Chapter 7

Collection Systems

Buried and linear assets—so often forgotten—can be high-maintenance and high-cost if not managed properly.

NYWEA

Environmental Finance Center
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Chapter 7:
Collection Systems

Municipal sanitary sewer collection and conveyance systems are an extensive, valuable and complex part of municipal infrastructure. Collection systems consist of pipelines, conduits, pumping stations, force mains and other components to collect wastewater and convey it to facilities that provide treatment prior to discharge to the environment.

The proper design, and operation and maintenance of these wastewater system components are critical factors given their relationship with potable water in the general level of good health enjoyed by us all. Most members of the general public take for granted a well operated wastewater collection system and are not fully aware of its design and technical workings. The taxpaying public expects these systems to function effectively and at a reasonable cost.

"Lack of proper maintenance results in the potential for subsequent basement back-ups, overflows, cave-ins, hydraulic overloads at treatment plants, and other safety, health and environmental problems."

The condition of many collection systems is poor and many systems have received minimal maintenance for a number of years as a result of the financial burdens of repair and upgrade in light of increasing regulations and decreasing public subsidies. Money is typically spent on above ground utilities that are more noticeable, and sewers are often the deepest infrastructure in the municipal right of way. When pipe or manhole replacement is required by a trenched excavation, the work often disturbs other utilities and roadway structures, and requires maintenance and protection of traffic. For such reasons, the sewer collection system can be one of the most expensive assets owned by a municipality. Wastewater systems usually suffer from a history of inadequate investment in maintenance and repair, often due in large part to the "out-of-sight/out-of-mind" nature of the buried asset. New York State contains 1,060 sewage collection systems, totaling 22,000 miles of sewers. More than 30 percent of these sewers are older than 60 years and beyond the expected useful life span. In 2008, the estimated monetary needs for inflow/infiltration correction, major sewer system rehabilitation, new collectors and interceptors and their appurtenances for statewide maintenance and repair totaled $6.6 billion (NYSDEC 2008). Based upon the value of the asset and its costly replacement, the maintenance of buried assets generally merits a greater level of attention.

Lack of proper maintenance results in deteriorated sewers with the potential for subsequent basement back-ups, overflows, cave-ins, hydraulic overloads at treatment plants, and other safety, health and

Proper maintenance of the collection system is critical for optimum system performance. (Town of Tonawanda) environmental problems. A most serious and environmentally threatening problem is sanitary sewer overflows (SSOs) which are a frequent cause of water quality violations and a threat to public health and the environment. Controlling leaks and blockages in sewer collection systems to prevent overflows is critical.

Capacity Management, Operation and Maintenance (CMOM) Programs

A framework for a dynamic management approach to collection systems is known as Capacity Management, Operation and Maintenance (CMOM) Programs. The USEPA in conjunction with municipal and industry representatives have developed this methodology to primarily address the need for adequate collection system capacity to convey peak flows in all parts of the sewer system to mitigate sewer overflows.

The USEPA estimates that almost one half of all flow at wastewater treatment plants is represented by

Rehabilitation Methods for Sewer Collection Systems and Underground Structures*

Operations	Type/Description	Advantages	Disadvantages	Areas of Application
Chemical Grout	Impregnation of the soil surrounding the pipe with a curable compound, thus effectively sealing the soil. Chemical grout can be used to stop leaks in pipe joints and cracks, as well as leaks around lateral connections and manholes.	• No excavation • Very flexible • Repair limited to damaged area • Quick • Economical • Longevity • Stops infiltration • Stabilizes soil outside the pipe.	• No structural repair to the pipe itself, except for the stabilization of the supporting soils outside the pipe. • Flow diversion required during inspection and application • Pipe sags or collapses require excavation for replacement	• Repair of sewer line joints • Manhole infiltration • Lateral infiltration • Underground structures
CIPP Lining	Flexible tube externally coated with a polyurethane membrane and internally with resin, is inverted on site by air/water pressure. The tube turns inside out and travels down the pipe and is later cured by hot water.	• No excavation - less disruptive than open-cut excavation • Economical compared to manhole-to-manhole replacement • New pipe within existing pipe	• Tightness of liner to pipe is questionable; an annular space exists. • Flow diversion required during inspection and application • Pipe sags or collapses require excavation for replacement	• Repair of holes and areas of extensive cracking • Structural repairs • Lateral repairs
Fold and Form Liner	A folded thermoplastic pipe is pulled into place through a manhole and then rounded, using heat or steam and pressure to conform to the internal diameter of the existing pipe.	• No excavation- less disruptive than open-cut excavation • New pipe within existing pipe	• Reduction of pipe diameter • Long-term buckling strength may be an issue • Limited to small diameter pipes • Flow diversion required during inspection and application • Pipe sags or collapses require excavation for replacement	• Repair of holes and areas of extensive cracking

