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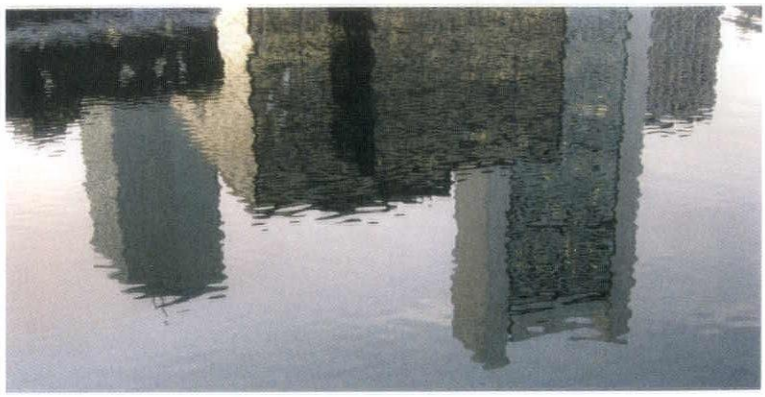

Features

Above: Reflections in Boston's Fort Point Channel. Photo by Kyle Nelson.
Cover: The L Street Brownies annual New Year's Day Polar Bear Plunge — a South Boston tradition since 1904. Photo by Kelvin Ma.

Departments

Online: www.architectureboston.com

water

truant
CONSTRUCTION
MANAGERS

photos: Eric Roth

Harvard University Statistics Department

The Swimsuit Issue

It was a classic editor's dilemma: how to sex up a magazine issue devoted to an important but — let's admit it — possibly wonky discussion of water, policy, and design.

And then the skies opened.

At this writing, New England has been hit by two storm systems producing record-breaking rainfalls and catastrophic flooding. Boston alone has received 14 inches of rain. Suddenly everyone is a policy expert: television reporters fill newscasts with spot interviews about combined sewer outfalls and FEMA maps. People understand, with painfully earned clarity, the complex relationship between infrastructure and the environment, and the effects on their health and welfare. The questions of where, what, and how we build have rarely seemed so important.

This will undoubtedly prove to be a mixed blessing for those who have been laboring to promote effective water management policy in this region. New Englanders have been famously complacent about the challenges facing this region: gardens grow, water flows from the tap, beaches seem cleaner — what's to worry about? Plenty, it turns out. But it may be hard to focus attention on concerns such as groundwater recharge or low river flow when YouTube videos of imperilled dams and washed-out roadways are so fresh in our memory.

Focusing public attention is not the only challenge for those who care about water resources, both salt and fresh. The path from science to policy to regulation to implementation was murky enough without the recent controversies and politics associated with climate change. Those who labor in what has been called "Water World" — the dedicated army of environmentalists, scientists, researchers, engineers, planners, and lawyers working in public agencies, universities, think tanks, and nonprofits as well as in the private sector — struggle to promote prudent policy that is often at odds with individual behaviors and interests.

The inevitable result is an omnium-gatherum of regulatory devices administered by international organizations, federal and state agencies, municipal code officials, and volunteer boards. Conflicts abound, good intentions are thwarted. And no one sees this more clearly on a daily basis than architects.

Architects occupy a territory that is at the intersection between water policy and implementation — a territory perhaps better likened to a traffic rotary, with participants moving seemingly in the same direction but actually toward different destinations, with the attendant confusion, stress, and occasional crash. From that vantage point, architects can see that new approaches to wastewater management are often at cross-purposes with communities that have learned to control growth through septic-system regulations. They know that protection of coastal wetlands often conflicts with developers and cash-starved coastal communities hoping to cash in on waterfront access. They hear firsthand that federal and state conservation mandates can lead to consumer frustration with new products and appliances that fail to perform as expected. They witness well-intentioned building owners and developers discouraged by local permitting processes.

One problem is that we are not starting fresh: New Englanders in particular must contend with established building patterns and aging infrastructure. Even a quick glance at a US Geological Survey map of eastern Massachusetts is enough to identify vast tracts that environmental planners today would probably redline. But the Chelsea tank farms occupy what might otherwise be clam flats, homeowners struggle to stabilize their houses on Plum Island despite erosion of the barrier beach, and neighborhoods encroaching on Revere's Rumney Marsh (recognized as one of the state's most biologically significant estuaries) thrive even as their foundations settle. These are not situations easily undone.

Since the March floods, the questions of where, what, and how we build have rarely seemed so important.

Similarly, we have inherited political structures that often frustrate reform. Competing jurisdictions can be formidable roadblocks, especially to hybrid solutions that emerge from a more sophisticated understanding of complex systems. A plumbing code that is developed and administered separately from a building code makes little sense in this new world.

A more effective, integrated approach to water resources will someday be implemented, simply because it must. The question is only one of time — and the attendant cost due to waste, inefficiency, and natural calamity. ■

Elizabeth S. Padjen FAIA
Editor

Letters Letters Letters

Chris Mottalini's "After You Left, They Took It Apart" [Spring 2010] draws attention to the very real threat to many of Paul Rudolph's architectural masterpieces. The loss of Rudolph's work has been noticed beyond the architectural community, with the term "Rudolphed" added to the online Urban Dictionary to describe "any of innumerable mid-century modernist structures facing the wrecking ball."

The Paul Rudolph Foundation was founded to protect, preserve, and promote the architectural legacy of America's foremost Late Modernist. One of the Foundation's primary goals is advocating for the preservation of Rudolph's buildings, and it commissioned Chris Mottalini to photograph these homes only after all efforts to save them had been exhausted.

We believe that preservation is a key part of educating others about Rudolph's legacy — by perpetuating the direct experience of the architect's spaces. As Edward Hopper noted, "If you could say it in words, there would be no reason to paint." The same can be said for the power of Paul Rudolph's architecture — if its subtlety and spatial complexity could be captured, it would not need to be personally experienced in three dimensions.

It is encouraging to see that Paul Rudolph's architecture inspires artists like Chris Mottalini to continue his work well beyond the Foundation's original commission. But without preservation of the buildings he is photographing, the true genius of Rudolph's mastery of space and light will be lost to future generations. History will not judge us on what we have built, as much as what we refused to destroy.

Kelvin Dickinson
The Paul Rudolph Foundation
New York City

Nancy Berliner's comparative perspective ["Not So Different," Spring 2010] addresses the mass clearance of urban fabric in Chinese cities in the light of our country's past half-century of modernization. The fresh and concrete examples drawn from her personal life in China spotlight some of the planning issues that we indirectly tackle through a curatorial approach derived from the principles of fine-arts conservation. Those principles are flexible and robust, particularly as they were originally encoded in the Secretary of the Interior's Standards for Rehabilitation of Historic Structures. They operate as physically conservative and either may or may not be culturally progressive. In any case, their efficacy as positive planning tools is questionable.

It is worth recalling that our country's historic commissions and their legal powers mostly responded to post-World War II urban renewal and highway expansion when thousands of buildings were demolished. Today, damage to cities and towns may come less from thoughtless demolition than from our undermining historic town centers when we relocate retail, municipal, and county functions to sites that nobody can reach on foot. Anthropologists can characterize the cycle of successful historic preservation as the structural transformation from Trash to Glorious National Heritage, but in our profession more interesting narratives may already be taking shape as young designers pursue combined works with fewer curatorial inhibitions.

Henry Moss AIA
Concord, Massachusetts
Co-chair, BSA Historic Resources Committee

Your Re:Use issue [Spring 2010] was very provocative. We do indeed live and operate in a new era. For over five decades, preservation was paramount. It resulted in the restoration of significant landmarks and critical urban fabric, but the rules, ethics, and intentions of preservation have certainly changed. A curatorial approach to fixing a building in a particular place in time lacks relevance in the broader challenges facing the design community today — such as reuse of anonymous midcentury buildings, post-industrial landscapes, and more recent construction that is already obsolete.

