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Pipeline

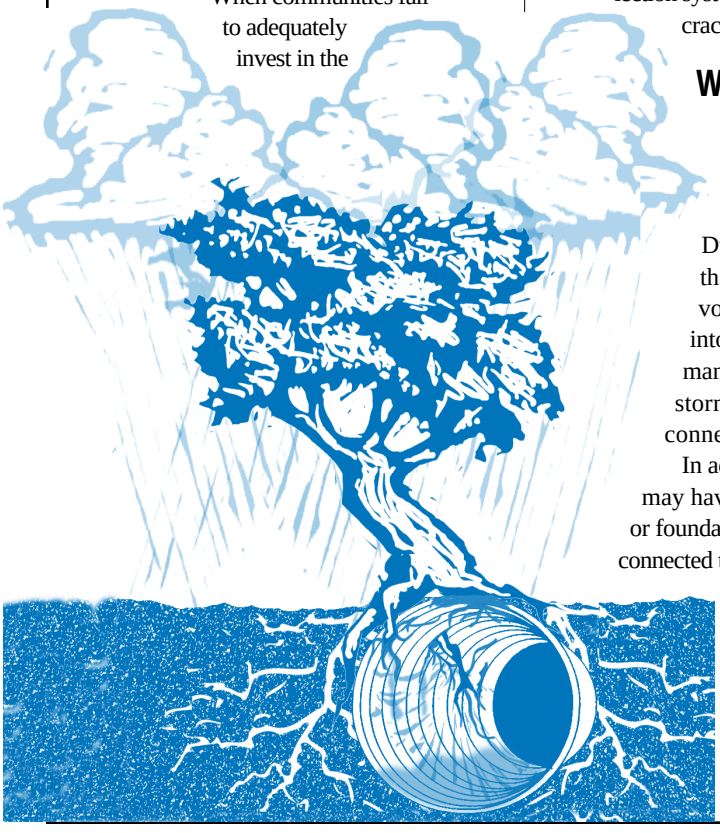
Small Community Wastewater Issues Explained to the Public

INFILTRATION AND INFLOW CAN BE COSTLY FOR COMMUNITIES

Many small towns in the U.S. have aging wastewater collection systems (sewerage systems) that are deteriorating or in desperate need of repair. Some older towns still use brick sewers built more than a century ago, while many more communities rely on outdated combined systems to collect both wastewater and stormwater flows.

Collection systems need regular monitoring and maintenance just like other parts of the wastewater system. But because they are located underground, problems often go unnoticed until major complications surface in the community, such as sewer backups, flooding, collapsed streets, or contamination of nearby water resources.

When communities fail to adequately invest in the upkeep of their wastewater collection systems, the problemsthat result can threaten public health and the environment and tend to be far more expensive to correct than they are to prevent. Infiltration and inflow are two such problems affecting large and small collection systems around the country.



What is infiltration?

The term infiltration is used by wastewater professionals to describe the excess water that sometimes seeps, trickles, or flows into old or damaged collection systems from the surrounding soil. For example, high groundwater or water remaining in the soil after rain or snow often can infiltrate mainline pipes, joints, service laterals, connections, and other parts of a collection system that have deteriorated, cracked, sagged, or collapsed.

What is inflow?

Additional unwanted water also can enter collection systems from above-ground sources. During storms or snow thaws, for example, large volumes of water may flow into systems through leaky manhole covers or combined stormwater/wastewater connections.

In addition, private residences may have roof, cellar, yard, area, or foundation drains inappropriately connected to sanitary sewers. Any extra water flowing into wastewater collection systems from above-ground sources, either intentionally or unintentionally, is referred to as inflow.

Communities should be concerned about I/I because...

- I/I decreases the efficiency and capacity of wastewater collection systems and treatment systems, which can impact a community's potential for growth,
- I/I can hurry the need for the construction of relief sewer facilities,
- I/I contributes to the hydraulic overloading of treatment processes, which can affect public health and the community's compliance with state and federal water quality standards,
- I/I can cause backflooding of sewers into streets and private properties, and
- I/I can increase collection system and treatment facility operating costs—for example, adding to the necessary run time for pumps and pump stations and costs for energy, maintenance, and repairs.

