Evaluating the Effectiveness of Wastewater Collection System Maintenance

By Randy Stalnaker and Mike Rigsby

In some regions of the United States, the U.S. Environmental Protection Agency (EPA) has begun enforcing Sanitary Sewer Overflow (SSO) regulations. Numerous utilities have been subjected to enforcement actions in the form of fines or administrative orders to correct the problem.

In addition, the EPA is in the process of determining whether to establish a national policy addressing SSOs. The agency has appointed a group of stakeholders, called the SSO Advisory Committee, to help make that determination and develop a framework from which a national policy could be written.

Since the relationship between system maintenance and prevention of overflows has been established in previous studies[1], the SSO Advisory Committee has indicated that adequate maintenance of the sewer system is one critical component of any program to minimize the number of SSOs, ensure compliance with applicable laws and avoid enforcement action. EPA believes that most SSOs result from poor collection system installation or maintenance[2].

Nevertheless, obtaining funding for adequate maintenance of sanitary sewer systems can be difficult. Governing bodies such as city councils or commissions are frequently reluctant to provide sufficient resources for proper maintenance of aging infrastructures. Budget policies tend to favor new construction rather than maintenance, repair and replacement[3].

Method

Thirteen major U.S. cities (with separate sanitary sewer systems) were surveyed to assess resources allocated to maintenance, environmental factors, and the percentage of the system cleaned and televised and the nature and number of SSO occurrences. To assure confidentiality, the utilities are identified by number only.

Each of the 13 cities was asked to provide the length and age of the system, population served, number of service connections, budget for system maintenance, number of employees assigned to system maintenance, amount of system cleaned, amount of system televised, amount of system replaced or rehabilitated annually, number of stoppages, number of dry and wet weather overflows, number of back-ups into buildings, average dry weather flows, peak flows during wet weather and annual rainfall amount.

The data gathered was then analyzed to compare the relative amount of resources dedicated to sewer system maintenance, with the intention to provide benchmarking information.

Benchmarking is defined as a method of comparing a utility or operation with a selected group of similar operations[4]. Benchmarking has recently received a great deal of attention. In 1995, the Association of Metropolitan Sewerage Agencies conducted a survey of its members that focused on wet weather SSOs, their prevalence and what these utilities have done to address the problem. The survey found an average of 827 sewer backups per thousand miles of sewer line occur per year[5].

Efforts have been made in the past to develop useful benchmarks[6,7]. This paper expands on those efforts in an attempt to provide benchmarks that can be easily calculated to compare and evaluate adequacy of personnel, review allocation of funds and identify possible shortcomings.

Findings

Our survey's findings can be divided into three types: system characteristics, resources allocated to maintenance and benchmarking ratios. Each will be addressed separately.

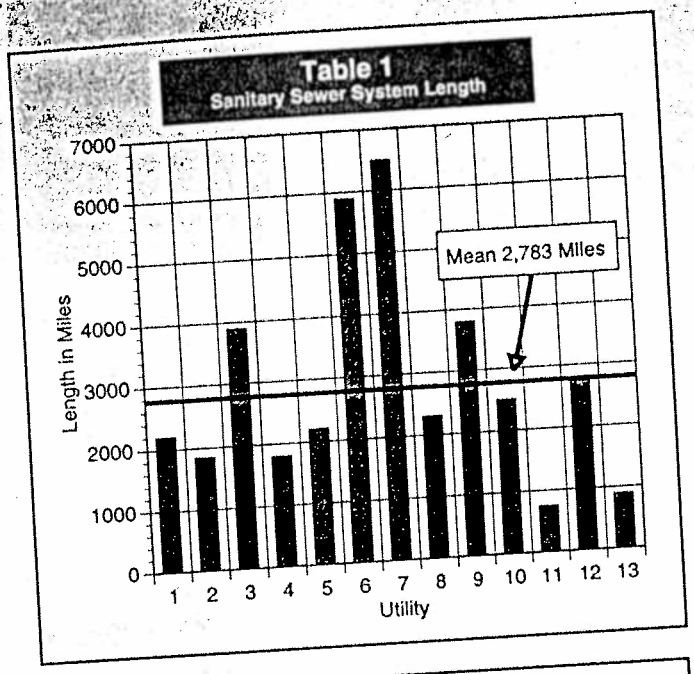
System Characteristics: Table 1 shows the length of each of the 13 sanitary sewer systems that participated in the survey. The average system length is 2,873 miles.