New guiding principals are emerging — frugality, sustainability, and the conservation of capital — and reuse can effectively achieve these goals. What is most exciting is the potential for reuse projects to fundamentally transform the meaning and purpose of the artifact, ultimately creating a new entity.

The hope is that through these acts of re-appropriation we are enriching the environment by creating new meaning, but also by continuing an active dialogue with our cultural legacy.

Robert Miklos FAIA
designLAB architects
Boston

George Thrush's interesting article ["After Life: Designing What Comes Next," Spring 2010] concludes by suggesting the sensible notion that not all buildings deserve to be saved. This raises the provocative question of whether all *communities*, particularly suburban dormitory communities with no supporting transportation infrastructure or other inherent economic advantage of location, deserve to be saved. The first question isn't really whether a suburban big-box retail store can be repurposed in place as a church or indoor racetrack, but whether *any* building would make sense in a particular location once gasoline prices reach six, seven, or twelve dollars per gallon, as they inevitably will.

As the article points out, "reuse will succeed because it makes economic sense," but those economics are likely to be wrenching and involve demographic shifts which inevitably require the abandonment of previously developed areas. The same energy-driven economics which will force the realignment of population around transportation infrastructure will also change the equation for material reuse. Rule-of-thumb ratios of labor to material costs per square foot for an urban new construction project are typically 60/40.

This will change in favor of material as the embodied energy costs of materials rise. The value of components in existing buildings will therefore become more valuable, whether reused in place or recycled to be used in new buildings elsewhere. That geographically inconvenient big-box retail store in Thrush's article may be reused after all, relocated piece by piece, which suggests a bright future for the building salvage industry particularly, and of recycling generally. Like the farmer in Amelia Thrall's essay ["Recycling 2.0/Materials," Spring 2010], we are all destined to be saving balls of string in the not-too-distant future.

Michael E. Liu AIA, NCARB
The Architectural Team
Chelsea, Massachusetts

It is clear that sustainability/reuse challenges are quite different in the industries of fashion, architecture, and consumer products, and that some progress is being made in each of these areas. I have followed the work of Natalie Chanin ["Recycling 2.0/Fashion," Spring 2010] after hearing her speak at a materials conference in New York and have been impressed with the creatively detailed clothes she designs out of reused t-shirts as well as the fact that she uses local Alabama women to hand-sew the garments. This is a praiseworthy model for other industries: reuse existing materials and create manufacturing in the US.

Reuse challenges in architecture and product design are a bit more complex. One of the hallmarks of good architecture is the ability to withstand the test of both time and taste. Thoughtful buildings could easily be repurposed if they are built to outlive the short-term mentality of our times. Cradle to Cradle guidelines suggest that for the recycling/reuse of consumer products to be cost effective they must be designed to be disassembled within six seconds. Lisa Ann Pasquale writes in "Recycling 2.0/Manufacturing" that "Matsushita's Eco Technology Centre... assesses the ease of disassembly and recycling, and reports suggestions back to designers, so new units are easier to process." This makes complete sense; however, high disposal fees were the motivating factor, thereby justifying the cost of the technology center. What it all comes back to is that financial pressure yields results. In an ideal world, the bottom line would be three pronged and would track not only financial profit but environmental and social profit as well.

Carol Catalano
Catalano Design
Boston

Jeff Stein captures the essence of Ada Tolla and Giuseppe Lignano's creativity ["Raw Material," Spring 2010]. I believe that their firm, LOT-EK, conjures up a special magic precisely because they studied architecture in Italy, where history is embedded visually and physically at every corner.

What emerges from this delightful interview is the opportunity for the highest form of architectural and design creativity to shape a physical environment that fits instead of disturbs a precious and precarious evolutionary process. The framework for our thinking has until recently been too narrow to encompass the hard-wired biophilia we unconsciously carry within us. It's time to let it emerge, to be translated into the building professions and their education, and to free up the same delight in the found object that LOT-EK shows us, this time with the mindset of regenerating value for our planetary home.

Peter Papesch AIA, LEED
Boston
Chair, BSA Sustainability Education Committee

Editor's note: The architect for the project featured in "Old House, New Episode" [The Lurker, Spring 2010] is H. P. Rovinelli Architects of Boston.

We want to hear from you. Letters may be e-mailed to epadjen@architects.org or sent to *ArchitectureBoston*, 52 Broad Street, Boston, MA 02109. Letters may be edited for clarity and length, and must include your name, address, and daytime telephone number. Length should not exceed 300 words.

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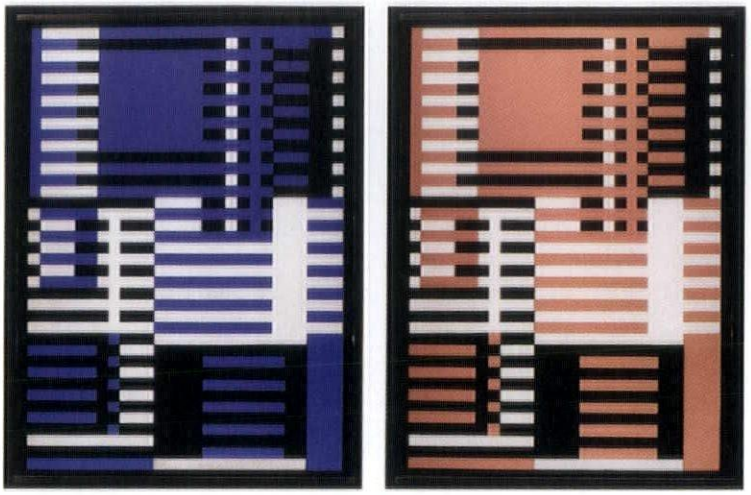


Upward and *Goldrosa*, c. 1926, by Josef Albers. © 2009 The Josef and Anni Albers Foundation / Artists Rights Society.

Bauhaus 1919–1933: Workshops for Modernity

Museum of Modern Art, New York City
November 8, 2009–January 25, 2010
www.moma.org/interactives/exhibitions/2009/bauhaus/

The Bauhaus retains impressive cultural significance for an institution that operated for a mere 14 peripatetic years. When Nazi pressure forced closure of the school in its third and final location, many of the teachers and students emigrated westward; a few landed in Boston. Graduates of local architecture schools are the progeny of aesthetic seeds first planted in Weimar Germany.

The pedagogy at the Bauhaus focused on a potent question, one that retains contemporary relevance: to what degree should art engage technology? To draw or not to draw? The dense MoMA exhibition (still available online), packed with sketches, drawings, paintings, photographs, and objects, chronologically traces the Bauhaus' relationship to industrial production as it shifted from a craft-based school to one whose motto became "art and technology — a new unity." An example is a studio exercise in which students created patterns with only the standard keys of a typewriter. The resulting abstract designs (later used for factory-produced textiles) are a wonderful example of how the machine can be harnessed for creative good. But no matter the cleverness evident in such techno-forward work, it is difficult not to be charmed simultaneously by the meticulous, hand-painted color-theory exercises by the students of Paul Klee.

The impressively comprehensive exhibition features work by both instructors and students. The devotion of seminal practitioners to introductory teaching — among them artists Josef Albers and Vasily Kandinsky, architects Walter Gropius and Ludwig Mies van der Rohe — was remarkable at the time and remains so in retrospect. These are the figures who persist, and theirs are the works that visitors want to see; but the student work is equally, if not more, delightful for its confident, experimental exuberance.

Christina Crawford AIA, LEED AP is a practicing architect and urban designer at Utile, Inc., in Boston. She teaches at Northeastern University School of Architecture and serves on the board of the New England chapter of the Society of Architectural Historians.

Havana Revisited: An Architectural Heritage

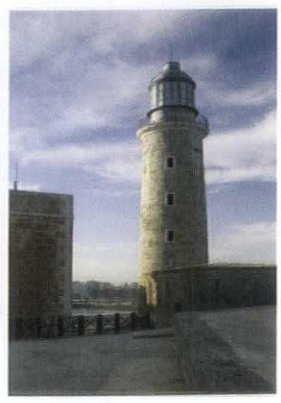
David Rockefeller Center for Latin American Studies
1730 Cambridge Street
Cambridge, Massachusetts
February 3–June 1, 2010

This exhibition immediately brought to mind a great observation: "In order for things to remain the same, there must be change." But the Havana in Cathryn Griffith's images tells a different story. Although things have remained the same, there has been no change to the urban fabric, making it seem almost fossilized.

