solution changes from dark blue to colorless (end point). Go Slow- drop by drop. Record the burette reading to the nearest 0.01mls.

9. The total number of ml of PAO Titrant used is equal to the mg/L dissolved oxygen.

Dissolved Oxygen Results

Meter Results

1. De-ionized water ____________________________________mg/L

2. Tap water ____________________________________mg/L

3. What is the meter procedure measuring?

4. What factors would determine which the best method to use is?

5. What are two forms of bacteria present in a wastewater digester?

Wrinkler Method Results

1. **De-ionized Water**

200ml final Burette reading-
Sample initial Burette reading- -________________ = _______________mg/L

100ml final Burette reading-
duplicate initial Burette reading- -_______________dup=______________mg/L
mls x 2

2. **Tap water**

200ml final Burette reading-
Sample initial Burette reading- -_______________=_________________mg/L
mls
100ml final Burette reading
Sample initial Burette reading- -_______________=__________________mg/L
mls x 2

3. What are some factors that can alter the (DO) content prior to testing?

4. Were your samples anaerobic or aerobic?

5. Why is it important to monitor the (DO) content of water and wastewater?

Be specific and give a detailed explanation.

Total Dissolved Solids Section

Water is a good solvent and picks up impurities easily. Pure water is tasteless, colorless, and odorless and is often called the universal solvent. Dissolved solids refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulfates) and some small amounts of organic matter that are dissolved in water.

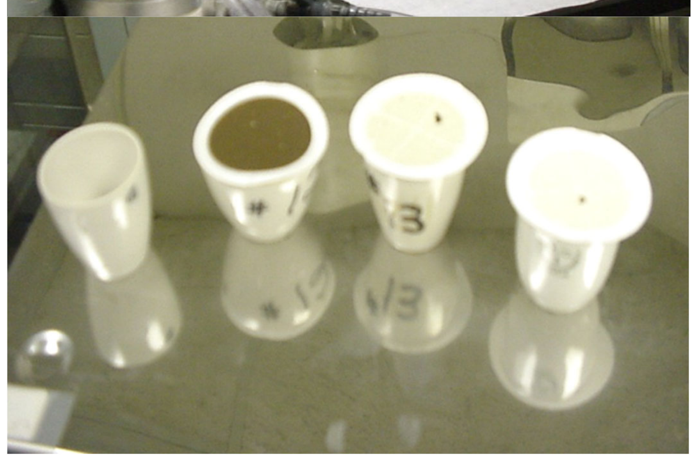
TDS in drinking-water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals used in the water treatment process, and the nature of the piping or hardware used to convey the water, i.e., the plumbing. In the United States, elevated TDS has been due to natural environmental features such as: mineral springs, carbonate deposits, salt deposits, and sea water intrusion, but other sources may include: salts used for road de-icing, anti-skid materials, drinking water treatment chemicals, stormwater and agricultural runoff, and point/non-point wastewater discharges.

In general, the total dissolved solids concentration is the sum of the cations (positively charged) and anions (negatively charged) ions in the water. Therefore, the total dissolved solids test provides a qualitative measure of the amount of dissolved ions, but does not tell us the nature or ion relationships.

In addition, the test does not provide us insight into the specific water quality issues, such as: Elevated Hardness, Salty Taste, or Corrosiveness. Therefore, the total dissolved solids test is used as an indicator test to determine the general quality of the water.

Total Solids

The term "total solids" refers to matter suspended or dissolved in water or wastewater, and is related to both specific conductance and turbidity.

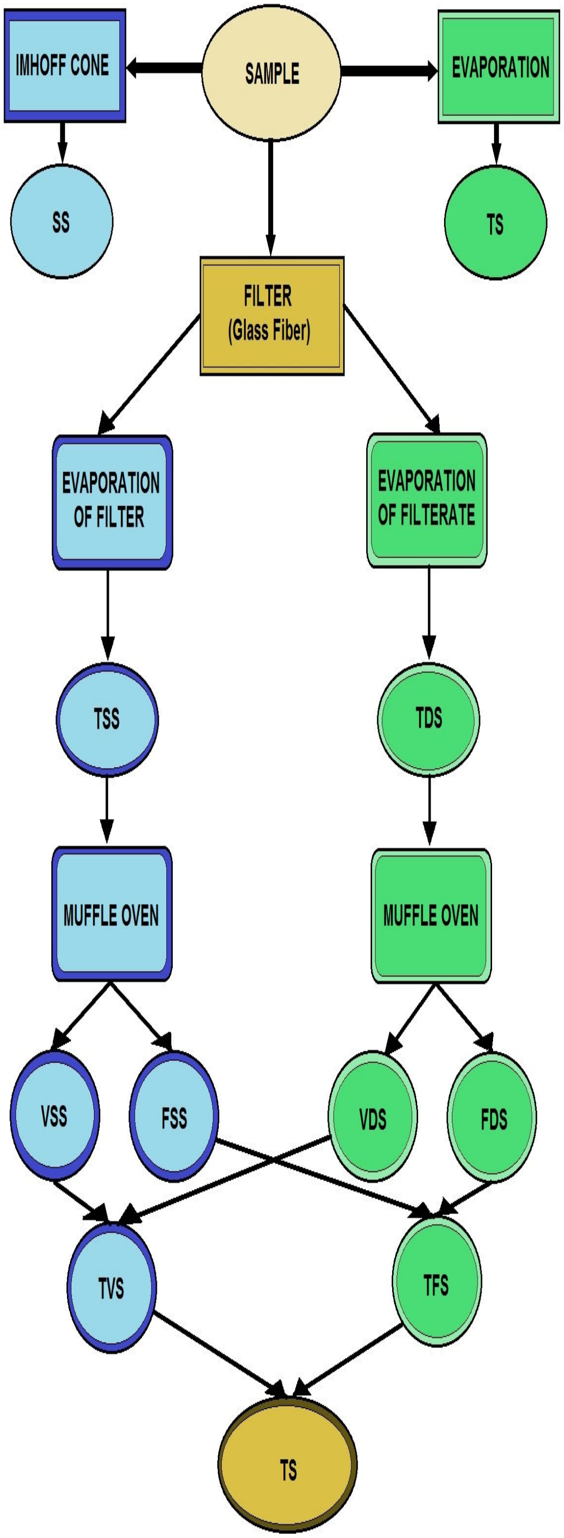


Total solids (also referred to as total residue) are the term used for material left in a container after evaporation and drying of a water sample.

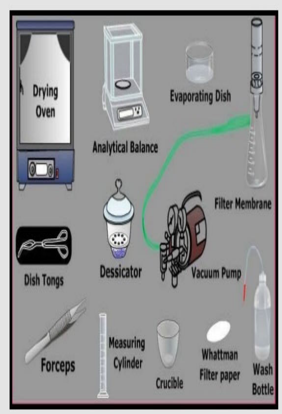
Total Solids includes both total suspended solids, the portion of total solids retained by a filter and total dissolved solids, the portion that passes through a filter (American Public Health Association, 1998).

Total solids can be measured by evaporating a water sample in a weighed dish, and then drying the residue in an oven at 103 to 105° C.

The increase in weight of the dish represents the total solids. Instead of total solids, laboratories often measure total suspended solids and/or total dissolved solids.



TSS: Total Suspended Solids
SS : Settled Solids
TS : Total Solids
FSS: Fixed Suspended Solids
TDS: Total Dissolved Solids
VDS: Volatile Dissolved Solids
FDS: Fixed Dissolved Solids
TVS: Total Volatile Solids
TFS: Total Fixed Solids
VSS: Volatile Suspended Solids



EQUIPMENT USED TO MEASURE AND DETERMINE TYPES OF SOLIDS

DETERMINATION OF DIFFERENT TYPES OF SOLIDS

Total Suspended Solids (TSS)
Total Suspended Solids (TSS) are solids in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life.

High TSS can block light from reaching submerged vegetation. As the amount of light passing through the water is reduced, photosynthesis slows down. Reduced rates of photosynthesis causes less dissolved oxygen to be released into the water by plants. If light is completely blocked from bottom dwelling plants, the plants will stop producing oxygen and will die. As the plants are decomposed, bacteria will use up even more oxygen from the water. Low dissolved oxygen can lead to fish kills.

Sampling downstream from a wastewater plant's discharge point.

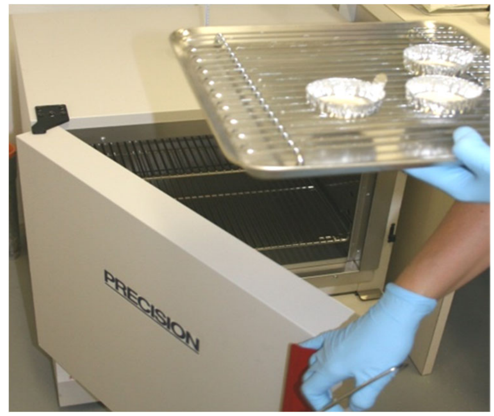
High TSS can also cause an increase in surface water temperature, because the suspended particles absorb heat from sunlight. This can cause dissolved oxygen levels to fall even further (because warmer waters can hold less DO), and can harm aquatic life in many other ways, as discussed in the temperature section. (The decrease in water clarity caused by TSS can affect the ability of fish to see and catch food.

Suspended sediment can also clog fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development. When suspended solids settle to the bottom of a water body, they can smother the eggs of fish and aquatic insects, as well as suffocate newly hatched insect larvae. Settling sediments can fill in spaces between rocks which could have been used by aquatic organisms for homes.

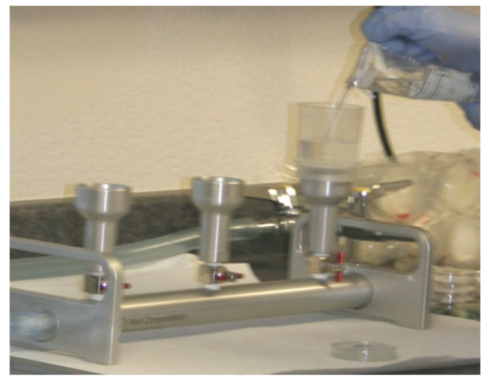
Dead fish in lake using reclaimed water.►

High TSS in a water body can often mean higher concentrations of bacteria, nutrients, pesticides, and metals in the water. These pollutants may attach to sediment particles on the land and be carried into water bodies with storm water. In the water, the pollutants may be released from the sediment or travel farther downstream. High TSS can cause problems for industrial use, because the solids may clog or scour pipes and machinery.

Measurement of Total Suspended Solids
To measure TSS, the water sample is filtered through a pre-weighed filter. The residue retained on the filter is dried in an oven at 103 to 105° C until the weight of the filter no longer changes. The increase in weight of the filter represents the total suspended solids. TSS can also be measured by analyzing for total solids and subtracting total dissolved solids.



Total Dissolved Solids (TDS) are solids in water that can pass through a filter (usually with a pore size of 0.45 micrometers). TDS is a measure of the amount of material dissolved in water.



This material can include carbonate, bicarbonate, chloride, sulfate, phosphate, nitrate, calcium, magnesium, sodium, organic ions, and other ions. A certain level of these ions in water is necessary for aquatic life. Changes in TDS concentrations can be harmful because the density of the water determines the flow of water into and out of an organism's cells (Mitchell and Stapp, 1992). However, if TDS concentrations are too high or too low, the growth of many aquatic lives can be limited, and death may occur.

Similar to TSS, high concentrations of TDS may also reduce water clarity, contribute to a decrease in photosynthesis, combine with toxic compounds and heavy metals, and lead to an increase in water temperature. TDS is used to estimate the quality of drinking water, because it represents the amount of ions in the water. Water with high TDS often has a bad taste and/or high water hardness, and could result in a laxative effect.

The TDS concentration of a water sample can be estimated from specific conductance if a linear correlation between the two parameters is first established. Depending on the chemistry of the water, TDS (mg/l) can be estimated by multiplying specific conductance (micromhos/cm) by a factor between 0.55 and 0.75. TDS can also be determined by measuring individual ions and adding them up.

Conductivity Meter

Fecal Coliform Analysis

FECAL TESTING CONCEPT

A sample is collected and analyzed using aseptic (sterile) technique. A measured volume of sample is filtered through a sterile 0.45µ membrane filter, transferred to an absorbent pad containing m-FC broth, then incubated at 44.5°C for 24 hours. Blue/blue gray colonies are counted and reported as colony forming units (cfu) per 100 ml of sample. The method is limited by turbidity in the sample. Excessive turbidity will reduce fecal coliform recovery, requiring the MPN method to be used instead of the membrane filter method.

Technical Learning College

Sample Collection

Fecal coliform must be collected in a clean, sterile borosilicate glass or plastic bottle containing sodium thiosulfate. Pre-sterilized bags or bottles containing sodium thiosulfate can also be used. Sodium thiosulfate is added to remove residual chlorine which will kill fecal coliforms during transit. 0.1 ml of 10% sodium thiosulfate is added to a 120 ml sample bottle prior to sterilization. The minimum bottle size should be 120 ml to allow enough head space (1") for proper sample mixing.

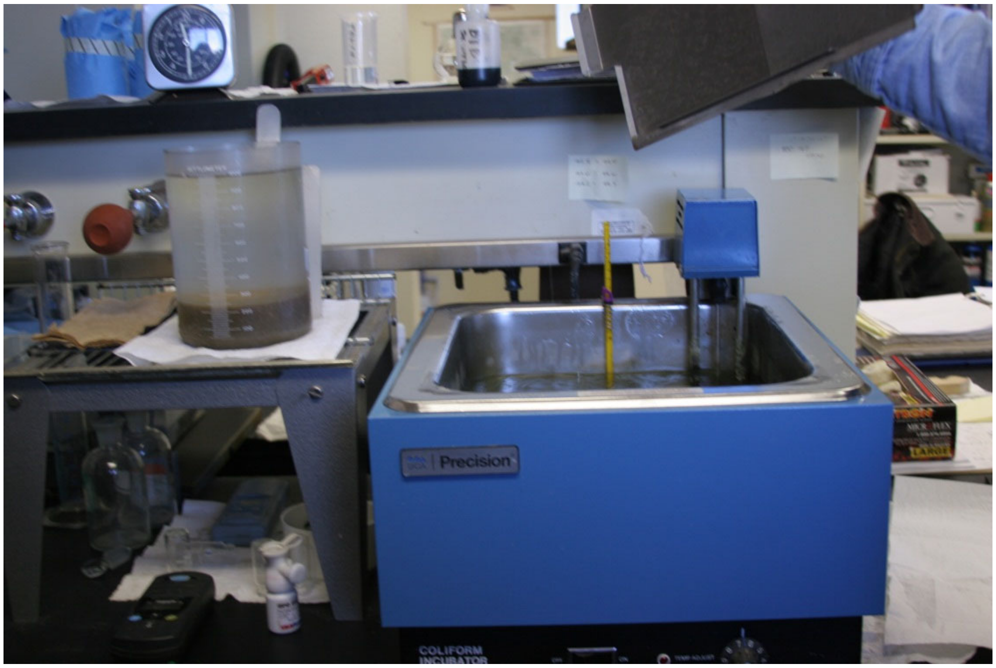
Collection Procedure

Select a site that will provide a representative sample. Fecal coliform samples are always grab samples and should be drawn directly from the flow stream without using collection other devices. We do not want to cross contaminate the sample. Keep the sample bottle lid closed tightly until it is to be filled.

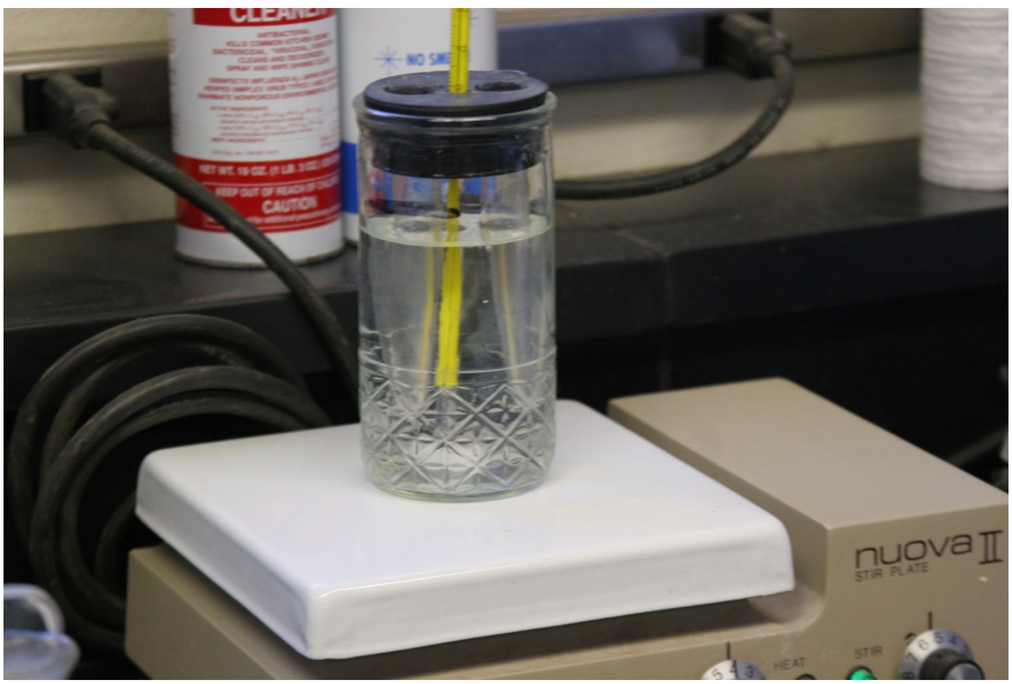
Remove the cap and do not contaminate the inner surface of the bottle, neck, threads or cap. Fill the container without rinsing, being sure to leave ample air space to allow mixing. Rinsing will remove the dechlorinating agent. All samples should be labeled properly with date and time of collection, sampler's name, and sample collection location. Leaking sample bottles allow for contamination of the sample and should be discarded and the sampling repeated.

Preservation

Fecal coliform samples should be analyzed as soon as possible after collection to prevent changes to the microorganism population. Fecal coliforms must be transported on ice, if they cannot be analyzed within 1 hour of collection. Fecal coliforms transported at ambient temperature may reproduce and higher bias to the numbers than desired or they may be killed off resulting in lower numbers, if handled poorly such as transport in sunlight. Fecal coliform samples should be stored by the laboratory in a refrigerator until time of analysis. The maximum holding time for state or federal permit reporting purposes is 6 hours.



An incubator for the coliform test. The operator will place the sample in this device for 24 to 48 hours depending on the desired results. There are several different methods to calculate coliform bacteria. This is an older true and tested method.

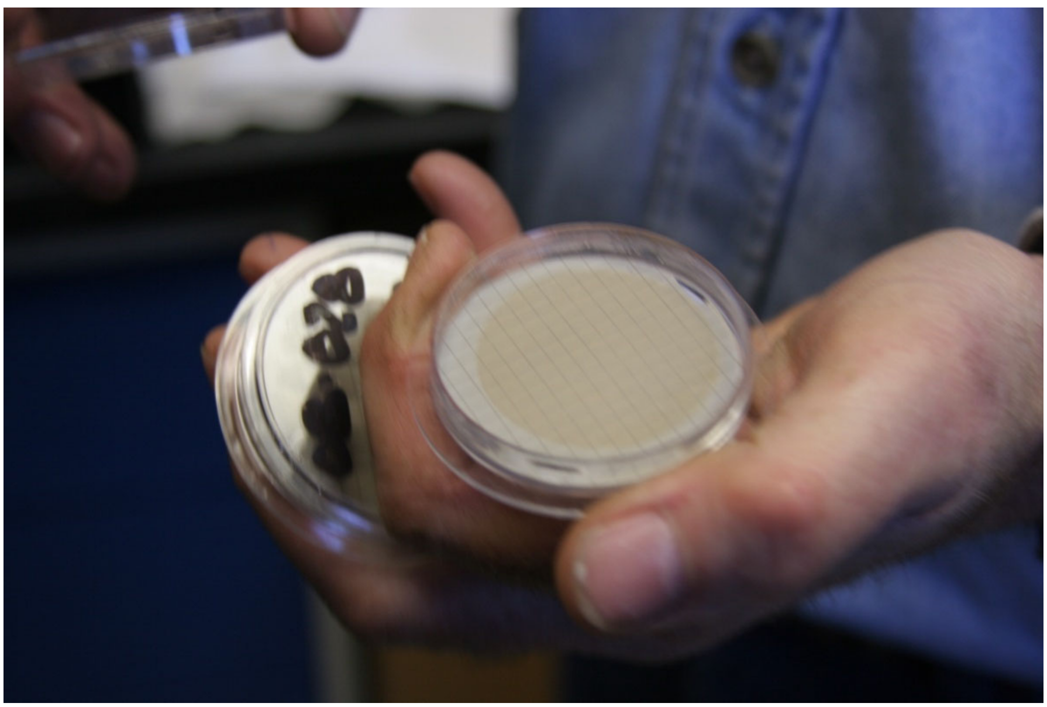


This glass bottle is used for quality control (QA/QC) for bacteria samples tubes.

This operator is wearing the proper safety measures for preparation of the fecal test.

This operator is splitting the sample for bacteriological analysis. Always wear gloves for your and others' safety. We have all seen the operator holds a sandwich in one hand while working in the lab, or the operator does not wear gloves at all.

Phase microscopes are used to see indicator bugs and other MO's microorganisms. This examination is used so that the operator knows how well the process is working.



This is a filter used for the coliform test.

Field Tests Examples /Procedures

pH

There are several different pH meters on the market. For this course, two types of pH meters will be discussed--the 230A and the 250A models. A two-buffer calibration is used, 7 pH and 10 pH, since most of the tested samples fall within these ranges. Following are the methods presently used in the calibration and measuring techniques of these meters:

(1) Calibration of the Orion 230A Model pH Meter

(a) Two-buffer calibration is used. The first calibration buffer (pH 7) is near the electrode isopotential point, and the second (pH 10) is near the expected sample pH. Choose buffers that are no more than three pH units apart. Use fresh buffers at the beginning of each week.

This calibration should be done at the beginning of each day and the results entered in the pH logbook.

(b) Uncover the fill hole. This should always be uncovered when using the meter and checked to make sure it is full of electrolyte solution. Turn on the meter's power. Rinse the electrode with high purity water then place it in the pH 7 buffer.

(c) Press "cal". CALIBRATE and P1 will be displayed.

(d) Wait for the meter to display READY with the pH reading flashing. If this is the correct pH, enter "yes" and proceed to step "E". If not, press the "timer" key and the first digit will start flashing. Pressing the "timer" or "setup" key ("timer" for raising the number or "setup" for decreasing it), correct the digit. When it is correct, press "yes." The second digit will start flashing. Repeat the previous steps for the second and third digits.

(e) The display will now show P2, indicating the meter is ready for the second buffer. Rinse the electrode with high purity water and place it in the second buffer (pH 10). Wait for the meter to display READY with the pH reading flashing. Use the above procedure for calibrating at this pH.

(f) The electrode slope, in percent, will be displayed (this value must be between 92 to 102 percent) along with the temperature. Record these figures in the logbook.

(g) Rinse the electrode with high purity water and return it to the storage solution. Turn off the power. When the electrode won't be used for awhile, cover the fill hole with the rubber sleeve.

(2) Calibration of the Orion 250A Model pH Meter

(a) This procedure is the same as the 230A Model through steps (a) and (b) above.

(b) Press the "mode" key until the pH mode indicator is displayed. Place the electrode in the first buffer and press the "2nd" key. P1 will be displayed.

(c) Go to step (d) in the calibration of the Orion 230A model and continue with the same set up.

(3) Measuring Techniques for pH with Orion Models 230A and 250A

(a) Making sure the fill hole is uncovered, turn on the meter's power. Rinse the electrode with high purity water.

(b) Place the electrode in the sample.

(c) When the display is stable and shows READY, record the sample pH and temperature.

(d) Rinse the electrode, return to the storage solution, and turn the power off. When finished for the day, cover the fill hole.

Sampling Procedures for Hexavalent Chromium (Hach Kit)

(1) Rinse out the two color viewing tubes with a portion of the sample to be tested.

(2) Refill one of the color viewing tubes to the 5 ml mark with a sample (this is the test sample). Using the clippers provided in the test kit, open one ChromaVer three chromium reagent powder pillow. Add the contents of the pillow to the sample. Stopper and shake to mix and put the tube in the color comparator.

(3) Fill the other viewing tube with a sample and put it in the left side of the color comparator (this is the blank).

(4) Let the viewing tubes sit in the color comparator for approximately 5 minutes. The samples should not be exposed to direct sunlight.

(5) Hold the color comparator up to a light source and view the two samples through the two openings in the front. Rotate the dial on the holder until the color appears the same in both samples. Record the results from the dial (which is read in mg/l Cr +6) onto the chain of custody form.

Sampling Techniques for Dissolved Sulfides (Chemetrics, Inc. Kit)

(1) Collect a 25 ml grab sample in the container provided.

(2) Add three drops of activator (amber colored liquid) and mix well.

(3) Break a sulfide chemet Type S glass ampule and add the contents to the 25 ml container.

(4) Let stand five minutes.

(5) Take a reading and record the results on the chain of custody form. If the reading is 0.0 then show the results less than 0.1 mg/l.

Sampling Techniques for Free and Total Chlorine (older colorwheel Hach Kit)

Procedures for determining free chlorine are as follows.

(1) Rinse out the two color viewing tubes with a portion of the sample to be tested.

(2) Refill one of the color viewing tubes to the 5 ml mark with a sample (this is the test sample). Using the clippers provided in the test kit, open one DPD free chlorine reagent powder pillow. Add the contents of the pillow to the sample. Stopper and shake to mix and put the tube in the color comparator. All of the powder does not have to dissolve to obtain correct readings.

(3) Fill the other viewing tube with the original sample and put it in the left side of the color comparator (this is the blank).

(4) Let the viewing tubes sit in the color comparator for approximately 1 minute. The samples should not be exposed to direct sunlight.

(5) Hold the color comparator up to a light source and view the two samples through the two openings in the front. Rotate the dial on the holder until the color appears the same in both samples. Record the results from the dial (which is read in mg/l free chlorine) onto the chain of custody form.

Procedures for determining total chlorine are as follows.

(1) Rinse out the two color viewing tubes with a portion of the sample to be tested.

(2) Refill one of the color viewing tubes to the 5 ml mark with a sample (this is the test sample). Using the clippers provided in the test kit, open one DPD total chlorine reagent powder pillow. Add the contents of the pillow to the sample. Stopper and shake to mix and put the tube in the color comparator. All of the powder does not have to dissolve to obtain correct readings.

(3) Fill the other viewing tube with a sample and put it in the left side of the color comparator (this is the blank).

(4) Let the viewing tubes sit in the color comparator for approximately 3 minutes. The samples should not be exposed to direct sunlight.

(5) Hold the color comparator up to a light source and view the two samples through the two openings in the front. Rotate the dial on the holder until the color appears the same in both samples. Record the results from the dial (which is read in mg/l total chlorine) onto the chain of custody form.

Sampling QA/QC Example

If you cannot maintain Quality Assurance (QA) and Quality Control (QC) you should not take the samples at all. Each sample must be supported with documentation providing the **5-W's** and the key word **How**. Without that documentation, it will be impossible to establish the three criteria (**F.A.R**) for evidence admissibility.

When and why should you take samples? The first call on that is the lead person in the field...you!

- **When** to sample is determined by the best chance to obtain a representative sample.
- **Why** a sample is taken is more subjective. It is initiated if there is a lack of confidence in available data or because of incomplete data at the facility or home office.

Sample documentation centers around three prime issues: **representativeness, tracking and methodology:**

- Was the **representative** of what you needed to evaluate for compliance? Does it represent a specific waste stream, site, event or activity?
- Can you prove where it came from, where it went, what was done to it, and that there was not an opportunity to compromise the sample along the way through your **tracking** documentation?
- Was the correct **methodology** followed to insure that your sample was (1) taken properly for the substance in question, and (2) the proper analytical method was used to make an accurate evaluation of its presence?

What are some of the tools used to accomplish thorough tracking?

