

Hillsborough County Fla.'s Sewer Asset Management Program Pays Immediate Dividends

By Richard Kirby, William DiTullio and Ron Thompson



[EDITOR'S NOTE: This is the final part of a three-part series. The first paper, which appeared in the September/October 2006 issue, examined the Hillsborough County sewer inventory and condition assessment program. The second article, which appeared in September/October 2007, presented the findings of the work. In this article, the County's gravity sewer asset management program is discussed.]

Since the fall of 2006, Hillsborough County, Fla.'s Water Resource Services (WRS) has been in the process of implementing a comprehensive asset management system (CAMS) to proactively address the maintenance and capital needs of its gravity sewer system. About five years ago, WRS developed an advanced asset management strategy that included the design and procurement of the enterprise-wide CAMS. At the time, it was decided that the gravity sewer asset inventory information contained within the GIS database should be updated with location and condition data. This data would provide a baseline of the current condition of the collection system and will be used to develop asset specific deterioration curves for each of the WRS's manholes and pipelines.

In Fall 2006, InfraMetrix LLC of Tampa, Fla., was hired by WRS to conduct a county-wide inventory, inspection and condition assessment of the gravity sewer system. InfraMetrix performed an inspection program that utilized a combination of truck-mounted zoom camera and in-line CCTV inspection technology to collect physical attribute and condition data for each manhole and pipeline.

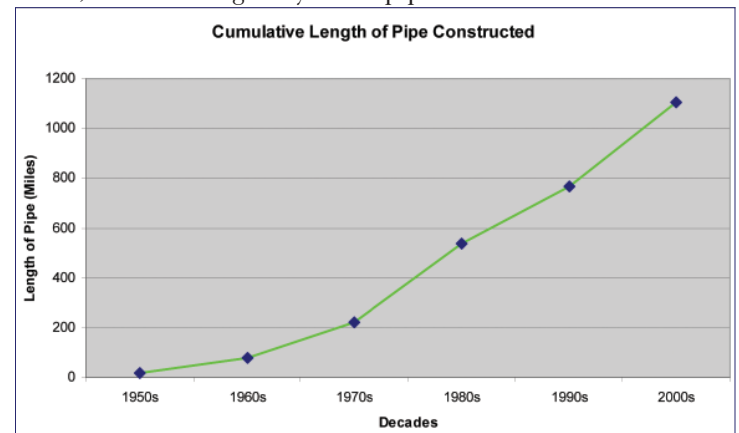
The field crews reported any obstructions or pipeline failures observed during the zoom camera inspection. Findings were reviewed and maintenance was performed to remove potential blockages. The field crews did not identify any structural defects that required immediate attention; however, major structural defects were reported to WRS when encountered.

The zoom camera videos were reviewed and the condition of the inspected assets was evaluated by certified Pipeline Assessment Certification Program (PACP) technicians. All maintenance, construction and structural defects (the defect categories) were entered into the GIS/CAMS database and an overall condition score was given to each manhole and pipeline for each category. Manholes and pipelines assigned a maintenance score of 3, 4 or 5 were cleaned to prevent grease, debris and obstruction related backups and overflows from occurring. Pipelines assigned a structural score of 4 or 5 were cleaned and inspected with in-line camera technology to collect more detailed information. A listing of the manholes and pipelines assigned a structural grade of 4 and 5 was provided to WRS monthly. These assets will be scheduled for rehabilitation.

Background

Hillsborough County is located on the central Gulf Coast of Florida. The County's WRS provides water, wastewater and reclaimed water services to approximately 155,000 accounts. The County owns and operates three water treatment plants, three isolated neighborhood facilities, four re-pump stations and