What is I/I?

When collection systems are old and in disrepair, it often is very difficult to determine exactly how much of the extra wastewater in the system is the result of inflow versus infiltration. When uncertainty exists, wastewater professionals usually refer to the overall problem as I/I.

What are the costs of I/I?

I/I problems place an additional burden on community collection systems and wastewater treatment facilities. Collection systems can be damaged when they are forced to transport larger volumes of flow than they have been designed to handle.

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INFILTRATION AND INFLOW CAN BE COSTLY FOR COMMUNITIES

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In extreme cases, pipes can collapse or burst causing pavement to buckle. Damage to pipes from I/I also can allow wastewater to contaminate vital groundwater and drinking water sources.

I/I also increases operation and treatment costs for the facilities that receive the additional wastewater flow. After rain and snow events, in particular, excess flows from I/I can overburden treatment plants to the extent that untreated wastewater must be discharged to the environment.

Sanitary and combined sewer overflows (SSOs and CSOs) can occur when wastewater flow volumes exceed the design capacity of the treatment plant. If the treatment plant cannot store the extra flow for later treatment, the excess wastewater bypasses the facility and is dumped untreated into receiving waters. SSOs and CSOs must meet National Pollutant Discharge Elimination System (NPDES) permit requirements and eventually be corrected. Monitoring and correcting SSOs and CSOs is costly for communities.

This *Pipeline* issue provides an overview of common methods for evaluating and correcting I/I problems in small communities. I/I prevention and collection system maintenance also are discussed.

Readers are encouraged to reprint *Pipeline* articles in local newspapers or include them in flyers, newsletters, or educational presentations.

If you have any questions about reprinting articles or about any of the topics discussed in this newsletter, please contact the National Small Flows Clearinghouse at (800) 624-8301 or (304) 293-4191.

Causes of Infiltration:

- poor soil conditions in which sewer lines are laid,
- poor materials or shoddy construction and workmanship,
- excessive groundwater levels,
- precipitation and percolation of surface waters,
- water retained in the surrounding soils, and
- poor condition of pipes, joints, and connecting sewer structures.

Causes of Inflow:

- deliberate or poorly planned connections of storm water or other drainage water into sewer systems, and
- draining of swamps, wetlands, or low-lying or flooded areas into collection systems through connections or leaky manhole covers.

Source: U.S. Environmental Protection Agency (EPA). Inflow/Infiltration: A Guide for Decision Makers.

For more information or to order this EPA document from the NSFC, refer to the list of products on page 8. Please request Item WWBLGN31.

Trouble Signs of I/I In The System

How do you know if I/I is a problem for your community's collection system? The following conditions can indicate the presence of I/I and the need to evaluate your system.

- greater than anticipated flows measured at wastewater treatment facilities,
- hydraulic overloading of treatment facilities indicated by "washout" of treatment processes,
- sewer system overflows or bypasses,
- basement floodings after rainfall events,
- lift station overflows,
- excessive power costs for pumping stations,
- overtaxing of lift station facilities, perhaps resulting in frequent motor replacements,
- excessive treatment costs
- water quality problems in the community that could be associated with the raw wastewater discharge,
- surcharging of manholes resulting in a loss of pipe,
- overburden through defective pipe joints,
- complaints of odors,
- pipe corrosion,
- settlement, structural failure, or eventual collapse of pipes.

Source: U.S. Environmental Protection Agency (EPA). October 1991. *Sewer System Infrastructure Analysis and Rehabilitation.* EPA/625/6-91/030. NSFC Item #WWBKDM67.

For more information or to order this EPA document from the NSFC, refer to the list of products on page 8. Please request Item #WWBKDM67.

Gathering Information Is First Step In Fighting I/I

The only way community officials can identify whether I/I or any other problems exist for certain in the community's wastewater collection system is by performing a preliminary evaluation of the system, followed by a thorough system-wide inventory known as a sanitary system evaluation survey (SSES).