- Field Log or Notebook
- Field Photography
- Field Lab Data Sheet
- Sample Number
- Analysis Request
- QAPjP
- Sample Plan
- Check Lists
- Field Generated Diagrams and Maps
- Chain of Custody
- Lab Sample Traffic Report

Laboratory

123 W. Main St
Sun City, Arizona 85541

LAB I.D. NUMBER

Sampler:

DATE:

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Company:
Department:
Address:
Contact:
Telephone:

Sample Identification	Date	Time	Matrix	Lab ID	Metals* See Attached	TSS	Lead/Copper	BOD/COD	Nitrate	Nitrate + Nitrite	TKN / Amonia	VOC / THM's	Semi Volital Organics (625)	Chloride		Cyanide	Floride	Surfactants (MBAS)	Tot. Coliform MPN	Fecal Coliform MPN-HPC	Organo-Phosphorus Pest. (8141)	Sulfate	EC Conductivity	Number/Containers

Project Name

Project Number

Field Measurements:

pH:

Temp:

Sample Receipt

No. Containers:

Custody Seals:

Received Intact: Yes No

Received Cold: Yes No

Temperature:

PRIORITY:

RELINQUISHED BY:

Signature: Time:

Printed Name: Date:

SAMPLED RECEIVED BY:

Signature: Time:

Printed Name: Date:

RELINQUISHED BY:

Signature: Time:

Printed Name: Date:

Company

SAMPLED RECEIVED BY:

Signature: Time:

Printed Name: Date:

Company

Stormwater Devices

Catch Basin

Catch Basin

Box Culvert

Motor Oil

Concrete Pipe

Retention Basin

Wash

Code of Federal Regulations

Title 40, Volume 14, Parts 87 to 135
Revised as of July 1, 2000
From the U.S. Government Printing Office via GPO Access
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TITLE 40--PROTECTION OF ENVIRONMENT AGENCY

PART 122--EPA ADMINISTERED PERMIT PROGRAMS: THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Table of Contents

Subpart B--Permit Application and Special NPDES Program Requirements

Sec. 122.**26** Storm water discharges (applicable to State NPDES programs, see Sec. 123.25).

(a) Permit requirement. (1) Prior to October 1, 1994, discharges composed entirely of storm water shall not be required to obtain a NPDES permit except:

(i) A discharge with respect to which a permit has been issued prior to February 4, 1987;

(ii) A discharge associated with industrial activity (see Sec. 122.**26**(a)(4));

(iii) A discharge from a large municipal separate storm sewer system;

(iv) A discharge from a medium municipal separate storm sewer system;

(v) A discharge which the Director, or in States with approved NPDES programs, either the Director or the EPA Regional Administrator, determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States. This designation may include a discharge from any conveyance or system of conveyances used for collecting and conveying storm water runoff or a system of discharges from municipal separate storm sewers, except for those discharges from conveyances which do not require a permit under paragraph (a)(2) of this section or agricultural storm water runoff which is exempted from the definition of point source at Sec. 122.2.

The Director may designate discharges from municipal separate storm sewers on a system-wide or jurisdiction-wide basis. In making this determination the Director may consider the following factors:

(A) The location of the discharge with respect to waters of the United States as defined at 40 CFR 122.2.

(B) The size of the discharge;

(C) The quantity and nature of the pollutants discharged to waters of the United States; and

(D) Other relevant factors.

(2) The Director may not require a permit for discharges of storm water runoff from mining operations or oil and gas exploration, production, processing or treatment operations or transmission facilities, composed entirely of flows which are from conveyances or systems of conveyances (including but not limited to pipes, conduits, ditches, and channels) used for collecting and conveying precipitation runoff and which

are not contaminated by contact with or that has not come into contact with, any overburden, raw material, intermediate products, finished product, byproduct or waste products located on the site of such operations.

(3) Large and medium municipal separate storm sewer systems. (i) Permits must be obtained for all discharges from large and medium municipal separate storm sewer systems.

(ii) The Director may either issue one system-wide permit covering all discharges from municipal separate storm sewers within a large or medium municipal storm sewer system or issue distinct permits for appropriate categories of discharges within a large or medium municipal separate storm sewer system including, but not limited to: all discharges owned or operated by the same municipality; located within the same jurisdiction; all discharges within a system that discharge to the same watershed; discharges within a system that are similar in nature; or for individual discharges from municipal separate storm sewers within the system.

(iii) The operator of a discharge from a municipal separate storm sewer which is part of a large or medium municipal separate storm sewer system must either:

(A) Participate in a permit application (to be a permittee or a co-permittee) with one or more other operators of discharges from the large or medium municipal storm sewer system which covers all, or a portion of all, discharges from the municipal separate storm sewer system;

(B) Submit a distinct permit application which only covers discharges from the municipal separate storm sewers for which the operator is responsible; or

(C) A regional authority may be responsible for submitting a permit application under the following guidelines:

(1) The regional authority together with co-applicants shall have authority over a storm water management program that is in existence, or shall be in existence at the time part 1 of the application is due;

(2) The permit applicant or co-applicants shall establish their ability to make a timely submission of part 1 and part 2 of the municipal application;

(3) Each of the operators of municipal separate storm sewers within the systems described in paragraphs (b)(4) (i), (ii), and (iii) or (b)(7) (i), (ii), and (iii) of this section, that are under the purview of the designated regional authority, shall comply with the application requirements of paragraph (d) of this section.

(iv) One permit application may be submitted for all or a portion of all municipal separate storm sewers within adjacent or interconnected large or medium municipal separate storm sewer systems. The Director may issue one system-wide permit covering all, or a portion of all municipal separate storm sewers in adjacent or interconnected large or medium municipal separate storm sewer systems.

(v) Permits for all or a portion of all discharges from large or medium municipal separate storm sewer systems that are issued on a system-wide, jurisdiction-wide, watershed or other basis may specify different conditions relating to different discharges covered by the permit, including different management programs for different drainage areas which contribute storm water to the system.

(vi) Co-permittees need only comply with permit conditions relating to discharges from the municipal separate storm sewers for which they are operators.

(4) Discharges through large and medium municipal separate storm sewer systems. In addition to meeting the requirements of paragraph (c)

of this section, an operator of a storm water discharge associated with industrial activity which discharges through a large or medium municipal separate storm sewer system shall submit, to the operator of the municipal separate storm sewer system receiving the discharge no later than May 15, 1991, or 180 days prior to commencing such discharge:the name of the facility; a contact person and phone number; the location of the discharge; a description, including Standard Industrial Classification, which best reflects the principal products or services provided by each facility; and any existing NPDES permit number.

(5) Other municipal separate storm sewers. The Director may issue permits for municipal separate storm sewers that are designated under paragraph (a)(1)(v) of this section on a system-wide basis, jurisdiction-wide basis, watershed basis or other appropriate basis, or may issue permits for individual discharges.

(6) Non-municipal separate storm sewers. For storm water discharges associated with industrial activity from point sources which discharge through a non-municipal or non-publicly owned separate storm sewer system, the Director, in his discretion, may issue: a single NPDES permit, with each discharger a co-permittee to a permit issued to the operator of the portion of the system that discharges into waters of the United States; or, individual permits to each discharger of storm water associated with industrial activity through the non-municipal conveyance system.

(i) All storm water discharges associated with industrial activity that discharge through a storm water discharge system that is not a municipal separate storm sewer must be covered by an individual permit, or a permit issued to the operator of the portion of the system that discharges to waters of the United States, with each discharger to the non-municipal conveyance a co-permittee to that permit.

(ii) Where there is more than one operator of a single system of such conveyances, all operators of storm water discharges associated with industrial activity must submit applications.

(iii) Any permit covering more than one operator shall identify the effluent limitations, or other permit conditions, if any, that apply to each operator.

(7) Combined sewer systems. Conveyances that discharge storm water runoff combined with municipal sewage are point sources that must obtain NPDES permits in accordance with the procedures of Sec. 122.21 and are not subject to the provisions of this section.

(8) Whether a discharge from a municipal separate storm sewer is or is not subject to regulation under this section shall have no bearing on whether the owner or operator of the discharge is eligible for funding under title II, title III or title VI of the Clean Water Act. See 40 CFR part 35, subpart I, appendix A(b)H.2.j.

(9)(i) On and after October 1, 1994, for discharges composed entirely of storm water, that are not required by paragraph (a)(1) of this section to obtain a permit, operators shall be required to obtain a NPDES permit only if:

(A) The discharge is from a small MS4 required to be regulated pursuant to Sec. 122.32;

(B) The discharge is a storm water discharge associated with small construction activity pursuant to paragraph (b)(15) of this section;

(C) The Director, or in States with approved NPDES programs either the Director or the EPA Regional Administrator, determines that storm water controls are needed for the discharge based on wasteload allocations that are part of ``total maximum daily loads'' (TMDLs) that address the pollutant(s) of concern; or

(D) The Director, or in States with approved NPDES programs either the Director or the EPA Regional Administrator, determines that the discharge, or category of discharges within a geographic area, contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

(ii) Operators of small MS4s designated pursuant to paragraphs (a)(9)(i)(A), (a)(9)(i)(C), and (a)(9)(i)(D) of this section shall seek coverage under an NPDES permit in accordance with Secs. 122.33 through 122.35. Operators of non-municipal sources designated pursuant to paragraphs (a)(9)(i)(B), (a)(9)(i)(C), and (a)(9)(i)(D) of this section shall seek coverage under an NPDES permit in accordance with paragraph (c)(1) of this section.

(iii) Operators of storm water discharges designated pursuant to paragraphs (a)(9)(i)(C) and (a)(9)(i)(D) of this section shall apply to the Director for a permit within 180 days of receipt of notice, unless permission for a later date is granted by the Director (see Sec. 124.52(c) of this chapter).

(b) Definitions. (1) Co-permittee means a permittee to a NPDES permit that is only responsible for permit conditions relating to the discharge for which it is operator.

(2) Illicit discharge means any discharge to a municipal separate storm sewer that is not composed entirely of storm water except discharges pursuant to a NPDES permit (other than the NPDES permit for discharges from the municipal separate storm sewer) and discharges resulting from fire fighting activities.

(3) Incorporated place means the District of Columbia, or a city, town, township, or village that is incorporated under the laws of the State in which it is located.

(4) Large municipal separate storm sewer system means all municipal separate storm sewers that are either:

(i) Located in an incorporated place with a population of 250,000 or more as determined by the 1990 Decennial Census by the Bureau of the Census (Appendix F of this part); or

(ii) Located in the counties listed in appendix H, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties; or

(iii) Owned or operated by a municipality other than those described in paragraph (b)(4) (i) or (ii) of this section and that are designated by the Director as part of the large or medium municipal separate storm sewer system due to the interrelationship between the discharges of the designated storm sewer and the discharges from municipal separate storm sewers described under paragraph (b)(4) (i) or (ii) of this section. In making this determination the Director may consider the following factors:

(A) Physical interconnections between the municipal separate storm sewers;

(B) The location of discharges from the designated municipal separate storm sewer relative to discharges from municipal separate storm sewers described in paragraph (b)(4)(i) of this section;

(C) The quantity and nature of pollutants discharged to waters of the United States;

(D) The nature of the receiving waters; and

(E) Other relevant factors; or

(iv) The Director may, upon petition, designate as a large municipal separate storm sewer system, municipal separate storm sewers located within the boundaries of a region defined by a storm water management regional authority based on a jurisdictional, watershed, or other appropriate basis that includes one or more of the systems described in paragraph (b)(4) (i), (ii), (iii) of this section.

(5) Major municipal separate storm sewer outfall (or ``major outfall'') means a municipal separate storm sewer outfall that discharges from a single pipe with an inside diameter of 36 inches or more or its equivalent (discharge from a single conveyance other than circular pipe which is associated with a drainage area of more than 50 acres); or for municipal separate storm sewers that receive storm water from lands zoned for industrial activity (based on comprehensive zoning plans or the equivalent), an outfall that discharges from a single pipe with an inside diameter of 12 inches or more or from its equivalent (discharge from other than a circular pipe associated with a drainage area of 2 acres or more).

(6) Major outfall means a major municipal separate storm sewer outfall.

(7) Medium municipal separate storm sewer system means all municipal separate storm sewers that are either:

(i) Located in an incorporated place with a population of 100,000 or more but less than 250,000, as determined by the 1990 Decennial Census by the Bureau of the Census (Appendix G of this part); or

(ii) Located in the counties listed in appendix I, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties; or

(iii) Owned or operated by a municipality other than those described in paragraph (b)(7) (i) or (ii) of this section and that are designated by the Director as part of the large or medium municipal separate storm sewer system due to the interrelationship between the discharges of the designated storm sewer and the discharges from municipal separate storm sewers described under paragraph (b)(7) (i) or (ii) of this section. In making this determination the Director may consider the following factors:

(A) Physical interconnections between the municipal separate storm sewers;

(B) The location of discharges from the designated municipal separate storm sewer relative to discharges from municipal separate storm sewers described in paragraph (b)(7)(i) of this section;

(C) The quantity and nature of pollutants discharged to waters of the United States;

(D) The nature of the receiving waters; or

(E) Other relevant factors; or

(iv) The Director may, upon petition, designate as a medium municipal separate storm sewer system, municipal separate storm sewers located within the boundaries of a region defined by a storm water management regional authority based on a jurisdictional, watershed, or other appropriate basis that includes one or more of the systems described in paragraphs (b)(7) (i), (ii), (iii) of this section.

(8) Municipal separate storm sewer means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

(i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to waters of the United States;

(ii) Designed or used for collecting or conveying storm water;

(iii) Which is not a combined sewer; and

(iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

(9) Outfall means a point source as defined by 40 CFR 122.2 at the point where a municipal separate storm sewer discharges to waters of the United States and does not include open conveyances connecting two municipal separate storm sewers, or pipes, tunnels or other conveyances which connect segments of the same stream or other waters of the United States and are used to convey waters of the United States.

(10) Overburden means any material of any nature, consolidated or unconsolidated, that overlies a mineral deposit, excluding topsoil or similar naturally-occurring surface materials that are not disturbed by mining operations.

(11) Runoff coefficient means the fraction of total rainfall that will appear at a conveyance as runoff.

(12) Significant materials includes, but is not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under section 101(14) of CERCLA; any chemical the facility is required to report pursuant to section 313 of title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with storm water discharges.

(13) Storm water means storm water runoff, snow melt runoff, and surface runoff and drainage.

(14) Storm water discharge associated with industrial activity means the discharge from any conveyance that is used for collecting and conveying storm water and that is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the NPDES program under this part 122. For the categories of industries identified in this section, the term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters (as defined at part 401 of this chapter); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and final products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water. For the purposes of this paragraph, material handling activities include storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product, by-product or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with storm water drained from the above described areas. Industrial facilities (including industrial facilities that are federally, State, or municipally owned or operated that meet the description of the

facilities listed in paragraphs (b)(14)(i) through (xi) of this section) include those facilities designated under the provisions of paragraph (a)(1)(v) of this section. The following categories of facilities are considered to be engaging in ``industrial activity'' for purposes of paragraph (b)(14):

(i) Facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards under 40 CFR subchapter N (except facilities with toxic pollutant effluent standards which are exempted under category (xi) in paragraph (b)(14) of this section);

(ii) Facilities classified as Standard Industrial Classifications 24 (except 2434), **26** (except 265 and 267), 28 (except 283), 29, 311, 32 (except 323), 33, 3441, 373;

(iii) Facilities classified as Standard Industrial Classifications 10 through 14 (mineral industry) including active or inactive mining operations (except for areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(1) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of non-coal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations; (inactive mining operations are mining sites that are not being actively mined, but which have an identifiable owner/operator; inactive mining sites do not include sites where mining claims are being maintained prior to disturbances associated with the extraction, beneficiation, or processing of mined materials, nor sites where minimal activities are undertaken for the sole purpose of maintaining a mining claim);

(iv) Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under subtitle C of RCRA;

(v) Landfills, land application sites, and open dumps that receive or have received any industrial wastes (waste that is received from any of the facilities described under this subsection) including those that are subject to regulation under subtitle D of RCRA;

(vi) Facilities involved in the recycling of materials, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards, including but limited to those classified as Standard Industrial Classification 5015 and 5093;

(vii) Steam electric power generating facilities, including coal handling sites;

(viii) Transportation facilities classified as Standard Industrial Classifications 40, 41, 42 (except 4221-25), 43, 44, 45, and 5171 which have vehicle maintenance shops, equipment cleaning operations, or airport deicing operations. Only those portions of the facility that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, airport deicing operations, or which are otherwise identified under paragraphs (b)(14) (i)-(vii) or (ix)-(xi) of this section are associated with industrial activity;

(ix) Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located within the confines of the facility, with a design flow of 1.0 mgd or more, or required to have an approved pretreatment program under 40 CFR part 403. Not included are farm lands, domestic gardens or lands used for sludge management where sludge is beneficially reused and which are not physically located in the confines of the facility, or areas that are in compliance with section 405 of the CWA;

(x) Construction activity including clearing, grading and excavation, except operations that result in the disturbance of less than five acres of total land area. Construction activity also includes the disturbance of less than five acres of total land area that is a part of a larger common plan of development or sale if the larger common plan will ultimately disturb five acres or more;

(xi) Facilities under Standard Industrial Classifications 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39, and 4221-25;

(15) Storm water discharge associated with small construction activity means the discharge of storm water from:

(i) Construction activities including clearing, grading, and excavating that result in land disturbance of equal to or greater than one acre and less than five acres. Small construction activity also includes the disturbance of less than one acre of total land area that is part of a larger common plan of development or sale if the larger common plan will ultimately disturb equal to or greater than one and less than five acres. Small construction activity does not include routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of the facility. The Director may waive the otherwise applicable requirements in a general permit for a storm water discharge from construction activities that disturb less than five acres where:

(A) The value of the rainfall erosivity factor (``R'' in the Revised Universal Soil Loss Equation) is less than five during the period of construction activity. The rainfall erosivity factor is determined in accordance with Chapter 2 of Agriculture Handbook Number 703, Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE), pages 21-64, dated January 1997. The Director of the Federal Register approves this incorporation by reference in accordance with 5 U.S.C 552(a) and 1 CFR part 51. Copies may be obtained from EPA's Water Resource Center, Mail Code RC4100, 401 M St. S.W., Washington, DC 20460. A copy is also available for inspection at the U.S. EPA Water Docket , 401 M Street S.W., Washington, DC. 20460, or the Office of the Federal Register, 800 N. Capitol Street N.W. Suite 700, Washington, DC. An operator must certify to the Director that the construction activity will take place during a period when the value of the rainfall erosivity factor is less than five; or

(B) Storm water controls are not needed based on a ``total maximum daily load'' (TMDL) approved or established by EPA that addresses the pollutant(s) of concern or, for non-impaired waters that do not require TMDLs, an equivalent analysis that determines allocations for small construction sites for the pollutant(s) of concern or that determines that such allocations are not needed to protect water quality based on consideration of existing in-stream concentrations, expected growth in pollutant contributions from all sources, and a margin of safety. For the purpose of this paragraph, the pollutant(s) of concern include sediment or a parameter that addresses sediment (such as total suspended solids, turbidity or siltation) and any other pollutant that has been identified as a cause of impairment of any water body that will receive a discharge from the construction activity.

The operator must certify to the Director that the construction activity will take place, and storm water discharges will occur, within the drainage area addressed by the TMDL or equivalent analysis.

(ii) Any other construction activity designated by the Director, or in States with approved NPDES programs either the Director or the EPA Regional Administrator, based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants to waters of the United States.

A great method of attaching permit-required signage to a storm drain cover. Again, found throughout San Francisco.

Exhibit 1 to Sec. 122.**26**(b)(15).--Summary of Coverage of ``Storm Water Discharges Associated with Small Construction Activity'' Under the NPDES Storm Water Program

Automatic Designation: Required Nationwide Coverage.	Construction activities that result in a land disturbance of equal to or greater than one acre and less than five acres. Construction activities disturbing less than one acre if part of a larger common plan of development or sale with a planned disturbance of equal to or greater than one acre and less than five acres. (see Sec. 122.**26**(b)(15)(i).)
Potential Designation: Optional Evaluation and Designation by the NPDES Permitting Authority or EPA Regional Administrator.	Construction activities that result in a land disturbance of less than one acre based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants. (see Sec. 122.**26**(b)(15)(ii).)
Potential Waiver: Waiver from Requirements as Determined by the NPDES Permitting Authority..	Any automatically designated construction activity where the operator certifies: (1) A rainfall erosivity factor of less than five, or (2) That the activity will occur within an area where controls are not needed based on a TMDL or, for non-impaired waters that do not require a TMDL, an equivalent analysis for the pollutant(s) of concern. (see Sec. 122.**26**(b)(15)(i).)

(16) Small municipal separate storm sewer system means all separate storm sewers that are:

(i) Owned or operated by the United States, a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to waters of the United States.

(ii) Not defined as ``large'' or ``medium'' municipal separate storm sewer systems pursuant to paragraphs (b)(4) and (b)(7) of this section, or designated under paragraph (a)(1)(v) of this section.

(iii) This term includes systems similar to separate storm sewer systems in municipalities, such as systems at military bases, large hospital or prison complexes, and highways and other thoroughfares. The term does not include separate storm sewers in very discrete areas, such as individual buildings.

(17) Small MS4 means a small municipal separate storm sewer system.

(18) Municipal separate storm sewer system means all separate storm

sewers that are defined as ``large'' or ``medium'' or ``small'' municipal separate storm sewer systems pursuant to paragraphs (b)(4), (b)(7), and (b)(16) of this section, or designated under paragraph (a)(1)(v) of this section.

(19) MS4 means a municipal separate storm sewer system.

(20) Uncontrolled sanitary landfill means a landfill or open dump, whether in operation or closed, that does not meet the requirements for runon or runoff controls established pursuant to subtitle D of the Solid Waste Disposal Act.

(c) Application requirements for storm water discharges associated with industrial activity and storm water discharges associated with small construction activity--(1) Individual application. Dischargers of storm water associated with industrial activity and with small construction activity are required to apply for an individual permit or seek coverage under a promulgated storm water general permit. Facilities that are required to obtain an individual permit, or any discharge of storm water which the Director is evaluating for designation (see 40 CFR 124.52(c)) under paragraph (a)(1)(v) of this section and is not a municipal separate storm sewer, and which is not part of a group application described under paragraph (c)(2) of this section, shall submit an NPDES application in accordance with the requirements of Sec. 122.21 as modified and supplemented by the provisions of the remainder of this paragraph. Applicants for discharges composed entirely of storm water shall submit Form 1 and Form 2F. Applicants for discharges composed of storm water and non-storm water shall submit Form 1, Form 2C, and Form 2F. Applicants for new sources or new discharges (as defined in Sec. 122.2 of this part) composed of storm water and non-storm water shall submit Form 1, Form 2D, and Form 2F.

(i) Except as provided in Sec. 122.**26**(c)(1) (ii)-(iv), the operator of a storm water discharge associated with industrial activity subject to this section shall provide:

(A) A site map showing topography (or indicating the outline of drainage areas served by the outfall(s) covered in the application if a topographic map is unavailable) of the facility including: each of its drainage and discharge structures; the drainage area of each storm water outfall; paved areas and buildings within the drainage area of each storm water outfall, each past or present area used for outdoor storage or disposal of significant materials, each existing structural control measure to reduce pollutants in storm water runoff, materials loading and access areas, areas where pesticides, herbicides, soil conditioners and fertilizers are applied, each of its hazardous waste treatment, storage or disposal facilities (including each area not required to have a RCRA permit which is used for accumulating hazardous waste under 40 CFR 262.34); each well where fluids from the facility are injected underground; springs, and other surface water bodies which receive storm water discharges from the facility;

(B) An estimate of the area of impervious surfaces (including paved areas and building roofs) and the total area drained by each outfall (within a mile radius of the facility) and a narrative description of the following: Significant materials that in the three years prior to the submittal of this application have been treated, stored or disposed in a manner to allow exposure to storm water; method of treatment, storage or disposal of such materials; materials management practices employed, in the three years prior to the submittal of this application, to minimize contact by these materials with storm water runoff; materials loading and access areas; the location, manner and frequency in which pesticides, herbicides, soil conditioners and fertilizers are applied; the location and a description of existing structural and non-structural control measures to reduce pollutants in storm water runoff; and a description of the treatment the storm water receives, including the ultimate disposal of any solid or fluid wastes other than by discharge;

(C) A certification that all outfalls that should contain storm water discharges associated with industrial activity have been tested or evaluated for the presence of non-storm water discharges which are not covered by a NPDES permit; tests for such non-storm water discharges may include smoke tests, fluorometric dye tests, analysis of accurate schematics, as well as other appropriate tests. The certification shall include a description of the method used, the date of any testing, and the on-site drainage points that were directly observed during a test;

(D) Existing information regarding significant leaks or spills of toxic or hazardous pollutants at the facility that have taken place within the three years prior to the submittal of this application;

(E) Quantitative data based on samples collected during storm events and collected in accordance with Sec. 122.21 of this part from all outfalls containing a storm water discharge associated with industrial activity for the following parameters:

(1) Any pollutant limited in an effluent guideline to which the facility is subject;
(2) Any pollutant listed in the facility's NPDES permit for its process wastewater (if the facility is operating under an existing NPDES permit);
(3) Oil and grease, pH, BOD5, COD, TSS, total phosphorus, total Kjeldahl nitrogen, and nitrate plus nitrite nitrogen;
(4) Any information on the discharge required under paragraph Sec. 122.21(g)(7) (iii) and (iv) of this part;
(5) Flow measurements or estimates of the flow rate, and the total amount of discharge for the storm event(s) sampled, and the method of flow measurement or estimation; and
(6) The date and duration (in hours) of the storm event(s) sampled, rainfall measurements or estimates of the storm event (in inches) which generated the sampled runoff and the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event (in hours);

(F) Operators of a discharge which is composed entirely of storm water are exempt from the requirements of Sec. 122.21 (g)(2), (g)(3), (g)(4), (g)(5), (g)(7)(iii), (g)(7)(iv), (g)(7)(v), and (g)(7)(viii); and

(G) Operators of new sources or new discharges (as defined in Sec. 122.2 of this part) which are composed in part or entirely of storm water must include estimates for the pollutants or parameters listed in paragraph (c)(1)(i)(E) of this section instead of actual sampling data, along with the source of each estimate. Operators of new sources or new discharges composed in part or entirely of storm water must provide quantitative data for the parameters listed in paragraph (c)(1)(i)(E) of this section within two years after commencement of discharge, unless such data has already been reported under the monitoring requirements of the NPDES permit for the discharge. Operators of a new source or new discharge which is composed entirely of storm water are exempt from the requirements of Sec. 122.21 (k)(3)(ii), (k)(3)(iii), and (k)(5).

(ii) An operator of an existing or new storm water discharge that is associated with industrial activity solely under paragraph (b)(14)(x) of this section or is associated with small construction activity solely under paragraph (b)(15) of this section, is exempt from the requirements of Sec. 122.21(g) and paragraph (c)(1)(i) of this section. Such operator shall provide a narrative description of:

(A) The location (including a map) and the nature of the construction activity;

(B) The total area of the site and the area of the site that is expected to undergo excavation during the life of the permit;

(C) Proposed measures, including best management practices, to control pollutants in storm water discharges during construction, including a brief description of applicable State and local erosion and sediment control requirements;

(D) Proposed measures to control pollutants in storm water discharges that will occur after construction operations have been completed, including a brief description of applicable State or local erosion and sediment control requirements;

(E) An estimate of the runoff coefficient of the site and the increase in impervious area after the construction addressed in the permit application is completed, the nature of fill material and existing data describing the soil or the quality of the discharge; and

(F) The name of the receiving water.

(iii) The operator of an existing or new discharge composed entirely of storm water from an oil or gas exploration, production, processing, or treatment operation, or transmission facility is not required to submit a permit application in accordance with paragraph (c)(1)(i) of this section, unless the facility:

(A) Has had a discharge of storm water resulting in the discharge of a reportable quantity for which notification is or was required pursuant to 40 CFR 117.21 or 40 CFR 302.6 at anytime since November 16, 1987; or

(B) Has had a discharge of storm water resulting in the discharge of a reportable quantity for which notification is or was required pursuant to 40 CFR 110.6 at any time since November 16, 1987; or

(C) Contributes to a violation of a water quality standard.

(iv) The operator of an existing or new discharge composed entirely of storm water from a mining operation is not required to submit a permit application unless the discharge has come into contact with, any overburden, raw material, intermediate products, finished product, byproduct or waste products located on the site of such operations.

(v) Applicants shall provide such other information the Director may reasonably require under Sec. 122.21(g)(13) of this part to determine whether to issue a permit and may require any facility subject to paragraph (c)(1)(ii) of this section to comply with paragraph (c)(1)(i) of this section.

(2) Group application for discharges associated with industrial activity. In lieu of individual applications or notice of intent to be covered by a general permit for storm water discharges associated with industrial activity, a group application may be filed by an entity representing a group of applicants (except facilities that have existing individual NPDES permits for storm water) that are part of the same subcategory (see 40 CFR subchapter N, part 405 to 471) or, where such grouping is inapplicable, are sufficiently similar as to be appropriate for general permit coverage under Sec. 122.28 of this part. The part 1 application shall be submitted to the Office of Water Enforcement and Permits, U.S. EPA, 401 M Street, SW., Washington, DC 20460 (EN-336) for approval. Once a part 1 application is approved, group applicants are to submit Part 2 of the group application to the Office of Water Enforcement and Permits. A group application shall consist of:

(i) Part 1. Part 1 of a group application shall:

(A) Identify the participants in the group application by name and location. Facilities participating in the group application shall be listed in nine subdivisions, based on the facility location relative to the nine precipitation zones indicated in appendix E to this part.