Operations	Type/Description	Advantages	Disadvantages	Areas of Application
Slip Lining	Insertion by pulling or pushing a new pipe into the old one. The remaining annular space may be filled with granular material.	• No excavation - less disruptive than open-cut excavation • New pipe within existing pipe	• Reduction of pipe diameter • Full length of pipe has to be lined • Lateral connection is difficult to reconnect • Grouting of annular space may be necessary. • Flow diversion required during inspection and application • Pipe sags or collapses require excavation for replacement	• From manhole to manhole • Medium level of damage
Pipe Bursting	Technique which uses radial forces to break out and push away the pieces of the existing pipe and permit a new pipe to be simultaneously installed.	• New pipe inserted in place of existing pipe. • Limited surface disruption	• Spot excavation required • Laterals reconnected by digging • More expensive than pipe rehabilitation methods. • Flow diversion required during inspection and application • Pipe sags or collapses require excavation for replacement	• Replacement of badly damaged sewers • Interceptors or collector sewers with few laterals • Can insert larger diameter to provide capacity upgrade
New Pipe Installation	Soil is excavated and new pipe is installed.	• Completely new pipe • Longer useful life? • Modification of diameter is possible • Simple and well-known technology	• Large surface area disturbed • Risk of damaging other pipes and cables during excavation • Expensive • Time consuming	• Where collapses, sags, poorly constructed lateral connections and severe structural defects exist. • To address hydraulic deficiencies • Where trenchless options are inappropriate

**From "Methods to Control Leaks in Sewer Collection System," White Paper: Center for Innovative Grouting Materials and Technology (CIGMAT), Dept. of Civil and Environmental Engineering, University of Houston, Texas, October 2004.*

infiltration and inflow (I/I). Controlling I/I is a critical factor in effective system performance.

Sewer Rehabilitation Methods

Methods for controlling collection system leaks, infiltration and exfiltration include:

- Chemical grouting
- Cured-in-place liners
- Fold and form liners
- Slip lining
- Pipe bursting
- Complete replacement with modern materials

Asset Management Approach to Buried Infrastructure

Knowing what buried assets are owned and where they are located is the starting point in developing an asset management plan. This is vital in developing a long-term capital plan leading to the sustainability of the buried asset.

By incorporating the use of record mapping, institutional knowledge of the system, maintenance logs, and technical data on the initial construction and materials, municipalities can build an initial inventory of assets and update it as more information becomes known. It is important that a starting point be established to build upon.

Assessing the condition of the collection system and subsequent remaining life will lead to a risk-based asset management protocol. Knowing the five core components of asset management will lead to a better decision-making process in assuring sustainability of the buried assets.

1) Asset Inventory
2) Level of Service
3) Critical Assets
4) Life Cycle Costing
5) Long-Term Funding Strategy

Minoa's sewer camera work helps the Village set priorities.

Green Technologies for Reducing Stormwater

Green technologies also play a role for maximizing existing collection capacity by decreasing I/I flows in the system by utilizing groundwater surface recharge. Many municipalities are using rain barrels, rain gardens, rooftop green areas, or porous pavements to very effectively mitigate stormwater entering the sanitary system. Inflow to the collection system is also reduced by disconnecting private property sources including storm sewer culverts, sump pumps, roof leaders, and basement drains. Keeping stormwater out of the sanitary system reduces the costs for conveyance, pumping and treatment, often far more cost effectively than building additional capacity at the treatment plant.

