

JOURNAL SPECIAL REPORT

DANGER BELOW

R.I.'s gas-pipe network leaks like a sieve. Fixing it is a huge job.

By Alex Kuffner
Journal Staff Writer

PROVIDENCE — Rhode Island's natural gas distribution system has a troubling percentage of bare steel and iron pipes — outdated materials prone to corrosion and cracking that need to be replaced for the public's safety.

Aging pipes are a nationwide concern. They cause leaks that can endanger homes and people, cost billions of dollars in lost gas, and contribute to emissions that warm the atmosphere.

The problem is particularly acute in Rhode Island. According to a state-by-state survey by the federal government:

- Rhode Island has the second-highest percentage of cast- or wrought-iron pipes: 24 percent.
- It has the seventh-highest percentage of bare steel pipes: 8 percent.
- And it has the second-highest percentage of pipes that were installed before 1970: 48 percent.

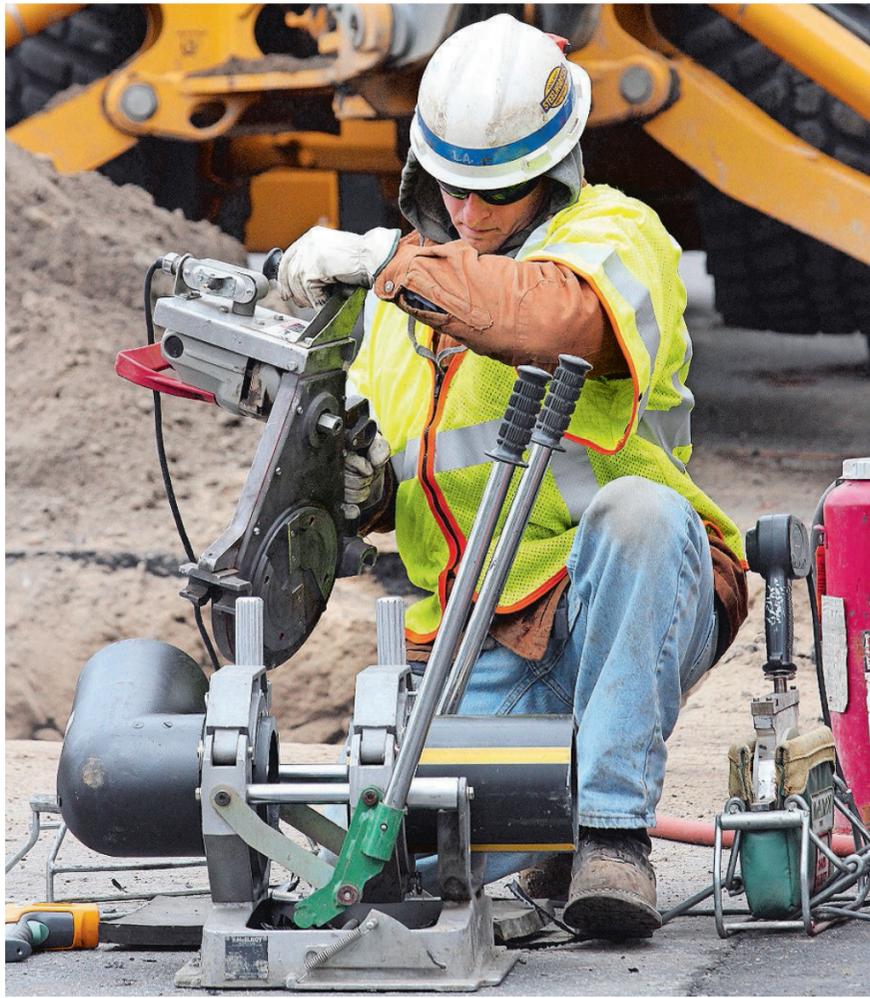
National Grid bought the Rhode Island gas network a decade ago and has spent \$450 million in the last six years to replace 330 miles of aging pipes. Ratepayers are funding one of the most aggressive rebuilds in the country.

An hours-long gas leak on the night of March 29 that closed Route 195 and shut down part of Providence has focused new attention on pipeline safety in Rhode Island. State regulators blamed construction around the high-pressure pipe that destabilized it, causing a joint to crack open.