(B) Include a narrative description summarizing the industrial activities of participants of the group application and explaining why the participants, as a whole, are sufficiently similar to be a covered by a general permit;

(C) Include a list of significant materials stored exposed to precipitation by participants in the group application and materials management practices employed to diminish contact by these materials with precipitation and storm water runoff;

(D) For groups of more than 1,000 members, identify at least 100 dischargers participating in the group application from which quantitative data will be submitted. For groups of 100 or more members, identify a minimum of ten percent of the dischargers participating in the group application from which quantitative data will be submitted. For groups of between 21 and 99 members identify a minimum of ten dischargers participating in the group application from which quantitative data will be submitted. For groups of 4 to 20 members, identify a minimum of 50 percent of the dischargers participating in the group application from which quantitative data will be submitted. For groups with more than 10 members, either a minimum of two dischargers from each precipitation zone indicated in appendix E of this part in which ten or more members of the group are located, or one discharger from each precipitation zone indicated in appendix E of this part in which nine or fewer members of the group are located, must be identified to submit quantitative data. For groups of 4 to 10 members, at least one facility in each precipitation zone indicated in appendix E of this part in which members of the group are located must be identified to submit quantitative data. A description of why the facilities selected to perform sampling and analysis are representative of the group as a whole in terms of the information provided in paragraphs (c)(1)(i)(B) and (c)(1)(i)(C) of this section, shall accompany this section. Different factors impacting the nature of the storm water discharges, such as the processes used and material management, shall be represented, to the extent feasible, in a manner roughly equivalent to their proportion in the group.

(ii) Part 2. Part 2 of a group application shall contain quantitative data(NPDES Form 2F), as modified by paragraph (c)(1) of this section, so that when part 1 and part 2 of the group application are taken together, a complete NPDES application (Form 1, Form 2C, and Form 2F) can be
evaluated for each discharger identified in paragraph (c)(2)(i)(D) of this section.

(d) Application requirements for large and medium municipal separate storm sewer discharges. The operator of a discharge from a large or medium municipal separate storm sewer or a municipal separate storm sewer that is designated by the Director under paragraph (a)(1)(v) of this section, may submit a jurisdiction-wide or system-wide permit application. Where more than one public entity owns or operates a municipal separate storm sewer within a geographic area (including adjacent or interconnected municipal separate storm sewer systems), such operators may be a coapplicant to the same application. Permit applications for discharges from large and medium municipal storm sewers or municipal storm sewers designated under paragraph (a)(1)(v) of this section shall include;

(1) Part 1. Part 1 of the application shall consist of;

(i) General information. The applicants' name, address, telephone number of contact person, ownership status and status as a State or local government entity.

(ii) Legal authority. A description of existing legal authority to control discharges to the municipal separate storm sewer system. When existing legal authority is not sufficient to meet the criteria provided in paragraph (d)(2)(i) of this section, the description shall list additional authorities as will be necessary to meet the criteria and shall include a schedule and commitment to seek such additional authority that will be needed to meet the criteria.

(iii) Source identification. (A) A description of the historic use of ordinances, guidance or other controls which limited the discharge of non-storm water discharges to any Publicly Owned Treatment Works serving the same area as the municipal separate storm sewer system.

(B) A USGS 7.5 minute topographic map (or equivalent topographic map with a scale between 1:10,000 and 1:24,000 if cost effective) extending one mile beyond the service boundaries of the municipal storm sewer system covered by the permit application. The following information shall be provided:

(1) The location of known municipal storm sewer system outfalls discharging to waters of the United States;

(2) A description of the land use activities (e.g. divisions indicating undeveloped, residential, commercial, agricultural and industrial uses) accompanied with estimates of population densities and projected growth for a ten year period within the drainage area served by the separate storm sewer. For each land use type, an estimate of an average runoff coefficient shall be provided;

(3) The location and a description of the activities of the facility of each currently operating or closed municipal landfill or other treatment, storage or disposal facility for municipal waste;

(4) The location and the permit number of any known discharge to the municipal storm sewer that has been issued a NPDES permit;

(5) The location of major structural controls for storm water discharge (retention basins, detention basins, major infiltration devices, etc.); and

(6) The identification of publicly owned parks, recreational areas, and other open lands.

(iv) Discharge characterization. (A) Monthly mean rain and snow fall estimates (or summary of weather bureau data) and the monthly average number of storm events.

(B) Existing quantitative data describing the volume and quality of discharges from the municipal storm sewer, including a description of the outfalls sampled, sampling procedures and analytical methods used.

(C) A list of water bodies that receive discharges from the municipal separate storm sewer system, including downstream segments, lakes and estuaries, where pollutants from the system discharges may accumulate and cause water degradation and a brief description of known water quality impacts. At a minimum, the description of impacts shall include a description of whether the water bodies receiving such discharges have been:

(1) Assessed and reported in section 305(b) reports submitted by the State, the basis for the assessment (evaluated or monitored), a summary of designated use support and attainment of Clean Water Act (CWA) goals (fishable and swimmable waters), and causes of nonsupport of designated uses;

(2) Listed under section 304(l)(1)(A)(i), section 304(l)(1)(A)(ii),

or section 304(l)(1)(B) of the CWA that is not expected to meet water quality standards or water quality goals;

(3) Listed in State Nonpoint Source Assessments required by section 319(a) of the CWA that, without additional action to control nonpoint sources of pollution, cannot reasonably be expected to attain or maintain water quality standards due to storm sewers, construction, highway maintenance and runoff from municipal landfills and municipal sludge adding significant pollution (or contributing to a violation of water quality standards);

(4) Identified and classified according to eutrophic condition of publicly owned lakes listed in State reports required under section 314(a) of the CWA (include the following: A description of those publicly owned lakes for which uses are known to be impaired; a description of procedures, processes and methods to control the discharge of pollutants from municipal separate storm sewers into such lakes; and a description of methods and procedures to restore the quality of such lakes);

(5) Areas of concern of the Great Lakes identified by the International Joint Commission;

(6) Designated estuaries under the National Estuary Program under section 320 of the CWA;

(7) Recognized by the applicant as highly valued or sensitive waters;

(8) Defined by the State or U.S. Fish and Wildlife Services's National Wetlands Inventory as wetlands; and

(9) Found to have pollutants in bottom sediments, fish tissue or biosurvey data.

(D) Field screening. Results of a field screening analysis for illicit connections and illegal dumping for either selected field screening points or major outfalls covered in the permit application. At a minimum, a screening analysis shall include a narrative description, for either each field screening point or major outfall, of visual observations made during dry weather periods. If any flow is observed, two grab samples shall be collected during a 24 hour period with a minimum period of four hours between samples. For all such samples, a narrative description of the color, odor, turbidity, the presence of an oil sheen or surface scum as well as any other relevant observations regarding the potential presence of non-storm water discharges or illegal dumping shall be provided. In addition, a narrative description of the results of a field analysis using suitable methods to estimate pH, total chlorine, total copper, total phenol, and detergents (or surfactants) shall be provided along with a description of the flow rate. Where the field analysis does not involve analytical methods approved under 40 CFR part 136, the applicant shall provide a description of the method used including the name of the manufacturer of the test method along with the range and accuracy of the test. Field screening points shall be either major outfalls or other outfall points (or any other point of access such as manholes) randomly located throughout the storm sewer system by placing a grid over a drainage system map and identifying those cells of the grid which contain a segment of the storm sewer system or major outfall. The field screening points shall be established using the following guidelines and criteria:

(1) A grid system consisting of perpendicular north-south and east-west lines spaced \1/4\ mile apart shall be overlayed on a map of the municipal storm sewer system, creating a series of cells;

(2) All cells that contain a segment of the storm sewer system shall be identified; one field screening point shall be selected in each cell;

major outfalls may be used as field screening points;
(3) Field screening points should be located downstream of any sources of suspected illegal or illicit activity;
(4) Field screening points shall be located to the degree practicable at the farthest manhole or other accessible location downstream in the system, within each cell; however, safety of personnel and accessibility of the location should be considered in making this determination;
(5) Hydrological conditions; total drainage area of the site; population density of the site; traffic density; age of the structures or buildings in the area; history of the area; and land use types;
(6) For medium municipal separate storm sewer systems, no more than 250 cells need to have identified field screening points; in large municipal separate storm sewer systems, no more than 500 cells need to have identified field screening points; cells established by the grid that contain no storm sewer segments will be eliminated from consideration; if fewer than 250 cells in medium municipal sewers are created, and fewer than 500 in large systems are created by the overlay on the municipal sewer map, then all those cells which contain a segment of the sewer system shall be subject to field screening (unless access to the separate storm sewer system is impossible); and
(7) Large or medium municipal separate storm sewer systems which are unable to utilize the procedures described in paragraphs (d)(1)(iv)(D)(1) through (6) of this section, because a sufficiently detailed map of the separate storm sewer systems is unavailable, shall field screen no more than 500 or 250 major outfalls respectively (or all major outfalls in the system, if less); in such circumstances, the applicant shall establish a grid system consisting of north-south and east-west lines spaced \1/4\ mile apart as an overlay to the boundaries of the municipal storm sewer system, thereby creating a series of cells; the applicant will then select major outfalls in as many cells as possible until at least 500 major outfalls (large municipalities) or 250 major outfalls (medium municipalities) are selected; a field screening analysis shall be undertaken at these major outfalls.
(E) Characterization plan. Information and a proposed program to meet the requirements of paragraph (d)(2)(iii) of this section. Such description shall include: the location of outfalls or field screening points appropriate for representative data collection under paragraph (d)(2)(iii)(A) of this section, a description of why the outfall or field screening point is representative, the seasons during which sampling is intended, a description of the sampling equipment. The proposed location of outfalls or field screening points for such sampling should reflect water quality concerns (see paragraph (d)(1)(iv)(C) of this section) to the extent practicable.
(v) Management programs. (A) A description of the existing management programs to control pollutants from the municipal separate storm sewer system. The description shall provide information on existing structural and source controls, including operation and maintenance measures for structural controls, that are currently being implemented. Such controls may include, but are not limited to: Procedures to control pollution resulting from construction activities; floodplain management controls; wetland protection measures; best management practices for new subdivisions; and emergency spill response programs. The description may address controls established under State law as well as local requirements.
(B) A description of the existing program to identify illicit connections to the municipal storm sewer system. The description should

include inspection procedures and methods for detecting and preventing illicit discharges, and describe areas where this program has been implemented.

(vi) Fiscal resources. (A) A description of the financial resources currently available to the municipality to complete part 2 of the permit application. A description of the municipality's budget for existing storm water programs, including an overview of the municipality's financial resources and budget, including overall indebtedness and assets, and sources of funds for storm water programs.

(2) Part 2. Part 2 of the application shall consist of:

(i) Adequate legal authority. A demonstration that the applicant can operate pursuant to legal authority established by statute, ordinance or series of contracts which authorizes or enables the applicant at a minimum to:

(A) Control through ordinance, permit, contract, order or similar means, the contribution of pollutants to the municipal storm sewer by storm water discharges associated with industrial activity and the quality of storm water discharged from sites of industrial activity;

(B) Prohibit through ordinance, order or similar means, illicit discharges to the municipal separate storm sewer;

(C) Control through ordinance, order or similar means the discharge to a municipal separate storm sewer of spills, dumping or disposal of materials other than storm water;

(D) Control through interagency agreements among coapplicants the contribution of pollutants from one portion of the municipal system to another portion of the municipal system;

(E) Require compliance with conditions in ordinances, permits, contracts or orders; and

(F) Carry out all inspection, surveillance and monitoring procedures necessary to determine compliance and noncompliance with permit conditions including the prohibition on illicit discharges to the municipal separate storm sewer.

(ii) Source identification. The location of any major outfall that discharges to waters of the United States that was not reported under paragraph (d)(1)(iii)(B)(1) of this section. Provide an inventory, organized by watershed of the name and address, and a description (such as SIC codes) which best reflects the principal products or services provided by each facility which may discharge, to the municipal separate storm sewer, storm water associated with industrial activity;

(iii) Characterization data. When ``quantitative data'' for a pollutant are required under paragraph (d)(a)(iii)(A)(3) of this section, the applicant must collect a sample of effluent in accordance with 40 CFR 122.21(g)(7) and analyze it for the pollutant in accordance with analytical methods approved under part 136 of this chapter. When no analytical method is approved the applicant may use any suitable method but must provide a description of the method. The applicant must provide information characterizing the quality and quantity of discharges covered in the permit application, including:

(A) Quantitative data from representative outfalls designated by the Director (based on information received in part 1 of the application, the Director shall designate between five and ten outfalls or field screening points as representative of the commercial, residential and industrial land use activities of the drainage area contributing to the system or, where there are less than five outfalls covered in the application, the Director shall designate all outfalls) developed as follows:

(1) For each outfall or field screening point designated under this

subparagraph, samples shall be collected of storm water discharges from three storm events occurring at least one month apart in accordance with the requirements at Sec. 122.21(g)(7) (the Director may allow exemptions to sampling three storm events when climatic conditions create good cause for such exemptions);

(2) A narrative description shall be provided of the date and duration of the storm event(s) sampled, rainfall estimates of the storm event which generated the sampled discharge and the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event;

(3) For samples collected and described under paragraphs (d)(2)(iii)(A)(1) and (A)(2) of this section, quantitative data shall be provided for: the organic pollutants listed in Table II; the pollutants listed in Table III (toxic metals, cyanide, and total phenols) of appendix D of 40 CFR part 122, and for the following pollutants:

Total suspended solids (TSS)
Total dissolved solids (TDS)
COD
BOD<INF>5</INF>
Oil and grease
Fecal coliform
Fecal streptococcus
pH
Total Kjeldahl nitrogen
Nitrate plus nitrite
Dissolved phosphorus
Total ammonia plus organic nitrogen
Total phosphorus

(4) Additional limited quantitative data required by the Director for determining permit conditions (the Director may require that quantitative data shall be provided for additional parameters, and may establish sampling conditions such as the location, season of sample collection, form of precipitation (snow melt, rainfall) and other parameters necessary to insure representativeness);

(B) Estimates of the annual pollutant load of the cumulative discharges to waters of the United States from all identified municipal outfalls and the event mean concentration of the cumulative discharges to waters of the United States from all identified municipal outfalls during a storm event (as described under Sec. 122.21(c)(7)) for BOD<INF>5</INF>, COD, TSS, dissolved solids, total nitrogen, total ammonia plus organic nitrogen, total phosphorus, dissolved phosphorus, cadmium, copper, lead, and zinc. Estimates shall be accompanied by a description of the procedures for estimating constituent loads and concentrations, including any modeling, data analysis, and calculation methods;

(C) A proposed schedule to provide estimates for each major outfall identified in either paragraph (d)(2)(ii) or (d)(1)(iii)(B)(1) of this section of the seasonal pollutant load and of the event mean concentration of a representative storm for any constituent detected in any sample required under paragraph (d)(2)(iii)(A) of this section; and

(D) A proposed monitoring program for representative data collection for the term of the permit that describes the location of outfalls or field screening points to be sampled (or the location of insert stations), why the location is representative, the frequency of sampling, parameters to be sampled, and a description of sampling equipment.

(iv) Proposed management program. A proposed management program covers the duration of the permit. It shall include a comprehensive planning process which involves public participation and where necessary intergovernmental coordination, to reduce the discharge of pollutants to the maximum extent practicable using management practices, control techniques and system, design and engineering methods, and such other provisions which are appropriate. The program shall also include a description of staff and equipment available to implement the program. Separate proposed programs may be submitted by each coapplicant. Proposed programs may impose controls on a system wide basis, a watershed basis, a jurisdiction basis, or on individual outfalls. Proposed programs will be considered by the Director when developing permit conditions to reduce pollutants in discharges to the maximum extent practicable. Proposed management programs shall describe priorities for implementing controls. Such programs shall be based on:

(A) A description of structural and source control measures to reduce pollutants from runoff from commercial and residential areas that are discharged from the municipal storm sewer system that are to be implemented during the life of the permit, accompanied with an estimate of the expected reduction of pollutant loads and a proposed schedule for implementing such controls. At a minimum, the description shall include:

(1) A description of maintenance activities and a maintenance schedule for structural controls to reduce pollutants (including floatables) in discharges from municipal separate storm sewers;

(2) A description of planning procedures including a comprehensive master plan to develop, implement and enforce controls to reduce the discharge of pollutants from municipal separate storm sewers which receive discharges from areas of new development and significant redevelopment. Such plan shall address controls to reduce pollutants in discharges from municipal separate storm sewers after construction is completed. (Controls to reduce pollutants in discharges from municipal separate storm sewers containing construction site runoff are addressed in paragraph (d)(2)(iv)(D) of this section;

(3) A description of practices for operating and maintaining public streets, roads and highways and procedures for reducing the impact on receiving waters of discharges from municipal storm sewer systems, including pollutants discharged as a result of deicing activities;

(4) A description of procedures to assure that flood management projects assess the impacts on the water quality of receiving water bodies and that existing structural flood control devices have been evaluated to determine if retrofitting the device to provide additional pollutant removal from storm water is feasible;

(5) A description of a program to monitor pollutants in runoff from operating or closed municipal landfills or other treatment, storage or disposal facilities for municipal waste, which shall identify priorities and procedures for inspections and establishing and implementing control measures for such discharges (this program can be coordinated with the program developed under paragraph (d)(2)(iv)(C) of this section); and

(6) A description of a program to reduce to the maximum extent practicable, pollutants in discharges from municipal separate storm sewers associated with the application of pesticides, herbicides and fertilizer which will include, as appropriate, controls such as educational activities, permits, certifications and other measures for commercial applicators and distributors, and controls for application in public right-of-ways and at municipal facilities.

(B) A description of a program, including a schedule, to detect and remove (or require the discharger to the municipal separate storm sewer to obtain a separate NPDES permit for) illicit discharges and improper disposal into the storm sewer. The proposed program shall include:

(1) A description of a program, including inspections, to implement and enforce an ordinance, orders or similar means to prevent illicit discharges to the municipal separate storm sewer system; this program description shall address all types of illicit discharges, however the following category of non-storm water discharges or flows shall be addressed where such discharges are identified by the municipality as sources of pollutants to waters of the United States: water line flushing, landscape irrigation, diverted stream flows, rising ground waters, uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20)) to separate storm sewers, uncontaminated pumped ground water, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, springs, water from crawl space pumps, footing drains, lawn watering, individual residential car washing, flows from riparian habitats and wetlands, dechlorinated swimming pool discharges, and street wash water (program descriptions shall address discharges or flows from fire fighting only where such discharges or flows are identified as significant sources of pollutants to waters of the United States);

(2) A description of procedures to conduct on-going field screening activities during the life of the permit, including areas or locations that will be evaluated by such field screens;

(3) A description of procedures to be followed to investigate portions of the separate storm sewer system that, based on the results of the field screen, or other appropriate information, indicate a reasonable potential of containing illicit discharges or other sources of non-storm water (such procedures may include: sampling procedures for constituents such as fecal coliform, fecal streptococcus, surfactants (MBAS), residual chlorine, fluorides and potassium; testing with fluorometric dyes; or conducting in storm sewer inspections where safety and other considerations allow. Such description shall include the location of storm sewers that have been identified for such evaluation);

(4) A description of procedures to prevent, contain, and respond to spills that may discharge into the municipal separate storm sewer;

(5) A description of a program to promote, publicize, and facilitate public reporting of the presence of illicit discharges or water quality impacts associated with discharges from municipal separate storm sewers;

(6) A description of educational activities, public information activities, and other appropriate activities to facilitate the proper management and disposal of used oil and toxic materials; and

(7) A description of controls to limit infiltration of seepage from municipalsanitary sewers to municipal separate storm sewer systems where necessary;

(C) A description of a program to monitor and control pollutants in storm water discharges to municipal systems from municipal landfills, hazardous waste treatment, disposal and recovery facilities, industrial facilities that are subject to section 313 of title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA), and industrial facilities that the municipal permit applicant determines are contributing a substantial pollutant loading to the municipal storm sewer system. The program shall:

(1) Identify priorities and procedures for inspections and establishing and implementing control measures for such discharges;

(2) Describe a monitoring program for storm water discharges associated with the industrial facilities identified in paragraph

(d)(2)(iv)(C) of this section, to be implemented during the term of the permit, including the submission of quantitative data on the following constituents: any pollutants limited in effluent guidelines subcategories, where applicable; any pollutant listed in an existing NPDES permit for a facility; oil and grease, COD, pH, BOD<INF>5</INF>, TSS, total phosphorus, total Kjeldahl nitrogen, nitrate plus nitrite nitrogen, and any information on discharges required under Sec. 122.21(g)(7) (vi) and (vii).

(D) A description of a program to implement and maintain structural and non-structural best management practices to reduce pollutants in storm water runoff from construction sites to the municipal storm sewer system, which shall include:

(1) A description of procedures for site planning which incorporate consideration of potential water quality impacts;

(2) A description of requirements for nonstructural and structural best management practices;

(3) A description of procedures for identifying priorities for inspecting sites and enforcing control measures which consider the nature of the construction activity, topography, and the characteristics of soils and receiving water quality; and

(4) A description of appropriate educational and training measures for construction site operators.

(v) Assessment of controls. Estimated reductions in loadings of pollutants from discharges of municipal storm sewer constituents from municipal storm sewer systems expected as the result of the municipal storm water quality management program. The assessment shall also identify known impacts of storm water controls on ground water.

(vi) Fiscal analysis. For each fiscal year to be covered by the permit, a fiscal analysis of the necessary capital and operation and maintenance expenditures necessary to accomplish the activities of the programs under paragraphs (d)(2) (iii) and (iv) of this section. Such analysis shall include a description of the source of funds that are proposed to meet the necessary expenditures, including legal restrictions on the use of such funds.

(vii) Where more than one legal entity submits an application, the application shall contain a description of the roles and responsibilities of each legal entity and procedures to ensure effective coordination.

(viii) Where requirements under paragraph (d)(1)(iv)(E), (d)(2)(ii), (d)(2)(iii)(B) and (d)(2)(iv) of this section are not practicable or are not applicable, the Director may exclude any operator of a discharge from a municipal separate storm sewer which is designated under paragraph (a)(1)(v), (b)(4)(ii) or (b)(7)(ii) of this section from such requirements. The Director shall not exclude the operator of a discharge from a municipal separate storm sewer identified in appendix F, G, H or I of part 122, from any of the permit application requirements under this paragraph except where authorized under this section.

(e) Application deadlines. Any operator of a point source required to obtain a permit under this section that does not have an effective NPDES permit authorizing discharges from its storm water outfalls shall submit an application in accordance with the following deadlines:

(1) Storm water discharges associated with industrial activity. (i) Except as provided in paragraph (e)(1)(ii) of this section, for any storm water discharge associated with industrial activity identified in paragraphs (b)(14)(i) through (xi) of this section, that is not part of a group application as described in paragraph (c)(2) of this section or that is not authorized by a storm water general permit, a permit application

made pursuant to paragraph (c) of this section must be submitted to the Director by October 1, 1992;

(ii) For any storm water discharge associated with industrial activity from a facility that is owned or operated by a municipality with a population of less than 100,000 that is not authorized by a general or individual permit, other than an airport, powerplant, or uncontrolled sanitary landfill, the permit application must be submitted to the Director by March 10, 2003.

(2) For any group application submitted in accordance with paragraph (c)(2) of this section:

(i) Part 1. (A) Except as provided in paragraph (e)(2)(i)(B) of this section, part 1 of the application shall be submitted to the Director, Office of Wastewater Enforcement and Compliance by September 30, 1991;

(B) Any municipality with a population of less than 250,000 shall not be required to submit a part 1 application before May 18, 1992.

(C) For any storm water discharge associated with industrial activity from a facility that is owned or operated by a municipality with a population of less than 100,000 other than an airport, powerplant, or uncontrolled sanitary landfill, permit applications requirements are reserved.

(ii) Based on information in the part 1 application, the Director will approve or deny the members in the group application within 60 days after receiving part 1 of the group application.

(iii) Part 2. (A) Except as provided in paragraph (e)(2)(iii)(B) of this section, part 2 of the application shall be submitted to the Director, Office of Wastewater Enforcement and Compliance by October 1, 1992;

(B) Any municipality with a population of less than 250,000 shall not be required to submit a part 1 application before May 17, 1993.

(C) For any storm water discharge associated with industrial activity from a facility that is owned or operated by a municipality with a population of less than 100,000 other than an airport, powerplant, or uncontrolled sanitary landfill, permit applications requirements are reserved.

(iv) Rejected facilities. (A) Except as provided in paragraph (e)(2)(iv)(B) of this section, facilities that are rejected as members of the group shall submit an individual application (or obtain coverage under an applicable general permit) no later than 12 months after the date of receipt of the notice of rejection or October 1, 1992, whichever comes first.

(B) Facilities that are owned or operated by a municipality and that are rejected as members of part 1 group application shall submit an individual application no later than 180 days after the date of receipt of the notice of rejection or October 1, 1992, whichever is later.

(v) A facility listed under paragraph (b)(14) (i)-(xi) of this section may add on to a group application submitted in accordance with paragraph (e)(2)(i) of this section at the discretion of the Office of Water Enforcement and Permits, and only upon a showing of good cause by the facility and the group applicant; the request for the addition of the facility shall be made no later than February 18, 1992; the addition of the facility shall not cause the percentage of the facilities that are required to submit quantitative data to be less than 10%, unless there are over 100 facilities in the group that are submitting quantitative data; approval to become part of group application must be obtained from the group or the trade association representing the individual facilities.

(3) For any discharge from a large municipal separate storm sewer

system;

(i) Part 1 of the application shall be submitted to the Director by November 18, 1991;

(ii) Based on information received in the part 1 application the Director will approve or deny a sampling plan under paragraph (d)(1)(iv)(E) of this section within 90 days after receiving the part 1 application;

(iii) Part 2 of the application shall be submitted to the Director by November 16, 1992.

(4) For any discharge from a medium municipal separate storm sewer system;

(i) Part 1 of the application shall be submitted to the Director by May 18, 1992.

(ii) Based on information received in the part 1 application the Director will approve or deny a sampling plan under paragraph (d)(1)(iv)(E) of this section within 90 days after receiving the part 1 application.

(iii) Part 2 of the application shall be submitted to the Director by May 17, 1993.

(5) A permit application shall be submitted to the Director within 180 days of notice, unless permission for a later date is granted by the Director (see Sec. 124.52(c) of this chapter), for:

(i) A storm water discharge that the Director, or in States with approved NPDES programs, either the Director or the EPA Regional Administrator, determines that the discharge contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States (see paragraphs (a)(1)(v) and (b)(15)(ii) of this section);

(ii) A storm water discharge subject to paragraph (c)(1)(v) of this section.

(6) Facilities with existing NPDES permits for storm water discharges associated with industrial activity shall maintain existing permits. Facilities with permits for storm water discharges associated with industrial activity which expire on or after May 18, 1992 shall submit a new application in accordance with the requirements of 40 CFR 122.21 and 40 CFR 122.**26**(c) (Form 1, Form 2F, and other applicable Forms) 180 days before the expiration of such permits.

