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Clockwise from top: Supports are all that remain of the Long Island Bridge. The buildings on the island sit empty, except for furnishings and possessions left behind when the city shut down programs there.

Drought threatens building foundations

Wood pilings under many structures risk rotting as groundwater levels drop

By Sabrina Shankman and Daniel Kool
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In the mid-19th century, as architects and builders erected many of the neighborhoods and landmarks that now define Boston, they leaned on a European practice of driving wood pilings deep into the ground and building up from there. Saturated by groundwater, those pilings could stay strong for centuries — as long as they remained submerged.

Of course, those architects and builders didn't know about climate change.

Now, as a prolonged climate-fueled drought afflicts the region, groundwater levels have dropped to alarming levels, in some cases to record lows, triggering worries that buildings across large swaths of the city could be put at risk as pilings are exposed to air and begin to decay. There are nearly 10,000 row houses and other buildings in nearly a dozen neighborhoods that rely on wood

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Free Staters test limits of N.H. libertarianism

With foothold in GOP, antigovernment forces call for curbs on authority

IS A MASS. AND CASS SOLUTION JUST OUT OF REACH?

Drought threatens city building foundations

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pilings for support, from the North End to the Back Bay and Fenway. Some of the city's most historic landmarks, including Trinity Church, Custom House Tower, and Old South Church, are supported by the pilings, which typically extend 15 to 20 feet below the surface.

Experts said rotting halts when groundwater levels rise again, but will resume whenever pilings are re-exposed, a prospect made increasingly possible by the likelihood of more frequent and long-lasting droughts.

"The more prolonged periods of drought, the more frequent we have them, the more sustained they are, the bigger risk it is to the buildings that are supported on pilings," said Christian Simonelli, executive director of the Boston Groundwater Trust, an organization established by the Boston City Council to monitor groundwater levels in threatened parts of the city and make recommendations.

This summer, as drought in Boston went from mild to significant to critical, the trust has observed drops in many of its 813 monitoring wells across the city, with 31 at their lowest level on record, Simonelli said.

"I'll be very clear: We need rain. We can't go another three or four months like this."

It's a potentially expensive problem. In a 2021 analysis, Garrett Dash Nelson, president of the Norman B. Leventhal Map & Education Center at the Boston Public Library, found that more than \$36 billion of assessed property in Boston lies on former mud flats that were filled in with sand and gravel. Nearly all the buildings on those former mud flats that were constructed in the early part of the 20th century and earlier are supported by wood pilings. "And there are many ways in which that estimate really is a floor," Nelson said at a recent



JESSICA RINALDI/GLOBE STAFF

Jake Ryan, a Boston Groundwater Trust field engineer, measured the groundwater level at a test well in the Fenway. Drought increases the risk of decay for some building foundations.

meeting of the Groundwater Trust, noting that his estimate excludes properties not listed in the tax assessor's database.

Giuliana Zelada-Tumialan, a structural engineer with Simpson Gumpertz & Heger, said taking into account the current high costs in the construction industry, underpinning a typical Boston row house — in which steel and concrete supports replace the exposed tops of rotted woodpiles — runs about \$400,000.

A short period of decay to pilings isn't necessarily an immediate threat to a building, experts said. But significant problems can begin to arise in as little as three years. Rotted pilings can cause a building to settle and crack — making it hard or impossible to open windows and doors and leaving jagged scars across the facade — or, in the worst case, make it unsafe to occupy.

Worries about groundwater

have dogged Boston for a century, having nothing to do with climate. Historically, the biggest threat has been underground infrastructure such as subway tunnels, sewers, and basements, which can crack and allow water to quickly siphon away. Before regular monitoring began in 1999, sometimes such leaks would only be discovered when

later, in 1984, the woodpiles under nearly 20 row houses on Brimmer Street on Beacon Hill were discovered to be rotted, reigniting concerns about Boston's groundwater levels.