Although the rupture was not related to age, it raised questions about the integrity of one of the oldest networks in the country, with roots that stretch back before the Civil War.

According to the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration, nearly one in every six miles of gas main in Rhode Island was put in the ground before 1940 — more than three times the national average.

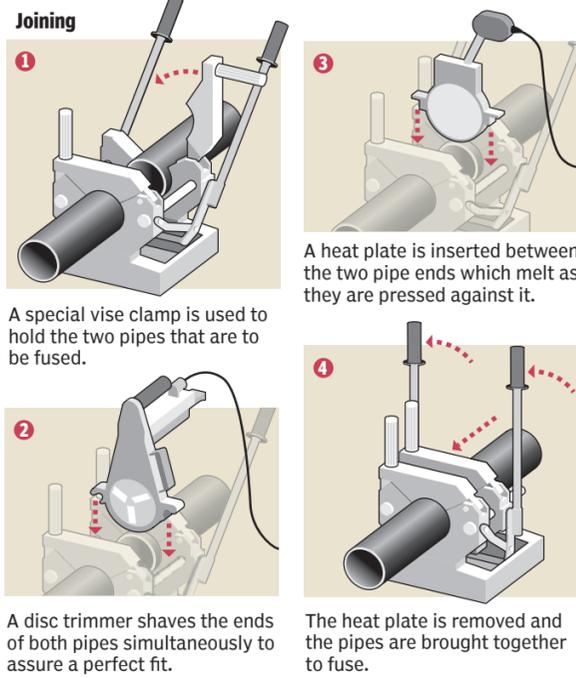
SEE PIPES, A10



National Grid and private contractors connect businesses and residences near the corner of Ives and Fremont streets, in Providence, to a new gas main, replacing the old steel pipes with high-density plastic pipes. Rhode Island has an alarmingly high percentage of bare steel and iron pipes, both prone to leaks from corrosion and cracking. [THE PROVIDENCE JOURNAL/BOB BREIDENBACH]

Better than metal

The gas pipes being used to replace old metal pipes around Rhode Island are made of a polyethylene material that when fused together, is stronger and less prone to leaks.



SOURCE: National Grid

THE PROVIDENCE JOURNAL

More inside

■ It started when the first gas lines in Rhode Island were installed downtown and on the city's East Side in 1848 to fuel street lights. From there, gas became the state's natural choice. **A10**

■ In the wake of a fatal house explosion blamed on an old, severed gas line, Colorado's governor says his state should have comprehensive maps of oil and gas pipelines to help prevent a repeat. **A11**

Coming tomorrow

The gas-pipe rupture in Providence in March was minor compared with some incidents in Rhode Island. We'll give a look at what's happened and what's possible.

IMMIGRATION

In China, Kushners solicit cash for visas

'Invest \$500,000 and immigrate to the United States,' says appeal by Trump in-laws

By Emily Rauhala and William Wan
The Washington Post

BEIJING — The Kushner family came to the United States as refugees, worked hard and made it big — and if you invest in Kushner properties, so can you.

That was the message delivered Saturday by White House senior adviser Jared Kushner's sister Nicole Kushner Meyer to a ballroom full of wealthy Chinese investors in Beijing.

Over several hours of slide shows and presentations, representatives from the Kushner family business urged Chinese citizens gathered at a Ritz-Carlton hotel to consider investing hundreds of thousands of dollars in a New Jersey luxury apartment complex that would help them secure what's known as an investor visa.

The potential investors were advised to invest sooner rather than later in case visa rules change under the Trump administration. "Invest early, and you will invest under the old rules," one speaker said.

The tagline on a brochure for the event: "Invest \$500,000 and immigrate to the United States."

And the highlight of the afternoon was Meyer, a principal for

SEE KUSHNERS, A8

'125 YEARS OF WOMEN'

Lifetime of activism grew from Brown days

Planned Parenthood's Richards learned 'Anyone could change the world'

By Linda Borg
Journal Staff Writer

PROVIDENCE — In a speech that was funny and inspirational, Cecile Richards, president of

Planned Parenthood, said her four years at Brown University inspired her to embark on a path of social justice.

Richards, Class of 1980, recalled arriving in Providence lugging a huge suitcase of A-line woolen skirts, which her mother thought would be smart for a New England Ivy League woman. But this was the late 1970s, an era of paisley and bell-bottom jeans.

