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Julia Hunt
Director of Water Utilities
Arlington, Texas

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Arlington gets efficiencies from GIS data combined with condition assessments

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DEEP INTEGRATION

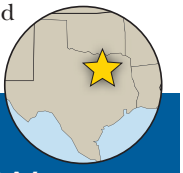
The City of Arlington creates a sophisticated database combining GIS data with line condition assessments, producing major efficiencies

By Peter Kenter

Utility technician Marcus Phillips, left, and crew chief Alex Holmes clean a sewer line — an essential daily task in an extremely organized system maintenance and rehabilitation program. (Photography by Glen Ellman)

The Arlington (Texas) Water Utilities Department has always been an early adopter of technology. In the mid-1990s, the department launched a project to electronically catalog the entire sanitary sewer and water system.

But what began as a simple mapping project has blossomed into a system that combines explicit descriptions of department assets with geographic information system (GIS) coordinates. The result is a database that can produce a computerized ranking for any length of pipe and provide impartial



PROFILE: Arlington Water Utilities, City of Arlington, Texas

FOUNDED:
1894

POPULATION:
367,000 (100,000 accounts)

AREA SERVED:
99.7 square miles

EMPLOYEES:
222

INFRASTRUCTURE:
1,400 miles of water mains,
1,200 miles of sewer mains

ANNUAL BUDGET:
$116 million

WEBSITE:
www.arlingtontx.gov/water

Arlington Water Utilities employees take pride in using technology and people power to keep their system operating reliably and efficiently.

> **"We realized that department personnel had a lot of expertise with waterlines, sanitary sewers, manholes and other utilities, but that these people would soon be retiring along with their knowledge."**
>
> **Julia Hunt, P.E.**

Julia Hunt

APWA AWARD

This year, Julia Hunt, director of Water Utilities for the City of Arlington, accepted a Top Ten Public Works Leader of the Year award presented by the American Public Works Association (APWA). The award is a national honor for meeting the highest standards of professional conduct in the field.

Hunt was nominated by Ronnie Bates, president of the Texas Chapter of the APWA, in light of her record of accomplishments and exemplary career in public works. In a supporting letter, Arlington mayor Robert Cluck wrote: "Julia has consistently demonstrated superb engineering talent and visionary leadership skills that have allowed her to bring value to the organization."

guidance on which assets most immediately need repair or rehabilitation.

The department has achieved greater efficiency, not only by allocating its resources to the projects that need the greatest attention, but also by integrating all construction and repairs of road-building projects.

Sound leadership

Julia Hunt, P.E., director of Water Utilities, has contributed to the project since its inception. She began working with the city as a co-op education student in 1981 while studying civil engineering at Texas A&M University. One of her early assignments when she joined the department full time in 1985 as a graduate engineer was to buy its first desktop computer.

"It was an IBM XT with a math co-processor so that we could run a hydraulic engineering program," says Hunt. "I stayed closely involved with computer applications, so when a new position as GIS manager opened up in the water department in 1996, I applied and was selected for the job."

At the time, the city, between Dallas and Fort Worth, was hand-tracing and uniquely identifying tax parcel information, then digitizing it. The process involved using a mouse-like "puck" to trace the outlines of the parcels on paper maps. It was the first step in creating a virtual representation of the city's infrastructure.

Retaining staff knowledge

"We realized that department personnel had a lot of expertise with waterlines, sanitary sewers, manholes and other utilities, but that these people would soon be retiring along with their knowledge," says Hunt. "It's an issue that every utility struggles with. That realization led to the recognition that we needed to relate the information to the parcels we had already recorded on the mainframe and city's early GIS."

Information services manager Bob Lemus has worked in GIS since the early 1990s and became the city's GIS applications supervisor in 1999. The current GIS uses Esri ArcMap 10 software. "I'll give Julia credit," says Lemus. "By the time I had arrived, the main work was done converting the paper map data into electronic GIS.

"Just as important, however, was the GIS implementation plan. Years ago, people were transferring map images and spatial information to AutoCAD. The system chosen here features a relational database, allowing information to be easily interconnected. We're now reaping the benefits from a design plan initiated years ago."

