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## CHAPTER 1

### INTRODUCTION

#### 1.1 BACKGROUND

Combined sewer systems (CSSs) are designed to carry sanitary sewage (consisting of domestic, commercial, and industrial wastewater) and storm water (surface drainage from rainfall or snowmelt) in a single pipe to a treatment facility. CSSs serve about 43 million people in approximately 950 communities nationwide, most of them located in the Northeast and Great Lakes regions. During dry weather, CSSs convey domestic, commercial, and industrial wastewater to a publicly owned treatment works (POTW). In periods of rainfall or snowmelt, total wastewater flows can exceed the capacity of the CSS or the treatment facilities. When this occurs, the CSS is designed to overflow directly to surface water bodies, such as lakes, rivers, estuaries, or coastal waters. These overflows-called combined sewer overflows (CSOs)-can be a major source of water pollution.

CSOs contain many types of contaminants, including pathogens, oxygen-demanding pollutants, suspended solids, nutrients, toxics, and floatable matter. Their presence in CSOs and the volume of the flows can cause a variety of adverse impacts on the physical characteristics of surface water, impair the viability of aquatic habitats, and pose a potential threat to drinking water supplies. CSOs have been shown to be a major contributor to use impairment and aesthetic degradation of many receiving waters and have contributed to shellfish harvesting restrictions, beach closures, and even occasional fish kills.

#### 1.2 HISTORY OF THE CSO CONTROL POLICY

Historically, the control of CSOs has proven to be extremely complex. This is partly due to the difficulty in quantifying CSO impacts on receiving water quality and the site-specific variability in the volume, frequency, and characteristics of CSOs. In addition, the financial considerations for communities with CSOs can be significant. The U.S. Environmental Protection Agency (EPA)

estimates the CSO abatement costs for the 950 communities served by CSSs to be approximately \$45 billion based on results from the 1996 Clean Water Needs Survey.

To address these challenges, EPA issued a National Combined Sewer Overflow Control Strategy on August 10, 1989 (*54 Federal Register 37370*). This Strategy reaffirmed that CSOs are point source discharges subject to National Pollutant Discharge Elimination System (NPDES) permit requirements and to Clean Water Act (CWA) requirements. The CSO Strategy recommended that all CSOs be identified and categorized according to their status of compliance with these requirements. It also set forth three objectives:

- Ensure that if CSOs occur, they are only as a result of wet weather
- Bring all wet weather CSO discharge points into compliance with the technology-based and water quality-based requirements of the CWA
- Minimize the water quality, aquatic biota, and human health impacts of CSOs.

In addition, the CSO Strategy charged all States with developing state-wide permitting strategies designed to reduce, eliminate, or control CSOs.

Although the CSO Strategy was successful in focusing attention, it failed to resolve many fundamental issues. In mid-1991, EPA initiated a process to accelerate implementation of the Strategy. The process included negotiations with representatives of the regulated community, State regulatory agencies, and environmental groups. These negotiations were conducted through the Office of Water Management Advisory Group. The initiative resulted in the development of a CSO Control Policy, published in the *Federal Register* on April 19, 1994 (*59 Federal Register 18688*).

The intent of the CSO Control Policy is to:

- Provide guidance to permittees with CSOs, NPDES permitting and enforcement authorities, and State water quality standards (WQS) authorities

- Ensure coordination among the appropriate parties in planning, selecting, designing, and implementing CSO management practices and controls to meet the requirements of the CWA
- Ensure public involvement during the decision-making process.

The CSO Control Policy contains provisions for developing appropriate, site-specific NPDES permit requirements for all CSSs that overflow due to wet weather events. It also announces an enforcement initiative that requires the immediate elimination of overflows that occur during dry weather and ensures that the remaining CWA requirements are complied with as soon as possible.

### **1.3 KEY ELEMENTS OF THE CSO CONTROL POLICY**

The CSO Control Policy contains four key principles to ensure that CSO controls are cost-effective and meet the requirements of the CWA:

- Provide clear levels of control that would be presumed to meet appropriate health and environmental objectives
- Provide sufficient flexibility to municipalities, especially those that are financially disadvantaged, to consider the site-specific nature of CSOs and to determine the most cost-effective means of reducing pollutants and meeting CWA objectives and requirements
- Allow a phased approach for implementation of CSO controls considering a community's financial capability
- Review and revise, as appropriate, WQS and their implementation procedures when developing long-term CSO control plans to reflect the site-specific wet weather impacts of CSOs.