Richards was part of a two-day forum, "125 Years of Women at Brown," sponsored by the Women's Leadership Council at the university. The conference celebrates the major role that women have played in the university and honors the impact that Brown's graduates are making across the world.

At Brown, "my life changed forever," Richards told a crowd

SEE RICHARDS, A2



Richards

COVENTRY

Acting out a Revolutionary 'what if?'

240 years later, redcoats try raiding Nathanael Greene's home

By Kate Bramson
Journal Staff Writer

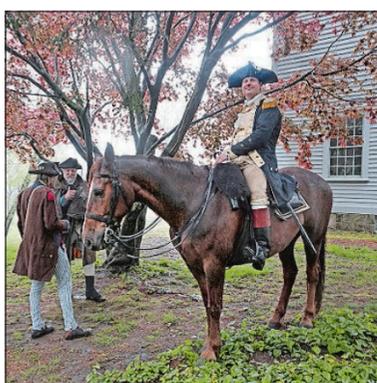
COVENTRY — Sixth-grader Olivia Murphy eagerly awaits the time when her social studies class turns to the Revolutionary War.

She's ready to share what she has

learned after eight years of reenacting the period with her parents, Angela and Edward Murphy of Sandown, New Hampshire.

Already, as her peers learn about the family's travels, such as this weekend's

SEE GREENE, A7



Dave Loda, of Bolton, Conn., mounted on Huckleberry, plays the role of Gen. Nathanael Greene at the Greene homestead on Saturday. He waits under a tree for the rain to stop. [THE PROVIDENCE JOURNAL/SANDOR BODO]

TODAY **MON** **TUE**

61°/41° 58°/38° 57°/41°

Complete forecast, B8

R.I. manufacturing costs are low?

The state is primed for growth in advanced manufacturing, a site-selection expert says. **B1**



AS MUCH AS

\$391

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Sunday

DANGER BELOW

How gas became R.I.'s natural choice

It started with coal, and Providence was an early adopter

By Alex Kuffner
Journal Staff Writer

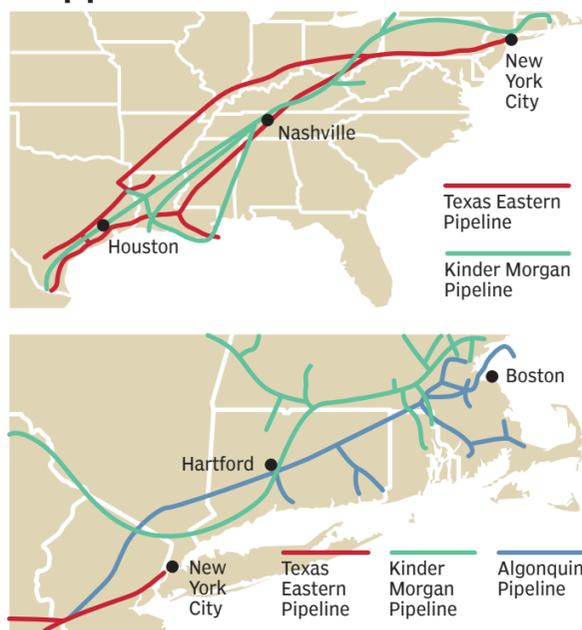
PROVIDENCE — The first gas lines in Rhode Island were installed downtown and on the city's East Side in 1848 to fuel street lights. Although wells that tapped into underground stores of natural gas were in operation in New York by then, there were no big transmission lines to send gas elsewhere. But a less-efficient type of flammable gas could be produced from coal by heating it to a high temperature through a process first discovered in the 1600s. The early gaslight utilities in the United States used this manufactured alternative, known as coal gas.

After the Providence Gas Co. incorporated in 1847, it built a coal gasification plant on Pike Street, near the southern end of Benefit Street, and the next year, Providence became the 10th city in the U.S. to be illuminated by gas. With the advent of electric lights in the late 1800s and early 1900s, the company moved into the heating business. Smaller companies offered similar service in other parts of the state — Newport Gas Light, Valley Gas, Bristol and Warren Gas and others. It wasn't until 1953 that true natural gas came to Rhode Island after a pair of interstate petroleum pipelines built to supply the military during World War II were converted to gas use. Across the country, consumer demand soon doubled, and within 25 years Providence Gas had more than 100,000 customers.

