

# TAKING THE STRESS OUT OF TESTING

Greensboro Water Resources develops pilot program to test aging prestressed concrete water mains

By Peter Kenter

The City of Greensboro, North Carolina, emphasizes growth and economic development to benefit its population of 250,000. The city's Water Resources department, with responsibility for water and wastewater infrastructure, is part of that effort. Developing a pilot program to effectively inspect prestressed concrete cylinder pipe water main is just one way in which the department strives to create value for the city.

Water Resources engineer Melinda King is part of a group that performs feasibility studies and plans reviews for developers and other customers (see sidebar). The department also collects information on the condition of water and wastewater systems and devises testing protocols for infrastructure.

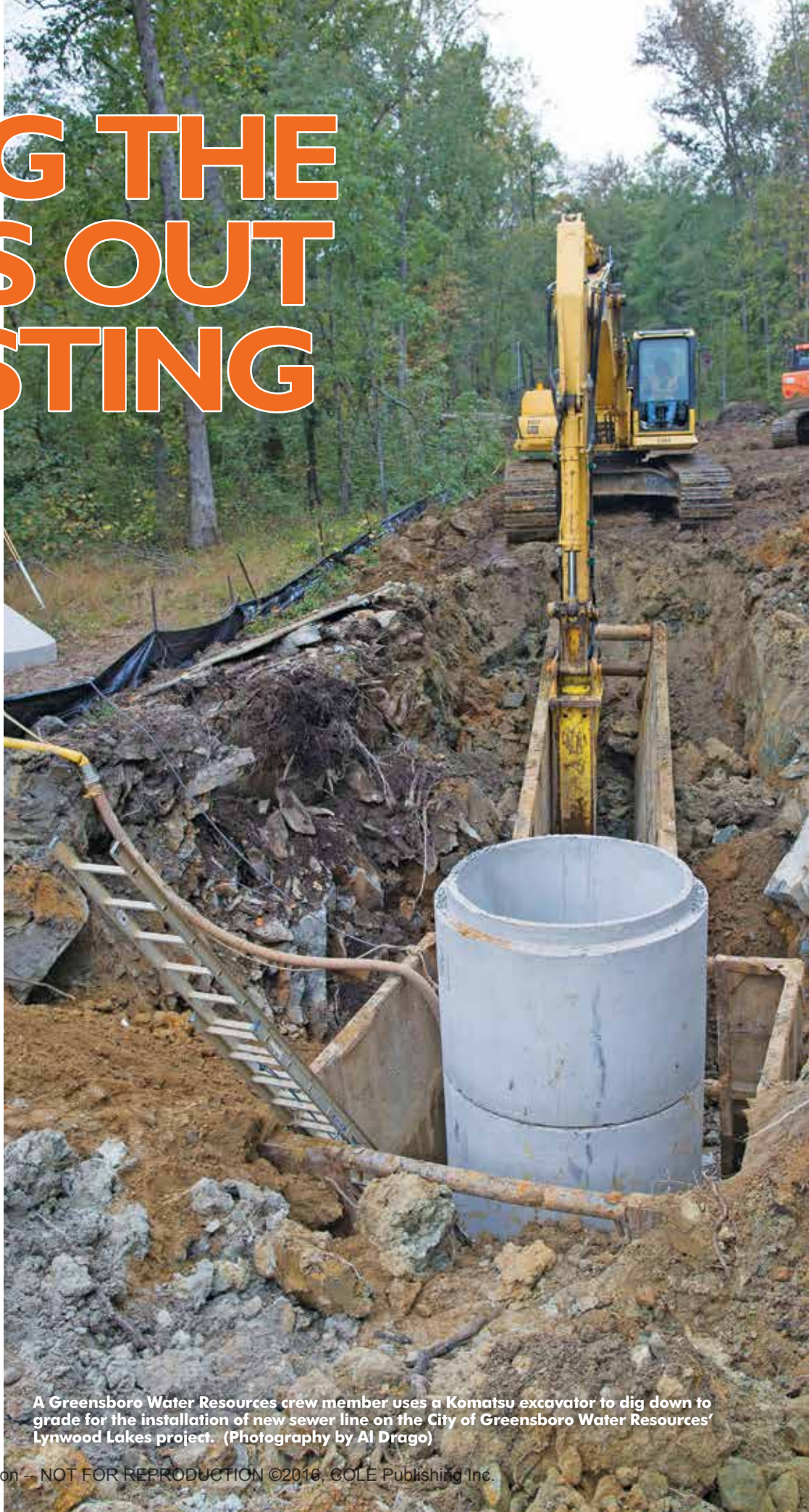
"Parts of both our water and wastewater systems date back to the late 1880s, with the vast majority being installed from the 1940s through the 1960s as part of growth related to the post-World War II baby boom," King says.