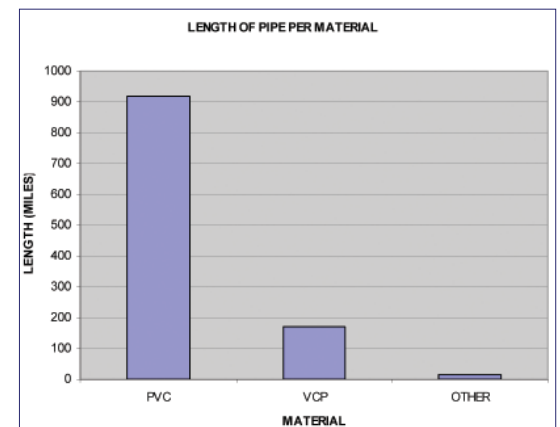
approximately 1,600 miles of transmission mains. It also provides reclaimed water and wastewater services to approximately 12,000 residential and 120,000 commercial customers. The reclaimed water system provides an average of 13 million gallons of reclaimed water through a network of approximately 240 miles of transmission mains. The wastewater system consists of seven advanced wastewater treatment plants with a permitted capacity of 37.2 mgd, more than 530 pumping or lift stations, 655 miles of force mains and approximately 30,800 manholes and 1,200 miles of gravity sewer pipelines.



The Hillsborough County sewer system dates back to the 1950s. The majority of the pipelines (79.8 percent) were installed since the 1970s.

The County's pipelines are predominantly constructed of polyvinyl chloride pipe (PVC) and vitrified clay pipe (VCP) material. More than 80 percent of the gravity sewer system is constructed of PVC pipe.

Gravity sewer manholes are predominantly pre-cast concrete (88.3 percent) and brick (10.2 percent) material. The average manhole depth is 6.6 feet.

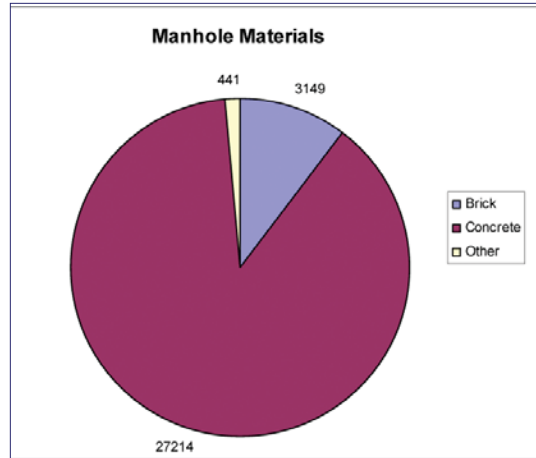


Data Collection and Evaluation Process

InfraMetrix was charged with conducting the county-wide inventory and condition assessment of the gravity sewer system. The principal objectives of the project were to:

- Locate all manholes (on road, off road and in easements) and cleanouts with survey-grade GPS coordinates;

- Inspect all manholes and pipelines;
- Find the immediate maintenance and structural needs;
- Clean and obtain detailed information about structural defects in manholes and pipelines requiring attention in the short-term;
- Establish the maintenance and structural condition of each asset; and
- Provide GIS and CAMS attributes in a format easily integrated into the existing software databases.



WRS decided to inspect all manholes and pipelines, even though the majority of the pipelines were less than 30 years old and constructed of PVC, to obtain baseline condition data for all assets during the same time frame.

To achieve the objectives in a timely and cost-effective fashion, WRS decided to use a combination of zoom camera and in-line inspection technologies. The zoom camera inspection established the maintenance and structural condition of each asset and provided visual documentation of which manholes and pipelines required cleaning and repair. The zoom camera data was also used to update the location and inventory data contained within the existing GIS.

The zoom inspection provided a rapid screening process for identifying the current maintenance and structural needs of the collection system. During the project, the zoom camera crews identified a number of manholes and pipelines that required immediate cleaning. By addressing these needs under the InfraMetrix contract, WRS was able to respond in a timely fashion and avert overflows that may have impacted public health, the environment and required public and regulatory notification and eliminate unnecessary pipe cleaning and in-line CCTV.

At the end of each day, the zoom camera inspection crews submitted the manhole and pipeline videos for evaluation by a team of PACP certified viewers. The viewers watched each video and assigned the appropriate Manhole Assessment (a modification to the NASSCO MACP defect coding adopted by WRS) and Pipeline Assessment Certification Program defect codes to the observed defects. In assigning defect codes and determining the internal condition grade of the manholes and pipelines, the viewers considered maintenance issues (grease, debris, encrustation, infiltration, obstructions and roots) and structural issues (breaks, cracks, fractures, holes, displaced joints and surface damage) recorded during the zoom camera inspection.

After the internal condition grades were determined, an external grade was assigned to each manhole and pipeline, providing a basis for evaluating other factors that may influence the risk and schedule for future zoom inspection, maintenance and repairs.

