GUIDE FOR EVALUATING CAPACITY, MANAGEMENT, OPERATION, AND MAINTENANCE (CMOM) PROGRAMS AT SANITARY SEWER COLLECTION SYSTEMS

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CHAPTER 1. INTRODUCTION

1.1 Purpose of this Guide

This guide identifies some of the criteria used by EPA to evaluate a collection system's management, operation, and maintenance (CMOM) program activities. The guide is intended for use by EPA and state inspectors as well as the regulated community – owners or operators of sewer systems collecting domestic sewage as well as consultants or other third-party evaluators or compliance assistance providers. Collection system owners or operators can review their own systems by following the checklist in Chapter 3 to reduce the occurrence of sewer overflows and improve or maintain compliance. The guidance herein may also be taken a step further. If a federal or state reviewer observes a practice that does not effectively meet the elements of a CMOM program, he or she may make recommendations to educate the operator, inspector, case developer, or those involved in a settlement agreement. Additionally, having key board members (policy makers) read this guide will also allow them to better understand the benefits of investing in good CMOM programs.

The guide is applicable to small, medium, and large systems; both publicly and privately owned systems; and both regional and satellite collection systems. Regardless of size, each owner or operator will have an organization and practices unique to its collection system. While these specific characteristics will vary among systems, the CMOM concepts and best management practices are likely to apply to all types of systems. Where appropriate, this document provides guidance on the differences.

This document does not, however, substitute for the CWA or EPA's regulations, nor is it a regulation itself. Thus, the document does not and cannot impose legally binding requirements upon these circumstances. EPA and state decision-makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance where appropriate. EPA may change this guidance in the future.

Individuals reviewing a collection system are strongly encouraged to read the guidance portion of this document prior to conducting a review. Reviewers should use the checklist in Chapter 3 as the primary tool for questions during the paperwork and/or onsite review of the collection system.

While some sections or topics may not appear to relate directly to environmental performance, taken as a whole, they provide an indication of how well the utility is run.

1.2 Terminology

To provide a more user-friendly guidance and for clarification, the terminology for several terms has been modified. The following paragraphs list these terms and reasoning for the modifications.

Frequently, the term "COLLECTION SYSTEM OWNER OR OPERATOR", abbreviated as "OWNER OR OPERATOR," is used in this guide and refers to the entities responsible for the administration and oversight of the sewer system and its associated staff (in either a municipal or industrial context); capacity evaluation, management, operation, and maintenance programs; equipment; and facilities. The owner and operator may be two different entities. For example, the owner may own the infrastructure and be responsible for its maintenance while it designates responsibility for the day to day operation of

the system to the operator. It should be noted that the term used in EPA's CMOM Program Self Assessment Checklist is "MUNICIPAL WASTEWATER UTILITY OPERATORS" or "UTILITY" rather than "collection system owner or operator." Both refer to the same individual(s).
The term "REVIEW" is used in this document in place of "INSPECTION" or "AUDIT." Because "inspection" often refers to an evaluation conducted by the regulatory authority and "audit" has been used to refer to an evaluation with very specific requirements, "review" is more appropriately used to capture the wider universe of evaluations (e.g., those conducted by a regulatory authority, the system itself, and/or by a third-party).

Similarly, the term used to describe the person conducting the CMOM review is the "REVIEWER" – this could be either an inspector, a third party reviewer hired by the owner or operator, or personnel of the owner or operator performing a self-evaluation of the collection system.

The term "FACILITY" is used in this document to refer to the components of the collection system (e.g., pump stations, sewer lines).

1.3 How to Use the Guide

The guide and checklist provide a three-tiered approach to the CMOM review:

- Evaluation of the CMOM program, based on interviews with management and field personnel, as well as observation of routine activities and functions
- Review of pertinent records and information management systems
- Evaluation based on field/site review

Chapter 2 provides a breakdown and overview of each CMOM concept and what to look for when reviewing the system, defines the CMOM elements for the reviewer, and follows through with a discussion of the indicators or other clues about which the reviewer should be aware. Chapters 2 and 3 present detailed information on conducting reviews of collection systems. Chapter 3 contains the comprehensive reviewer checklist, supported by the information in Chapter 2. Appendix A presents a Collection System Performance Indicator Data Collection Form which provides examples of the types of information a reviewer should attempt to obtain while on-site.

The "one size does not fit all" approach to reviewing CMOM programs cannot be overstated. The principles covered in this guide are applicable to all wastewater collection systems, however, these principles may be implemented through different means depending on the system. Larger systems may have the resources and the need to implement more costly and complex means of meeting the CMOM program elements. In occasional cases a CMOM feature may not be implemented at all, due to characteristics of the system. A reviewer should be able to look at the system as a whole and determine whether certain key elements are present or should be present and to what extent the system incorporates the CMOM principles.

Reviewers will also find that the location or names of some documents, logs, or reports may vary from system to system. This guide tries to provide a general description of the materials the reviewer should request.

Although use of this guide cannot guarantee a collection system will avoid permit violations or discharge violations, generally, when owners or operators adequately practice the principles laid out in the guide, they should experience fewer problems and, therefore, fewer instances of noncompliance.

1.4 Overview of the Underlying Issues

Sanitary sewer collection systems are designed to remove wastewater from homes and other buildings and convey it to a wastewater treatment plant. The collection system is a critical element in the successful performance of the wastewater treatment process. EPA estimates that collection systems in the U.S. have a total replacement value between $1 to $2 trillion. Under certain conditions, poorly designed, built, managed, operated, and/or maintained systems can pose risks to public health, the environment, or both. These risks arise from sanitary sewer overflows (SSOs) from the collection system or by compromised performance of the wastewater treatment plant. Effective and continuous management, operation, and maintenance, as well as ensuring adequate capacity and rehabilitation when necessary, are critical to maintaining collection system capacity and performance while extending the life of the system.

EPA believes that every sanitary sewer system has the capacity to have an SSO. This may be due to a number of factors including, but not limited to:

- Blockages
- Structural, mechanical, or electrical failures
- Collapsed or broken sewer pipes
- Insufficient conveyance capacity
- Vandalism

SSOs include untreated discharges from sanitary sewer systems that reach waters of the United States (photo: US EPA).

Additionally, high levels of inflow and infiltration (I/I) during wet weather can cause SSOs. Many collection systems that were designed according to industry standards experience wet weather SSOs because levels of I/I may exceed levels originally expected; prevention of I/I has proven more difficult and costly than anticipated; or the capacity of the system has become inadequate due to an increase in service population without corresponding system upgrades (EPA 2004).

SSOs can cause or contribute to environmental and human health impacts (e.g., water quality standards violations, contamination of drinking water supplies, beach closures, etc.) which, in addition to flooded basements and overloaded wastewater treatment plants, are some symptoms of collection systems with inadequate capacity and improper management, operation, and maintenance. These problems create the need for both the owner or operator and the regulatory authority to conduct more thorough evaluations of sanitary sewer collection systems.

1.5 Purpose of CMOM Programs

CMOM programs incorporate many of the standard operation and maintenance activities that are routinely implemented by the owner or operator with a new set of information management requirements in order to:

- Better manage, operate, and maintain collection systems
- Investigate capacity constrained areas of the collection system
- Proactively prevent SSOs
- Respond to SSO events

The CMOM approach helps the owner or operator provide a high level of service to customers and reduce regulatory noncompliance. CMOM can help utilities optimize use of human and material resources by shifting maintenance activities from "reactive" to "proactive"–often leading to savings through avoided costs due to overtime, reduced emergency construction costs, lower insurance premiums, changes in financial performance goals, and fewer lawsuits. CMOM programs can also help improve communication relations with the public, other municipal works and regional planning organizations, and regulators.

It is important to note that the collection system board members or equivalent entity should ensure that the CMOM program is established as a matter of policy. The program should not be micro-managed, but an understanding of the resources required of the operating staff to implement and maintain the program is necessary.

In CMOM planning, the owner or operator selects performance goal targets, and designs CMOM activities to meet the goals. The CMOM planning framework covers operation and maintenance (O&M) planning, capacity assessment and assurance, capital improvement planning, and financial management planning. Information collection and management practices are used to track how the elements of the CMOM program are meeting performance goals, and whether overall system efficiency is improving.

On an periodic basis, utility activities should be reviewed and adjusted to better meet the performance goals. Once the long-term goal of the CMOM program is established, interim goals may be set. For instance, an initial goal may be to develop a geographic information system (GIS) of the system. Once the GIS is complete, a new goal might be to use the GIS to track emergency calls and use the information to improve maintenance planning.

An important component of a successful CMOM program is periodically collecting information on current systems and activities to develop a "snapshot-in-time" analysis. From this analysis, the owner or operator evaluates its performance and plans its CMOM program activities.

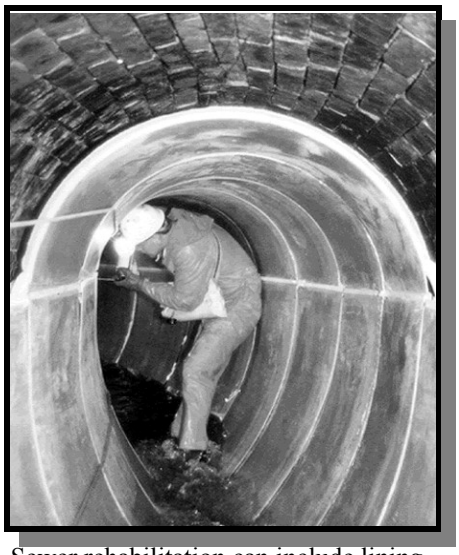
Maintaining the value of the investment is also important. Collection systems represent major capital investments for communities and are one of the communities' major capital assets. Equipment and facilities will deteriorate through normal use and age. Maintaining value of the capital asset is a major goal of the CMOM program. The infrastructure is what produces sales and service. Proper reinvestment in capital facilities maintains the ability to provide service and generate sales at the least cost possible and helps ensure compliance with environmental requirements. As a capital asset, this will result in the

need for ongoing investment in the collection system and treatment plant to ensure design capacity while maintaining existing facilities and equipment as well as extending the life of the system.

The performance of wastewater collection systems is directly linked to the effectiveness of its CMOM program. Performance characteristics of a system with an inadequate CMOM program include frequent blockages resulting in overflows and backups. Other major performance indicators include pump station reliability, equipment availability, and avoidance of catastrophic system failures such as a collapsed pipe.

A CMOM program is what an owner or operator should use to manage its assets; in this case, the collection system itself. The CMOM program consists of a set of best management practices that have been developed by the industry and are applied over the entire life cycle of the collection system and treatment plant. These practices include:

- Designing and constructing for O&M
- Knowing what comprises the system (inventory and physical attributes)
- Knowing where the system is (maps and location)
- Knowing the condition of the system (assessment)
- Planning and scheduling work based on condition and performance
- Repairing, replacing, and rehabilitating system components based on condition and performance
- Managing timely, relevant information to establish and prioritize appropriate CMOM activities
- Training of personnel



Sewer rehabilitation can include lining aging sewers (photo: NJ Department of Environmental Protection).

1.6 National Pollutant Discharge Elimination System Regulatory Requirement

The National Pollutant Discharge Elimination System (NPDES) program prohibits discharges of pollutants from any point source into the nation's waters except as authorized under an NPDES permit. EPA and state NPDES inspectors evaluate collection systems and treatment plants to determine compliance with permit conditions including proper O&M. Among others, these permit conditions are based on regulation in 40 CFR 122.41(e): "The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit."

When violations occur, the collection system or wastewater treatment plant owner or operator can face fines and requirements to implement programs to compensate residents and restore the environment. For example, in June 2004, the U.S. District Court for the Southern District of Ohio entered a consent decree resolving CSO, SSO, and wastewater treatment plant violations at the Hamilton County sewer system in Cincinnati, Ohio. In addition to a $1.2 million civil penalty, the settlement included programs to clean up residents' basements, compensate residents, and implement measures to prevent further basement backups. The settlement also includes over $5.3 million in supplemental environmental projects.

1.7 EPA Region 4 MOM Programs Project

EPA Region 4 created the "Publicly Owned Treatment Works MOM Programs Project" under which the Region invites permitted owners or operators, and contributing satellite systems, in watersheds it selects to perform a detailed self-assessment of the management, operation, and maintenance (MOM) programs associated with their collection system. Participants provide a report which includes the results of the review, any improvements that should be made, and schedules to make those improvements. Participants that identify and report a history of unpermitted discharges from their collection system, and a schedule for the necessary improvements, can be eligible for smaller civil penalties while under a remediation schedule.

EPA's Office of Compliance coordinated with EPA Region 4 on the development of this CMOM Guide. This guide is based in part on material obtained from the Region 4 MOM Programs Project. Some of the more specific items of the Region 4 program have been omitted in order to provide a more streamlined review framework. The fundamental concepts behind CMOM have been maintained in this guide. By combining elements of the Region's program with existing NPDES inspection guidance, this CMOM Guide provides a comprehensive framework for reviewers and regulated communities to evaluate the effectiveness of O&M throughout the collection system.

CHAPTER 2. COLLECTION SYSTEM CAPACITY, MANAGEMENT, OPERATION, AND MAINTENANCE PROGRAMS

This chapter provides an overview of the CMOM program elements. The information will help evaluate wastewater collection system operation and maintenance (O&M) practices. The key elements of the CMOM program, which are presented in detail in the following sections, include:

- Collection System Management
- Collection System Operation
- Collection System Maintenance
- Collection System Capacity Evaluation

In addition to this overview, there are several areas (e.g., 2.1.3 Internal Communications, 2.1.4 Customer Service, etc.) in this guide that go into greater depth regarding the operation and maintenance of a collection system. The intent of this detail is not only to provide the owner or operator with suggestions as to what to look for in their own program, but to provide the reviewer a complete overview of good operations, in general, regardless of a particular item resulting in poor performance or a violation.

For EPA and state inspectors or other reviewers, conducting an evaluation of collection system CMOM programs shares many similarities with other types of compliance reviews. Overall, the reviewer would examine records, interview staff and conduct field investigations, generally in that order although tailored, if necessary, to meet site-specific needs. Prior to performing the on-site interviews and evaluations, preliminary information may be requested that will provide an overall understanding of the organization to allow for a more focused approach for the review. This information also provides a basis for more detailed data gathering during on site activities. The information typically requested prior to the review should include a schematic map of the collection system (could be as-built drawings) and any written operations or maintenance procedures. Depending on the volume of information, the collection system owner or operator may need ample lead time to gather and copy these documents. Alternatively, the reviewer may offer to examine the documents and bring them back when doing the on-site review so that extra copies are not necessary. No matter which method is used, the importance of up-front preparation cannot be overemphasized. With the exception of pump stations and manholes, much of the collection system is not visible. Therefore, the more complete the reviewer's understanding of the system is prior to the review, the more successful the assessment will be.

The reviewer would then proceed with the on-site activities. Guidance for conducting compliance reviews is provided in the *NPDES Compliance Inspection Manual* (EPA 2004). The manual provides the general procedures for performing compliance reviews and is a valuable source of information on such topics as entry, legal authority, and responsibilities of the reviewer. Although CMOM evaluations are not specifically addressed in the manual, the general

review procedures can be applied to CMOM reviews. Another good reference for general review information is the *Multi-Media Investigations Manual, NEIC* (EPA 1992). Some issues with entry are specific to CMOM reviews. Some facilities may be on private property and the reviewer may need property owner consent for entry.

***Documents to Review On-site Include*:**

- Organization chart(s)
- Staffing plans
- Job descriptions
- Sewer use ordinance
- Overall map of system showing facilities such as pump stations, treatment plants, major gravity sewers, and force mains
- O&M budget with cost centers[1] for wastewater collection
- Performance measures for inspections, cleaning, repair, and rehabilitation
- Recent annual report, if available
- Routine reports regarding system O&M activities
- Collection system master plan
- Capital improvement projects (CIP) plan
- Flow records or monitoring
- Safety manual
- Emergency response plan
- Management policies and procedures
- Detailed maps/schematics of the collection system and pump stations
- Work order management system
- O&M manuals
- Materials management program
- Vehicle management and maintenance records
- Procurement process
- Training plan for employees
- Employee work schedules
- Public complaint log
- Rate ordinance or resolution
- Financial report ("notes" section)
- As built plans
- Discharge monitoring reports (DMRs)

The above list is not all inclusive nor will all utilities necessarily have formal, written documentation for each of the items listed. The *Collection System Performance Indicator Data Collection Form*, included as Appendix A, provides examples of the types of information a reviewer should attempt to obtain while on-site.

Reviewer - Point to Note
A schedule should be established by the reviewer for the staff interviews and field assessments.

Interviews are generally conducted with line managers and supervisors who are responsible for the various O&M activities

[1] A cost center is any unit of activity, group of employees, line of products, etc., isolated or arranged in order to allocate and assign costs more easily.

and support services staff from engineering, construction, human resources, and purchasing, where appropriate. Appendix B presents an example agenda and schedule that would be used for a large collection system owner or operator. The collection system's size and physical characteristics will determine the length of time needed for the review. A guideline for the time required, given a two person review team, would be two days for a small system, and a week or more for large systems.

Field reviews are typically conducted after interviews. The following is a list of typical field sites the team should visit:

- Mechanical and electrical maintenance shop(s)
- Fleet maintenance facilities (vehicles and other rolling stock)
- Materials management facilities (warehouse, outside storage yards)
- Field maintenance equipment storage locations (i.e., crew trucks, mechanical and hydraulic cleaning equipment, construction and repair equipment, and television inspection equipment)
- Safety equipment storage locations
- Pump stations
- Dispatch and supervisory control and data acquisition (SCADA) systems
- Crew and training facilities
- Chemical application equipment and chemical storage areas (use of chemicals for root and grease control, hydrogen sulfide control [odors, corrosion])
- Site of SSOs, if applicable
- A small, but representative, selection of manholes

Collection system operators typically assist with manhole cover removal and other physical activities. The inspector should refrain from entering confined spaces. A confined space is defined by the Occupational Safety and Health Administration (OSHA) as 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; and (3) is not designed for continuous employee occupancy [29 CFR 1910.146(b)]. A "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 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 [29 CFR 1910.146(b)].

Though OSHA has promulgated standards for confined spaces, those standards do not apply directly to municipalities, except in those states that have approved plans and have asserted jurisdiction under Section 18 of the OSHA Act. Contract operators and private facilities do have to comply with the OSHA requirements and the inspector may find that some municipalities elect to do so voluntarily. In sewer collection systems, the two most common confined spaces are the underground pumping station and manholes. The underground pumping station is typically entered through a relatively narrow metal or concrete shaft via a fixed ladder. Inspectors conducting the field evaluation component of the CMOM audit should be able to identify and

avoid permit-required confined spaces. Although most confined spaces are unmarked, confined spaces that may have signage posted near their entry containing the following language:

DANGER–PERMIT REQUIRED–CONFINED SPACE
AUTHORIZED PERSONNEL ONLY

If confined space entry is absolutely necessary, inspectors should consult with the collection system owner or operator first, have appropriate training on confined space entry, and use the proper hazard detection and personal safety equipment. More information on confined space entry can be found in *Operation and Maintenance of Wastewater Collection Systems Volumes I and II* (California State University (CSU) Sacramento 1996; CSU Sacramento 1998).

2.1 Collection System Management

Collection system management activities form the backbone for operation and effective maintenance activities. The goals of a management program should include:

- Protection of public health and prevention of unnecessary property damage
- Minimization of infiltration, inflow and exfiltration, and maximum conveyance of wastewater to the wastewater treatment plant
- Provision of prompt response to service interruptions
- Efficient use of allocated funds
- Identification of and remedy solutions to design, construction, and operational deficiencies
- Performance of all activities in a safe manner to avoid injuries

Management Documents to Review

- Organization chart(s)
- Staffing plans–Number of people and classifications
- Job descriptions for each classification
- Sewer use ordinance
- Safety manual
- Training program documentation
- Notes to financial reports

Without the proper procedures, management and training systems, O&M activities may lack organization and precision, resulting in a potential risk to human health and environmental contamination of surrounding water bodies, lands, dwellings, or groundwater. The following sections discuss the common elements of a robust collection system management program.

2.1.1 Organizational Structure

Well-established organizational structure, which delineates responsibilities and authority for each position, is an important component of a CMOM program for a collection system. This information may take the form of an organizational chart or narrative description of roles and

responsibilities, or both. The organizational chart should show the overall personnel structure, including operation and maintenance staff. Additionally, up-to-date job descriptions should be available. Job descriptions should include the nature of the work performed, the minimum requirements for the position, the necessary special qualifications or certifications, examples of the types work, lists of licences required for the position, performance measures or promotion potential. Other items to note in regard to the organizational structure are the percent of staff positions currently vacant, on average, the length of time positions remain vacant, and the percent of collection system work that is contracted out.

Reviewer - Point to Note
The reviewer may want to note the turnover rate and current levels of staffing (i.e., how many vacant positions exist and for how long they have been vacant). This may provide some indication of potential understaffing, which can create response problems.

Reviewers should evaluate specific qualifications of personnel and determine if the tasks designated to individuals, crews, or teams match the job descriptions and training requirements spelled out in the organizational structure. From an evaluation standpoint, the reviewer might try to determine what type of work is performed by outside contractors and what specific work is reserved for collection system personnel. If much of the work is contracted, it is appropriate to review the contract and to look at the contractor's capabilities. If the contractor handles emergency response, the reviewer should examine the contract with the owner or operator to determine if the emergency response procedures and requirements are outlined.

The inclusion of job descriptions in the organizational structure ensures that all employees know their specific job responsibilities and have the proper credentials. Additionally, it is useful in the course of interviews to discuss staff management. The reviewer should note whether staff receive a satisfactory explanation of their job descriptions and responsibilities. In addition, when evaluating the CMOM program, job descriptions will help a reviewer determine who should be interviewed.

Reviewer - Point to Note
A reviewer should look for indications that responsibilities are understood by employees. Such indications may include training programs, meetings between management and staff, or policies and procedures.

When evaluating the organizational structure, the reviewer should look for the following:

- Except in very small systems, operation and maintenance personnel ideally should report to the same supervisor or director. The supervisor or director should have overall responsibility for the collection system.

- In some systems, maintenance may be carried out by a city-wide maintenance

organization, which may also be responsible for such diverse activities as road repair and maintenance of the water distribution system. This can be an effective approach, but only if adequate lines of responsibility and communication are established.

- In general, one supervisor should manage a team of individuals small enough that is safe and effective. However, the individuals on the team may have additional employees reporting to them. This prevents the top supervisors from having to track too many individuals. The employee-supervisor ratio at individual collection systems will vary depending on their need for supervisors.

In a utility with well-established organizational structure, staff and management should be able to articulate their job and position responsibilities. Personnel should be trained to deal with constantly changing situations and requirements, both regulatory and operational.

The system's personnel requirements vary in relation to the overall size and complexity of the collection system. In very small systems, these responsibilities may include operation of the treatment plant as well as the collection system. In many systems, collection system personnel are responsible for the stormwater as well as wastewater collection system. References providing staff guidelines or recommendations are available to help the reviewer determine if staffing is adequate for the collection system being reviewed. Following is a list of available references:

- *Manpower Requirements for Wastewater Collection Systems in Cities of 150,000 to 500,000 Population* (EPA 1974)
- *Manpower Requirements for Wastewater Collection Systems in Cities and Towns of up to 150,000 Population* (EPA 1973)
- *Operation and Maintenance of Wastewater Collection Systems*, Volume II (California State University (CSU) Sacramento 1998)

Volumes I and II of *Operations and Maintenance of Wastewater Collection Systems* can be obtained through:

Office of Water Programs
California State University Sacramento
6000 J Street
Sacramento, CA 95819-6025
phone: 916/278-6142
www.owp.csus.edu

The following tables have been taken from the two EPA documents listed above to provide the reviewer with guidance. However, these documents may not take into account technological advances that have occurred since their publication date that might reduce staffing requirements. For instance, advances in remote data acquisition and telemetry have likely reduced the number

of field inspection staff needed for systems with several pump stations. Other system-specific characteristics should also be accounted for when using these tables. An example of this might be collection systems that are not primarily constructed of brick will not require the masons the tables specify.

STAFF COMPLEMENTS FOR WASTEWATER COLLECTION SYSTEM MAINTENANCE
POPULATION SIZE
(Estimated Number of Personnel)

Occupational Title	5,000		10,000		25,000		50,000		100,000	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Superintendent	1	5	1	10	1	20	1	40	1	40
Assistant Superintendent										
Maintenance Supervisor							1	40	2	80
Foreman	1	15	1	20	1	20	1	40	1	40
Maintenance Man II	1	15	1	20	1	20	1	40	1	40
Maintenance Man I	1	15	1	20	2	60	3	120	5	200
Mason II							1	40	1	40
Mason I									1	40
Maint. Equipment Personnel					1	40	2	80	3	120
Construction Equipment Personnel	1	15	1	20	1	20	1	40	1	40
Auto. Equipment Personnel									1	40
Photo. Inspection Technician									1	40
Laborer	1	15	1	20	2	40	2	80	5	200
Dispatcher							1	40	2	80
Clerk Typist							1	20	1	20
Stock Clerk							1	40	1	40
Sewer Maint. Staff	6	80	6	110	9	220	16	620	27	1,060
Maintenance Mechanic II	see comment (c) below									
Maintenance Mechanic I	see comment (d) below									
Maintenance Mechanic Helper	see comment (d) below									
Construction Inspection Supervisor	see comments (e) and (f) below									
Total Staff										

(a) Estimated number of personnel.
(b) Estimated total man-hours per week.
(c) Multiply number of lift stations maintained by 8/3.
(d) Multiply number of lift station visits per week by 1.
(e) Multiply estimated construction site visits per week by 8/3.
(f) Determined by the number of Construction Inspectors employed and developed on a judgmental basis.

Unit processes included in this staffing table are:

1. Maintenance of sanitary sewer main lines & appurtenances (laterals not included).
2. Maintenance of storm sewer main lines.
3. Maintenance of lift stations.
4. Inspection of newly constructed sewer main lines and appurtenances.

(U.S. EPA 1973)

STAFF COMPLEMENTS FOR WASTEWATER COLLECTION SYSTEM MAINTENANCE
POPULATION SIZE
(Estimated Number of Personnel)

Occupational Title	**150,000**	**200,000**	**300,000**	**400,000**	**500,000**
Superintendent	1	1	1	1	1
Assistant Superintendent	1	1	1	1	1
Maintenance Supervisor II	1	1	1	1	1
Maintenance Supervisor I	1	2	2	3	3
Equipment Supervisor	1	1	1	1	1
TV Technician II	1	2	2	3	3
TV Technician I	1	2	2	3	3
Foreman	2	3	4	5	6
Maintenance Man II	3	5	6	8	9
Maintenance Man I	11	17	22	29	33
Mason II	1	2	2	3	3
Mason I	1	2	2	3	3
Maintenance Equipment Personnel	6	8	12	15	18
Construction Equipment Personnel	3	4	6	8	9
Auto. Equipment Personnel	2	3	4	5	6
Laborer	7	10	14	18	22
Dispatcher	2	2	2	3	3
Stock Clerk	1	2	2	3	3
Clerk Typist	2	2	2	3	3
Sewer Maintenance Staff	48	70	88	116	131
Maintenance Mechanic II	see comment (a) below				
Maintenance Mechanic I	see comment (b) below				
Maintenance Mechanic Helper	see comment (b) below				
Electrician	see comment (c) below				
Construction Inspector Supervisor	see comment (d) below				
Construction Inspector	see comment (e) below				
Total Staff					

(a) Divide number of lift stations maintained by 15.
(b) Divide number of lift station visits per week by 40
(c) Divide number of lift stations maintained by 15.
(d) Determined by the number of Construction Inspectors employed and developed on a judgmental basis.
(e) Divide estimated daily construction site visits by 2.

Unit processes included in this staffing table are:

1. Maintenance of sanitary sewer main lines & appurtenances (laterals not included).
2. Maintenance of storm sewer main lines.
3. Maintenance of lift stations.
4. Inspection of newly constructed main lines and appurtenances.

(U.S. EPA 1974)

2.1.2 Training

The commitment of management to training is key to a successful program. It is important to recognize training as a budget expense item. A guideline for the typical amount of funding for training is three to five percent of the gross budget for the collection system. However, in large collection systems or those undergoing extensive construction this percentage may be considerably lower, and, in systems with a high turnover, training costs may be higher due to orienting new employees. Other changes, such as incorporation of new technology, will have a short-term impact on training costs. Although training is not explicitly required under current regulations, a collection system with untrained or poorly trained collection system personnel runs a greater risk of experiencing noncompliance.