Pennsylvania-based Southern Union took over the system in 2000 and six years later sold it to the U.S. arm of the British conglomerate National Grid. The modern natural gas supply system is divided into three tiers: ■ The big interstate transmission lines that run over long distances and bring gas from points of extraction in one part of the country to areas of demand in other parts. ■ The medium-sized distribution mains that are buried beneath roads. ■ The small service lines that connect individual homes and businesses. Two major pipelines bring gas to New England: the Algonquin Gas Transmission line, now owned by Enbridge after its merger with Spectra Energy, and the Tennessee Gas Pipeline,

owned by Houston-based Kinder Morgan. So-called lateral lines branch off these high-capacity trunklines into Rhode Island. Both the Algonquin and Tennessee Gas lines ultimately connect to historically rich wellfields in Texas and Louisiana, but they are increasingly picking up supplies from newer shale deposits in Pennsylvania and Ohio that have been tapped through hydraulic fracturing, or fracking, which uses a mixture of water, sand and chemicals to blast through thin layers of rock. Supplies also come into the lines from Canada and a liquefied natural gas terminal in Massachusetts. The transmission lines in Rhode Island connect to National Grid's distribution system of 3,193 miles of mains and 2,447 miles of service lines that serve customers in 33 of the state's 39 cities and towns.

Gas pipelines to the Northeast



SOURCE: Enbridge, Kinder Morgan

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PIPES

From Page A1

As of 2016, there were 133 miles of main installed before 1900, most of them in Providence, that were still in use, according to a filing with the state.

National Grid bought the Rhode Island gas network a decade ago and has spent \$450 million in the last six years to replace 330 miles of aging pipes. Ratepayers are funding one of the most aggressive rebuilds in the country.

But it will still take another 18 years to finish the job. In the meantime, the company maintains that older pipes can be used safely.

The data, however, is clear: when iron and steel pipes are replaced with plastic, leaks plummet.

Gas leaks aren't just a safety hazard. They also contribute to climate change and waste money.

How much do they cost consumers? A report from the office of U.S. Sen. Edward Markey, a Massachusetts Democrat, estimated the amount of money that Americans paid for gas that leaked out of the nation's pipeline system from 2000 to 2011 at \$20 billion — at least.

In 2011 alone, according to the report, gas distribution companies lost 69 billion cubic feet of gas into the atmosphere.

"Almost enough to meet the state of Maine's gas needs for a year and equal to the annual carbon dioxide emissions of about six million automobiles," the report said.

A Boston University-led study in 2016 measured 100 leaks in Boston and found the rate of leakage ranged from 0.2 cubic feet to 1,219 cubic feet per day. The average home uses about 202 cubic feet of natural gas per day, according to the U.S. Energy Information Administration.

As a greenhouse gas, methane — the primary component of natural gas — is up to 86 times more potent than carbon dioxide in its heat-trapping abilities, studies have found.

