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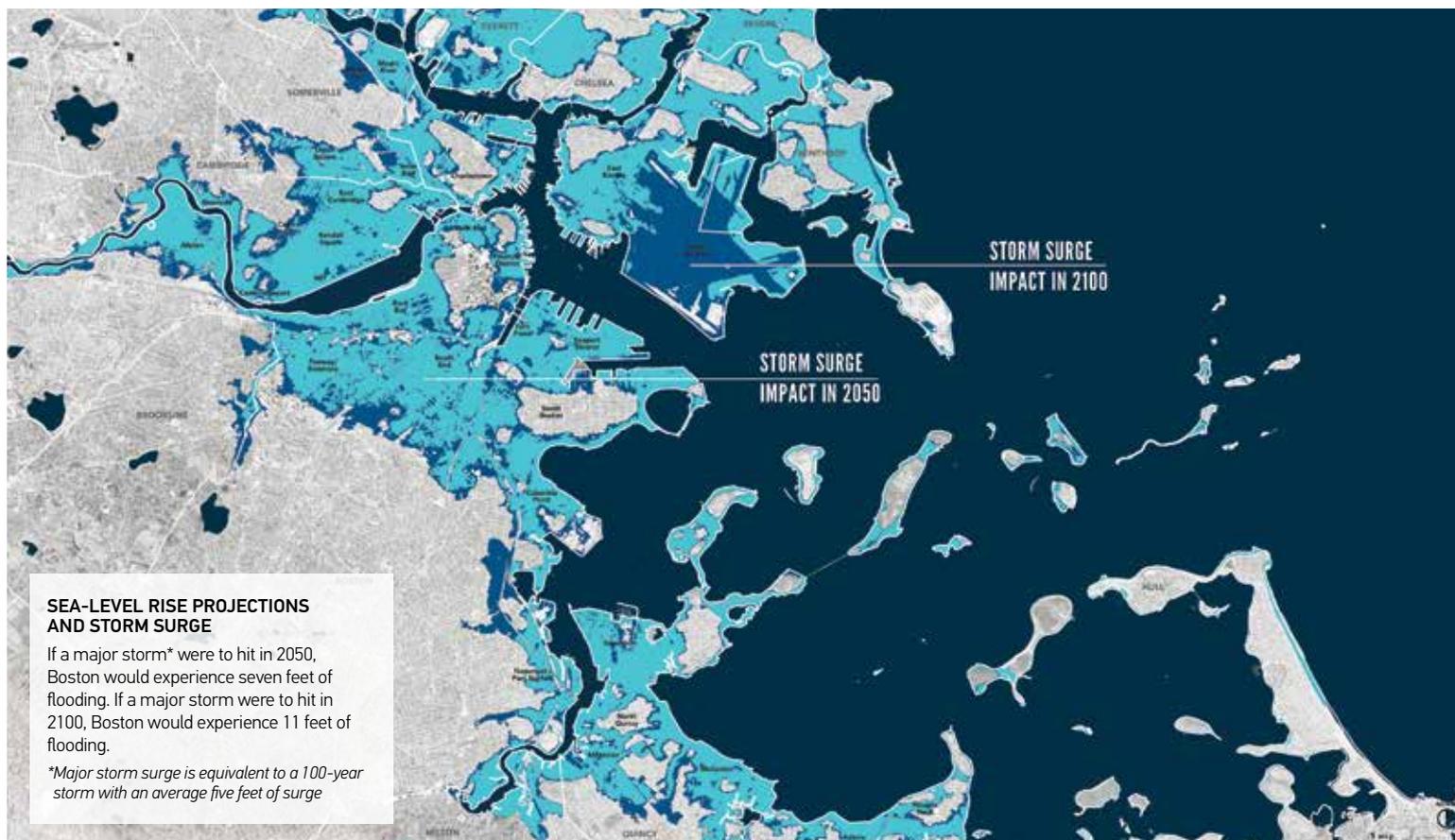
**SEA-LEVEL RISE COULD  
MEAN A STORMY FUTURE  
FOR BOSTON.**