The following elements are essential for an effective training program:

- Fundamental mission, goals, and policies of the collection system are addressed
- Mandatory training requirements are identified for key employees
- On-the-job training progress and performance are measured
- Effectiveness of the training is assessed including periodic testing, drills, or demonstrations
- New employees receive training

The owner or operator should generally provide training in the following areas:

- Routine line maintenance (may be on-the-job training only)
- Safety during confined space entry (every system should also have a strict policy and permit program)
- Traffic control (where applicable)
- Record keeping
- Pump station O&M
- Electrical and instrumentation (may be a combination of formal and on-the-job training)
- Public relations and customer service
- SSO/Emergency response
- Pump station operations and maintenance
- Pipe repair; bursting or cured in place pipe (CIPP); or closed circuit TV and trench/shoring (where these activities are not outsourced)

Sources of Training

Training is required to safely perform inspections, follow replacement procedures, and lubricate and clean parts and equipment. Following are the many sources of maintenance training:

- Manufacturer
- In-house
- On-the-job (OJT)
- Industry-wide (e.g., consultants, regulatory authorities, professional associations, or educational institutions)

The training program should identify the types of training required and offered. Types of training vary, but may include general environmental awareness, specific equipment, policies and

procedures, and conducting maintenance activities. If the owner or operator is carrying out its own training, the reviewer should evaluate one or more examples of training materials to answer the following questions: are the materials appropriate to the training topic and the level of those being trained; and are they likely to accomplish the intended goal?

Owner or Operator - Point to Note
The owner or operator should routinely assess the effectiveness of training through periodic testing, drills, demonstrations, or informal reviews, and improve training based on this assessment.

2.1.3 Internal Communication

Communication is essential to ensuring that collection systems run efficiently and effectively. It is especially important that an effective communication link exists between wastewater treatment plant operators and collection system crews as well as with other municipal departments.

Effective communication requires the top-down, bottom-up, and lateral exchange of information amongst staff. Examples of top-down communication are bulletin board posters, paycheck inserts, regular staff meetings, e-mail or informal brown-bag lunch discussions. Examples of bottom-up communication may include the establishing environmental committees, confidential hotlines, e-mail, or direct open discussions. Collection system owners or operators may also offer incentives to employees for performance, and encourage them to submit suggestions for ways to improve the performance of the collection system. “Front line” employees are often an excellent source of ideas, issues, and information about how to improve performance at the work site. In this context, the reviewer can check for morale-boosting activities or reward programs, such as “Employee of the Month” and “Employee of the Year.”

The reviewer should attempt to determine lines of internal communication to ensure all employees receive information and have an appropriate forum to provide feedback. The reviewer should assess the level of communication by interviewing several levels of staff or by simply observing collection system teams on work assignments. The owner or operator should have procedures and be able to demonstrate internal communication between the various levels and functions of the collection system regarding its management, operation, and maintenance programs.

2.1.4 Customer Service

The community often knows very little about the wastewater treatment and collection services performed for them. The community may only be aware of the collection system and its owner or operator through articles in local newspapers, public radio and television announcements, or only when there is an SSO. Collection system representatives should talk to schools and universities, make presentations to local officials and businesses about the wastewater field. Formal presentations can also be given to citizens, building inspectors, public utility officials,

and members of the media.

An effective customer service and public relations program ensures that the owner or operator addresses all incoming inquiries, requests, and complaints in a timely fashion. From this information, owners or operators may further develop or revise programs to better address areas of concern. The reviewer should examine customer service records for the following:

- Personnel who received the complaint or request
- Date and nature of the complaint or request
- Location of the problem
- Name, address, and telephone number of the customer
- Cause of the problem
- To whom the follow-up action was assigned
- The initial date of the follow-up action
- Date the complaint or request was resolved
- Total days to end the problem
- Feedback to the customer

Awareness of past issues, population served, compliance history, and other elements help a reviewer determine whether the amount and types of inquiries, requests, or complaints are increasing or decreasing. For example, there may have been many complaints during only a certain week. The reviewer can examine those records to determine if there were specific circumstances (e.g., a large precipitation event) that caused the increase in inquiries or complaints.

Reviewer - Point to Note
To fully understand the context of customer inquiries, requests, or complaints, a reviewer should understand the history, topography, boundaries, and demographics of the collection system's jurisdiction before site evaluations are conducted.

Employees who handle customer service should be specifically trained to handle complaints, requests, or inquiries. These employees should be provided with sample correspondence, Q/A's, or "scripts" to help guide them through written or oral responses to customers. The reviewer should look for procedures on how to answer the telephone, e-mail, and other communication used by personnel. A reviewer may evaluate staff telephone responses by evaluating:

- The number of persons available to answer calls
- The number of repeat callers
- The average length of calls
- The volume of calls per day

Collection system field crews and their activities are the most visible segment of any wastewater treatment organization. Workers project a public image for their system on city and town streets. For this reason, personnel need to be trained in what to expect in public situations. For example,

collection system supervisory staff should be familiar with the areas around public rights-of-way and easements to which their field crews must gain access to service facilities. Additionally, crew leaders should know how to deal with the public when approached.

Collection systems field crews influence the public's confidence in the collection system owner or operator. Reviewers should observe whether personnel wear uniforms or not, and if vehicles and equipment are identifiable as utility property and kept in good working order. Vehicles should be equipped with adequate emergency lighting and flashers, traffic control signs and barriers, etc. Before major construction or maintenance work begins, owners or operators should notify homeowners where properties may be affected. Methods of notification may include door hangers, newspaper notices, fliers, signs, or public radio or television announcements. Information should also be provided to residents on cleanup and safety procedures following basement backups and other overflows.

2.1.5 Management Information Systems

The ability of the owner or operator to effectively manage its collection system is directly related to its ability to maintain access to the most current information concerning the facilities. Maintenance of this current information is an effort involving all members of the collection system from the staff answering the telephone to the worker in the street. Operational information informs and clarifies financial information. This will make the financial information more useful for the policy makers, leading to better decisions. A satisfactory management information system should provide the owner or operator with the following advantages:

A growing number of sewer systems have shifted to computer-based collection system management [photo: Milwaukee Metropolitan Sewerage District (MMSD)].

- Maintain preventive maintenance and inspection schedules
- Offer budgetary justification
- Track repairs and work orders
- Organize capital replacement plans
- Manage tools and equipment inventories
- Create purchase orders
- Record customer service inquiries, complaints, or requests
- Provide measurement of effectiveness of program and O&M activities

Owners and operators have been shifting to computer-based systems to manage data. Only the smaller collection system owners or operators may still rely on paper management systems.

Computer-based Maintenance Management Systems (CMMSs) are designed to manage the data needed to track the collection system's O&M performance. Geographic Information Systems (GIS) are used to map and locate facilities and because of computer-based compatibility, can often easily be integrated with a CMMS. The computer-based system however, can only be as accurate as the data used to develop it, which was most likely paper files.

Types of Management Information Tracking

- Customer service
- Safety incident
- Emergency response
- Process change
- Inspection scheduling and tracking
- Monitoring and/or sampling schedules
- Compliance
- Planned maintenance (schedules and work orders)
- Parts inventory

Regardless of the information management style chosen, the collection system should have written instructions regarding the use of the management information systems. These procedures may include operating the system, upgrading the system, accessing data and information, and generating and printing reports. The system should be kept current with accurate information. Work reports from the field crews should be complete, accurate, and legible.

The reviewer may select some number of complaints and see how well they can be tracked through the system to an ultimate conclusion. Work reports generated by the field crew should be randomly chosen and scanned for legibility and completeness. The reviewer should do a random check of the timeliness and accuracy of data entry. Additionally, the reviewer should obtain selected original data sources (such as field reports) and compare them to the appropriate database output to determine how long entry takes. This will provide a check on how current the database is and what data entry backlog exists.

2.1.6 SSO Notification Program

The owner or operator should maintain a written procedure indicating the entities, (e.g., drinking water purveyors, the public, public health officials, and the regulatory authority) that should be notified in the event of an SSO. The procedure should clearly indicate the chain of communication used to notify the proper personnel of an SSO event for reporting and remediation. The procedure should include the names, titles, phone numbers, and responsibility of all personnel involved. The reviewer should verify that the personnel listed in the procedure are still in the position listed and are aware of their responsibilities.

Reviewer - Point to Note
To verify the effectiveness of the notification program, the reviewer should walk an overflow occurrence report through the chain of events that would occur from the time of initial notification.

The procedure may allow for different levels of response for different types of SSOs. For example, the regulatory authority may request that SSOs due to sewer line obstructions be

reported on a monthly basis. Therefore, the procedure may simply be to gather this information from the maintenance information system and have the appropriate personnel put together a reporting form. A chronic SSO at a pump station that discharges when overloaded during wet weather may require a more complex notification procedure, including immediate telephone notification to specified authorities.

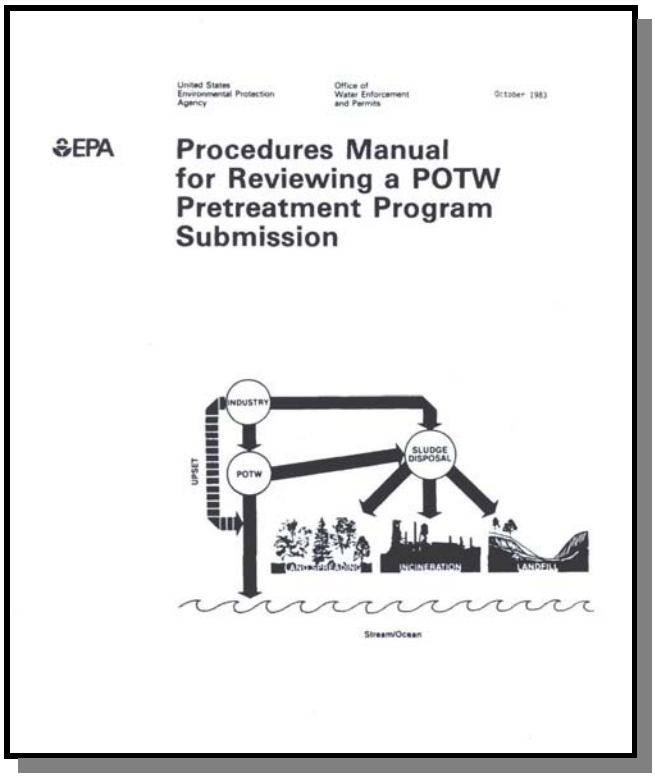
To verify the effectiveness of the notification program, the reviewer should walk an overflow occurrence report through the chain of events that would occur from the time of initial notification. This can be done by choosing several random overflow events from the complaint records and observing whether they are handled as procedures dictate. The minimum information that should be reported for an SSO includes the date, time, location, cause, volume of the overflow (which may be estimated), how it was stopped, and any remediation methods taken. The reviewer should not only verify that the SSO notification procedures are appropriate, but also verify that the owner or operator has reliable methods for the detection of overflows and a phone number or hotline for the public to report observed overflow events.

2.1.7 Legal Authority

The collection system owner or operator should select and enforce the legal authority necessary to regulate the volume of flow entering the collection system, including residential and commercial customers, satellite communities and industrial users. The legal authority may take the form of sewer use ordinances, contracts, service agreements, and other legally binding documents.

A **satellite community** is a collection systems which does not own the treatment facility to which it discharges.

The pretreatment program seeks to prevent the discharge of materials into the sewer system (by non-domestic users) that interfere with proper operation of the wastewater treatment plant or may pass through the plant untreated. At the time the operator of a wastewater treatment plant submits its pretreatment program to the regulatory authority for approval, the plant operator must include a statement from the city solicitor or other legal authority that the plant has the authority to carry out the program [40 CFR 403.9(a)(1)]. The reviewer should verify the existence of this statement and inquire as to whether any significant changes have occurred in the program such that the legal authority may need further review. Additionally, some owners or operators may have a pretreatment program approved by the state, through which discharge permits are issued to industrial users and enforcement is conducted. Further information on legal authority under the pretreatment program may be found in *Procedures Manual for Reviewing a POTW Pretreatment Program Submission* (EPA 1983).


United States Environmental Protection Agency
Office of Water Enforcement and Permits
October 1983

EPA

Procedures Manual for Reviewing a POTW Pretreatment Program Submission

The owner or operator should have the authority to ensure that new and rehabilitated sewers and connections have been properly designed, constructed, and tested before being put into service. This authority could take the form of design and performance specifications in a sewer use ordinance or other legal document such as a statute or series of contracts or joint powers agreements. The ordinance or legal document should contain, at a minimum, general prohibitions, adequate grease control requirements and measures, prohibitions on stormwater inflow, infiltration from laterals, and new construction standards.

The grease control section of the document should contain the requirement to install grease traps at appropriate facilities (e.g., restaurants). Additionally, these facilities should be required to properly maintain the grease traps and pump them out on a regular basis. The document should also address periodic inspections of grease traps by collection system personnel and the ability to enforce (i.e., levy fines on persistent offenders).

General Prohibitions

- Fire and explosion hazards
- Corrosive and obstructive materials
- Material which may cause interference at the wastewater treatment plant
- Heat which may inhibit biological activity at the wastewater treatment plant
- Oils or petroleum products which may cause interference or pass through the wastewater treatment plant

The owner or operator should maintain strict control over the connection of private sewer laterals to sewer mains. These connections have significant potential as sources of infiltration. Standards for new connections should be clearly specified. The sewer use ordinance should contain provisions for inspection, approval of new connections, and a program to implement the requirements. A method to maintain control over existing connections is to require an inspection of the lateral prior to sale of a property. It is important to note that implementing this type of program may require a change to the local ordinance or code.

The owner or operator should also have the legal authority to prohibit stormwater connections to the sanitary sewer. Stormwater connections may include catch basins; roof, cellar and yard drains; sump pumps; direct connections between the storm and sanitary sewers; leaking manhole covers; uncapped cleanouts; and the direct entrance of streams into the collection system. This practice is now discouraged. Direct stormwater connections to a separate sanitary sewer system are known as inflow. Inflow can severely impact the ability of the collection system to transport flows to the treatment plant during wet weather, leading to overflows and noncompliance with the wastewater treatment plant's NPDES permit.

Sources of stormwater in the collection system may include building downspouts connected directly to the system (photo: MMSD).

Satellite communities should not be allowed to contribute excessive flows that cause or contribute to overflows, flooding, or noncompliance at the wastewater treatment plant. Should any of these situations exist, it is not sufficient for the owner or operator to charge the satellite community for the excess flow. The owner or operator must be able to prohibit the contribution of the excess flow. This may be done through a legal inter-jurisdictional agreement between the wastewater treatment plant owner or operator and the satellite community that addresses allowable flows and sets requirements. The reviewer should examine all contracts between systems and their satellites (unless too numerous, then select representative contracts). Contracts should have a date of termination and allow for renewal under renegotiated terms. Contracts should limit flow from satellite communities and limit peak wet weather flow rates.

Owner or Operator - Point to Note
The owner or operator should have a comprehensive program which addresses flows from satellite communities.

2.2 Collection System Operation

Collection systems have little of what is traditionally referred to as "operability" as compared to a wastewater treatment plant (i.e., the number of ways to route the wastewater is typically limited). However, the design of some collection systems does allow flow to be diverted or routed from one pipe to another or even to different treatment plants. This can be accomplished by redirecting flow at a pump station from one discharge point to another or opening and closing valves on gravity sewers and force mains.

Owner or Operator - Point to Note
There should be detailed, written procedures available to guide owners or operators through flow routing activities. Also, there should be operating procedures for mechanical equipment such as pump station pump on/off and service rotation settings or in-line grit removal (grit trap) operations.

There are many reasons why the owner or operator may want to divert flows; among them, to relieve overloading on a system of piping or the wastewater treatment plant or to add more flow to piping serving an area not yet fully developed to maintain a cleansing velocity.

2.2.1 Budgeting

The budget is one of the most important variables in the CMOM program. Although an adequate budget is not a guarantee of a well operated collection system, an inadequate budget will make attaining this goal difficult. Funding can come from a variety of sources, including user fees or appropriations from the state or local government.

Reviewer - Point to Note
Reviewers need to determine the source of the funding for the collection system and who controls it. Reviewers should also request budget documents, summaries, or pie charts to learn more about the systems' budget.

A key element of the operation budget program is the tracking of costs in order to have accurate records each time the annual operating budget is developed. Having an annual baseline provides documentation for future budget considerations and provides justification for future rate increases. Collection system management should be aware of the procedures for calculating user rates and for recommending and making user rate changes.

Collection system and wastewater treatment plant costs may be combined into one budget, or budget line items may be divided into each of two individual budgets. For example, electrical and mechanical maintenance work performed by plant staff on a pump station may be carried as an O&M cost in the treatment plant budget, although pumping stations are generally considered to be a collection system component.

The cost of preventive and corrective maintenance and major collection system repairs and alterations are key items in the annual operating budget. The collection system owner or operator should keep adequate records of all maintenance costs, both in-house and contracted, plus the costs for spare parts. This will assist in the preparation of the following year's budget. In general, there should be an annual (12-month cycle) budget of discretionary and non-discretionary items. There may also be a Capital Improvement Plan (CIP) which may encompass small projects (one to two year cycles) or larger projects (three to five year cycles). Larger projects may include items such as equipment, labor, training, or root cause failure analysis.

Examples of O&M Budget Items

- Labor (usually at least 50% of total budget)
- Utilities
- Capital
- Maintenance materials and supplies
- Chemicals
- Motor vehicles
- Contracted services

The major categories of operating costs are labor, utilities, and supplies. Cost accounting for

these categories should include information on unit costs, total costs, and the amount and/or quantities used. The reviewer should evaluate the current and proposed budget, and current year balance sheets. In examining current and proposed expenditure levels, the reviewer should consider:

- Whether the budgets include contributions to capital reserve (sinking) funds. These funds are savings for replacement of system components once they reach their service life.
- Whether all income from water and sewer billings supports those functions, or if it goes into the general fund.
- Whether raising user fees is a feasible option to meet budget needs based on recent expenditure history.

2.2.2 Monitoring

The collection system owner or operator may be responsible for fulfilling some water quality or other monitoring requirements. Responsibilities may include:

- Monitoring discharges into the collection system from industrial users
- Monitoring to determine the effects of SSOs on receiving waters
- Monitoring required as part of an NPDES permit, a 308 letter, administrative order, or consent decree

The owner or operator should maintain written procedures to ensure that sampling is carried out in a safe, effective, and consistent manner. The procedures should specify, at a minimum the following:

- Sampling location(s)
- Sample volumes, preservatives, and holding times
- Instructions for the operation of any automatic sampling and/or field monitoring (e.g., pH or dissolved oxygen) equipment
- Sampling frequency
- Sampling and analytical methodologies
- Laboratory QA/QC

Records should be maintained of sampling events. These records should at a minimum include the following:

- Date, time, and location of sampling
- Sample parameters
- Date shipped or delivered to the laboratory

2.2.3 Hydrogen Sulfide Monitoring and Control

The collection system owner or operator should have a program under which they monitor areas of the collection system which may be vulnerable to the adverse effects of hydrogen sulfide. It may be possible to perform visual inspections of these areas. The records should note such items as the condition of metal components, the presence of exposed rebar (metal reinforcement in concrete), copper sulfate coating on copper pipes and electrical components, and loss of concrete from the pipe crown or walls.

Areas Subject to Generation of Hydrogen Sulfide:

- Sewers with low velocity conditions and/or long detention times
- Sewers subject to solids deposition
- Pump stations
- Turbulent areas, such as drop manholes or force main discharge points
- Inverted siphon discharges

As mentioned in Section 2.4.2, the collection system owner or operator should be carrying out routine manhole inspections. The hydrogen sulfide readings generated as a result of these inspections should be added to the records of potential areas of corrosion. A quick check of the pH of the pipe crown or structure enables early indication of potential hydrogen sulfide corrosion. A pH of less than four indicates further investigation is warranted. "Coupons" may be installed in structures or pipelines believed to be potentially subject to corrosion. Coupons are small pieces of steel inserted into the area and measured periodically to determine whether corrosion is occurring.

Reviewer - Point to Note
The reviewer should be aware that a system in which infiltration and inflow (I/I) has successfully been reduced may actually face an increased risk of corrosion. The reviewer should pay particular attention to the hydrogen sulfide monitoring program in these systems.

The reduction of flow through the pipes allows room for hydrogen sulfide gases to rise into the airway portion of the sewer pipe and react with the bacteria and moisture on the pipe walls to form sulfuric acid. Sulfuric acid corrodes ferrous metals and concrete.

There are several methods to prevent or control hydrogen sulfide corrosion. The first is proper design. Design considerations are beyond the scope of this manual but may be found in the *Design Manual: Odor and Corrosion Control in Sanitary Sewerage Systems and Treatment Plants* (EPA 1985). The level of dissolved sulfide in the wastewater may also be reduced by chemical or physical means such as aeration, or the addition of chlorine, hydrogen peroxide, potassium permanganate, iron salts, or sodium hydroxide. Whenever chemical control agents are used, the owner or operator should have procedures for their application and maintain records of the dosages of the various chemicals. Alternatively, sewer cleaning to remove deposited solids reduces hydrogen sulfide generation. Also, air relief valves may be installed at the high points of the force main system. The valve allows air to exit thus avoiding air space at the crown of the pipe where acid can form. The reviewer should examine the records to see that these valves are

receiving periodic maintenance.

Collection systems vary widely in their vulnerability to hydrogen sulfide corrosion. Vitrified clay and plastic pipes are very resistant to hydrogen sulfide corrosion while concrete, steel, and iron pipes are more susceptible. The physical aspects of the collection system are also important. Sewage in pipes on a decline that moves the wastewater at a higher velocity will have less hydrogen sulfide than sewage in pipes where the wastewater may experience longer detention times. Therefore, some systems may need a more comprehensive corrosion control program while some might limit observations to vulnerable points.

2.2.4 Safety

The reasons for development of a safety program should be obvious for any collection system owner or operator. The purpose of the program is to define the principles under which the work is to be accomplished, to make the employees aware of safe working procedures, and to establish and enforce specific regulations and procedures. The program should be in writing (e.g., procedures, policies, and training courses) and training should be well documented.

Point to Note
Although a safety program may not be explicitly required under current NPDES regulations, an excessive injury rate among personnel increases the likelihood of collection system noncompliance with other requirements. Furthermore, when good safety practices are not followed, there may be a risk to the public or to collection system workers.

The purpose of safety training is to stress the importance of safety to employees. Safety training can be accomplished through the use of manuals, meetings, posters, and a safety suggestion program. One of the most common reasons for injury and fatalities in wastewater collection systems is the failure of victims to recognize hazards. Safety training cuts across all job descriptions and should emphasize the need to recognize and address hazardous situations. Safety programs should be in place for the following areas:

- Confined spaces
- Chemical handling
- Trenching and excavations
- Material Safety Data Sheets (MSDS)
- Biological hazards in wastewater
- Traffic control and work site safety
- Lockout/Tagout
- Electrical and mechanical safety
- Pneumatic or hydraulic systems safety

The collection system owner or operator should have written procedures which address all of the

above issues and are made available to employees. In addition to training, safety programs should incorporate procedures to enforce the program. For example, this could include periodic tests or "pop" quizzes to monitor performance and/or compliance and follow-up on safety related incidents.

Reviewer - Point to Note
The reviewer should, in the course of interviewing personnel, determine their familiarity with health and safety procedures according to their job description.

The owner or operator should maintain all of the safety equipment necessary for system staff to perform their daily activities and also undertake any emergency repairs. This equipment should include, at minimum:

- Atmospheric gas testing equipment
- Respirators and/or self-contained breathing apparatus
- Full body harness
- Tripods or non-entry rescue equipment
- Hard hats
- Safety glasses
- Rubber boots
- Rubber and/or disposable gloves
- Antibacterial soap
- First aid kit
- Protective clothing
- Confined space ventilation equipment
- Traffic and/or public access control equipment
- Hazardous gas meter

Each field crew vehicle should have adequate health and safety supplies. If the reviewer has access to the municipal vehicle storage area, he or she might choose to check actual vehicle stocks, not just supplies in storage.

2.2.5 Emergency Preparedness and Response

The collection system owner or operator should have a comprehensive plan in place for dealing with both routine and catastrophic emergencies. Routine emergencies include situations such as overflowing manholes, line breaks, localized electrical failure, and power outages at pump stations. Catastrophic emergencies include floods, tornados, earthquakes, other natural events, serious chemical spills, or widespread electrical

SSOs can include overflows out of manholes onto city streets, sidewalks, and surrounding areas (photo: U.S. EPA).

failure. Ideally, this plan is written, reviewed, and adjusted as needed at periodic intervals.

The reviewer should determine if the emergency response plan generally follows the guidelines described below. The location where the plan is housed may vary but, in general, such a document should be available in the yard office or other building commonly accessible to and frequented by collection system personnel. The emergency preparedness and response procedures may be contained in the collection system's O&M manual, or may be reflected in the descriptions of equipment and unit operations. Putting emergency procedures in a stand-alone document, rather than combining it with other information in the O&M manual, makes it easier for collection system personnel to find information.

The plan should utilize the most current information on the collection system. For larger systems, a structured analysis, or *risk assessment*, should be made of the collection system, treatment plant, and the community. The risk assessment should identify areas where the collection system is vulnerable to failure and determine the effect and relative severity to collection systems operations, equipment and public safety, and health of such a failure. The risk assessment should concentrate on such factors as topography, weather, sewer system size, and other site-specific factors which reflect the unique characteristics of the system. Once the areas of vulnerability are known, the collection system owner or operator should have appropriate plans in place to ensure collection system operations continue for the duration of the emergency.

The plans must clearly identify the steps staff should take in the event of emergency situations. Plans should include information on when it is appropriate to initiate and cease emergency operations. The plans should be very specific as to the collection system or repair equipment involved. Instructions should be available which explain how to operate equipment or systems during an emergency event when they are not functioning as intended but are not fully inoperable. The plan should also include specific procedures for reporting events that result in an overflow or other noncompliance event to the appropriate authorities.

The owner or operator should track emergency situations to become better prepared for future emergencies and to assist with reporting and maintaining compliance with emergency-related requirements. Typical components of an emergency program may include:

- General information regarding emergencies, such as telephone numbers of collection system personnel, fire department, and ambulance.
- Identification of hazards (e.g., chlorine storage areas) and use of universal classification system for hazards: combustible material, flammable liquids, energized electrical circuits, and hazardous materials.
- Vulnerability analysis that identifies the various types of emergencies that could occur, such as natural disasters, power outages, or equipment failures.
- Emergency response procedures.
- Methods to reduce risk of emergencies.
- Responsibilities of staff and management.

- 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.

2.2.6 Modeling

Computer programs (modeling programs) are available that are capable of simulating the different flows within the collection system. The purpose of modeling is to determine system capacity requirements with respect to sewer design and structural conditions. Therefore the input of accurate data on sizes, location, elevation, and condition of sewer system components such as pipes, manholes, and pump stations is necessary. When possible, flow monitoring data should be used to calibrate the model.

Reviewer - Point to Note
The reviewer should determine whether a model used by the owner or operator:

- Has user support
- Has adequate documentation such as a user's manual that describes data input requirements, output to be expected, model capabilities and limitations, and hardware

Modeling is also useful in examining effects before and after rehabilitation. For example, models can be applied to "before" and "after" scenarios to estimate the effects of repairs. If a collection system is not experiencing any capacity related issues (i.e., overflows, bypasses, basement backups, street flooding, hydraulic overload at the treatment plant, etc.) then maintenance of a model may be optional for that system, although most medium and large systems should maintain a model of the larger diameter portion of their system. If any of the mentioned conditions are occurring then development and maintenance of a model is essential to performing a capacity assessment in the problem areas.

Computer modeling is a specialized and complex subject. The reviewer may not have a comprehensive knowledge of modeling. If this is the case the he or she should obtain the following basic information:

- Is the owner or operator using a model?
- What areas of the collection system are being modeled and why?
- What model (including the version) is being used? Who developed the model and when?

- How are the modeling results being used?

2.2.7 Mapping

The importance of maintaining accurate, current maps of the collection system cannot be overstated. Efficient collection system maintenance and repairs are unlikely if mapping is not adequate. Collection system maps should clearly indicate the information that personnel need to carry out their assignments. The collection system maps should contain information on the following:

- Main, trunk and interceptor sewers
- Building/house laterals
- Manholes
- Cleanouts
- Force mains
- Pump stations
- Service area boundaries
- Other landmarks (roads, water bodies, etc.)

Collection system maps should have a numbering system which uniquely identifies all manholes and sewer cleanouts. The system should be simple and easy to understand. Manholes and sewer cleanouts should have permanently assigned numbers and never be renumbered. Maps should also indicate the property served and reference its cleanout.

Sewer line maps should indicate the diameter, the length between the centers of manholes, and the slope or direction of flow. The dimensions of easements and property lines should be included on the maps. Other information that should be included on maps are access and overflow points, a scale, and a north arrow. All maps should have the date the map was drafted and the date of the last revision. Although optional, maps often include materials of pipe construction. Maps may come in different sizes and scales to be used for different purposes. Detailed local maps may be used by maintenance or repair crews to perform the duties. However, these detailed local maps should be keyed to one overall map that shows the entire system.