Griffith's urban documentation — a nostalgic then-and-now comparison of vintage postcards with her own modern photographs — captures Havana as a living colonial museum. The photos by themselves would have been simple episodic glimpses of the city, but combined with the postcards, they become a narrative that takes us through time and makes us think beyond the art before us. The social and cultural issues plaguing Havana today, which created the fossilized city in these images, suddenly become the point, which remains frustratingly beyond the reach of this exhibition.

Frank Valdes AIA is an associate at DiMella Shaffer in Boston.

El Morro, Havana. Photo (right) by Cathryn Griffith.



The SHIFTboston Forum

Institute of Contemporary Art
Boston
January 14, 2010

"What if this could happen in Boston?"

This was the question posed by SHIFTboston, an organization that challenges designers to think critically about the experience and environment of Boston. Its 2009 ideas competition generated worldwide attention, with more than 6,000 responses from more than 90 countries, finally attracting 142 entries from 16 states and 14 countries. With a full house of 300 (mostly young designers) at the awards "forum" and even more waiting at the door, it was clear that there is widespread interest in the future of Boston and that a shift may already be underway.

The city's renewed interest in connecting residents from every neighborhood with the waterfront was apparent in the number of entries that embraced the waterfront as the city's next frontier. From barges demarcating the original boundaries of the city to a kayak-sharing commuter system to entire parks suspended over the harbor, many of the ideas recalled Boston's history of expansion into the harbor, but with a new twist: reclaiming it without necessarily infilling. The winning team, Sapir Ng of Tsoi/Kobus and Andrzej Zarzycki of New Jersey Institute of Technology, embraced a mostly unconsidered frontier: Boston's underground. Instead of building up or out, their proposal, "The Tremont Underground Theater Space," ventured into the subterranean and made use of abandoned subway infrastructure, revived as an interactive theater space.

Other proposals took on the challenge of shaping attitudes instead of the cityscape. "Waterline" proposed a city-wide continuous blue line at head height — the presumed future water level after global warming. An honorable mention went to "What the Hell is That?" — a proposal to fetishize Boston City Hall as nail polish, makeup compacts, and other trendy commodities, merging architecture and cultural production to manipulate the public image of the building.

In a city that increasingly struggles to retain and attract talent despite the many world-class institutions that call Boston home, perhaps a shift in attitude toward design and development is the key. SHIFTboston brings to the forefront the argument that the city should not be afraid to borrow good ideas that work for other cities, nor be afraid of showcasing a willingness to experiment. As the winning entry highlights, Boston should likewise recognize, advocate, and make full use of what it already has.

Alyson Fletcher, ASSOC. AIA is currently biking across the country with Bike & Build to raise money for affordable housing (http://bikeandbuild.org/rider/3547). She was previously co-chair of Common Boston.

Competition entries may be viewed at: www.shiftboston.org.

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Design That Drives Us Crazy

^ Photo by Joan Wickersham.

The premise: That driving in Boston is always bad, but in some places it's even worse. Sometimes it's bad design. Sometimes it's bad signage or badly coordinated traffic lights. Sometimes it's dumb policy. Sometimes it's a piece of roadway that was designed 50 or a hundred years ago to handle a much smaller volume of traffic going at much slower speeds. But whatever the reason, certain intersections or interchanges are reliably, inherently nightmarish. These places feel not just ill-conceived but dangerous. They're the places that make drivers grit their teeth and pray.

8:30 Cambridge. Driving west along Mass Ave, entering Harvard Square. Goal is to get through the Square and turn up Garden Street.

Travel in right-hand lane to avoid cars double-parked on left.

Now move into left lane to avoid getting trapped in right-lane underpass, while going very slowly to merge with speeding cars coming from behind on another road on the left.

8:32 Waiting at traffic light. Arrow turns green; move forward. But cars to the right of you have simultaneously received a green light; as you try to move right across three lanes of traffic, those cars are equally urgent in their desire to move left across the same lanes.

Blue car abruptly changes lanes and cuts you off.

Bus suddenly cuts from right to left lane heading for underpass.

Cars zoom by in right lane so you can't move over.

Tan car honks at you.

You start, stop, swear, fleetingly imagine a utopian intersection where drivers with conflicting entry and exit points don't all get green arrows at once.

8:33 Your green arrow quits long before the mess has time to unsnarl. Cars coming along Mass Ave from Porter Square now get green light and energetically launch themselves into the mêlée.

8:36 Still in Cambridge. Intersection of Brattle, Mason, and Ash Streets. Cars entering intersection from four different directions, three of which have stop signs. Cars traveling on Brattle toward Harvard Square and curving left onto Mason do not have a stop sign — but the driver waiting at one of the other stop signs has no way of knowing that. He starts across the intersection. Sudden braking, people inside cars looking scared and angry, glaring at each other in self-righteous confusion before driving on.

8:47 Traveling west on Soldiers Field Road in Newton, about to attempt entrance to Mass Pike. Start to make a big turn to the right.

Cars merge in from left.

More cars merge in from another road on the left.

And then a third road of four lanes of fast-moving traffic merges in from left. Those cars are trying to move from the left to the right-hand lanes. You need to get over from the right to the left.

Now 10 lanes of traffic from at least four different directions are suddenly weaving together and splitting off, a high-speed minuet happening on a very small dance floor.

8:48 A woman in a silver SUV makes eye contact: she will let you cut across. But no, turns out she was just making eye contact.

8:49 Good thing you know to get into far left lane before you reach Mass Pike entrance ramp, because the only sign appears too late to alert anyone who didn't already know which lane to choose.

9:07 Route 95 South, just after the Route 9 exit. Sign announces that travel is permissible in breakdown lane from 6–10 AM and from 3–7 PM on weekdays. Calm, official-sounding tone of sign makes you briefly doubt your suspicion that this is wacko policy.

9:09 At the moment, traffic happens to be fairly light, so no one is driving in the breakdown lane — which is lucky because a broken-down car is parked in it, lights flashing, hood up, owner pacing nearby looking anxious. You don't blame him.

9:12 Get off highway to reverse direction. Get on again; a speeding black car whips very close by you on left, honking. Yikes. It was traveling in the breakdown lane and crossed your entrance ramp at 75 mph just as you were feeling your way up to the highway.

Calm, official-sounding tone of sign makes you briefly doubt your suspicion that this is wacko policy.

9:20 Traffic on 95 North is heavy, moving slowly, except in the breakdown lane, where it's whipping along. A car ahead of you is trying to exit — it needs to speed up to enter the rapid flow of the breakdown lane and somehow simultaneously slow down to safely navigate the curving mouth of the exit ramp.

9:24 Move into breakdown lane, just to see what driving there is like. A car comes up fast and close behind you, while a slower truck moves up the entrance ramp to your right. Without the usual cushion of the breakdown lane, the diagonals of the merger have been shaved off into an abrupt and unforgiving right angle. The truck merges in front of you and you brake to slow down, hoping the guy behind you has good reflexes.

9:40 Back on the Mass Pike, heading east this time. A chance to experience Exit 17 in Newton/Watertown from the opposite direction. Fiendish. Two lanes of traffic on the exit ramp, merging into four lanes of fast-moving cars sweeping around from the left. You wait for a pause, venture out, and cross several lanes of traffic to get from right to left while other cars move across those same busy lanes from left to right. This is why you would not want to run with bulls in Pamplona.

9:50 Pull off road, park at Whole Foods, get coffee, and wait for hands to stop shaking. Get back on road.

10:32 In North End near Haymarket, trying to get on Storrow Drive heading back toward Cambridge. Remember you once succeeded at this, starting around here somewhere. Follow signs for 93 North, looking for more signs for Storrow Drive West. Suddenly you are on Zakim Bridge heading for Concord, New Hampshire. No idea how that happened (great view of Bunker Hill Monument, though).