Each month, the GPS, zoom, cleaning and in-line CCTV and condition data was submitted to WRS's Program Manager, TBE Group, for review and approval for GIS and CAMS integration.

The decisive benefit of the combination zoom camera and in-line CCTV inspection approach was the ability to inspect all 30,000 manholes and 1,200 miles of pipelines within two years and address the collection system's immediate needs during the contract term for less than the cost of performing in-line CCTV.

Findings and Conclusions

The zoom camera and CCTV data provided the County with a comprehensive evaluation of the maintenance and structural condition of the county-wide gravity sewer system. The evaluation consisted of a review of the MA and PACP grades assigned to each asset as well as an analysis of the defect grades themselves. The overall finding of the inventory and condition assessment project was enlightening. The gravity sewer system was found to be in much better service and structural condition than anticipated. WRS had budgeted to spend \$3,315,000 for cleaning and in-line CCTV. Only \$1,625,000 was required. These savings allowed InfraMetrix to:

- Develop a Standards Manual including procedures for data collection, cleaning and CCTV, and emergency responses,

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- Provide recommendation for job codes for generating work orders from the MA and PACP defects;
- Develop a methodology for prioritizing future maintenance and capital improvements
- Determine useful life and remaining life for the manholes and pipelines
- Provide manhole and pipeline improvement recommendations
- Present the findings and conclusions in a report on maintenance and capital planning

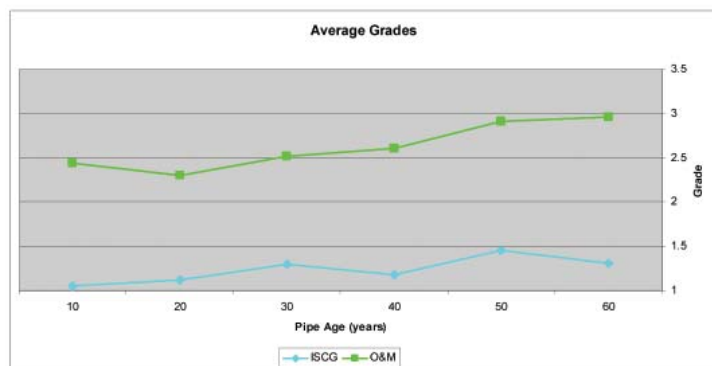
The project will be completed approximately \$1 million under budget. These funds will help fund the rehabilitation of manholes and pipelines assigned a structural condition grade of 4 and 5.

General Findings

The service (O&M) and structural (ISCG) condition of the manholes and pipelines were both evaluated using a condition scale of 1 to 5.

| Internal-Condition Grade | Condition Rating | |
|--------------------------|---|--|
| | Structural Condition Description | O & M Condition Description |
| 1 | Excellent (Acceptable structural condition) | Excellent (Minor defects) |
| 2 | Good (Minimal collapse likelihood in short term but potential for further deterioration) | Good (Defects that have not begun to deteriorate) |
| 3 | Fair (Collapse unlikely in near future but further deterioration likely) | Fair (Moderate defects that continue to deteriorate) |
| 4 | Poor (Collapse likely in foreseeable future) | Poor (Severe defects that become a 5 in the near future) |
| 5 | Immediate Attention (Collapsed or collapse imminent) | Immediate Attention (Defects requiring immediate attention) |

As previously mentioned, the service and structural condition of WRS’s pipelines were better than anticipated. The figure shows the average service and structural condition grades for WRS’s gravity sewers. These grades suggest that the service (O&M) condition of the sewer system is generally good with the older pipelines more prone to accumulation of grease and debris. Although a number of pipelines were found to fall within the fair to good categories, 5,876 pipelines (20.1 percent) fell into the grade 3, 4 and 5 categories. These pipelines were cleaned during the project, resulting in no pipelines with an O&M grade greater than 3 at the completion of the project.