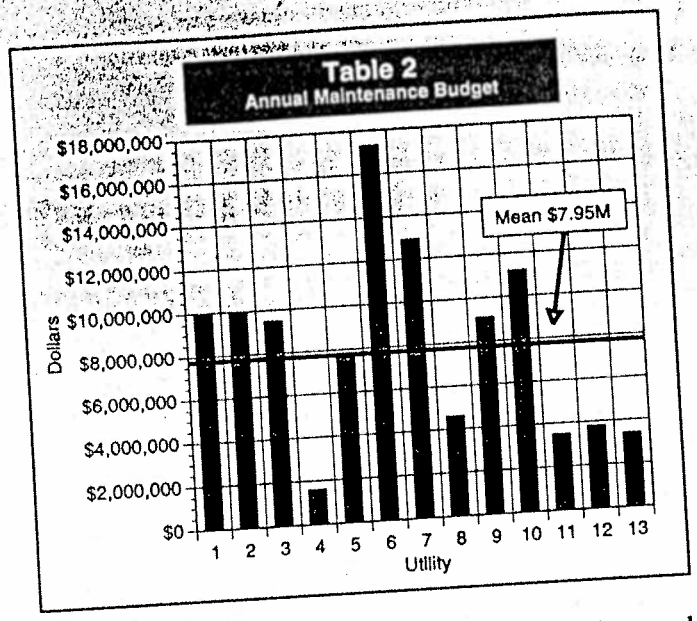
Resources Allocated to Maintenance: Table 2 illustrates the size of the annual sanitary sewer system maintenance budget. The average annual maintenance budget for these 13 utilities is $7,952,013.

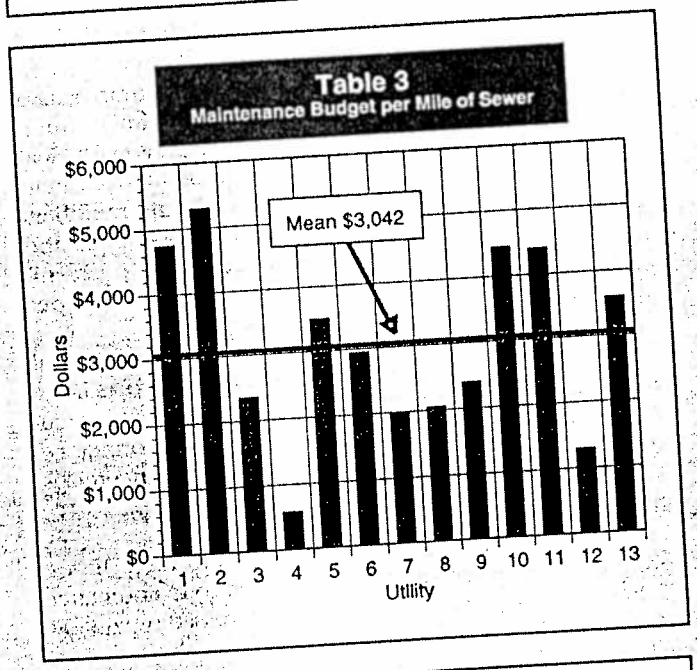
Benchmarking Ratios: The ratio between the size of the annual maintenance budget and the length of the system is shown in Table 3. The survey found that the average budget for these utilities is approximately $3,042 per mile of sewer. Furthermore, the findings were relatively consistent, with most of the utilities not varying dramatically from the average.