Geographic Information System (GIS) technology have made the mapping and map updating process considerably more efficient. GIS is a computerized mapping program capable of combining mapping with detailed information about the physical

Key Design Characteristics

- Line locations, grades, depths, and capacities
- Maximum manhole spacing and size
- Minimum pipe size
- Pumping Station dimensions and capacities
- Drop manholes
- Flow velocities and calculations (peak flow and low-flow)
- Accessibility features
- Other technical specifications (e.g., materials, equipment)

structures within the collection system. If a GIS program is being used by the owner or operator, the reviewer should ask if the program is capable of accepting information from the owner or operator's management program.

Specific procedures should be established for correction of errors and updating maps and drawings. Field personnel should be properly trained to recognize discrepancies between field conditions and map data and record changes necessary to correct the existing mapping system. Reviewers should check to see that maps and plans are available to the personnel in the office and to field personnel or contractors involved in all engineering endeavors.

2.2.8 New Construction

The owner or operator should maintain strict control over the introduction of flows into the system from new construction. New construction may be public (i.e., an expansion of the collection system) or private (i.e., a developer constructing sewers for a new development). Quality sanitary sewer designs keep costs and problems associated with operations, maintenance, and construction to a minimum. Design flaws are difficult to correct once construction is complete. The reviewer should be aware that this has historically not been adequately addressed in some collection systems. The owner or operator should have standards for new construction, procedures for reviewing designs and protocols for inspection, start-up, testing, and approval of new construction. The procedures should provide documentation of all activities, especially inspection. Reviewers should examine construction inspection records and be able to answer the following:

- Does the volume of records seem reasonable given system size?
- Do records reflect that the public works inspectors are complying with procedures?

The state or other regulatory authority may also maintain standards for new construction. The standards held by the owner or operator should be at least as stringent. Start-up and testing should be in accordance with the manufacturers' recommendation where applicable and with recognized industry practices. Each step of the review, start-up, testing, and approval procedures should be documented.

The owner or operator approval procedure should reflect future ease of maintenance concerns. After construction is complete, a procedure for construction testing and inspection should be used. Construction supervision should be provided by qualified personnel such as a registered professional engineer.

2.2.9 Pump Stations

Proper operation, maintenance, and repair of pump stations typically requires special electrical, hydraulic, and mechanical knowledge. Pump station failure may damage equipment, the environment, or endanger public health. Variation in equipment types, pump station

configuration, and geographical factors determine pump station design and O&M requirements.

The reviewer should verify that the O&M manual contains procedures in writing for the following:

- Are pumps rotated manually or automatically? If manually, how frequently?
- Are wet well operating levels set to limit pump starts and stops?
- Is there a procedure for manipulating pump operations (manually or automatically) during wet weather to increase in-line storage of wet weather flows?
- Is flow monitoring provided? How is the data collected used?
- Does the pump station have capacity-related overflows? Maintenance related overflows? Is overflow monitoring provided?
- Is there a history of power outages? Is there a source of emergency power? If the emergency power source is a generator, is it regularly exercised under load?

2.3 Equipment and Collection System Maintenance

Every collection system owner or operator should have a well-planned, systematic, and comprehensive maintenance program. The goals of a maintenance program should include:

- Prevention of overflows
- Maximization of service and system reliability at minimum cost
- Assurance of infrastructure sustainability (i.e., ensure all components reach their service life)

There should then be procedures which describe the maintenance approach for various systems. In addition, there should be detailed instructions for the maintenance and repair of individual facilities. These instructions should provide a level of detail such that any qualified collection system personnel or repair technician could perform the repair or maintenance activity.

Maintenance may be planned or unplanned. There are essentially two types of planned maintenance; predictive and preventive. Predictive maintenance is a method that tries to look for early warning signs of equipment failure such that emergency maintenance is avoided. Preventive maintenance consists of scheduled maintenance activities performed on a regular basis. There are two types of unplanned maintenance, corrective and emergency. Corrective maintenance consists of scheduled repairs to problems identified under planned or predictive maintenance. Emergency maintenance are activities (typically repairs) performed in response to a serious equipment or line failure where action must be taken immediately. The goal of every owner or operator should be to reduce corrective and emergency maintenance through the use of planned and predictive maintenance. The reviewer should evaluate the progress of the owner or operator in achieving that goal. The goals of the reviewer in assessment of the maintenance program are:

- Identify SSOs caused by inadequate maintenance
- Determine maintenance trends (i.e., frequent emergency maintenance performed as opposed to predictive maintenance)
- Identify sustainability issues (i.e., inadequate maintenance to allow system components to reach service life and/or many components nearing or at service life)

2.3.1 Maintenance Budgeting

The cost of a maintenance program is a significant part of the annual operating budget. The collection system owner or operator should track all maintenance costs incurred throughout the year, both by internal staff and contractors, to ensure that the budget is based on representative costs from past years. Budgets should be developed from past cost records which usually are categorized according to preventive maintenance, corrective maintenance, and projected and actual major repair requirements. Annual costs should be compared to the budget periodically to control maintenance expenditures.

The reviewer should evaluate the maintenance budget keeping in mind the system's characteristics, such as age. Costs for emergency repairs should be a relatively small percentage of the budget; five to ten percent would not be considered excessive. The establishment of an "emergency reserve" may also be included as part of the maintenance budget. This is especially useful where full replacement is not funded. The budget should also be considered in light of maintenance work order backlog. The labor budget should be evaluated for consistency with local pay rates and staffing needs and the reviewer should compare local pay rates and staffing needs according to the tables in Section 2.1.1.

2.3.2 Planned and Unplanned Maintenance

A planned maintenance program is a systematic approach to performing maintenance activities so that equipment failure is avoided. Planned maintenance is composed of predictive and preventive maintenance. In the end, a good planned maintenance program should reduce material and capital repair and replacement costs, improve personnel utilization and morale, reduce SSOs, and sustain public confidence.

Examples of predictive maintenance includes monitoring equipment for early warning signs of impending failure, such as excess vibration, heat, dirty oil, and leakage. Assessment and inspection activities can be classified as predictive maintenance. Vibration and lubrication analyses, thermography, and ultrasonics are among the more common predictive maintenance tools. Predictive maintenance also takes into account historical information about the system as all systems will deteriorate over time. A predictive maintenance program strives to identify potential problem areas and

Reviewer - Point to Note
The reviewer should inquire as to whether tools such as vibration and lubrication analysis, thermography, or ultrasonics are used, and obtain information on the extent of the programs.

uncover trends that could affect equipment performance. Predictive maintenance offers an early warning. It allows collection system personnel to detect early signs of increasing rates of wear and therefore failure, and thus shift a "corrective" task into a "planned" task. To be truly effective predictive, however, maintenance should not spur personnel into doing the work too soon and wasting useful life and value of the equipment in question.

The basis of a good predictive maintenance program is recordkeeping. Only with accurate recordkeeping can baseline conditions be established, problem areas identified, and a proactive approach taken to repairs and replacement.

Effective preventive maintenance minimizes system costs and environmental impacts by reducing breakdowns and thus the need for corrective or emergency maintenance, improves reliability by minimizing the time equipment is out of service, increases the useful life of equipment thus avoiding costly premature replacement, and avoids potential noncompliance situations. An effective preventive maintenance program includes:

- Trained personnel
- Scheduling based on system specific knowledge
- Detailed instructions related to the maintenance of various pieces of equipment
- A system for recordkeeping
- System knowledge in the form of maps, historical knowledge and records

An effective preventive maintenance program builds on the inspection activities and predictive maintenance described in Sections 2.4.1 to 2.4.4, and includes a well thought-out schedule for these activities.

Lubrication

Lubrication is probably one of the most important maintenance activities for mechanical systems, such as pumps and motors. Frequency of lubrication, choice of lubricant and lubrication procedure are all important factors in this activity. These items should closely follow manufacturer instructions, but may be modified to fit site-specific conditions and particular equipment applications.

The basis of the schedule for mechanical equipment maintenance (i.e., pump station components) should be the manufacturers' recommended activities and frequencies. This schedule may then be augmented by the knowledge and experience of collection system personnel to reflect the site-specific requirements. The schedule for sewer line cleaning, inspection, root removal, and repair activities should be based on periodic inspection data. In most systems, uniform frequencies for sewer line cleaning, inspection, and root removal are not necessary and inefficient. In many systems, a relatively small percentage of the pipe generates most of the problems. Efficient use of inspection data allows the owner or operator to implement a schedule in the most constructive manner. In rare cases it may be appropriate to reduce maintenance frequency for a particular piece of equipment. An example of a scheduling code and maintenance schedule for a pump is shown below:

Rotary Pump Maintenance Schedule	
Frequency	**Maintenance Required**
D	Check packing gland assembly
D	Check discharge pressure
S	Inspect and lubricate bearings
A	Flush bearings and replace lubricant

D = Daily A = Annually
S = Semiannually

Typically, there is a maintenance card or record for each piece of equipment within the collection system. These records should contain maintenance recommendations, schedule, and instructions on conducting the specific maintenance activity. The records should include documentation regarding any maintenance activities conducted to date and other observations related to that piece of equipment or system. Maintenance records are generally kept where maintenance personnel have easy access to them. The reviewer should examine the full series of periodic work orders (i.e. weekly, monthly, semiannually, and annually) for a selection of system components (e.g., a few pump stations, several line segments). The reviewer should then compare the recommended maintenance frequency to that which is actually performed. He or she should also look at the backlog of work; not focusing solely on the number of backlogged work orders, but on what that number represents in time. A very large system can have a hundred orders backlogged and only be one week behind. In a computerized system, a listing of all open work orders is usually very simple for collection system personnel to generate. The owner or operator should be able to explain their system for prioritizing work orders.

The reviewer needs to clearly understand the following:

- How the maintenance data management system works
- How work orders are generated and distributed
- How field crews use the work orders
- How data from the field is collected and returned
- How and on whose authority work orders are closed out

The reviewer should check to see if data entry is timely and up to date.

Unplanned maintenance is that which takes place in response to equipment breakdowns or emergencies. Unplanned maintenance may be corrective or emergency maintenance. Corrective maintenance could occur as a result of preventive or predictive maintenance activities which identified a problem situation. A work order should be issued so that the request for corrective maintenance is directed to the proper personnel. An example of non-emergency corrective maintenance could be a broken belt on a belt driven pump. The worn belt was not detected and

replaced through preventive maintenance and therefore the pump is out of service until corrective maintenance can be performed. Although the pump station may function with one pump out of service, should another pump fail, the situation may become critical during peak flow periods.

If the information can be easily generated the reviewer should select a sampling of work orders and compare them to the corrective maintenance database to determine if repairs are being made in a timely manner. Reviewers should note the current backlog of corrective maintenance work orders. A corrective maintenance backlog of two weeks or less would indicate an owner or operator in control of corrective maintenance. The owner or operator should be able to explain corrective maintenance work orders that have not been completed within six months.

Corrective maintenance takes resources away from predictive and preventive maintenance. When corrective maintenance becomes a predominant activity, personnel may not be able to perform planned maintenance, thus leading to more corrective maintenance and emergency situations. Emergency maintenance occurs when a piece of equipment or system fails, creating a threat to public health, the environment, or associated equipment. This type of maintenance involves repairs, on short notice, of malfunctioning equipment or sewers. A broken force main, totally non-functional pump station, and street cave-ins are all examples of emergency situations.

Types of Portable Emergency Equipment

- Bypass pumps
- Portable generator
- Air compressor, trailer-mounted
- Manhole lifters and gas testing equipment
- Sewer rodder and/or flushing machine
- Portable lights and hand tools
- Chemical spray units (for insects and rodent control)
- Truck (1-ton) and trailers
- Vacuum truck
- Repair equipment for excavation (backhoe, shoring equipment, concrete mixers, gasoline operated saws, traffic control equipment, etc.)
- Confined space entry gear

Emergency crews should be geared to a 24-hour-a-day, year-round operation. Most large systems have staffed 24-hour crews; many small systems have an “on-call” system. The owner or operator should be able to produce written procedures which spell out the type of action to take in a particular type of emergency and the equipment and personnel requirements necessary to carry out the action. The crews should have copies of these procedures and be familiar with them. Equipment must be located in an easily accessible area and be ready to move in a short period of time. Vehicles and equipment must be ready to perform, under extreme climatic conditions if necessary. The emergency crew

Reviewer - Point to Note
The reviewer should note the presence of supplies during the review of the yard where equipment and spare parts are maintained and personnel are dispatched.

may need materials such as piping, pipe fittings, bedding materials and concrete. The owner or operator should have supplies on hand to allow for two point (i.e. segment, fitting, or appurtenance) repairs of any part of its system.

Pump stations should be subject to inspection and preventive maintenance on a regular schedule. The frequency of inspection may vary from once a week, for a reliable pump station equipped with a telemetry system, to continuous staffing at a large pump station. The basic inspection should include verification that alarm systems are operating properly, wet well levels are properly set, all indicator lights and voltage readings are within acceptable limits, suction and discharge pressures are within normal limits, that the pumps are running without excessive heat or vibration and have the required amount of lubrication, and that the emergency generator is ready if needed. Less frequent inspections may include such items as vibration analysis and internal inspection of pump components.

Owner or Operator - Point to Note
Occasionally a supervisor should perform an unscheduled inspection to confirm that tasks have been performed as expected.

Observations and tasks performed should be recorded in a log book or on a checklist at the pump station. It is important to note how this data returns to the central maintenance data management system. At the time of the inspection, collection system personnel may perform minor repairs if necessary. If non-emergency repairs are required that are beyond the staff's training, it will probably be necessary to prepare a work order which routs a request though the proper channels to initiate the repair action. During the review the reviewer should check a random number of work orders to see how they move through the system. The reviewer should note whether repairs are being carried out promptly. In pump stations, for critical equipment (pumps, drives, power equipment, and control equipment), there should not be much backlog, unless the staff is waiting for parts.

During the review, the reviewer should also make on-site observations of a representative pump stations. The reviewer should plan at least half an hour to look at the simplest two-pump prefabricated station, and one to two hours to look at a larger station. In large systems, drive time between stations may be significant. The reviewer should strive to see a range of pump station sizes and types (i.e., the largest, smallest, most remote and any that review of work orders has indicated might be problematic).

Overall, the pump station should be clean, in good structural condition and exhibit minimal odor. The reviewer should note the settings of the pumps (i.e., which are operating, which are on stand-by, and which are not operating and why). The operating pumps should be observed for noise, heat, and excessive vibration. The settings in the wet well should be noted (as indicated on the controls, as direct observation of the reviewer in the wet well is not recommended) and the presence of any flashing alarm lights. The reviewer is reminded of the atmospheric hazards in a pump station (make sure ventilation has been running prior to arrival) and to avoid confined

space entry. If the pump station has an overflow its outlet should be observed, if possible, for signs of any recent overflows such as floatable materials or toilet paper. The reviewer should check the log book and/or checklist kept at the pump station to ensure that records are current and all maintenance activities have been performed. Below is a listing of items that indicate inadequate maintenance:

- Overall poor housekeeping and cleanliness
- Excessive grease accumulation in wet well
- Excessive corrosion on railings, ladders, and other metal components
- Sagging, worn, improperly sized, or inadequate belts
- Excessive equipment out of service for repair or any equipment for which repair has not been ordered (i.e., a work order issued)
- Pumps running with excessive heat, vibration, or noise
- Peeling paint and/or dirty equipment (the care given to equipment's outer surfaces often, but not always, mirrors internal condition)
- Check valves not closing when pumps shut off
- Inoperative instrumentation, alarms, and recording equipment
- "Jury-rigged" repairs (i.e., "temporary" repairs using inappropriate materials)
- Leakage from pumps, piping, or valves (some types of pump seals are designed to "leak" seal water)
- Inadequate lighting or ineffective/inoperative ventilation equipment

2.3.3 Sewer Cleaning

The purpose of sewer cleaning is to remove accumulated material from the sewer. Cleaning helps to prevent blockages and is also used to prepare the sewer for inspections. Stoppages in gravity sewers are usually caused by a structural defect, poor design, poor construction, an accumulation of material in the pipe (especially grease), or root intrusion. Protruding traps (lateral sewer connections incorrectly installed so that they protrude into the main sewer) may catch debris which then causes a further buildup of solids that eventually block the sewer. If the flow is less than approximately 1.0 to 1.4 feet per second, grit and solids can accumulate leading to a potential blockage.

Results of Various Flow Velocities

Velocity	Result
2.0 ft/sec	Very little material buildup in pipe
1.4-2.0 ft/sec	Heavier grit (sand and gravel) begin to accumulate
1.0-1.4 ft/sec	Inorganic grit and solids accumulate
Below 1.0 ft/sec	Significant amounts of organic and inorganic solids accumulate

(EPA 1974)

There are three major methods of sewer cleaning: hydraulic, mechanical, and chemical.

Hydraulic cleaning (also referred to as flushing) refers to any application of water to clean the pipe. Mechanical cleaning uses physical devices to scrape, cut, or pull material from the sewer. Chemical cleaning can facilitate the control of odors, grease buildup, root growth, corrosion, and insect and rodent infestation. For additional information on sewer cleaning methods refer to Volumes I and II of *Operation and Maintenance of Wastewater Collection Systems* (CSU Sacramento 1996 and 1998).

Sewer Cleaning Records

- Date, time, and location of stoppage or routine cleaning activity
- Method of cleaning used
- Cause of stoppage
- Identity of cleaning crew
- Further actions necessary and/or initiated
- Weather conditions

The backbone of an effective sewer cleaning program is accurate recordkeeping. Accurate recordkeeping provides the collection system owner or operator with information on the areas of the collection system susceptible to stoppages such that all portions of the system can be on an appropriate schedule. The reviewer should examine the records for legibility and completeness. He or she should then review the database to determine if entry of the field notes is current and accurate.

Root and grease buildup can cause blockages in a sewer system [photo: North Carolina Department of Natural Research (NCDNR)].

Sewers vary widely in their need for preventive cleaning. The collection system in a restaurant district may require cleaning every six months in order to prevent grease blockages. An area of the sewer system with new PVC piping and no significant grease contribution with reasonable and consistent slopes (i.e., no sags) may be able to go five years with no problems.

The owner or operator should be able to identify problem collection system areas, preferably on a map. Potential problem areas identified should include those due to grease or industrial discharges, hydraulic bottlenecks in the collection system, areas of poor design (e.g., insufficiently sloped sewers), areas prone to root intrusion, sags, and displacements. The connection between problem areas in the collection system and the preventive maintenance cleaning schedule should be clear. The owner or operator should also be able to identify the number of stoppages experienced per mile of sewer pipe. If the system is experiencing a steady increase in stoppages, the reviewer should try to determine the cause (i.e., lack of preventive maintenance funding, deterioration of the sewers due to age, an increase in grease producing activities, etc).

2.3.4 Parts and Equipment Inventory

An inventory of spare parts, equipment, and supplies should be maintained by the collection system owner or operator. The inventory should be based on equipment manufacturer's recommendations, supplemented by historical experience with maintenance and equipment problems. Without such an inventory, the collection system may experience long down times or periods of inefficient operation in the event of a breakdown or malfunction.

Files should be maintained on all pieces of equipment and major tools. The owner or operator should have a system to assure that each crew always has adequate tools. Tools should be subject to sign out procedures to provide accountability. Tools and equipment should be replaced at the end of their useful life. The reviewer should inquire as to how this is determined and how funds are made available to ensure this is the case. In addition, the reviewer should look at the tools and note their condition.

Basic Equipment Inventory

- Type, age, and description of the equipment
- Manufacturer
- Fuel type and other special requirements
- Operating costs and repair history

The owner or operator should maintain a yard where equipment, supplies, and spare parts are maintained and personnel are dispatched. Very large systems may maintain more than one yard. In this case, the reviewer should perform a visual survey at the main yard. In small to medium size systems, collection system operations may share the yard with the department of public works, water department, or other municipal agencies. In this case the reviewer should determine what percentage is being allotted for collection system items. The most important features of the yard are convenience and accessibility.

The reviewer should observe a random sampling of inspection and maintenance crew vehicles for equipment as described above. A review of the equipment and manufacturer's manuals aids in determining what spare parts should be maintained. The owner or operator should then consider the frequency of usage of the part, how critical the part is, and finally how difficult the part is to obtain when determining how many of the part to keep in stock. Spare parts should be kept in a clean, well-protected stock room. Critical parts are those which are essential to the operation of the collection system. Similar to equipment and tools management, a tracking system should be in place, including procedures on logging out materials, when maintenance personnel must use them. The owner or operator should be able to produce the spare parts inventory and clearly identify those parts deemed critical. The reviewer should evaluate the inventory and selected items in the stockroom to determine whether the specified number of these parts are being maintained.

Owner or Operator - Point to Note
The owner or operator should have a procedure for determining which spare parts are critical.

2.4 Sewer System Capacity Evaluation - Testing and Inspection

The collection system owner or operator should have a program in place to periodically evaluate the capacity of the sewer system in both wet and dry weather flows and ensure the capacity is maintained as it was designed. The capacity evaluation program builds upon ongoing activities and the everyday preventive maintenance that takes place in a system. The capacity evaluation begins with an inventory and characterization of the system components. The inventory should include the following basic information about the system:

- Population served
- Total system size (feet or miles)
- Inventory of pipe length, size, material and age, and interior and exterior condition as available
- Inventory of appurtenances such as bypasses, siphons, diversions, pump stations, tide or flood gates and manholes, etc., including size or capacity, material and age, and condition as available
- Force main locations, length, size and materials, and condition as available
- Pipe slopes and inverts
- Location of house laterals - both upper and lower

The system then undergoes general inspection (described below in Sections 2.4.1 to 2.4.4) which serves to continuously update and add to the inventory information.

The next step in the capacity evaluation is to identify the location of wet weather related SSOs, surcharged lines, basement backups, and any other areas of known capacity limitations. These areas warrant further investigation in the form of flow and rainfall monitoring and inspection procedures to identify and quantify the problem. The reviewer should determine that the capacity evaluation includes an estimate peak flows experienced in the system, an estimate of the capacity of key system components, and identifies the major sources of I/I that contribute to hydraulic overloading events. The capacity evaluation should also make use of a hydraulic model, if any, to identify areas with hydraulic limitations and evaluate alternatives to alleviate capacity limitations. Short and long term alternatives to address hydraulic deficiencies should be identified, prioritized, and scheduled for implementation.

A sewer inspection is an important part of a sewer system capacity evaluation (photo: N.J. Department of Environmental Protection).

2.4.1 Flow Monitoring

Fundamental information about the collection system is obtained by flow monitoring. Flow monitoring provides information on dry weather flows as well as areas of the collection system potentially affected by I/I. Flow measurement may also be performed for billing purposes, to assess the need for new sewers in a certain area, or to calibrate a model. There are three techniques commonly used for monitoring flow rates: (1) permanent and long-term, (2) temporary, and (3) instantaneous. Permanent installations are done at key points in the collection system such as the discharge point of a satellite collection system, pump stations, and key junctions. Temporary monitoring consists of flow meters typically installed for 30-90 days. Instantaneous flow metering is performed by collection system personnel, one reading is taken and then the measuring device is removed. The collection system owner or operator should have a flow monitoring plan that describes their flow monitoring strategy or should at least be able to provide the following information:

- Purpose of the flow monitoring
- Location of all flow meters
- Type of flow meters
- Flow meter inspection and calibration frequency

A flow monitoring plan should provide for routine inspection, service, and calibration checks (as opposed to actual calibration). In some cases, the data is calibrated rather than the flow meter. Checks should include taking independent water level (and ideally velocity readings), cleaning accumulated debris and silt from the flow meter area, downloading data (sometimes only once per month), and checking the desiccant and battery state. Records of each inspection should be maintained.

Flow measurements performed for the purpose of quantifying I/I are typically separated into three components: base flow, infiltration, and inflow. Base flow is generally taken to mean the wastewater generated without any I/I component. Infiltration is the seepage of groundwater into pipes or manholes through defects such as cracks, broken joints, etc. Inflow is the water which enters the sewer through direct connections such as roof leaders, direct connections from storm drains or yard, area, and foundation drains, the holes in and around the rim of manhole covers, etc. Many collection system owners or operators add a third classification: rainfall induced infiltration (RII). RII is stormwater that enters the collection system through defects that lie so close to the ground surface that they are easily reached. Although not from piped sources, RII tends to act more like inflow than infiltration.

In addition to the use of flow meters, which may be expensive for a small owner or operator, other methods of inspecting flows may be employed such as visually monitoring manholes during low-flow periods to determine areas with excessive I/I. For a very small system, this technique may be an effective and low-cost means of identifying problem areas in the system which require further investigation.

The owner or operator should have in place a program for the efficient identification of excessive I/I. The program should look at the wastewater treatment plant, pump stations, permanent meter flows, and rainfall data to characterize peaking factors for the whole system and major drainage basins. The reviewer should evaluate the program including procedures and records associated with the flow monitoring plan. Temporary meters should be used on a "roving" basis to identify areas with high wet weather flows. Areas with high wet weather flows should then be subject to inspection and rehabilitation activities.

2.4.2 Sewer System Testing

Sewer system testing techniques are often used to identify leaks which allow unwanted infiltration into the sewer system and determine the location of illicit connections and other sources of stormwater inflow. Two commonly implemented techniques include smoke testing and dyed water testing. Regardless of the program(s) implemented by the owner or operator, the reviewer should evaluate any procedures and records that have been established for these programs. The reviewer should also evaluate any public relations program and assess how the owner or operator communicates with the public during these tests (i.e., when there is a possibility of smoke entering a home or building).

Smoke testing is a relatively inexpensive and quick method of detecting sources of inflow in sewer systems, such as down spouts, or driveway and yard drains and works best suited for detecting cross connections and point source inflow leaks. Smoke testing is not typically used on a routine basis, but rather when evidence of excessive I/I already exists. With each end of the sewer of interest plugged, smoke is introduced into the test section, usually via a manhole. Sources of inflow can then be identified when smoke escapes through them.

Areas Usually Smoke Tested

- Drainage paths
- Ponding areas
- Roof leaders
- Cellars
- Yard and area drains
- Fountain drains
- Abandoned building sewers
- Faulty service connections

If the collection system owner or operator implements a regular program of smoke testing, the program should include a public notification procedure. The owner or operator should also have procedures to define:

- How line segments are isolated
- The maximum amount of line to be smoked at one time
- The weather conditions in which smoke testing is conducted (i.e., no rain or snow, little wind and daylight only)

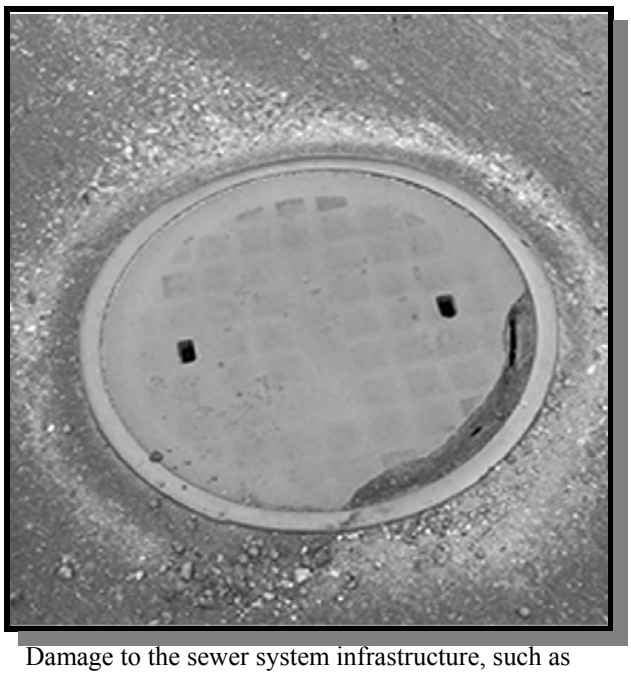
The results of positive smoke tests should be documented with carefully labeled photographs. Building inspections are sometimes conducted as part of a smoke testing program and, in some cases, may be the only way to find illegal connections. If properly connected to the sanitary sewer system, smoke should exit the vent stacks of the surrounding properties. If traces of the

smoke or its odor enter the building, it is an indication that gases from the sewer system may also be entering. Building inspections can be labor intensive and require advanced preparation and communication with the public.

Dyed water testing may be used to establish the connection of a fixture or appurtenance to the sewer. It is often used to confirm smoke testing or to test fixtures that did not smoke. As is the case with smoke testing, it is not used on a routine basis but rather in areas that have displayed high wet weather flows. Dyed water testing can be used to identify structurally damaged manholes that might create potential I/I problems. This is accomplished by flooding the area close to the suspected manholes with dyed water and checking for entry of dyed water at the frame-chimney area, cone/corbel, and walls of the manhole.

2.4.3 Sewer System Inspection

Visual inspection of manholes and pipelines are the first line of defense in the identification of existing or potential problem areas. Visual inspections should take place on both a scheduled basis and as part of any preventive or corrective maintenance activity. Visual inspections provide additional information concerning the accuracy of system mapping, the presence and degree of I/I problems, and the physical state-of-repair of the system. By observing the manhole directly and the incoming and outgoing lines with a mirror, it is possible to determine structural condition, the presence of roots, condition of joints, depth of debris in the line, and depth of flow. The reviewer should examine the records of visual inspections to ensure that the following information is recorded:



Damage to the sewer system infrastructure, such as this broken manhole cover allows stormwater into the sewer system (photo: Limno-Tech, Inc.)