BY ELIZABETH S. PADJEN

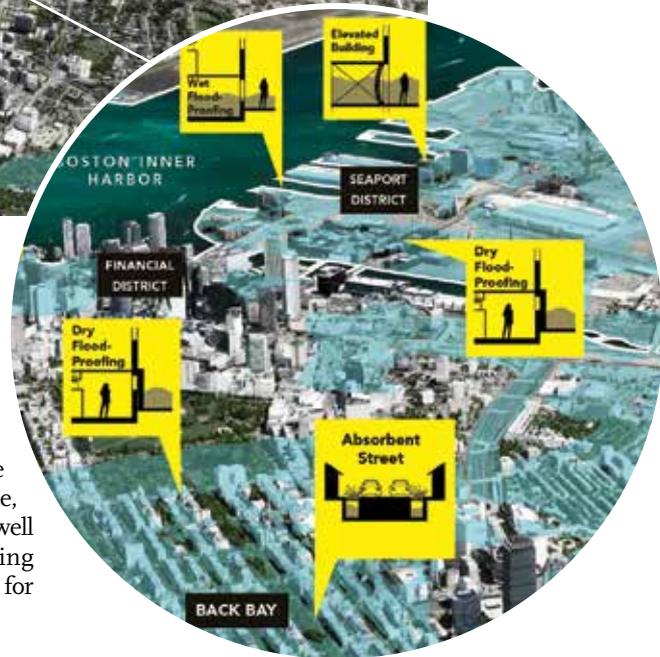
**F**ive hours. You can't sit through any discussion in Boston about sea-level rise without hearing those two words, a reference to Superstorm Sandy. Whether by luck, providence, or meteorology, the massive hurricane hit Boston at low tide. If it had hit five hours earlier, at the top of the tide cycle, the mayor would have waded to City Hall to survey the devastation.

There's nothing like the prospect of a hanging to concentrate the mind—an adage invoked by Robert Culver, the managing director of Sasaki Associates, at the “Sea Change: Boston”

symposium on April 26, an event cohosted by Sasaki and the Boston Architectural College. Since Sandy's 2012 landfall, conferences in Boston about sea levels have been increasingly frequent and intense—much like the storms expected in coming years. Although Sandy can't really be described as a wake-up call—some scientists, academics, and planners in the region recognized the threat decades ago, and the Boston Harbor Association produced its own excellent conference two years before the hurricane struck—Bostonians are no longer hitting the snooze button either.