According to the U.S. Environmental Protection Agency, small communities can successfully conduct their own SSESes and correct many I/I problems without hiring outside consultants or sewer service companies. However, if a preliminary investigation reveals evidence of serious or widespread collection system problems, hiring a qualified professional who specializes in sewerage system evaluation and rehabilitation can be a very wise investment. *(Refer to page 7 for information on hiring a qualified consultant.)*

Regardless, community leaders can save time and money by first gathering some basic information about their sewerage system from the community.

Interview Local Experts

Community officials or wastewater consultants conducting a collection system evaluation should begin the process by questioning those in the community who may have firsthand knowledge of the system's condition and problems. Some of the people who should be interviewed include active and retired local wastewater and water treatment plant managers and operators, sewer maintenance personnel, local contractors, municipal engineers, and officials who have dealt with the wastewater system on a regular basis.

For example, treatment plant operators, municipal engineers, and sewer maintenance personnel can provide information about the structure of the existing system, any inspections or maintenance that has been performed, and observed or reported problems with the system. Retired personnel also should be interviewed in case they know of any changes or additions to the system that occurred in the past for which documentation may be scarce or nonexistent.

Local contractors know about construction practices typically followed for area homes and public buildings, and community officials can provide guidance for dealing with regulations regarding wastewater treatment, collection systems, and relevant jurisdictional issues.

Homeowners should be interviewed as well. They often can provide important information about the construction or condition of the service laterals leading to the main sewer from their homes including any maintenance, additions, or repairs. They also can report on any problems in their area with flooding of streets or basements or frequent sewer backups.

Determine the Base Flow

In addition, officials should interview local wastewater and water treatment plant operators, industry representatives, and homeowners to find out about local water usage to calculate the base flow—the volume of wastewater that is supposed to be collected and conveyed by the sewerage system. Estimating the base flow is essential for determining the amount of excess water in the system due to I/I.

Water treatment plant managers maintain records of local home and industrial water use. These records, along with population information and a survey of industrial plant personnel, local businesses, and homeowners, will help officials develop an accurate picture of water use in the area and possible ways to reduce the burden to the system through water conservation. *(Refer to page6 for more information about the benefits of water conservation.)*

Analyze and Update Records

All communities with collection systems should maintain current and complete sewer maps on file. But these records often must be updated before they can be used to accurately assess system conditions.

However, analysis of existing sewer maps combined with an analysis of area records from prior collection system maintenance; local topographical, climatological, and geological information; and the information collected by interviewing community officials, residents, and local professionals, usually will provide enough information to indicate if a more in-depth SSES is warranted.

Ideally, all of the information in the sewer maps should be verified. It is important that these maps at least accurate include and up-to-date information about the location and condition of the following:

- maps and/or as-built drawings of all sanitary and combined sewers, indicating their size, slope, and direction of flow;
- the location of all treatment facilities, pumping stations, and overflow and bypass points;
- the materials used to construct sewers;
- the type of soil and bedding around sewers;
- the date of their construction;
- the types of joints used;
- all manholes, including those that may have become buried;
- any new sewer extensions or sewer line changes;
- groundwater elevations in the area and precipitation rates; and
- any storm sewers near, crossing, or constructed in the same trenches as sanitary sewers.

Identify Likely Problem Areas

Updating and verifying all the information about a community's wastewater collection system is a huge undertaking. Therefore, the most practical course of action usually is to first take inventory of all known and likely problem areas so they can be taken care of as quickly as possible.

In addition to areas where sewer backups, flooding, or other problems have been reported, the following areas may warrant quick attention:

- low-lying areas,
- areas with poor unstable soils,
- areas with high groundwater,
- old sections of sewers,
- sewers located near or crossing storm sewers, and
- sewers constructed near rivers, streams, ponding areas, or swamps.

Field Inspections Help Pinpoint I/I

Once officials have analyzed all the preliminary data and identified likely I/I trouble spots in the community, the next step is to proceed with field inspections of these sections of the sewer. This way, communities can combine the necessary task of updating and verifying the sewer map information, while tackling the most urgent I/I problems first.