- Manhole identification number and location
- Cracks or breaks in the manhole or pipe (inspection sheets and/or logs should record details on defects)
- Accumulations of grease, debris, or grit
- Wastewater flow characteristics (e.g., flowing freely or backed up)
- Inflow
- Infiltration (presence of clear water in or flowing through the manhole)
- Presence of corrosion
- Offsets or misalignments
- Condition of the frame
- Evidence of surcharge
- Atmospheric hazard measurements (especially hydrogen sulfide)
- If repair is necessary, a notation as to whether a work order has been issued

Manholes should undergo routine inspection typically every one to five years. There should be a baseline for manhole inspections (e.g., once every two years) with problematic manholes being inspected more frequently. The reviewer should conduct visual observation at a small but representative number of manholes for the items listed above.

There are various pipeline inspection techniques, the most common include: lamping, camera inspection, sonar, and CCTV. These will be explained further in the following sections.

2.4.3.1 Sewer System Inspection Techniques

Sewer inspection is an important component of any maintenance program. There are a number of inspection techniques that may be employed to inspect a sewer system. The reviewer should determine if a inspection program includes frequency and schedule of inspections and procedures to record the results. Sewer system cleaning should always be considered before inspection is performed in order to provide adequate clearance and inspection results. Additionally, a reviewer should evaluate records maintained for inspection activities including if information is maintained on standardized logs and should include:

- Location and identification of line being inspected
- Pipe size and type
- Name of personnel performing inspection
- Distance inspected
- Cleanliness of the line
- Condition of the manhole with pipe defects identified by footage from the starting manhole
- Results of inspection, including estimates of I/I

Lamping involves lowering a still camera into a manhole. The camera is lined up with the centerline of the junction of the manhole frame and sewer. A picture is the taken down the pipe with a strobe-like flash. A disadvantage of this technique is that only the first 10-12 feet of the pipe can be inspected upstream and downstream of the access point. Additionally, it has limited use in small diameter sewers. The benefits of this technique include not requiring confined space entry and little equipment and set-up time is required.

Camera inspection is more comprehensive then lamping in that more of the sewer can be viewed. A still camera is mounted on a floatable raft and released into a pipe. The camera takes pictures with a strobe-like flash as it floats through the sewer pipe. This technique is often employed in larger lines where access points are far apart. Similarly to lamping, portions of the pipe may still be missed using this technique. Obviously, there also must be flow in the pipe for the raft to float. This technique also does not fully capture the invert of the pipe and its condition.

Sonar is a newer technology deployed similarly to CCTV cameras, described in more detail below. The sonar emits a pulse which bounces off the walls of the sewer. The time it takes for

this pulse to bounce back provides data providing an image of the interior of the pipe including its structural condition. A benefit of this technique is that it can be used in flooded or inaccessible sections of the sewer. The drawback is that the technique requires heavy and expensive equipment.

Sewer scanner and evaluation is an experimental technology where a 360 degree scanner produces a full digital picture of the interior of the pipe. This technique is similar to sonar in that a more complete image of a pipe can be made than with CCTV, but not all types of sewer defects may be identified as readily (i.e., infiltration, corrosion).

Closed Circuit Television (CCTV) inspections are a helpful tool for early detection of potential problems. This technique involves a closed-circuit camera with a light which is self-propelled or pulled down the pipe. As it moves it records the interior of the pipe. CCTV inspections may be done on a routine basis as part of the preventive maintenance program as well as part of an investigation into the cause of I/I. CCTV, however, eliminates the hazards associated with confined space entry. The output is displayed on a monitor and videotaped. A benefit of CCTV inspection is that a permanent visual record is captured for subsequent reviews.

2.5 Sewer System Rehabilitation

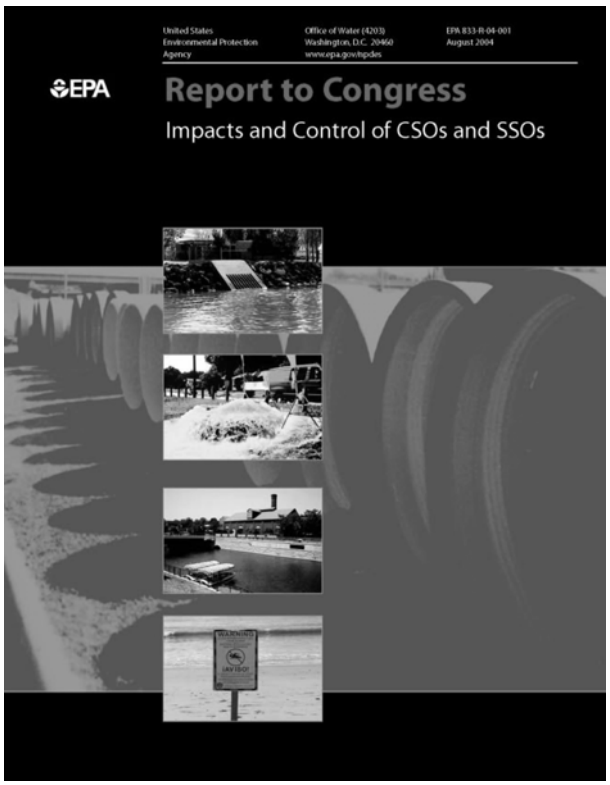
The collection system owner or operator should have a sewer rehabilitation program. The objective of sewer rehabilitation is to maintain the overall viability of a collection system. This is done in three ways: (1) ensuring its structural integrity; (2) limiting the loss of conveyance and wastewater treatment capacity due to excessive I/I; and (3) limiting the potential for groundwater contamination by controlling exfiltration from the pipe network. The rehabilitation program should build on information obtained as a result of all forms of maintenance and observations made as part of the capacity evaluation and asset inventory to assure the continued ability of the system to provide sales and service at the least cost. The reviewer should try to gain a sense of how rehabilitation is prioritorized. Priorities may be stated in the written program or may be determined through interviews with system personnel.

There are many rehabilitation methods. The choice of methods depends on pipe size, type, location, dimensional changes, sewer flow, material deposition, surface conditions, severity of I/I, and other physical factors. Non-structural repairs typically involve the sealing of leaking joints in otherwise sound pipe.

Structural repairs involve either the replacement of all or a portion of a sewer line, or the lining of the sewer. These repairs can be carried out by excavating usually for repairs limited to one or two pipe segments (these are known as point repairs) or by trenchless technologies (in which repair is carried out via existing manholes or a limited number of access excavations).

The rehabilitation program should identify the methods that have been used in the past, their success rating and methods to be used in the future. An reviewer who wants further guidance on methods of rehabilitation may consult:

- Technology Description from 2004 Report to Congress (EPA 2004)
- *Operation and Maintenance of Wastewater Collection Systems,* Volumes I and II (CSU Sacramento 1996 and 1998)
- *Existing Sewer Evaluation and Rehabilitation* (WEF 1994)



The reviewer should determine the owner's or operator's policies regarding service lateral rehabilitation since service laterals can constitute a serious source of I/I. Manholes should not be neglected in the rehabilitation program. Manhole covers can allow significant inflow to enter the system because they are often located in the path of surface runoff. Manholes themselves can also be a significant source of infiltration from cracks in the barrel of the manhole.

The owner or operator should be able to produce documentation on the location and methods used for sewer rehabilitation. The reviewer should compare the rehabilitation accomplished with that recommended by the capacity evaluation program. When examining the collection system rehabilitation program, the reviewer should be able to answer the following questions:

- Is rehabilitation taking place before it becomes emergency maintenance?
- Are recommendations made as a result of the previously described inspections?
- Does the rehabilitation program take into account the age and condition of the sewers?

CHAPTER 3. CHECKLIST FOR CONDUCTING EVALUATIONS OF WASTEWATER COLLECTION SYSTEM CAPACITY, MANAGEMENT, OPERATION, AND MAINTENANCE (CMOM) PROGRAMS

The following is a comprehensive checklist available for use in the review process. The checklist consists of a series of questions organized by major categories and sub-categories. The major category is followed by a brief statement describing the category. Following the sub-category is a brief clarifying statement. References are then given.

Questions are provided in a table format that includes the question, response, and documentation available.

Response is completed by using information and data acquired from the data and information request, onsite interviews, and site reviews. An alternative to this process is to transmit the entire checklist to the collection system owner or operator to complete and return electronically.

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I. General Information - Collection System Description

Question	Response	Documentation Available	
		Yes	No
Size of service area (acres).			
Population of service area.			
Number of pump stations.			
Feet (or miles) of sewer.			
Age of system (e.g., 30% over 30 years, 20% over 50 years, etc.).			

Comments:

II. Continuing Sewer Assessment Plan

Question	Response	Documentation Available	
		Yes	No
Does the collection system experience problems related to I/I? How do these problems manifest themselves? (Manhole overflows, basement flooding, structure, SSOs)			
How does the owner or operator prioritize investigation, repairs and rehabilitation related to I/I?			
What methods are considered to remedy hydraulic deficiencies?			
Does the plan include a schedule for investigative activities?			
Is the plan regularly updated?			

Comments:

III. A. Collection System Management: Organizational Structure

Question	Response	Documentation Available	
		Yes	No
Is an organizational chart available that shows the overall personnel structure for the collection system, including operation and maintenance staff?			
Are there organizational charts that show functional groups and classifications?			
Are up to date job descriptions available that delineate responsibilities and authority for each position?			
Are the following items discussed in the job descriptions: ☐ nature of work to be performed, ☐ minimum requirements for the position, ☐ necessary special qualifications or certifications, ☐ examples of the types of work, ☐ list of licences required for the position, ☐ performance measures or promotional potential?			
Does the organizational chart indicate how many positions are budgeted as opposed to actually filled?			
On average, how long do positions remain vacant?			
Are collection system staff responsible for any other duties, (e.g., road repair or maintenance, O&M of the storm water collection system)?			

Comments:

III. B. Collection System Management: Training

Question	Response	Documentation Available	
		Yes	No
Is there a documented formal training program?			
Does the training program address the fundamental mission, goals, and policies of the collection system owner or operator?			
Does the owner or operator provide training in the following areas: ☐ safety, ☐ routine line maintenance, ☐ confined space entry, ☐ traffic control, ☐ record keeping, ☐ electrical and instrumentation, ☐ pipe repair, ☐ bursting CIPP, ☐ public relations, ☐ SSO/emergency response, ☐ pump station operations and maintenance, ☐ CCTV and trench/shoring, ☐ other?			
Which of these programs have formal curriculums?			
Does On-the-Job (OJT) training use Standard Operating and Standard Maintenance Procedures (SOPs & SMPs)?			
Is OJT progress and performance measured?			
Does the owner or operator have mandatory training requirements identified for key employees?			
What percentage of employees met or exceeded their annual training goals during the past year?			
Which of the following methods are used to assess the effectiveness of the training: ☐ periodic testing, ☐ drills, ☐ demonstration, ☐ none?			
What percentage of the training offered by the owner or operator is in the form of the following: manufacturer training, on-the-job training, in-house classroom training, industry-wide training?			

Comments:

III. C. Collection System Management: Communication and Customer Service

Question	Response	Documentation Available	
		Yes	No
What type of public education/outreach programs does the owner or operator have about user rates?			
Do these programs include communication with groups such as local governments, community groups, the media, schools, youth organizations, senior citizens? List applicable groups.			
Is there a public relations program in place?			
Are the employees of the collection system trained in public relations?			
Are there sample correspondence or "scripts" to help guide staff through written or oral responses to customers?			
What methods are used to notify the public of major construction or maintenance work: ☐ door hangers, ☐ newspaper, ☐ fliers, ☐ signs, ☐ other, ☐ none?			
Is the homeowner notified prior to construction that his/her property may be affected?			
Is information provided to residents on cleanup procedures following basement backups and overflows from manholes when they occur?			
Which of the following methods are used to communicate with system staff: ☐ regular meetings, ☐ bulletin boards, ☐ e-mail, ☐ other?			
How often are staff meetings held (e.g., daily, weekly, monthly)?			
Are incentives offered to employees for performance improvements?			
Does the owner or operator have an "Employee of the Month/Quarter/Year" program?			

Question	Response	Documentation Available	
		Yes	No
How often are performance reviews conducted (e.g., semi-annually, annually, etc.)?			
Does the owner or operator regularly communicate with other municipal departments?			
Does the owner or operator have a formal procedure in place to evaluate and respond to complaints?			
What are the common complaints received?			
Does the owner or operator have a process for customer evaluation of the services provided?			
Do customer service records include the following information: ☐ personnel who received the complaint or request, ☐ nature of complaint or request, ☐ to whom the follow-up action was assigned, ☐ date of the complaint or request, ☐ date the complaint or request was resolved, ☐ customer contact information, ☐ location of the problem, ☐ date the follow-up action was assigned, ☐ cause of the problem, ☐ feedback to customer?			
Does the owner or operator have a goal for how quickly customer complaints (or emergency calls) are resolved?			
What percentage of customer complaints (or emergency calls) are resolved within the timeline goals?			
How are complaint records maintained? (i.e., computerized) Is this information used as the basis for other activities such as routine preventative maintenance?			

Comments:

III. D. Collection System Management: Management Information Systems

Question	Response	Documentation Available	
		Yes	No
What types of work reports are prepared by the O&M Staff?			
Do the work reports include enough information? (See example report forms)			
How are records kept?			
Are records maintained for a period of at least three years?			
Are the records able to distinguish activities taken in response to an overflow event?			
Does the owner or operator use computer technology for its management information system? (Computer Based Maintenance Management Systems, spreadsheets, data bases, SCADA, etc). If so, what type of system(s) is used?			
Are there written instructions for managing and tracking the following information: ☐ complaint work orders, ☐ scheduled work orders, ☐ customer service, ☐ scheduled preventative maintenance, ☐ scheduled inspections, ☐ sewer system inventory, ☐ safety incidents, ☐ scheduled monitoring/sampling, ☐ compliance/overflow tracking, ☐ equipment/tools tracking, ☐ parts inventory?			
Do the written instructions for tracking procedures include the following information: ☐ accessing data and information, ☐ instructions for using the tracking system, ☐ updating the MIS, ☐ developing and printing reports?			
How often is the management information system updated (immediately, within one week of the incident, monthly as time permits)?			

Comments:

III. E. Collection System Management: SSO Notification Program

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator have standard procedures for notifying state agencies, health agencies, the regulatory authority, and the drinking water purveyor of overflow events?			
Are above notification procedures dependent on the size or location of the overflow? If so, describe this procedure.			
Is there a Standard form for recording overflow events? Does it include location, type, receiving water, estimated volume, cause?			
Are chronic SSO locations posted?			

Comments:

III. F. Collection System Management: Legal Authority

Question	Response	Documentation Available	
		Yes	No
Does the collection system receive flow from satellite communities?			
What is the total area from satellite communities that contribute flow to the collection system (acres or square miles)?			
Does the owner or operator require satellite communities to enter into an agreement?			
Does the agreement include the requirements listed in the sewer use ordinance (SUO)?			
Do the agreements have a date of termination and allow for renewal under different terms?			
Does the owner or operator maintain the legal authority to control the maximum flow introduced into the collection system from satellite communities?			
Are standards, inspections, and approval for new connections clearly documented in a SUO?			
Does the SUO require satellite communities to adopt the same industrial and commercial regulator discharge limits as the owner or operator?			
Does the SUO require satellite communities to adopt the same inspection and sampling schedules as required by the pretreatment ordinance?			
Does the SUO require the satellite communities or the owner or operator to issue control permits for significant industrial users?			
Does the SUO contain provisions for addressing overstrength wastewater from satellite communities?			
Does the SUO contain procedures for the following: inspection standards, pretreatment requirements, building/sewer permit issues?			

Does the SUO contain general prohibitions of the following materials: ☐ fire and explosion hazards, ☐ oils or petroleum, ☐ corrosive materials, ☐ materials which may cause interference at the wastewater treatment plant, ☐ obstructive materials?			
Does the SUO contain procedures and enforcement actions for the following: ☐ fats, oils, and grease (FOG); ☐ I/I; building structures over the sewer lines; ☐ storm water connections to sanitary lines; ☐ defects in service laterals located on private property; ☐ sump pumps, air conditioner?			

Comments:

IV. A. Collection System Operation: Budgeting

Question	Response	Documentation Available	
		Yes	No
What are the owner or operator's current rates?			
What is the average annual fee for residential users?			
How are user rates calculated?			
How often are user charges evaluated and adjusted based on that evaluation?			
How many rate changes have there been in the last 10 years and what were they?			
Does the owner or operator receive sufficient funding from its revenues?			
Are collection system enterprise funds used for non-enterprise fund activities?			
Is there a budget for annual operating costs?			
Does the budget provide sufficient line item detail for labor, materials and equipment?			
Are costs for collection system O&M separated from other utility services, i.e., water, storm water and treatment plants?			
Do O&M managers have current O&M budget data?			
What is the collection system's average annual O&M budget?			
What percentage of the collection system's overall budget is allocated to maintenance of the collection system?			
Does the owner or operator have a Capital Improvement Plan (CIP) that provides for system repair/replacement on a prioritized basis?			
What is the collection system's average annual CIP budget?			

Question	Response	Documentation Available	
		Yes	No
What percentage of the maintenance budget is allotted to the following maintenance: Predictive maintenance (tracking design, life span, and scheduled parts replacement), preventative maintenance (identifying and fixing system weakness which, if left unaddressed, could lead to overflows), corrective maintenance (fixing system components that are functioning but not at 100% capacity/efficiency), emergency maintenance (reactive maintenance, overflows, equipment breakdowns).			
Does the owner or operator have a budgeted program for the replacement of under-capacity pipes?			
Does the owner or operator have a budgeted program for the replacement of over-capacity pipes?			
Are O&M staff involved in O&M budget preparation?			
How are priorities determined for budgeting for O&M during the budget process?			
Does the owner or operator maintain a fund for future equipment and infrastructure replacement?			
How is new work typically financed?			

Comments:

IV. B. Collection System Operation: Compliance

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator have inter-jurisdictional or inter-municipal agreements?	Already asked		
Is there a sewer-use and a grease ordinance?			
Is there a process in place for enforcing sewer and grease ordinances?			
Are all grease traps inspected regularly?			
How does the owner or operator learn of new or existing unknown grease traps?			
Who is responsible for enforcing the sewer ordinance and grease ordinance? Does this party communicate with the utility department on a regular basis?			
Are there any significant industrial dischargers to the system?			
Is there a pretreatment program in place? If so, please describe.			
Is there an ordinance dealing with private service laterals?			
Is there an ordinance dealing with storm water connections or requirements to remove storm water connections?			

Comments:

IV. C. Collection System Operation: Water Quality Monitoring

Question	Response	Documentation Available	
		Yes	No
Is there a water quality monitoring program in the service areas?			
If so, who performs the monitoring?			
How many locations are monitored?			
What parameters are monitored and how often?			
Is water quality monitored after an SSO event?			
Are there written standard sampling procedures available?			
Is analysis performed in-house or by a contract laboratory?			
Are chain-of-custody forms used?			

Comments:

IV. D. Collection System Operation: Hydrogen Sulfide Monitoring and Control

Question	Response	Documentation Available	
		Yes	No
Are odors a frequent source of complaints? How many?			
Are the locations of the frequent odor complaints documented?			
What is the typical sewer slope? Does the owner or operator take hydrogen sulfide corrosion into consideration when designing sewers?			
Does the collection system owner or operator have a hydrogen sulfide problem, and if so, does it have in place corrosion control programs? What are the major elements of the program?			
Does the owner or operator have written procedures for the application of chemical dosages?			
Are chemical dosages, dates, and locations documented?			
Does the owner or operator have a program in place for renewing or replacing severely corroded sewer lines to prevent collapse?			
Are the following methods used for hydrogen sulfide control: ☐ aeration, ☐ iron salts, ☐ enzymes, ☐ activated charcoal canisters, ☐ chlorine, ☐ sodium hydroxide, ☐ hydrogen peroxide, ☐ potassium permanganate, ☐ biofiltration, ☐ others?			
Does the system contain air relief valves at the high points of the force main system?			
How often are th valves maintained and inspected (weekly, monthly, etc.)?			
Does the owner or operator enforce pretreatment requirements?			

Comments:

IV. E. Collection System Operation: Safety

Question	Response	Documentation Available	
		Yes	No
Is there a documented safety program supported by the top administration official?			
Is there a Safety Department that provides training, equipment, and an evaluation of procedures?			
If not, who provides safety training?			
Does the owner or operator have written procedures for the following: ☐ lockout/tagout, ☐ MSDS, ☐ chemical handling, ☐ confined spaces permit program, ☐ trenching and excavations, ☐ biological hazards in wastewater, ☐ traffic control and work site safety, ☐ electrical and mechanical systems, ☐ pneumatic and hydraulic systems safety?			
What is the agency's lost-time injury rate(percent or in hours)?			
Is there a permit required confined space entry procedure for manholes, wetwells, etc.? Are confined spaces clearly marked?			
Are the following equipment items available and in adequate supply: ☐ rubber/disposable gloves; ☐ confined space ventilation equipment; ☐ hard hats, ☐ safety glasses, ☐ rubber boots; ☐ antibacterial soap and first aid kit; ☐ tripods or non-entry rescue equipment; ☐ fire extinguishers; ☐ equipment to enter manholes; ☐ portable crane/hoist; ☐ atmospheric testing equipment and gas detectors; ☐ oxygen sensors; ☐ H_2S monitors; ☐ full body harness; ☐ protective clothing; ☐ traffic/public access control equipment; ☐ 5-minute escape breathing devices; ☐ life preservers for lagoons; ☐ safety buoy at activated sludge plants; ☐ fiberglass or wooden ladders for electrical work; ☐ respirators and/or self-contained breathing apparatus; ☐ methane gas or OVA analyzer; ☐ LEL metering?			
Are safety monitors clearly identified?			
How often are safety procedures reviewed and revised?			

Question	Response	Documentation Available	
		Yes	No
Are workplace accidents investigated?			
How does the Administration communicate with field personnel on safety procedures; memo, direct communication, video, etc.?			
Is there a Safety Committee with participation by O&M staff? How often does it meet?			
Is there a formal Safety Training Program? Are records of training maintained?			

Comments:

IV. F. Collection System Operation: Emergency Preparedness and Response

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator have an emergency response plan? A contingency plan?			
How often is the plan reviewed and updated? What was the date it was last updated?			
Does the plan take into consideration vulnerable points in the system, severe natural events, failure of critical system components, vandalism or other third party events, and a root cause analysis protocol?			
Are staff trained and drilled to respond to emergency situations? Are responsibilities detailed for all personnel who respond to emergencies?			
Are there emergency operation procedures for equipment and processes?			
Does the owner or operator have standard procedures for notifying state agencies, local health departments, the regulatory authority, and drinking water authorities of significant overflow events?			
Does the procedure include an up-to-date list of the names, titles, phone numbers, and responsibilities of all personnel involved?			
Do work crews have immediate access to tools and equipment during emergencies?			
Is there a public notification plan? If so, does it cover both regular business hours and off-hours?			
Does the owner or operator have procedures to limit public access to and contact with areas affected with SSOs?			
Does the owner or operator use containment techniques to protect the storm drainage systems?			

Do the overflow records include the following information: ☐ date and time, ☐ cause(s), ☐ names of affected receiving water(s), ☐ location, ☐ how it was stopped, ☐ any remediation efforts, ☐ estimated flow/volume discharged, ☐ duration of overflow?			
Does the owner or operator have signage to keep public from affected area?			
Is there a hazard classification system? Where is it located?			
Does the owner or operator conduct vulnerability analyses?			
Are risk assessments performed? How often?			

Comments:

IV. G. Collection System Operation: Modeling

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator have a hydraulic model of the collection system including pump stations? What model is used?			
What uses does the model serve (predicting flow capacity, peak flows, force main pressures, etc.)?			
Does the model produce results consistent with observed conditions?			
Is the model kept up to date with respect to new construction and repairs that may affect hydraulic capacity?			

Comments:

IV. H. Collection System Operation: Engineering - System Mapping and As-built Plans (Record Drawings)

Question	Response	Documentation Available	
		Yes	No
What type of mapping/inventory system is used?			
Is the mapping tied to a GPS system?			
Are "as-built" plans (record drawings) or maps available for use by field crews in the office and in the field?			
Do field crews record changes or inaccuracies and is there a process in place to update "as built" plans (record drawings)?			
Do the maps show the date the map was drafted and the date of the last revision?			
Do the sewer line maps include the following: ☐ scale; ☐ north arrow; ☐ date the map was drafted; ☐ date of the last revision; ☐ service area boundaries; ☐ property lines; ☐ other landmarks; ☐ manhole and other access points; ☐ location of building laterals; ☐ street names; ☐ SSOs/CSOs; ☐ flow monitors; ☐ force mains; ☐ pump stations; ☐ lined sewers; ☐ main, trunk, and interceptor sewers; ☐ easement lines and dimensions; ☐ pipe material; ☐ pipe diameter; ☐ pipe diameter; ☐ installation date; ☐ slope; ☐ manhole rim elevation; ☐ manhole coordinates; ☐ manhole invert elevation; ☐ distance between manholes?			
Are the following sewer attributes recorded: ☐ size, ☐ shape, ☐ invert elevation, ☐ material, ☐ separate/combined sewer, ☐ installation date?			
Are the following manhole attributes recorded: ☐ shape, ☐ type, ☐ depth, ☐ age, ☐ material?			
Is there a systematic numbering and identification method/system established to identify sewer system manhole, sewer lines, and other items (pump stations, etc.)?			

Comments:

IV. I. Collection System Operation: Engineering - Design

Question	Response	Documentation Available	
		Yes	No
Is there a document which details design criteria and standard construction details?			
Is life cycle cost analysis performed as part of the design process?			
Is there a document that describes the procedures that the owner or operator follows in conducting design review? Are there any standard forms that are used as a guide?			
Are O&M staff involved in the design review process?			
Does the owner or operator have documentation on private service lateral design and inspection standards?			
Does the owner or operator attempt to standardize equipment and sewer system components?			

Comments:

IV. J. Collection System Operation: Engineering - Capacity

Question	Response	Documentation Available	
		Yes	No
What procedures are used in determining whether the capacity of existing gravity sewer system, pump stations and force mains are adequate for new connections?			
Is any metering of flow performed prior to allowing new connections?			
Is there a hydraulic model of the system used to predict the effects of new connections?			
Is there any certification as to the adequacy of the sewer system to carry additional flow from new connections required?			

Comments:

IV. K. Collection System Operation: Engineering - Construction

Question	Response	Documentation Available	
		Yes	No
Who constructs new sewers? If other than the owner or operator, does the owner or operator review and approve the design?			
Is there a document that describes the procedures that the owner or operator follows in conducting their construction inspection and testing program?			
Are there any standard forms that guide the owner or operator in conducting their construction inspection and testing program?			
Is new construction inspected by the owner or operator or others?			
What are the qualifications of the inspector(s)?			
What percentage of time is a construction inspector on site?			
Is inspection supervision provided by a registered professional engineer?			
How is the new gravity sewer construction tested? (Air, water, weirs, etc.)			
Are new manholes tested for inflow and infiltration?			
Are new gravity sewers televised?			
What tests are performed on pump stations?			
What tests are performed on force mains?			
Is new construction built to standard specifications established by the owner or operator and/or the State?			
Is there a warranty for new construction? If so, is there a warranty inspection done at the end of this period?			

Comments:

IV. L. Collection System Operation: Pump Station Operation

Question	Response	Documentation Available	
		Yes	No
How many pump stations are in the system? How many have backup power sources?			
Are enough trained personnel assigned to properly maintain pump stations?			
Are these personnel assigned full-time or part-time to pump station duties?			
Are there manned and un-manned pump stations in the system? How many of each?			
Is there a procedure for manipulating pump operations (manually or automatically during wet weather to increase in-line storage of wet weather flows?			
Are well-operating levels set to limit pump start/stops?			
Are the lead, lag, and backup pumps rotated regularly?			

Comments:

IV. L. 1. Collection System Operation: Pump Stations - Inspection

Question	Response	Documentation Available	
		Yes	No
How often are pump stations inspected?			
What work is accomplished during inspections?			
Is there a checklist?			
Are records maintained for each inspection?			
What are the average annual labor hours spent on pump station inspections?			
Are there Standard Operating Procedures (SOPs) and Standard Maintenance Procedures (SMPs) for each station?			
What are the critical operating characteristics maintained for each station? Are the stations maintained within these criteria?			

Comments:

IV. L. 2. Collection System Operation: Pump Stations - Emergencies

Question	Response	Documentation Available	
		Yes	No
Is there an Emergency Operating Procedure for each pump station?			
Is there sufficient redundancy of equipment in all pump stations?			
Who responds to lift station failures and overflows? How are they notified?			
How is loss of power at a station dealt with? (i.e. on-site electrical generators, alternate power source, portable electric generator(s))			
What equipment is available for pump station bypass?			
What process is used to investigate the cause of pump station failure and take necessary action to prevent future failures?			