Funding

Funding options for support of realistic capital planning need to be evaluated and pursued in a way to maximize the leveraging power of each source. Gone are the days of utilizing only one funding source to accomplish major works. Some options include:

- Short-term Bond Anticipation Notes *(BANs)*
- USEPA
- NYSDEC
- NYS Environmental Facilities Corporation *(CWSRF)*
- USDA Rural Development *(WEP)*
- Member Item Initiatives
- Green funding opportunities - i.e., NYSEFC Green Innovation Grant Program *(GIGP)*
- NYS Regional Development Council
- NYS Department of State
- Appalachian Regional Commission
- USEDA Economic Development Administration
- NYSERDA
- CWSRF Engineering Planning Grant

Additional funding considerations

Consider project phasing, sanitary district consolidation, innovative inter-municipal agreements, public/private partnerships, Private Activity Bonding (PAB), funding that rewards "carbon footprint" reduction—such as the USDOT TIGER grants—and initiative programs, like the Clean Water State Revolving Fund Engineering Planning Grant. Also, investigate the feasibility of developing an offset plan. An offset plan establishes a program to ensure the new development flow in one or more segments of the Publicly-Owned Treatment Works (POTW) with capacity constraints will be offset by the removal of infiltration and inflow within the system in a specific volume determined by the sewer jurisdiction. This program may lead the way to discussing project cost sharing and incentive opportunities during the approval of new sewer connections and developments.

Summary and Conclusions

Municipal sanitary sewer collection and conveyance systems represent a major portion of the wastewater facility and municipal investment. Capital improvement plans must be based upon good databases. Asset management must be a core activity for maintenance and protection of these tremendously high replacement cost buried assets.

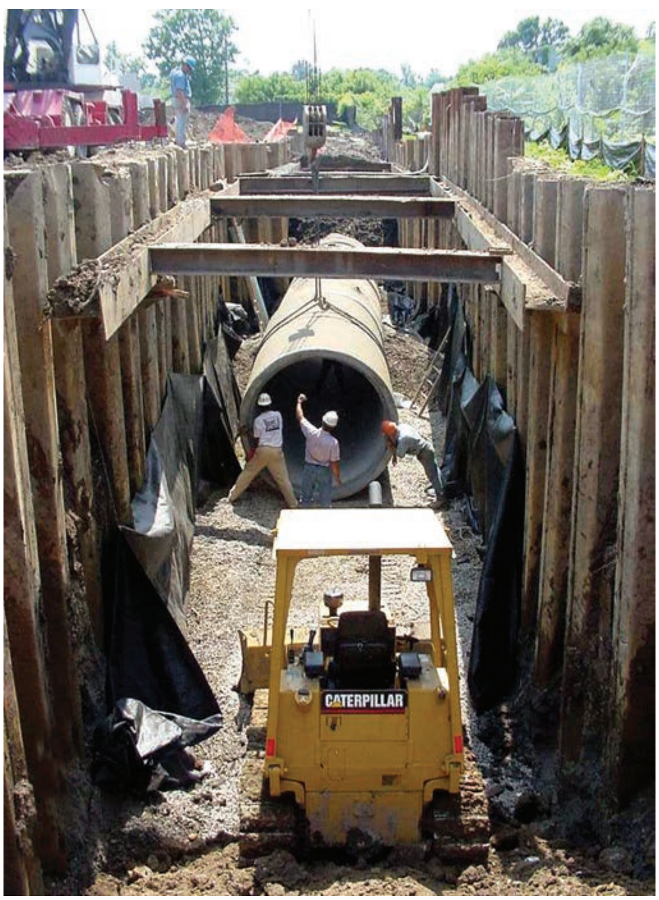

Photo courtesy of NYS EFC.

Groundwater infiltration makes efficient treatment difficult.

These systems must be managed proactively, not reacting to problems as they occur. It is critical that investment be made in asset management strategies to identify the location, conditions and needs of the buried assets. Good asset management also is important for capital planning of scarce local resources and to ready a municipality for funding initiatives. When the next round of "stimulus," green investment funding, New York Works, or Regional Economic Development Council funding sources come along, the municipality that is first in line and well prepared will reap the best returns on grant funds. A Capital Improvement Plan established from the asset management analysis should identify the most critical system needs to be addressed on an annual basis. Good processes and good data yield high confidence decisions regarding sustainable funding of this critical infrastructure.

The bottom line is knowing component asset life, consequences of system failure, and future maintenance or replacement costs, drives good decision-making.

This chapter prepared by David Miller, PE at the Onondaga County Department of Water Environment Protection, with additional assistance from Robert Albright of CDM Smith.