(7) The Director shall issue or deny permits for discharges composed entirely of storm water under this section in accordance with the following schedule:

(i)(A) Except as provided in paragraph (e)(7)(i)(B) of this section, the Director shall issue or deny permits for storm water discharges associated with industrial activity no later than October 1, 1993, or, for new sources or existing sources which fail to submit a complete permit application by October 1, 1992, one year after receipt of a complete permit application;

(B) For any municipality with a population of less than 250,000 which submits a timely Part I group application under paragraph (e)(2)(i)(B) of this section, the Director shall issue or deny permits for storm water discharges associated with industrial activity no later than May 17, 1994, or, for any such municipality which fails to submit a complete Part II group permit application by May 17, 1993, one year after receipt of a complete permit application;

(ii) The Director shall issue or deny permits for large municipal separate storm sewer systems no later than November 16, 1993, or, for new sources or existing sources which fail to submit a complete permit application by November 16, 1992, one year after receipt of a complete

permit application;
(iii) The Director shall issue or deny permits for medium municipal separate storm sewer systems no later than May 17, 1994, or, for new sources or existing sources which fail to submit a complete permit application by May 17, 1993, one year after receipt of a complete permit application.
(8) For any storm water discharge associated with small construction activity identified in paragraph (b)(15)(i) of this section, see Sec. 122.21(c)(1). Discharges from these sources require permit authorization by March 10, 2003, unless designated for coverage before then.
(9) For any discharge from a regulated small MS4, the permit application made under Sec. 122.33 must be submitted to the Director by:
(i) March 10, 2003 if designated under Sec. 122.32(a)(1) unless your MS4 serves a jurisdiction with a population under 10,000 and the NPDES permitting authority has established a phasing schedule under Sec. 123.35(d)(3) (see Sec. 122.33(c)(1)); or
(ii) Within 180 days of notice, unless the NPDES permitting authority grants a later date, if designated under Sec. 122.32(a)(2) (see Sec. 122.33(c)(2)).
(f) Petitions. (1) Any operator of a municipal separate storm sewer system may petition the Director to require a separate NPDES permit (or a permit issued under an approved NPDES State program) for any discharge into the municipal separate storm sewer system.
(2) Any person may petition the Director to require a NPDES permit for a discharge which is composed entirely of storm water which contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.
(3) The owner or operator of a municipal separate storm sewer system may petition the Director to reduce the Census estimates of the population served by such separate system to account for storm water discharged to combined sewers as defined by 40 CFR 35.2005(b)(11) that is treated in a publicly owned treatment works. In municipalities in which combined sewers are operated, the Census estimates of population may be reduced proportional to the fraction, based on estimated lengths, of the length of combined sewers over the sum of the length of combined sewers and municipal separate storm sewers where an applicant has submitted the NPDES permit number associated with each discharge point and a map indicating areas served by combined sewers and the location of any combined sewer overflow discharge point.
(4) Any person may petition the Director for the designation of a large, medium, or small municipal separate storm sewer system as defined by paragraph (b)(4)(iv), (b)(7)(iv), or (b)(16) of this section.
(5) The Director shall make a final determination on any petition received under this section within 90 days after receiving the petition with the exception of petitions to designate a small MS4 in which case the Director shall make a final determination on the petition within 180 days after its receipt.
(g) Conditional exclusion for ``no exposure'' of industrial activities and materials to storm water. Discharges composed entirely of storm water are not storm water discharges associated with industrial activity if there is ``no exposure'' of industrial materials and activities to rain, snow, snowmelt and/or runoff, and the discharger satisfies the conditions in paragraphs (g)(1) through (g)(4) of this section. ``No exposure'' means that all industrial materials and activities are protected by a storm resistant shelter to prevent exposure to rain, snow, snowmelt, and/or runoff. Industrial materials or

activities include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products. Material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, final product or waste product.

(1) Qualification. To qualify for this exclusion, the operator of the discharge must:

(i) Provide a storm resistant shelter to protect industrial materials and activities from exposure to rain, snow, snow melt, and runoff;

(ii) Complete and sign (according to Sec. 122.22) a certification that there are no discharges of storm water contaminated by exposure to industrial materials and activities from the entire facility, except as provided in paragraph (g)(2) of this section;

(iii) Submit the signed certification to the NPDES permitting authority once every five years;

(iv) Allow the Director to inspect the facility to determine compliance with the ``no exposure'' conditions;

(v) Allow the Director to make any ``no exposure'' inspection reports available to the public upon request; and

(vi) For facilities that discharge through an MS4, upon request, submit a copy of the certification of ``no exposure'' to the MS4 operator, as well as allow inspection and public reporting by the MS4 operator.

(2) Industrial materials and activities not requiring storm resistant shelter. To qualify for this exclusion, storm resistant shelter is not required for:

(i) Drums, barrels, tanks, and similar containers that are tightly sealed, provided those containers are not deteriorated and do not leak (``Sealed'' means banded or otherwise secured and without operational taps or valves);

(ii) Adequately maintained vehicles used in material handling; and

(iii) Final products, other than products that would be mobilized in storm water discharge (e.g., rock salt).

(3) Limitations. (i) Storm water discharges from construction activities identified in paragraphs (b)(14)(x) and (b)(15) are not eligible for this conditional exclusion.

(ii) This conditional exclusion from the requirement for an NPDES permit is available on a facility-wide basis only, not for individual outfalls. If a facility has some discharges of storm water that would otherwise be ``no exposure'' discharges, individual permit requirements should be adjusted accordingly.

(iii) If circumstances change and industrial materials or activities become exposed to rain, snow, snow melt, and/or runoff, the conditions for this exclusion no longer apply. In such cases, the discharge becomes subject to enforcement for un-permitted discharge. Any conditionally exempt discharger who anticipates changes in circumstances should apply for and obtain permit authorization prior to the change of circumstances.

(iv) Notwithstanding the provisions of this paragraph, the NPDES permitting authority retains the authority to require permit authorization (and deny this exclusion) upon making a determination that the discharge causes, has a reasonable potential to cause, or contributes to an instream excursion above an applicable water quality standard, including designated uses.

(4) Certification. The no exposure certification must require the

submission of the following information, at a minimum, to aid the NPDES permitting authority in determining if the facility qualifies for the no exposure exclusion:

(i) The legal name, address and phone number of the discharger (see Sec. 122.21(b));

(ii) The facility name and address, the county name and the latitude and longitude where the facility is located;

(iii) The certification must indicate that none of the following materials or activities are, or will be in the foreseeable future, exposed to precipitation:

(A) Using, storing or cleaning industrial machinery or equipment, and areas where residuals from using, storing or cleaning industrial machinery or equipment remain and are exposed to storm water;

(B) Materials or residuals on the ground or in storm water inlets from spills/leaks;

(C) Materials or products from past industrial activity;

(D) Material handling equipment (except adequately maintained vehicles);

(E) Materials or products during loading/unloading or transporting activities;

(F) Materials or products stored outdoors (except final products intended for outside use, e.g., new cars, where exposure to storm water does not result in the discharge of pollutants);

(G) Materials contained in open, deteriorated or leaking storage drums, barrels, tanks, and similar containers;

(H) Materials or products handled/stored on roads or railways owned or maintained by the discharger;

(I) Waste material (except waste in covered, non-leaking containers, e.g., dumpsters);

(J) Application or disposal of process wastewater (unless otherwise permitted); and

(K) Particulate matter or visible deposits of residuals from roof stacks/vents not otherwise regulated, i.e., under an air quality control permit, and evident in the storm water outflow;

(iv) All ``no exposure'' certifications must include the following certification statement, and be signed in accordance with the signatory requirements of Sec. 122.22: ``I certify under penalty of law that I have read and understand the eligibility requirements for claiming a condition of ``no exposure'' and obtaining an exclusion from NPDES storm water permitting; and that there are no discharges of storm water contaminated by exposure to industrial activities or materials from the industrial facility identified in this document (except as allowed under paragraph (g)(2)) of this section. I understand that I am obligated to submit a no exposure certification form once every five years to the NPDES permitting authority and, if requested, to the operator of the local MS4 into which this facility discharges (where applicable). I understand that I must allow the NPDES permitting authority, or MS4 operator where the discharge is into the local MS4, to perform inspections to confirm the condition of no exposure and to make such inspection
reports publicly available upon request. I understand that I must obtain coverage under an NPDES permit prior to any point source discharge of storm water from the facility. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons

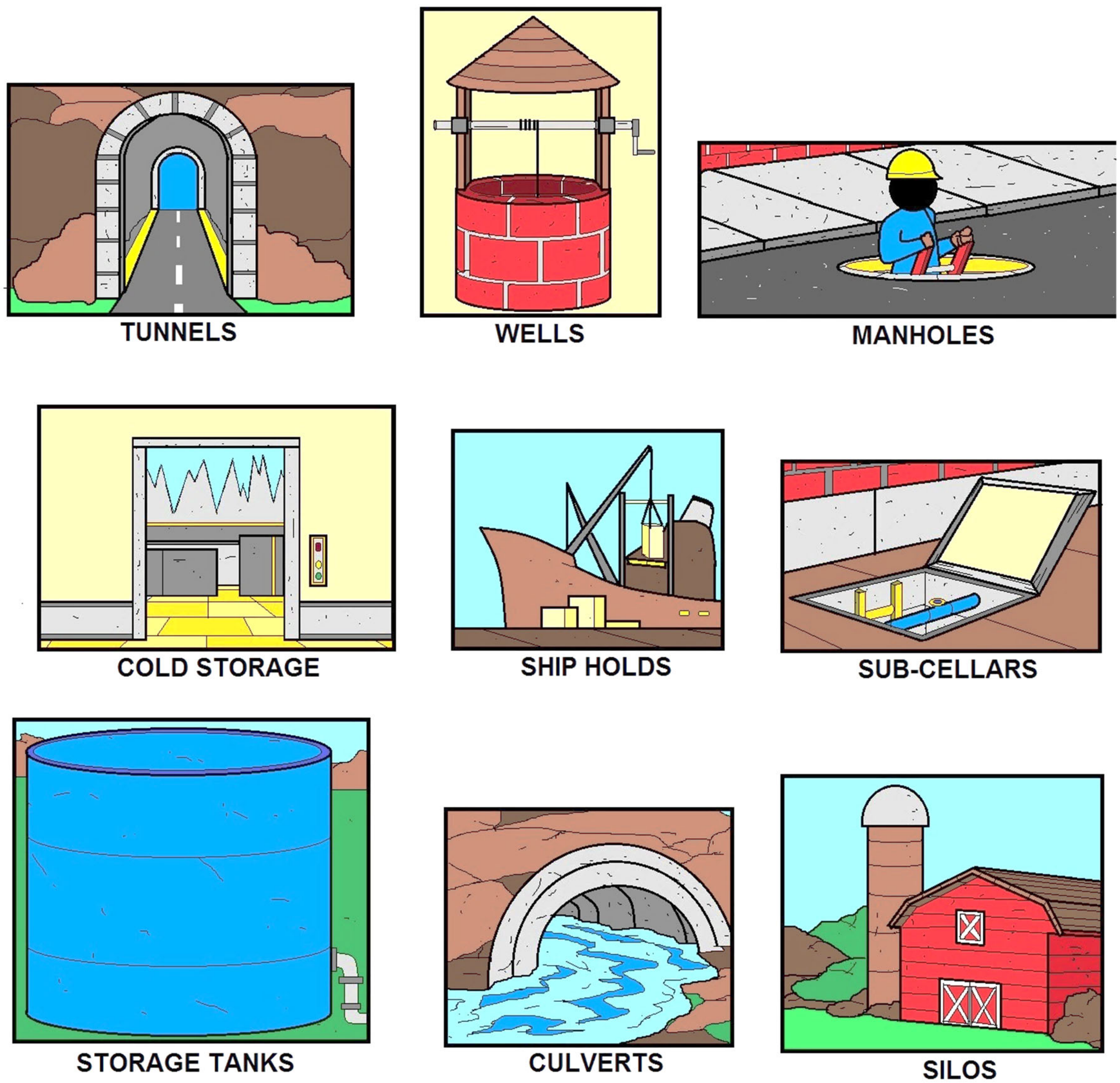
directly involved in gathering the information, the information submitted is to the best of my knowledge and belief true, accurate and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.''

[55 FR 48063, Nov. 16, 1990, as amended at 56 FR 12100, Mar. 21, 1991; 56 FR 56554, Nov. 5, 1991; 57 FR 11412, Apr. 2, 1992; 57 FR 60447, Dec. 18, 1992; 60 FR 17956, Apr. 7, 1995; 60 FR 19464, Apr. 18, 1995; 60 FR 40235, Aug. 7, 1995; 64 FR 68838, Dec. 8, 1999; 65 FR 30907, May 15, 2000]

Confined Space Section

Section Focus: You will learn the basics of proper confined space entry. At the end of this section, you will be able to understand and describe confined space and permit required confined spaces. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Scope/Background: The Confined Space Entry Program is provided to protect authorized employees that will enter confined spaces and may be exposed to hazardous atmospheres, engulfment in materials, conditions which may trap or asphyxiate due to converging or sloping walls, or contains any other safety or health hazards.
Reference: OSHA-Permit-Required Confined Spaces (**29 CFR 1910.146**).



EXAMPLES OF CONFINED SPACES

Scenario. A fixed ladder drops deep inside a permit required or type II confined space. One man goes inside and passes out from hazardous fumes. A second man goes in and dies within seconds trying to help his buddy.

A third man goes in to save the others and dies on the spot. Only the first man survives, that is if you can say that being brain dead is surviving. Never try to rescue your buddies unless you are trained and have proper equipment. Never! Call 911 first. This scenario actually happened inside a sewer system. ***Don't be the next victim.***

Hazardous Incident Number 1

A man was overcome by carbon dioxide gas after entering a 4,500-liter wine vat containing crushed grape skins and seeds. He entered through a 15 inch opening at the top of the vat.

The juice from the crushed grapes had been drained off through the drainer at the bottom of the tank. The atmosphere was inert due to the presence of a large amount of carbon dioxide.

Carbon dioxide is added to the winemaking process as an antioxidant to displace oxygen during the winemaking process.

Contributing Factors

- Lack of atmospheric monitoring equipment to test the internal atmosphere in the wine vats. (Non-scientific methods such as the sniff test are not satisfactory and expose workers to harmful gases).
- The employee appeared to have a lack of appreciation of the risks associated with carbon dioxide; that is, the rapidity of symptoms, the onset of euphoria, loss of muscle control and was dead within four (4) minutes.

Confined Space Entry Permits

✓ Confined Space Entry Permits must be completed before any employee enters a permit-required confined space. The permit must be completed and signed by an authorized member of management before entry.
✓ Permits will expire before the completion of the shift or if any pre-entry conditions change.
✓ Permits will be maintained on file for 12 months.

Hazardous Incident Number 2 - Three Sanitation Workers and One Policeman Die in an Underground Pumping Station in Kentucky

Introduction
On July 5, 1985, a police officer and two sewer workers died in an attempt to rescue a third sewer worker, who had been overcome by sewer gas at the bottom of an underground pumping station. All four persons were pronounced dead upon removal from the station.

Synopsis of Events
On July 5, 1985, at approximately 10 a.m., two sewer workers (27 and 28 years of age) entered a 50-foot-deep underground pumping station. The station is 1 of 12 that pump sewage to the city's waste water treatment plant. The workers entered through a metal shaft (3 feet in diameter) on a fixed ladder that leads to an underground room (8 feet by 8 feet by 7 feet).

The ventilating fan was not functioning correctly. The workers were not wearing personal protective clothing or equipment.

The two workers proceeded to remove the bolts of an inspection plate from a check valve. The plate blew off, allowing raw sewage to flood the chamber, overwhelming one of the workers. The second worker exited the pumping station and radioed the police department, requesting assistance.

He again entered the station and was also overcome. Two police officers responded to the call at approximately 10:09 a.m. and one officer entered the pumping station. Later the sewage systems field manager arrived on the scene and followed the officer into the pumping station. None of the rescuers returned to the top of the ladder.

A construction worker, who was passing by the site, stopped and entered the station in a rescue attempt. After descending approximately 10 feet into the shaft, he called for help. The second police officer assisted the construction worker out of the shaft. None of the responding men wore respirators.

Fire department personnel arrived at the accident site at approximately 10:11 a.m. One fireman, wearing a self-contained breathing apparatus (**SCBA**), entered the shaft, but could not locate the four men. By this time sewage had completely flooded the underground room.

The fireman exited the pumping station. A second volunteer fireman (6'8", 240 lbs.) entered the shaft wearing a SCBA and a life line. As he began his descent he apparently slipped from the ladder and became wedged in the shaft approximately 20 feet down. (His body was folded with his head and feet facing upward.) Not being able to breathe, he removed the face mask and lost consciousness.

Rescuers at the site extricated the fireman after a 30-minute effort. No further rescue attempts were made, until professional divers were required to enter the station and removed the bodies. Autopsy results revealed a considerable amount of sewage in the lungs of the sewer workers and only a trace of sewage in the lungs of the field manager and police officer.

Recommendations/Discussion

Recommendation #1: Employers should develop proper work procedures and should adequately train employees to maintain and repair the sewage system. This training should include recognition of potential hazards associated with failures within those systems.

Discussion: The sewer workers did not have an understanding of the pumping station's design; therefore, mechanical failures and hazards associated with those failures were not adequately identified. Records were not kept of mechanical failures or repairs. The sewer workers "believed" that a malfunctioning valve had previously been repaired.

This valve permitted the pumping station to flood. The lack of training resulted in the employee not being able to properly isolate the work area from fumes and sewage seepage.

Recommendation #2: Employers should develop comprehensive policies and procedures for confined space entry.

Discussion: Prior to confined space entry, all procedures should be documented. All types of emergencies and potential hazardous conditions should be addressed.

These procedures should minimally include the following:
1. Air quality testing to assure adequate oxygen supply, adequate ventilation, and the absence of all toxic air contaminants;
2. Employee and supervisory training in the selection and usage of respiratory protection;
3. Development of site-specific working procedures and emergency access and egress plans;
4. Emergency rescue training;
5. Availability, storage, and maintenance of emergency rescue equipment.

The air quality was not determined before the sewer workers entered the confined space and the ventilation system was not functioning properly. One respirator was available for use; however, it was not appropriate for the chemical contamination (sewer gas) present. Life lines were not available.

Once confined space pre-entry procedures are developed, employees should be trained to follow them.

Recommendation #3: Fire fighters, police officers, and others responsible for emergency rescue should be trained for confined space rescue.

Discussion: A police officer died in the rescue attempt of the sewer workers. The police officer was not trained in confined space rescue techniques and did not recognize the hazards associated with the confined space.

The volunteer fireman, who attempted the rescue and wedged himself inside the shaft, should not have been allowed to enter. His size alone created a potential hazard for himself and the incident delayed possible rescue of the victims. Emergency rescue teams must be cognizant of all hazards associated with confined spaces, including rescue hindrances, and they should wear proper personal protection and devices for emergency egress.

Hazardous Incident Number 3
Unnecessary Confined Space Deaths

Two self-employed well cleaners (the victims) drowned while cleaning a residential well. Victim #1 was a 40-year-old male and victim #2 was a 43-year-old male. The well was 36 inches in diameter and 40-feet deep. Concrete casings supported the sides of the well, while the well floor was left as exposed soil to allow flow of ground water.

At the time of the incident, victim #1 was at the well bottom brushing down the concrete casings and shoveling muck from the well floor; he apparently became disoriented and was unable to exit the well. Victim #2 then entered the well in a rescue attempt. However, the two were unable to exit the well due to inadequate rescue equipment. The homeowner called 911 and emergency rescue units arrived within approximately 10 minutes. Victim #2 was removed from the well approximately 20 minutes after the first rescue unit arrived. He was transported to the local hospital and pronounced dead shortly after arrival.

Victim #1 was pulled from the well approximately 4 hours after the 911 call. He was pronounced dead at the scene. NIOSH investigators determined that, to prevent similar occurrences, employers, including the self-employed involved in well cleaning operations, should:

- Develop and implement a comprehensive confined space entry program.
- NIOSH investigators also determined, for the protection of rescue personnel, volunteer fire departments should:
- identify the types of confined spaces within their jurisdictions and develop and implement confined space entry and rescue programs
- develop and implement a respiratory protection program to protect firefighters from respiratory hazards
- Develop and implement a general safety program to help firefighters recognize, understand, and control hazards.

On May 1, 1993, two self-employed well cleaners (the victims) drowned while conducting well cleaning operations at a residential well site. On June 23, 1993, the Maryland Occupational Safety and Health Administration (**MOSH**), notified the Division of Safety Research (**DSR**) of these deaths and requested technical assistance. On July 12, 1993, an environmental health and safety specialist and an engineering intern from DSR conducted a field investigation of this incident.

Interviews were conducted with the MOSH investigator, the county confined space rescue team, the county volunteer fire department, and the son of victim #2. Photographs were obtained of the incident site. Medical examiner's reports for both victims were also obtained. No atmospheric testing was conducted as the well site had been filled in and sealed.

The investigation was complicated in part by certain factors: the time lapse between the incident and the investigation, the number of emergency responders, the particular sequence of events, and the time frames of these events, and differing perceptions of the series of events occurring in a crisis situation.

Therefore, a scenario of this incident was developed after carefully evaluating a diverse mixture of information. The victims in this incident worked part-time as self-employed well cleaners and grave diggers.

This was the only source of employment for victim #1. Victim #2 was employed full-time as a truck driver for the county in which the incident occurred. Neither victim had any safety or confined space training. However, both victims were aware that well cleaning was a dangerous job, according to the son of victim #2.

In summarizing this confined space investigation, there were three major hazards identified: (1) oxygen deficient atmosphere (NIOSH, 1979), (2) toxic (carbon monoxide) atmosphere (NIOSH, 1972), and (3) cold water exposure (Golden, 1976). The medical examiner listed the blood carboxyhemoglobin saturation levels as 37% in victim #1 and 13% in victim #2.

The bacterial action and biomass in the well could have been a source for a small percentage of the carbon monoxide. However, an external source was probably responsible for the largest percentage of carbon monoxide. Testing conducted by the volunteer fire unit indicated that the oxygen level (only gas tested) at the 20-foot level was 17% by volume. When the well was pumped to the bottom, the oxygen level would have likely decreased to 12 to 15% by volume. Under conditions of reduced ambient oxygen concentration, such as the reduced oxygen level in the well, the exposure to carbon monoxide was even more critical. The water temperature in the well was reported to be between 35 and 40 degrees F. Survival time in water at 32 degrees F is predicted to be less than 15 minutes (Golden, 1976).

Cause of Death
The medical examiner listed the cause of death for victim #1 as "drowning complicating carbon monoxide poisoning," and the cause of death for victim #2 as drowning.

Recommendation #1: Employers involved in well cleaning operations, including the self-employed, should develop and implement a comprehensive confined space entry program.

Discussion: There was no confined space entry program in effect at the residential well site at the time of the incident. The atmosphere was not tested before entry, no mechanical ventilation or respiratory protection was provided, and no rescue plans were developed.

Employers, even self-employed well cleaning operations, should develop and implement a written confined space entry program to address all provisions outlined in the following NIOSH Publications: Working in Confined Spaces: Criteria for a Recommended Standard (Pub. No. 80-106); NIOSH Alert, Request for Assistance in Preventing Occupational Fatalities in Confined Spaces (Pub. No. 86-110); A Guide to Safety in Confined Spaces (Pub. No. 87-113); and NIOSH Guide to Industrial Respiratory Protection (Pub. No. 87-116).

Most of this text is credited to OSHA.

Confined Spaces are

-large enough to allow entry of any body part, and
-limited or restricted entry or exit, and
-not designed for continuous employee occupancy
Permit Required Confined Spaces are confined spaces that have any of the following
-potential hazardous atmosphere
-material inside that may engulf or trap you
-internal design that could trap or asphyxiate you
-any other serious safety or health hazard

Entry Permits are required before you enter any "**Permit Required Confined Space**"

Hazards include

- Fire & Explosion
- Engulfment
- Asphyxiation
- Entrapment
- Slips & Falls
- Electric Shock
- Noise & Vibration
- Chemical Exposure
- Toxic Atmospheres
- Thermal / Chemical Burns

Engineering Controls

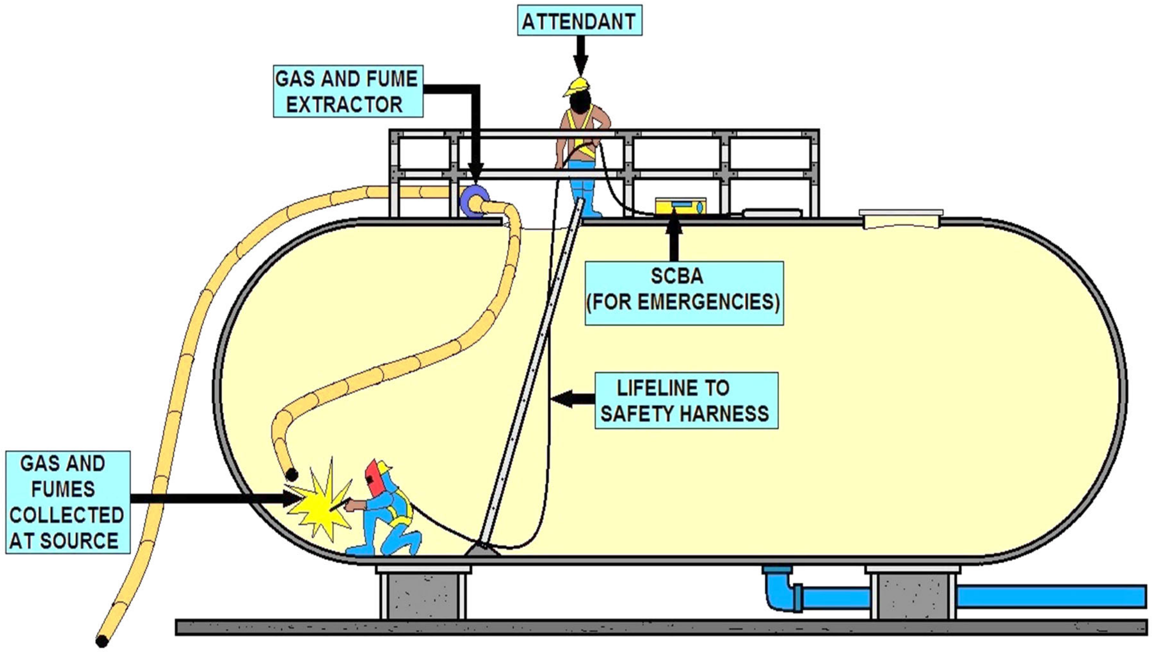
- ❑ Ventilation
- ❑ Locked Access
- ❑ Lighting

Administrative Controls

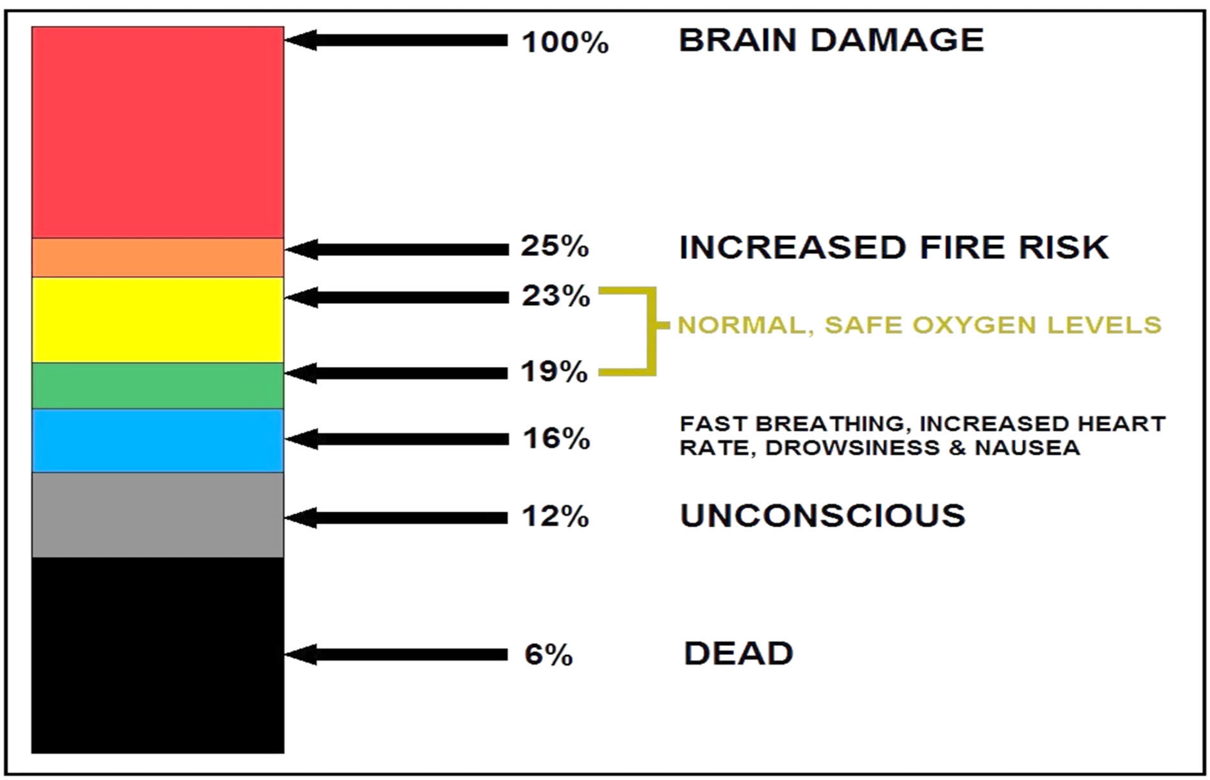
- ❑ Controlled Access
- ❑ Hazard Assessments
- ❑ Entry Permits & Procedures
- ❑ Signs & Lockout Tagout
- ❑ Training

A.
B. Smart Safety Rules

Know what you are getting into.
Know how to get out in an emergency.
Know the hazards & how they are controlled.
Only authorized & trained personnel may enter a Confined Space or act as an attendant.
No smoking in Confined Space or near entrance or exit area.
Attendant must be present at all times.
Constant visual or voice communication must be maintained between the attendant and entrants.
No bottom or side entry will be made, or work conducted below the level any hanging material or material which could cause engulfment.
Air and oxygen monitoring is required before entering a Permit-Required Confined Space.
Ventilation & oxygen monitoring is required when welding is performed.



CONFINED SPACE DIAGRAM



RESULTS OF OXYGEN LEVELS IN CONFINED SPACES

Confined Space Terms

"Acceptable entry conditions" means the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within the space.