Comments:

IV. L. 3. Collection System Operation: Pump Stations - Emergency Response and Monitoring

Question	Response	Documentation Available	
		Yes	No
How are lift stations monitored?			
If a SCADA system is used, what parameters are monitored?			

Comments:

IV. L. 4. Collection System Operation: Pump Stations - Recordkeeping

Question	Response	Documentation Available	
		Yes	No
Are operations logs maintained for all pump stations?			
Are manufacturer's specifications and equipment manuals available for all equipment?			
Are pump run times maintained for all pumps?			
Are elapsed time meters used to assess performance?			

Comments:

IV. L. 5. Collection System Operation: Pump Stations - Force Mains and Air/Vacuum Valves

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator regularly inspect the route of force mains?			
Does the owner or operator have a program to regularly assess force main condition?			
Is there a process in place to investigate the cause of force main failures?			
Does the owner or operator have a regular maintenance/inspection program for air/vacuum valves?			
Have force main failures been caused by water hammer?			

Comments:

V. A. Equipment and Collection System Maintenance: Maintenance Budgeting

Question	Response	Documentation Available	
		Yes	No
How does the collection system owner or operator track yearly maintenance costs?			
Is there a maintenance cost control system?			
Are maintenance costs developed from past cost records?			
How does the owner or operator categorize costs? Preventive? Corrective? Projected Costs? Projected Repair?			
How does the owner or operator control expenditures?			

Comments:

V. B. Equipment and Collection System Maintenance: Planned Maintenance

Question	Response	Documentation Available	
		Yes	No
Are preventive maintenance tasks and frequencies established for all pump stations and equipment?			
How were preventive maintenance frequencies established?			
What percentage of the operator's time is devoted to planned as opposed to unplanned maintenance?			
What predictive maintenance techniques are used as part of PM program?			
Is there a formal procedure to repair or replace pump stations and equipment when useful life is reached?			
Has an energy audit been performed on pump station electrical usage?			
Is an adequate parts inventory maintained for all equipment?			
Is there a sufficient number of trained personnel to properly maintain all stations?			
Who performs mechanical and electrical maintenance?			
Are there Standard Maintenance Procedures (SMPs) for each station?			

Comments:

V. C. Equipment and Collection System Maintenance: Maintenance Scheduling

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator plan and schedule preventive and corrective maintenance activities?			
Is there an established priority system? Who sets priorities for maintenance?			
Is a maintenance card or record kept for each piece of mechanical equipment within the collection system?			
Do equipment maintenance records include the following information: ☐ maintenance recommendations, ☐ instructions on conducting the specific maintenance activity, ☐ other observations on the equipment, ☐ maintenance schedule, ☐ a record of maintenance on the equipment to date.			
Are dated tags used to show out-of-service equipment?			
Is maintenance backlog tracked?			
How is O&M performance tracked and measured?			
What percent of repair finds are spent on emergency repairs?			
Are corrective repair work orders backlogged more than six months?			
Is maintenance performed for other public works divisions?			
How are priorities determined for this work?			
How is this work funded?			
Are maintenance logs maintained for all pump stations?			

Comments:

V. D. Equipment and Collection System Maintenance: Maintenance Right-of-Way

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator perform scheduled maintenance on Rights-of-Way and Easements?			
Does the owner or operator monitor street paving projects?			
Does the owner or operator have a program to locate and raise manholes (air valves, etc) as needed?			
How are priorities determined?			
How is the effectiveness of the maintenance schedule measured?			

Comments:

V. E. Equipment and Collection System Maintenance: Sewer Cleaning

Question	Response	Documentation Available	
		Yes	No
Is there a routine schedule for cleaning sewer lines on a system wide basis, *e.g.*, at the rate of once every seven to twelve years or a rate of between 8% and 14% per year?			
What is the owner or operator's goals for annual system cleaning?			
What percent of the sewer lines are cleaned, even high/repeat cleaning trouble spots, during the past year?			
Is there a program to identify sewer line segments that have chronic problems and should be cleaned on a more frequent schedule?			
What is the average number of stoppages experienced per mile of sewer pipe per year?			
Has the number of stoppages increased, decreased, or stayed the same over the past five years?			
Are stoppages diagnosed to determine the cause?			
Are stoppages plotted on maps and correlated with other data such as pipe size and material, or location?			
Do the sewer cleaning records include the following information: ☐ date and time, ☐ cause of stoppage, ☐ method of cleaning, location of stoppage or routine cleaning activity, ☐ identity of cleaning crew, ☐ further actions necessary/initiated?			
If sewer cleaning is done by a contractor are videos taken of before and after cleaning?			

Comments:

V. E. 1. Equipment and Collection System Maintenance: Sewer Cleaning - Cleaning Equipment

Question	Response	Documentation Available	
		Yes	No
What type of cleaning equipment does the owner or operator use?			
How many cleaning units of each type does the owner or operator have? What is the age of each?			
How many cleaning crews and shifts does the owner or operator employ?			
How many cleaning crews are dedicated to preventive maintenance cleaning?			
How many cleaning crews are dedicated to corrective maintenance cleaning?			
What has the owner or operator's experience been regarding pipe damage caused by mechanical equipment?			
Where is the equipment stationed?			

Comments:

V. E. 2. Equipment and Collection System Maintenance: Sewer Cleaning - Chemical Cleaning and Root Removal

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator have a root control program?			
Does the owner or operator have a FOG program?			
Are chemical cleaners used?			
What types of chemical cleaners are used?			
How often are they applied?			
How are the chemical cleaners applied?			
What results are achieved through the use of chemical cleaners?			

Comments:

V. F. Equipment and Collection System Maintenance: Parts Inventory

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator have a central location for the storage of spare parts?			
Have critical spare parts been identified?			
Are adequate supplies on hand to allow for two point repairs in any part if the system?			
Is there a parts standardization policy in place?			
Does the owner or operator maintain a stock of spare parts on its maintenance vehicles?			
What method(s) does the owner or operator employ to keep track of the location, usage, and ordering of spare parts? Are parts logged out when taken by maintenance personnel for use?			
Does the owner or operator salvage specific equipment parts when equipment is placed out-of-service and not replaced?			
How often does the owner or operator conduct a check of the inventory of parts to ensure that their tracking system is working?			
Who has the responsibility of tracking the inventory?			
For those parts which are not kept in inventory, does the owner or operator have a readily available source or supplier?			

Comments:

V. G. Equipment and Collection System Maintenance: Equipment and Tools Management

Question	Response	Documentation Available	
		Yes	No
Is there a list of equipment and tools used for operation and maintenance?			
Do personnel feel they have access to the necessary equipment and tools to do all aspects of operation and maintenance of the collection system?			
Is there access to suitable equipment if the owner or operator's equipment is down for repair?			
Does the owner or operator own or have access to portable generators?			
Where does the owner or operator store its equipment?			
Is a detailed equipment maintenance log kept?			
Are written equipment maintenance procedures available?			
What is the procedure for equipment replacement?			
Are the services of an in-house vehicle and equipment maintenance services used?			
What is the typical turnaround time for equipment and vehicle maintenance?			

Comments:

VI. Management Information Systems: Performance Indicators

Question	Response	Documentation Available	
		Yes	No
How many sanitary sewer overflows (SSOs) have occurred in the last 5 years? How many less than 1,000 gallons?			
Does the owner or operator document and report all SSOs regardless of size?			
Does the owner or operator document basement backups?			
Are there areas that experience basement or street flooding?			
How many SSOs have reached "Waters of the US"? Is there a record?			
Approximately, what percent of SSOs discharge were from each of the following in the last 5 years: manholes, pump stations, main and trunk sewers, lateral and branch sewers, structural bypasses?			
What is the per capita wastewater flow for the maximum month and maximum week or day?			
What is average annual influent BOD?			
What is the ratio of maximum wet weather flow to average dry weather flow?			
Approximately, what percent of SSO discharge were caused by the following in the last 5 years: debris buildup, collapsed pipe, root intrusion, capacity limitations, excessive infiltration and inflow, FOG, vandalism?			
What percent of SSOs were released to: soil; surface water; basements; paved areas; coastal, ocean, or beach areas; rivers, lakes or streams?			
For surface water releases, what percent are to surface waters that could affect: contact recreation, shellfish growing areas, drinking water sources?			
How many chronic SSO locations are in the collection system?			

Are pipes with chronic SSOs being monitored for sufficient capacity and/or structural condition?			
Prior to collapse, are structurally deteriorating pipelines being monitored for renewal or replacement?			
What is the annual number of mainline sewer cave-ins? What was the cause (i.e. pipe corrosion, leaks, etc.)			
What other types of performance indicators does the owner or operator use?			

Comments:

VII. A. Sewer System Capacity Evaluation (SSES): Internal TV Inspection

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator use internal T.V. inspection? If so please describe the program.			
Do the internal TV record logs include the following: ☐ pipe size, type, length, and joint spacing; ☐ distance recorded by internal TV; ☐ results of the internal TV inspection; ☐ internal TV operator name; ☐ cleanliness of the line; ☐ location and identification of line being televised by manholes?			
Is a rating system used to determine the severity of the defects found during the inspection process?			
Is there documentation explaining the codes used for internal TV results reporting?			
Approximately what percent of the total defects determined by TV inspection during the past 5 years were the following:			
Are main line and lateral repairs checked by internal TV inspection after the repair(s) have been made?			

Comments:

VII. B. SSES: Survey and Rehabilitation (general)

Question	Response	Documentation Available	
		Yes	No
Have SSES's been performed in the past? If so, is documentation available?			
Has any sewer rehabilitation work been done in the past 15 years? If so, please describe?			
Does the owner or operator have standard procedures for performing SSES work?			
Do the SSES reports include recommendations for rehabilitation, replacement, and repair?			
Were defects identified in the SSES repaired?			
Does the owner or operator have a multi-year Capital Improvements Program that includes rehabilitation, replacement, and repair?			
How are priorities established for rehabilitation, replacement, and repair?			
Has the owner or operator established schedules for performing recommended rehabilitation, both short term and long term?			
Has funding been approved for the recommended rehabilitation?			
Is post rehabilitation flow monitoring used to assess the success of the rehabilitation?			

Comments:

VII. C. SSES: Sewer Cleaning Related to I/I Reduction

Question	Response	Documentation Available	
		Yes	No
Are sewers cleaned prior to flow monitoring?			
Are sewers cleaned prior to internal T.V. inspection?			
When cleaning, is debris removed from the system?			

Comments:

VII. D. SSES: Flow Monitoring

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator have a flow monitoring program? If so, please describe.			
Does the owner or operator have a comprehensive capacity assessment and planning program?			
Are flows measured prior to allowing new connections?			
Number of permanent meters? Number of temporary meters?			
What type(s) of meters are used?			
Number of rain gauges?			
How frequently are flow meters checked?			
Do the flow meter checks include: ☐ independent water level, ☐ checking the desiccant, ☐ velocity reading, ☐ cleaning away debris, ☐ downloading data, ☐ battery condition?			
Are records maintained for each inspection?			
Do the flow monitoring records include: ☐ descriptive location of flow meter, ☐ type of flow meter, ☐ frequency of flow meter inspection, ☐ frequency of flow meter calibration?			
Are flow data used for billing, capacity analysis, and/or I/I investigations?			
What is the ratio of peak wet weather flow to average dry weather flow at the wastewater treatment plant?			
Does the owner or operator have any wet weather capacity problems?			
Are low points or flood-plain areas monitored during rain events?			
Does the owner or operator have any dry weather capacity problems?			

VII. E. SSES: Smoke Testing and Dyed Water Flooding

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator have a smoke testing program to identify sources of inflow and infiltration into the system including private service laterals and illegal connections? If so please describe.			
Are there written procedures for the frequency and schedule of smoke testing?			
Is there a documented procedure for isolating line segments?			
Is there a documented procedure for notifying local residents that smoke testing will be conducted in the area?			
What is the guideline for the maximum amount of line to be tested at one time?			
Are there guidelines for the weather conditions under which smoke testing should be conducted?			
Do the written records contain location, address, and description of the smoking element that produced a positive result?			
What follow-up occurs as a result of positive results for smoke or dye testing?			
Is there a goal for the percent of the system smoke tested each year?			
What percent of the system has been smoke tested over the past year?			
Does the owner or operator have a dyed water flooding program If so please describe.			
Is there a goal for the percent of the system dye tested each year?			
What percent of the system has been dye tested over the past year?			
Does the owner or operator share smoke and dye testing equipment with another owner or operator?			

Comments:

VII. F. SSES: Manhole Inspection

Question	Response	Documentation Available	
		Yes	No
Does the owner or operator have a routine manhole inspection and assessment program?			
What is the purpose of the inspection program?			
Does the owner or operator have a goal for the number of manholes inspected annually?			
How many manholes were inspected during the past year?			
Do the records for manhole/pipe inspection include the following: ☐ conditions of the frame and cover; ☐ evidence of surcharge; offsets or misalignments; ☐ atmospheric hazards measurements; ☐ details on the root cause of cracks or breaks in the manhole or pope including blockages; ☐ recording conditions of corbel, walls, bench, trough, and pipe seals; ☐ presence of corrosion, if repair is necessary; ☐ manhole identifying number/location; wastewater flow characteristics; ☐ accumulations of grease, debris, or grit; ☐ presence of infiltration, location, and estimated quantity; ☐ inflow from manhole covers?			
Are manholes susceptible to inflow identified and inspected on a regular frequency?			
Is there a data management system for tracking manhole inspection activities?			
What triggers whether a manhole needs rehabilitation?			
Does the owner or operator have a multi-year Capital Improvements Program that includes rehabilitation, replacement, and repair of manholes?			
How are priorities established for rehabilitation, replacement, and repair of manholes?			
Has the owner or operator established schedules for performing rehabilitation, both short term and long term of manholes?			

Question	Response	Documentation Available	
		Yes	No
Has funding been approved for the rehabilitation of manholes?			
Does the owner or operator have a grouting program?			

Comments:

VIII. A. Rehabilitation: Manhole Repairs

Question	Response	Documentation Available	
		Yes	No
What rehabilitation techniques are used for manhole repairs?			
How are priorities determined for manhole repairs?			
What type of documentation is kept?			
Does the owner or operator use manhole inserts?			
Are they used system wide or only on low lying manholes?			

Comments:

VIII. B. Rehabilitation: Mainline Sewers

Question	Response	Documentation Available	
		Yes	No
What type of main line repairs has the owner or operator used in the past?			
Does the owner or operator currently use any of above techniques for main line repairs? What other techniques is the owner or operator presently using?			
How are priorities established for main line repairs?			
What type of follow-up is performed after the repair (e.g., CCTV)?			

Comments:

Appendix A

EXAMPLE
COLLECTION SYSTEM PERFORMANCE
INDICATOR DATA
COLLECTION FORM

EXAMPLE
COLLECTION SYSTEM PERFORMANCE INDICATOR DATA COLLECTION FORM

I. General Information

A. Agency Name _____

B. Agency Address

Street _____

City _____ State _____ Zip _____

C. Contact Person _____

D. Telephone: Voice _____ Fax _____ Email _____

E. Data provided for latest fiscal/calendar year, 20___

II. Collection System Description

A. Service Area _____ Square miles

B. Population Served _____

C. System Inventory

Miles of gravity sewer	Miles of force main	Number of maintenance access structures	Number of pump stations	Number of siphons	Number of air, vacuum, or air/vacuum relief valves

D. Number of Service Connections:

Residential _____ Commercial _____ Industrial _____ Total _____

E. Lateral Responsibility (check one)

1. At main line connection only _____
2. From main line to property line or easement/cleanout _____
3. Beyond property line/cleanout _____
4. Other _____

F. System combined (storm and sanitary)? Yes ___ No ___ If yes, % combined ____

G. Average Annual Precipitation _____ inches

H. System Flow Characteristics (total for service area)

Peak Dry Weather Flow (MGD)	Peak Wet Weather Flow (MGD)	Average Daily Flow (MGD)

III. Special Conditions

A. Indicate local conditions that are accounted for during design, construction, operation, and maintenance of the collection system.

1. Precipitation: Yes ____ No _____ If yes, provide brief explanation _____ _____ _____

2. Terrain: Yes ____ No _____ If yes, provide brief explanation_____ _____

3. Soils: Yes ____ No _____ If yes, provide brief explanation _____ _____

4. Temperature: Yes ____ No _____ If yes, provide brief explanation _____ _____

5. Groundwater: Yes _____ No _____ If yes, provide brief explanation _____ _____

6. Geology: Yes ____ No _____ If yes, provide brief explanation _____ _____

7. Other: _____ _____

B. Is corrosion a significant problem? Yes ____ No ____
   - Is there a corrosion control program in place? Yes ____ No ____

C. Is odor a significant problem? Yes ____ No ____
   - Is there an odor control program in place? Yes ____ No ____

D. Is grease a significant problem? Yes ____ No ____
   - Is there a grease control program in place? Yes ____ No ____

E. Are roots a significant problem? Yes ____ No ____
   - Is there a root control program in place? Yes ____ No ____

IV. Age Distribution of Collection System

Age	Gravity Sewer, miles	Force Mains, miles or feet	Number of Pump Stations
0 - 25 years			
26 - 50 years			
51 - 75 years			
> 76 years			

V. Size Distribution of Collection System

Diameter in inches	Gravity Sewer, miles	Force Mains, miles or feet
8 inches or less		
9 - 18 inches		
19 - 36 inches		
> 36 inches		

VI. Distribution of Gravity Sewer By Material

A. Vitrified Clay Pipe (VCP) _____ Miles
B. Reinforced Concrete Pipe (RCP) _____ Miles
C. Unreinforced Concrete Pipe (CP) _____ Miles
D. Plastic (all types) _____ Miles
E. Brick _____ Miles
F. Other _____ Miles
G. Other _____ Miles
H. Other _____ Miles

VII. Distribution of Force Mains By Material

(circle one)

A. Reinforced Concrete Pipe (RCP) _____ miles or feet
B. Prestressed Concrete Cylinder Pipe (PCCP) _____ miles or feet
C. Asbestos Cement Pipe (ACP) _____ miles or feet
D. Polyvinyl Chloride (PVC) _____ miles or feet
E. Steel _____ miles or feet
F. Ductile Iron _____ miles or feet
G. Cast Iron _____ miles or feet
H. Techite (RPMP) _____ miles or feet
I. High Density Polyethylene (HDPE) _____ miles or feet
J. Fiberglass Reinforced Plastic (FRP) _____ miles or feet
K. Other _____ miles or feet

VIII. Preventive Maintenance of System

A. Physical Inspection of Collection System, Preventive Maintenance

Inspection Activity	Total Annual Labor Hours Expended for This Activity	Total Completed (Miles of Pipe or Manholes Inspected Annually)	Crew Size (s)
CCTV			
Visual Manhole Inspection, Surface Only			
Visual Manhole Inspection, Remove Cover			
Visual Gravity Line Inspection, Surface Only			
Visual Force Main Inspection, Surface Only			
Other (Sonar, etc.)			

B. Mechanical and Hydraulic Cleaning, Preventive Maintenance

Cleaning Activity	Total Annual Labor Hours Expended for This Activity	Total Annual Labor Hours Expended for Scheduled PM	Total Miles Cleaned Annually	Crew Size (s)	Range of Pipe Diameters Cleaned
Hydraulic Jet					
Bails, Kites, Scooters					
Combination Machines					
Rod Machines					
Hand Rodding					
Bucket Machines					
Chemical Root Control					
Chemical or Biological Grease Control					

IX. Dry Weather Stoppages

A. Number of stoppages, annually _____
B. Average time to clear stoppage _____
C. Number of stoppages resulting in overflows and/or backups annually _____
D. Total quantity of overflow(s) _____
E. Is there an established procedure for problem diagnosis? Yes ____ No ____
F. Are future preventive measures initiated based on diagnosis? Yes ____ No ____
G. What equipment is available for emergency response? _____

X. Repairs and Rehabilitation, Proactive

A. Number of annual spot repairs identified _____
B. Number of annual spot repairs completed _____
C. Percent of spot repairs contracted _____
D. Number of manholes identified for rehabilitation _____
E. Number of manholes rehabilitated annually _____
F. Percent of manhole repairs contracted _____
G. Feet of main line needing rehabilitation _____
H. Feet of main line rehabilitated _____
I. Percent of main line rehabilitation contracted _____
J. Number of manholes scheduled for rehabilitation under Capital Improvement Program (s) _____
K. Feet of main line scheduled for rehabilitation under Capital Improvement Program (s) _____

XI. Repairs and Rehabilitation, Reactive

A. Number of annual line features _____
B. Number of line repairs _____

XII. Pump Stations

A. Number of pump stations inspected _____
- Frequency of inspections _____ (daily, every other day, weekly)

B. Number of inpsection crews _____
C. Crew size _____
D. Number of pump stations with pump capacity redundancy _____
E. Number of pump stations with backup power sources _____
F. Number of pump stations with dry weather capacity limitations _____
G. Number of pump stations with wet weather capacity limitations _____
H. Number of pump stations calibrated annually _____
I. Number of pump stations with permanent flowmeters _____
J. Number of pump stations with remote status monitoring _____
K. Number of pump stations with running time meters _____
L. Number of mechanical maintenance staff assigned to mechanical maintenance _____
M. Number of electrical maintenance staff assigned to electrical maintenance _____
N. Total labor hours scheduled annually for electrical and mechanical PM tasks _____
O. Total labor hours expended annually for electrical and mechanical PM tasks _____

XIII. Pump Station Failures, Dry Weather

A. Number of failures resulting in overflows/bypass or backup, annually _____
B. Total quantity of overflow/bypass _____ Gallons or MG
C. Average time to restore operational capability _____ hours
D. Total labor hours expended for electrical and mechanical corrective maintenance tasks _____
E. Is failure mode and effect diagnosed? Yes ___ No ___
F. Are future preventive measures initiated based on diagnosis? Yes ___ No ___
G. What equipment is available for emergency response? _____

XIV. Force Mains

A. Force mains inspected annually _____ miles or feet (visual surface inspection of alignment)
B. Force mains monitored annually _____ miles or feet (pressure profile, capacity)
C. Number of force main failures annually _____
D. Cause(s) of force main failures _____
_____

XV. Air Relief/Vacuum Valves

A. What is frequency of valve inspections? _____
B. What is frequency of PM (backflushing, etc)? _____
C. Number of annual valve failures _____
D. Cause(s) of valve failures _____
_____

XVI. System Operation and Maintenance Efficiency

A. Total full time or full time equivalent staff assigned to O & M (excluding administration staff but including line managers, supervisors) _____
B. Total estimated labor hours actually expended for active O & M tasks (this is the total above less hours for sick, vacation, holidays, training, breaks, etc., not directly related to performing O & M tasks) _____

XVII. Level of Service

A. Average annual rate for residential users _____
B. Rate based on: water consumption _____ Flat rate _____ Other _____
C. Number of complaints annually _____
D. Number of complaints that are agency responsibility _____
E. Number of public health or other warnings issued annually _____
F. Number of claims for damages due to backups annually _____
G. Total cost of claims settled annually _____

XVIII. Financial

A. Total annual revenue received from wastewater _____
   1. % of revenue for long-term debt _____
   2. % of revenue for treatment and disposal _____
   3. % of revenue for collection and conveyance _____
B. Current value of collection system assets _____
C. Annual O & M expenditure _____
D. Annual CIP expenditure for repair, replacement, or rehabilitation _____
E. Annual O & M training budget _____
F. Total number of O & M personnel (including administrative in O & M department) _____
G. Number of personnel with collection system certification _____
H. Number of personnel qualified for collection system certification _____
I. Amount of O & M budget allocated for contracted services _____
J. Hydroflush cost per foot _____
K. Rodding cost per foot _____
L. Bucketing cost per foot _____
M. CCTV cost per foot _____
N. Spot repairs, cost each _____

XIX. Safety

A. Total labor hours assigned to O & M _____
B. Number of lost time injuries _____
C. Total lost time days _____
D. Total cost of lost time injuries _____

XX. Regulatory

A. Total number of violations issued annually _____
B. Total cost of fines paid annually _____
C. What is minimum reportable quantity in gallons? _____
D. What is time reporting requirement? _____
E. Number of annual WWTP upsets due to wet weather flow _____

XXI. General

A. Has SSES been performed on system? Yes _____ No _____
B. Total O & M positions currently budgetd _____
C. Total O & M positions currently filled _____
D. Is computerized maintenance management system (s) used for O & M managing? Yes ____ No ___

E. Is GIS system used for O & M managing? Yes _____ No _____

XXII. Procedures or Other Documentation Available

A. Overflow, bypass and containment Yes _____ No _____
B. Problem evaluation and solution Yes _____ No _____
C. Cleanup procedure Yes _____ No _____
D. Failure mode and effect procedure Yes _____ No _____
E. O & M budget process Yes _____ No _____
F. O & M budget with line item detail Yes _____ No _____
G. Long-range CIP planning for system expansion, rehabilitation, and replacement Yes _____ No ____
H. Is there a written procedure for cleanup to mitigate effect of overflow? Yes _____ No _____
I. Is there a written procedure for containing overflows and bypasses? Yes _____ No _____
J. Is there an established procedure for containing overflows and bypasses? Yes _____ No _____
K. Is there an established procedure for problem evaluation and solution? Yes _____ No _____
L. Is there an established procedure for cleanup to mitigate effect of overflow? Yes _____ No _____
M. Is there a grease control program? Yes _____ No _____
N. Is there a pretreatment program? Yes _____ No _____
O. Is there a private source I/I reduction program? Yes _____ No _____
P. Do you have chronic O & M problems that are designed into your system? Yes _____ No _____
If yes, provide brief description _____
_____

Q. Do you have chronic O & M problems that are constructed into your system? Yes _____ No ____
If yes, provide brief description _____
_____

R. How would you rate your construction inspection program?
Very effective _____ Needs improvement _____ Poor _____

XXIII. Definitions/Clarifications

A. Maintenance access structures, most commonly manholes, in your system that are incorporated into your O & M program.

B. Pump capacity redundancy is the ability to maintain pumping at design capacity with the largest pump out of service.

C. Remote status monitoring is any remote monitoring system such as alarm telemetry or SCADA that provides remote pump station status information.

D. You will notice that in the section on stoppages and pump station failures, we are asking for dry weather incidents only. Dry weather system performance is a good indicator or effectiveness of O & M program. If you have wet weather information that you wish to provide also, please do.

E. Under the Special Conditions sections we are identifying conditions that are present in your system that require consideration during design, construction, and O & M of your system.

F. Any of the questions dealing with labor hours are designed to determine total labor hours irrespective of crew size or crews that are only assigned to cleaning, for example, less than full time.

G. Our goal is to obtain data that can be or are standardized and that are accurate. We also realize that some data may not be available; however, data can be accurately estimated. If you estimate data please follow with an (E).

H. If data is not available please indicate "NA." If data does not apply to your system, please indicate by "DNA."

I. Failure mode and effect refers to any established procedure you have to diagnose system failures to determine the cause and effect of the failure. This can apply to crews clearing stoppages or to pump station failures.

J. Pump station inspection (XII) means scheduled inspection by operators to verify station operation and perform PM. It excludes electrical or mechanical craft maintenance.

K. Stoppage in section IX refers only to stoppages other than pump stations. Pump stations are covered in Section XIII. Backup in this case refers to a basement or other structure backup as opposed to main line sewer backup.

XXIV. Additional Comments

_____

_____

_____

Appendix B

EXAMPLE INTERVIEW SCHEDULE AND TOPICS

EXAMPLE INTERVIEW SCHEDULE AND TOPICS

Days 1 and 2 Interviews

Work Practice or Maintenance Function	Description	Examples of Discussion Topics and Supporting Documents	Name	Interview Date, Time, and Location
Senior Management	Discuss project expectations, report review and comment process. Overview of organizational structure and "culture". Identify sensitive issues and how to approach. Schedule			
Project Kick off Meeting	Overview and purpose of project. Interview and field assessment process. Report content and review process. Questions and answers	None		
Physical Inspection and Testing – Gravity sewer system	Visual Inspection, pipe alignment. CCTV Smoke and Dye Testing Other	Reports, inspection forms, performance data, inspection strategy, crew assignments and schedules, equipment available, current expenditures and budgeted amounts, area maps, Standard Operating Procedures, field maps.		

