Approaching CMOM

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SECTION ONE

BACKGROUND

The Clean Water Act of 1972 (CWA) specifically prohibited the discharge of untreated sewage to the waters of the USA. Whether the source of the overflow was the Wastewater Treatment Facilities or an overflowing manhole on the collection system was of no concern. The implementation of the CWA was via the issuance of a National Pollutant Discharge Elimination System (NPDES) permit to the operator of the publicly operated treatment works (POTW's). The permits set discharge standards, monitoring and reporting requirements for the municipal dischargers. The "No Overflow" provisions of the permit were very visible but the actual requirement seemed to apply to overflows or bypasses of the treatment facilities or to major capacity related overflows on the collection system during major storm periods.

During the 70's and 80's, literally all of the POTW's had improved levels of wastewater treatment to meet secondary treatment standards and the collection systems were under study and implementing I/I control methods to reduce extraneous water in the system that was contributing to the major overflows during wet-weather storm periods. Major sewer system evaluation surveys were conducted in an effort to define programs of cost-effective I/I removal. Unless the expected I/I reduction was less than 35% to 40% of the rainfall derived infiltration (RDI) little rehabilitation could be economically justified. The emphasis for collection systems I/I control continued into the 90's, with a realization that overflows of the sanitary sewer system were not only caused by capacity related overflows, but also by maintenance related overflows. Overflows of this type on the sanitary sewer system, occasioned by stoppages and blockages, usually result in a backup and overflow at the nearest upstream manhole or in the home of an unfortunate user.

From the mid 90's to the present, the industry and EPA have been working on formulating new Sanitary Sewer Overflow (SSO) regulations. This time, overflows of any kind and volume were defined as a prohibited discharge. In preparing the new regulations, EPA recognized that currently acceptable maintenance practices were not effective in removing overflows, quite the contrary, using current maintenance practices, the number of overflows recorded each year was increasing.

An increasing number of overflows could not be attributed to capacity related overflows since these overflows were addressed during the 80's when Sewer System Evaluation Surveys (SSES's) were being conducted throughout the US and additional capacity became available via the construction of relief sewers. Presently, the major source of system overflows is the accumulating and growing number of deteriorating and failing pipe in the collection system.

TABLE 1.1 - Types and Causes of Overflows

TYPE	CAUSE
• Capacity Related	Design, Undersizing, Excessive I/I Deferred Improvements
• Maintenance Related	
Stoppages	Deferred Maintenance
Blockages	Pipeline Deterioration and Failure, Deferred Maintenance

Table 1.1 provides a listing of the types and causes of overflows. Capacity related overflows are shown to be caused by several different controllable problems appearing as bad judgement, poor planning and substandard construction practices. Maintenance related overflows, appear to be caused by operations that allow the accumulation and buildup of flow impeding damage conditions in the system and the inaction of management to provide timely and effective repairs and/or replacement of the affected element of the system.

By the mid 90's, it became apparent, that although most systems had conducted SSES's , built out major relief sewers and rehabilitated portions of their systems, planned reductions in I/I were not being achieved. The number of capacity related overflows had been reduced, but the number of maintenance related overflows, or those related to stoppages and blockages of the system were on the rise. This was evidenced by the increasing number of service calls regarding stoppages and blockages of service laterals and main lines of the system. Although perhaps millions of dollars were spent locally on system improvements to control and reduce I/I, little had been done to check the continuing deterioration of the collection system. Worse, the accumulating and growing system damage conditions were undefined, relatively unknown to systems management, and yet posed an immediate and imminent threat of system failure.

Although the CWA of 1972 prohibited the discharge of any untreated wastewater to the waters of the USA, regional enforcement authorities such as the SF Bay Regional Water Quality Control Board were using allowable discretionary authority to enforce the overflow provisions of the Act. Examples were defining an overflow as a spill having a volume of 1000 gallons or more, or as being allowed, if occurring during major storms having a return frequency in excess of five years. Approximately 25 years passed, at the end of which, NPDES permitted POTW's had been upgraded to best available technology, and collection system operations were continuing to control and reduce I/I, and at least meet the discretionary discharge conditions for wet weather overflows established in the permit.