10:37 Get off in Somerville at Sullivan Square intending to get back on 93 going in the other direction. No apparent way back onto highway. No signage. Venture under highway and drive for a while, eventually discovering mess of unmarked roads. Decide to turn left on one of them — but it's a good thing you're stopped at a red light, because the road you were about to turn into suddenly fills with oncoming cars, thus revealing itself to be an unmarked one-way street.

10:42 Take another unmarked left and hope for the best. Find yourself on the

Monsignor O'Brien Highway, which may or may not be good but at least it gives you a moment to breathe. Science Museum is coming up on right. Nice cultural asset for city, but you vaguely remember it can be tough to drive around there though you can't at the moment remember exactly why.

10:44 Oh yes — now you remember.

10:45 You happen to notice a tiny "Storrow Drive" sign affixed to a utility pole, and move back into right-hand lane which has apparently resumed its original function as a highway traffic lane after a brief, quixotic interlude as an entryway to the museum parking garage.

10:50 Getting off Storrow Drive. Unexpected fork in the middle of the exit ramp. Then a "Fenway" sign to the left, and a "Fenway Park" sign to the right.

10:54 Heading up Boylston Street (you think) toward Museum of Fine Arts. Many cars honking. At you? At one another? Arrive at an intersection where you know MFA is off to the left. A sign tells you MFA is on the right.

You decide to split the difference and go straight ahead.

Heading up Boylston Street (you think) toward Museum of Fine Arts. Many cars honking. At you? At one another?

10:56 Hospitals on all sides. You have no idea where you are or where MFA is, when you suddenly spot a small sign on the right telling you that the MFA is to the left.

11:05 Turning from Fenway onto Charlesgate East. A friend told you that it was always a nightmare trying to get onto Storrow Drive from here, but you follow the signs and have no trouble. False alarm. Proof that while some of these scary spots are universally and unequivocally harrowing, some are more subjectively bad.

11:10 Heading back to Cambridge across the Larz Anderson Bridge, and turning left onto Memorial Drive. Two lanes of traffic, but suddenly the right lane will fill up with parked cars. You know this and so you move into the left lane well before it happens.

But there's another car ahead of you in the right lane, a green station wagon with an out-of-state license plate, and you can't tell if that driver is aware of what's ahead. You have to drive as if that driver is innocent and about to be shocked out of his or her wits, at which point that car will suddenly swerve in front of yours.

Sooner or later he or she will notice those parked cars, but when?

Slow down. Drop back. Wait to see what will happen. ■

Joan Wickersham is the author of *The Suicide Index: Putting My Father's Death in Order* (Houghton Mifflin Harcourt), a National Book Award finalist. Her website is www.joanwickersham.com.

So, How'd That Work Out?

Updates from the (water)front

The law is the law. Play by the rules. You can't fight city hall.

We tend to think of the legislation, regulations, codes, and policies that govern our lives as a kind of political accretion, each new rule layered onto an increasingly formidable reef of legal hazards. But "codify" does not necessarily mean "ossify." These regulations are subject to review and change.

Like the men and women who devise them, political interventions are usually well-intended, often smart, and yet frequently flawed. Those addressing water issues are subject to the inconstancies of political and business interests, new technology and scientific advancement, as well as consumer markets and human behavior.

Here then is an update on some significant regulations. Some are successes. Some are works in progress. As for some...well, mistakes were made.

— Elizabeth S. Padjen FAIA

Conservation

Section 10.14.3 of the Massachusetts Uniform State Plumbing Code

In 1988, Massachusetts became the first state in the country to require new toilet fixtures to consume no more than 1.6 gallons per flush. Though one of our state's lesser-known historic achievements, this amendment to the state plumbing code shaped a new standard in water efficiency. With support from Massachusetts Representative Chester Atkins, the 1.6 gpf requirement was incorporated into the national Energy Policy Act of 1992, and municipalities across the country awoke to the cost benefits of replacing inefficient fixtures. (Reducing water use conserves energy as well as water; the treatment and transport of water in the US currently amounts to 56 billion kilowatt-hours annually.)

The idea of adopting a 1.6 gpf standard in Massachusetts was introduced by Amy Vickers. An engineer in her late twenties with an undergraduate degree in philosophy, she joined the Massachusetts Water Resources Authority after a frustrating period in New York City, where shortsighted politicians showed more interest in increasing supply than in reducing demand. Having seen a similar standard adopted successfully at a smaller scale in Glendale, Arizona, Vickers was confident that low-flow fixtures, together with the MWRA's plans for infrastructure repairs and extensive public outreach, could halt the alarmingly steady rise of water demands.

Results were immediate and long-lasting: demand fell below 1970s levels in just three years, and continues to decrease steadily — even with more communities added to the MWRA district — as fixtures are replaced, infrastructure is repaired and upgraded, and industrial water use is diminished. Today, the MWRA reports total annual water system demands that are just two-thirds of what they were two decades ago, with water consumption in Boston down to 1910 levels.

Conservation and efficiency policies are now recognized as astute actions in a fight against rising demand. Last year, Texas and California addressed looming water crises by mandating the use of high-efficiency toilets (HETs) designed for a flush equivalent to 1.28 gallons. Engineers Bill Gauley and John Koeller have conducted tests demonstrating that many HET fixtures are capable of superior performance, though a newly formed plumbing research group is still assessing whether codes for horizontal drainage piping should be reconsidered.

Gauley and Koeller, "mythbusters" in the field of water efficiency, are also trying to eradicate confusion about the impact of automatic sensors perpetuated by published estimates of gallons saved by installing "automatic, low-flow" fixtures. A recent study logged the increase in water use associated with sensor-operated toilet fixtures at 66 percent. (Aside from wasting water, the "phantom flush" is also known to terrify small children.) Comparison of 1.8 gpm (gallons per minute) manual faucets with 1.2 gpm sensor faucets revealed a 30 percent increase in water consumption with sensors. Because water only comes out at the faucet's maximum flow rate, which is not typical user behavior, sensor-operated and metered faucets are inherently inefficient.

Similarly, while showerheads with flow rates higher than now permitted by code may facilitate slightly briefer showers, the net result is elevated water consumption. To address lingering issues with user satisfaction, the EPA's WaterSense label will soon evaluate showerheads based on performance standards. Apart from specifying a flow rate of 2.0 gpm or less (compared to the standard rate of 2.5 gpm at 80 psi), the program will set standards for spray force, spray coverage, and flow rate across a range of pressures.

But a focus on fixtures can only go so far. Municipalities seeking a broad reduction in water use, indoors and out, are now providing audits and adopting tiered-rate programs based on calculations of anticipated needs. Assigning individual responsibility offers a strong incentive to conserve.

Amelia Thrall, ASSOC. AIA, LEED AP is a designer and educator based in Cambridge, Massachusetts.

Household Water

Average water consumption to wash 12 place settings:

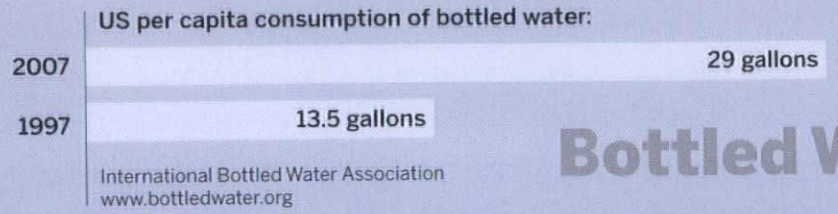
Hand	27 gallons
Machine	4 gallons

University of Bonn Institute of Agricultural Engineering
www.landtechnik.uni-bonn.de

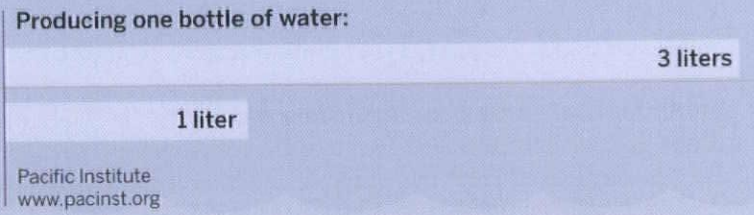
Washing clothes (water per load of laundry):

Top-loader	40 gallons
Front-loader	20–25 gallons

California Energy Commission Consumer Energy Center
www.consumerenergycenter.org



Bottled Water



Reuse

Massachusetts Department of Environmental Protection Interim Guidelines on Reclaimed Water (2000)

When it comes to renewable resources, water could be the poster child for recycling. Through a perpetual round of condensation, precipitation, infiltration, and evaporation, H_2O is endlessly renewed and made available again for our use. And use it we do, second only to oxygen as a ubiquitous resource that we take for granted as a basic entitlement.