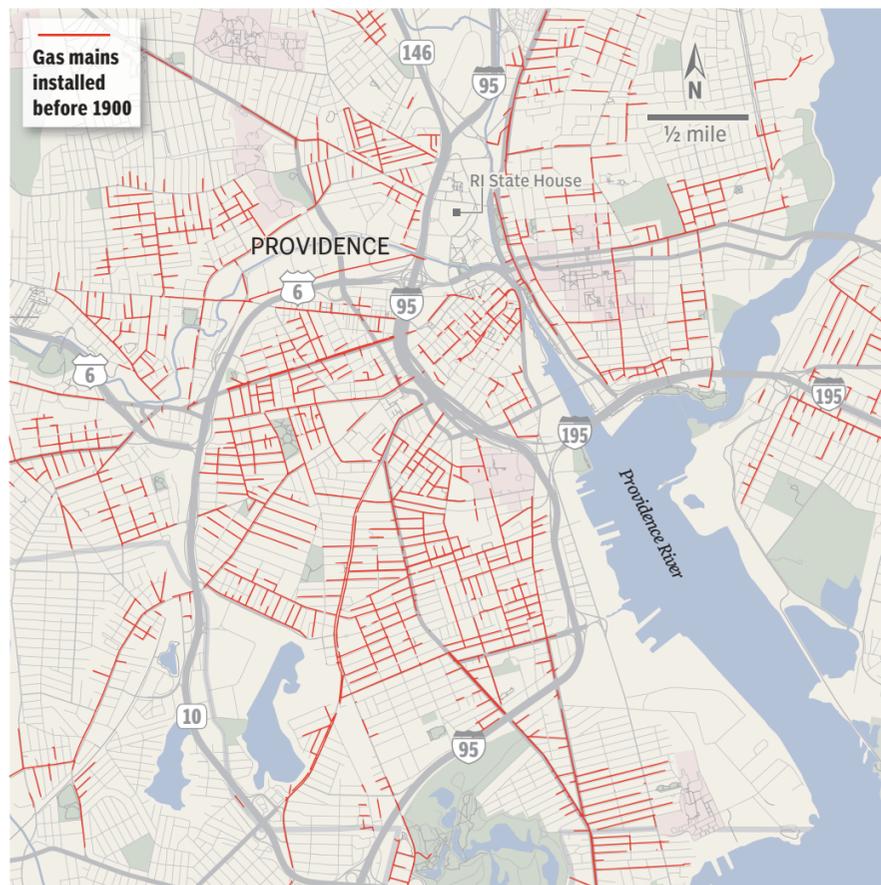
Using Environmental Protection Agency emissions rates, National Grid calculated that by replacing old pipes in Rhode Island, it reduced the total of methane leaked into the atmosphere by an average of 163 metric tons a year in each year from 2012 to 2016.

That's the equivalent in terms of carbon dioxide emissions of taking 869 cars off the road each year.

When the nation's first gas system was built in Baltimore in 1816 to light street lamps, it used wooden pipes to deliver a type of gas manufactured from coal.

Vintage natural gas mains

As of 2016, there were 133 miles of gas mains in use in Rhode Island that were installed before 1900. The majority are in Providence.



Source: Rhode Island Division of Public Utilities and Carriers

GATEHOUSE MEDIA

Gas mains installed before 1970

	Miles of pre-1970 pipeline	% of total pipeline
District of Columbia	709 miles	58.3%
Rhode Island	1,531 miles	47.9%
Nebraska	6,049 miles	46.8%
Louisiana	12,562 miles	46.5%
Colorado	16,677 miles	46.2%
West Virginia	4,948 miles	45.5%
Texas	46,916 miles	43.8%
Mississippi	7,247 miles	43.3%
Ohio	24,894 miles	42.9%
Connecticut	3,425 miles	42.6%

Iron gas mains

	Miles of iron pipeline	% of total pipeline
District of Columbia	411 miles	33.7%
Rhode Island	754 miles	23.6%
Connecticut	1,298 miles	16.2%
Massachusetts	3,194 miles	14.8%
New Jersey	4,369 miles	12.6%
Maryland	1,275 miles	8.5%
New York	3,615 miles	7.4%
Pennsylvania	2,804 miles	5.8%
New Hampshire	103 miles	5.3%
Michigan	2,752 miles	4.7%

Steel gas mains

	Miles of bare steel pipeline	% of total pipeline
West Virginia	2,825 miles	26%
Hawaii	105 miles	17.2%
Pennsylvania	6,946 miles	14.4%
Kansas	3,189 miles	14.1%
Ohio	7,300 miles	12.6%
New York	5,708 miles	11.7%
Rhode Island	241 miles	7.5%
Massachusetts	1,462 miles	6.8%
Arkansas	1,170 miles	5.8%
Texas	5,464 miles	5.1%

SOURCE: U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration



Gas line workers prepare to join pipes under Ives Street in Providence. National Grid will replace about 61 miles of pipes this year at a cost of about \$100 million. [THE PROVIDENCE JOURNAL/BOB BREIDENBACH]

By 1848, when Providence became the 10th city to be illuminated by locally made coal gas, wood was still in use, says National Grid spokesman David Graves — but iron was becoming more common, preferred for its strength and durability.

A century later, the completion of interstate transmission lines would finally bring

natural gas tapped from underground wells in the South to the Northeast. But this development created problems for existing pipelines like those in Rhode Island operated by the Providence Gas Co. and other small gas utilities.

