



Municipal Technical Advisory Service
INSTITUTE *for* PUBLIC SERVICE

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Managing Infiltration Inflow in Wastewater Collection Systems

Dear Reader:

The following document was created from the MTAS website ([mtas.tennessee.edu](http://www.mtas.tennessee.edu)). This website is maintained daily by MTAS staff and seeks to represent the most current information regarding issues relative to Tennessee municipal government.

We hope this information will be useful to you; reference to it will assist you with many of the questions that will arise in your tenure with municipal government. However, the *Tennessee Code Annotated* and other relevant laws or regulations should always be consulted before any action is taken based upon the contents of this document.

Please feel free to contact us if you have questions or comments regarding this information or any other MTAS website material.

Sincerely,

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Managing Infiltration Inflow in Wastewater Collection Systems

Reference Number: MTAS-587

What Is Infiltration/Inflow (I/I)?

Infiltration is water that enters the sewage collection system from the soil through foundation drains, defective pipes or joints and faulty connections (i.e., ground water).

Inflow is water that enters the sewage collection system from sources such as roof down spouts, basement and yard drains and cross connections with drainage lines (i.e., surface or rainwater).

If you have a wastewater collection system, chances are you have infiltration and inflow (I/I) problems. A third party engineer located in Tennessee says Tennessee sewer utilities average 47 percent I/I. Many systems have recognized I/I problems, but they are not addressed because the problems seem overwhelming — both in terms of money and manpower.

Beginning in 2018 newly renewed wastewater system permits have more extensive reporting requirements when a sanitary sewer overflow or backup occurs. The underlying intent is to force utilities to be more effective in reducing I/I and the overflows and backups which are often caused by I/I.

Is It Really I/I?

When an overflow occurs in the system, you may think it is I/I. But, it could be

- debris, roots, or grease in the system, restricting flow;
- sags in lines;
- protruding taps;
- collapsed lines due to corrosion;
- design bottlenecks;
- pump station problems — leaking check valves, improperly sized impeller, improperly sized motor, impeller wear, etc.; or
- forced main issues — corrosion, sediment, air locking, etc.

These are mostly operations and maintenance issues which can be identified and corrected with diligent operations and maintenance.

Managing Infiltration Inflow

Reference Number: MTAS-1457

There are two ways to manage infiltration and inflow problems — the outside expert way or the operator's way. The first way is usually an expensive and slow approach that may or may not prove effective. The operator's way is generally less expensive and often produces quicker results. However, like the traditional way, it may or may not prove effective. The best approach may be a combination of the two.

The Traditional Way: Bring in the Outside Experts

Bring in the Outside Experts to conduct a Sanitary Sewer Evaluation Study.

The Operator's Way: Use In-House Resources

Use In-House Resources

- Map the sewage collection system.
- Get flowcharts from the treatment plant and pump station capacities. Also get run times. (*Note: this requires run time meters at all pump stations.*) Pump capacities can be obtained from the manufacturer's literature or the wastewater system's equipment specifications.
- Install long-term flow monitors at key location throughout the system.

- Staff members who know the collection system best should study the map and list the most likely areas for I/I. Use pump run times (*you will need data through a wet and dry season*), records of overflows, rainfall records and knowledge of the collection system.
- Locate and document all overflows at pump stations, including complaints of sewage backups, surcharging manholes and so forth.
- Start with the worst areas (*based on information from Steps 3 and 4 above*) and physically walk the sewer lines to look for problems.
- Do nighttime flow isolations. If there is water in the line at night, it is probably coming from an I/I source.
- Check maintenance practices: Clean the lines, manholes, forced mains, siphons.
- Investigate the system repeatedly in all seasons and differing weather conditions. Use visual, smoke, dye, temperature, and CCTV techniques.
- If the line is lower than the ground water table, televise it. If it is above the ground water table, smoke test.
- Fix the inflow points, and bundle the infiltration location information for use by consulting engineers.

If the problem is mostly system-wide infiltration, the traditional way may be the best approach. If the problem is mostly inflow, the operator's way may be the best approach. A study of the outside expert way and the operator's way shows that they have many elements in common. Therefore, it is easy to switch to the traditional way if the operator's way does not yield results.

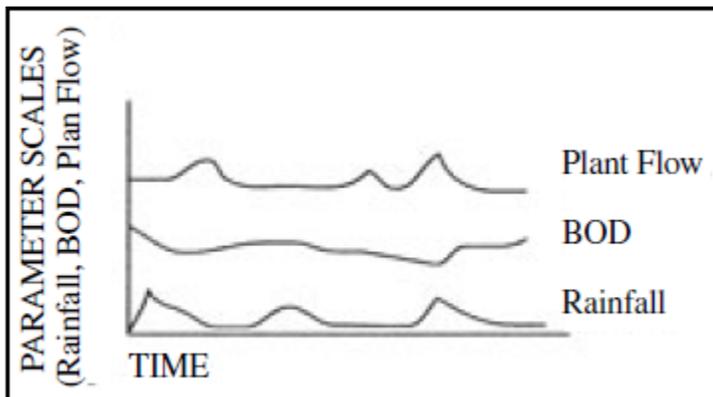
To help decide whether you should use the traditional way or the operator's way to solve I/I problems, you must first define the problem.

