

Date: 1999
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Publication: Water Control Quarterly
Title: Borough of Downingtown Stops Infiltration

In Pennsylvania, the Borough of Downingtown is a small suburban town of approximately 8,000 people. It is located 35 miles east of the city of Philadelphia.

Like most towns or cities with public sewer systems, Downingtown was experiencing high amounts of inflow and infiltration (I & I). The collector system is relatively small, consisting of 23 miles of sewer line ranging in size from 8" to 14" and 500 manholes. The collector lines are 90% vitrified clay and 95% of the manholes are of brick construction. Due to the high cost of treatment, and to try and control high user fees, in 1992 Downingtown decided to start an aggressive I & I program.

The first step taken was a Phase I Sanitary sewer system Evaluation Survey. The evaluation survey crew was comprised of two Borough sewer department employees and one representative of Rettew Associates, the Borough's engineers. During this process, the goals were to update and number the sanitary sewer system map, and to identify inflow and infiltration sources within the Borough.

To accomplish this, a flow monitoring survey was performed in June and August of 1992 between the hours of 11:00 p.m. and 7:00 a.m. Monitoring points were located and flows were recorded with a V-notch weir and velocity meter. The monitoring was performed at night to reduce the presence of wastewater within the system.

During the study, there were no rainfall events to introduce inflow into the measurements. Therefore, the inflow study would be performed at a later date.

During the flow monitoring evaluation, a total of 451,100 GPD of infiltration was observed. Using the allowable infiltration rate established by the E.P.A. (1,500 gallons per day per inch diameter per mile of pipe), it was determined that 195,670 GPD were considered excessive infiltration. Taking a closer look at Areas 2, 4, and 5, approximately 64% of the total infiltration observed and 83% of the total excessive infiltration occurred within these areas. This accounts only for 46% of the total length of pipe in the entire system.

The second step taken, in 1993, was the installation of seven (7) metering stations throughout the township. The purpose of this project was to determine the Borough's actual wastewater contribution to the Downingtown Area Regional Authority (DARA) treatment plant. DARA is a 7 million GPD treatment plant that also receives wastewater flows from four (4) other neighboring communities.

In order to install the metering stations, new manholes had to be installed. Seven metering stations were installed and each station was fitted with a precast fiberglass metering manhole and Parshall

flume. The equipment in each station consisted of an ultrasonic flow indicator and a 7-day chart recorder.

Soon, data from the metering stations was being collected and after a few rain events, we realized we had a serious inflow problem. Immediately after a rain event, the chart recorder would spike completely off the chart and not return to a readable range for a couple of days after the rain.

While investigating the problem, it was discovered that many of the manhole frames and covers had large notches in the frames to lock the covers. It was determined that these were letting in a tremendous amount of inflow.

In 1994, the Borough hired a temporary crew of three men to remove the old frames and covers and replace them with new machined self-sealing rubber O-ring frames and covers. A total of 107 manholes were replaced.

After the manhole frames and covers were replaced, the chart recorders would only show a small spike. To date, they have not exceeded the readable range even during a heavy rain event.

Based on the data collected in the Phase I Sewer System Evaluation Survey, and previous television inspection reports, the first grouting contract went out for bid and was completed in 1994. This contract involved the cleaning, TV inspection, testing and sealing of 4,689 linear feet. A total of 1,440 joints were tested, and 1,164 were sealed with 2,154 gallons of chemical grout.

Upon completion, the infiltration in Area 2 and 4 of the sewer system was reduced by 50,000 GPD. The second contract went out for bid and was completed in 1995 on Area 5 of the sewer system. In this contract, 5,376 linear feet were cleaned, TV inspected, tested, and sealed. During this second project, 1,176 joints were tested and 468 of them were sealed with 844 gallons of chemical grout. The completion of this contract saw an infiltration reduction of 60,000 GPD.

By the latter part of the 1995 season, the Borough had removed 110,000 GPD of infiltration from the system. With the reduction of infiltration from the grouting contracts, and the effect the manhole frame and cover replacements had on the inflow problem, the Borough decided to sell some of its capacity to a neighboring community.

Our current allotment was 1,975,000 GPD and our daily average was approximately 1,300,000 GPD. The amount sold was 300,000 GPD at \$8.00 per gallon for a total of \$2.4 million. This reduced our allotment to 1,675,000 GPD.

In order to continue preventative maintenance on the system and to maintain or reduce our current daily average flows, the Borough decided in 1996 to sell its existing TV inspection unit and purchase a new TV/Grout truck to continue the grouting program.

After receiving the new truck, the first project was to try and control a serious (rainfall-induced infiltration) problem in Area 1 of the system. Information from the Area 1 metering station had shown as much as 500,000 gallons in a single rain event. Area 1 is an 8" main with an average depth of 6 feet and the entire length is through open fields (high school football and soccer fields, etc.).

After grouting Area 1, rainfall induced infiltration is now a minor event. By the end of the 1997 season we had cleaned 24,000 feet, inspected 11,942 feet, tested 1,311 joints and sealed 1,078 joints with chemical grout.

In 1998, we added a lateral inspection camera and an American Logiball lateral sealing system to our TV/Grout truck. This equipment was used on a section of Area 5 that was sliplined with Insituform in 1984. The section consists of five (5) manhole runs at 1,513 feet. During TV inspection it was discovered that 38 laterals were leaking heavily (approx. 62,000 GPD). After sealing the laterals with 603 gallons of chemical grout, all but 2,000 gallons of infiltration were removed.

Also in 1998, the Borough was issued an additional 120,000 GPD capacity due to upgrades at the treatment plant. The extra capacity is being offered to the same township we sold capacity to in 1995. The sell will consist of 120,000 GPD at \$20.00 per gallon for an additional \$2.4 million. At the current value of \$20.00 per gallon, the 60,000 GPD removed by repairing the lateral leakage could be valued at \$1.2 million.

We recently purchased a manhole rehabilitation spray machine to repair the leaking and deteriorating brick manholes. The Borough is very proud of its I & I control and preventive maintenance program.