COURTESY SASAKI ASSOCIATES



**ABOVE**  
Some design strategies could lessen the possible effects of storm flooding during a high tide in 2050.

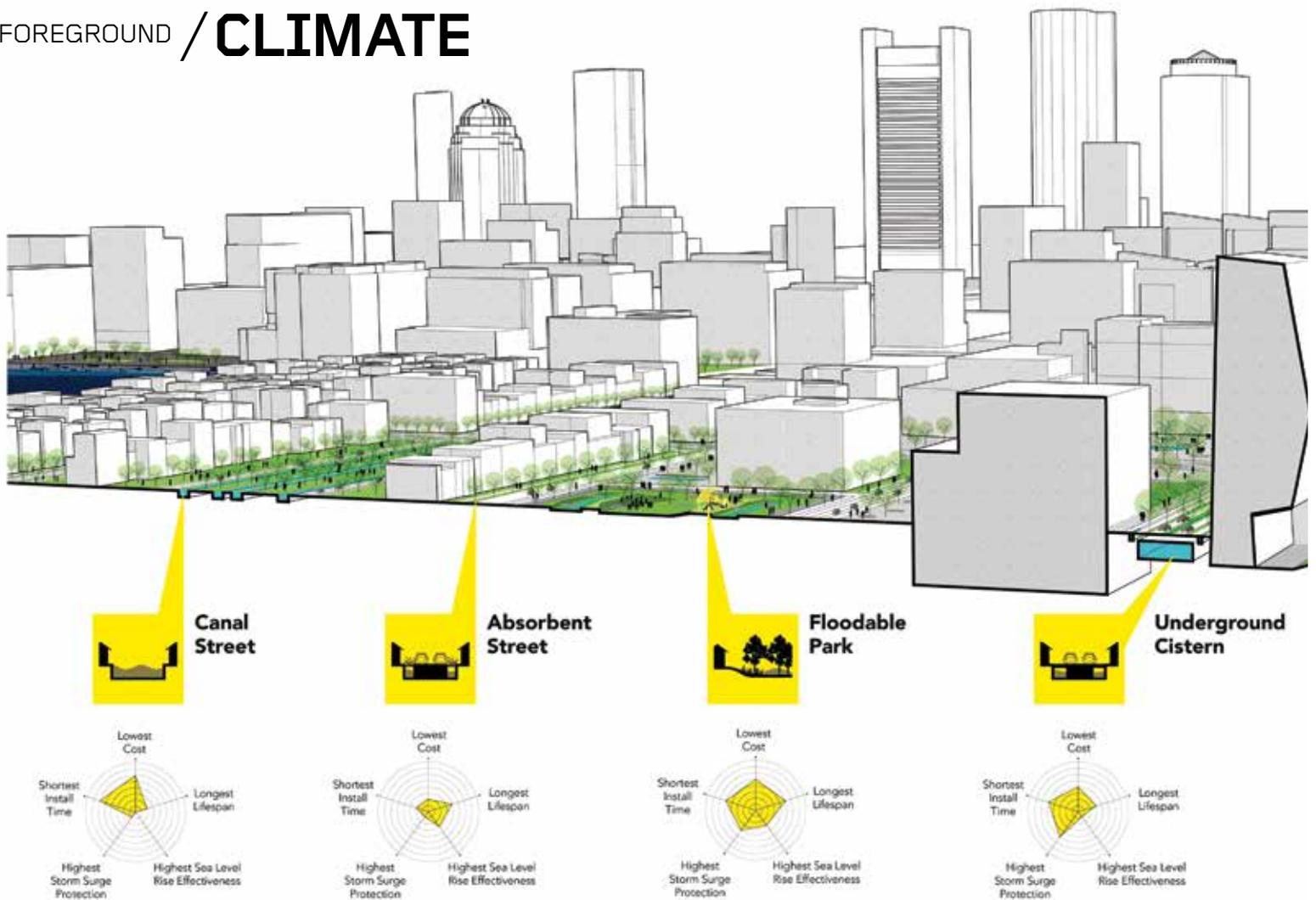
The new urgency guarantees good attendance. A capacity crowd of 200 registered for the conference, and at least as many attended the opening of an accompanying exhibition at District Hall, in the neighborhood formerly known as the Seaport District and recently rebranded as the Innovation District. The location was significant: The district's roughly 1,000 harborfront acres, much of which was previously parking lots serving the Financial District, represent Boston's future, with construction under way for housing and commercial space, and proposals for new hotels around the convention center. As one of the neighborhoods most vulnerable to flooding, it has been dubbed "the Inundation District," though this moniker was never mentioned during the event, perhaps out of deference to the developer who built District Hall as a community space/coffee bar/restaurant for the inno-

vation crowd (think Starbucks with whiteboard walls and no obligation to buy the coffee). Still, no one shied away from the cold, wet truth—a blue tape on the entry steps pronounced: "If nothing is done, this is where high tide could be in 2100." Inside, the whiteboards bore taped lines well above coffee-bar height, marking Category 3 hurricane flood lines for 2050 and, disturbingly, 2014.

Those dates framed the day's big questions: Can Boston take action—*enough* action—before the next big storm? Or will the city require its own Katrina or Sandy to muster the will to protect itself against catastrophe? Conversations about long-term sea-level rise—a projected one to two feet by 2050, and three to six feet by 2100—can contribute to a complacency that the city will somehow deal with a Yankee version

of Venice's *acqua alta*, with tourists splashing along the Freedom Trail in duck boots.

Boston, however, is also vulnerable to the storm surges of both hurricanes and winter nor'easters, the effects of which are often worsened by iced-over storm drains. Sandy was only one of four "100-year" storms to hit Boston in 18 months.