Defining the I/I Problem

Reference Number: MTAS-791

To help decide whether you should use the traditional way or the operator's way to solve I/I problems, you must first define the problem.

Document and be as specific as possible. Use complaint records. Does sewage back up in Mr. Johnson's basement every time it rains? Use influent biochemical oxygen demand (BOD) and suspended solids (SS) data. Weak (or low) BOD and SS influent readings usually indicate dilution of sewage by extraneous water. Use rainfall records. It is easier to see the impacts if the data is plotted on a graph. At the wastewater plant, post a running record of these parameters.



Identify and Document Problem Areas. Operators generally know the manholes that surcharge, pump stations that overflow, and lines that run full during rainfall events. Document the information.

Discuss the Information. Using the map, operator's knowledge of the system and data you've collected, ask the following:

- Do influent flows spike up during a rainfall event then go down quickly? If so, suspect roof leader, storm sewer or surface drain cross-connections. If flow jumps up and declines slowly, suspect stream inflow and/or groundwater infiltration.
- Where do lines cross creeks? Do the creeks stay up about the same length of time as the flow in the lines?
- Where are likely cross-connections with drainage lines or roof downspouts?
- Do lines pass through swampy areas or near springs?
- What color is the plant influent during a heavy rainfall? Normal raw wastewater is gray. If the influent is muddy, you may have an inflow source.
- Are grinder pumps located in depressions or near down spouts?

Look, Listen, Document and Analyze. Take a close look at the system. Walk the lines, open manholes, and make notes of the following:

- Surface depressions, cave ins, or road collapses;
- Debris in inverts;
- Broken manhole lids;
- Brick manholes showing active I/I;
- Clear flow in lines;
- Unusual flows; and
- Sluggish flow.

Develop an Infiltration/Inflow Correction Plan

Reference Number: MTAS-792

What Are You Trying to Solve?

Not every problem has a cost-effective solution. What is the benefit-to-cost ratio? It should be 1.0 or greater.

- Is there environmental damage? Are there health problems? Are regulatory agencies pressuring the town to solve its I/I problems?
- Are you trying to eliminate lift station overflows or excessive pumping costs?
- Are you trying to reduce treatment costs?
- Are you trying to solve a specific problem — solids washout of the treatment plant, a backup in Mr. Smith's basement.
- Reduce potential regulatory or legal liability.

Develop an I/I Correction Plan

At this point, you have in mind what you want to accomplish and why. You have accumulated data to help identify where the worst problems are, and you have ruled out other possible causes of the high water problems. During this process, you will be able to assess how much time and expertise you have in house for solving I/I problems. Now you are ready to tackle solutions. If you have decided your staff does not have the time, equipment, and/or expertise to identify, analyze and fix the problems, it is time to hire consultants and contractors.

If you can use in house resources to further identify, analyze and fix I/I problems, here are some tips:

- Look at the geologic and topographic conditions for the part of the system you will be working on first. Is the collection system under the ground water table? If yes, use nighttime flow isolation, televising the lines and flow monitoring to get more information. If no, use smoke testing, rainfall simulation, dye testing and flow monitoring to gain more information. In either case, use physical inspection of manholes. They can be big sources of I/I. Brick manholes are especially subject to I/I. Manhole covers that are in depressions, near streams or in streets or other areas subject to sheet runoff are subject to I/I.

- Focus on interceptors (large sewers), especially those near creeks. They can carry more I/I on a per-inch basis than smaller lines. For this reason, many sewer line rehabilitation experts advocate working from the sewer plant up to the system and not from the dead ends down.
- Size up the magnitude of the problem and what it is going to cost. Does the town need to borrow money and make an all out effort to improve the system? Or does a phased approach interest the town's governing body? First, you will have to answer why you have decided to fix I/I problems. Once you get the present I/I crisis solved by either the traditional way or the operator's way, MTAS strongly advocates annual budgeting for collection system maintenance. The goal is to strengthen the collection system infrastructure in order to minimize future I/I problems.

Rehabilitate the System

Use in house and/or outside expertise to fix the problems. Until your operators have experience with repair methods, outside contractors will be needed to make many of these repairs. Rehabilitation methods include:

- Point repairs;
- Cured in place pipe lining;
- Grouting;
- Manhole liners, coatings, and specialty seals;
- Pipebursting;
- Root control; and
- Line replacement.

Experience has shown that groundwater migrates along sewer pipes, sometimes for long distances. Because of migration rehabilitation starting low in the system is the recommended strategy. Also when working on a section of pipe, always renew all mains, taps, and service lines to a level above the groundwater. When possible include groundwater dams along pipes especially PVC to reduce the migration. A good rehabilitation strategy should reduce I/I in the renewed area by 50 percent. If rehabilitation work is successful, expect the former I/I water to appear at some other location.

In rehabilitation or new construction, 100 percent inspection is recommended.

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