Visual Inspections

Internal and external visual inspections should be performed first. Often major sources of inflow can be easily identified simply by walking around a section of the sewer.

From the surface, inspectors should note obvious defects to manhole covers and frames and whether the covers fit or are properly situated. They also should note conditions at stream crossings and drainage patterns in the area, the number and direction of incoming and outgoing lines, and the condition of the manhole stairs and walls.

To perform an internal (subsurface) visual inspection, it is necessary to enter the manhole with special equipment, such as portable lamps or mirrors to determine the condition of the sewer between two adjacent manholes. *(Refer to the section about safety precautions on page 6.)*

Through lamping, workers often can assess the structural condition of the sewer line, the condition of the joints, whether roots and debris are present, and the location and estimated rate of infiltration.

Timing

For the most accurate results, inspecting sites for infiltration should be planned to correspond with periods of high groundwater, since this is when infiltration is at its peak. To identify major sources of infiltration without influence of rainfall or added domestic or industrial flows, inspections should be performed for three consecutive days in the early morning hours before 6 a.m. on days when it hasn't rained for the past 24 hours. Groundwater gauges can be used to verify that the level of groundwater is about the level of the sewers.

Likewise, inspections for inflow should be timed to take place only during periods of heavy rainfall when inflow is at its peak.

Flow Monitoring

In addition to a visual assessment of the degree of inflow and infiltration in the system, in some cases, it may be necessary to measure the amount of wastewater flow in the system over time and compare it with base flow estimates to determine the amount of extraneous water in the sewer system.

Flow monitoring may not be necessary if the sources of I/I are obvious and relatively easy to correct. Although it is advisable to correct all instances of I/I to protect the system, public health, and the environment, some communities may find flow monitoring helpful for prioritizing repairs when funding is limited.

Smoke Tests

Smoke testing is a common, simple, and inexpensive method for detecting improper sewer connections and other possible sources of inflow.

Smoke from a smoke bomb is released into a section of the sewer pipe that is isolated with pipe plugs or heavy canvas curtains with weights, and then it is blown through the section of the line by means of a motorized blower positioned over the manhole. Smoke testing is not appropriate if the sewer lines have sags, water traps, or are flowing full, because the smoke will not be able to properly travel through the lines, which may lead to false results. The test also will not reveal underground structural damage or leaking joints if the ground is covered, paved, frozen, or saturated.

In addition to revealing damage to pipes just below the surface, smoke tests are effective at indicating sources of inflow from inappropriate storm water connections—often on private property.

Local residents, police, and fire officials should be notified prior to smoke testing and be reassured that the smoke is harmless. Also, wastewater and sewer codes should be reviewed in advance to settle any jurisdictional issues, since workers may need to inspect private building connections.

Dye Tests

Dye tests are useful for locating sources of inflow from storm sewers or private properties. A dye test can be used to verify the results of a smoke test, or in place of a smoke test if the pipes have dips or are flowing at full capacity.

The dyes that are used are usually fluorescent and easily detectable. They also are biodegradable and safe for the environment and the sewer lines.

Closed-Circuit Television

By far the most effective and high-tech method of pinpointing and evaluating sources of I/I is subsurface inspection with closed-circuit television cameras. Small communities often can rent equipment or hire professional collection system inspectors who have this equipment. The contractor will provide a video copy and log describing his or her observations.

In very large sewers, the inspector may be able to perform a manual TV inspection, meaning he or she walks through the lighted section of pipe pointing the camera up and down the pipe walls stopping and commenting at points of concern or interest. Otherwise, the television is pulled through the sewer line using either electric or manually operated winches.

Closed circuit television can even be used to inspect small-diameter service connections from individual buildings. Sometimes light hydraulic cleaning of the lines is required prior to inspection.

Although visual inspections and smoke and dye tests are very low-cost, closed-circuit television inspection also can be a very economical choice for small communities because of its accuracy in pinpointing I/I sources.

For more detailed information about I/I field inspection, testing procedures, SSES criteria, refer to the documents listed on page 8.