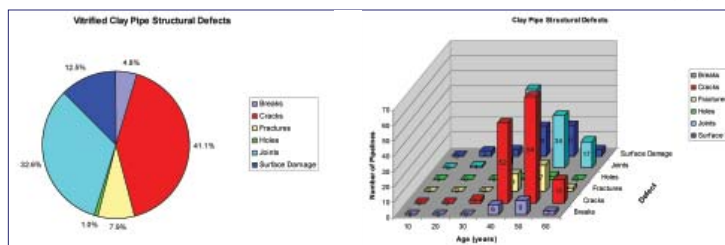


The average structural condition (ISCG) of the sewer system is 1.08. Approximately 1.1 percent of the pipelines were assigned a structural grade of 4 or greater and were inspected with in-line CCTV.

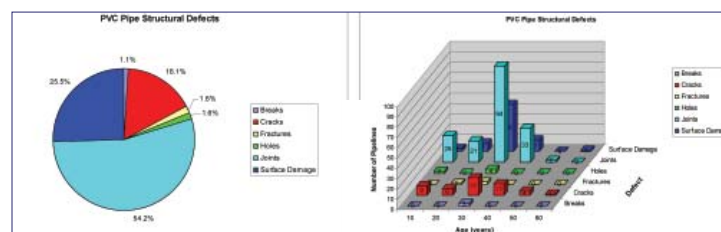
Structural Assessment of Pipelines and Manholes

Pipelines: Approximately 2.9 percent (891 pipelines) of the gravity sewer system was observed to contain structural defects. This percentage includes 518 (1.7 percent) VCP pipelines and 373 (1.2 percent) PVC pipelines. The figures present the distribution of the number of pipelines with structural defects by age and pipe material.

Cracked pipe represents the largest category of defects found in defective VCP pipe. Slightly more than 40 percent (213 pipelines) of the defective VCP was found to contain cracked pipe.



Joint defects represented the next highest defect category. Approximately 33 percent (169 pipelines) of the defective VCP was found to contain joint defects. Overall, however, the condition of VCP was determined to be fair to good. VCP pipelines that fell into the grade 4 and 5 categories were televised. These pipelines will be repaired. Considering the fact that only 518 VCP pipelines out of 3,590 VCP pipelines (14.4 percent) were observed to have structural defects, the VCP pipelines are generally in good condition.



Joint defects, primarily of set joints, represent the largest category of defects found in defective PVC pipe. Slightly more than 54 percent (202 pipelines) of the defective PVC was found to contain joint defects. Surface damage defects represented the next highest defect category. Approximately 25 percent (95 pipelines) of the defective PVC was found to contain surface damage. Overall the condition of PVC pipe was determined to be better than good. PVC pipelines that fell into the grade 4 and 5 categories were televised. These pipelines will be repaired. Considering the fact that only 373 PVC pipelines out of 24,015 VCP pipelines (1.6 percent) were observed to have structural defects, the PVC pipelines are generally in “like new” condition.

Manholes: Approximately 88 percent of the gravity sewer manholes have been constructed of pre-cast concrete, 10 percent of brick and the remaining 2 percent of other materials. The most significant defects found in pre-cast concrete manholes occurred near the top of the manhole. Evidence of active and previous infiltration was observed in the vicinity of the frame and cover, chimney and cone sections in 3,745 of the 30,804 manholes. Slightly more than 12 percent of the manholes contribute infiltration to the collection system. Surface damage to the frame was observed in 8,863 manholes and surface damage to the chimney was observed in 1,191 manholes. Approximately 1,500 manholes were selected for

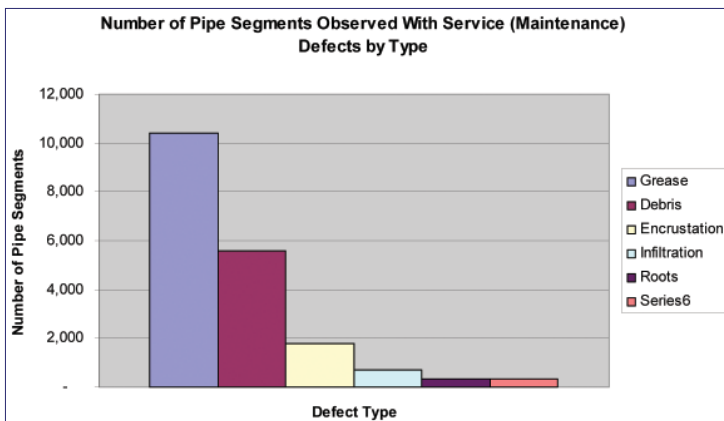
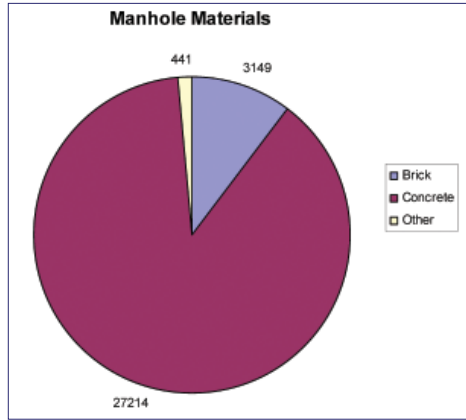
rehabilitation. A contract to perform this work will be advertised for construction in winter/spring 2009.