"Attendant" means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

"Authorized entrant" means an employee who is authorized by the employer to enter a permit space.

"Blanking or blinding" means the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

"Confined space" means a space that:
(1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and

(2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and

(3) Is not designed for continuous employee occupancy.

"Double block and bleed" means the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

"Emergency" means any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

"Engulfment" means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

"Entry" means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

"Entry permit (permit)" means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in paragraph (f) of this section.

"Entry supervisor" means the person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section.

NOTE: An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

"Hazardous atmosphere" means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:

(1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);

(2) Airborne combustible dust at a concentration that meets or exceeds its LFL;

NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.

(3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;

(4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this Part and which could result in employee exposure in excess of its dose or permissible exposure limit;

NOTE: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.

(5) Any other atmospheric condition that is immediately dangerous to life or health.

NOTE: For air contaminants for which OSHA has not determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data Sheets that comply with the Hazard Communication Standard, section 1910.1200 of this Part, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

"Hot work permit" means the employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.

"Immediately dangerous to life or health (IDLH)" means any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

NOTE: Some materials -- hydrogen fluoride gas and cadmium vapor, for example -- may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

"Inerting" means the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.

NOTE: This procedure produces an IDLH oxygen-deficient atmosphere.

"Isolation" means the process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

"Line breaking" means the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

"Non-permit confined space" means a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

"Oxygen deficient atmosphere" means an atmosphere containing less than 19.5 percent oxygen by volume.

"Oxygen enriched atmosphere" means an atmosphere containing more than 23.5 percent oxygen by volume.

"Permit-required confined space (permit space)" means a confined space that has one or more of the following characteristics:

(1) Contains or has a potential to contain a hazardous atmosphere;

(2) Contains a material that has the potential for engulfing an entrant;

(3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or

(4) Contains any other recognized serious safety or health hazard.

"Permit-required confined space program (permit space program)" means the employer's overall program for controlling, and, where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

"Permit system" means the employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

"Prohibited condition" means any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

"Rescue service" means the personnel designated to rescue employees from permit spaces.

"Retrieval system" means the equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

"Testing" means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

Would you consider this a confined space? How about a permit required? Think about the various chemicals that we use inside confined spaces.

Confined Space Entry Program - Introduction

Purpose
The Confined Space Entry Program is provided to protect authorized employees that will enter confined spaces and may be exposed to hazardous atmospheres, engulfment in materials, conditions which may trap or asphyxiate due to converging or sloping walls, or contains any other safety or health hazards.
Reference: OSHA-Permit-Required Confined Spaces (**29 CFR 1910.146**).

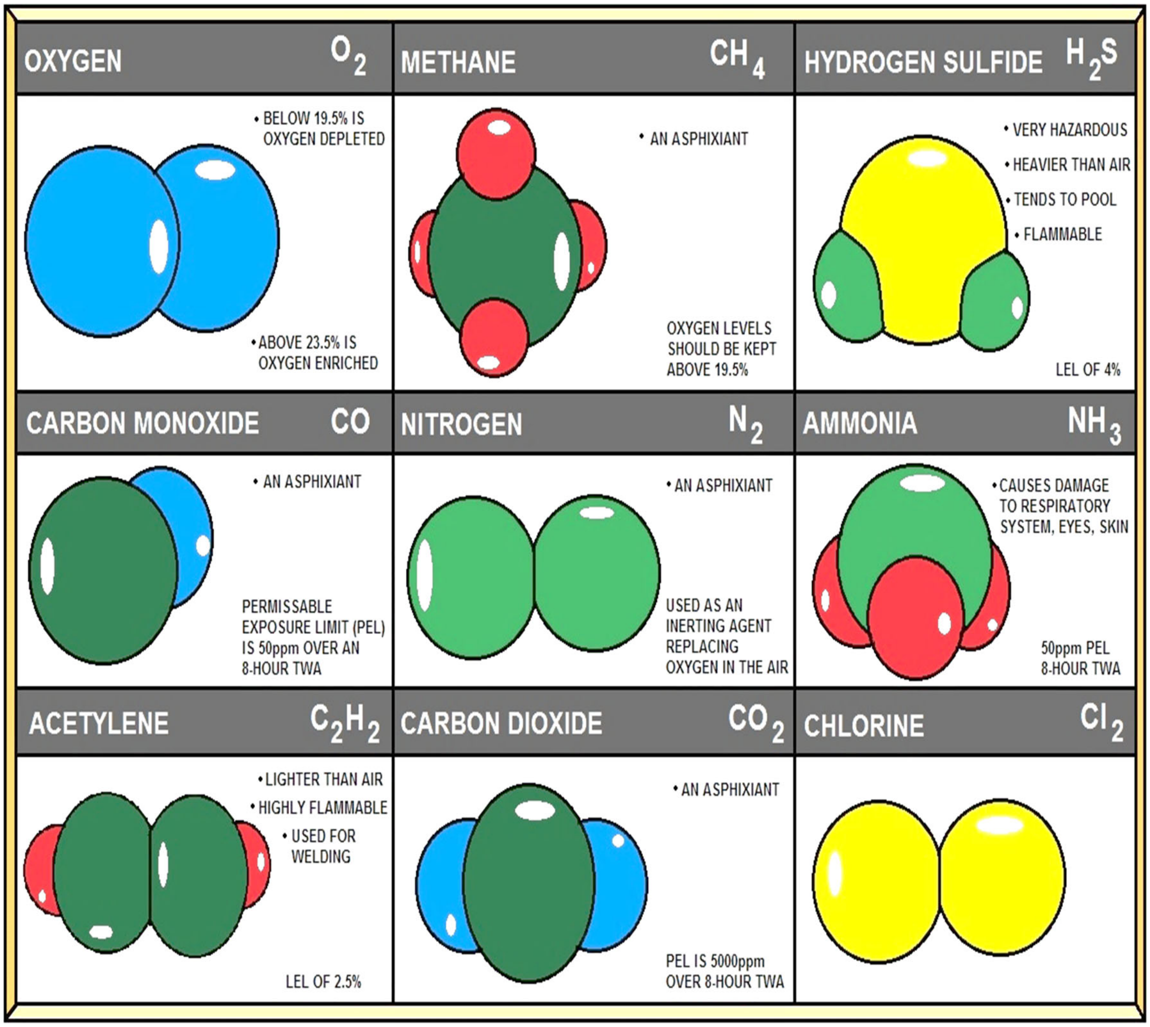
Scope
You are required to recognize the dangers and hazards associated with confined spaces, and this program is designed to assist you in the safety of and compliance with the OSHA standards associated with such.

Most communities will utilize the Fire Department for all rescues and additional assistance dealing with confined spaces, understanding that most Fire Department operations utilize additional in house SOG's/SOP's pertaining to such operations.

Definitions
Confined space:
- ✓ Is large enough or so configured that an employee can bodily enter and perform work.
- ✓ Has limited or restricted means for entry or exit (i.e. tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- ✓ Is not designed for continuous employee occupancy.
- ✓ Permit required confined space (permit space), is a confined space that has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere.
2. Contains a material that has the potential for engulfing an entrant.
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly covering walls or by a floor which slopes downward and tapers to a smaller cross-section.
4. Contains any other recognized serious safety or health hazard.

Each Permit-Required Confined Space will be marked
"***Confined Space - Entry Permit Required***".
Most of this text is credited to OSHA.



COMMONLY FOUND GASES INSIDE CONFINED SPACES

Confined Space Hazards

Fatalities and injuries constantly occur among construction workers who, during the course of their jobs, are required to enter confined spaces. In some circumstances, these workers are exposed to multiple hazards, any of which may cause bodily injury, illness, or death.

Newspaper and magazine articles abound with stories of workers injured and killed from a variety of atmospheric factors and physical agents. Throughout the construction jobsite, contractors and workers encounter both inherent and induced hazards within confined workspaces.

Inherent Hazards
Inherent hazards, such as electrical, thermal, chemical, mechanical, etc., are associated with specific types of equipment and the interactions among them.

Examples include high voltage (shock or corona discharge and the resulting burns), radiation generated by equipment, defective design, omission of protective features (no provision for grounding non-current-carrying conductive parts), high or low temperatures, high noise levels, and high-pressure vessels and lines (rupturing with resultant release of fragments, fluids, gases, etc.).

Inherent hazards usually cannot be eliminated without degrading the system or equipment, or without making them inoperative. Therefore, emphasis must be placed on hazard control methods.

Induced Hazards
Induced hazards arise, and are induced from, a multitude of incorrect decisions and actions that occur during the actual construction process. Some examples are: omission of protective features, physical arrangements that may cause unintentional worker contact with electrical energy sources, oxygen-deficient atmospheres created at the bottom of pits or shafts, lack of safety factors in structural strength, and flammable atmospheres.

Typical Examples of Confined Workspaces
Following are typical examples of confined workspaces in construction which contain both inherent and induced hazards.

Vaults
A variety of vaults are found on the construction jobsite. On various occasions, workers must enter these vaults to perform a number of functions.

The restricted nature of vaults and their frequently below-grade location can create an assortment of safety and health problems.

Oxygen-Deficient Atmosphere
One of the major problems confronting construction workers while working in vaults is the ever-present possibility of an oxygen-deficient atmosphere.

Explosive or Toxic Gases, Vapors, or Fumes
While working in an electrical vault, workers may be exposed to the build-up of explosive gases such as those used for heating (propane). Welding and soldering produce toxic fumes which are confined in the limited atmosphere.

Electrical Shock
Electrical shock is often encountered from power tools, line cords, etc. In many instances, such electrical shock results from the fact that the contractor has not provided an approved grounding system or the protection afforded by ground-fault circuit interrupters or low-voltage systems.

Purging
In some instances, purging agents such as nitrogen and argon may enter the vault from areas adjacent to it. These agents may displace the oxygen in the vault to the extent that it will asphyxiate workers almost immediately.

Materials Falling In and On
A hazard normally considered a problem associated with confined spaces is material or equipment which may fall into the vault or onto workers as they enter and leave the vault.

Vibration could cause the materials on top of the vault to roll off and strike workers. If the manhole covers were removed, or if they were not installed in the first place, materials could fall into the vault, causing injury to the workers inside.

Condenser Pits
A common confined space found in the construction of nuclear power plants is the condenser pit. Because of their large size, they are often overlooked as potentially hazardous confined spaces.

These below-grade areas create large containment areas for the accumulation of toxic fumes, gases, and so forth, or for the creation of oxygen-deficient atmospheres when purging with argon, Freon, and other inert gases.

Other hazards will be created by workers above dropping equipment, tools, and materials into the pit.

Manholes
Throughout the construction site, manholes are commonplace. As means of entry into and exit from vaults, tanks, pits, and so forth, manholes perform a necessary function. However, these confined spaces may present serious hazards which could cause injuries and fatalities.

A variety of hazards are associated with manholes. To begin with, the manhole could be a dangerous trap into which the worker could fall. Often covers are removed and not replaced, or else they are not provided in the first place.

Pipe Assemblies
One of the most frequently unrecognized types of confined spaces encountered throughout the construction site is the pipe assembly. Piping of sixteen to thirty-six inches in diameter is commonly used for a variety of purposes.
For any number of reasons, workers will enter the pipe. Once inside, they are faced with potential oxygen-deficient atmospheres, often caused by purging with argon or another inert gas. Welding fumes generated by the worker in the pipe, or by other workers operating outside the pipe at either end, subject the worker to toxic atmospheres.

The generally restricted dimensions of the pipe provide little room for the workers to move about and gain any degree of comfort while performing their tasks. Once inside the pipe, communication is extremely difficult. In situations where the pipe bends, communication and extrication become even more difficult. Electrical shock is another problem to which the worker is exposed.

Ungrounded tools and equipment or inadequate line cords are some of the causes. As well, heat within the pipe run may cause the worker to suffer heat prostration.

Ventilation Ducts
Ventilation ducts, like pipe runs, are very common at the construction site. These sheet metal enclosures create a complex network which moves heated and cooled air and exhaust fumes to desired locations in the plant.

Ventilation ducts may require that workers enter them to cut out access holes, install essential parts of the duct, etc. Depending on where these ducts are located, oxygen deficiency could exist. They usually possess many bends, which create difficult entry and exit and which also make it difficult for workers inside the duct to communicate with those outside it. Electrical shock hazards and heat stress are other problems associated with work inside ventilation ducts.

Tanks
Tanks are another type of confined workspace commonly found in construction. They are used for a variety of purposes, including the storage of water, chemicals, etc.

Tanks require entry for cleaning and repairs. Ventilation is always a problem. Oxygen-deficient atmospheres, along with toxic and explosive atmospheres created by the substances stored in the tanks, present hazards to workers. Heat, another problem in tanks, may cause heat prostration, particularly on a hot day.

Since electrical line cords are often taken into the tank, the hazard of electrical shock is always present. The nature of the tank's structure often dictates that workers must climb ladders to reach high places on the walls of the tank.

Sumps
Sumps are commonplace. They are used as collection places for water and other liquids. Workers entering sumps may encounter an oxygen-deficient atmosphere.

Also, because of the wet nature of the sump, electrical shock hazards are present when power tools are used inside. Sumps are often poorly illuminated. Inadequate lighting may create an accident situation.

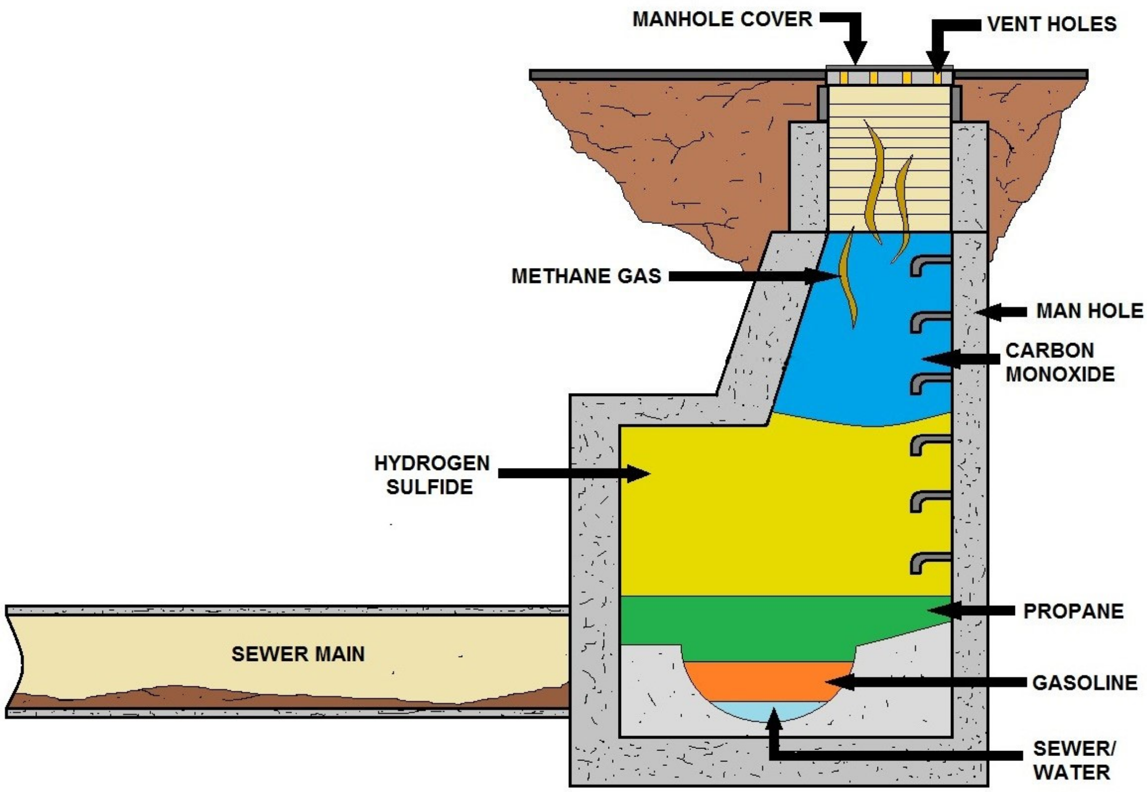
Containment Cavities
These large below-grade areas are characterized by little or no air movement. Ventilation is always a problem. In addition, the possibility of oxygen deficiency exists. As well, welding and other gases may easily collect in these areas, creating toxic atmospheres. As these structures near completion, more confined spaces will exist as rooms are built off the existing structure.

Electrical Transformers
Electrical transformers are located on the jobsite. They often contain a nitrogen purge or dry air. Before they are opened, they must be well vented by having air pumped in. Workers, particularly electricians and power plant operators, will enter these transformers through hatches on top for various work-related reasons. Testing for oxygen deficiency and for toxic atmospheres is mandatory.

Heat Sinks
These larger pit areas hold cooling water in the event that there is a problem with the pumps located at the water supply to the plant--normally a river or lake--which would prevent cooling water from reaching the reactor core.

When in the pits, workers are exposed to welding fumes and electrical hazards, particularly because water accumulates in the bottom of the sink.

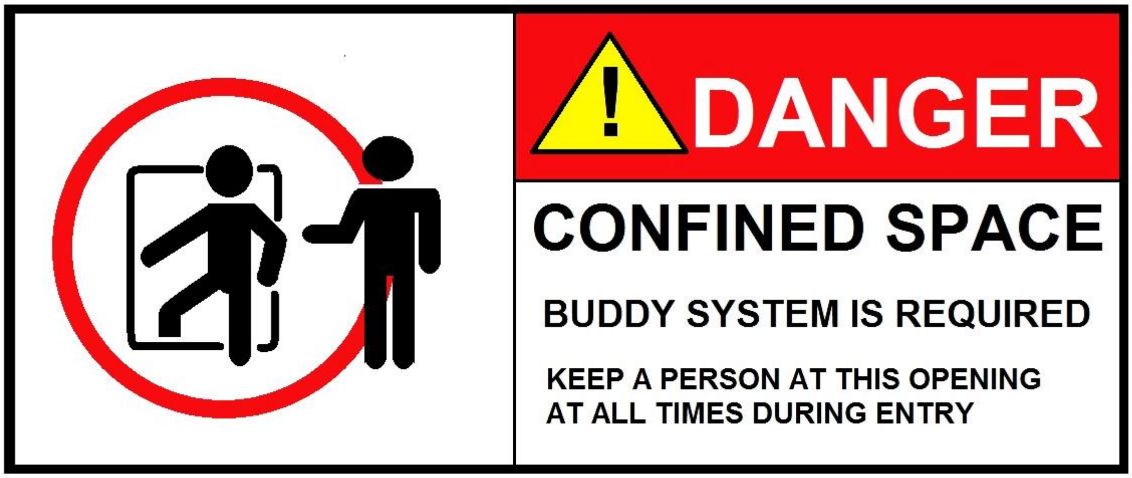
Generally, it is difficult to communicate with workers in the heat sink, because the rebar in the walls of the structure deaden radio signals.



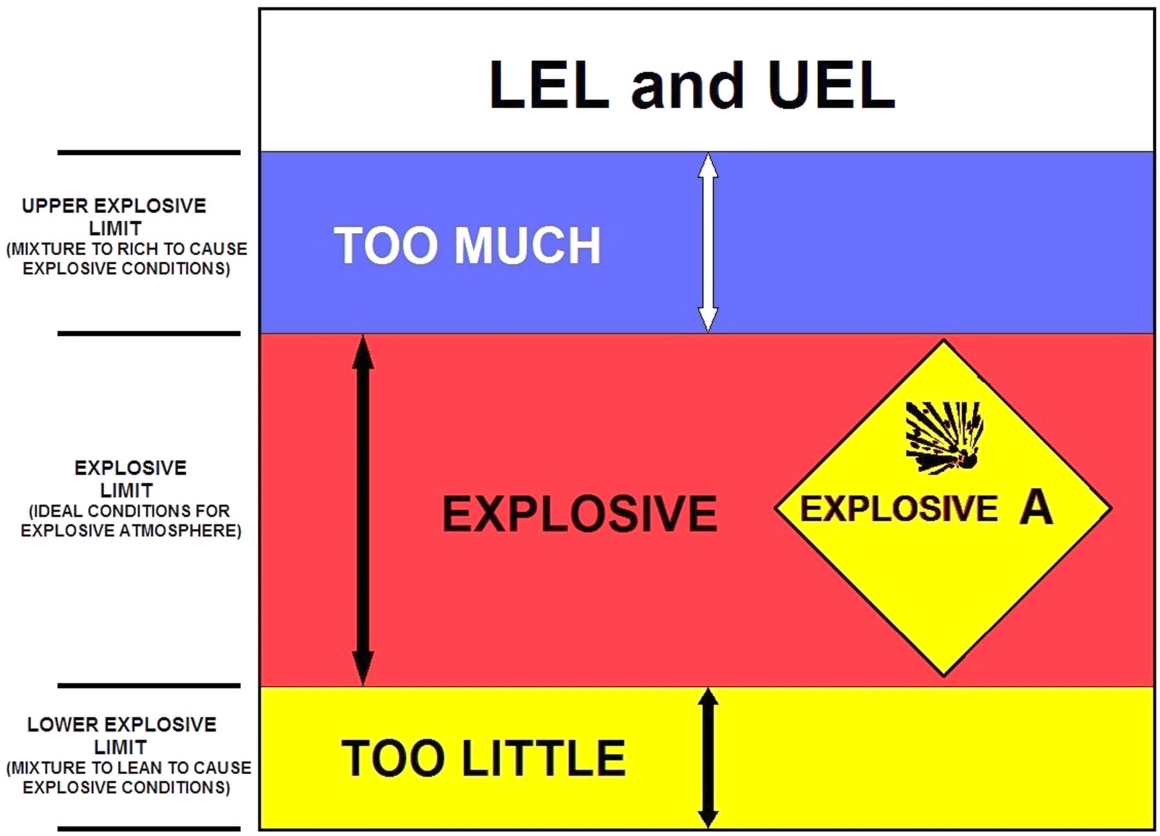
POSSIBLE HAZARDOUS ATMOSPHERES PRESENT IN A CONFINED SPACE (EXAMPLE IS OF A SEWER MAIN)

COMMON HAZARDOUS GASES THAT MAY BE PRESENT IN CONFINED SPACE					
SUBSTANCE *	8-HOUR TIME-WEIGHTED AVERAGE (TWA)	15-MINUTE SHORT-TERM EXPOSURE LIMIT (STEL)	CEILING LIMIT (Never To Be Exceeded)	IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH)	RECOMMENDED ALARM SETTINGS (Low / High)
AMMONIA	25 ppm	35 ppm	—	300 ppm	13 ppm / 25 ppm
CARBON MONOXIDE	25 ppm	100 ppm	—	1200 ppm	13 ppm / 25 ppm
CHLORINE	0.5 ppm	1 ppm	—	10 ppm	0.25 ppm / 0.5 ppm
HYDROGEN SULFIDE	—	—	10 ppm	100 ppm	5 ppm / 10 ppm
METHANE	1000 ppm	—	—	—	500 ppm / 1000 ppm
NITROGEN DIOXIDE	—	—	1 ppm	20 ppm	0.5 ppm / 1 ppm
SULFUR DIOXIDE	2 ppm	5 ppm	—	100 ppm	1 ppm / 2 ppm
OXYGEN	—	—	—	—	20.5 % of Atmosphere
LOWER EXPLOSIVE LIMIT (LEL)	—	—	—	—	5 % LEL

EXAMPLE OF A CHART OF CONFINED SPACE GASES



EXAMPLE OF A CONFINED SPACE ENTRY DANGER SIGN



UNDERSTANDING UPPER (UEL) & LOWER (LEL) EXPLOSIVE LIMITS

Unusual Conditions

Confined Space within a Confined Space
By the very nature of construction, situations are created which illustrate one of the most hazardous confined spaces of all--a confined space within a confined space.

This situation appears as tanks within pits, pipe assemblies or vessels within pits, etc. In this situation, not only do the potential hazards associated with the outer confined space require testing, monitoring, and control, but those of the inner space also require similar procedures.

Often, only the outer space is evaluated. When workers enter the inner space, they are faced with potentially hazardous conditions.

A good example of a confined space within a confined space is a vessel with a nitrogen purge inside a filtering water access pit. Workers entering the pit and/or the vessel should do so only after both spaces have been evaluated and proper control measures established.

Hazards in One Space Entering another Space
During an examination of confined spaces in construction, one often encounters situations which are not always easy to evaluate or control. For instance, a room or area which classifies as a confined space may be relatively safe for work.

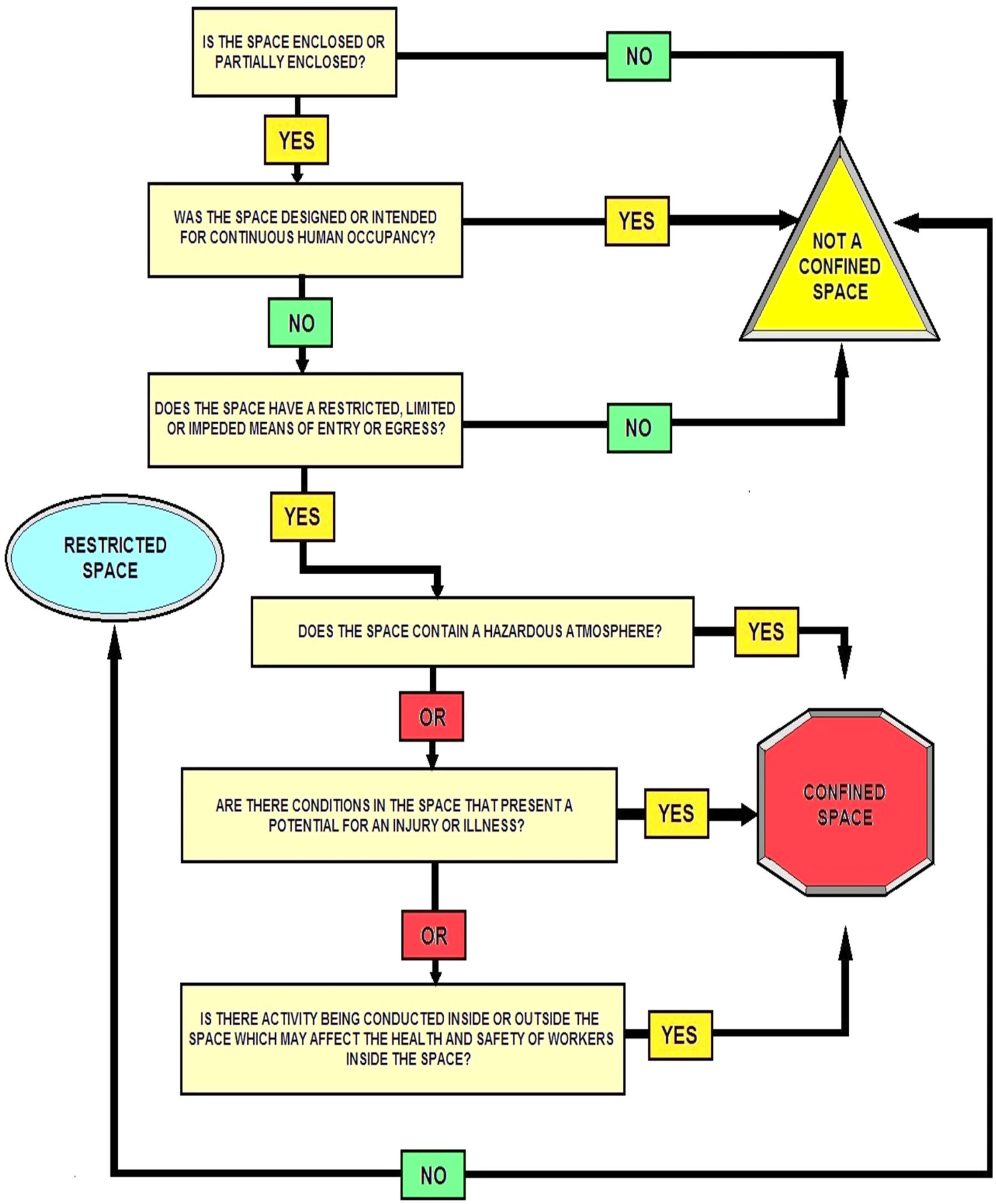
However, access passages from other areas outside or adjacent to the room could, at some point, allow the transfer of hazardous agents into the "***safe***" one. One such instance would be a pipe coming through a wall into a containment room.

Welding fumes and other toxic materials generated in one room may easily travel through the pipe into another area, causing it to change from a safe to an unsafe workplace.

A serious problem with a situation such as this is that workers working in the "**safe**" area are not aware of the hazards leaking into their area. Thus, they are not prepared to take action to avoid or control it.

Session Conclusion
In this discussion, we have defined inherent and induced hazards in confined spaces. We have examined typical confined spaces on construction sites and we have described representative hazards within these confined spaces.

Most of this text is credited to OSHA.



