

# Making the Most of It

City uses regulatory action to embark on mobile GIS, asset management programs.

By Jay Sheehan and Ted Chapin

**M**anhole investigations and studies are a first step toward comprehensive collection system improvements, and are often required to meet consent decrees from regulatory agencies. By thinking ahead, these projects can be used to develop a data platform for GIS, and provide the infrastructure and condition data necessary to start an asset management system to organize maintenance needs and planning. When faced with a Consent Decree, Waterbury, CT, used a mandatory manhole inspection project as an opportunity to meet regulatory requirements and develop tools that make municipal staff more efficient, such as GIS and handheld computers for remote data collection, and trained staff in the skills needed to maintain compliance for the future.

When the EPA and the Connecticut Department of Environmental Protection (DEP) determined that Waterbury's sanitary collection and treatment system was in violation of the

Clean Water Act, it issued a Consent Decree requiring Waterbury to initiate programs to ensure compliance with that federal law. Part of this mandate was a manhole inspection program. Woodard & Curran ([www.woodardcurran.com](http://www.woodardcurran.com)) worked with Waterbury to leverage these regulatory requirements into an opportunity to develop tools to enhance the operations and maintenance of the collection system infrastructure. This program was the city's introduction to asset management.

## Aging Infrastructure: Waterbury's Collection System

Located in west-central Connecticut, Waterbury is a growing city with about 110,000 residents. It is the fifth largest city in Connecticut. Waterbury's collection system comprises over 90 discrete sewage areas, which are interconnected by about 320 miles of sanitary sewer lines supported by 20 pump stations and four flow metering stations. The system includes more than 9,500 manholes and accepts discharges from three

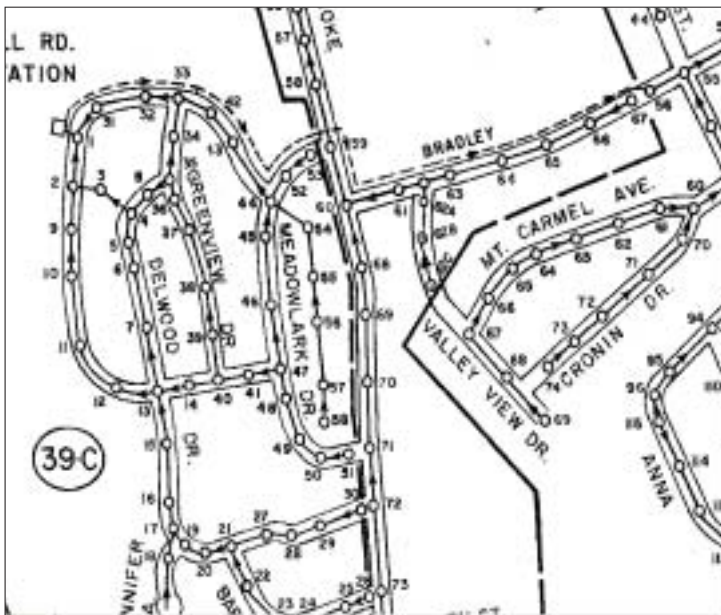
adjacent towns. With aging infrastructure dating back to the early 1900's, complying with the Consent Decree was a challenging task.

Adding to the challenge of compliance due to the age and size of the col-

lection system were limited mapping and information technology resources. Waterbury needed an approach that could be quickly and inexpensively initiated and would allow for growth in the amount and complexity of data to meet the requirements of compliance as well as ongoing maintenance and operations. To help meet these goals, the city and the consultant began an infrastructure inventory, operational enhancements, capital improvements, training, and a public education program.

Manhole investigations and studies are essential for comprehensive sanitary collection system management and are often needed to meet regulatory requirements. An inventory of manholes and their conditions is an essential first step toward developing data and tools for system-wide planning. Manhole inspection programs can be used to develop a data platform for GIS and to provide the infrastructure and condition data necessary to start an asset management system to organize maintenance, operations, and planning activities.