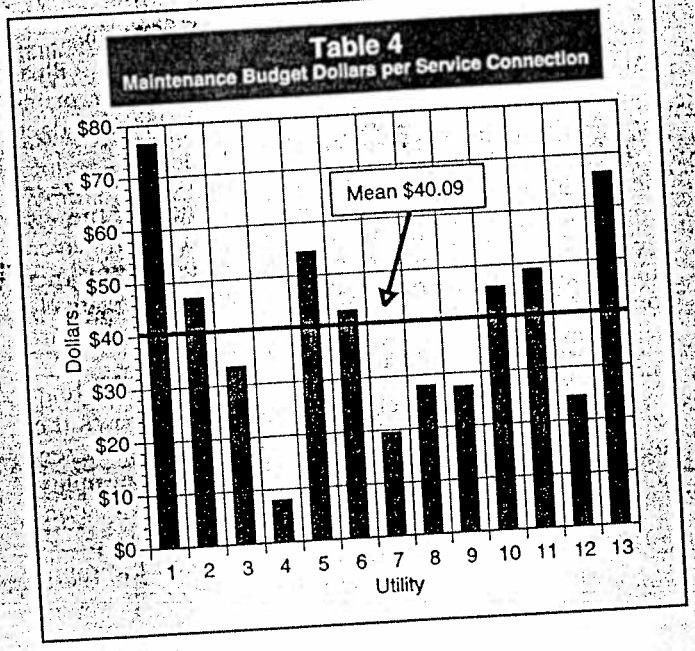
Table 4 illustrates related information comparing budget resources to system characteristics. It compares the size of the maintenance budget with the number of service connections to the system. The average utility included in the survey spends about $40 per service connection per year on maintenance.

Table 5 illustrates the relationship between the number of maintenance workers and the length of the sewer system. The average number of workers per mile is









approximately .06 or about 60 workers per thousand miles of sewer system.

Table 6 shows the percentage of the system cleaned annually by the surveyed utilities. The results indicate a great deal of variability with an average mount of 24.02%.

The percentage of the sewer system televised annually is also variable. The average percentage televised annually is approximately 4.8% as seen in Table 7.

Discussion

Although the survey requested information on dry and wet weather SSOs, it was not always forthcoming. We believe that there are two reasons for this:

- Not all cities keep comprehensive or consistent records of overflows and/or sewer backups. Different operators use different terminology, making it difficult to ensure consistency in data interpretation.
- There may be reluctance to share information concerning overflows because of the potential for enforcement action, unfavorable publicity or lawsuits by environmental groups.

Since information concerning overflows was incomplete, it is not included in this paper. However, the analysis of the data on SSOs that was obtained showed little relationship to maintenance. That is, the results of this survey do not indicate a direct relationship between a higher level of maintenance and a utility's experiencing fewer SSOs. These findings are consistent with those of a previous survey of different utilities[8]. Some of the reasons for these findings are local factors, age of the system and amount of rainfall.

Local factors are the most important in preventing SSOs. These factors include knowledge of the sewer system on the part of managers and supervisors to make the most efficient use of maintenance resources, especially cleaning. Knowledge and training of maintenance workers also is a factor and there is certain to be variability among utilities in this area. Topography is also important and obviously varies between utilities.

Age of the system and differing rates of deterioration are factors. Sewer system deteriorate at different rates depending on internal conditions as well as methods used in construction and the materials used.

Amount of rainfall is a major factor. One city included in the survey allocates only a small amount of resources to system maintenance, but achieves excellent results in the area of SSO prevention because it is located in an arid part of the country.

Conclusion

The results of this survey and the analysis of the data obtained can be of value to collection system operators. First, it allows them to compare the resources they are allocating to maintenance of their collection systems. From these tables, operators can determine whether resources allocated are at a level comparable to similar cities. If resources allocated are below average and collection system performance is not satisfactory to the operator, the information can be useful to provide to the operator's city council (or other governing body) as evidence of inadequate funding.

Survey results could also be used as a defense against proposed enforcement actions. If an operator can demonstrate that an average or greater level of resources is being dedicated to sanitary sewer system maintenance or that system performance is not below average, the regulatory agency may be persuaded not to pursue an enforcement action.

Recommendations

Collection system operators must keep consistent and comprehensive records of overflows, stoppages, backups and all facets of maintenance. Without this data, proper analysis of collection system performance is impossible. Regulatory agencies will also be less sensitive to the vagaries of operating and maintaining a sanitary sewer system if there are not adequate records.