HOW TO PROPERLY DETERMINE THE TYPE OF CONFINED SPACE CHART

Permitted Confined Space Entry Program

Definition of Confined Spaces Requiring an Entry Permit
Confined space:
- ✓ Is large enough or so configured that an employee can bodily enter and perform work.
- ✓ Has limited or restricted means for entry or exit (i.e. tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- ✓ Is not designed for continuous employee occupancy.

Purpose
The Permit Required Space (**PRCS**) Program is provided to protect authorized employees that will enter confined spaces and may be exposed to hazardous atmospheres, engulfment in materials, conditions which may trap or asphyxiate due to converging or sloping walls, or contains any other safety or health hazards.

Many workplaces contain confined spaces not designed for human occupancy which due to their configuration hinder employee activities including entry, work and exit. Asphyxiation is the leading cause of death in confined spaces.

Subpart P applies to all open excavations in the earth's surface.
- ✓ All trenches are excavations.
- ✓ All excavations are not trenches.

Permit Required Confined Space Entry General Rules
During all confined space entries, the following safety rules must be strictly enforced:
1. Only authorized and trained employees may enter a confined space or act as safety watchmen/attendants.

2. No smoking is permitted in a confined space or near entrance/exit area.

3. During confined space entries, a watchmen or attendant must be present at all times.

4. Constant visual or voice communication will be maintained between the safety watchmen and employees entering a confined space.

5. No bottom or side entry will be made or work conducted below the level any hanging material or material which could cause engulfment.

6. Air and oxygen monitoring is required before entering any permit-required confined space. Oxygen levels in a confined space must be between 19.5 and 23.5 percent. Levels above or below will require the use of an SCBA or other approved air supplied respirator. Additional ventilation and oxygen level monitoring is required when welding is performed. The monitoring will check oxygen levels, explosive gas levels and carbon monoxide levels. Entry will not be permitted if explosive gas is detected above one-half the Lower Explosive Limit (**LEL**).

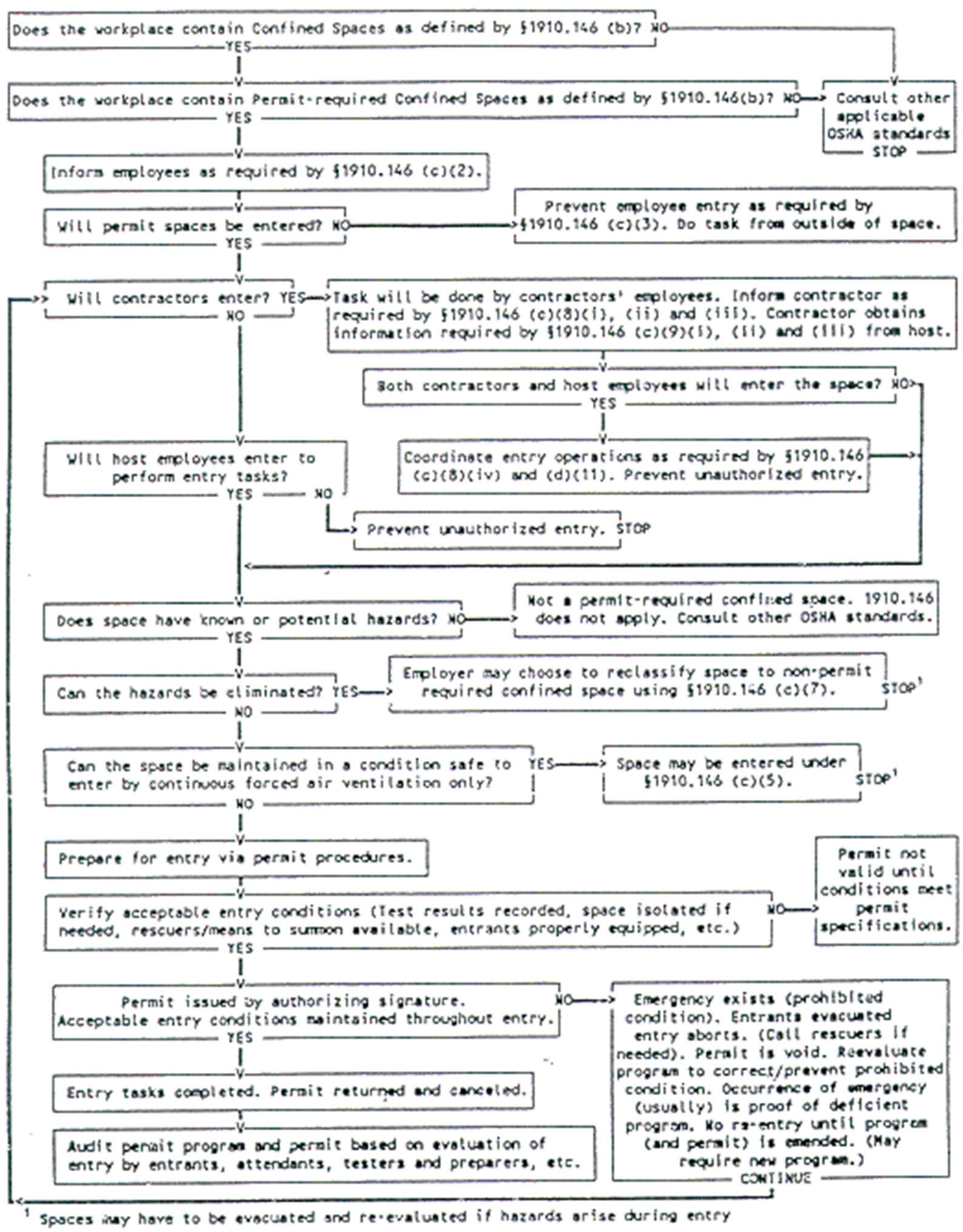
7. To prevent injuries to others, all openings to confined spaces will be protected by a barricade when covers are removed.

Appendix A to §1910.146

Permit-Required Confined Space Decision Flow Chart

Note: Appendices A through F serve to provide information and non-mandatory guidelines to assist employers and employees in complying with the appropriate requirements of this section.

APPENDIX A TO §1910.146—PERMIT-REQUIRED CONFINED SPACE DECISION FLOW CHART



[58 FR 4549, Jan. 14, 1993; 58 FR 34846, June 29, 1993; 63 FR 66039, Dec. 1, 1998]

Confined Space Entry Permit *Example*

Date & Time Issued		Date & time Expires	
Space I.D.		Supervisor	
Equipment Affected		Task	
Standby Team			
Pre-Entry Atmospheric Checks	Time (am - pm)		
	Oxygen		
	Explosive (% LEL)		
	Toxic (PPM)		
	Testers Signature		

Pre-entry Fluid System Isolation	Yes	No
Pumps /lines blinded, blocked, disconnected		
Ventilation Source Established		
Mechanical Forced Air		
Natural Ventilation		
Post Ventilation Pre-Entry Atmospheric Checks		
Time		
Oxygen (%)		
Explosive (% LEL		
Toxic (PPM)		
Tester Signature		
Communication Procedures Established per specific Confined Space SOP		
Rescue Procedures established per specific Confined Space SOP		

Training Verification - for the following persons & space to be entered	YES	NO
All persons entering Confined Space		
All persons acting as Supervisor for the Entry		
All persons assigned backup positions		
All persons assigned to monitor access and interior activities		
All persons assigned to emergency rescue team		

Equipment on Scene	YES	NO	NA		YES	NO	NA
Gas Monitor				Life Line			
Safety Harness				Hoisting Equipment			
Fall Arrest Gear				Powered Comm Eq.			

SCBAs				Air Line Respirators			
Protective Clothing				Elect Gear Properly Rated			

Periodic Atmospheric Checks				
Time (am - pm)				
Oxygen				
Explosive (% LEL)				
Toxic (PPM)				
Testers Signature				

A review of the work authorized by this permit and the information contained on this Entry Permit. Written instructions and safety procedures have been received and are understood. Entry cannot be approved if any squares are marked in the "**No**" column. This permit is not valid unless all appropriate items are completed.

Permit Prepared By: (Supervisor) ________________________________

Approved By: (Unit Supervisor) __________________________________

This permit to be kept at job site.
Return job site copy to Safety Office following job completion.

Copies: Safety Office, Unit Supervisor, Job site

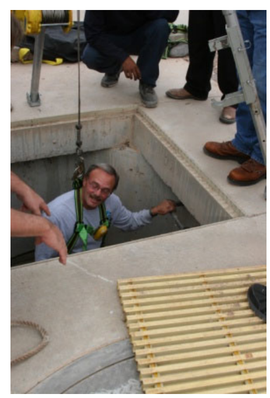
Confined Space Duties & Responsibilities

Examples of assignments
Employees

- Follow program requirements.
- Report any previously un-identified hazards associated with confined spaces.
- Do not enter any confined spaces that have not been evaluated for safety concerns.

Management
- Provide annual Confined Space training to all employees that may need confined space training.
- Ensure confined space assessments have been conducted.
- Annually review this program and all Entry Permits.

Rescue or Training Department
- Ensure proper training for entry & rescue teams.
- Provide proper equipment for entry & rescue teams.
- Ensure all permit required confined spaces are posted.
- Evaluate rescue teams and service to ensure they are adequately trained and prepared.
- Ensure rescue team at access during entry into spaces with Immediately Dangerous to Life or Health (IDLH) atmospheres.
- Provide annual confined space awareness training to all employees that may need confined space awareness training.



Entry Supervisor
Entry supervisors are responsible for the overall permit space entry and must coordinate all entry procedures, tests, permits, equipment and other relevant activities.

The following entry supervisor duties are required:
Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.

Verify by checking that the appropriate entries have been made on the permit, all tests specified by the permit have been conducted, and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin.

Terminate the entry and cancel the permit when the entry is complete or there is a need for terminating the permit.

Verify that rescue services are available and that the means for summoning them are operable.

Remove unauthorized persons who enter or attempt to enter the space during entry operations.

Determine whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space that entry operations remain consistent with the permit terms and that acceptable entry conditions are maintained.

Entry Attendants
At least one attendant is required outside the permit space into which entry is authorized for the duration of the entry operation.

Responsibilities include:
- To know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure
- To be aware of possible behavioral effects of hazard exposure on entrants
- To continuously maintain an accurate count of entrants in the permit space and ensures a means to accurately identify authorized entrants
- To remain outside the permit space during entry operations until relieved by another attendant (once properly relieved, they may participate in other permit space activities, including rescue if they are properly trained and equipped).
- To communicate with entrants as necessary to monitor entrant status and alert entrants of the need to evacuate.
- To monitor activities inside and outside the space to determine if it is safe for entrants to remain in the space; orders the entrants to immediately evacuate if: the attendant detects a prohibited condition, detects entrant behavioral effects of hazard exposure, detects a situation outside the space that could endanger the entrants; or if the attendant cannot effectively and safely perform all the attendant duties.
- To summon rescue and other emergency services as soon as the attendant determines the entrants need assistance to escape the permit space hazards.
- To perform non-entry rescues as specified by that rescue procedure and entry supervisor and not to perform duties that might interfere with the attendants' primary duty to monitor and protect the entrants.

Most of this text is credited to OSHA.

Is Entry Necessary?

Can the task be accomplished from the outside? For example, measures that eliminate the need for employees to enter confined spaces should be carefully evaluated and implemented if at all possible before considering human entry into confined spaces to perform non-emergency tasks.

CONFINED SPACE ENTRY CHECKLIST EXAMPLE

Entering a Confined Space Procedures

This space requires an emergency retrieval system, continuous air monitoring, and safety watch or two-way communication for safe entry.

Donning the personal protective equipment (**PPE**) necessary for confined space entry.
The full-body harness provides fully adjustable leg and shoulder straps for worker comfort and proper fit. Stamped steel sliding back D-ring and sub-pelvic strap provide optimum force distribution.

Example of a "***D-Ring***" and fall protection harness used when entering a confined space. The D-Ring provides a compatible anchor point for connecting devices such as lanyards or retractable lifelines. The shock absorbing lanyard provides a deceleration distance during a fall to reduce fall arrest forces for extra protection against injury.

Tripod-retrieval assembly in use for an entry into one of the many confined spaces.

Checking the cable tension and inertial locking mechanism of the retrieval assembly.

Correct use of this device prevents free-falls greater than 2 feet.

The entrant descends into the space as the attendant critiques the operation.

Dramatic rescue simulation using the tripod-retrieval system.

The entrant is now safely out of the space and is ready to return to his many other projects after this simulated exercise.

Duties of the Person Authorizing or in Charge of the Entry

The person who authorizes or is in charge of the permit entry confined space must comply with the following:

1. Make certain that all pre-entry requirements as outlined on the permit have been completed before any worker is allowed to enter the confined space.
2. Make certain that any required pre-entry conditions are present.
3. If an in-plant/facility rescue team is to be used in the event of an emergency, make sure they would be available. If your Employer does not maintain an in-plant rescue team, dial 911 on any telephone for the Rescue Squad.
4. Make sure that any communication equipment which would be used to summon either the in-plant rescue team or other emergency assistance is operating correctly.
5. Terminate the entry upon becoming aware of a condition or set of conditions whose hazard potential exceeds the limits authorized by the entry permit.

If the person who would otherwise issue an entry permit is in charge of the entry and present during the entire entry, then a written permit is not required if that person uses a checklist as provided in the section on "***Permits***".

This person may also serve as the attendant at the site.

Special Considerations During A Permit Required Entry

Certain work being performed in a permit entry confined space could cause the atmosphere in the space to change.

Examples of this are welding, drilling, or sludge removal. In these situations, air monitoring of the confined space should be conducted on a continuous basis throughout the time of the entry.

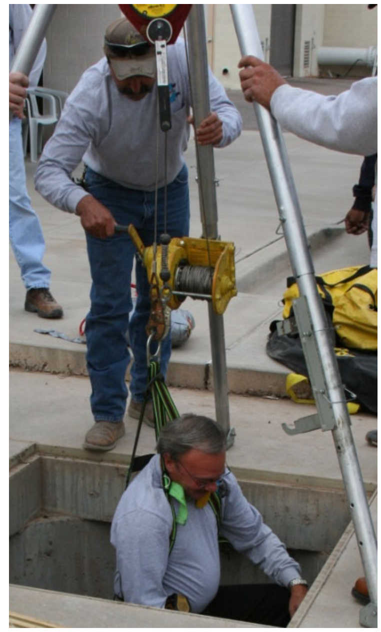
If the workers leave the confined space for any significant period of time, such as for a lunch or other break, the atmosphere of the confined space must be retested before the workers reenter the confined space.

Unauthorized Persons

Take the following actions when unauthorized persons approach or enter a permit space while entry is under way:

1. Warn the unauthorized persons that they must stay away from the permit space,
2. Advise unauthorized persons that they must exit immediately if they have entered the space, and
3. Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space.

Entrants



All entrants must be authorized by the entry supervisor to enter permit spaces, have received the required training, have used the proper equipment, and observed the entry procedures and permit requirements.

The following entrant duties are required:
Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

Properly use the equipment required for safe entry;
Communicate with the attendant as necessary to enable the attendant to monitor the status of the entrants and to enable the attendant to alert the entrants of the need to evacuate the space if necessary;

Alert the attendant whenever; the entrant recognizes any warning signs or symptoms of exposure to a dangerous situation, or any prohibited condition is detected; and Exit the permit space as quickly as possible whenever the attendant or entry supervisor gives an order to evacuate the permit space, the entrant recognizes any warning signs or symptoms of exposure to a dangerous situation, the entrant detects a prohibited condition, or an evacuation alarm is activated.

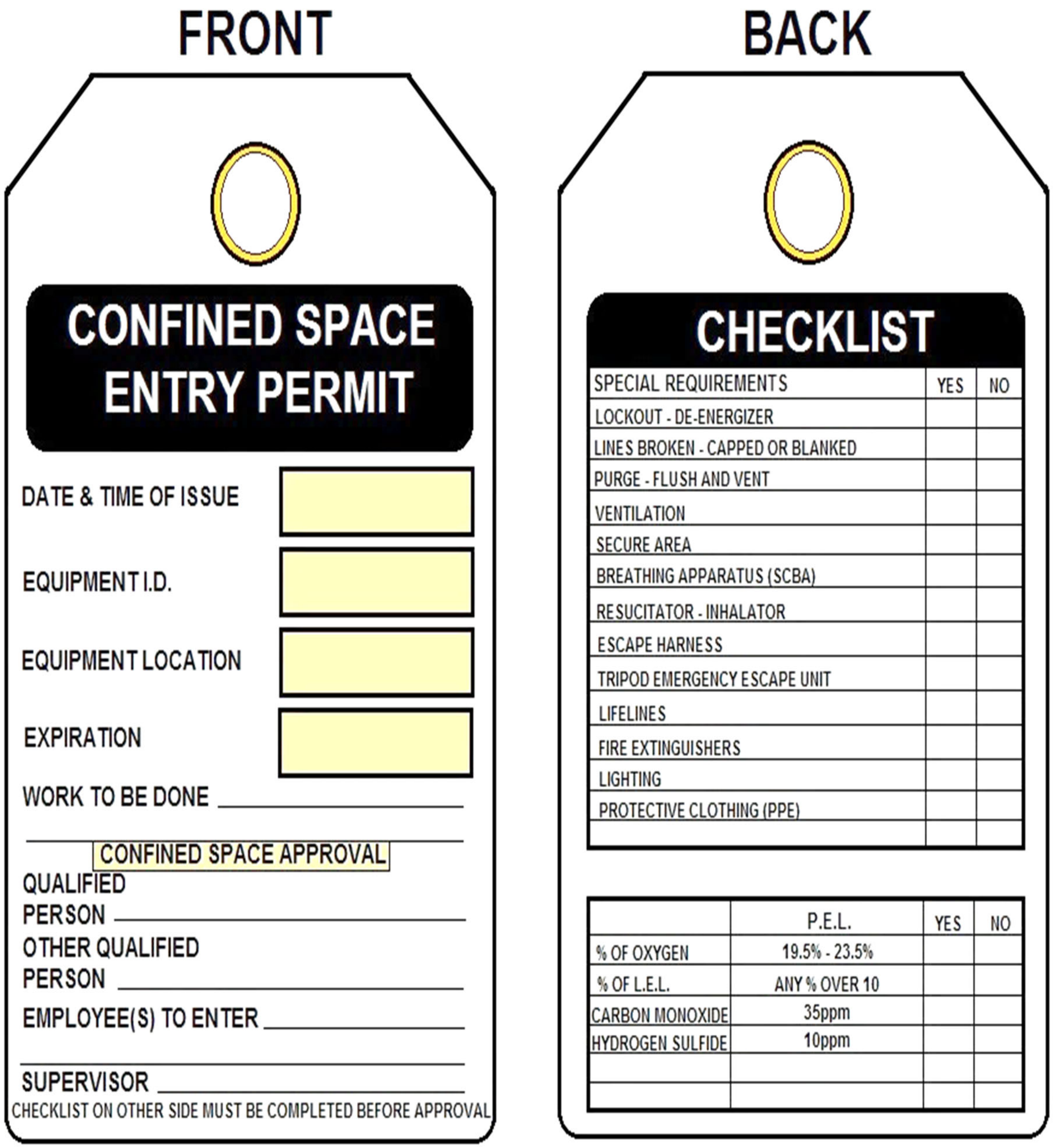
Hazards
- ✓ **Explosive / Flammable Atmospheres**
- ✓ **Toxic Atmospheres**
- ✓ **Engulfment**
- ✓ **Asphyxiation**
- ✓ **Entrapment**
- ✓ **Slips & falls**
- ✓ **Chemical Exposure**
- ✓ **Electric Shock**
- ✓ **Thermal / Chemical Burns**
- ✓ **Noise & Vibration**

Hazard Control

Engineering Controls
- ➢ Locked entry points
- ➢ Temporary ventilation
- ➢ Temporary Lighting

Administrative Controls
- ➢ Signs
- ➢ Employee training
- ➢ Entry procedures
- ➢ Atmospheric Monitoring
- ➢ Rescue procedures
- ➢ Use of prescribed Personal Protective Equipment

Entry Standard Operating Procedures
This program outlines:
- ➢ Hazards
- ➢ Hazard Control & Abatement
- ➢ Acceptable Entry Conditions
- ➢ Means of Entry
- ➢ Entry Equipment Required
- ➢ Emergency Procedures



FRONT

CONFINED SPACE ENTRY PERMIT

DATE & TIME OF ISSUE

EQUIPMENT I.D.

EQUIPMENT LOCATION

EXPIRATION

WORK TO BE DONE ______________

CONFINED SPACE APPROVAL

QUALIFIED PERSON ______________

OTHER QUALIFIED PERSON ______________

EMPLOYEE(S) TO ENTER ______________

SUPERVISOR ______________

CHECKLIST ON OTHER SIDE MUST BE COMPLETED BEFORE APPROVAL

BACK

CHECKLIST

SPECIAL REQUIREMENTS	YES	NO
LOCKOUT - DE-ENERGIZER		
LINES BROKEN - CAPPED OR BLANKED		
PURGE - FLUSH AND VENT		
VENTILATION		
SECURE AREA		
BREATHING APPARATUS (SCBA)		
RESUCITATOR - INHALATOR		
ESCAPE HARNESS		
TRIPOD EMERGENCY ESCAPE UNIT		
LIFELINES		
FIRE EXTINGUISHERS		
LIGHTING		
PROTECTIVE CLOTHING (PPE)		

	P.E.L.	YES	NO
% OF OXYGEN	19.5% - 23.5%		
% OF L.E.L.	ANY % OVER 10		
CARBON MONOXIDE	35ppm		
HYDROGEN SULFIDE	10ppm		

EXAMPLE OF A CONFINED SPACE ENTRY TAG

Permit Required Confined Space Entry General Rules

During all confined space entries, the following safety rules must be strictly enforced:

1. Only authorized and trained employees may enter a confined space or act as safety watchman/attendant.

2. No smoking is permitted in a confined space or near entrance/exit area.

3. During confined space entries, a watchman must be present at all times.

4. Constant visual or voice communication will be maintained between the safety watchman/attendant and employees entering a confined space.

5. No bottom or side entry will be made or work conducted below the level of any hanging material or material which could cause engulfment.

6. Air and oxygen monitoring is required before entering any permit-required confined space. Oxygen levels in a confined space must be between 19.5 and 23.5 percent. Levels above or below will require the use of an SCBA or other approved air supplied respirator.

Additional ventilation and oxygen level monitoring is required when welding is performed. The monitoring will check oxygen levels, explosive gas levels and carbon monoxide levels. Entry will not be permitted if explosive gas is detected above one-half the Lower Explosive Limit (**LEL**), or 10% of a specific gas explosive limit.

7. To prevent injuries to others, all openings to confined spaces will be protected by a barricade when covers are removed.

Confined Space Entry Procedures

Each employee who enters or is involved in the entry must:

1. Understand the procedures for confined space entry
2. Know the Hazards of the specific space
3. Review the specific procedures for each entry
4. Understand how to use entry and rescue equipment

Confined Space Entry Permits

✓ Confined Space Entry Permits must be completed before any employee enters a permit-required confined space. The permit must be completed and signed by an authorized member of management before entry.

✓ Permits will expire before the completion of the shift or if any pre-entry conditions change.

✓ Permits will be maintained on file for 12 months.

Contractor Entry

All work by non-company employees that involves the entry into confined spaces will follow the procedures of this program. The information of this program and specific hazards of the confined spaces to be entered will be provided to contractor management prior to commencing entry or work.

Important Rescue Service Questions

What is the availability of the rescue service?

Is it unavailable at certain times of the day or in certain situations?

What is the likelihood that key personnel of the rescue service might be unavailable at times?

If the rescue service becomes unavailable while an entry is underway, does it have the capability of notifying the employer so that the employer can instruct the attendant to abort the entry immediately?

Confined Space Training

***Training for Confined Space Entry includes*:**

1. Duties of entry supervisor, entrant and attendants
2. Confined space entry permits
3. Hazards of confined spaces
4. Use of air monitoring equipment
5. First aid and CPR training
6. Emergency action & rescue procedures
7. Confined space entry & rescue equipment
8. Rescue training, including entry and removal from representative spaces

Confined Space Training and Education
OSHA's General Industry Regulation, §1910.146 Permit-required confined spaces, contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces. This regulation does not apply to construction.

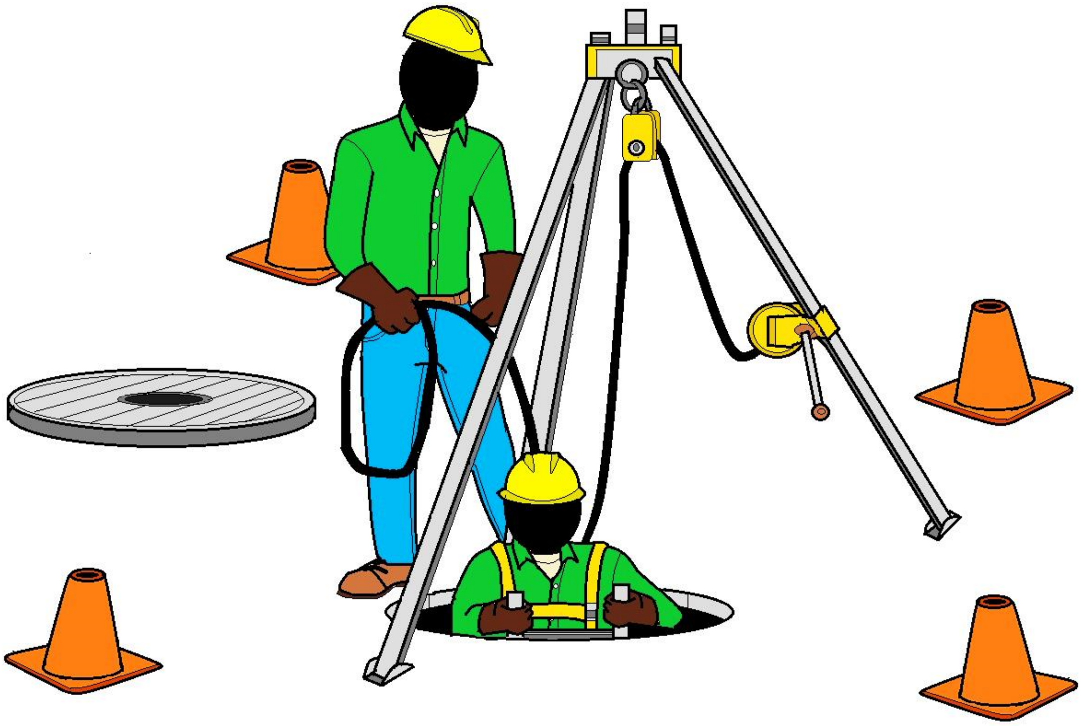
On May 4, 2015, OSHA issued a new standard for construction work in confined spaces, which became effective August 3, 2015. Confined spaces can present physical and atmospheric hazards that can be avoided if they are recognized and addressed prior to entering these spaces to perform work. The new standard, Subpart AA of 29 CFR 1926 will help prevent construction workers from being hurt or killed by eliminating and isolating hazards in confined spaces at construction sites similar to the way workers in other industries are already protected. These requirements are shown below.

§1926.21 Safety Training and Education. (Partial)
(b)(6)(i) All employees required to enter into confined or enclosed spaces shall be instructed as to the nature of the hazards involved, the necessary precautions to be taken, and in the use of protective and emergency equipment required. The employer shall comply with any specific regulations that apply to work in dangerous or potentially dangerous areas.

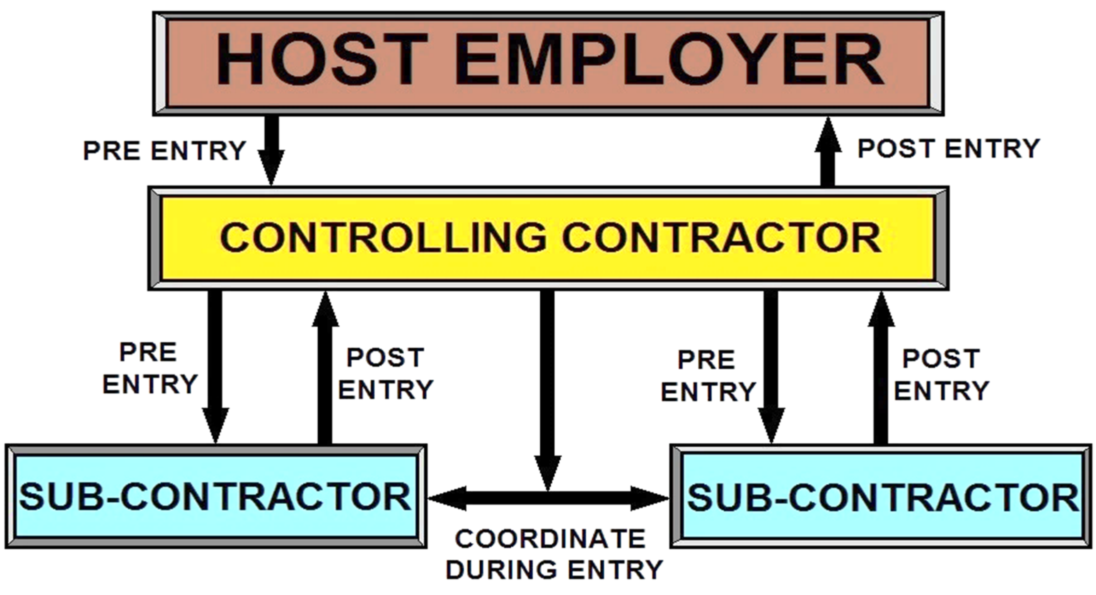
(ii) For purposes of paragraph (b)(6)(i) of this section, "***confined or enclosed space***" means any space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. Confined or enclosed spaces include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels pipelines, and open top spaces more than 4 feet in depth such as pits, tubs, vaults, and vessels.