The new Sanitary Sewer Overflow (SSO) Regulations were promulgated in 1999, but as yet have not been published as final. That action is not expected until later in 2003. In it's draft form, the SSO regulations define the emergency or disaster conditions under which a sewage spill is allowed; any other spills of untreated wastewater to the waters of the USA are prohibited, and in the event of an enforcement action, the burden of proving the discharge was unavoidable rests with the permittee. These new regulations appear to reinforce the provisions of the CWA and remove the guesswork allowed by the insertion of discretionary provisions in the permit. The new regulations also provide guidelines for the development of a Capacity, Management, Operation and Maintenance (CMOM) program designed to improve maintenance practices, reduce operating costs and raise the level of reliability of collection systems. In establishing these guidelines, EPA recognizes that current collection system operation and maintenance practices are insufficient to provide the reliability necessary to operate the system in a safe and functionally efficient manner. The draft further states, that when implemented, the quality of a permittee's CMOM program will be considered in any enforcement actions taken in response to a permit violation; ie: a spill or overflow of untreated wastewater to the waters of the USA. .

What is a CMOM program? In general, it is the application of good business practices to the operations of the sanitary sewer system. It is a dynamic management, operation and maintenance approach for sanitary sewer collection systems that uses information about system performance, changing conditions, and operation and maintenance practices to guide and modify responses, routine activities, procedures, and capital investment in the system.

In California, some of the Regional Water Quality Control Boards have already implemented the provisions of the SSO regulations through issuance of a General Permit to not only POTW's, but to all public agencies operating sanitary sewer systems. In Orange County, all cities and districts are now operating under a General Permit that defines the "No Overflow" discharge prohibition and further provides the guidelines for the development of a CMOM program. Presently, the SF Bay Regional Water Quality Control Board is considering the adoption of a General Permit that is similar in all respects to the permit used in Orange County, it is intended for application to all collection system agencies in Region 2, and is expected to be implemented by the end of summer 2003.

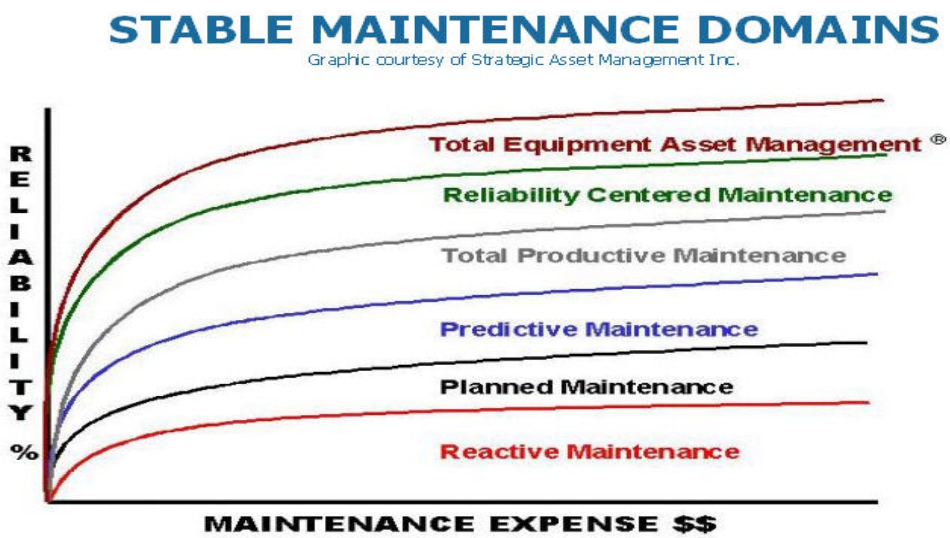
Reliability of the Sanitary Sewer System Collection system damage is an accumulating and ongoing problem of unknown dimensions in most sanitary sewer systems. The current level of capital expenditures on system repairs and replacements is inadequate to reduce the number of overflows reported each year. Although the sanitary sewer system is likely to be a city's most highly valued asset, it and other underground utilities not publicly visible, generally receive a low priority for city maintenance dollars. Current Maintenance practices in most cities ignore consideration of line replacement until failure has taken place.