Water pipe installed prior to the 1970s is typically cast iron while later installations also include ductile iron and PCCP. Ductile iron and PVC are the generally preferred materials for replacement. Older sewer pipe primarily includes vitrified clay with some cast iron. New installations generally use PVC and ductile iron.

## Robust rehab

"For a system the size of Greensboro's, we rate both water and wastewater infrastructure as being in moderately good condition," King says. "We maintain a very robust rehabilitation and replacement program for both our sewer and water pipes."

The sewer rehab program has been funded continually since 1998 and the water rehab pro-



A Greensboro Water Resources crew member uses a Komatsu excavator to dig down to grade for the installation of new sewer line on the City of Greensboro Water Resources' Lynwood Lakes project. (Photography by Al Drago)



“It’s challenging to design a gravity sewer around a lake, and some of the sewer pipe is buried as deep as 40 feet with one section going underneath the lake.”

– Melinda King



Workman Zachary Seals covers a temporary stream crossing set up to block water from entering the construction site on the edge of the Lynwood Lakes project.



gram since 2008.

“The department has made a commitment to have these programs funded at a level of 1 percent of system footage to be rehabilitated and/or replaced per year by 2020,” says King. “These programs consistently achieve prices that are generally below the national average, allowing more footage to be rehabilitated for every dollar spent.”

Most work is contracted out. Water pipes have been replaced using directional drilling and pipe bursting, and rehabilitated with internal epoxy spray pipe lining. Techniques employed for sewer pipe renewal include directional drilling, pipe bursting, slip lining and cured-in-place pipe lining.

The city owns an impressive fleet of maintenance equipment, including six combination trucks (four Vactors and two Vac-Cons), two power rodders by Sewer Equipment Co. of America, and two CUES camera trucks.

“We perform all sewer cleaning services in-house and do CCTV inspections on all areas of the system requiring maintenance work,” King says. “We outsource all CCTV work related to potential rehabilitation or resurfacing on a basin-by-basin basis.”

Leak detection is also performed in-house using acoustic listening devices and correlators from Echologics.

The city incorporates GIS data on infrastructure using ArcGIS by Esri. The process of incorporating existing GIS infrastructure data has been largely completed. “We’re still trying to collect full information on some of the infrastructure built 100 years ago or more,” King says. “However, when operation crews receive a work order and find something that is not correct, they inform

the mapping division through a work order. The mapping department then goes out and uses Trimble tablets to correct the data.”

### System expansion

The department remains committed to new construction as well, including several major system expansion projects.

Current major work includes an extensive \$22.5 million water and sewer project for the Greensboro-Randolph Megasite, a parcel of land seen as critical for economic development. Required infrastructure includes approximately 87,900 feet of 16-inch water main, 42,700 feet of 16-inch force main, and a 1 to 1.5 mgd sewer lift station.

Another region the city has recognized as a potential growth area is eastern Guilford County. The city will upgrade an existing lift station to increase its capacity to 3,000 gpm. Additional construction will include a new 6,000 gpm pump station, 24,000 feet of 30-inch water main, 12,800 feet of 18-inch water main, 11,200 feet of 42-inch water main, and 12,000 feet of 36-inch gravity sewer.

Additionally, the Lynwood Lakes water and sewer project involves construction of approximately 26,000 feet of waterline and 30,000 feet of sanitary sewer line to serve 300 residences in Guilford County.

“Lynwood Lakes is a complex project that involves a lake and an existing neighborhood,” King says. “It’s challenging to design a gravity sewer around a lake, and some of the sewer pipe is buried as deep as 40 feet with one section going underneath the lake. On this project we’re using traditional jack and bore drilling, blasting and hand tunneling.”

### PROFILE:

City of Greensboro  
(North Carolina)  
Water Resources

**YEAR ESTABLISHED:**  
1837

**CUSTOMERS SERVED:**  
104,000

**AREA SERVED:**  
131 square miles

**DEPARTMENT STAFF:**  
344

**INFRASTRUCTURE:**  
Sewer: 1,416 miles; Water: 1,490 miles.

**ANNUAL DEPARTMENT OPERATING BUDGET (2015-16):**  
Sewer and water: \$96.4 million;  
Stormwater: \$6.6 million.

**ASSOCIATIONS:**  
American Public Works Association, American Water Works Association, Water Resources Research Institute, National Association of Clean Water Agencies, North Carolina American Water Works Association & Water Environment Federation, North Carolina Water Quality Association, North Carolina Pretreatment Consortium, Cape Fear River Assembly, Upper Cape Fear River Basin Association.

**WEBSITE:**  
[www.greensboro-nc.gov/index.aspx?page=2220](http://www.greensboro-nc.gov/index.aspx?page=2220)





**“By first developing a pilot methodology, we could determine whether a full-scale test would provide accuracy and ratepayer value.”**

**– Melinda King**

**Left: Melinda King, project manager for the City of Greensboro Water Resources' Lynwood Lakes project, on site in Greensboro, North Carolina. The \$9.8 million project includes 26,000 feet of water line and 30,000 feet of sanitary sewer line to serve 300 residences. Right: Workman Ed Davis uses a level to make sure a new section of pipe is set at the proper grade.**

### Preparing an inspection pilot

The department has also been hard at work with a pilot project designed to accurately test the condition of PCCP water mains, in particular the prestressed wire in the pipe, which is vulnerable to corrosion and hydrogen embrittlement.