**ABOVE**  
Strategies for Boston include designing public spaces to accommodate floodwaters.

Each time, the city escaped calamity because of a fortuitous tide cycle; in the case of the January 2014 nor'easter, different timing could have produced 500-year flood levels. With projected sea-level rise, future storms will become more common and more devastating. But one could also hit tomorrow.

When? How bad? At what cost? Robert Nairn, a director of the global water-engineering firm Baird & Associates, used a wharf project in Australia to stress a need for greater attention to risk evaluation, or "risk-based planning." Coastal designers and planners focus on 100-year storms, a shorthand way of indicating flood severity (Sandy produced 700-year flood levels in New York); only rarely do they analyze risk in terms of the

cost of destruction against the costs of preemptive construction. One problem Nairn outlined is the lack of historical data for longer storm return periods. Monte Carlo modeling, a sophisticated analytical tool involving multiple variables, was used in the Australian project to address that limitation and to develop design criteria for a 1,000-year storm—part of a risk assessment for a mile-long wharf that accounts for 2 percent of the Australian GDP.

We unfortunately live in a statistics-illiterate society. Terms such as "100-year storm" have ill served both the public and planners; recasting the definition as a 1 percent chance of occurring in any given year is not much more useful. Nairn offered a counterintuitive statistic: There is

an almost 64 percent chance that 100-year flood levels will be exceeded in a 100-year period. But as the popularity of lotteries shows, an understanding of probability theory remains one of the great challenges in communicating sea-level risks to the public and to policy makers.

There are people, however, who thrive on risk assessment: insurance executives. As Culver, of Sasaki, pointed out, that industry—specifically the secondary and reinsurance segment—is an increasingly powerful hidden player in coastal design and planning decisions. "The secondary insurer may in fact end up being the real judge," he said. Many developers hope to cash out in a few years after construction, but the cost of insuring risk at the time of sale becomes a significant

factor in a project's financial profile. Determining that cost will require a greater understanding of the relationship between design decisions and risk. "Insurance companies are very much concerned about the lack of real information through which they can do reasonable probability analysis," Culver said. "Insurance companies are not stupid."

## LONG WHARF ALREADY FLOODS REGULARLY, AS DOES MORRISSEY BOULEVARD.

Compensation for possible or actual losses remains one of the thorniest aspects of sea-level rise, especially when the public's patience for underwriting repeated rebuilding in vulnerable areas seems to be waning. As Kristina Ford, a Columbia University professor and the former planning director of New Orleans, condemned the city leaders who drained swamps and built levees in the name of greater economic development for New Orleans, it was hard not to ponder future assessments of the Innovation District. But who really is at fault when structures are legally constructed in an area zoned for a presumed public benefit?

Jerold Kayden, a planning professor at the Harvard Graduate School of Design, described the legal and ethical conundrum in terms of five Rs: resilience, retrofit, retreat, regulation, and rights. Property rights, some Americans will still be shocked to learn, are not absolute. That concept is represented in the common law

of nuisance; "public nuisances" are those that are harmful to society as a whole. "As harsh as it may sound," Kayden said, "one may ask whether building or staying in harm's way in vulnerable areas may be understood as some type of land-use nuisance."

Even owners who claim they do not need or want help in the event of a disaster are not necessarily beyond definitions of nuisance because, as Kayden noted, "society's collective humanity does not allow it to take seriously the property owner's claim." Constitutional law covering takings and just compensation is evolving, as is the growing canon of zoning and environmental regulations, and the issue of fairness is increasingly complicated. Any young lawyers in the audience could easily have imagined coastal land-use law as a lucrative career track.

Kayden cited two examples from case law—*Lucas v. South Carolina Coastal Council* (1992) and *Pendoley v. Ferreira* (1963)—to suggest that nuisance could provide the underpinning for future takings. Regulatory tools exist to accomplish many of the goals of coastal planning, but Kayden believes that the social context for regulatory and legal decisions will shift from sympathy for coastal landowners to a new focus on "moral hazard"—the tendency to pursue risks if paying for the consequences is not a factor.