Communities Have Many Options For Rehabilitating Systems

In some cases, identifying I/I in the system is easier than deciding on the best way to solve the problem. The solutions to such problems as illegal connections from roof drains and area drains are fairly direct. However, fixing old deteriorating collection systems with a variety of I/I sources can be complicated. And sometimes, the systems with the worst problems are located in small communities with limited resources.

Fortunately, new technologies have made sewer line rehabilitation more affordable than in the past. And when weighed against the potential costs of I/I to the environment and to the community's potential for growth and quality of life, I/I reduction always is a good investment.

Excavation and Replacement

Digging up and replacing old deteriorating sections of sewer line used to be one of the only solutions available for stopping I/I. Today, this method is reserved only for cases in which the structural integrity of the pipe is severely degraded, the pipe is seriously misaligned, or when other rehabilitation methods would be too expensive to be worth the effort.

The cost-effectiveness of new trenchless or in-place rehabilitation technologies have eliminated the need to excavate and replace sewer lines in many cases. The new technologies also are less disruptive to traffic patterns and utility services.

Chemical or Cement Grouting

One less disruptive rehabilitation method is cement or chemical grouting, which sometimes can be used to rehabilitate sewer lines externally by excavating adjacent to the pipe. Internal chemical grouting is a common technique communities use to rehabilitate leaking joints, manhole walls, and minor cracks in nonpressurized pipelines.

Chemical grouting is not a good option if the cracks in the pipe are large or affect the structural integrity of the pipe—longitudinal cracks, for example. Grouting does not improve or reinforce the structural integrity of the pipes, and large joints and cracks and misaligned pipe may be impossible to seal or may require excessive amounts of grout.

Types of chemical grouts used for sewer pipe repairs include acrylic-based gels, urethane gel, and polyurethane foam. The sewer lines must be cleaned thoroughly just prior to application of grout.

Linings and Insertions

Sections of pipeline often can be rehabilitated internally by sliding a slightly smaller flexible liner pipe inside an existing pipe and then reconnecting the service line to the new liner. The space between the existing pipe and liner pipe may be grouted to provide added strength to the line.

Sliplinings for sewers can be constructed of polyethylene, fiberglass reinforced polyester, polyrinyl chloride (PVC), or other materials resistant to thecorrosive atmosphere in the collection system. They may be inserted as a single flexible continuous pipe or in short sections that can be jointed to form a continuous lining.

In another method, called fold and formed or "deformed" pipe lining, folded or deformed pipe is pulled through the line between two access points, then the pipe is heated, pressurized, and expanded or rerounded in the sewer to form a tight fit.

Two other methods that involve the insertion of liners or pipes internally into existing sewers include spiral-wound installation and cured-in-place pipe. With spiral-wound installation, the wall pipe is fabricated at the bottom of a manhole or access shaft and is pulled through a winding machine with rollers to form a circular pipe. The pipe may be expanded outward for a better fit or it can remain a fixed diameter.

Cured-in-place pipe (CIPP), also sometimes referred to as inversion lining, is a popular and practical method for correcting I/I and rehabilitating pipes that need minor structural reinforcement. It is also safer than some other rehabilitation methods and quicker to install.

CIPP is formed by inserting a polyester or epoxy resin-filled felt tube into a pipe, which is inverted against the inner wall of the existing pipe and then allowed to cure. A remote cutting device is used with a closed-circuit camera to reopen service connections. This method is practical because the resin can bridge gaps, fill cracks, and maneuver around pipe defects.