Work Practice or Maintenance Function	Description	Examples of Discussion Topics and Supporting Documents	Name	Interview Date, Time, and Location
Preventive Maintenance - Mechanical and hydraulic cleaning	High velocity jets and combination machines. Other hydraulic methods Rodding Machines Bucket Machines	Reports, performance data, preventive maintenance cleaning strategy, crew assignments and schedules, equipment available, current and budgeted, problem areas, Standard Operating Procedures, Standard Maintenance Procedures, problem diagnosis		
Chemical and biological cleaning	Root control Grease control Odor control Corrosion control	Grease control ordinance, enforcement, odor and corrosion control strategy, root control program, design for O&M considerations, materials used (MSDS), reports, performance data, preventive maintenance cleaning strategy, crew assignments and schedules, equipment available, current and budgeted, problem areas, Standard Operating Procedures, Standard Maintenance Procedures, problem diagnosis, public education, enforcement		
Pump Stations	Routine inspection Electrical and mechanical maintenance SCADA Standby/emergency systems Valves Forcemains	Logs, inspection sheets, Standard Maintenance Procedures, Standard Operating procedures, pump station inventory and attribute data base, spares inventory, Reports, performance data, preventive maintenance strategy, crew assignments and schedules, equipment available, current and budgeted, critical pump stations, Standard Operating Procedures, Standard Maintenance Procedures, problem diagnosis, preventive and predictive maintenance methods, maintenance tasks and frequencies, O&M manuals, capacity issues		

Work Practice or Maintenance Function	Description	Examples of Discussion Topics and Supporting Documents	Name	Interview Date, Time, and Location
Training and Certification	Training program, technical, supervisory and management. Certification program	Knowledge, skills and abilities, basic skills, career paths, minimum qualifications, certification, educational assistance program, internal and external training, OJT, training budget		
Work Management	Planning and scheduling work Materials management Priority Backlog management Procurement Manual or Computer Maintenance Management System (CMMS)	Complaints and emergencies normal hours and after hours. Corrective, preventive and predictive maintenance work orders, work backlog, labor utilization, reports,		

Work Practice or Maintenance Function	Description	Examples of Discussion Topics and Supporting Documents	Name	Interview Date, Time, and Location
Safety	Safety committee Safety meetings Safety enforcement Documentation of comprehensive safety training Compliance with safety regulations Documentation of effectiveness of safety program (e.g., reduction of accidents) Documentation of attendance and learning at safety training sessions	Policy and procedures for trenching, confined space, lockout tagout, PPE. Safety manual, formal training, tracking, accident investigation		
Financial	Annual O&M Budget Rates CIP for rehabilitation/rehab Non-enterprise fund allocations	O&M budget process, line item accounts, five year CIP plan, repair, rehabilitation, replacement strategy for pipes and pump stations		

Work Practice or Maintenance Function	Description	Examples of Discussion Topics and Supporting Documents	Name	Interview Date, Time, and Location
Construction and Repair	Emergency repair Spot repairs, gravity system Rehabilitation Lateral installation Inspection New Construction Testing	Reports, inspection forms, performance data, inspection strategy, crew assignments and schedules, equipment available, current and budgeted, area maps, Standard Operating Procedures, field maps,		
Fleet Management	Maintenance Replacement Availability Budgeting	Inventory, repair and replacement process, maintenance turn around time, preventive maintenance, Standard Operating Procedures, Standard Maintenance Procedures, CMMS,		

Day 3 - Field

Pump Stations

Work Practice or Maintenance Function	Description	Examples of Discussion Topics and Supporting Documents	Name	Interview Date, Time and Location
Pump Station Maintenance	Submersible Cast in place wet well dry well Prefabricated Grinder/Low Pressure System	Logs, O&M manuals, on-site procedures, vehicles and equipment, SCADA, Supervisory controls, electrical systems, flow meters, HVAC, variable speed systems, chronic problems, pumps and hydraulic systems.		

Day 4 – Field

Facilities and Crews

Work Practice or Maintenance Function	Description	Examples of Discussion Topics and Supporting Documents	Name	Interview Date, Time and Location
Facilities	Electrical and mechanical repair shops and equipment Warehouse and equipment storage areas Vehicle maintenance shops Crew areas; locker rooms, training areas, dispatch areas	Logs, O&M manuals, on-site procedures, vehicles and equipment, SCADA, Supervisory controls, electrical systems, flow meters, HVAC, variable speed systems, chronic problems, pumps and hydraulic systems,		
Crews Exit Interview	CCTV Cleaning Construction Repair Overview of findings for week	N/A None		

Appendix C

INFORMATION SOURCES

Information Sources
(Updated November 2004)

WEBSITES (water and/or wastewater-oriented; financial related)

EPA National Compliance Assistance Clearinghouse	www.epa.gov/clearinghouse
Compliance Assistance Centers	http://www.assistancecenters.net
Construction Industry Compliance Assistance Center	www.cicacenter.org
EPA NPDES website	http://www.epa.gov/npdes
EPA Operator On-Site Technical Assistance Program–104(g) (hands-on assistance to small municipal WWTP operators at no cost to community)	www.epa.gov/owm/mab/smcomm/104g/sstc.htm
EPA Office of Wastewater Management	www.epa.gov/owm
EPA Clean Water Tribal Grant Program	www.epa.gov/owm/mab/indian/cwisa.htm
EPA Colonias Program	www.epa.gov/owm/mab/mexican
EPA Clean Water State Revolving Loan Fund Program	www.epa.gov/owm/cwfinance/cwsrf
EPA Website (Headquarters & Regions)	www.epa.gov/
EPA Small Business Gateway	http://www.epa.gov/smallbusiness
Environmental Finance Center	http://sspa.boisestate.edu/efc
National Environmental Services Center/WV University	www.nesc.wvu.edu
Local Govt. Environmental Assistance Network	www.lgean.org
Rural Community Assistance Program (RCAP)	www.rcap.org
Water Environment Federation (WEF)	www.wef.org
AMSA	www.amsa-cleanwater.org/pubs/
American Water Works Assoc. (AWWA)	http://www.awwa.org/
National Association of Towns & Townships (NATAT)	http://www.natat.org/

PUBLICATIONS /TRAINING VIDEOS /NEWSLETTERS, etc.

EPA National Service Center For Environmental Publications (NSCEP)
USEPA/NSCEP
PO Box 42419
Cincinnati, OH 45242
Tele: 1-800-490-9198 or 513-489-8190 (fax: 513-489-8695)

EPA Office of Water Resource Center
Tele: 202-566-1729 (24 hours)
center.water-resources@epa.gov

National Environmental Services Center (formerly the National Small Flows Clearinghouse)
West Virginia University Small Business Gateway
P.O. Box 6064
Morgantown, WV 26506
Tele: 1-800-624-8301

California State University - Sacremento
Tele: 916-278-6142
(training videos, etc.)

List Compiled by Sharie Centilla, USEPA/OECA
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California State University (CSU) Sacramento.1996. Operation and Maintenance of Wastewater Collection Systems. Volume I, Fifth Ed. Prepared for EPA, Office of Water Programs Operations. Sacramento, CA: California State University, Sacramento Foundation.

California State University (CSU) Sacramento. 1998. Operation and Maintenance of Wastewater Collection Systems. Volume II, Fifth Ed. Prepared for EPA, Office of Water Programs Operations. Sacramento, CA: California State University, Sacramento Foundation.

U.S. EPA National Enforcement Investigations Center (NEIC). 1992. Multi-media Investigations Manual. EPA-330/9-89-003-R.

U.S. Environmental Protection Agency. 1974. "Process Design Manual for Sulfide Control in Sanitary Sewerage Systems." Prepared for the Technology Transfer Office of the U.S. Environmental Protection Agency. EPA 625/1-74-005. pg. 3-27.

U.S. EPA Office of Water. 1973. *Manpower Requirements for Wastewater Collection Systems in Cities and Towns of up to 150,000 Population*. EPA-832-R-73-104.

U. S. EPA Office of Water. 1974. *Manpower Requirements for Wastewater Collection Systems in Cities of 150,000 to 500,000 Population*. EPA-832-R-74-102.

U.S. EPA Office of Water. 1983. *Procedures Manual for Reviewing a POTW Pretreatment Program Submission. EPA*-833-B-83-200.

U.S. EPA Office of Water. 1985. *Design Manual: Odor and Corrosion Control in Sanitary Sewerage Systems and Treatment Plants*. EPA-625-1-85-018.

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U.S. EPA Office of Water. 2004. *Report to Congress: Impacts and Controls on CSOs and SSOs.* EPA-833-R-04-001.

Water Environment Federation. 1994. *Existing Sewer Evaluation & Rehabilitation*: WEF Manual of Practice FD-6, ASCE Manuals and Reports on Engineering Practice No. 62. Alexandria, VA: WEF.

Efficiency Made Easy

Promotes water efficient products and practices, saving H2O and electricity. Partners receive recognition and use of EPA logo.

~ Success story: Georgia's Cobb County replaced 1682 toilets with low flow saving 9.5 million gal/yr.

www.epa.gov/watersense

Artie Buff, 404-562-9336

Water conservation in action.

National Partnership for Environmental Priorities (NPEP)

Partnership with EPA that reduces the use of any of the 31 Priority Chemicals (e.g. Lead, Polycyclic Aromatic Hydrocarbons (PAHs).

~ Success stories: Wirerope Works eliminated 27,000 lbs. Lead, Saving $50,000/yr.

www.epa.gov/epaoswer/hazwaste/minimize/partnership.htm

Dave Langston, 404-562-8478

Performance Track

Go above and beyond legal requirements. Benefits: Reduced Reporting under Maximum Achievable Control Technology (MACT), Extended Accumulation for RCRA Waste, and more.

~ Success story: Rohm and Haas Electronic Materials replaced burner control sections with high-efficiency motor controllers. Saving $49,000/yr, and reducing energy use by 3.7 billion BTU/yr.

www.epa.gov/performancetrack

Reggie Barrino, 404-562-9635

Energy Star

Save money through energy efficient products and practices. Covers 50 product categories. In 2007, program saved consumers $16 billion in energy costs.

~ Success story: Marriott instituted various energy saving techniques saving $6 million; 3M increases energy efficiency 9%, saves $10 million.

www.energystar.gov

Danny Orlando, 404-562-9087

Waste Reduction Resource Center (WRRC)

Pollution Prevention (P2) Info clearinghouse—Online technical P2 library/case studies, training courses, Topic Hubs, P2 News, State P2 Contact Information.

http://wrrc.p2pays.org

1-800-476-8686

Waste Wise

Information geared towards municipal solid waste and select industrial wastes (e.g. packaging, paper, wood pallets, batteries) Free technical assistance, case studies, and public recognition/awards.

~ Success story: Pepsi switched from corrugated to reusable shipping, saving $44 million.

www.epa.gov/wastewise

Rhonda Rollins, 404-562-8664

Wooden pallets being prepared for reuse.

Resource Conservation Challenge (RCC)

Save money and energy - Manage materials more efficiently through recycling and reuse.

www.epa.gov/rcc
www.epa.gov/region4/recycle

~ Success story: Rooms To Go's comprehensive recycling program grossed over $1 million in 2007.

Dee Rodgers-Smith (Solid Waste), 404-562-8688
Mary Beth Van Pelt (Organics), 404-562-8615
Kim Clifton (E-Waste), 404-562-8477
Steve Smith (C&D), 404-562-8501

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Sector-specific Regulatory Compliance Assistance

Compliance Assistance Centers

Make sense of environmental regulations, in terminology directly related to your industry. Save money on compliance and reduce wastes. Sectors include: chemicals, printing, auto repair, and more.

www.epa.gov/compliance/assistance

Wesley Hardegree, 404-562-9629

Mills like the one above can get help with environmental regulations.

Industry Sector Notebooks

Profiles environmental challenges for more than 35 manufacturing, transportation and agricultural sectors. Covers typical operations, pollutants, regulations, P2 opportunities, common environmental violations, and voluntary initiatives.

www.epa.gov/compliance/sectornotebooks.html

State Pollution Prevention (P2) Resources

Find all the P2 State contacts at:
~ http://wrrc.p2pays.org

EPA partnership programs and general P2
~ www.epa.gov/partners and www.epa.gov/p2

Buy environmentally responsible computers
~ www.epeat.net

Recycling opportunities for practically everything.
~ www.earth911.org

Best management practices/Lower plant energy bills
~ www1.eere.energy.gov/industry

Additional Success Stories

~ EPA's Colorado Lab—Reduces water usage 50%, saving 650,000 gallons, and $1,900/yr.

~ Retail complex in Oregon uses native landscaping—maintenance costs reduced 80%, and water bill $2,400.

~ Fiberglass Mfr. reduces waste acetone by 80%, goes from Small Quantity Generator (SQG) to Conditionally Exempt Small Quantity Generator (CESQG).

~ Dow reconditions steel drums, Saves $2.3 million, conserves 7.8 million lbs of steel.

~ Seydel's (textiles) reduction & re-manufacturing efforts generates $518,000 in revenue.

~ Institute for Local Self-reliance (ISLR) deconstructs/recycles home, nets $7,400 in materials.

EPA United States Environmental Protection Agency

Mention of trade names, products, or services does not convey official EPA approval, endorsement, or recommendation.

Make your pockets GREENER with Voluntary Programs

EPA has over 60 voluntary programs to help you reduce waste, understand legal requirements, and save millions; with flexible, market-driven solutions. Other companies have saved millions of dollars...and so can you!

Environmental Protection Agency Region 4
61 Forsyth St.
Atlanta, GA 30303
www.epa.gov/region4

For More Information Contact
Waste Reduction Resource Center
1-800-476-8686

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www.epa.gov/region4

For More Information Contact
Waste Reduction Resource Center
1-800-476-8686

Useful References for Management, Operations, and Maintenance Programs

The following references may be obtained from their cited sources. Documents referenced to California State University, Sacramento may be obtained by contacting:

California State University, Sacramento
Office of Water Programs
6000 J Street
Sacramento, California 95819-6025
(Tel) 1-916-278-6142 (Fax) 1-916-278-5959
(E-mail) wateroffice@csus.edu

Documents referenced to the Water Environment Federation may be obtained by contacting:

Water Environment Federation
601 Wythe Street
Alexandria, VA 22314-1994 USA
(Member Services Center) 1-800-666-0206
(Fax) 1-703-684-2492 (E-mail) pubs@wef.org
(Internet) http://www.wef.org/TechResCatalog/marketplace/

Documents referenced to the Environmental Protection Agency may be obtained by contacting either the NCEP (if in stock) or the NTIS:

U.S. Environmental Protection Agency
National Service Center for Environmental Publications
P.O. Box 42419
Cincinnati, OH 45242
(Tel) 1-800-490-9198 (Fax) 1-513-489-8695
(Internet) http://www.epa.gov/ncepihom/orderpub.html

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
(Tel) 1-800-553-NTIS (Fax Orders) 1-703-605-6900
(E-mail) orders@ntis.fedworld.gov
(Internet) http://www.ntis.gov/ordering.htm

The EPA Region 4 Guide may be obtained by contacting Region 4 directly:

U.S. Environmental Protection Agency, Region 4
Water Management Division
Water Programs Enforcement Branch
61 Forsyth Street, SW
Atlanta, GA 30303-8909

Useful References for Management, Operations, and Maintenance Programs

➢ Sewer System Infrastructure Analysis and Rehabilitation, October 1991, United States Environmental Protection Agency, EPA/625/6-91/030

- Collection Systems: Methods for Evaluating and Improving Performance, 1998, California State University, Sacramento Foundation, Rick Arbour and Ken Kerri, USEPA Grant No. CX924908-01-0

- Wastewater Collection Systems Management, Manual of Practice 7, 1998, Water Environment Federation, 601 Wythe Street, Alexandria, Virginia, 22314

- Operation and Maintenance of Wastewater Collection Systems, A Field Study Program, Fifth Edition, Volume 1, 1996, California State University, Sacramento

- Operation and Maintenance of Wastewater Collection Systems, A Field Study Program, Fifth Edition, Volume 2, 1996, California State University, Sacramento

- NPDES Compliance Inspection Manual, Chapters 4 and 9, September 1994, EPA 300-B-94-014

➢ Handbook for Retrofitting POTWs, July 1989, EPA 625-689-020

- Pretreatment Compliance Monitoring and Enforcement Guidance, September 1986, United States Environmental Protection Agency

➢ Guidance for Conducting a Pretreatment Compliance Inspection, September 1991, EPA 300R-92-009

- EPA Region 4 Guide for Conducting Evaluations of Municipal Wastewater Collection System Management, Operation, and Maintenance Programs, October 30, 1996

➢ = Available for viewing on-line at the National Environmental Publications Internet Site (NEPIS). Go to www.epa.gov/necepihom/nepishom and search using the document code (e.g., 625689020).

EPA Region 4
Introduction to Conducting Evaluations
of
Municipal Wastewater Collection System
Management, Operation, and Maintenance Programs

Version 1.0

PURPOSE & DISCLAIMER

This document is the work product of the EPA Region 4, Water Management Division, Water Programs Enforcement Branch (WPEB) and supercedes a 10-30-1996 draft previously released. This document serves as an introduction for new Region 4 inspectors in the WPEB Municipal Infrastructure Enforcement Program and as introductory information for utilities invited to participate in the Region 4 Management, Operation, and Maintenance (MOM) Programs Project. Questions in this document are provided to initiate the thought process necessary for conducting an evaluation of a collection system. Formal instruction for conducting an evaluation under the MOM Programs Project is provided in separate literature.

The MOM Programs Project is conducted in compliance with EPA Policy, EPA Guidance, and Rules and Regulations promulgated under the Clean Water Act. If some statement or part of the document is not in compliance with the Act, EPA Policy, EPA Guidance or the Rules and Regulations, then it should not be construed as conveying rights not conveyed by the Clean Water Act, EPA Policy, or the Rules and Regulations.

September 2003

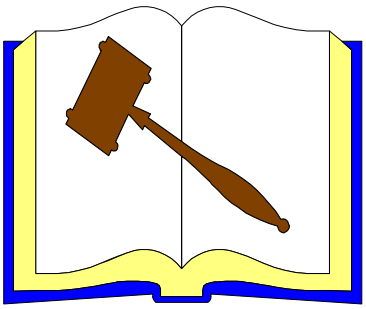
Introduction

Many collection systems have received minimal maintenance for many years. This has resulted in deteriorated sewers with a high potential for overflows, cave-ins, hydraulic overloads at treatment plants, and other problems. There are two central reasons for conducting an evaluation of a municipal collection system:

Public and Environmental Health

Sanitary sewer overflows (SSOs) are a frequent cause of water quality violations. Beach closings, flooded basements, closed shellfish beds, and overloaded water treatment plants are a few of the symptoms of an inadequate collection system. Streams influenced by frequent SSOs support only the hardiest of species.

Legal Considerations

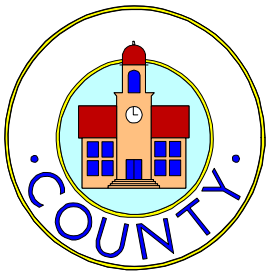


A discharge permit issued through the National Pollutant Discharge Elimination System (NPDES) requires that the "permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit." SSOs may be considered a violation of this permit provision.

SSOs may also be considered an unpermitted discharge of pollutants from a point source, as defined in the Clean Water Act.

A goal of the collection system evaluation should be to discover if a utility is plagued by overflows and/or bypasses within its system of conveyance to a treatment facility. If so, what are the impacts? Is the utility aware of the problem? Are they taking appropriate steps to address the problem in a timely manner and prevent future reoccurrence?

Management



The first stop on any evaluation should be the "home office." This location is a point of administration, and may include functions such as utility management, finance, engineering, planning, procurement, warehousing, personnel, or legal review. In a large city, this work may be split between different departments. A small town may have only one or two people doing some of these activities. Much of the information needed from this source can be obtained before the evaluation by a written request. Areas of review should include:

✔ *Financial Administration*

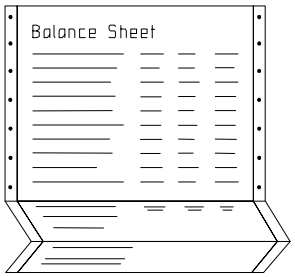
EPA and others have published guidance on the financial aspects of operating a wastewater utility. This is the single most important aspect of utility operation. Inadequate funding diminishes the chances for success.

User Rate/User Charge

- ! What are the utility's current rates?
- ! How are user rates calculated?
- ! How often are user charges adjusted based on that evaluation?
- ! Does the utility receive full funding from its revenue?
- ! Are utility funds used for other government activities?

Budget

The utility should be operating on an annual budget that details funding for all functions.



- ! Does the utility budget for annual operating costs?
- ! Does the budget provide sufficient itemization?
- ! Does the utility maintain a fund for future equipment and infrastructure replacement? How is work financed?

! Does the budget provide for sufficient funding?

Public Education/Outreach

The utility should be talking with the public on issues such as user rates and charges. It is up to the utility to educate the public on wastewater treatment, its impact on water resources, and the importance of keeping the user rates current. By maximizing resources and operating facilities efficiently, the utility may be able to delay increases in user rates for a short time. Adjustments for more efficient operation should be made before approaching the public on these issues.

! What type of public education/outreach programs does the utility have about the use of income from utility rates?

! Do these programs include communication with several groups such as local governments, community groups, the media, young people (schools, youth organizations)?

✔ *Personnel Administration*

Organization

! Is an organizational chart available which shows the various positions budgeted and filled?

! Are position descriptions available?

Operator Safety Program

A utility can have several levels of a safety program. It should consist of top administration, a safety department, a safety committee, and field personnel. For a small utility, top administration could be the mayor while a large utility could employ a personnel manager. All utilities should have a safety program that includes a safety policy, safety training and promotion, and accident investigation and reporting.

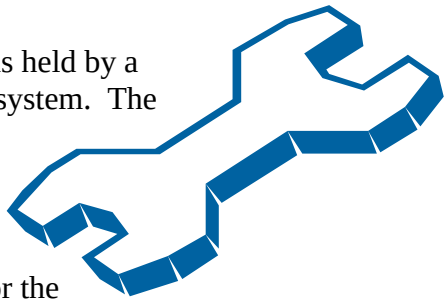
! Is there a documented safety program supported by a top administration official?

! Is there a safety department that provides training,

equipment, and an evaluation of procedures?

- ! Are all operators required to follow safe work procedures, such as the use of protective clothing and headgear, confined spaces, lock-out/tag-out policies, etc.?
- ! Is there a confined space entry procedure for manholes, wet wells, etc.?
- ! How often are safety procedures reviewed and revised?
- ! Does the safety department communicate with field personnel on safety by a procedures memo, direct communication, a video, etc.?

✔ *Equipment and Tools Administration*



The amount and types of equipment and tools held by a utility depend on the size, age, and condition of the system. The decision as to the type and amount of equipment to have on hand is a difficult one. A small utility may find it hard to justify the purchase of expensive, specialized equipment. The utility must identify the problems in the collection system and arrange for the appropriate tools and equipment accordingly. An alternative to purchasing is leasing, contracting, or sharing costs with other communities.

- ! Is there a list of equipment and tools used for operation and maintenance?
- ! Do field personnel feel they have access to the necessary equipment and tools to do all aspects of the operation and maintenance of its collection system?
- ! Is there access to suitable equipment if the utility's equipment is down for repair?
- ! Does the utility own or have ready access to a sufficient number of emergency power generators?
- ! Where does the utility store its equipment?
- ! Is a detailed equipment maintenance log kept?
- ! Are written equipment maintenance procedures available?

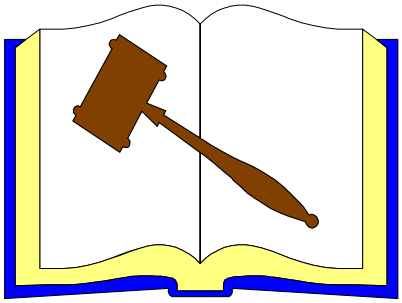
- ! What is the procedure for equipment replacement?

- ! If an in-house motor pool is used, what is the turnaround time for service?

Equipment that has reached its useful life should be replaced. To reduce the financial burden of equipment replacement, a fund should be established for equipment replacement. A utility should keep detailed records on the cost of operating the equipment to make good decisions about equipment replacement.

✔ *Legal Administration*

The utility should have legal documents to protect its collection system. Typically, sewer ordinances exist to satisfy Clean Water Act pretreatment regulations and to assure the utility's compliance with its NPDES permit. A legally sound sewer ordinance will give the utility retribution when corrosive and/or toxic materials are introduced into the collection system. Another important element is a grease control ordinance. Grease traps should be inspected by the utility for compliance. Some utilities choose to permit each trap owner.



- ! Is there a sewer use and a grease control ordinance?

- ! Is there active enforcement of the sewer and grease control ordinances?

- ! Are all grease traps inspected regularly?

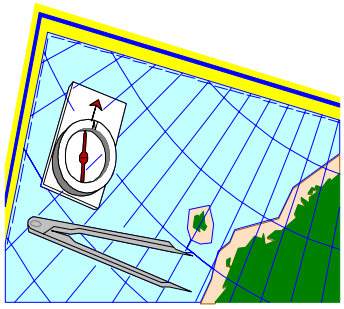
- ! How does the utility learn of new or existing grease traps?

- ! Who is responsible for enforcing the sewer ordinance and grease ordinance? Does this party communicate with the utility department on a regular basis?

- ! Are there any significant industrial dischargers to the system?

- ! Is there a pretreatment program in place?

✔ *Engineering Administration*



System Mapping and As-Built Plans

The utility should have an overall map of the collection system with sufficient detail to allow easy interpretation. There should be a collection system inventory organized by plant service areas that include the following information:

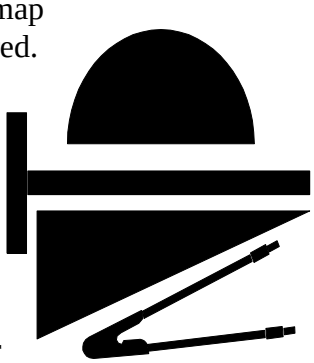
Gravity Lines:	Lineal feet by diameter
Manholes:	Number
Pump Stations:	Number by type
Force Mains:	Lineal feet by diameter
Air Release Valves:	Number and location
Inverted Syphons:	Number and location
Other Major Appurtenances:	Number and location
Service Population	By facility service area

A sewer atlas detailing the location of the above items should be available. The type of sewer atlas used by the utility will depend on their needs and resources. A large metropolitan utility may find that a sophisticated, computerized mapping system is required. A small community may be satisfied with a hand-drafted version.

! What type of mapping/inventory system is used?

! Is there a procedure for recording changes and updating the mapping system?

Mapping and inventory revisions should occur when there are changes in the collection system such as additions or repairs. Comprehensive maps of the system should be printed annually for large utilities, and a staff of "mappers" will likely be required to keep the maps up to date. Utilities may alternatively choose to contract map services. This is especially true if much catch-up work is required.



Design and Capacity Analysis

Through the interview and document review process, the evaluator should discover design procedures and the criteria needed for new work. In particular, the evaluator should discover how the utility determines the adequacy of the existing system for transmitting and treating future flows. The evaluator should discover what control the utility has over new connections to the system.

- Is there a document which details the design criteria and standard construction details. for gravity sewers, force mains, and pump stations?

- Is there a document that describes the procedures that the utility follows in conducting a design review? Are there any standard forms that guide the utility?

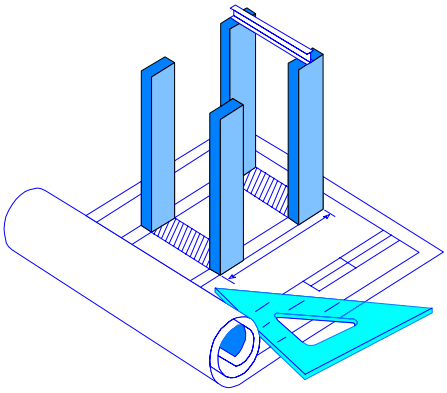
- What procedures are used in determining whether the existing sewer system capacity is adequate for new connections?

- Is any flow metering accomplished prior to allowing new connections?

- Is there a mathematical model of flow in the system used to predict the effects of new connections?

- Is any certification required which attests capacity is available for a new connection before it is made?

Construction



Through the interview and document review process, the evaluator should determine what procedures the utility uses to inspect and test new construction. These activities are important to ensure that new facilities do not contribute to future operation and maintenance problems. Excessive infiltration and inflow problems can exist with new construction if not properly built.

- Is there a document that describes the procedures that the utility follows in conducting their construction inspection and testing program? Are there any standard forms that guide the utility in conducting their construction inspection and testing program?

- Is new construction inspected by the utility or others?

- What are the qualifications of the inspector(s)?

- Is inspection supervision provided by a registered Professional Engineer?

- How is new construction tested? (air, water, weirs, etc.)

- Is new construction televised using closed-circuit camera techniques?

- Is new construction built to standard specs set by the local utility and/or the State?

- Is there a warranty for new construction? If so, is there a warranty inspection done at the end of this period?

Sewer System Evaluation Survey (SSES) and Rehabilitation

The SSES and sewer rehabilitation program is a structured methodology for finding the holes in a system and fixing them. Cost analysis is the major factor in determining the scope of rehabilitation. Due to the requirements of EPA's Construction Grants Program, many systems did evaluation surveys as a condition of their grant. Some systems also received grant funds for rehabilitation.