Against this theoretical groundwork, design—the design of buildings, either new or retrofitted, and of

blue-green infrastructure—seemed the easy part; one panelist, Robbin Peach, the program manager for resilience at the Massachusetts Port Authority, even called it the low-hanging fruit. (Massport, as the agency is called, is the owner of Logan Airport and a major landowner in the Innovation District, where it signs 99-year leases; it may be the local stakeholder with the longest time horizon.) Nor did the costs of resilient construction seem to faze presenters: Culver estimated the upcharge at 2 to 3 percent, low enough for developers to pitch resilient projects. Kristina Ford suggested that resilient construction could follow the history of LEED standards—after initial industry resistance, the market now demands and pays for them. Moreover, an impressive international portfolio of resilient projects is now available for study and emulation, including Boston's own waterfront Spaulding Rehabilitation Hospital in the Charlestown Navy Yard.

Barbara Wilks, FASLA, an architect and landscape architect, presented work from the Red Hook proposal for the Rebuild by Design initiative that demonstrated how well-designed barriers and protections can also create new economic and social opportunities for devastated communities—the sort of "multivalent" projects that address disparate issues at once. It provoked a profound, and perhaps unanswerable, question from an audience member, Carl Spector, the director of climate and environmental planning for the city of Boston: What does it mean



**ABOVE**  
Harborwalk flooded during a major winter storm in January 2013.

when our responses to sea-level rise contribute to a greater sense of security and to economic development, thereby increasing the social and economic value of neighborhoods in ways that draw more people to living on the coast?

The landscape architect Walter Meyer provided a science-based approach to resilient design. For a seaside park in Mayagüez, Puerto Rico, Meyer looked at evidence of the pre-Columbian landscape—an application of the ecologist Eric Sanderson’s “forensic ecology” approach—adapting lessons from a local river environment to the almost two-mile park site to protect the city from hurricanes and tsunamis and to correct storm sewer outfall problems. For a dune construction project in the east Rockaways, Meyer similarly looked at larger systems related to Sandy, presenting underreported aspects of the storm and their implications for design. His studies of wind fetch, bathymetrics, wave refraction, groundwater liquefaction, dune formation, and vegetation bore intriguing implications. He has found, for example, that planting native pitch pines, which is currently not allowed by U.S. Army Corps of Engineers standards, helps to anchor dunes.

Both Wilks and Meyer demonstrated that site-specific resilient design is achievable in Boston. But talk of the larger regional picture was more discouraging, particularly for smaller communities, which are caught in a kudzu-like tangle of home-rule traditions, turf wars, funding scarcity, and limited planning capacity. “Regional planning in Massachusetts and in most of New England is entirely an advisory process,” said Martin Pillsbury of the Metropolitan Area Planning Council. “We don’t have any regulatory authority.” Despite these “fiefdoms,” some facsimile of a regional plan for the metropolitan area could emerge with the participation of strong quasi-independent regional entities such as Massport, the Massachusetts Water Resources Authority, and the Massachusetts Bay Transportation Authority.

“Sea Change: Boston” grew out of research at Sasaki led by Jason Hellenbrung, ASLA, and Gina Ford, ASLA, both principals with extensive waterfront experience that includes participation in Rebuild by Design; the project soon developed into a collaboration with the Boston Architectural College, the city of Boston, and the Boston Harbor Association. Practice-based research is all the

rage these days, but the point was to spark a public conversation. The exhibition gave an engaging overview of the risks and possible responses; Sasaki plans to circulate it to other public venues.

Local residents may not yet understand the complex threat before them, but they know the sea around them is changing. Major storms inevitably bring televised images of bedraggled reporters pointing at threatened houses in Scituate and on Plum Island, Massachusetts. Warmer water has attracted squid and jellies, and caused the Pilgrim Nuclear Power Station to power down last summer when temperatures were too high to provide cooling. Long Wharf, between the aquarium and the North End, now floods regularly, as does Morrissey Boulevard, where portable signboards warn of “wicked high tides”—the new vernacular for astronomical high tides. Brian Swett, the city’s chief of environment and energy, stated the challenge succinctly: “We need to avoid the unmanageable and manage the unavoidable.” Someplace in between is still a Boston that is wicked wet. ●

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