Coatings

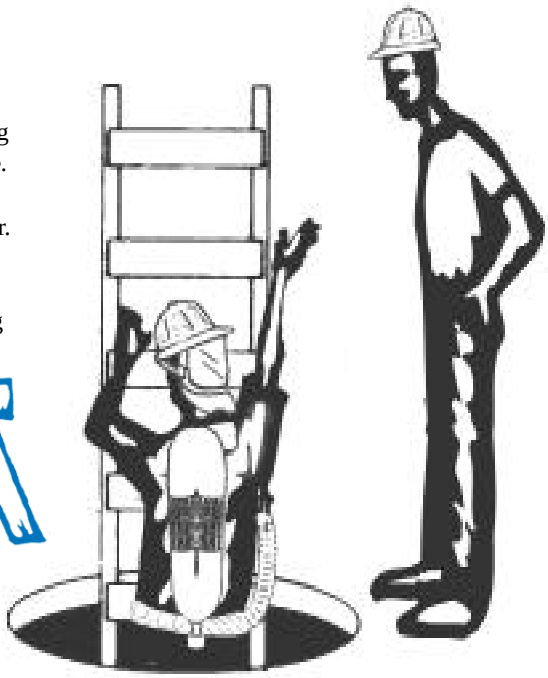
Coatings are sometimes used to extend the life of an existing sewer by increasing its strength and protecting it from corrosion. However, coatings and spray-on linings can be difficult to apply if infiltration is present.

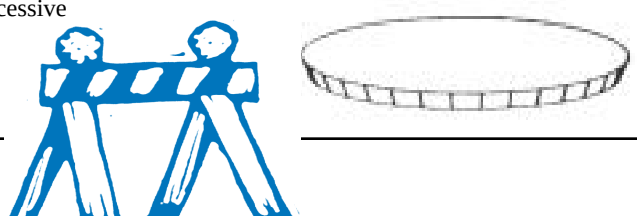
Line Cleaning and Root Control

Debris, grease, and root intrusion in sewer lines can obstruct visual or video inspection and reduce the effectiveness of rehabilitation methods.

Small communities can rent or contract professional line cleaning services using high-velocity water machines and other hydraulically propelled devices.

Roots also can be removed using an EPA-approved chemical foam that is safe for the environment and won't harm the rest of the plant above.





Fixing Manholes Also Reduces I/I

Old, degraded, or leaky manhole structures often are a major source of I/I in communities. In areas with temperature variations, movement of the surrounding soil and the expansion and contraction of the surrounding pavement can cause structural damage to the manhole frame seal, chimney, or cone.

Many of the options for reducing I/I through manholes are similar to the options available for rehabilitating sewer lines. For example, chemical grouting or sealing is a cost-effective option that doesn't add to the structural integrity of the manhole.

In addition, cement coatings and chemical patching compounds have been used to coat systems to reduce flow. They can be applied by machine or by hand.

Like sewer pipes, manholes can be structurally rehabilitated with the use of linings. Poured-in-place concrete linings, for example, have been used effectively. Other choices include placed PVC rib-lock liners, prefabricated reinforced plastic mortar or fiberglass reinforced plastic, prefabricated high density polyethylene, spiral-wound liner, and cured-in-place structural manhole liners.

In addition, unwanted inflow can enter manholes through ill-fitting covers and leaky frames. Surface water often can enter through holes in the cover or through the space between the cover and the frame. Leaky manhole covers can be replaced with new watertight covers, or they can be fixed with rubber gaskets or by installing hole plugs or watertight inserts under the existing covers.

The Manhole frame-chimney joint area sometimes also can be sealed without excavation, or during excavation when the frame is being reconstructed or replaced. The seal is achieved by installing a flexible material or manufactured seal to either the surface of the chimney or the frame. However, as is sometimes the case with sewer pipes, occasionally structural damage is so extensive that rehabilitation of manholes is not a practical option and excavation and replacement is necessary.

Sewer Workers Must Receive Safety Training

It is extremely important that wastewater system workers receive comprehensive training on safety procedures for inspecting and rehabilitating collection systems. Some common hazards sewer workers encounter include slips and falls on damp, icy, or slimy walls or falls from corroded steps or structures that give way, and injuries associated with confined spaces, such as cave-ins, asphyxiation from gases trapped in the system, or explosions from methane, propane, gasoline, or other gases that find their way into the sewer.

Safety precautions also must include training on proper sanitary practices to avoid contracting or spreading illness from pathogens present in wastewater or from animals or insects in the sewers. Traffic hazards, electrocution, and drowning are other risks that can be reduced through proper safety training.

Residents Can Help By Conserving Water

Sometimes an ounce of prevention can be worth gallons and gallons of reduced wastewater flows.