Our experience and conditioning conspire to convince that water comes in two categories: clean or dirty, fresh or foul, pure or polluted. This prejudice is a costly one, resulting in the use of highest-quality H_2O for flushing toilets and watering the lawn, and countless gallons of additional wastewater diverted from watersheds to expensive treatment facilities. But what is perhaps the simplest strategy for changing this behavior — the reuse of water for non-potable purposes — may be the most controversial.

It is not a new idea. The 18th-century Yin Yu Tang house, built in southeastern China and now on display at the Peabody Essex Museum in Salem, Massachusetts, diverts all roof runoff to cisterns in the courtyard so that it can be used for domestic purposes. Currently an estimated 20 percent of the world's agriculture is produced with reused raw wastewater. Yet in the US, the approved use of "gray water," as the more lightly polluted form of used water is described, is sporadic at best, although the International Plumbing Code now allows it for toilets and underground irrigation.

Here in Massachusetts, old habits are giving way to new behaviors. Interim Guidelines established in 2000 by the Massachusetts Department of Environmental Protection (DEP) allowed water reuse for irrigation of golf courses and commercial nurseries (for non-food crops); recharging of certain stressed aquifers; and toilet flushing in commercial buildings.

Following the successful implementation of the Interim Guidelines, the state issued new regulations in March 2009 — 314 CMR 20.00 — which established a reclaimed-water permit program overseen by DEP for the uses that had been outlined in the Interim Guidelines. The Massachusetts Plumbing Board has responded to the new regulations by allowing gray-water systems under specific conditions, including: required board approval, devices to prevent contamination of potable water by the gray-water system, identification and labeling to prevent visual confusion of the systems (gray-water piping must be painted purple), and identification of gray water itself through the addition of a non-toxic blue dye.

These incremental steps will likely soon lead to routine water reuse, perhaps eventually extending to residential and agricultural applications. In combination with efforts to limit stormwater runoff by reducing impervious surfaces and installing constructed wetlands, these practices may amount to more than just a drop in the bucket toward maintaining our water resources and protecting critical habitat.

Vernon Woodworth AIA, LEED AP represented the AIA as a member of the International Code Council's Sustainable Building Technology Council, which recently completed work on the International Green Construction Code. He helped draft requirements for stormwater runoff, rainwater reuse, and the installation of green roofs.

Management

Arizona's Groundwater Management Act of 1980

Back in the 1970s, a number of people in Arizona became very concerned about water. It wasn't just that the growth patterns at the time were draining the ancient aquifers under the desert. The population projections foretold even more water use, with no additional supply in sight, unless usage was tightened. Facing up to this dead-end scenario prompted passage of the Groundwater Management Act of 1980, heralded as a state-of-the-art approach in identifying water supplies and requiring conservation that would head off groundwater overdraft and ensure a "safe yield" through 2025 — in other words, to make sure the place didn't run dry.

Although New Englanders might question the wisdom of so much expansive growth in the middle of a desert in the first place, Arizona's experience tackling water-resources management holds some valuable lessons for this, and indeed any, region. Recent critiques suggest that it's necessary to be continually vigilant through the boom and bust of economic cycles. Being prudent with water requires not only regulatory action, but also a cultural transformation by both consumers and developers, who now have many more tools to make conservation part of their building plans.

Water and human settlement go hand-in-hand everywhere in the world, but especially so in Arizona. Snowpack from the state's mountains feeds into four rivers, but that water quickly evaporates in the desert, which only gets 8 to 14 inches of rainfall a year (New England receives 35–55 inches of precipitation). Early settlement relied on pumping water out of the underground aquifers, and irrigation canals and projects like the Roosevelt Dam, 80 miles east of Phoenix. The state also engaged in an ongoing brawl with California over rights to water from the Colorado River. Through the 1960s and '70s, sprawling development patterns required more water from aquifers than could possibly be restored, and more from dams and rivers. Following the $4 billion Central Arizona Project Canal, which delivered water from the Colorado, state leaders, led by then-governor Bruce Babbitt, began to focus on the demand side — namely, the 1980 legislation restricting the amount of groundwater that could be used. The statute led to the creation of the Arizona Department of Water Resources, charged with monitoring "withdrawals" and conservation targets for agricultural, municipal, and industrial users, and enforcing the mandate that new subdivisions have future renewable supplies of water.

What followed next is a cautionary tale for New England policymakers. The quest for loopholes was almost immediate. Farmers, for example, could take land out of production and bank or trade their water rights. Some complained that the baseline for water use was too low, and restrictions phased in too slowly. It was not clear how violations would be penalized, which undermined the authority and intention of the regulations. Municipalities received funding for conservation programs regardless of how much water they actually saved. A requirement that new development show a 100-year water supply was significantly altered due to pressure from real-estate interests and the development community. "The conservation goals of the law have been systematically weakened by legislative amendments, consumer resistance, and timorous regulators," writes Arizona State University professor Paul Hirt in the July 2008 issue of *Environmental History*. A sustainable future water supply, he says, is "a mirage."

Jim Holway, director of Western Lands and Communities, a joint venture of the Sonoran Institute and the Lincoln Institute of Land Policy, sees things more optimistically. "We have three decades of experience in comprehensive water management programs, in the face of limited and highly variable water supplies and changing demands," he says. The 1980 law has been augmented with requirements for an assured water supply for growth, groundwater recharge projects, banking water underground for future shortages, and the reuse of treated wastewater. The state is now turning to the next big curve ball — the inevitable impacts of climate change.

Success means an evolutionary process, says Holway, who was formerly assistant director at the Department of Water Resources. That includes identifying issues as they come up, measuring and reporting water use to facilitate planning, and quantifying water rights and permits to provide incentives for conservation. Only by managing all sources of water — groundwater, surface water, reclaimed wastewater, and stormwater — can a place like Arizona avoid going dry.

Anthony Flint is director of public affairs at the Lincoln Institute of Land Policy, a think tank in Cambridge, Massachusetts.

Virtual Water

	Water required to produce:
One ton of steel	62,600 gallons
One ton of cement	1,360 gallons

Charlotte Harbor National Estuary Program
www.chnep.org

	Water required to produce:
One gallon of paint	13 gallons
One board-foot of lumber	5.4 gallons

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Public Access

Chapter 91, the Massachusetts Public Waterfront Act

The year 2010 marks the 20th anniversary of the Massachusetts Department of Environmental Protection's regulations implementing Chapter 91, the Public Waterfront Act. Since 1990, much has been learned about development along urban waterfronts, especially Boston Harbor, and it is instructive to take a look at the successes and shortcomings of the program as originally envisioned.

Chapter 91 introduced new requirements for both public access and public ground-floor uses; its greatest success has been to demonstrate the value of opening previously inaccessible waterfront areas for the enjoyment of the public. Real estate developers have become some of the strongest advocates for public access, recognizing the inherent value of an active, public waterfront.