Woodard & Curran's approach was to provide sound engineering advice using the latest technological tools, including ArcGIS' ArcView for visualizing, managing, creating, and analyzing geographical data and ArcPad mobile computing and field mapping applications (ESRI, [www.esri.com](http://www.esri.com)). Since the Consent Decree required that all manholes be located, and five percent opened and inspected, the city needed a baseline inventory from which to select manholes for inspection. The consultant began to construct a GIS database by scanning and georeferencing existing hardcopy sewer system maps. Using an existing AutoCAD (Autodesk, Inc., [www.autodesk.com](http://www.autodesk.com)) drawing of the sewer system, attributes such as manhole ID, sewer subarea, and flow direction were added from the scanned maps



Example of existing sewer system maps.

to the features of the collection system using heads-up attribution. This resulted in a geographically referenced, to-scale representation of the sewer system. The consultant combined these data with existing basemap data from the city as well as other geographic data from DEP, such as wetlands, to compose a GIS that would serve as the basis for an asset management system.

## GIS for Electronic Data Collection

The first use of the GIS was to provide field crews conducting manhole inspections with handheld computers to collect data electronically. The consultant developed a mobile GIS interface that facilitated rapid entry of inspection results directly into a database on the handheld computer, for later synchronization with a central database. This highly efficient process eliminated data quality errors in transcribing paper data forms and provided field personnel with a mobile, interactive map interface to help locate manholes needing investigation.

In addition to the manhole inspections, other maintenance activities, such as pipe cleaning, TV inspection, and smoke testing, will be automated to streamline the collection and integration of information. Reduced reliance on paper forms results in better data quality and seamless integration of datasets. By designing scalable databases and modular interfaces, the GIS can grow to meet the needs of low-cost startup and long-term utility. This phased implementation makes asset management more affordable.

Woodard & Curran and city staff used the mobile GIS in a manhole inspection protocol that located manholes while simultaneously assessing their condition. Manholes were first categorized as paved over, buried, or accessible. A subset of accessible manholes were internally inspected and evaluated for conditions that required surface, structural, or hydraulic rehabilitation or maintenance.

GIS was used to monitor progress toward compliance, summarize the results of field inspections, and produce cartographic-quality maps for reports to regulatory agencies. Ultimately, city per-

sonnel will be trained in the use of the mobile GIS application for use in ongoing maintenance activities. Web-based GIS was used to allow remote access to the data by personnel from the consultant and the

city, with reduced requirements for hardware, software, and GIS expertise. This is a potential future platform for additional data automation and asset management programs.

This approach saved both time and money. The time required to perform the manhole inspections themselves decreased by over 20 percent, whereas the time required to integrate and transfer the collected data decreased by over



*Field workers used handheld computers with a GIS to collect information during manhole inspections.*

66 percent. In addition, database integrity is protected by using the mobile data collection tools. The mobile GIS tool allows for the consistent and standardized collection of data with referential integrity and domain constraints built-in. Data entry errors inher-



*Overlay of scanned sewer maps and GIS layers depicting manholes with identification labels, pipes, flow direction, and sewer subareas.*

ent in a paper to database transfer do not exist within this framework.

Critical to the success of the compliance effort and the use of GIS in ongoing operations and maintenance is training of city personnel. Waterbury staff must be able to use the appropriate tools to sustain the quality and utility of their inspection data. Education of the public is also an important step in restoring the public's confidence in the proper operation of the wastewater collection system. Web-based GIS and other online resources are valuable tools for the dissemination of information, and have proven extremely helpful.

## Additional Benefits

Faced with regulatory action, Waterbury needed to document the measures necessary to achieve regulatory compliance and improve the overall management and operations of its sanitary collection system. In just two years, the initiation of an asset management program has benefited Waterbury in many ways. Asset management has allowed Waterbury to maintain compliance and avoid future regulatory action, reduced strain on staff by reducing manual entry and management of data, provided a defensible planning and reporting tool, and supported operations and maintenance activities over time. **GE**

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