One of the most effective ways communities can reduce I/I and the costs associated with it is by simply conserving water. Community leaders faced with costly collection system repairs should consider identifying high volume water users in the community and adding a public education component to their rehabilitation program focusing on water conservation.

Encourage the Use of Low-Flow Fixtures

In households without low-flow fixtures, up to 75 percent of water is used to flush toilets and take showers. A public education program encouraging residents to replace old fixtures with low-flow models for the good of the community and to save on water bills can be well-worth the investment.

In addition, plumbing codes can be changed to ensure that new homes and buildings include water-efficient fixtures. Communities also may want to urge high-volume industrial and commercial users in the community to implement a water conservation program.

For more detailed information on water conservation and implementing a public education program, readers can contact the NSFC to request a free copy of the Winter 1998 issue of the newsletter *On Tap*, published by the National Drinking Water Clearinghouse. Please request Item ONTAP27.

Small Community Sewer Rehabilitation Project Reduces I/I in Alaska By Colleen Mackne

High levels of I/I were causing hydraulic overloading of the Cordova Wastewater Treatment Plant in Cordova, Alaska. This led to operational problems, resulting in National Pollutant Discharge Elimination System (NPDES) permit violations.

Located in the southern maritime area of Alaska, Cordova receives 168 inches of rainfall each year. During heavy precipitation, the treatment plant often experienced flows of more than 2.5 million gallons per day (mgd). In addition, the underlying soils in Cordova are comprised mostly of bedrock, which tends to produce high surface runoff. Portions of the city's collection system are located in the tidal flats of Orca Inlet and thus, are subject to seawater infiltration.

Originally built in 1948, Cordova's collection system includes 50,750 feet of gravity sewers and five pump stations. Seperate sanitary and stormwater sewer systems exist but combine prior to arrival at the wastewater treatment plant. I/I from parts of the storm drain systems are a major source of flow to the wastewater treatment plant.

A collection system rehabilitation project was initiated, which led to a 70 percent reduction in I/I. Starting with a sewer system evaluation plan to analyze the problem, the city's collection system was divided into eight sewer drainage basins.A monitoring plan was designed to identify key mans basins. In addition, several manholes were visually inspected to identify possible sources of I/I.

There was a significant amount of groundwater infiltration in six of the eight basins, ranging from 1.4 to 3.8 times the sanitary flow rate. This indicated that there were many system defects below the groundwater table.

To measure the effect of I/I on Cordova's collection and treatment systems, a capacity analysis was performed on the trunk sewers, pump stations, and the treatment plant. This analysis evaluated the type and cost of facility improvements necessary to transport, treat, and dispose of peak wet-weather flows.

From the sewer system evaluation survey, the actual sources of I/I were identified using smoke testing, manhole inspection, and closed-circuit television inspection of pipelines. Smoke testing detected illegal storm drain connections suspected of being major contributors to the city's inflow problem. Manhole inspection indicated that 73 percent of all manholes had structural problems. Seventy-one manholes had active infiltration, while 62 manholes were subject to inflow. During closed-circuit television inspection of the laterals, 44,172 feet of Cordova sewer mains were monitored, and a total of 182 defects were found. Seventy-one of them were located on private properties in the upper lateral sections. Ultimately, the city implemented a program to encourage homeowners to repair laterals.

The cost of reducing I/I was compared to the cost of constructing additional collection and treatment facilities for peak I/I. It was estimated that upgrading the collection system, pump station, and treatment plant would cost approximately $12.6 million. However, the cost for rehabilitating the collection system and reducing I/I was estimated at $4.2 million. Therefore, correcting the I/I problem in six of the eight basins was the most feasible option.

During the rehabilitation project, 11,000 feet of sewer main were sliplined, 3,000 feet were replaced, and 30,000 feet were rehabilitated by chemical grouting and point repairs. In addition, the project included rehabilitating 255 manholes, inspecting 21,000 feet of sewer service lateral pipe, performing 111 repairs on lower laterals, installing 370 feet of new storm sewers, and removing storm pipe connections. The total cost of the project came to $4.4 million.