While the creation of public access has been a resounding success, the development of public uses has had a mixed track record. The Chapter 91 regulations require that Facilities of Public Accommodations (FPAs) be located on the ground floor of buildings that are within 100 feet of the shoreline; buildings on Commonwealth tidelands must dedicate the entire ground floor to FPAs. The definition of FPAs encompasses retail, restaurant, and hotel uses, along with other public uses such as museums, art galleries, and cultural institutions. The public-use requirements were based in part on the early work of the City of Boston in developing its Harborpark zoning. The City developed the idea of requiring at least one public use in each waterfront project in order to guarantee that public access would be achieved without an actual taking of private rights.

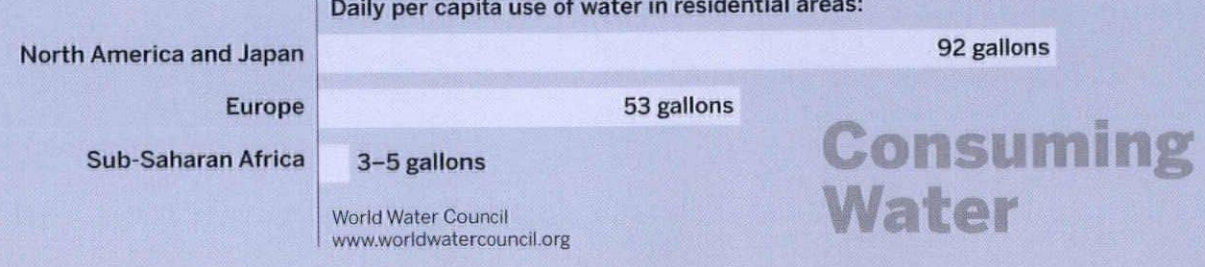
The Chapter 91 framers expanded this concept to require that most or all of the ground floor be public. But, with the exception of hotel projects, most waterfront developers have been unable to achieve full compliance, particularly in low-density and residential projects, such as in the Charlestown Navy Yard. Urban planners have learned that public uses are more successful when concentrated around public squares and in dense retail districts with high pedestrian and vehicular traffic. Waterfronts, however, have four inherent disadvantages in attracting public uses: the public can be drawn from only 50 percent of the surrounding area, since one half of the nearby area is the harbor itself; parking is strongly discouraged and expensive because it must be built below grade; there is virtually no pass-by traffic; and density is limited by Chapter 91 height and open space requirements. It is therefore not surprising that the vision of interior FPAs has not been successfully realized, and that storefronts have remained vacant for many years. Even Rowes Wharf, the model of waterfront development and public programming, has been unable to fully develop its ground floor with public uses.

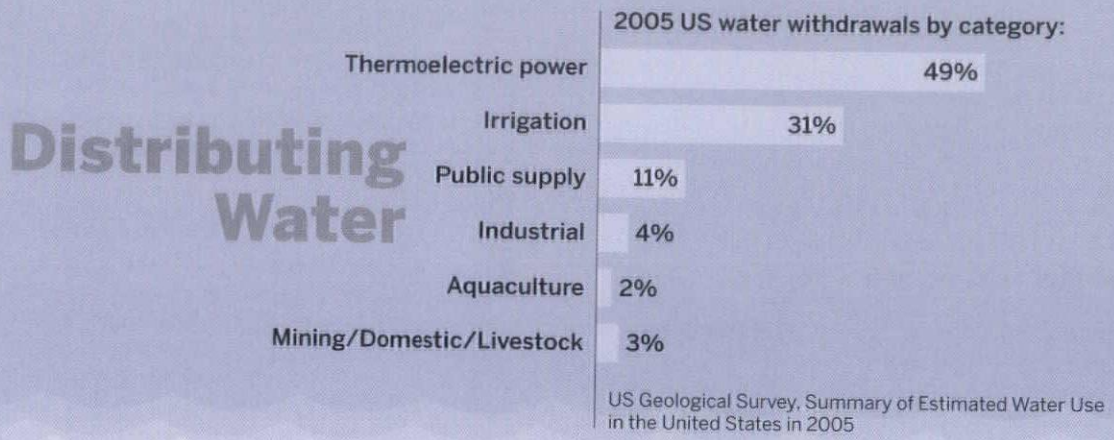
So what is the fix? Waterfronts can never overcome the obstacles presented by their location at the "edge" rather than at the center. We must carefully consider what is realistic. New Urbanists have demonstrated that streets can feel public, even in exclusively residential areas. Form-based codes have shifted the focus toward the "feel" of the architecture and the place, and away from regulating specific land uses. These planning concepts move us away from the traditional zoning standards that were the underpinnings of the Chapter 91 regulations. We need to understand that public ground-floor uses are less important to the success of a waterfront project than the public use of the exterior spaces.

In an active, ever-changing urban environment, 20 years is a long time to go without rethinking the rules. It is time to take a fresh look and consider whether there are better solutions.

A longer version of this story, including the history of waterfront regulation in Massachusetts, is available at: www.architectureboston.com.

Jamie M. Fay AICP is the founder and president of Fort Point Associates in Boston, an urban planning and environmental consulting firm, where he has been principal-in-charge and lead consultant for a variety of waterfront planning and development projects. He is also vice president of The Boston Harbor Association.





Groundwater

The Boston Groundwater Conservation Overlay District Boston Zoning Code Article 32

Many Bostonians became aware of the danger that lurked below only during the early 1980s, when a church and other buildings on the flat of Beacon Hill began to crack because low groundwater levels had destabilized their foundations.

Groundwater continues to be a challenge in Boston and elsewhere, as levels fall below the tops of the wood piles that support buildings, allowing the wood to rot and threatening the structural integrity of what is above ground. And efforts are growing, both in kind and geographically, to address the issue.

In 1986, in response to the apparent crisis, the Boston City Council created the Boston Groundwater Trust. Revived by Mayor Tom Menino in 1997, the Trust monitors groundwater levels and recommends solutions — a mandate strengthened by the adoption in 2006 of Article 32, creating Boston's Groundwater Conservation Overlay District (GCOD). The district extends from the Fenway through the South End, Back Bay, and Chinatown, skipping over downtown's terra firma but including smaller districts encircling downtown, such as the Bulfinch Triangle, the wharf areas along Commercial Street in the North End, and the Fort Point Channel area.