The department chose a one-two punch with two condition assessment tools, both supplied by Pure Technologies. The first is PipeDiver, a free-swimming inline tool that uses remote field eddy current/transformer coupling (RFEC/TC) technology to electromagnetically identify breaks in prestressed wires along the entire length of a PCCP main. The second is SmartBall, another free-swimming tool that records information on leaks and air or gas pockets inside a pipe.

“By first developing a pilot methodology, we could determine whether a full-scale test would provide accuracy and ratepayer value,” King says. “Our primary testing target is the 19,000-foot Bryan Park Water Main, a 36-inch PCCP transmission main out of our Townsend Water Treatment Plant. That main had previously experienced a failure along a joint. Before a full-scale inspection, we wanted to judge the effectiveness of our inspection tools and gauge the difficulty associated with the inspection effort — and ultimately determine whether a full-scale test was warranted.”

Standing in for the Bryan Park Water Main was the Bridge Point Water Main, a 2,000-foot length of 30-inch PCCP main with few residential customers. This water main could be temporarily isolated and depressurized with little to no interruption of service in case of a problem during inspection.

### Relying on in-house crews

The in-house project was completed without the use of outside construction contractors and

employed only city crews. The project methodology was designed by engineering consulting firm Brown and Caldwell. The engineering firm brought in representatives of Pure Technologies to assist with the pilot.

By selectively opening three hydrants, the water velocity of the pipe was adjusted to accommodate the requirements of the inspection tools. Acoustic sensors allowed crews to track the devices so they could be retrieved at the extraction point.

City staff installed 16-inch tapping sleeves and valves to provide access at the inspection tool insertion and extraction sites. The 16-inch pipe coupons and prestressed wires from the taps were collected by crews to provide a benchmark for use in the pipe evaluation.

“The SmartBall inspection detected no leaks or gas pockets in the Bridge Point main,” King says. “PipeDiver revealed five areas of wire break zones in four of the 110 16-foot pipe sticks that make up the length of the main.”

PipeDiver can detect a minimum of five broken wires in one location. The number of wire breaks detected per zone ranged between five and 10.

“At an estimated pressure of 140 psi, it was determined by the engineers that pipe sticks containing more than 24 broken wires would represent a distressed pipe,” King says. “Sticks containing 10 or fewer broken wires represented a low level of distress.”

### Joint inspection spurs repairs

Of the six pipe joints exposed and inspected, four required minor mortar repairs, while a fifth required major mortar repairs. In a sixth, the mortar had failed, exposing the steel in the joint to soil and moisture, with inspectors noting that corrosion of the steel in the joint would eventually lead to a leak or failure of the pipe.

“We found nothing that couldn't be repaired,” King says. “But the pilot inspection has changed both our inspection protocol and our approach to Bryan Park planned for May 2017. Based on our results, we're moving to PCCP inspections every five years. Because we'll be moving to repeat inspections, we will also be installing permanent insertion and extraction points at Bryan Park — possibly one vault and a direct-bury point that can easily be dug up.”

Given the results of Bridge Point, the Bryan Park project will also be focusing more heavily on joint inspections, King says. “By performing the pilot inspection, we know our full-scale inspec-



**City of Greensboro construction inspector Chris Hall conducts a hydrostatic sewer test to check for leaks on a new sewer line in Greensboro.**

# DATA FOR DEVELOPMENT

Businesses thrive on accurate development data. That's why the City of Greensboro Water Resources is committed to providing developers and other customers with accurate cost projections on connecting with the city's water and wastewater services. Water Resources engineer Melinda King is part of the group that provides feasibility studies and plan reviews.

"We strive to assist our customers with moving forward on their business plans as part of a commitment to developer-friendly coordination," says King. "If they provide us with the appropriate data, we will create anything from a sketch plan review to a feasibility study that provides them with a probable cost to extend water and sewer services to their site."

As a self-permitting agency, Greensboro Water Resources has developed an agreement with the State of North Carolina to grant permits to developers, depending on the complexity of the plan.

"The COGWR is a delegated authority for the North Carolina Division of Water Resources, so providing there are no variances from state regulations, we can permit sewer and water services through plan review," says King. "In most cases, our standards are higher than those required by the state."

King's department also works to incorporate new sewer and water developments into its infrastructure database.

"Once construction is complete, the developer submits survey grade information and my group collects the GIS information and incorporates it into the database of known sewer and water infrastructure," she says. "We take the information full circle from plan review to completed construction."

tion will be more effective and demonstrate that we are good stewards of the funds that we're entrusted with." ♦

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