After rehabilitation was complete, the actual percentage of I/I reduction was determined by comparing I/I after rehabilitation to I/I that was measured during the flow monitoring stage. Wastewater flows and rainfall values were also used for comparison. A 70 percent reduction in I/I was achieved.

CONTACTS

The National Small Flows Clearinghouse (NSFC)

The NSFC offers technical assistance and free and low-cost information about small community wastewater technologies and issues, including wastewater collection systems and I/I. Only a few of the NSFC's many resources and services are listed in this issue. For a complete listing, contact the NSFC at (800) 624-8301 or (304) 293-4191 to request a free catalog, or visit the NSFC's Web site at www.nsfc.wvu.edu.

Local and State Health Agencies

Community officials should contact their local and state health agencies for assistance when planning collectionsystem inspection and rehabilitation. State and local health agencies are listed in the blue pages of local phone directories.

Rural Water Association (RWA)

Communities who wish to perform a smoke test to determine if they have cracks or defective joints in their sewer lines can contact their state Rural Water Association (RWA) for advice on where to purchase or rent the equipment needed.State RWAs provide a variety of other services that can help communities with collection systems. For the number of your state RWA, contact the NSFC or call their national office at (580) 252-0629.

National Association of Sewer Service Companies (NASSCO)

NASSCO is an association of the leading providers of products and services to sewer collection system owners in North America. They publish three importantreference works on collection systems that would be very helpful to any community planning to evaluate or rehabilitate their system. The three works are NASSCO's *Specification Guidelines for Sewer Collection System Maintenance & Rehabilitation,* the *Manual of Practices for Wastewater Collection Systems,* and *The Inspector Handbook for Sewer Collection System Rehabilitation.* Contact NASSCO headquarters at (717) 264-5756 for information.

RESOURCES AVAILABLE FROM NSFC

To order products listed as available from the National Small Flows Clearinghouse (NSFC), call (800) 624-8301 or (304) 293-4191, fax (304) 293-3161, e-mail nsfc_orders@estd.wvu.edu, *or write NSFC, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Please request each item by number and title. A shipping and handling charge will apply.*

Inflow/Infiltration: A Guide for Decision Makers

This guide for local officials explains how to evaluate inflow/infiltration (I/I) problems and includes methods for identifying their source and location. Safety procedures for collection system workers are included. This guide is particularly helpful for small communities dealing with I/I problems. The price is $6.05. Request Item #WWBLGN31.

Sewer System Infrastructure Analysis and Rehabilitation

This 96-page handbook provides guidance to engineers and public decision makers on the evaluation and rehabilitation of existing sewers. It presents information about typical problems, procedures, and methods for rehabilitation, as well as case studies and information on costs, the application and advantages and disadvantages of rehabilitation techniques, and materials used in rehabilitation. This free book could be useful to engineers, local officials, operators, contractors /developers, and planners. Request Item #WWBKDM67.

Customized Bibliographic Database Search

The NSFC's Bibliographic Database is a collection of thousands of articles dealing with onsite and small community wastewater collection, treatment, and disposal systems and related topics. Customers can request a search on infiltration or another topic and receive the latest literature on the subject. Call the NSFC and ask to speak with a technical assistance specialist to request a customized search. The cost is 15 cents per page. Request Item #WWPCM12.

Manufacturers and Consultants Database Search

The NSFC Manufacturers and Consultants Database houses a list of industry contacts for wastewater products and consulting services. This database serves as a reference for engineers, private citizens, and community officials, and a referral database for wastewater products and trade items. Customers can receive a list of people to contact regarding sewer inspections and repairs, leak detection equipment, liners and impermeable barriers, or other related products and services. Call the NSFC and ask to speak with a technical assistance specialist to request a customized search. The cost is 15 cents per page. Request Item #WWPCCM16.

More Information Is Available

The NSFC also offers a variety of products on other subjects related to I/I, such as combined sewer overflows (CSOs). For a complete listing, contact the NSFC to receive a free catalog. Request Item #WWCAT.

PIPELINE

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