In addition, the CSO Control Policy clearly defines expectations for permittees, State WQS authorities, and NPDES permitting and enforcement authorities. These expectations include the following:

- Permittees should immediately implement the nine minimum controls (NMC), which are technology-based actions or measures designed to reduce CSOs and their effects on receiving water quality, as soon as practicable but no later than January 1, 1997.
- Permittees should give priority to environmentally sensitive areas
- Permittees should develop long-term control plans (LTCPs) for controlling CSOs. A permittee may use one of two approaches: 1) demonstrate that its plan is adequate to meet the water quality-based requirements of the CWA (“demonstration approach”), or 2) implement a minimum level of treatment (e.g., primary clarification of at least 85 percent of the collected combined sewage flows) that is presumed to meet the water quality-based requirements of the CWA, unless data indicate otherwise (“presumption approach”).
- WQS authorities should review and revise, as appropriate, State WQS during the CSO long-term planning process.
- NPDES permitting authorities should consider the financial capability of permittees when reviewing CSO control plans.

Exhibit I-1 illustrates the roles and responsibilities of permittees, NPDES permitting and enforcement authorities, and State WQS authorities.

In addition to these key elements and expectations, the CSO Control Policy also addresses important issues such as ongoing or completed CSO control projects, public participation, small communities, and watershed planning.

### Exhibit I-1. Roles and Responsibilities

| Permittee   | NPDES Permitting Authority  | NPDES Enforcement Authority   | State WQS Authorities  |
|---|---|---|--|
| <ul style="list-style-type: none"> <li>• Evaluate and implement NMC</li> <li>• Submit documentation of NMC implementation by January 1, 1997</li> <li>• Develop LTCP and submit for review to NPDES permitting authority</li> <li>• Support the review of WQS in CSO-impacted receiving water bodies</li> <li>• Comply with permit conditions based on narrative WQS</li> <li>• Implement selected CSO controls from LTCP</li> <li>• Perform post-construction compliance monitoring</li> <li>• Reassess overflows to sensitive areas</li> <li>• Coordinate all activities with NPDES permitting authority, State WQS authority, and State watershed personnel</li> </ul> | <ul style="list-style-type: none"> <li>• Reassess/revise CSO permitting strategy</li> <li>• Incorporate into Phase I permits CSO-related conditions (e.g., NMC implementation and documentation and LTCP development)</li> <li>• Review documentation of NMC implementation</li> <li>• Coordinate review of LTCP components throughout the LTCP development process and accept/approve permittee's LTCP</li> <li>• Coordinate the review and revision of WQS as appropriate</li> <li>• Incorporate into Phase II permits CSO-related conditions (e.g., continued NMC implementation and LTCP implementation)</li> <li>• Incorporate implementation schedule into an appropriate enforceable mechanism</li> <li>• Review implementation activity reports (e.g., compliance schedule progress reports)</li> </ul> | <ul style="list-style-type: none"> <li>• Ensure that CSO requirements and schedules for compliance are incorporated into appropriate enforceable mechanisms</li> <li>• Monitor adherence to January 1, 1997, deadline for NMC implementation and documentation</li> <li>• Take appropriate enforcement action against dry weather overflows</li> <li>• Monitor compliance with Phase I, Phase II, and post-Phase II permits and take enforcement action as appropriate</li> </ul> | <ul style="list-style-type: none"> <li>• Review WQS in CSO-impacted receiving water bodies</li> <li>• Coordinate review with LTCP development</li> <li>• Revise WQS as appropriate:                             <ul style="list-style-type: none"> <li>Development of site-specific criteria</li> <li>Modification of designated use to                                     <ul style="list-style-type: none"> <li>- Create partial use reflecting specific situations</li> <li>- Define use more explicitly</li> </ul> </li> <li>Temporary variance from WQS</li> </ul> </li> </ul> |

NMC = nine minimum controls  
 LTCP = long-term control plan  
 WQS = water quality standards