The SSES is a two-phase operation. The first phase is to gather preliminary information and technical data. Flow monitoring, records and map evaluations, and system inspection are some of the tasks to be completed. Prioritizing areas for further evaluation is the end result of phase one.

The second phase is to conduct further testing of the prioritized sewer areas identified in the preliminary phase and analyze these results. Rehabilitation recommendations based on a cost-effective analysis is the end result of phase two and concludes the SSES.

Rehabilitation may consist of a variety of techniques designed to reduce inflow and infiltration into the sewer system. Many methods are available with highly variable costs and service lives. Rehabilitation costs are usually significantly less than replacement costs.

SSES and rehabilitation activities are best described as a highly intensive program of operation and maintenance. Because over time many utilities have neglected proactive operation and maintenance of their sewer systems, these activities are often used to "catch-up" to a condition which can be maintained on a regular basis. Many of the techniques used in SSES and rehabilitation activities are described in the Operation and Maintenance section of this document, and should also be elements found in a proactive operation and maintenance program.

- Have SSES activities been performed in the past? If so, is documentation available?

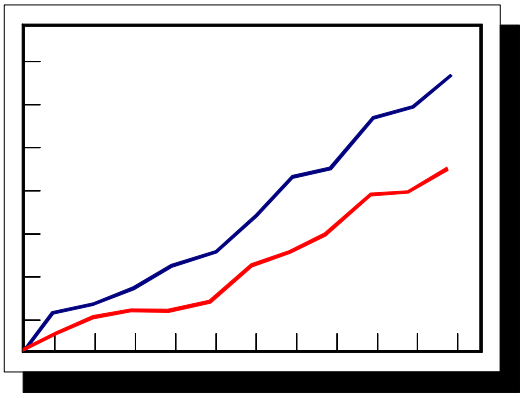
- Has any sewer rehabilitation work been done in the past 15 years?

- How many sanitary sewer overflows have occurred in the last year?

- Is there a record?

✔ *Water Quality Monitoring*

Monitoring streams in the service areas can help identify problems in the collection system such as leaking pipes, washed-out stream crossings, and other pollution sources which could be attributed to the sewer system. Fecal Coliform is a common parameter monitored to detect potential contamination from sewers.



- **!** Is there a water quality monitoring program in the service areas?
- **!** If so, what parameters are monitored and at what frequency?
- **!** How many locations are monitored?

✔ *Management Information Systems*

A management information system uses data from work reports prepared by field personnel to optimize the operation and maintenance of the collection system. A powerful tool, the information system is used as an aide to schedule preventive and reactive work on the system. It can also be used to measure efficiency, and track and develop costs.

- **!** What types of work reports are prepared by the field personnel?

  Examples include:
  - Main Sewer Construction
  - Main Sewer Maintenance
  - Main Sewer Repair
  - Structure Maintenance
  - Structure Repair or Abandonment
  - Building Sewer Maintenance
  - Building Sewer Repair

- **!** Do the work reports include complete and useful information?
- **!** How are records kept?
- **!** Does the facility use computer software to manage information? If so, what type of systems are used?

! What kind of management reports are generated from the work report data?

Examples include:
- Payroll
- Production
- Work Costs
- System Inventory
- Main line maintenance history
- Service line maintenance history
- Main and service line repair history

Performance Indicators

Performance indicators are used to determine the condition of the system. These indicators are not absolute because there may be other reasons to suggest a less than adequate system condition. However, if several of the factors indicate possible problems, further investigation is warranted.

! What is the per capita wastewater flow for the maximum month, week, and day?

EPA considers Infiltration/Inflow (I/I) to be excessive if the total daily flow during periods of high groundwater exceeds 120 gallons per capita per day (gpcd), and during a storm event exceeds 275 gpcd.

! What is average annual BOD of the treatment facility influent?

An average of much less than 200 mg/L may indicate excessive I/I.

! What is the ratio of maximum wet weather flow to average dry weather flow?

A review of 10 case studies by EPA found that peak wet weather flow ranged from 3.5 to 20 times the average dry weather flow. Typically, as the ratio approaches 4 to 5, the likelihood of surcharge and overflow increases.

! What is the annual number of overflows, and what are the causes (i.e., grease blockages, debris blockages, pump malfunctions, overloaded sewers, lift station power loss, etc.)?

! What is the annual number of sewer cave-ins? What were the causes (i.e., pipe corrosion, root intrusion, leaks, etc.)

✔ *Complaints*

- ! How are public complaints handled?
- ! What are the common complaints received?
- ! How often are these complaints reported?
- ! Is there a record?
- ! Does the utility have a procedure in place to evaluate and respond to complaints?

✔ *Public Relations*

- ! Is there a public relations program in place?
- ! Are the employees of the utility trained in public relations?
- ! What type of public notification is given for treatment plant upsets or collection system overflows?
- ! Is the public notified prior to major construction or maintenance work?
- ! How often does the utility communicate with other municipal departments?

✔ *Emergency Maintenance and/or Contingency Plans*

- ! Does the utility have a written emergency maintenance plan?
- ! What type of equipment does the utility have available for emergency maintenance? How quickly can the utility access that equipment in case of an emergency?

✔ *Spare Parts Inventory Management*

- ! Does the utility have a central location for the storage of spare parts?
- ! Have spare parts which are difficult to obtain, but critical to operation been identified?
- ! Does the utility maintain a stock of common spare parts on its maintenance vehicles?

- ! What methods are employed to keep track of the location, usage, and reordering of spare parts? Are parts logged out when taken by maintenance personnel for use?

- ! Does the utility salvage specific equipment parts when equipment is placed out of service and not replaced?

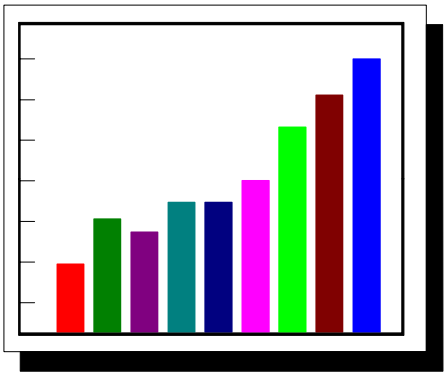
- ! How often does the utility conduct a check of the inventory of parts to ensure their tracking system is working?

- ! Who has the responsibility to track the inventory?

Operation and Maintenance

The operation and maintenance (O&M) of a wastewater collection system is a difficult undertaking. Besides keeping the system in good working order, a proper O&M program should convey all wastewater to the treatment plant. A well-operated system will employ many, if not all, of the techniques described in this section.

✔ *Maintenance Scheduling*



- ! Does the utility schedule its maintenance activities?

- ! How are priorities determined?

- ! How is the effectiveness of the maintenance schedule measured?

✔ *Sewer Cleaning*

Sewer utilities have been cleaning lines for a long time. Most sewer cleaning programs have been directed towards emergency situations which occur due to stoppages. A better O&M program will have regular cleaning schedules for the system.

- ! Is there a routine schedule established for cleaning sewer lines on a system-wide basis (e.g., “once every seven to twelve years,” or “between 8% and 14% per year” ?

- Is there a process present to identify sewer line segments that have chronic problems and that should be cleaned on a more frequent schedule?

Cleaning Equipment

Mechanical cleaning equipment, such as a rodding device or bucket machine, has been the mainstay of utility cleaning operations for a long time. Though this type of equipment is still in use, hydraulic cleaning equipment which uses water pressure directed through a nozzle has generally replaced the need for mechanical equipment.

- What type of cleaning equipment does the sewer utility use?
- How many cleaning units of each type does the utility have?
- How many cleaning crews and shifts does the utility employ?
- How many cleaning crews are dedicated to routine cleaning?
- How many cleaning crews are dedicated to emergency cleaning?
- What has the utility's experience been regarding pipe damage caused by mechanical cleaning equipment?
- Where is the cleaning equipment stationed?

Chemical Cleaning and Root Removal

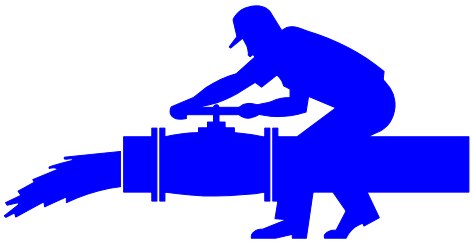
Roots are a major cause of stoppages in many systems, so root removal and control is an important utility operation.

- Does the utility have a root control program?
- Are chemical cleaners used? What types?
- How often are they applied?
- How are the chemical cleaners applied?
- What results are achieved through the use of chemical cleaners?

✔ *Hydrogen Sulfide Monitoring and Control*

The presence of hydrogen sulfide gas in gravity and pressure sewer lines can, and often does, lead to serious and catastrophic corrosion of concrete pipes and the metallic components of sewer systems. Hydrogen sulfide corrosion is usually a problem in areas having little topographic relief where there may be long travel times. Hydrogen sulfide corrosion can also be a problem downstream from pump stations having long wet well holding times.

- **!** Are odors a frequent source of complaints?
- **!** Has the sewer utility verified the existence/non-existence of a hydrogen sulfide problem, and if one is present, does it have in place corrosion control programs?
- **!** What are the major elements of the utility's program?



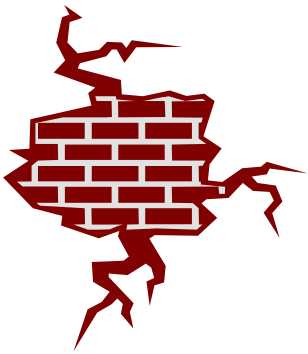
A control program could be use of chemicals or aeration to prevent the formation of hydrogen sulfide. Pipe materials which resists corrosion are also effective. Often, a combination of approaches will be included in a program.

✔ *Lift Stations*

Lift stations are an important part of most wastewater systems. In coastal or other areas with little topographical relief , lift stations are a major O&M item. The effects of deteriorated collection systems are often realized at lift stations in the form of severe overflows during rain events.

Operation

- **!** How many personnel are detailed to pump station operations and maintenance?
- **!** Are these personnel assigned full-time or part-time to pump station duties?
- **!** Is there sufficient redundancy of equipment?



Emergencies

- **!** Who responds to lift station overflows? How are they notified?

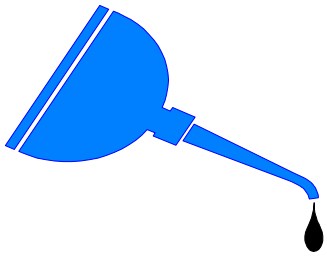
- How is loss of power at a station dealt with? (e.g., on-site electrical generators, alternate power source, portable electric generators)

Alarms and Monitoring

- How are lift stations monitored?

The answer to this question will depend on the station size, and the size and complexity of the system. In many systems, audible alarms or flashing lights are used to indicate a problem at the station. Reliance is placed on either the local populace or law enforcement to notice and report an alarm. In more modernized systems, alarm conditions are remotely monitored at a central location. This is particularly true for the larger stations. These SCADA (Supervisory Control and Data Acquisition) systems allow for real-time control, monitoring, and record keeping from remote locations.

Inspection



- How often are lift stations visited?
- What is inspected during these visits?
- Is there a checklist?

Preventative and Routine Maintenance

- Is there a preventive maintenance program for lift station equipment, and if so, what is involved in this program?
- Is an adequate parts inventory maintained for all equipment?
- Is there a sufficient number of trained personnel to properly maintain all stations?

Record keeping

- Are O&M logs maintained for all pump stations?

.

- Are manufacturer's specifications and equipment manuals available for all equipment?
- Are run-times or ampere readings recorded for all pumps? How is this information used to assess performance?

Force Mains and Air Release/Vacuum Valves

Force mains and air release/vacuum valves are an integral part of the transmission system. Force mains receive the lift station effluent and convey it to the gravity system or the treatment plant. Air release/vacuum valves are installed at the high points of the force main.

The route of force mains should be inspected regularly in order to determine if any leaks are present. This is particularly true where the route is through remote areas. Air release/vacuum valves should be identified and receive regular documented maintenance. Malfunctions of these valves can lead to overflows and/or a reduced hydraulic capacity of the force main.

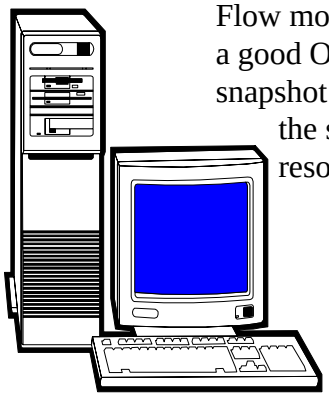
- **!** Does the utility schedule and conduct inspections of force main routes?

- **!** Does the utility have a scheduled maintenance/inspection program for air release/vacuum valves?

✔ *Sewer System Evaluation*

As discussed in the Management section, many of the techniques in use for SSES work should be a part of a utility's operation and maintenance program. Larger utilities can justify the purchase of much of the equipment used in this effort.

Flow Monitoring



Flow monitoring data collection and evaluation should be an important part of a good O&M program. A well-designed flow monitoring program will give a snapshot of the current condition of the system. By isolating the portions of the system that are making the greatest contribution to the problem, resources can be directed where they will be of greatest benefit.

Techniques used to monitor flow include continuous metering, nighttime field measurements, quantification of pump run-times, and flow measurements taken at the treatment plant. Continuous flow measurement at key locations throughout the collection system will give the most accurate indication of system integrity. The other techniques have been used to some advantage with smaller systems.

Use of meters which measure depth of flow and velocity will allow accurate results, even under surcharged conditions. Meters are available which allow continuous data recording

which can either be downloaded locally or transmitted to a remote location. Coupled with appropriate software, this is a powerful tool for sewer system evaluation.

- Does the utility have a flow monitoring program? If so, what methods are used?

Manhole Inspection

Inspecting manholes is an important part of any maintenance program. Often utilities are unaware of the location of many of their manholes. This is unfortunate since manholes are an important source of I/I and are good indicators of problems in the system. Missing manhole lids and offset manhole cones are often the result of sewer overflows. Debris on manhole steps or high waterlines indicate the presence of surcharged conditions.

Some utilities use manhole inserts to reduce inflow to the system. A manhole insert is a small, tub-shaped plastic device installed at the top of the manhole and held in position by the manhole lid. Its purpose is to catch water that enters the manhole via holes in the lid or via the access pick holes.

- Does the utility have a routine manhole inspection program?

- Is there a data management system for documenting and tracking manhole inspection activities?

- What triggers whether a manhole needs rehabilitation?

Sewer Cleaning Related to I/I Reduction

- Are sewers cleaned prior to flow monitoring?

- Are sewers cleaned prior to televised inspection?

Televised Inspection

Inspecting sewers using closed-circuit television (CCTV) cameras is a powerful tool for I/I reduction. Leaking joints or punctures can be easily detected and often repaired at the time of inspection. CCTV is also a good method to inspect the integrity of new construction before the warranty expires.

- Does the utility use televised inspection? If so, in what context?

Smoke Testing and Dyed Water Flooding

These techniques are useful to locate defects in the system and illegal connections.

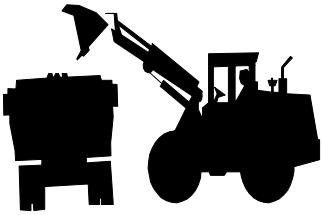
- ! Does the utility use smoke testing to identify sources of inflow into the system?

- ! Does the utility use dyed water flooding to identify suspected sources (indirect connections) of inflow into the system when smoke testing yields inconclusive results?

- ! Is there a data management system for tracking these activities?

- ! Is there a document that describes the procedures that the utility follows? Are there any standard forms?

✔ *Rehabilitation*



Several techniques are available for sewer rehabilitation. A determination of the best techniques to apply to a particular situation should be made following the SSES and an economic analysis comparing the different options.

Main Line Repairs

Point and Replacement Repairs

Point repairs consist of repairing cracked, corroded, or broken gravity sewers and force mains. This work typically includes excavation to the location of the break, removal of the broken pipe section(s) and replacement with new pipe.

Joint Testing and Grouting

Joint testing and grouting are done on sewer line sections with leaking joints but no structural defects. This work can be done in conjunction with the routine televising of lines. Grouting has a limited life and must be repeated every 5-10 years.

Sewer Lining

Sewer lining is a technique which returns pipe to new condition. Many of the current systems can be used where pipe is structurally deficient. Due to the limited excavation required for these techniques, they are good choices where surface construction would cause much disruption.

- ! What type of main line repairs has the utility used in the past?

- ! Does the utility currently use any of above techniques for main line repairs?

Manhole Repairs

Manhole repairs consist of repairing structural defects or leakage in individual manholes and castings. The structural repair work may include:

- Complete manhole replacement
- Replacing castings (lid and frame)
- Replacing defective adjusting rings or top segments
- Spray relining the existing manhole
- Grouting fissures to eliminate leakage

! What rehabilitation techniques are used for manhole repairs?

! What type of documentation is kept?

✔ *Service Laterals*

Service laterals can often be the largest source of I/I to a system. Taps, joints, and locations of structural damage are common points where I/I may be introduced into the collection system. Most utilities have legally established what part(s) of the service lateral they maintain. Jurisdiction may cover the tap only, cover all construction to the property line, or cover construction all the way to the building. The utility itself may not have direct control over installation of new service laterals. Typically the municipality's building inspectors have this responsibility. What is important is that there is communication and a consistency of standards between the utility and building departments.

! To what degree does the utility have responsibility for service laterals?

! Does the utility have a written procedure for the approval and inspection of new construction service laterals?

! Does the utility require service laterals to meet certain standards of construction? How are these standards made available to builders?

! Does the utility have a procedure to actively find and remove illegal tap-ins?

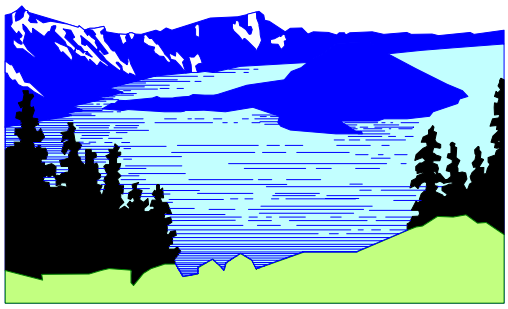
! What is the utility's jurisdiction related to repair/replacement of service laterals?

! Does the utility include I/I originating from service laterals as part of their system evaluations?

✔ *Alternative Collection Systems*

Alternative collection systems differ significantly from the conventional gravity sewer commonly employed to convey wastewater. Alternative systems include: grinder pump pressure systems, septic tank effluent pump (STEP) systems, small diameter gravity systems, and vacuum collection systems. Each system has its own unique operation and maintenance requirements and could be found as a subset of a system which is predominately gravity sewer or by itself as a stand-alone utility.

Although each alternative system operates differently and has different maintenance requirements, all require a similar management system. In each system appurtenances are located at each residence, so the utility needs to have ready access, maintain adequate spare parts, and install alarm systems to notify the utility of any problems between inspections.



Grinder Pump Systems

Grinder systems employ a holding tank (typically up to 100 gallons and located near an individual residence) which houses a small pump with a grinder attached. Wastewater is discharged intermittently using float controls. The collection system is comprised mostly of 1½" and 2" PVC plastic lines. Manholes are generally not installed, but cleanouts should be installed at the ends of all lines and at critical points. Air release valves are installed at the downstream side of high points. Pressures are low.

A system serving 500 homes would include 500 individual pump stations so a utility needs to have an appropriate staffing level for maintenance. A minimum of two personnel should be available. Generally speaking, a staff including two full-time employees per 1,000 stations has been found sufficient for well-designed systems.

Major sources of emergency maintenance include electrical problems and grease buildup in the holding tanks, resulting in failure of the floats to activate the pumps. Corrosion within the holding tank can also be a problem. Grinding solids reduces the likelihood of solids deposition, but hydrogen sulfide may be a problem where the pressure line discharges to the treatment plant or into a gravity collection system.

Pump preventive maintenance is critical and adequate spare pumps should be in inventory. Pumps and grinders may require frequent replacement and overhaul. Pump life is limited and a plan to replace all pumps should be in place. Infiltration is generally not a problem, but exfiltration may occur through deteriorated joints.

Septic Tank Effluent Pump Systems

STEP systems are similar to the grinder pump system except a septic tank replaces the holding tank and grinders are not present on the pumps. A greater range in pump types (centrifugal, progressive cavity, etc.) are common with these systems. Although the septic tank provides preliminary treatment and solids settlement, it is part of the collection system.

Significant infiltration may occur with poorly sealed and constructed septic tanks. Lines are generally sized assuming low infiltration rates. High infiltration rates will increase pump operation and may reduce pump life.

The wastewater is highly septic and can cause odor and corrosion problems where the pressure line discharges into a conventional manhole or treatment works. Proper operation and maintenance of the septic tank is essential for proper function of the collection system, so tanks should be pumped out on a set schedule.

Small Diameter Gravity Sewers

Like STEP systems, small diameter gravity systems use septic tanks for preliminary treatment and solids removal. However, no pumps are used. The septic tank overflows into a small diameter (4" and up) pipe placed at a moderate grade. The lower solids concentration in the wastewater results in less deposition of solids in the pipe.

Cleanouts are generally used in place of manholes, and pipes are sized assuming low infiltration rates. Similar to the STEP system, the integrity and maintenance of the septic tank is a critical factor for proper operation.

Vacuum Sewer Systems

Vacuum systems have a central vacuum station which includes vacuum pumps, holding tanks, and pressure pumps. The vacuum pumps provide a continuous suction in the collection line. A holding tank and vacuum valve are installed near each residence.

When the wastewater reaches a set level in the holding tank, the valve is opened to release a slug of liquid into the collection line. A loss of vacuum in the system will generally trigger a fault condition. Major breaks may cause the system to shut down, and leaks are difficult to locate. Once the wastewater arrives at a central vacuum station, it enters a holding tank and is pumped to the treatment facility through a force main.

- Does the utility have control of the near-residence portions of the collection system?
- Who owns the near-residence systems?
- Does the utility do periodic inspections of the near-residence facilities?
- What is the frequency of these inspections?
- Are pressure check valves installed on pumps?
- Are clean-outs installed at the end of each branch line?
- Is a pipe locating system installed?
- Are air release valves installed on the downstream side of high points?
- Does the system have a warning alarm system at each residence?
- How does the utility respond to the alarm system?
- Are odor control systems are installed?

EPA Region 4
Guide to
Collection and Transmission System
Management, Operation, and Maintenance Programs

Version 1.1

PURPOSE & DISCLAIMER

This document is the work product of the EPA Region 4, Water Protection Division, Clean Water Enforcement Branch (CWEB) and supercedes a previous draft dated September 2003 (Version 1.0). This document serves as an introduction for new Region 4 inspectors in the CWEB Municipal Infrastructure Enforcement Program and contains descriptive information for utilities conducting self-assessments in the Region 4 Management, Operation, and Maintenance (MOM) Programs Project.

The MOM Programs Project is conducted in compliance with EPA Policy, EPA Guidance, and Rules and Regulations promulgated under the Clean Water Act. If some statement or part of the document is not in compliance with the Act, EPA Policy, EPA Guidance or the Rules and Regulations, then it should not be construed as conveying rights not conveyed by the Clean Water Act, EPA Policy, or the Rules and Regulations.

October 2011

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INTRODUCTION

A utility should develop an appropriate, comprehensive Management, Operation and Maintenance (MOM) Program for the sewerage infrastructure (sewer system and wastewater treatment plant) which it owns and operates. A comprehensive MOM Program is comprised of individual management, operation, and maintenance programs, each of which:

- is specific to, and tailored for, the utility's infrastructure;
- has a written purpose explaining why the program is needed; has specific written goal(s) establishing the accomplishment(s) desired for the current fiscal year;
- has the details of the activities and procedures that are followed to implement the program written down in the form of Standard Management Procedures (SP), Standard Operating Procedures (SOP), and/or Standard Maintenance Procedures (SMP) that are used by the utility's personnel;
- is implemented by well-trained personnel; has established appropriate performance measures which are tracked by management; and,
- has a written procedure requiring periodic review, evaluation, and any necessary revision.

An important concept is that MOM programs are utility-specific. Most, if not all, of the programs described in this guide are based on actual programs observed at proactive utilities. However, utilities may have different titles for the various MOM programs described in this guide and may have them organized very differently. Some utilities may be organized in a way that they consolidate some of the MOM programs described in this guide, or they may exclude part of a program described in this guide because of justifiable circumstances. Utilities may also have additional MOM programs that are not contained in this guide.

Tailored to the Utility

The utility should have programs tailored to match its geographic, physical, and climatic conditions; level of complexity; infrastructure configuration; and level of sophistication. Utilities may also have a number of their MOM programs implemented through a managed contract rather than by their own trained personnel.

Program Purpose

The purpose of a given MOM program is the reason why the program is needed and why it exists.

> *Example*: The purpose our utility's smoke testing program is to identify sources of inflow our sewer system that need to be eliminated so that we can regain some of our peak flow capacity.

Program Goal

The individual program goal(s) establishes the accomplishments desired for the given MOM program during the upcoming fiscal year.

> *Example*: The goal our smoke testing program for this fiscal year is to reclaim system peak

capacity, and to reduce treatment plant hydraulic loading by identifying sources of inflow to the system by conducting investigations in the ABC and DEF sewersheds. This goal will be accomplished in a cost-effective manner using our personnel and by using a contractor.

Program Documentation

The program documentation specifies, in writing, the specific details of the activities and procedures that personnel follow to implement the program. Program documentation should be maintained in a central location and made available to all personnel.

> *Example*: Our utility has a long-term, ongoing, smoke testing program. The program priorities and standard operating procedures are contained in a manual entitled "Smoke Testing Program for Utility X."

Implemented by Trained Personnel

Training programs are established and followed to ensure that utility personnel are well-trained to implement each program and successfully achieve each program's goals.

> *Example*: All personnel assigned to our smoke testing activity receive three hours of basic training followed by eighty (80) hours of on-the-job training to assure competency. Our contract with outside sources to conduct smoke testing requires the contractor to follow our standard operating procedures.

Performance Measures

Appropriate performance measures should be established for each program and reviewed at minimum on an annual basis.

> *Example*: During this fiscal year, the performance goal is to smoke test 200,000 lineal feet of gravity sewer in two sewersheds selected according to our priority procedures. Last year, we exceeded our performance goal of 178,000 lineal feet of gravity sewer by smoke testing 193,000 lineal feet. As a result, 623 defects were identified and passed on to our rehabilitation and private service lateral programs for correction.

Periodic Evaluation

An evaluation by utility management should occur for each program, annually at minimum, to evaluate how well a program accomplished the program goals established at the beginning of the period and to determine whether the program, as presently implemented, is using the most efficient approach. Remedies should be identified and scheduled to correct any deficiencies. Questions the evaluation should answer are:

- Are there program design, resource or implementation deficiencies that keep the program from achieving its performance measures?
- Are these program deficiencies leading to sanitary sewer overflows, permit violations or other

Clean Water Act violations?

- Are there program deficiencies leading to decreased customer service and/or unwarranted deterioration of utility assets?
- Are there changes that should be made to the program that will make its implementation more efficient, thereby conserving resources for better implementation of other programs?

Example: The smoke testing program has yielded good results during the past four years. Following our priority criteria, most of the significant inflow problems have been eliminated. Next year the program will be reduced by 25% and the resources applied to our maintenance of way program. Peak flows will be monitored at key locations to determine if this reduction in the smoke testing program will need to be reversed in the future. Additionally, we are conducting a cost analysis to determine whether we should contract out for all smoke testing work in the future.

SYSTEM PROFILE AND PERFORMANCE SUMMARY

A proactive utility will maintain a profile of its system as a basis for explaining its situation to regulatory agencies, the public, and when networking with other utilities. A profile typically contains basic population and inventory information as well as a recent system performance summary. An example of a system performance summary is provided on the following page.

Population Served: .....

Number of Customers: .....

Number of Treatment Plants: .....

Total Wastewater Design Treatment Capacity:

Total Volume of Wastewater Treated: .....

Miles of Gravity Sewers: .....

Number of Manholes: .....

Number of Inverted Siphons: .....

Number of Pump Stations: .....

Miles of Force Main: .....

Number of Employees: .....

Annual Capital Improvement Budget: .....

Annual Operation and Maintenance Budget: ...

Total Annual Operating Budget: .....

System-Wide MOM Programs Recent Performance Summary													
Performance Measures for Previous 12 Months	Year Month												
	A. Number of Customer Complaints												
	B. Number of NPDES Permit Violations												
	C. Number of Capacity-Related Overflows												
	D. Number of Maintenance-Related Overflows												
	E. Number of Operations-Related Overflows												
	F. Number of Blockages												
	G. Number of Cave-Ins												
	H. Number of Pump Station Failures												
	I. Peak Flow Factor at Treatment Plant (1 hour high/dry month avg.)												
	J. Monthly Average Treatment Plant Flow Rate (gal/capita/day)												
	K. Monthly High One Day Treatment Flow Rate (gal/capita/day)												
	L. Number of By-Passes at Treatment Plant												
	M. Volume of Treatment Plant By-Passes (gal)												
	N. WWTP Weekly Average Influent BOD (mg/L)												

MANAGEMENT PROGRAMS

1. Organization

a. Organizational Chart

An organizational chart clearly depicts all units in the organization, the lines of authority between the various organization units, a description of the functions of each of the organization units, the title and duties of each position in the organization units and an indication of whether or not each position is currently budgeted and filled.

b. Relation to Other Municipal Functions

An organizational chart clearly depicts the relationship of the sewerage utility to other municipal functions such as public works, streets and drainage, building inspection, building permits, and public health. There is a mechanism for updating the chart in manner timely to changes which may occur in the organization.