Industry discussion points for the need to 1) improve system reliability via improved maintenance practices, and 2) take timely and efficient actions to repair or replace damage conditions that lead to the occurrence of a system overflow.

Improving System Reliability Figure 1.1 is a graphic comparing system reliability to maintenance expense for various stable maintenance modes. Reactive Maintenance as shown in the figure is the "bury it and forget it" maintenance mode that awaits a system failure before considering maintenance repairs. If we equate high reliability with safe and functional operation, Reactive Maintenance would obviously present the users with the least reliable system.

Scheduled or Planned Maintenance usually establishes a cleaning or maintenance frequency for the individual components of the system, then follows that schedule of work to maintain the entire system. In theory, one expects a high level of reliability when Scheduled maintenance is practiced, but in reality, for other that those fortunate incidents when scheduled maintenance finds and fixes a significant damage event just prior to it causing an overflow or system failure, this maintenance mode is still reactive. After a stoppage or blockage occurs, the line cleaning frequency may be shortened and shortened, but actions to repair or replace the line segment usually do not take place until there have been numerous overflow occasions or a line failure. Operated in that manner, Scheduled Maintenance it is only an enhanced form of Reactive Maintenance.

FIGURE 1.1 – Reliability vs. Expense for Stable Maintenance Modes



Predictive Maintenance of the sanitary sewer system is defined by additionally performing periodic condition assessments of the system and evaluating the extent of system structural and condition damage that are the cause of system overflows. This maintenance mode provides the means to implement a "dynamic system management framework that encourages evaluating and prioritizing efforts to identify and correct performance-limiting situations in the collection system".(Ref.1)

In predictive maintenance, periodic condition assessments provide the means to monitor, track and evaluate the structural and condition-limiting performance characteristics of the system. When structural or condition damage is found that is known to possibly impede or restrict the design flow carrying capacity of the line segment, the subject sewer line is scheduled for repair or replacement as soon as practical. In making the final decision of whether to repair or replace the line segment, a comparison of the differential life-cycle costs over the extended life of the repaired line segment is made between the two alternatives. The calculation provides management with the assurance that only lines having reached the end of their useful life are replaced, and that the repair or replacement needed is taking place timely and effectively before the occurrence of a system overflow. Before facilities replacement, all collection system facilities, including pump stations, access structures and line segments undergo this type of evaluation.

Referring back to Figure 1.1, if high system reliability is necessary to achieve the goal of "no overflows", regardless of how much money is expended on maintenance, the goal cannot be achieved as long as sanitary sewer systems continue in a Reactive or Scheduled Maintenance mode.

> *CONCLUSION: A goal of "no overflows" cannot be achieved without improving current maintenance practices. A Predictive Maintenance level can improve system reliability above present levels and provide the path to achieving a goal of "No Overflows".*

Improvements in reliability shown by the several maintenance modes above Predictive Maintenance are supplements of the Predictive Maintenance Mode. Total Productive Maintenance occurs when an organized and committed staff, including management, engineering and maintenance personnel, working together toward a common objective, gain enough cross-training to understand each others needs in performing their support role. This understanding encourages innovation and ideas to increase productivity throughout the entire organization. Productive maintenance is seen with improvements in the unit costs of performance measures conducted as part of a CMOM program.

Reliability Centered Maintenance occurs when the entire organization is focused on meeting performance objectives that are the accepted reliability measures. All connected personnel are fully aware of theirs and others contribution to the success of meeting the annual performance objectives and the ultimate goal of "no overflows". Monthly monitoring and tracking of system performance measures are discussed with and by staff. Results are proudly displayed for all to see.