Getting buy-in from department workers was a major consideration. Some field crew members were concerned that because the original paper maps used to record parcel data were not 100 percent accurate, the database would reflect those inaccuracies.

"We had to make those people part of the process," says Hunt. "We gave them access to an interface to the maps and database and told them that if they found anything wrong, we would correct it within 14 days. That process continues today. Department field workers form the first line of defense against inaccuracies."

Proposed changes or additions to the original database can be submitted by department staff, creating temporary edits that are confirmed by the GIS department.

All new sewer and water construction is verified by one mem-

Construction crew workers Jose Ortiz (on backhoe), Pedro Sanchez (second from right) and Armando Rodriquez help restore a roadway after a water main replacement.

ber of a dedicated team of three GIS technicians who check valves, lines, fire hydrants and cleanouts, observing reality as compared to the virtual reality of the database.

Input simplified

"The information must be entered from a standard list of attributes and numbers to ensure that it is accurate," says Lemus. "We place restraints on the database to remove values that could not possibly be right. For example, if you're identifying waterline material, you have to choose from PVC, ductile iron and cast iron — you couldn't indicate it was made of wood."

Later, a GIS technician who was not involved in the assessment provides a quality assurance check as standard operating procedure. Spot checks by supervisors provide an additional layer of quality assurance.

A change in the way roadwork projects were allocated in 2002 led to the development of a new repair protocol for the water department. The city instituted a quarter-cent sales tax and dedicated the proceeds to the Public Works and Transportation department, specifically for roadway maintenance.

"Because of that funding, road construction suddenly became more aggressive," says Lemus. "We were seeing sanitary sewer and water projects completed, and then a few months later Public Works would put the same stretch on its project list. Sometimes it was the other way around, with a water project cutting into a brand-new street and putting a zipper patch onto it."

Public Works had developed a system for determining road conditions mapped out by a van carrying sophisticated surface monitoring equipment. The city's entire road surface is monitored every three years, and the information is translated into a scoring system to determine which road segments require the greatest attention.

Objective assessment

A proposed new system, dubbed Renewal, Rehabilitation and Prioritization (RRP) would score candidate water or sanitary sewer line projects in an objective fashion compatible with the road construction scoring system. The two-pronged program aimed to standardize the methods used to set priorities for repair and rehabilitation of department assets and to consolidate that information at a central location.

"The biggest challenge was getting everyone on the team, from field staff to managers, to understand why it was important to capture the best information our field leaders were giving us, so we could develop a scoring system to prioritize those decisions," says Hunt. "This would give us a defensible position for our repair and rehabilitation schedule. A customer may point to a water main that broke twice last year, but we could show them why other projects were scheduled in front of it."

The prioritizing system was based on factors that included work order history, pipe material, pipe age, pipe capacity, soil conditions, customer service calls, cost of service, and criticality of the infrastructure. The result was a rating system that scored water and sanitary sewer lines from 0 to 100 — the higher the number, the greater the need for attention.

Utility information services manager Bob Lemus and his team have an important role in taking care of the city's GIS, which includes Esri ArcMap 10 software.

"We also interviewed staff to try to quantify the gut feelings people had about what lines needed to be renewed and rehabilitated," says Lemus. "After the application was developed we did a lot of ground truthing, checking the scores against reality, until everyone felt comfortable.

"Julia passed some of the first reports to management staff to see if the scores made sense. Even when scores seemed to deviate a little too high or a little too low, when they looked at the line segments, the score was more accurate than their gut feelings."

Cooperating with construction

Later that year, the two depart-

ments formed a roadway, water and drainage committee, designed to coordinate all construction projects and take advantage of any scheduled work. However, no additional funding was made available on the sanitary sewer and water side — repair and rehabilitation budgets still relied on water and wastewater rate revenue.

"We meet with Public Works once a month or as needed, and we rely heavily on that rating system and the GIS maps," says Brad Franklin, P.E., manager of water engineering. "The scoring system is cross-referenced with the roadway repair schedule, which occasionally influences the priority of a particular length of sewer or water main."

Water Utilities has increased its cleaning of the sanitary sewer system, with a goal of cleaning all 6- to 15-inch sanitary sewer lines at least once every three years. The problematic lines are also CCTV inspected to determine the best course of action.