From the federal pipeline safety administration: "... cast iron pipelines were linked using bell and spigot

joints with packing material stuffed in the bell to form a gas-tight seal. Since these pipelines transported wet, manufactured gas, the packing material absorbed moisture and generally did not leak.

"As dry, natural gas began gasplanting manufactured gas use in the mid-20th century, the packing material sealing the joints dried out, causing leaks."

And because iron pipes are susceptible to movement in the ground caused by the freeze-and-thaw cycle, leaks became especially common in the North.

So steel, which first came into use in the 1920s, supplanted iron as the material of choice for pipelines, and joints were largely replaced by welds. But the steel pipe was uncoated, or bare, and

it was soon discovered to be vulnerable to corrosion.

Since the federal government banned the use of bare steel for gas pipes in 1971, the standard has been high-density plastic, which is non-corroding and flexible enough to withstand ground movement.

But even as changes were made to pipeline materials, they affected only new construction. Old pipes buried in the ground were never dug up and replaced.

Pipeline engineer Mohammad Najafi describes the attitude as "out of sight, out of mind."

In most cases, however, the design life of a pipeline is only about 50 years, says Najafi, director of the Center for Underground Infrastructure Research and Education at the University of Texas at Arlington.

National Grid knew it was inheriting an aging system when it took over the gas distribution business in Rhode Island in 2006, says Graves.

The company conducted an inspection before purchasing the business from Southern Union, the Pennsylvania utility that had bought out Providence Gas. "It became obvious that we had some issues," says Graves.

Old pipes were to be expected. Typically, the most problematic systems

SEE PIPES, A11

**DANGER
BELOW**

Fatal Colorado blast leads to call to map gas lines

Two were killed April 17 in explosion caused by gas leak in severed pipeline

By Dan Elliott and Kristen Wyatt
The Associated Press

DENVER — Colorado Gov. John Hickenlooper said Wednesday that the state should have comprehensive maps of oil and gas pipelines to help prevent a repeat of a fatal house explosion blamed on an old, severed gas line. Hickenlooper said that may require a new law, and the legislature is unlikely to

pass one this year because the session is almost over.

“But I don’t think it’s unreasonable for that to be public information,” he said.

Hickenlooper spoke a day after investigators announced that an April 17 explosion that killed two people was caused by odorless, unrefined gas leaking from the severed underground pipeline.

The line was believed to be abandoned but was still connected to a gas well with a valve turned to the open position, investigators said.

The underground flow line was 1 inch in diameter and had been severed within 10 feet of the home, officials

said. Investigators said they do not know when or how the line was cut.

State regulations require abandoned lines to be disconnected and capped. Investigators have said they do not know why that was not done.

With 54,000 active oil and gas wells, Colorado has thousands of similar lines, known as flow lines. They carry oil or gas from a well to a storage tank or other collection point.

The Colorado Oil and Gas Conservation Commission, which regulates the industry, said it does not have complete records of the locations.



Investigators stand by as debris is removed from a house that was destroyed in a deadly explosion in Firestone, Colo., in April. The home explosion that killed two people was caused by unrefined natural gas that was leaking from a small abandoned pipeline from a nearby well. [DAILY TIMES CALL/MATTHEW JONAS]

“Some of these old wells where the flow lines are,” said Hickenlooper, a Democrat and a former petroleum geologist.

“We’ll try to go to every data source we can get.”

He said it could take two years to compile the data.

Immediately after investigators announced their findings about the explosion, Hickenlooper ordered inspections of all flow lines within 1,000 feet of occupied buildings.

The order, issued by the Oil and Gas Conservation Commission, requires energy companies to give the state GPS location data on their flow lines. A commission spokesman did not immediately respond to questions about whether that data would be sufficient to create a flow line map.

A 2007 survey by the federal pipeline safety administration found that Rhode Island had the highest percentage of leak-prone pipes in the nation, with 52 percent made of cast-iron or unlined steel. Leaks were widespread, and now, they’re on the rise. From 2005 to 2008, the system averaged 1,400 leaks per year, 50 percent higher than the average of 900 per year between 1991 and 2004, according to a National Grid filing to the Public Utilities Commission in 2008.

PIPES

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are buried under historic East Coast cities: Boston, New York, Washington, D.C.