Manholes were generally found to be in good service condition. Some manholes were cleaned to remove debris from the walls and bench to avoid future pipeline maintenance issues.

Overall, the Hillsborough gravity sewer system is in very good structural condition. Although some manholes and pipelines were found to be in need of immediate attention, these issues have been addressed or are in the process of being resolved.

Service (Maintenance) Assessment of Pipelines and Manholes

Pipelines: The overall service condition of the gravity sewer system was found to be better than expected. Less than 15 percent were found to have a PACP O&M grade of 3, 4 or 5. However, approximately 65.2 percent (19,084 pipelines) of the gravity sewer system was observed to contain maintenance defects. Maintenance defects were observed within 3,737 VCP pipelines, 15,269 PVC pipelines and 237 pipelines of other materials.



Grease represents the largest category of defects found. Slightly more than 35.6 percent (10,410 pipelines) of the defective pipe was found to contain grease. Debris represented the next highest defect category. Approximately 19 percent (5,559 pipelines) of the defective pipe was found to contain debris. The balance of the maintenance defects included encrustation, infiltration, obstructions and roots. Active or signs of infiltration was observed within 2,476 pipelines.

Manholes: During the inspection of manholes, debris was observed on manhole walls, benches and within inverts. A total of 6,251 manholes were assigned an O&M grade of 3, 4 or 5. Of this number 3,384 were recommended for cleaning.

Overall, the Hillsborough gravity sewer system is in good service condition. Although some pipelines and manholes

were found to be in need of immediate attention, these issues were addressed and the next tier of maintenance needs will be schedule for cleaning.

Dividends Realized

The benefits that Hillsborough County received from this project fall into two categories. The first category of benefits represents the desired benefits that WRS intended to receive from the gravity sewer inventory, inspection and condition assessment project.

The desired benefits included:

- Survey-grade GPS coordinates for cleanouts and manholes located on road, off road and within easements;
- Updated spatial mapping of the collection system based on actual location of manholes found in the field;
- Updated physical characteristic attributes (size, material, type, etc.);
- Listing of observed service (O&M) and structural (ISCG) defects for each asset;
- Videos and photographs of O&M and structural defects;
- Zoom camera inspection for all inspected manholes and pipelines;
- A listing of observed defects within each manhole and pipelines;
- Identification of immediate O&M and structural needs;
- Cleaning to remove potential obstructions with pipelines graded with an O&M grade of 3, 4 and 5;
- In-CCTV inspection videos of pipeline graded with an ISCG 4 and 5;
- Condition grades for all inspected manholes and pipelines collected within the same time frame; and
- Integrating all of the information listed above into the appropriate GIS/CAMS database.

The following dividends were realized by WRS:

- A spatial analysis of maintenance needs identified neighborhoods prone to the accumulation of grease, requiring more frequent cleaning;
- Less than 3 percent of the County's gravity sewer pipelines were observed to have defects;
- More than 85 percent of the VCP pipelines were observed to be in fair to excellent condition. 382 VCP pipelines contain cracks or defective joints;
- Nearly 98 percent of the PVC pipelines were observed to be in fair to excellent condition. 287 pipelines contain joint defects or surface damage;
- Identified areas experiencing periodic high water levels or surcharging;
- 1,500 manholes were determined to require repair;
- Condition data will provide the basis for future maintenance and capital planning; and
- The project will be completed approximately \$1 million under budget. These funds will help fund the rehabilitation of manholes and pipelines assigned a structural condition grade of 4 and 5.

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