## 1.4 GUIDANCE TO SUPPORT IMPLEMENTATION OF THE CSO CONTROL POLICY

To help permittees and NPDES permitting and WQS authorities implement the provisions of the CSO Control Policy, EPA has developed the following guidance documents:

- *Combined Sewer Overflows - Guidance for Long-Term Control Plan* (U.S. EPA, 1995a) (EPA 832-B-95-002)
- *Combined Sewer Overflows - Guidance for Nine Minimum Controls* (U.S. EPA, 1995b) (EPA 832-B-95-003)
- *Combined Sewer Overflows - Guidance for Screening and Ranking* (U.S. EPA, 1995c) (EPA 832-B-95-004)
- *Combined Sewer Overflows - Guidance for Funding Options* (U.S. EPA, 1995d) (EPA 832-B-95-007)
- *Combined Sewer Overflows - Guidance for Permit Writers* (U.S. EPA, 1995e) (EPA 832-B-95-008)
- *Combined Sewer Overflows - Guidance for Financial Capability Assessment and Schedule Development* (U.S. EPA, 1997) (EPA 832-B-97-004).

EPA has printed a limited number of copies of each guidance document and has made them available through several sources:

- EPA's Water Resource Center (202-260-7786)
- National Small Flows Clearinghouse (800-624-8301 or <http://www.estd.wvu.edu/nsfc/>)
- National Technical Information Service (NTIS) (800-553-6847 or <http://www.ntis.gov>)
- Educational Resources Information Center (ERIC) (800-276-0462 or <http://www.aspensys.com/eric/catalog/>)
- State environmental offices
- EPA Regional Offices.

Electronic copies of some of the guidance documents are also available on EPA's Office of Water Internet site (<http://www.epa.gov/ow/>).

## 1.5 PURPOSE OF GUIDANCE

This manual explains the role of monitoring and modeling in the development and implementation of a CSO control program. It expands discussions of monitoring and modeling introduced in the CSO Control Policy and presents examples of data collection and CSS simulation.

This manual is not a "how-to" manual defining how many samples to collect or which flow metering technologies to use. Rather, it is a *set of guidelines that provides flexibility for a municipality to develop a site-specific strategy for characterizing its CSS operation and impacts and for developing and implementing a comprehensive CSO controlplan. CSSs vary greatly in their size, structure, operation, and receiving water impacts. A monitoring and modeling strategy appropriate for a large city such as New York or San Francisco would generally not apply to a small CSS with only one or two flow regulators and outfalls. In addition, communities have varying degrees of knowledge about how their CSSs react hydraulically to wet weather and how their CSOs affect receiving water quality. A municipality that does not know the location of its CSO outfalls has different information collection needs from a municipality that has already conducted CSS flow and water quality studies.*

This manual provides guidance for communities of all sizes. It presents low-cost monitoring and modeling techniques, which should prove particularly helpful to small communities. However, communities with large CSSs should note that inexpensive techniques often prove useful in extending monitoring resources and in verifying the performance of more sophisticated techniques and equipment.

To use this manual, a municipality should already be familiar with the basic functioning of its CSS, basic monitoring procedures, and the general purpose of modeling. Since basic monitoring and modeling techniques are already covered extensively in other technical literature, this manual

focuses mainly on the process of characterization as described in the CSO Control Policy, referring to other literature for more in-depth explanations of specific techniques or procedures.

## **1.6 MANUAL ORGANIZATION**

This manual begins with an overview of monitoring and modeling under the CSO Control Policy, and then provides a detailed discussion of the monitoring and modeling activities that should be conducted for NMC implementation and LTCP development and implementation. These activities (and the chapters in which they are discussed) are as follows:

- Chapter 2 - Introduction To Monitoring and Modeling
- Chapter 3 - Initial System Characterization-Existing Data Analysis and Field Investigation
- Chapter 4 - Monitoring and Modeling Plan
- Chapter 5 - CSS Monitoring
- Chapter 6 - Receiving Water Monitoring
- Chapter 7 - CSS Modeling
- Chapter 8 - Receiving Water Modeling
- Chapter 9 - Assessing Receiving Water Impacts and Attainment of Water Quality Standards.