Inspection information is collected in a database using Granite XP data collection and management software from CUES. On reviewing the video, that information is translated into a digital rating using Pipeline Assessment and Certification Program standards supplied by the National Association of Sewer Service Companies (NASSCO). The information is then weighted and incorporated into the RRP score.

"If we're looking for an answer, we don't pass the buck to someone else. We don't make excuses. We do our best to provide the type of service we believe our citizens expect."

Julia Hunt, P.E.

"You can give this observed rating a higher weight in the total RRP rating if advisable," says Lemus. "For example, if the line is cracked, there's not much more to be said about it — it's very important. A break at a busy roadway scores even higher."

Database maturing

The water department database is mature, offering sewer and water main attributes as requested. Users can view simple maps or drill down into GIS or other map data. A data snapshot captured in summer of 2011, for example, shows that the city has 1,400 miles of public waterlines, about 38 percent PVC, 43 percent asbestos cement, 6 percent cast iron, 6 percent prestressed concrete, and 7 percent of other materials.

About 1,200 miles of public sanitary sewer lines are 66 percent PVC, 29 percent vitreous clay pipe, and 5 percent other materials. The largest part of the infrastructure dates back to a building boom that occurred in the 1970s and early 1980s.

The city took advantage of the database by accessing water flow modeling information when the Dallas Cowboys constructed Cowboys Stadium in 2009, a short distance from Rangers Ballpark, home of the Texas Rangers.

"We called some cities with similar stadiums to determine water needs and wastewater flows," says Hunt. "We were able to determine from our computer models that most of the planned water and sanitary sewer lines were already large enough and that the network of waterlines would almost fully supply the stadium's needs. We needed only to upsize one section of water supply line."

Planning big projects

Each year, the department produces a report on the entire system. Individual pipe lengths are coordinated with the condition of roadways. The roadway, water and drainage committee considers entire subdivisions when selecting the combined projects, and those requiring the most attention are color-coded. Larger subdivision projects are planned two to three years in advance and coordinated with Public Works street rehabilitation plans.

"We'd rather take advantage of road-building funds to repair pavement than use water revenue zipper patching on these projects," says Franklin. "Water Engineering looks at the RRP scores and tries to combine the greatest number of repairs and rehabs with the highest scores

Utility technician Aaron Hillard tamps the soil with a Multiquip tamper after connecting a new service line.

into the smallest number of GIS coordinates or geographic area. Once we create the project list, our field operations managers visit the actual streets and determine if they agree with the priority."

The most common source of waterline damage is the area's highly elastic clay-rich soil. Known as "black gumbo," the soil expands and contracts significantly with alternating dry spells and rainfall, eventually crushing lines as it shifts. On the sanitary sewer side, root infiltration is the worst culprit.

While in-house operations crews repair line breaks and leaks and deal with other short-term emergencies, most of the new construction and rehab work is completed by outside contractors. Five on-staff engineers act as project managers, designing tender packages and offering work to the lowest qualified bidder.

Planned replacement

While the most cost-effective repair method in the area is dig-and-replace, the department has specified technologies that include cured-in-place pipe lining, directional drilling, and pipe bursting. Sanitary sewer and waterlines are most often replaced by PVC, although larger water mains are replaced with ductile iron.

The department aims to replace 2 percent of its water infrastructure each year, although funding sometimes dictates settling for a lower percentage. The department maintains an ongoing gap analysis that quantifies the expected average lifespan of water infrastructure. The goal is to keep the gap from growing and ultimately to decrease the gap as the system is rejuvenated.

The continuous rehab program has paid off. By progressively investing in the most compromised water infrastructure, the city has achieved a performance measure of just 2.7 breaks per 100 miles of water main annually during normal weather conditions.

The GIS and associated databases continue to evolve on the macro and micro levels. The department is developing a master plan for Lake Arlington that includes computer modeling of the effects of potential development and other factors. On the other end, the city has launched a program to check each water valve by manually exercising it and recording its condition.

While data technology may appear to be the star of the Arlington Water Department, Hunt credits its human team with the department's success. "We spend a lot of effort to make sure there are no walls within our organization," she says. "If we're looking for an answer, we don't pass the buck to someone else. We don't make excuses. We do our best to provide the type of service we believe our citizens expect." ✦

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