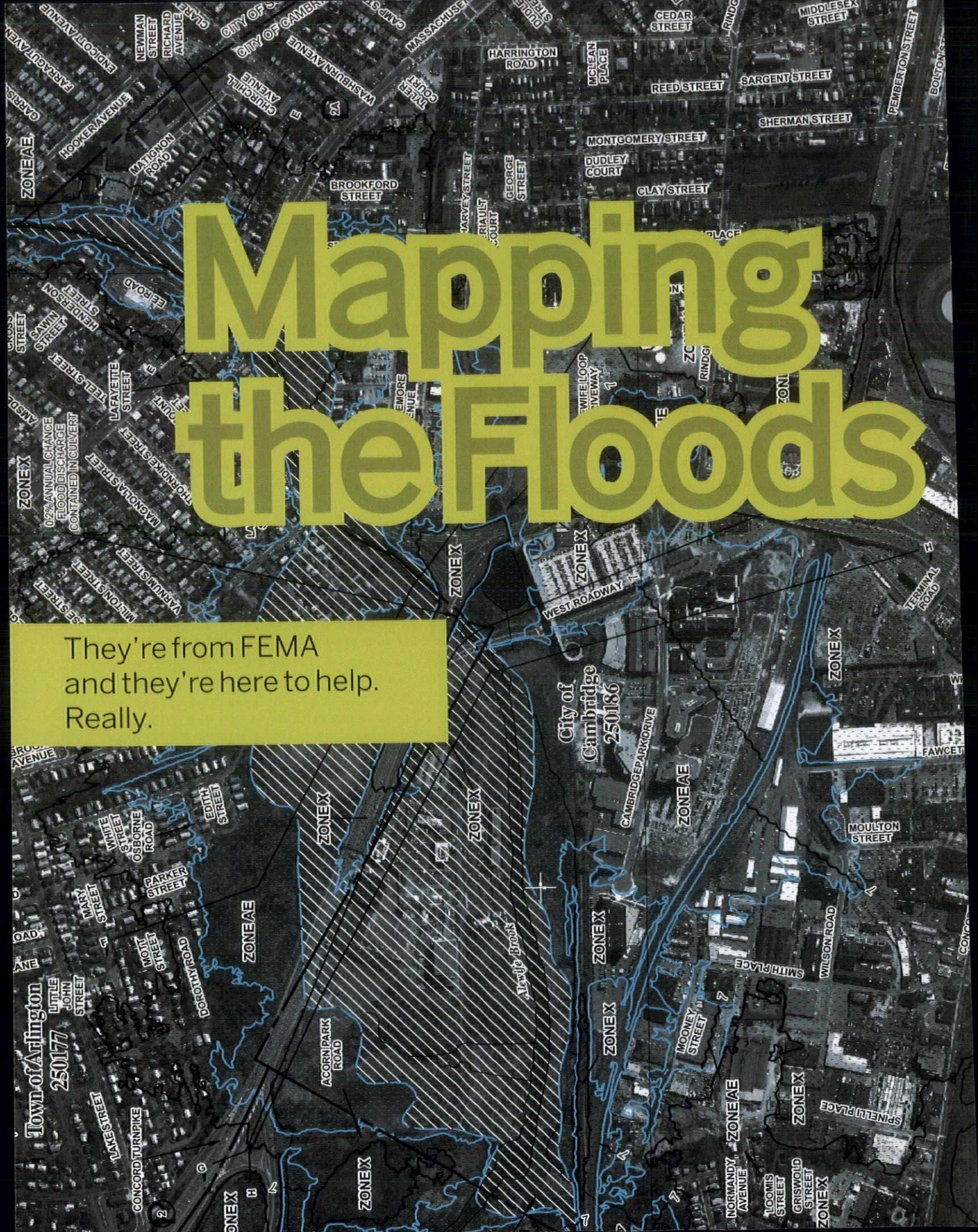
The GCOD is a success, according to Elliott Laffer, executive director of the Boston Groundwater Trust. Its regulations apply to excavation-related construction and to rehabilitation or expansion (of any structure) of an area greater than 50 square feet. It requires a study to determine the effect on area groundwater, and installation of a recharge system. A homeowner in the Back Bay doing a gut rehab, for example, has to capture the equivalent of roof water from a one-inch rain and drain that water back into the ground. Complying with Article 32 typically costs several thousand dollars — compared to the hundreds of thousands of dollars it can cost to replace the tops of rotted piles and restore a foundation. Since the creation of the GCOD, more than 150 cases have been through the Zoning Board of Appeals, which issues permits, and there has been almost 100 percent compliance. Laffer also reports that a new, ongoing study by Tufts University researchers has found that the recharge wells installed since 2006 have resulted in a small but measurable improvement, which will increase as more wells are put in.

Apparent success has spawned ambitious imitation. Legislation was filed during the last session on Beacon Hill with the intention of protecting similarly endangered buildings elsewhere in the Commonwealth. But, because of the potentially enormous cost of remedies and uncertainty about where and to what extent the problem exists outside Boston, that legislative proposal will be rewritten and filed in the next session, according to one of the sponsors, Democratic State Representative Marty Walz of the Back Bay. The legislation included a provision for tax credits for homeowners who install recharge systems, assistance that will now be provided under another bill, filed on behalf of the City of Boston. It also would have required that governmental bodies remedy groundwater depletion caused by tunnels and other infrastructure under their control, an unrealistic demand in today's fiscally challenged economic environment.

Some infrastructure repairs are already under way. The Boston Water and Sewer Commission has had an inspection and replacement program for several years to address the problem of broken sewer pipes that drain groundwater out from under neighborhoods along with sewage. A recharge system was installed in the Fenway, and the Massachusetts Water Resources Authority is currently replacing pipes in East Boston.

A central element of the proposed statewide legislation is regulations on sump pumps, Walz said, to keep water that is pumped out of structures from going into the sewer or storm overflow system and to direct it to replenishment of the groundwater table instead. "The goal is preventing groundwater depletion," she said, adding that the GCOD in Boston is good but doesn't go far enough. "We've got to get government to repair infrastructure."

Tom Palmer is a consultant specializing in public relations and strategic and crisis communications. He formerly covered real estate and development for *The Boston Globe*.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MONTGOMERY STREET
DUDLEY COURT
CLAY STREET
BROOKFORD STREET
CEDAR STREET
MIDDLESEX STREET
PEMBERTON STREET
MCLEAN PLACE
HOOKER AVENUE
MATIGNON ROAD
NEWMAN STREET
RICHARD AVENUE
MASSACHUSETTS AVENUE
WASHBURN AVENUE
CHURCHILL AVENUE
TYLER COURT
ENDICOTT AVENUE
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Detail, Flood Insurance Rate Map, Middlesex County, Massachusetts (revised preliminary, May 29, 2008), showing flood zone and flood plain boundaries in the Town of Arlington and City of Cambridge. Courtesy, National Flood Insurance Program, Federal Emergency Management Agency.

by Elizabeth Stoel and Meera Deean

In 2003, the Federal Emergency Management Agency, perhaps best known for its response to the New Orleans floods of 2005, began remapping flood plains nationwide, digitizing and updating elevational data that had remained on government maps since the 1970s, and generating new data for densely populated and high-risk areas. This large-scale government effort has several aims: to determine what properties should carry flood insurance, to produce more-accurate assessment tools for flood hazard, to create maps that can be tied to GIS databases and used as planning tools, and, at its core, to guide future development away from high-risk or environmentally sensitive areas.

As the new maps have been released over the past year, they have had sometimes dire financial and design consequences for landowners, developers, and municipalities. Being in a flood zone increases construction and insurance costs substantially, and residents and business owners in a flood zone, whether it is classified as high risk or not, are required to buy flood insurance if they have a federally backed mortgage. Government officials take the maps into account when they establish zoning and building standards, plan infrastructure and transportation, and prepare for and respond to floods. In Massachusetts, about 50,000 properties carry flood insurance, a strong indicator of the number in flood zones.

At their best, the new digital maps factor in topography, hydrology, erosion, and changes in population density, but they ignore climate-change projections. Flood-prone areas are generally defined by one of two hazard levels: 1-percent-annual-chance flood (also known as the 100-year flood) areas and 0.2-percent-annual-chance flood (also known as the 500-year flood) areas. FEMA defines a flood as a condition where two or more acres of normally dry land or two or more properties are inundated by water or mudflow. The previous paper maps were often based on 1960s- and 1970s-era US Geological Survey 10- and 20-foot-interval contour maps, with additional surveying by engineers performed only in those areas historically known to be flood prone.

The maps do not become official until the public-appeal periods expire and FEMA releases them in their final form, but their impact already is being felt across the Commonwealth even in this preliminary phase. For any new construction or substantial improvement (work totaling more than 50 percent of the purchase value of the property), developers or owners are required to build to current flood-zone standards, which usually means raising the lowest level to above the flood level. In Hull, a builder renovating an old rooming house was told that, in order to go forward with the work, he would have to elevate the house by 3 feet and place it on piers. In Provincetown, an estimated 600 properties, including the Town Hall, are being reclassified. In the Alewife area of Cambridge, more than 100 properties have been newly determined to be in a flood plain. In Newburyport and Salisbury, hundreds of properties on both sides of the Merrimack River are affected, and town officials are challenging the FEMA flood map designation. The maps have gone into effect in Suffolk and Bristol counties, and about 80 homes in the Savin Hall neighborhood of Dorchester are now officially in a flood plain.

The impact of the new flood plain maps is already being felt across the Commonwealth.

Following the law of unintended consequences, even structures intended to prevent flooding can subject nearby property owners to FEMA scrutiny. Dams, levees, dikes, and hurricane barriers need to be certified as meeting federal standards. Without this certification, properties adjacent to these public works are officially considered flood prone. In Chicopee, a 7-mile-long riverfront levee system protects the town from floods, but it has to be repaired and recertified by FEMA, at a cost of roughly $6 million, or approximately 5,000 properties will be classified as being in a flood plain. New Bedford's hurricane barrier, a 3.5-mile-long steel and stone structure from 1966, will have to be recertified as well, and city officials are struggling with how to pay for the necessary engineering studies and recertification of the hurricane barrier. (Similarly, in parts of New Orleans, map certification will be delayed until 2011 due to the ongoing levee reconstruction project.)