The Groundwater Trust was established in 1986 and in the years since has dug narrow wells in vulnerable neighborhoods to keep a close eye on

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CHRISTIAN SIMONELLI, *Boston Groundwater Trust*

the foundation of a building cracked.

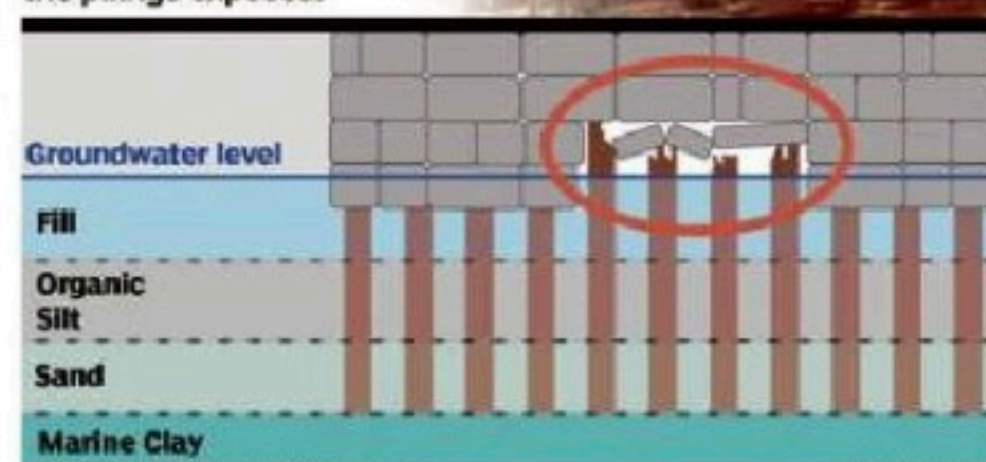
In 1929, for instance, cracks began to appear in the walls of the Boston Public Library's main building in Copley Square, caused by rotted woodpiles below ground. More than 50 years

changes. The constant monitoring, along with rapid repairs of underground leaks by the city, led to a sharp decrease in groundwater problems. But now, with climate change, there's a new worry.

As global temperatures rise

How wood pilings support city buildings

Wood pilings have to stay submerged, or they begin to decay. Periods of severe drought, like the one Boston's experiencing, and which are expected more as climate change progresses, can cause water levels to drop, leaving the pilings exposed.



SOURCE: Boston Groundwater Trust

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due to the burning of fossil fuels, weather patterns globally have been increasingly upended. As part of that worrisome trend, Massachusetts is projected to see an increase in both extreme precipitation and drought, according to a recent report from UMass Boston. Both are problems for groundwater in the city.

"We're going to get more rainfall, but when we do get it, it will be in big storms with large amounts," said Jayne Knott, a groundwater hydrologist who contributed to the UMass report. "That's typically bad for groundwater, especially in a city where you have a lot of impervious surfaces because when the water comes quickly, it tends to run off."

Now, the Groundwater Trust is teaming up with the city and state to focus on how best to prepare. The group will address the issue at an event this month at the Boston Public Library.

Over the past few decades, the city has made some significant changes to help capture more rainfall and redirect it into the ground. A special zoning district, established in 2006, requires that any new buildings be made to capture rainwater in order to direct it into the ground rather than storm sewers. And a

network of groundwater recharge systems has been built across the city, helping pump more water into the ground.

New efforts in green infrastructure offer another solution, said Michelle Laboy, an assistant professor of architecture at Northeastern University. "You can build a swale that's almost like a vegetated ditch, and once it fills up, it can hold the water for a little bit of time, and then slowly let it infiltrate," she said. "The ground can be a sponge, but you need to give it time."

As a result of this work, Simonelli said, groundwater test wells recorded fewer record lows during this drought than in the drought of 2016 — the worst in state history — when 200 test wells registered the lowest level on record.

But in a future when extreme drought may happen more frequently, technology that captures the rain can only help so much, Simonelli said. "What do we do if it doesn't rain?"

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