OSHA's Construction Regulations also contain requirements dealing with confined space hazards in underground construction (Subpart S), underground electric transmission and distribution work (§1926.956), excavations (Subpart P), and welding and cutting (Subpart J).

Further guidance may be obtained from American National Standard ANSI Z117.1-1989, Safety Requirements for Confined Spaces. This standard provides minimum safety requirements to be followed while entering, exiting and working in confined spaces at normal atmospheric pressure. This standard does not pertain to underground mining, tunneling, caisson work or other similar tasks that have established national consensus standards.



ENTERING A CONFINED SPACE



COORDINATING CONFINED SPACE ENTRY ON JOBSITES

Your Employer is Responsible for Certain Training Requirements

These are as follows:

1. **GENERAL:** As an employer, your employer must ensure that all workers who must enter a permit entry confined space in the course of their work are informed of appropriate procedures and controls for entry into such spaces. These workers must be made aware of the fact that an unauthorized entry could be fatal, and that their senses are unable to detect and evaluate the severity of atmospheric hazards.

2. **TRAINING FOR AUTHORIZED ENTRANTS:** Your employer must ensure that all authorized entrants know the emergency action plan and have received training covering the following subjects prior to entering any permit entry confined space:

a**. Hazard Recognition**: Each worker must understand the nature of the hazard before entering and the need to perform appropriate testing to determine if it is safe to enter.

b. **Use of Personal Protective Equipment**: Each employee must be taught the proper use of all personal protective equipment required for entry or rescue, and the proper use of protective barriers and shields.

c. **Self-Rescue**: Each worker must be trained to get out of the confined space as rapidly as possible without help whenever an order to evacuate is given by the attendant, whenever an automatic evacuation alarm is activated, or whenever workers recognize the warning signs of exposure to substances that could be found in the confined space.

They must also be made aware of the toxic effects or symptoms of exposure to hazardous materials he could encounter in the confined space. This includes anything that could be absorbed through the skin or which could be carried through the skin by any solvents that are used. They must be trained to relay an alarm to the attendant and to attempt self- rescue immediately upon becoming aware of these effects.

d. **Special Work Practices or Procedures**: Each worker must be trained in any modifications of normal work practices that are necessary for permit entry confined space work.

3. **TRAINING FOR PERSONS AUTHORIZING OR IN CHARGE OF ENTRY:** In addition to other requirements already covered, the person authorizing or in charge of entry shall be trained to recognize the effects of exposure to hazards that could be in the confined space. They must also carry out all duties that the permit assigns to them.

Rescue practice training. This photo is showing a sand bag being utilized as a dummy.

4. **TRAINING FOR ATTENDANT** Any worker functioning as an attendant at a permit entry confined space must be trained in the company's emergency action plan, the duties of the attendant, and in;

a. Proper use of the communications equipment furnished for communicating with authorized workers entering the confined space or for summoning emergency or rescue services.

b. Authorized procedures for summoning rescue or other emergency services.

c. Recognition of the unusual actions of a worker which could indicate that they could be experiencing a toxic reaction to contaminants that could be present in the space.

d. Any training for rescuers, if the attendant will function as a rescuer also.

e. Any training for workers who enter the confined space, if the permit specifies that the duty of the attendant will rotate among the workers authorized to enter the confined space.

CONFINED SPACE AUTHORIZED ENTRANT’S LOG EXAMPLE

CONFINED SPACE:

DATE: **TIME:**

ENTRANT’S NAME (PRINT)	TIME IN	TIME OUT

ENTRY Attendant:

ENTRY Supervisor Review:

What do you think? Is this a dangerous confined space? Would you weld inside a large pipe all alone? I am sure he is paid well, but is he safe and sound?

Confined Space Entry Procedure

Space ________________ Date Last Modified ____________

Place check mark in all applicable areas

	Hazards		**Personal Protective Equipment**
	Explosive / Combustion Hazard		Air supplied Respirator
	Exposed Electrical Circuits		Air Purifying Respirator
	Unguarded Machine Parts		Welding Protection
	Atmospheric Hazard		Gloves
	Potential Atmospheric Hazard		Hard Hat
	Thermal Hazard		**Ventilation Requirements**
	Chemical Hazard		Continuous ___cu.ft/min Note*: See Ventilation Guidelines for Confined Spaces for typical ventilation configurations and formulas.*
	Fall Hazard		
	Engulfment hazard	Note: *Additional ventilation may be required for hot work, grinding or other operations that would produce airborne fumes, mist or dust. Entry Supervisor must assess additional ventilation requirements base on tasks to be performed in the space*	
	Converging Walls		
	Floors slope-small cross-section		
	Slip Hazard		
	Entry Path		Vent Exhaust Point:
	Side entry		Vent Supply Point:
	Bottom entry		Space Volume
	Door		**Initial Purge Time=** 7.5 X ______(space volume) Effective Blower Capacity
	Top open entry		
	Top manhole entry		**20 Air Changes per Hour (ACH) for duration of entry**
	Hinged hatch		**Minimum initial Purge Time= 20 Minutes**
	Entry & Rescue Equipment		**Adequate Blower Capacity (ABC) = ________** ABC = Space Volume x 20 ACH 60 minutes
	Life Line		
	Floor level opening barrier		**Acceptable Entry Conditions**
	Body Harness		Confined Space Entry permit posted
	Tripod		Oxygen 19.5 23.5%
	Man Winch		Lower Explosive Level %
	Fall Arrest Unit		Toxic fumes/vapors Less than PEL
	Emerg Retrieval Line		No engulfing material in space
	Atmospheric Monitor		No hazardous chemicals or material
	Blower /Saddle / Trunks		Drained - Flushed
	Drop Light		Rescue Team Available on Site
	Communication Gear		Ventilation Established & Maintained
	Ladder		LOTO Electrical components in space
	Hand held radios		LOTO Mechanical Components in space
	Portable Lighting		LOTO All pipes to and from space

Other Hazards

Flammable Atmospheres

A flammable atmosphere generally arises from enriched oxygen atmospheres, vaporization of flammable liquids, byproducts of work, chemical reactions, concentrations of combustible dusts, and desorption of chemical from inner surfaces of the confined space.

An atmosphere becomes flammable when the ratio of oxygen to combustible material in the air is neither too rich nor too lean for combustion to occur. Combustible gases or vapors will accumulate when there is inadequate ventilation in areas such as a confined space.

Flammable gases such as acetylene, butane, propane, hydrogen, methane, natural or manufactured gases or vapors from liquid hydrocarbons can be trapped in confined spaces, and since many gases are heavier than air, they will seek lower levels as in pits, sewers, and various types of storage tanks and vessels. In a closed top tank, it should also be noted that lighter than air gases may rise and develop a flammable concentration if trapped above the opening.

The byproducts of work procedures can generate flammable or explosive conditions within a confined space. Specific kinds of work such as spray painting can result in the release of explosive gases or vapors. Welding in a confined space is a major cause of explosions in areas that contain combustible gas.

Chemical reactions forming flammable atmospheres occur when surfaces are initially exposed to the atmosphere, or when chemicals combine to form flammable gases. This condition arises when dilute sulfuric acid reacts with iron to form hydrogen or when calcium carbide makes contact with water to form acetylene.

Other examples of spontaneous chemical reactions that may produce explosions from small amounts of unstable compounds are acetylene-metal compounds, peroxides, and nitrates. In a dry state, these compounds have the potential to explode upon percussion or exposure to increased temperature.

Another class of chemical reactions that form flammable atmospheres arise from deposits of pyrophoric substances (carbon, ferrous oxide, ferrous sulfate, iron, etc.) that can be found in tanks used by the chemical and petroleum industry. These tanks containing flammable deposits will spontaneously ignite upon exposure to air.

Combustible dust concentrations are usually found during the process of loading, unloading, and conveying grain products, nitrated fertilizers, finely ground chemical products, and any other combustible material.

High charges of static electricity, which rapidly accumulate during periods of relatively low humidity (below 50%) can cause certain substances to accumulate electrostatic charges of sufficient energy to produce sparks and ignite a flammable atmosphere.

These sparks may also cause explosions when the right air or oxygen to dust or gas mixture is present.

Toxic Atmospheres

The substances to be regarded as toxic in a confined space can cover the entire spectrum of gases, vapors, and finely-divided airborne dust in industry. The sources of toxic atmospheres encountered may arise from the following:

1. The manufacturing process (for example, in producing polyvinyl chloride, hydrogen chloride is used as well as vinyl chloride monomer, which is carcinogenic).
2. The product stored [removing decomposed organic material from a tank can liberate toxic substances, such as hydrogen sulfide (**H_2S**)].
3. The operation performed in the confined space (for example, welding or brazing with metals capable of producing toxic fumes).

During loading, unloading, formulation, and production, mechanical and/or human error may also produce toxic gases which are not part of the planned operation.

Carbon monoxide (**CO**) is a hazardous gas that may build up in a confined space. This odorless, colorless gas that has approximately the same density as air is formed from incomplete combustion of organic materials such as wood, coal, gas, oil, and gasoline; it can be formed from microbial decomposition of organic matter in sewers, silos, and fermentation tanks.

CO is an insidious toxic gas because of its poor warning properties. Early stages of CO intoxication are nausea and headache. CO may be fatal at as little as 1000 ppm or 10% in air, and is considered dangerous at 200 ppm or 2%, because it forms Carboxyhemoglobin in the blood which prevents the distribution of oxygen in the body.

CO is a relatively abundant colorless, odorless gas. Therefore, any untested atmosphere must be suspect. It must also be noted that a safe reading on a combustible gas indicator does not ensure that CO is not present. CO must be tested for specifically.

The formation of CO may result from chemical reactions or work activities, therefore fatalities due to CO poisoning are not confined to any particular industry. There have been fatal accidents in sewage treatment plants due to decomposition products and lack of ventilation in confined spaces.

Another area where CO results as a product of decomposition is in the formation of silo gas in grain storage elevators. In another area, the paint industry, varnish is manufactured by introducing the various ingredients into a kettle, and heating them in an inert atmosphere, usually town gas, which is a mixture of carbon dioxide and nitrogen.

In welding operations, oxides of nitrogen and ozone are gases of major toxicological importance, and incomplete oxidation may occur and carbon monoxide can form as a byproduct.

Another poor work practice, which has led to fatalities, is the recirculation of diesel exhaust emissions. Increased CO levels can be prevented by strict control of the ventilation and the use of catalytic converters.

Procedures for Atmospheric Testing. - 1910.146 App B
OSHA Requirement

Sub-Part Title: General Environmental Controls

Atmospheric testing is required for two distinct purposes:
evaluation of the hazards of the permit space and verification that acceptable entry conditions for entry into that space exist.

(1) Evaluation testing. The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space.

Evaluation and interpretation of these data, and development of the entry procedure, should be done by, or reviewed by, a technically qualified professional (e.g., OSHA consultation service, or certified industrial hygienist, registered safety engineer, certified safety professional, certified marine chemist, etc.) based on evaluation of all serious hazards.

(2) Verification testing. The atmosphere of a permit space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing using permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions.

Results of testing (i.e., actual concentration, etc.) should be recorded on the permit in the space provided adjacent to the stipulated acceptable entry condition.

(3) Duration of testing. Measurement of values for each atmospheric parameter should be made for at least the minimum response time of the test instrument specified by the manufacturer.

(4) Testing stratified atmospheres. When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately 4 feet (1.22 m) in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and detector response.

(5) Order of testing. A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere.

Combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gases and vapors. If tests for toxic gases and vapors are necessary, they are performed last.

This is a ten-minute escape air pack or emergency air supply. The plastic bag with go over your head during an emergency and provide enough air to get out of the hole. There are smaller versions of this system.

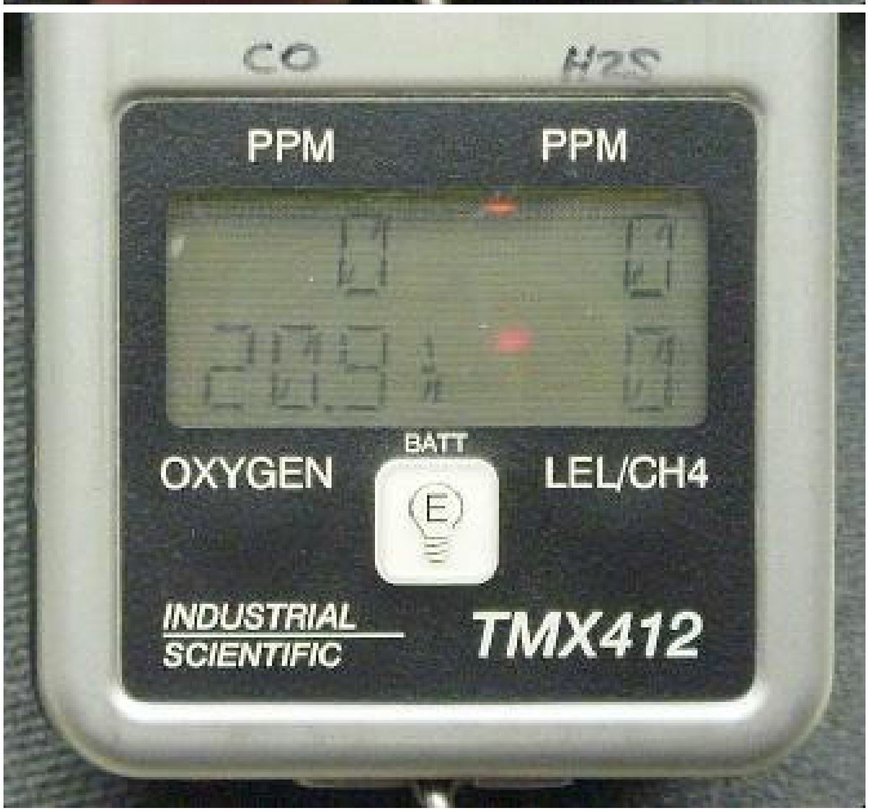
Functional Buttons:

On/Off	Press black button and hold until display tells you to RELEASE. Turn on in a clean-air environment.
Mode	Press "mode" button at display prompt.
E Button	Press (E) button at display prompt.
Alarm Mode	Red lights flash and unit beeps. Beeps are more frequent at higher contaminant levels, or lower oxygen level.

Forced air ventilation with a disposable air shaft.

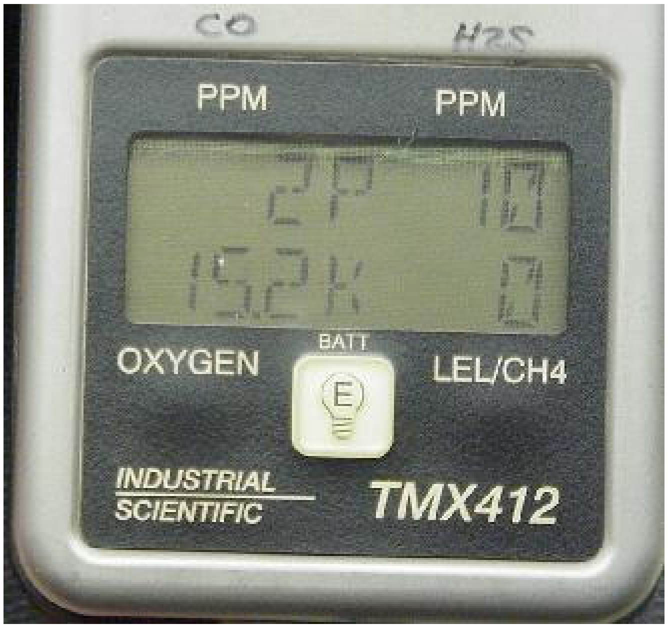
Typical Display of the TMX412

Location of gases on display.



Example of a clean air display. Carbon monoxide (**CO**) and hydrogen sulfide (**H_2S**) are in ppm; oxygen (**O_2**) and lower explosive limit (**LEL**) readings are percentage values. The battery-life indicator is just right of the oxygen display (i.e., 20.9); each line represents about one hour of service remaining.

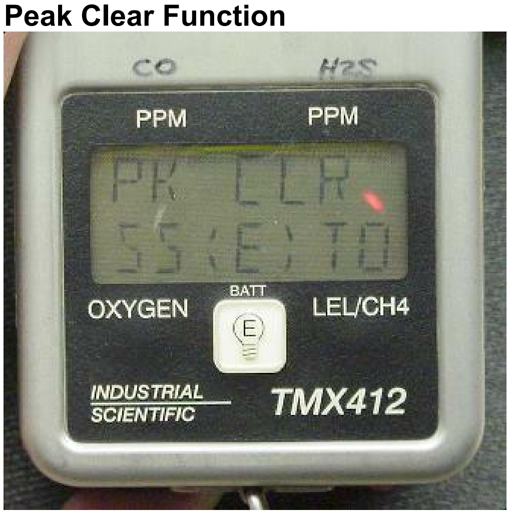
Peak Display Function



Example Display for Peak Mode: The display reads 2 ppm peak value for CO and 10 ppm peak value for H_2S (top line);
15.2 % for oxygen and 0 % for LEL (bottom line).

- Use the PEAK function to display highest recorded readings for CO, H2S, and LEL, and the lowest reading for O2.
- Readings are not erased when you turn the unit off. You must use the PEAK CLEAR function to erase the memory.
- Make sure you check the peak readings have been cleared before you start your monitoring session.
- Press mode button until display reads "P" (top line), and "K" (bottom line) (see photo).

Peak Clear Function



- Use the **PEAK CLEAR** function to clear peak readings from the internal memory. Readings are not erased when you turn the unit off. You must use the **PEAK CLEAR** function to erase the memory.
- Press mode button until display reads "**PK CLR PRESS (E) TO RESET**". After you press the (E) button, press mode button again until peak reading appears. Unit

should now read 0,0 (top line), and 21, 0 (bottom line) assuming this was performed in a clean-air environment.

Zero Function and Calibration Function:

- Zero and Calibration Functions are performed by Attendant or as specified by the Supervisor or manufacturer.
- Special equipment and experience is necessary to properly perform these functions.

Documentation and Training:

- Make sure you are familiar with all of our confined space entry equipment, including the multi-gas monitor, before use.
- Make sure to document your air monitoring data (e.g., peak values and other relevant data) on the Confined Space Air Monitoring Data Form.

You need continued atmospheric monitoring during the entry in any confined space. Most entrants will carry two gas monitors for increased safety.

Atmospheric Testing Policy *Example*

Before entry, it is necessary to test the atmosphere in the confined space for oxygen levels, flammability, and/or any contaminants that have a potential to be present in that confined space. This testing must be done by a qualified person using equipment which has been approved for use in such areas.

The testing equipment itself should be checked to make sure it is working properly before using it. Follow the manufacturer's recommended procedures.

Testing of the confined spaces should be conducted throughout the entire portion of the space that workers will occupy during the entry. This testing shall be done without the use of ventilation systems.

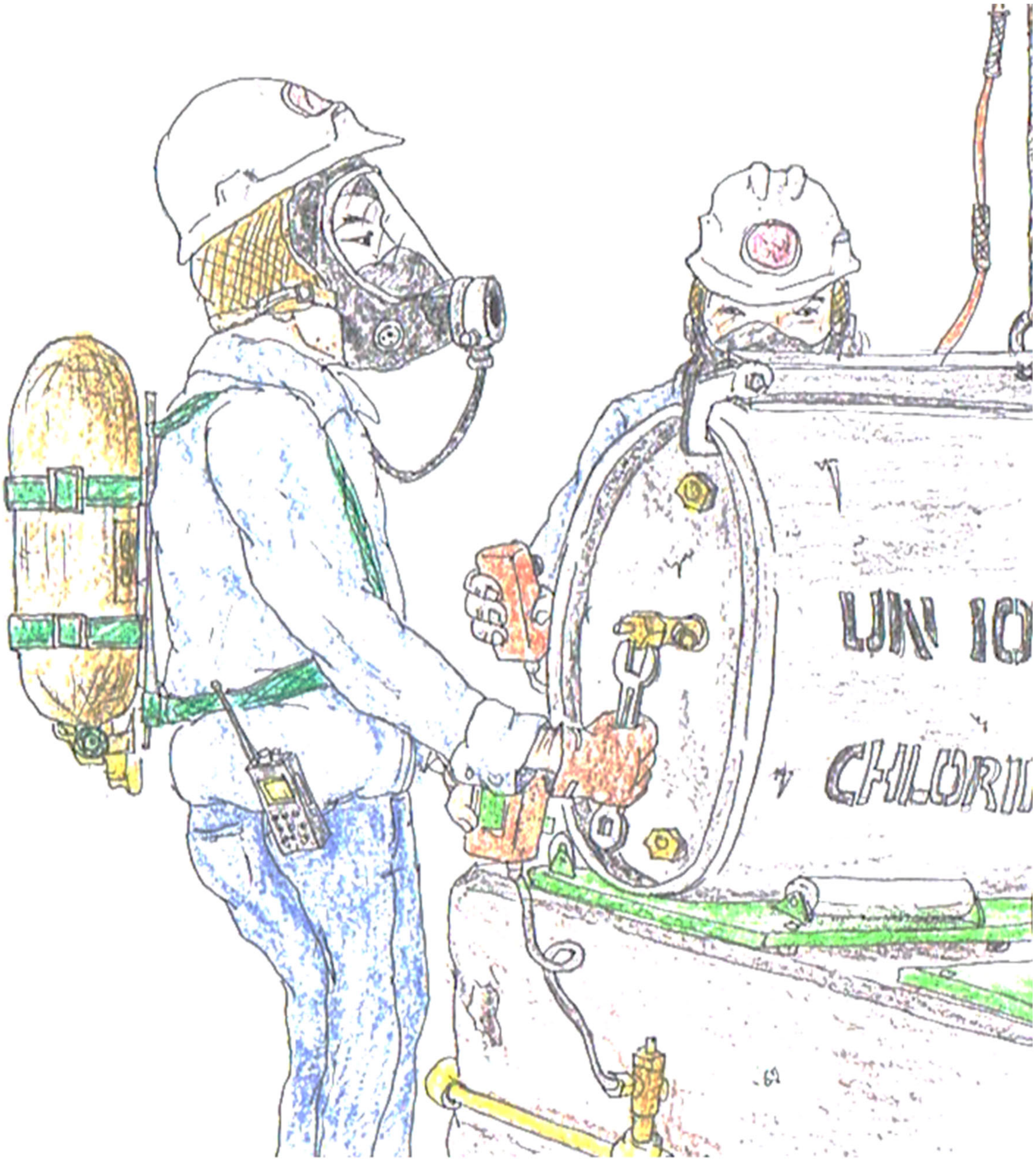
Where the entry is vertical into the confined space, it is recommended that remote probes be used to measure the atmosphere at various levels. This is necessary because some gases and vapors are lighter or heavier than air and can accumulate at different levels in the confined space. Test outside the confined space to make sure the surrounding air is not contaminated.

Atmospheric conditions are considered unacceptable if oxygen levels are less than 19.5% or greater than 23.5%. Regulations define the following unacceptable levels of other hazards monitored:

1. A flammable gas, vapor or mist greater than 10% of its lower flammable limit (**LFL**). LFL means the minimum concentration of the flammable material which will ignite if an ignition source is present.
2. An airborne combustible dust at a concentration that obscures vision at a distance of five feet or less.
3. An atmospheric concentration of a substance greater than the allowed limit in the Material Safety Data Sheet for that substance.

If test results conclude that the atmospheric condition of the confined space is unacceptable, entry is prohibited until such conditions are brought into acceptable limits. This may be done by purging, cleaning and/or ventilating the space.
Purging refers to the method by which gases, vapors, or other airborne impurities are displaced from a confined space.

The confined space may also be made non-flammable, non-explosive or otherwise chemically non-reactive by displacing or diluting the original atmosphere with steam or gas that is non-reactive with respect to that space, a process referred to as "***inerting***".
C.



Fire, Explosion, and Reactivity Hazards

Some chemicals present physical hazards such as the potential for fire, explosion, and reactivity. The SDS formerly called the MSDS explains these physical hazards.
Flammable chemicals—catch fire easily. The SDS will tell if it's flammable.
Flash point—the minimum temperature at which a liquid gives off enough vapors to burn. The lower the flash point, the more flammable the substance.
Flammable limits—the range of concentration of a substance in the air within which a substance can readily catch fire. Concentrations below or above the limits are less likely to ignite or burn.

Irritant (Corrosive) Atmospheres

Irritant or corrosive atmospheres can be divided into primary and secondary groups. The primary irritants exert no systemic toxic effects (effects on the entire body).

Examples of primary irritants are chlorine, ozone, hydrochloric acid, hydrofluoric acid, sulfuric acid, nitrogen dioxide, ammonia, and sulfur dioxide. A secondary irritant is one that may produce systemic toxic effects in addition to surface irritation. Examples of secondary irritants include benzene, carbon tetrachloride, ethyl chloride, trichloroethane, trichloroethylene, and chloropropene.

Irritant gases vary widely among all areas of industrial activity. They can be found in plastics plants, chemical plants, the petroleum industry, tanneries, refrigeration industries, paint manufacturing, and mining operations.

Prolonged exposure at irritant or corrosive concentrations in a confined space may produce little or no evidence of irritation. This may result in a general weakening of the defense reflexes from changes in sensitivity. The danger in this situation is that the worker is usually not aware of any increase in his/her exposure to toxic substances.

Asphyxiating Atmospheres
The normal atmosphere is composed approximately of 20.9% oxygen and 78.1% nitrogen, and 1% argon with small amounts of various other gases. Reduction of oxygen in a confined space may be the result of either consumption or displacement.

The consumption of oxygen takes place during combustion of flammable substances, as in welding, heating, cutting, and brazing. A more subtle consumption of oxygen occurs during bacterial action, as in the fermentation process.

Oxygen may also be consumed during chemical reactions as in the formation of rust on the exposed surface of the confined space (iron oxide). The number of people working in a confined space and the amount of their physical activity will also influence the oxygen consumption rate.

A second factor in oxygen deficiency is displacement by another gas. Examples of gases that are used to displace air, and therefore reduce the oxygen level are helium, argon, and nitrogen.

Carbon dioxide may also be used to displace air and can occur naturally in sewers, storage bins, wells, tunnels, wine vats, and grain elevators.

Aside from the natural development of these gases, or their use in the chemical process, certain gases are also used as inerting agents to displace flammable substances and retard pyrophoric reactions.

Gases such as nitrogen, argon, helium, and carbon dioxide, are frequently referred to as non-toxic inert gases but have claimed many lives. The use of nitrogen to inert a confined space has claimed more lives than carbon dioxide.

The total displacement of oxygen by nitrogen will cause immediate collapse and death.

Carbon Dioxide
Carbon dioxide and argon, with specific gravities greater than air, may lie in a tank or manhole for hours or days after opening. Since these gases are colorless and odorless, they pose an immediate hazard to health unless appropriate oxygen measurements and ventilation are adequately carried out.

Oxygen Deprivation
Oxygen deprivation is one form of asphyxiation. While it is desirable to maintain the atmospheric oxygen level at 21% by volume, the body can tolerate deviation from this ideal. When the oxygen level falls to 17%, the first sign of hypoxia is deterioration to night vision, which is not noticeable until a normal oxygen concentration is restored.

Physiologic effects are increased breathing volume and accelerated heartbeat.

Between 14-16% physiologic effects are increased breathing volume, accelerated heartbeat, very poor muscular coordination, rapid fatigue, and intermittent respiration.

Between 6-10% the effects are nausea, vomiting, inability to perform, and unconsciousness. Less than 6%, the effects are spasmodic breathing, convulsive movements, and death in minutes.

Mechanical Hazards
If activation of electrical or mechanical equipment would cause injury, each piece of equipment should be manually isolated to prevent inadvertent activation before workers enter or while they work in a confined space. The interplay of hazards associated with a confined space, such as the potential of flammable vapors or gases being present, and the build-up of static charge due to mechanical cleaning, such as abrasive blasting, all influence the precautions which must be taken.

To prevent vapor leaks, flashbacks, and other hazards, workers should completely isolate the space. To completely isolate a confined space, the closing of valves is not sufficient.