2. Training

a. Technical Training Program

This program specifies requirements (curriculum) for initial and refresher training to ensure each employee has a level of knowledge, commensurate with duties, of the overall functions of the utility's infrastructure. This program also includes outside technical training and networking opportunities, such as conferences and seminars, that are made available to employees.

The program includes the extent to which employee certification, at either the State or the utility's organization level, is required as a basis for obtaining or maintaining a position. Records of technical training are maintained and the degree to which completed technical training is tied to promotion and pay is specified. Finally, the program specifies the technical training required before an employee is permitted to undertake specific work assignments or tasks.

b. Skills Training Program

This program specifies requirements (curriculum) for initial and refresher training to ensure each employee has a level of knowledge, commensurate with duties, of the specific equipment to be used and the procedures to be followed in carrying out duties. This program should include outside skills training opportunities, such as manufacturers' or vendors' training workshops, that are made available to employees.

The program includes the extent to which employee certification, at either the State or the utility's organization level, is required as a basis for obtaining or maintaining a position. Records of skills training, whether formal or on-the-job apprenticeship, are maintained and the degree to which completed training is tied to promotion and pay is specified. Finally, the program specifies the skills and on-the-job training required before an employee is permitted to undertake specific work assignments or tasks.

c. Safety Training Program

This program specifies requirements (curriculum) for initial and refresher training to ensure each employee has an adequate level of knowledge regarding on-the-job safety. The program includes the extent to which employee safety certification at the State or at the utility's organization level is required as a basis for obtaining or maintaining a position. Records of safety training, including on-the-job safety meetings, are maintained. Finally, the program specifies the safety training required before an employee is permitted to undertake specific work assignments or tasks.

3. Safety

a. Safety Authority

A Safety Authority (whether a safety department, safety committee, safety officer, or similar mechanism) is present to establish utility safety policy, oversee compliance, and maintain the overall Safety Program. Program maintenance includes specifying safety resources needed for utility activities, assuring record of appropriate standard reporting forms, and establishing a Safety Review Board if appropriate.

b. Confined Space Program

This program provides marking for confined spaces, and uses a permitting system and written standard procedures for confined space entry.

c. General Safety Procedures Program

This program provides instruction in defensive driving, first aid, CPR, personal sanitation, personal protection clothing, and similar general work- related safety issues.

d. Traffic Management Procedures Program

This program provides for standard traffic management techniques, off-hour scheduling of line work, and coordination with law enforcement.

e. Lock-Out/Tag-Out Program

This program provides signs on equipment involved in the program, limitation to authorized personnel, required tag information, and permit requirements.

f. Safety Equipment Program

This program assures the availability of appropriate safety equipment such as tripods and hoists, well-calibrated atmospheric testing equipment, self-contained breathing apparatuses, lights and barricades, exhaust fans, and personal protective clothing.

g. Safety Performance Program

This program tracks parameters such as number of injuries, lost days, and workman's compensation claims to be used by management to assess Safety Program effectiveness.

4. Information Management Systems (IMS)

a. Management Programs IMS

This information management system enables utility management to adequately evaluate operation, maintenance, customer service (complaint response), and system rehabilitation activities so that overall system performance can be determined and utility planning can be conducted.

b. Operation Programs IMS

This information management system is used to track scheduled operational activities and to enhance operational performance. The system ensures timely production of operating reports and standardized data collection methods are used by field personnel (e.g., forms or PDA files). The system requires data review by the field supervisor and securely preserves operating records. While the system need not be computer-based, it should be capable of feeding information to the Management Programs IMS.

c. Maintenance Programs IMS

This information management system is used to track scheduled maintenance activities and to enhance maintenance performance. The system ensures timely production of maintenance reports and standardized data collection methods are used by field personnel (e.g., forms or PDA files). The system requires data review by the field supervisor and securely preserves maintenance records. While the system need not be computer-based, it should be capable of feeding information to the Management Programs IMS.

d. Customer Service IMS

This information management system is used to track reactive activities (i.e., emergencies or customer complaints) and to enhance customer service. The system ensures timely production of complaint reports and standardized data collection methods are used by field personnel (e.g., work order forms or PDA files). The system requires data review by the field supervisor and securely preserves service records. While the system need not be computer-based, it should be capable of feeding information into the Management Programs IMS.

5. Engineering

a. Collection and Transmission System Plans Program

This program ensures a full set of as-built plans for the collection and transmission system are available, field crews have ready access to the plans, and a written standard procedure is present to account changes, update the plans, and supply revised versions to field crews in a timely manner.

b. System Inventory Program

This program ensures an inventory of the utility's collection and transmission system is present, updated, and cataloged by service area or sewershed. The inventory lists the system components with their attributes and characteristics (e.g., pipe age, pipe size, pipe material, invert elevation, pump sizes, location of inverted siphons, pump stations, manholes, etc.).

c. Mapping Program

This program ensures adequately detailed maps are available to be used in conjunction with the utility's MOM programs. At minimum, the maps depict the location of gravity sewer lines, force mains, air valves, manholes (by identifying numbers), pump stations, major appurtenances, and the size of pipes.

d. Sewer System Design Program

This program ensures all new sewer system construction will be adequately designed and constructed using specifications that assure the integrity of the infrastructure. The program includes documented design criteria (e.g., slope and bedding materials), use of standardized construction details, use of standardized materials and construction practices, a standard design review process which includes review by utility personnel for possible maintenance concerns, standardized review forms, and record keeping procedures.

e. New Construction and Rehabilitation Inspection Program

This program ensures new construction or rehabilitative work is properly inspected, and built using the utility's standard construction specifications (including use of best management practices to prevent stream pollution). The program includes use of standardized construction procedures, standardized construction testing procedures, standardized inspection and testing forms/reports, and assurance that the inspection is conducted under the authority and supervision of a registered Professional Engineer. The program also provides subsequent closed circuit television (CCTV) inspection of line construction prior to expiration of the warranty, and retention of the tapes for reference.

f. Acquisition Considerations Program

This program ensures prospective infrastructure is inspected and evaluated for compliance with the utility's standard design and construction criteria before it is acquired by the utility from another entity. The program includes written standard procedures to conduct the evaluation and estimate the time/cost requirements to bring the infrastructure into compliance with utility standards.

g. Continuous Sewer System Assessment Program

i.) Prioritization

This program prioritizes sewer service areas (i.e., sewersheds) for sewer system assessment activities. Prioritization is based upon information such as complaints, flow monitoring (including flow isolation studies), historical location of sewer overflows, pump station run times, field crew work orders, and other relevant information available to the utility.

ii.) Dyed Water Flooding

This program conducts dyed water testing, when appropriate, to locate sources of inflow and other illicit connections to the sewer system. The program includes written standard procedures, standard forms, performance measures, and a mechanism for including dyed water testing information in the IMS.

iii.) Corrosion Defect Identification

This program identifies locations within the sewer infrastructure subject to corrosion and provides for inspection of those locations for corrosion on a routine basis. The program includes written procedures for corrosion identification, corrosion identification forms, performance goals, corrosion defect analysis, and a mechanism for including corrosion defect information in the IMS.

iv.) Manhole Inspection

This program ensures routine inspection of manholes within the sewer system. The program includes standard manhole inspection procedures, manhole inspection forms, performance goals, manhole defect analysis, and a mechanism for including manhole inspection information in the IMS.

v.) Flow Monitoring

This program supplies flow monitoring data to support engineering analyses related to sewer system capacity and peak flow evaluations, and to assist scheduling of sewer line maintenance. The program may include installation of an appropriate number of calibrated permanent and/or temporary flow meters, or rudimentary use of visual flow observations taken during base flow periods in wet and dry seasons. The latter option is more cost-effective for some very small utilities. Either program should include a procedure for adequate rainfall measurement, servicing meters, and a mechanism for including flow monitoring information in the IMS.

vi.) Closed Circuit Television (CCTV)

This program provides internal inspection of the integrity of gravity sewer lines. The appropriate number of qualified CCTV personnel and dedicated equipment, or the scope of a CCTV contract, is determined to ensure sewer inspection work is completed properly. The program includes standard operating procedures (including pre-inspection cleaning), performance measures, and mechanisms for including CCTV information in the IMS and retaining CCTV tapes.

vii.) Gravity System Defect Analysis

This program analyzes gravity sewer system defects. The program includes standard defect codes, written defect identification procedures and guidelines, a standardized process for cataloging gravity system defects, a mechanism for including gravity system defect information in the IMS, and training specified for personnel.

viii) Smoke Testing

This program identifies sources of inflow into the gravity sewer system by use of smoke

testing equipment. The program includes written standard smoke testing procedures, smoke testing forms, performance goals, smoke testing defect analysis, and a mechanism for including smoke testing information in the IMS.

ix.) Service Lateral Investigations

This program investigates infiltration and inflow contributions and other problems originating in service laterals. The program includes written standard investigation techniques, standard investigation forms, performance goals, standard analysis procedures, and a mechanism for including service lateral investigation information in the IMS.

x.) Pump Station Performance and Adequacy

This program permits evaluation of pump station performance and pump station adequacy. The program includes trend analysis of pump run-time meter, pump start-counter, or amperage data; historical review of the fundamental causes of pump failures; use of appropriate remote monitoring and alarm notification equipment; and a mechanism for including pump station performance information in the IMS.

h. Infrastructure Rehabilitation Program

This program rehabilitates gravity sewer lines, force mains, manholes, pump stations, and related appurtenances. The program includes a process for prioritizing rehabilitation, inventory of all completed rehabilitation (including a breakdown of the rehabilitation techniques used), inspection and performance measurement for all completed rehabilitation, written schedules for rehabilitation work, and a mechanism for including rehabilitation information in the IMS.

i. System Capacity Assurance Program

i.) Capacity Assurance for New Connections

This program ensures there is adequate capacity to collect, transmit, and treat additional sewage expected as a result of prospective new sewer connections. The program is integrated into, or thoroughly coordinated with, the building permit process. It is also integrated into the Acquisition Considerations Program described above in 5(f). The program has a mechanism for including capacity assurance information in the IMS.

ii.) Protocols for Capacity Assurance

The program includes, but is not limited to: use of standardized design flow rate rules of thumb (i.e., regarding pipe roughness, manhole head losses, accuracy of distance and slope on as-built drawings, and water use); use of techniques to predict the impacts of additional flow (i.e., use of a hydraulic model of gravity system, pressure system, and other appropriate techniques); and use of flow metering to confirm mathematical estimations of existing peak flow. The program requires certification of adequate capacity by a registered Professional Engineer, and includes an IMS mechanism for integrating analysis from this program with information on infiltration/inflow reduction activities.

6. Overflow Tracking

a. State Agency Reporting Program

This program includes written standard operating procedures which clearly define the minimum State Agency reporting requirements for events where sewage leaves the infrastructure before treatment, and the steps utility personnel must follow to meet or exceed those reporting requirements.

b. Local Agency Reporting Program

This program provides secondary notice to the public and to other appropriate organizations (e.g., downstream utilities with water intakes and local public health authorities) when an overflow presents an imminent and substantial threat to public health or the environment. The program includes written criteria for making this notice, procedures for notifying news media and posting notices at stream locations, and may also prepare an annual summary report available to the public.

c. Records Management Program

This program tracks all events where sewage leaves the utility's collection or transmission system before treatment (i.e., overflows to land, directly to waters, or indirectly to waters by storm drains or other paths). The program uses standardized forms which record, at minimum, the following information for response and inclusion in the IMS:

- Location of the discharge
- Name of the receiving water and description of the pathway (e.g., storm drain)
- Estimation of the discharge volume and the method of estimation
- Description of the system component that is source of the discharge
- Date and time the discharge started and stopped
- Root cause, or suspected root cause, of the discharge
- Steps taken to eliminate the discharge and steps taken to prevent reoccurrence.

7. Financial Analyses

a. Cost Analysis Program

This program regularly analyzes and projects future utility management, operations, and maintenance costs needed to properly implement these utility programs. The cost analyses include, at a minimum: overhead, labor and equipment, financial impacts of outsourcing certain activities, overtime, and the financial impacts imposed by organizational departments or agencies outside the utility. Cost analyses are performed for all management, operations, and maintenance equipment and the capital infrastructure investment. Cost analyses incorporate life cycle depreciation and establish cost-effective points for replacement. The program has a mechanism for including such replacement points in the IMS.

b. Capital Improvement Financing Program

This program analyzes, projects, plans and finances capital improvement needs established through proper engineering study. Capital improvement financing is planned using a five (5) year planning horizon with annual updates.

c. Budget and Customer Rate Program

This program establishes the annual utility budget and recommends customer rates. The program assures that the budget and funding provided by customer rates will meet the cost and capital financing needs set by programs 7(a) and 7(b) above.

8. Equipment and Supplies

a. Spare Parts Inventory Program

This program ensures proper management of the utility spare parts inventory including spare pipe. The program includes adequate parts storage facilities, identification and retention of an adequate number of critical spare parts (i.e., those which are difficult to obtain quickly but critical to proper operations), control of access to spare parts, an organized system for inventory management (either manual or computerized), arrangement with local vendors for common parts, and specification of spare parts to be carried on vehicles.

b. Equipment and Tools Inventory Program

This program ensures proper management of the utility equipment and tools inventory. The program includes adequate equipment and tools storage facilities, control of access to equipment and tools, an organized system for inventory management (either manual or computerized), and specification of equipment and tools to be carried on vehicles.

c. Vehicle Repair Program

This program ensures proper management of utility vehicles. The program includes provisions for vehicle maintenance and vehicle repair. Performance measures for the program will consider turn-around time, cost factors, contract maintenance, and the life cycle cost analysis performed for vehicles.

9. Customer Service

a. Complaint Management Program

This program ensures proper complaint management. The program includes written standard management procedures for dispatchers (i.e., dispatch priorities, work order generation, and standardized complaint and problem codes). The program uses an organized record keeping procedure (including the use of standardized forms) which facilitates tracking work orders and follow-up with customers, and uses a mechanism to evaluate response performance and supply this information to the IMS.

b. Public Information Program

This program communicates utility activities which may closely impact the public (e.g., smoke testing, major construction or maintenance, or emergency maintenance), and ensures communication of activities which may coincide with those of other departments and agencies (e.g., street paving).

c. Public Education Program

This program educates the public and solicits support regarding issues such as service lateral maintenance, grease management, food disposals, inflow sources,

maintenance/rehabilitation needs requiring increased rates, and problems caused by basement sump pumps.

10. Legal Support

a. Inter-Jurisdictional Agreement Program

This program develops, negotiates, and enforces agreements with neighboring utilities which send the utility flow or with major volume sewer customers. The program ensures that the agreements require the second party to have proper management, operation, and maintenance programs so the utility's infrastructure is not stressed by problems originating across jurisdictional boundaries. The program also ensures the agreements address flow-based capacity issues, specify the life of the agreement, have credible provisions for enforcement, and have provisions for modification.

b. Sewer Ordinance Program

This program develops, revises, and amends sewer ordinances as needed to support the proper management, operation, and maintenance of the utility. The program provides adequate legal authority for the utility regarding sewer use, grease management, pretreatment, private service laterals, sump pumps and roof drains, private haulers, recovering costs of damage to utility infrastructure, and other legal authorities as required. Legal support is provided for case work and guidance for utility staff.

11. Water Quality Monitoring

a. Routine Monitoring Program

This program determines the existence of unpermitted discharges originating at locations where sewers cross waterways or at other isolated or remote sewer locations. The program includes scheduled sampling during dry weather periods from a network of monitoring stations. The program also includes a map of the sampling network, and formally establishes sampling frequency, sampling parameters (i.e., fecal coliform and others), standard sampling procedures, quality assurance/quality control procedures, and a mechanism for including program information in the IMS.

b. Investigative Monitoring Program

This program determines the source of industrial, commercial, or sanitary wastewater resulting from cross connections with the stormwater drainage system, and typically activates through complaints or discovery by operations personnel. The program has formally established sampling parameters (i.e., fecal coliform and others), standard sampling procedures, quality assurance/quality control procedures, and a mechanism for including program information in the IMS.

c. Impact Monitoring Program

This program determines the impact of pollution resulting from discharges occurring within the utility infrastructure before treatment. Combined with the reporting programs described in Overflow Tracking (6) above, this program assists the utility, regulatory authorities, and public health authorities determine the appropriate response to protect health and/or the environment. The program has formally established sampling parameters (i.e., fecal coliform

and others), standard sampling procedures, quality assurance/quality control procedures, and a mechanism for including program information in the IMS.

12. Contingency Plan for Utility Infrastructure

a. Contingency Planning Program

This program develops and modifies contingency plans for the sewer system and the treatment facilities that will be implemented during emergency situations. The planning process includes a preparedness committee of senior and experienced management and field personnel. A system overview is conducted to determine vulnerability to a variety of events which may be due to utility failures, natural causes, or failures caused by another party. Based upon these hypothetical events and past experience taken from root cause failure information in the IMS, prediction system component failure is made. Strategies to timely repair or overcome such component failures are developed, and the six (6) major contingency plan components are available in writing: public notification, agency notification, emergency flow control, emergency operation and maintenance, preparedness training, and water quality monitoring (described in 11(c) above).

i.) Public Notification

The public notification component includes a set of criteria, developed with input from local public health authorities, which are used as a basis for initiating public notification; a step-by-step procedural flow diagram; a list of manager names and phone numbers; a plan for regular business hours, off-hours, weekends, and holidays; a list of *Public Contacts* with phone numbers; identification of managers authorized to give statements; and pre-scripted news releases.

ii.) Agency Notification

The agency notification component includes a set of criteria, developed with input from appropriate local, State, and Federal authorities, which are used as a basis for initiating agency notification; a step-by-step procedural flow diagram; a list of manager names and phone numbers; a plan for regular business hours, off hours, weekends, and holidays; a list of *Agency Contacts* with phone numbers; identification of personnel authorized to contact agencies; and copies of standard reporting forms used by the agencies.

iii.) Emergency Flow Control

The emergency flow control component is used to reduce overflow volumes and pollution where possible. The component includes a set of criteria which are used as a basis for initiating emergency flow control procedures; a step-by-step procedural flow diagram; a list of manager names and phone numbers; a plan for regular business hours, off-hours, weekends, and holidays; a list of *Emergency Flow Control Contacts* with phone numbers; identification of personnel authorized to initiate the emergency flow control program; and standard emergency flow control reporting forms.

Flow control activities may include flow re-routing, flow diversion, household flow reduction and advisories, commercial flow reduction and advisories, water pressure reduction and advisories, or use of pretreatment program protocols set forth in permits for

significant industrial users. The initiating criteria, reporting forms and report formats should be developed in cooperation with significant industrial users and appropriate local, State, and Federal authorities.

iv.) Emergency Operation and Maintenance

The emergency operation and maintenance component includes a set of criteria which are used as a basis for initiating emergency operation and maintenance procedures; a step-by-step procedural flow diagram; a list of manager names and phone numbers; a plan for regular business hours, off-hours, weekends, and holidays; a list of *Emergency Operation and Maintenance Contacts* with phone numbers; identification of personnel authorized to initiate emergency operation and maintenance procedures; and standard reporting forms.

The initiating criteria, reporting forms, and report formats should be developed in cooperation with utility's insurance representatives, State and Federal emergency management agencies, and the State regulatory authority. Further, development of the emergency operations and maintenance component should include analyses of the need and use of stand-by equipment (prearranged rentals), stand-by contractors, and access to critical spare parts.

v.) Preparedness Training

The preparedness training component ensures that all personnel are fully aware of procedures and able to efficiently implement the Contingency Plan. The preparedness training component includes specialized training courses, field trials, and special emergency situation safety training.

b. Response Flow Diagram

This diagram includes the roles of senior management and field personnel and shows the relationship of the six (6) major contingency plan components: public notification, agency notification, emergency flow control, emergency operation and maintenance, preparedness training, and water quality monitoring.

OPERATION PROGRAMS

1. Pump Station Operation

a. Preventive Operation Program

This program ensures reliable operation of the transmission system through use written standard operating procedures available for both manned and unmanned stations. Procedures may include reading and recording information from pump run-time meters, or start counters, or taking amperage readings; recording wet well conditions and grease accumulation; checking and resetting (as necessary) wet-well set points; checking and recording system pressure; checking remote monitoring and alarm equipment components; checking operation of alarms and stand-by power; and reporting maintenance needs. The program has established schedules, routes, priorities, standard forms, performance measures, and a mechanism for including program information in the IMS.

b. Reactive Operation Program

This program ensures timely response to atypical situations in the transmission system through use of written standard operating procedures available for both manned and unmanned stations. Procedures may include initiating auxiliary power with portable generators, installing portable pumps during high flow, or initiating the Contingency Plan. The program has established standard forms and reporting procedures, performance measures, and a mechanism for including program information in the IMS.

2. Pretreatment Program

This program ensures that operation of the utility's treatment facility is protected from pollutant pass-through or interference. If a utility has industrial or commercial users it may have this program which includes industrial user identification, permitting, monitoring and inspections, enforcement, and other components. Personnel involved with the utility pretreatment program will have frequent communication with operation and maintenance personnel to detect possible pretreatment permit violations. The program has standard operating procedures, performance measures, inspection schedules, and a mechanism for including program information in the IMS.

3. Corrosion Control Program

This program provides for inspection of the utility infrastructure for corrosion caused by hydrogen sulfide or other corrosives, the development and implementation of site-specific corrosion control measures, a monitoring program to evaluate corrosion control measures, program performance measures, and a mechanism for including program information in the IMS.

4. Fats, Oils, and Grease Control Program

This program prevents fats, oils, and grease from entering the utility infrastructure, therefore preserving sewer capacity, prolonging the infrastructure life, reducing overflow events, and saving the utility maintenance costs. The program includes a grease control ordinance, grease trap and interceptor design standards, permitting and inspecting commercial grease traps and interceptors, a credible enforcement component, a public education component for residential sources, performance measures, and a mechanism for including program information in the IMS.

5. Service Connection/Disconnection Program

This program includes written standard procedures for new sewer tap installation or for sewer disconnection; inspection of all new service connections to, or disconnections from, the utility sewer; a credible enforcement program; performance measures; and a mechanism for notifying personnel in the Mapping Program or including program information in the IMS.

6. Private Haulers Program

This program issues permits to private commercial or septic tank waste haulers discharging to the utility, and includes written standard operating procedures for inspection/sampling of the haulers, a credible enforcement program, program performance measures, and a mechanism for including program information in the IMS.

7. Line Location Program

This program responds to requests for utility sewer line locates, and includes written standard line location procedures, defined prioritization to assist scheduling, appropriate staffing and equipment for the average number of requests, standard line location procedures, standard forms, performance measures, and a mechanism for including program information in the IMS.

MAINTENANCE PROGRAMS

1. Pump Station Preventive Maintenance

a. Pump Station Repair Program

This program is a reactive maintenance component intended to repair pump stations that are currently in a state of disrepair but still cost-effective to service. The program includes established priorities for pump station repairs, maintaining an ongoing inventory of completed repairs, a work schedule for pump station repairs, and a mechanism for including pump station repair information in the IMS. Upon completion of pump station repairs, service activities are transferred to the pump station Preventive maintenance program.

b. Electrical Maintenance Program

This program is a component of the pump station Preventive maintenance program. The program includes an established number of crews and personnel required to perform effective electrical maintenance, written standard electrical maintenance procedures, scheduling Preventive maintenance, standard forms, performance measures, and a mechanism for including electrical maintenance information in the IMS.

c. Mechanical Maintenance Program

This program is a component of the pump station Preventive maintenance program. The program includes an established number of crews and personnel required to perform effective mechanical maintenance, written standard mechanical maintenance procedures, scheduling Preventive maintenance, standard forms, performance measures, and a mechanism for including mechanical maintenance information in the IMS.

d. Physical Maintenance Program

This program is a component of the pump station Preventive maintenance program. The program includes an established number of crews and personnel required to perform effective physical maintenance, written standard physical maintenance procedures, scheduling, standard forms, performance measures, and a mechanism for including physical maintenance information in the IMS.

2. Gravity Line Preventive Maintenance

a. Routine Hydraulic Cleaning Program

This program includes accurately determined cleaning needs, established priorities and scheduled cleaning activities, support of an appropriate number of crews and personnel, acquired necessary equipment (e.g., Jet Unit, Combination Unit, etc.), written standard hydraulic cleaning procedures, standard forms, performance measures, and a mechanism for including hydraulic cleaning information in the IMS.

b. Routine Mechanical Cleaning Program

This program includes accurately determined cleaning needs, established priorities and scheduled cleaning activities, support of an appropriate number of crews and personnel, acquired necessary equipment (e.g., Rodders, Bucket Machine, etc.), written standard mechanical cleaning procedures, standard forms, performance measures, and a mechanism

for including mechanical cleaning information in the IMS.

c. Root Control Program

This program includes accurately determined root control needs, established priorities and scheduled activities, support of an appropriate number of crews and personnel, acquired necessary equipment (e.g., mechanical, chemical, etc.), written standard root control procedures, standard forms, performance measures, and a mechanism for including root control information in the IMS.

d. Manhole Preventive Maintenance Program

This program includes accurately determined manhole maintenance needs, established priorities and scheduled activities, support of an appropriate number of crews and personnel, acquired necessary equipment (rings and lids, structural repair, etc.), written standard manhole maintenance procedures, standard forms, performance measures, and a mechanism for including manhole maintenance information in the IMS.

3. Air Valve Preventive Maintenance Program

This program provides for inspection and maintenance of air valves located on force mains (including regular valve exercise). The program includes an established number of crews and personnel required to perform effective Preventive maintenance, written standard air valve maintenance procedures, scheduling, standard forms, performance measures, and a mechanism for including air release valve maintenance information in the IMS.

4. Maintenance of Way

a. Maintenance of Rights-of-Way and Easements Program

This program includes accurately determined maintenance needs, established priorities and scheduled activities, support of an appropriate number of crews and personnel (based on the number of waterway crossings and/or miles of sewer off-street), written standard maintenance procedures, standard forms, performance measures, and a mechanism for including maintenance information in the IMS.

b. Street Paving Monitoring Program

This program includes accurately determined monitoring needs, established priorities and scheduled activities, coordination with storm drain projects and street and highway officials, support of an appropriate number of crews and personnel, acquired necessary equipment (e.g., manhole and valve raising, etc.), written standard monitoring procedures, standard forms, performance measures, and a mechanism for including monitoring information in the IMS.

5. Reactive Maintenance Program

This program provides response to customer complaints or other unscheduled system problems forwarded by dispatchers. The program includes support of an appropriate number of crews and personnel, written standard response procedures including a protocol for initiating the Contingency Plan, standard forms, collection of information in support of failure analysis, sewer map availability, performance measures, and a mechanism for including reactive maintenance information in the IMS.

System-Wide MOM Programs Recent Performance Summary													
Performance Measures for Previous 12 Months	Year / Month												
	A. Number of Customer Complaints												
	B. Number of NPDES Permit Violations												
	C. Number of Capacity-Related Overflows												
	D. Number of Maintenance-Related Overflows												
	E. Number of Operations-Related Overflows												
	F. Number of Blockages												
	G. Number of Cave-Ins												
	H. Number of Pump Station Failures												
	I. Peak Flow Factor at Treatment Plant (1 hour high/dry month avg.)												
	J. Monthly Average Treatment Plant Flow Rate (gal/capita/day)												
	K. Monthly High One Day Treatment Flow Rate (gal/capita/day)												
	L. Number of By-Passes at Treatment Plant												
	M. Volume of Treatment Plant By-Passes (gal)												
	N. WWTP Weekly Average Influent BOD (mg/L)												

SYSTEM PROFILE AND PERFORMANCE SUMMARY

A proactive utility will maintain a profile of its system as a basis for explaining its situation to regulatory agencies, the public, and when networking with other utilities. A profile typically contains basic population and inventory information as well as a recent system performance summary. An example of a system performance summary is provided on the following page.

Population Served: ..... _____

Number of Customers: ..... _____

Number of Treatment Plants: ..... _____

Total Wastewater Design Treatment Capacity: _____

Total Volume of Wastewater Treated: ..... _____

Miles of Gravity Sewers: ..... _____

Number of Manholes: ..... _____

Number of Inverted Siphons: ..... _____

Number of Pump Stations: ..... _____

Miles of Force Main: ..... _____

Number of Employees: ..... _____

Annual Capital Improvement Budget: ..... _____

Annual Operation and Maintenance Budget: ... _____

Total Annual Operating Budget: ..... _____