But the problems in Rhode Island were extreme. A 2007 survey by the federal pipeline safety administration found that Rhode Island had the highest percentage of leak-prone pipes in the nation, with 52 percent made of cast iron or unlined steel. The District of Columbia was second, at 46 percent, and Massachusetts was third, at 38 percent.

The national average? Three percent.

Leaks were widespread and on the rise. From 2005 to 2008, the system averaged 1,400 confirmed leaks per year, 50 percent higher than the average of 900 per year between 1991 and 2004, according to a National Grid filing to the Public Utilities Commission in 2008.

“This experience is a clear indication that damage and deterioration associated with corrosion is accelerating,” a company executive said in written testimony that accompanied the filing.

It was in that filing that National Grid first put forward a comprehensive plan to replace pipes. To pay for it, the company proposed what it described as the first increase in distribution rates in Rhode Island in a decade. Without the additional funds, National Grid estimated it would take 160 years to upgrade the system’s pipes.

The program ramped up slowly, replacing 25 miles of pipeline on average in each of the first three years. But in the last five years, the annual average has been 54 miles.

To put those numbers in perspective, under a 2001 filing with the division, Providence Gas committed to replacing seven miles of pipes annually.

National Grid’s work has concentrated on the oldest parts of the system, in Providence, Woonsocket, Pawtucket and Newport, and on leaky pipes identified during walking surveys that the company completes every three years and annual winter surveys done by truck. This year’s round of construction, which started in early April, will replace 61 miles of pipeline.

One day last month, crews were putting in new pipes at 15 locations around the state.

“We had a bad trend and we’re addressing it right now,” says Don Ledversis, chief compliance inspector for natural gas and propane at the Rhode Island Division of Public Utilities and Carriers.

According to federal data, he is right. The state is making progress, but at a steep cost.

■ The number of leaks in



National Grid crews use a backhoe near Ives and Fremont streets, in Providence, to dig down to the existing gas pipe to allow a transfer to the newly installed pipe. [THE PROVIDENCE JOURNAL PHOTOS/BOB BREIDENBACH]



National Grid and private contractors work on connecting businesses and residences near the corner of Ives and Fremont streets to a new gas main, replacing the old steel pipes with high density plastic pipes.

Rhode Island requiring repair has dropped by half since 2005 and the number of hazardous leaks — those that require immediate repair because they pose a danger to people or property — has dropped by more than a third. (Both numbers for the nation have gone up in the same period.)

The number of leaks caused by corrosion has dropped by two-thirds.

■ The year-end

backlog of known leaks that are being monitored and could be repaired dropped from a high in 2006 of 1,076 to 68 last year — a 94-percent decline.

■ The rate of leaks per 100 miles of main pipeline in National Grid’s system has been cut in half, from 46 in 2010 to 24 last year. That matches the national average and is below other East Coast states with old systems, including New York



Gas line work being done on Fremont Street in Providence.

(32), Massachusetts (39), and the District of Columbia (59).

There is still room for improvement.

■ The rate of hazardous leaks, at 13 per 100 miles, exceeds the national average of 9.4, though it is still lower than the other states listed above.

■ Leaks to service lines that lead to individual homes and businesses have been difficult to eradicate, with the rate of leak repairs per 1,000 services edging up from 2.6 in 2006 to 3.1 in 2015, according to National Grid. About 80 percent of service leaks occur in bare steel lines and about three-quarters of them require immediate repair because of

close proximity to buildings.

■ The number of minor leaks — those of the lowest priority for repair — has nearly doubled since 2006. They include one leak in a transmission line in Burrillville — first reported by the website ecoRI News — that has continued without repair for as long as a decade, according to officials.

Overall, progress has been slow. Rhode Island no longer leads the nation in leak-prone pipes, but it has fallen only to second place, behind the District of Columbia.

As the program has grown, so has the cost — nearly doubling from \$57 million in 2011 to about \$100 million this year.

For the typical customer,

using 846 therms of gas annually, the replacement program adds \$30.74 to their bill this year, a 2.7-percent increase. The total cost to that customer over the six previous years amounted to \$95.82.

Those additional costs will continue for a generation.

Najafi, the Texas pipeline expert, says “a huge amount of work” needs to be done to bring the nation’s pipes up to date.

In Rhode Island, that work is under way, but it still has a long way to go.

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