All pipes must be physically disconnected or isolation blanks bolted in place. Other special precautions must be taken in cases where flammable liquids or vapors may re-contaminate the confined space.

The pipes blanked or disconnected should be inspected and tested for leakage to check the effectiveness of the procedure. Other areas of concern are steam valves, pressure lines, and chemical transfer pipes. A less apparent hazard is the space referred to as a void, such as double walled vessels, which must be given special consideration in blanking off and inerting.

Thermal Effects
Four factors influence the interchange of heat between people and their environment. They are: (1) air temperature, (2) air velocity, (3) moisture contained in the air, and (4) radiant heat. Because of the nature and design of most confined spaces, moisture content and radiant heat are difficult to control.

As the body temperature rises progressively, workers will continue to function until the body temperature reaches approximately 102^{o}F.

When this body temperature is exceeded, the workers are less efficient, and are prone to heat exhaustion, heat cramps, or heat stroke. In a cold environment, certain physiologic mechanisms come into play, which tend to limit heat loss and increase heat production.

The most severe strain in cold conditions is chilling of the extremities so that activity is restricted. Special precautions must be taken in cold environments to prevent frostbite, trench foot, and general hypothermia.

Proper signage is essential.

Required Confined Space Equipment Policy Example

Air Testing Equipment
All air-testing equipment should be calibrated in accordance with the manufacturer's instruction.

Oxygen Meters and Monitors
The oxygen content of the air in a confined space is the first and most important constituent to measure before entry is made. The acceptable range of oxygen is between 19.5 and 23.5 percent. This content is measured before flammability is tested because rich mixtures of flammable gases or vapors give erroneous measurement results.

For example, a mixture of 90 percent methane and 10 percent air will test nonflammable because there is not enough oxygen to support the combustion process in the flammability meters. This mixture will not support life and will soon become explosive if ventilation is provided to the space. Before entry, spaces must be ventilated until both oxygen content and flammability are acceptable.

Flammability Meters
Flammability meters are used to measure the amount of flammable vapors or gases in the atmosphere as a percent of the LEL/LFL. The oxygen content must be near 21 percent for results to be meaningful.

Toxic Air Contamination Testers
Tests for toxic contaminants must be specific for the target toxin. The instrument manufacturer should be consulted for interferences. Therefore, it is important to know the history of the confined space so proper tests can be performed. Part of hazard assessment is to identify all possible contaminants that could be in the confined space.

Protective Devices

Fall-Protection Equipment
Fall-protection equipment for confined spaces should be the chest-waist harness type to minimize injuries from uncontrolled movements when it arrests a worker's fall. This type of harness also permits easier retrieval from a confined space than a waist belt. Adjustable lanyards should be used to limit free fall to two feet before arrest.

Respirators
An industrial hygienist should select respirators on the basis of his or her evaluation of possible confined-space hazards. NIOSH-approved respirators should be identified in the approved procedure required by the confined-space entry permit. It is important to note that air-purifying respirators cannot be used in an oxygen deficient atmosphere.

Lockout/Tagout Devices
Lockout/tagout devices permit employees to work safely on de-energized equipment without fear that the devices will be accidentally removed. Lock and tag devices are required to withstand a 50-pound pull without failure.

Devices used to block or restrain stored mechanical energy devices must be engineered for safety.

Safety Barriers
Safety barriers separate workers from hazards that cannot reasonably be eliminated by other engineering controls.

Required barriers will be identified in the approved confined-space entry procedure.

Ground Fault Circuit Interrupters
Ground fault circuit interrupter must be used for all portable electrical tools and equipment in confined spaces because most workers will be in contact with grounded surroundings.

Emergency Response Equipment

Fire Extinguishers
"***Hot work***" inside a confined space requires that an approved fire extinguisher and a person trained in its use be stationed in the confined space or in a suitable vantage point where he or she could effectively suppress any fire that might result from the work.

First Aid Equipment
Blankets, first-aid kit, Stokes stretchers, and any other equipment that may be needed for first-response treatment must be available just outside the confined space. Medical and safety professionals should select equipment on the basis of their evaluations of the potential hazards in the confined space.

Retrieval Equipment
A tripod or another suitable anchorage, hoisting device, harnesses, wristlets, ropes, and any other equipment that may be needed to make a rescue must be identified in the confined-space safe-entry procedures.

It is important that this equipment be available for immediate use. Harnesses and retrieval ropes must be worn by entrants unless they would increase hazards to the entrants or impede their rescue.

Summary
A Confined Space Entry Program
Should Include the Following:

- Written confined space entry procedures
- Evaluation to determine whether entry is necessary
- Issuance of a confined space entry permit
- Evaluation of the confined space by a qualified person
- Testing and monitoring the air quality in the confined space to ensure:
- Oxygen level is at least 19.5%
- Flammable range is less than 10% of the LFL (lower flammable limit)
- Training of workers and supervisors in the selection and use of:
    - *safe entry procedures*
    - *respiratory protection*
    - *lifelines and retrieval systems*
    - *protective clothing*
- Training of employees in safe work procedures in and around confined spaces
- Training of employees in confined space rescue procedures
- Conducting safety meetings to discuss confined space safety
- Availability and use of proper ventilation equipment
- Monitoring the air quality while workers are in the confined space.

Recommendation #2: Employers should identify the types of confined spaces within their jurisdiction and develop and implement confined space entry and rescue programs.

Discussion: Employers may be required to enter confined spaces to perform either non-emergency tasks or emergency rescue.

Therefore, employers should identify the types of confined spaces within their jurisdiction and develop and implement confined space entry and rescue programs that include written emergency rescue guidelines and procedures for entering confined spaces. A confined space program, as outlined in NIOSH Publications 80-106 and 87-113, should be implemented. At a minimum, the following should be addressed:

1. Is entry necessary? Can the task be accomplished from the outside? For example, measures that eliminate the need for employees to enter confined spaces should be carefully evaluated and implemented if at all possible before considering human entry into confined spaces to perform non-emergency tasks.

2. If entry is to be made, has the air quality in the confined space been tested for safety based on the following:
    - oxygen supply at least 19.5%
    - flammable range for all explosive gases less than 10% of the lower flammable limit
    - absence of toxic air contaminants?

3. Is ventilation equipment available and/or used?

4. Is appropriate rescue equipment available?

5. Are supervisors being continuously trained in the selection and use of appropriate rescue equipment such as:

- SCBA's
- lifelines
- human hoist systems offering mechanical advantage
- protective clothing
- ventilation systems

6. Are employees being properly trained in confined space entry procedures?

7.Are confined space safe work practices discussed in safety meetings?

8. Are employees trained in confined space rescue procedures?

9. Is the air quality monitored when the ventilation equipment is operating?

The American National Standards Institute (ANSI) Standard Z117.1-1989 (Safety Requirements for Confined Spaces), 3.2 and 3.2.1 state, "***Hazards shall be identified for each confined space. The hazard identification process shall include, ... the past and current uses of the confined space which may adversely affect the atmosphere of the confined space; ... The hazard identification process should consider items such as ... the operation of gasoline engine powered equipment in or around the confined space***."

D-Ring on the rear of the harness is necessary for the entrant to be retrieved from the confined space.

Confined Space Post Quiz

Confined space:
1. A confined space is large enough or so configured that an employee can ________________.

2. A confined space is not designed for ______________________.

3. A permit required confined space (permit space) contains a material that has __________________.

Confined Space Hazards
4. Fatalities and injuries constantly occur among construction workers who are required to enter __________________.

5. ______________ are associated with specific types of equipment and the interactions among them. These hazards can be electrical, thermal, chemical, mechanical, etc.

Typical Examples of Confined Workspaces
6. Confined workspaces in construction contain _____________________.

7. Workers must enter ________________ found on the construction jobsite to perform a number of functions.

8. The ever-present possibility of ______________________ is one of the major problems confronting construction workers while working in vaults.

9. According to the text, a _______________ normally considered a problem associated with confined spaces is material or equipment which may fall into the vault.

10. Manholes are necessary to provide a means of entry into and exit from vaults, tanks, and pits, but these confined spaces may present _________________ which could cause injuries and fatalities.

11. The pipe assembly is one of the _____________________ encountered throughout the construction site,

12. Once inside a pipe assembly, workers are faced with __________________, often caused by purging with argon or another inert gas.

13. _____________ is another problem to which the worker is exposed when inside a pipe assembly.

14. The worker may suffer _______________ caused by heat within the pipe run.

15. Tanks are ______________________ that are used for a variety of purposes, including the storage of water and chemicals.

16. According to the text, oxygen-deficient atmospheres, along with toxic and explosive atmospheres created by the substances stored in the tanks, present hazards to workers.
A. True B. False

17. Heat in tanks may cause _________________, particularly on a hot day.

18. Entry supervisors must coordinate all entry procedures, tests, ___________, equipment, and other activities related to the permit space entry.

19. Before endorsing the permit and allowing entry to begin, the ________________ must check that all appropriate entries have been made on the permit, all tests specified by the permit have been conducted, and that all procedures and equipment specified by the permit are in place.

20. A responsibility of the entry attendant is to know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.
A. True B. False

Confined Space Chapter Answers
1. Bodily enter and perform work, 2. Continuous employee occupancy, 3. The potential for engulfing an entrant, 4. Confined spaces, 5. Inherent hazards, 6. Both inherent and induced hazards, 7. A variety of vaults,8. An oxygen-deficient atmosphere, 9. Hazard, 10. Serious hazards, 11. Most frequently unrecognized types of confined spaces, 12. Potential oxygen-deficient atmospheres, 13. Electrical shock, 14. Heat prostration, 15. Another type of confined workspace, 16. True, 17. Heat prostration, 18. Permits, 19. Entry supervisor, 20. True

CWA Stormwater Glossary

This glossary includes a collection of terms used in this course and an explanation of each term.

Act or "the Act" *[40 CFR §403.3(b)]*
The Federal Water Pollution Control Act, also known as the Clean Water Act, as amended, 33 USC 1251*et.seq.*

Approval Authority *[40 CFR §403.3(c)]*
The Director in an NPDES State with an approved State Pretreatment Program and the appropriate EPA Regional Administrator in a non-NPDES State or State without an approved pretreatment program.

Approved POTW Pretreatment Program or Program *[40 CFR §403.3(d)]*
A program administered by a POTW that meets the criteria established in 40 CFR Part 403 and which has been approved by a Regional Administrator or State Director.

Approved State Pretreatment Program
A program administered by a State that meets the criteria established in 40 CFR §403.10 and which has been approved by a Regional Administrator

Approved/Authorized State
A State with an NPDES permit program approved pursuant to section 402(b) of the Act and an approved State Pretreatment Program.

Baseline Monitoring Report (BMR) *[paraphrased from 40 CFR §403.12(b)]*
A report submitted by categorical industrial users (CIUs) within 180 days after the effective date of an applicable categorical standard, or at least 90 days prior to commencement of discharge for new sources, which contains specific facility information, including flow and pollutant concentration data. For existing sources, the report must also certify as to the compliance status of the facility with respect to the categorical standards.

Best Available Technology Economically Achievable (BAT)
A level of technology based on the best existing control and treatment measures that are economically achievable within the given industrial category or subcategory.

Best Management Practices (BMPs)
Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the U.S. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Best Practicable Control Technology Currently Available (BPT)
A level of technology represented by the average of the best existing wastewater treatment performance levels within an industrial category or subcategory.

Best Professional Judgment (BPJ)
The method used by a permit writer to develop technology-based limitations on a case-by-case basis using all reasonably available and relevant data.

Blowdown
The discharge of water with high concentrations of accumulated solids from boilers to prevent plugging of the boiler tubes and/or steam lines. In cooling towers, blowdown is discharged to reduce the concentration of dissolved salts in the recirculating cooling water.

Bypass *[40 CFR §403.17(a)]*
The intentional diversion of wastestreams from any portion of an Industrial User's treatment facility.

Categorical Industrial User (CIU)
An industrial user subject to National categorical pretreatment standards.

Categorical Pretreatment Standards *[40 CFR § 403.6 and 40 CFR Parts 405-471*]
Limitations on pollutant discharges to POTWs promulgated by the EPA in accordance with Section 307 of the Clean Water Act, that apply to specific process wastewater discharges of particular industrial categories.

Chain of Custody (COC)
A record of each person involved in the possession of a sample from the person who collects the sample to the person who analyzes the sample in the laboratory.

Chronic
A stimulus that lingers or continues for a relatively long period of time, often one-tenth of the life span or more. Chronic should be considered a relative term depending on the life span of an organism. The measurement of chronic effect can be reduced growth, reduced reproduction, etc., in addition to lethality.

Clean Water Act (CWA)
The common name for the Federal Water Pollution Control Act. Public law 92-500; 33 U.S.C. 1251 et seq.; legislation which provides statutory authority for both NPDES and Pretreatment Programs.

Code of Federal Regulations (CFR)
A codification of Federal rules published annually by the Office of the Federal Register National Archives and Records Administration. Title 40 of the CFR contains the regulations for *Protection of the Environmen*t.

Combined Sewer Overflow (CSO)
A discharge of untreated wastewater from a combined sewer system at a point prior to the headworks of a publicly owned treatment works. CSOs generally occur during wet weather (rainfall or snowfall). During periods of wet weather, these systems become overloaded, bypass treatment works, and discharge directly to receiving waters.

Combined Wastestream Formula (CWF) *[paraphrased from 40 CFR §403.6(e)]*
Procedure 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.

Compliance Schedule
A schedule of remedial measures included in a permit or an enforcement order, including a sequence of interim requirements (for example, actions, operations, or milestone events) that lead to compliance with the CWA and regulations.

Composite Sample
Sample composed of two or more discrete samples. The aggregate sample will reflect the average water quality covering the compositing or sample period.

Concentration-based Limit
A limit based upon the relative strength of a pollutant in a wastestream, usually expressed in mg/l.

Continuous Discharge
A discharge that occurs without interruption during the operating hours of a facility, except for infrequent shutdowns for maintenance, process changes or similar activities.

Control Authority *[paraphrased from 40 CFR § 403.12(a)]*
A POTW with an approved pretreatment program or the approval authority in the absence of a POTW pretreatment program.

Conventional Pollutants
BOD, TSS, fecal coliform, oil and grease, and pH

Daily Maximum Limitations
The maximum allowable discharge of pollutants during a 24 hour period. Where daily maximum limitations are expressed in units of mass, the daily discharge is the total mass discharged over the course of the day. Where daily maximum limitations are expressed in terms of a concentration, the daily discharge is the arithmetic average measurement of the pollutant concentration derived from all measurements taken that day.

Detection Limit
The minimum concentration of an analyte(substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure set forth in 40 CFR Part 136, Appendix B.

Development Document
Detailed report of studies conducted by the U.S. EPA for the purpose of establishing effluent guidelines and categorical pretreatment standards.

Dilute Wastestream *[paraphrased from 40 CFR §403.6(e)(1)(i)]*
For purposes of the combined wastestream formula, the average daily flow (at least a 30-day average) from : (a) boiler blowdown streams, non-contact cooling streams, storm water streams, and demineralized backwash streams; provided, however, that where such streams contain a significant amount of a pollutant, and the combination of such streams, prior to treatment, with an industrial user's regulated process wastestream(s) will result in a substantial reduction of that pollutant, the Control Authority, upon application of the industrial user, may exercise its discretion to determine whether such stream(s) should be classified as diluted or unregulated. In its application to the Control Authority, the industrial user must provide engineering, production, sampling and analysis, and such other information so the control authority can make its determination; or (b) sanitary wastestreams

where such streams are not regulated by a categorical pretreatment standard; or (c) from any process wastestreams which were, or could have been, entirely exempted from categorical pretreatment standards pursuant to paragraph 8 of the NRDC v. Costle Consent Decree (12 ERC 1833) for one more of the following reasons (see Appendix D of 40 CFR Part 403):

a. the pollutants of concern are not detectable in the effluent from the industrial user (paragraph(8)(a)(iii));
b. the pollutants of concern are present only in trace amounts and are neither causing nor likely to cause toxic effects (paragraph (8)(a)(iii));
c. the pollutants of concern are present in amounts too small to be effectively deduced by technologies known to the Administrator (paragraph (8)(a)(iii)); or
d. the wastestream contains only pollutants which are compatible with the POTW (paragraph 8)(b)(I)).

Effluent Limitations Guideline
Any effluent limitations guidelines issued by the EPA pursuant to Section 304(b) of the CWA. These regulations are published to adopt or revise a national standard prescribing restrictions on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources, in specific industrial categories (e.g., metal finishing, metal molding and casting, etc).

Enforcement Response Plan *[paraphrased from 40 CFR §403.8(f)(5)]*
Step-by-step enforcement procedures followed by Control Authority staff to identify, document, and respond to violations.

Existing Source
Any source of discharge, the construction or operation of which commenced prior to the publication by the EPA of proposed categorical pretreatment standards, which will be applicable to such source if the standard is thereafter promulgated in accordance with Section 307 of the Act.

Federal Water Pollution Control Act (FWPCA)
The title of Public law 92-500; 33 U.S.C. 1251 et seq., also known as the Clean Water Act (CWA),enacted October 18, 1972.

Flow Weighted Average Formula (FWA) *[paraphrased from 40 CFR §403.6(e)]*
A procedure used to calculate alternative limits where wastestreams regulated by a categorical pretreatment standard and nonregulated wastestreams combine after treatment but prior to the monitoring point.

Flow Proportional Composite Sample
Combination of individual samples proportional to the flow of the wastestream at the time of sampling.

Fundamentally Different Factors *[paraphrased from 40 CFR §403.13]*
Case-by-case variance from categorical pretreatment standards based on the factors considered by the EPA in developing the applicable category/subcategory being fundamentally different than factors relating to a specific industrial user.

General Prohibitions *[40 CFR §403.5(a)(1)]*
No user shall introduce into a POTW any pollutant(s) which cause pass through or interference.

Grab Sample
A sample which is taken from a wastestream on a one-time basis with no regard to the flow of the wastestream and without consideration of time. A single grab sample should be taken over a period of time not to exceed 15 minutes.

Indirect Discharge or Discharge *[40 CFR §403.3(g)]*
The introduction of pollutants into a POTW from any non-domestic source regulated under section 307(b), (c), or (d) of the Act.

Industrial User (IU) or User *[40 CFR §403.3(h)]*
A source of indirect discharge.

Industrial Waste Survey
The process of identifying and locating industrial users and characterizing their industrial discharge.

Inhibition Concentration
Estimate of the toxicant concentration that would cause a given percent reduction (e.g., IC25) in a non-lethal biological measurement of the test organisms, such as reproduction or growth.

Interference *[paraphrased from 40 CFR §403.3(i)]*
A discharge which, alone or in conjunction with a discharge or discharges from other sources, both: (1)inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and (2) therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with ... [applicable] statutory provisions and regulations or permits issued there under (or more stringent State or local regulations) ...

Local Limits *[paraphrased 40 CFR § 403.5(c)]*
Specific discharge limits developed and enforced by POTWs upon industrial or commercial facilities to implement the general and specific discharge prohibitions listed in 40 CFR §§403.5(a)(1) and (b).

Monthly Average
The arithmetic average value of all samples taken in a calendar month for an individual pollutant parameter. The monthly average may be the average of all grab samples taken in a given calendar month, or the average of all composite samples taken in a given calendar month.

National Pollutant Discharge Elimination System (NPDES)
The national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing discharge permits from point sources to waters of the United States, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the CWA.

National Pretreatment Standard or Pretreatment Standard or Standard
[40 CFR §403.3(j)] Any regulation containing pollutant discharge limits promulgated by the EPA in accordance with section 307(b) and (c) of the Act, which applies to Industrial Users. This term includes prohibitive discharge limits established pursuant to §403.5.

New Source *[40 CFR §403.3(k)]*
Any building, structure, facility or installation from which there is or may be a discharge of pollutants, the construction of which commenced after the publication of proposed Pretreatment Standards under section 307(c) of the Act which will be applicable to such source if such standards are thereafter promulgated in accordance with that section *provided tha*t:
(a) The building, structure, facility or installation is constructed at a site at which no other discharge source is located; or
(b) The building, structure, facility or installation totally replaces the process or production equipment that causes the discharge of pollutants at an existing source; or
(c) The production or wastewater generating processes of the building, structure, facility, or installation are substantially independent of an existing source at the same site. In determining whether these are substantially independent, factors such as the extent to which the new facility is integrated with the existing plant, and the extent to which the new facility is engaged in the same general type of activity as the existing source, should be considered.
Construction on a site at which an existing source is located results in a modification rather than a new source if the construction does not create a new building, structure, facility, or installation meeting the criteria of paragraphs (k)(1)(ii), or (k)(1)(iii) of this section but otherwise alters, replaces, or adds to existing processor production equipment.
Construction of a new source, as defined under this paragraph has commenced if the owner or operator has:
(i) Begun, or caused to begin as part of a continuous onsite construction program:
(A) Any placement, assembly, or installation of facilities or equipment; or
(B) Significant site preparation work including clearing, excavation, or removal of existing buildings, structures, or facilities which is necessary for the placement, assembly, or installation of new source facilities or equipment, or
(C) Entered into a binding contractual obligation for the purchase of facilities or equipment which are intended to be used in its operation within a reasonable time. Options to purchase or contracts which can be terminated or modified without substantial loss, and contracts for feasibility, engineering, and design studies do not constitute a contractual obligation under this paragraph.

90-Day Final Compliance Report *[40 CFR §403.12(d)]*
A report submitted by categorical industrial users within 90 days following the date for final compliance with the standards. This report must contain flow measurement (of regulated process streams and other streams), measurement of pollutants, and a certification as to whether the categorical standards are being met.

Nonconventional Pollutants
Any pollutant that is neither a toxic pollutant nor a conventional pollutant (e.g., manganese, ammonia, etc.)

Non-Contact Cooling Water
Water used for cooling which does not come into direct contact with any raw material, intermediate product, waste product, or finished product. The only pollutant contributed from the discharge is heat.

Non-Regulated Wastestream
Unregulated and dilute wastestreams (not regulated by categorical standards).

Pass Through *[40 CFR §403.3(n)]*
A discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation).

Periodic Compliance Report *[paraphrased from 40 CFR §403.12(e) & (h)]*
A report on compliance status submitted by categorical industrial users and significant noncategorical industrial users to the control authority at least semiannually (once every six months).

Point Source *[40 CFR 122.2]*
Any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fixture, container, rolling stock concentrated animal feeding operation vessel, or other floating craft from which pollutants are or may be discharged.

Pollutant *[40 CFR 122.2]*
Dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal and agricultural waste discharged into water.

Pretreatment *[paraphrased from 40 CFR §403.3(q)]*
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.

Pretreatment Requirements *[40 CFR §403.3(r)]*
Any substantive or procedural requirement related to Pretreatment, other than a National Pretreatment Standard, imposed on an Industrial User.

Pretreatment Standards for Existing Sources (PSES)
Categorical Standards and requirements applicable to industrial sources that began construction prior to the publication of the proposed pretreatment standards for that industrial category.(see individual standards at 40 CFR Parts 405-471.)

Pretreatment Standards for New Sources (PSNS)
Categorical Standards and requirements applicable to industrial sources that began construction after the publication of the proposed pretreatment standards for that industrial category. (see individual standards at 40 CFR Parts 405-471.)

Priority Pollutant
Pollutant listed by the Administrator of the EPA 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.

Process Wastewater
Any water which, during manufacturing or processing, comes into contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product.

Production-Based Standards
A discharge standard expressed in terms of pollutant mass allowed in a discharge per unit of product manufactured.

Publicly Owned Treatment Works (POTW) *[40 CFR §403.3(o)]*
A treatment works as defined by section 212 of the Act, which is owned by a State or municipality (as defined by section 502(4) of the Act). This definition includes any devices or systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes or other conveyances only if they convey wastewater to a POTW Treatment Plant.

The term also means the municipality as defined in section 502(4) of the Act, which has jurisdiction over the Indirect Discharges to and the discharges from such a treatment works.

Regulated Wastestream
For purposes of applying the combined wastestream formula, a wastestream from an industrial process that is regulated by a categorical standard.

Removal Credit *[paraphrased from 40 CFR §403.7]*
Variance from a pollutant limit specified in a categorical pretreatment standard to reflect removal by the POTW of said pollutant.

Representative Sample
A sample from a wastestream that is as nearly identical as possible in composition to that in the larger volume of wastewater being discharged and typical of the discharge from the facility on a normal operating day.

Sanitary Sewer Overflow (SSO)
Untreated or partially treated sewage overflows from a sanitary sewer collection system.

Self-Monitoring
Sampling and analyses performed by a facility to ensure compliance with a permit or other regulatory requirements.

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

Significant Industrial User (SIU) *[paraphrased from 40 CFR §403.3(t)]*
(1) All users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR chapter I, subchapter N; and (2) Any other industrial user that: discharges an average of 25,000 gallons per day or more of process wastewater to the POTW (excluding sanitary, noncontact cooling and boiler blowdown wastewater); contributes a process wastestream which 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 as 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)].

Significant Noncompliance (SNC) *[40 CFR §403.8(f)(2)(vii)]*
Industrial user violations meeting one or more of the following criteria:
1) Chronic violations of wastewater discharge limits, defined here as those in which sixty-six percent or more of all of the measurements taken during a six month period exceed (by any magnitude) the daily maximum limit or the average limit for the same pollutant parameter;
2) Technical Review Criteria (TRC) violations, defined here as those in which thirty-three percent or more of all of the measurements for each pollutants parameter taken during a six-month period equal or exceed the product of the daily maximum limit or the average limit multiplied by the applicable TRC (TRC=1.4 for BOD, TSS, fats, oil, and grease, and 1.2 for all other pollutants except pH);
3) Any other violation of a pretreatment effluent limit (daily maximum or longer-term average) that the Control Authority determines has caused, alone or in combination with other dischargers, interference or pass through (including endangering the health of POTW personnel or the general public);
4) Any discharge of a pollutant that has caused imminent endangerment to human health, welfare or to the environment or has resulted in the POTW's exercise of its emergency authority under paragraph (f)(1)(vi)(B) of this section to halt or prevent such a discharge;
5) Failure to meet, within 90 days after the schedule date, a compliance schedule milestone contained in a local control mechanism or enforcement order for starting construction, completing construction, or attaining final compliance;
6) Failure to provide, within 30 days after the due date, required reports such as baseline monitoring reports, 90-day compliance reports, periodic self-monitoring reports, and reports on compliance with compliance schedules;
7) Failure to accurately report noncompliance;
8) Any other violation or group of violations which the Control Authority determines will adversely affect the operation or implementation of the local pretreatment program.

Slug Discharge *[40 CFR §403.8(f)(2)(v)]*
Any discharge of a non-routine, episodic nature, including but not limited to, an accidental spill or a non-customary batch discharge.

Specific Prohibitions *[40 CFR §403.5(b)]*
The following pollutants shall not be introduced into a POTW:
1) Pollutants which create a fire or explosion hazard in the POTW, including but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees
Centigrade using the test methods specified in 40 CFR Part 261.21;
2) Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works is specifically designed to accommodate such discharges;

3) Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW resulting in interference;
4) Any pollutant, including oxygen demanding pollutants(BOD, etc.) Released in a discharge at a flow rate and/or concentration which will cause interference with the POTW;
5) Heat in amounts which will inhibit biological activity in the POTW resulting in interference, but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds 40°C(104°F) unless the Approval Authority, upon request of the POTW, approves alternative temperature limits;
6) Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;
7) Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems;
8) Any trucked or hauled pollutants, except at discharge points designated by the POTW.

Standard Industrial Classification (SIC)
A system developed by the U.S. Office of Management and Budget that is used to classify various types of business entities. Effective in 1998, the SIC scheme is replace by the North American Industry Classification System (NAICS), although the EPA has not yet implemented this change.

Storm Water
Rain water, snow melt, and surface runoff and drainage.

Time Proportional Composite Sample
A sample consisting of a series of aliquots collected from a representative point in the discharge stream at equal time intervals over the entire discharge period on the sampling day.

Toxic Pollutant
Any pollutant listed as toxic under section 307(a)(1) of the CWA, or in the case of sludge use or disposal practices, any pollutant identified in regulations implementing section 405(d) of the CWA.

Toxicity Reduction Evaluation
A site-specific study conducted in a stepwise process designed to identify the causative agent(s) of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and then confirm the reduction in effluent toxicity.

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

Toxicity Identification Evaluation
Set of procedures to identify the specific chemicals responsible for effluent toxicity.

Unregulated Wastestream
For purposes of applying the combined wastestream formula, a wastestream not regulated by a categorical standard nor considered a dilute wastestream.

Upset *[paraphrased from 40 CFR §403.16(a)]*
An exceptional incident in which there is unintentional and temporary noncompliance with categorical Pretreatment Standards because of factors beyond the reasonable control of the Industrial User. An Upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or careless or improper operation.

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

Water Quality Standard
A statute or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular waterbody, and an antidegradation statement.

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