A broader study of collection system performance and maintenance practices should be conducted. Operators must be willing to share their data freely. If this study was performed by a recognized, objective national organization, it could lead to development of useful standards enabling system operators to make the best use of their scarce resources.

Table 5
Maintenance Workers per Mile of Sewer

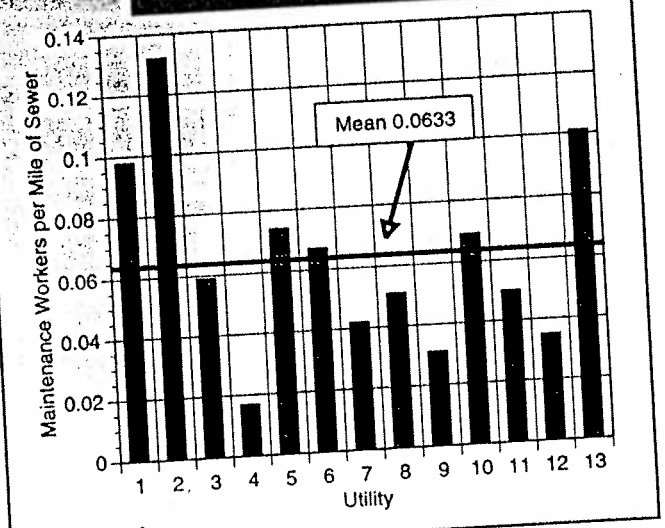


Table 6
Percent of System Cleaned Annually

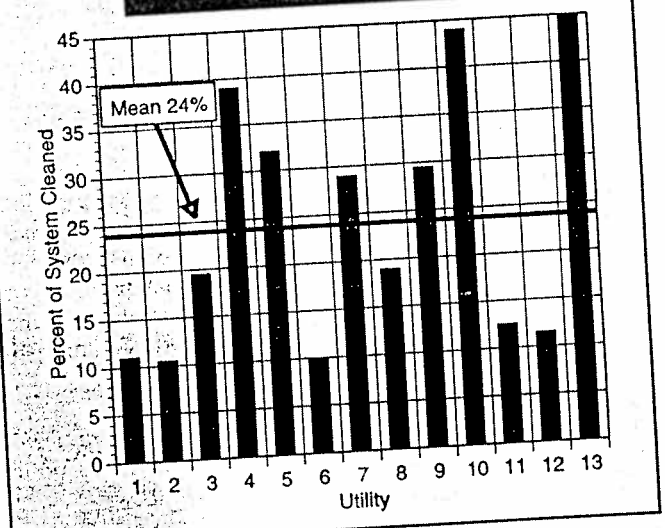
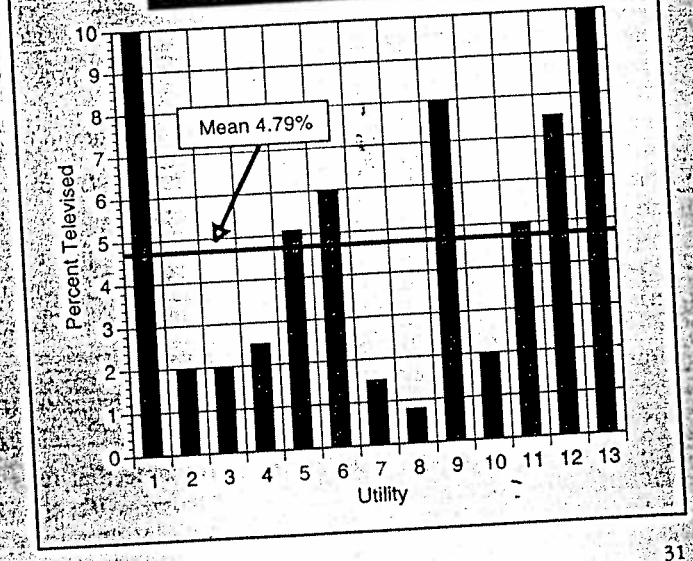


Table 7
Percent of System Televised Annually



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