As FEMA's Mike Goetz, chief of New England Risk Analysis Branch, explained, the National Flood Insurance Program (NFIP), of which FEMA flood maps are an integral and necessary part, "tries to make risk management and assessment a part of the everyday life and calculus of communities." The program, established in 1968, encourages communities to exceed the minimum requirements for flood plain management — building at higher elevations and buying up properties in high-risk areas to create open space. Towns and cities can participate in the NFIP's voluntary Community Rating System and earn points that reduce their flood insurance premiums. Goetz described its intentions: "We are trying to incentivize communities and show that doing these good things can actually not only improve the environment, but also that those who have to purchase flood insurance won't be hit as hard financially." Richard Zingarelli, the NFIP Coordinator of the Massachusetts Department of Conservation and Recreation, commented, "The flood insurance program does not want to burden homeowners, but we don't want someone to take a summer cottage on a barrier island and turn it into a mansion."

Thus far, FEMA mapping methods have not been without controversy. At this time, 92 percent of the US has been mapped by the agency, but only 21 percent of the country has maps that fully meet FEMA's own data quality standards, according to a recent report from the National Research Council. The report, which the Research Council produced at the request of FEMA and the National Oceanic and Atmospheric Administration, argued that the agency could more accurately determine flood risk with newer mapping technologies such as LIDAR (Light Detection and Ranging), which measures elevation using aircraft-mounted lasers. Even more significantly, it noted that the maps must be continually updated to reflect natural and development-related changes.

The findings of the National Research Council point to a larger issue lurking in the muddy waters of the $1 billion FEMA project. Flood plains are dynamic entities, constantly shifting, with every new development producing runoff and erosion capable of impacting rivers and streams for many miles downstream. Just as the original FEMA flood maps of the 1970s were intended to be revised regularly but instead were left in place for 30 years due to the exorbitant cost of sustaining a massive, ongoing, nationwide mapping project, the new maps — already less accurate than they could be due to the reuse of outdated maps — will become increasingly inaccurate as time goes by. According to Zingarelli, "The intent is for the mapping to be a continual, ongoing process," but this depends on funding from Congress. The maps' inaccuracy over time will be accelerated by climate change, as sea-level rise (which some current predictions put at 6 feet by the end of this century) will affect not only shoreline sea levels, but also inland river and stream beds and hurricane frequency and severity.

To address these issues, FEMA has launched the next phase of its mapping project: Risk MAP (Mapping, Assessment, and Planning). It has begun to use LIDAR in coastal areas and along rivers and levees to produce more accurate maps, and now has fairly extensive data for parts of New England. As Goetz explained, "Risk MAP is being used to plan mitigation activities: it might mean purchasing flood prone areas (as a community or city or region), or elevating buildings. We're not trying to add levees and dams. We're trying to do fairly soft mitigation techniques with less impact on the environment." In addition, FEMA is beginning to think about stormwater management as an issue that extends far beyond the flood zone itself, taking "a more comprehensive and holistic look at what's happening in a watershed."

The proactive, watershed planning approach FEMA is advocating suggests that, in order to keep up with the changing landscape, perhaps it is time to consider new, alternative modes of occupying the water's edge that are capable of withstanding change and water infiltration. Architects, engineers, and landscape architects may be able to provide guidance and insight into the issue. American Institute of Architects' Latrobe Prize winners Catherine Seavitt, Guy Nordenson, and Adam Yarinsky, the co-authors of the forthcoming book *On the Water: Palisade Bay*, have begun to investigate new ways of building on the waterfront. In their publication, they introduce the concept of "resilience," a strategy focused on soft infrastructure such as constructed islands, reefs, piers, and wetlands that can absorb the impact of natural disasters. (Their work inspired the *Rising Currents* project and exhibition at the Museum of Modern Art.) As Seavitt explained, "Reframing the debate can create openings for action.... It is interesting to think that you can design something in such a way that it becomes beautiful, or a great amenity to a community, and somehow goes beyond the arguments or the entities that are there. More than just a strategy for mitigation or adaptation, it's giving something back that's even better." ■

Elizabeth Stoel is a writer and designer in New York City. Meera Deean is a designer in Cambridge, Massachusetts and a publication consultant.

Thank You.

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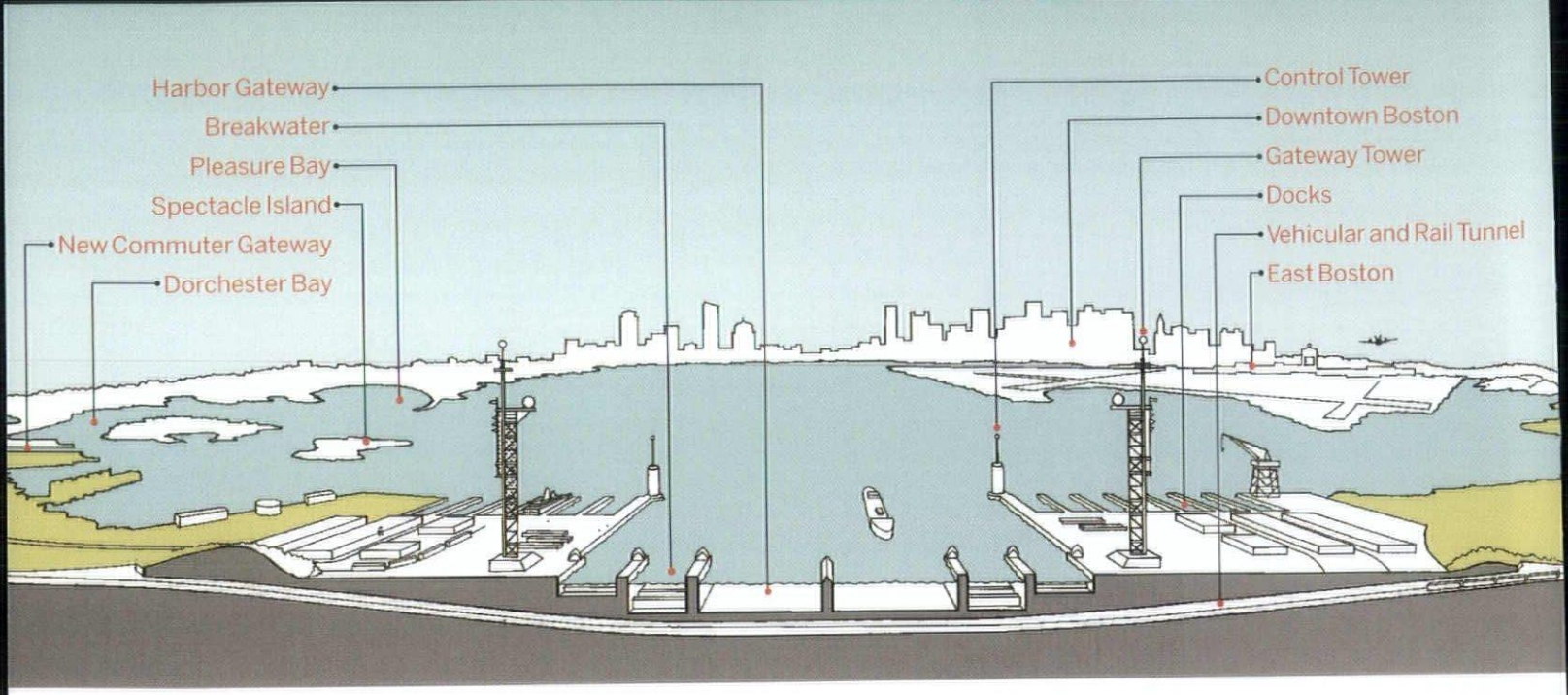
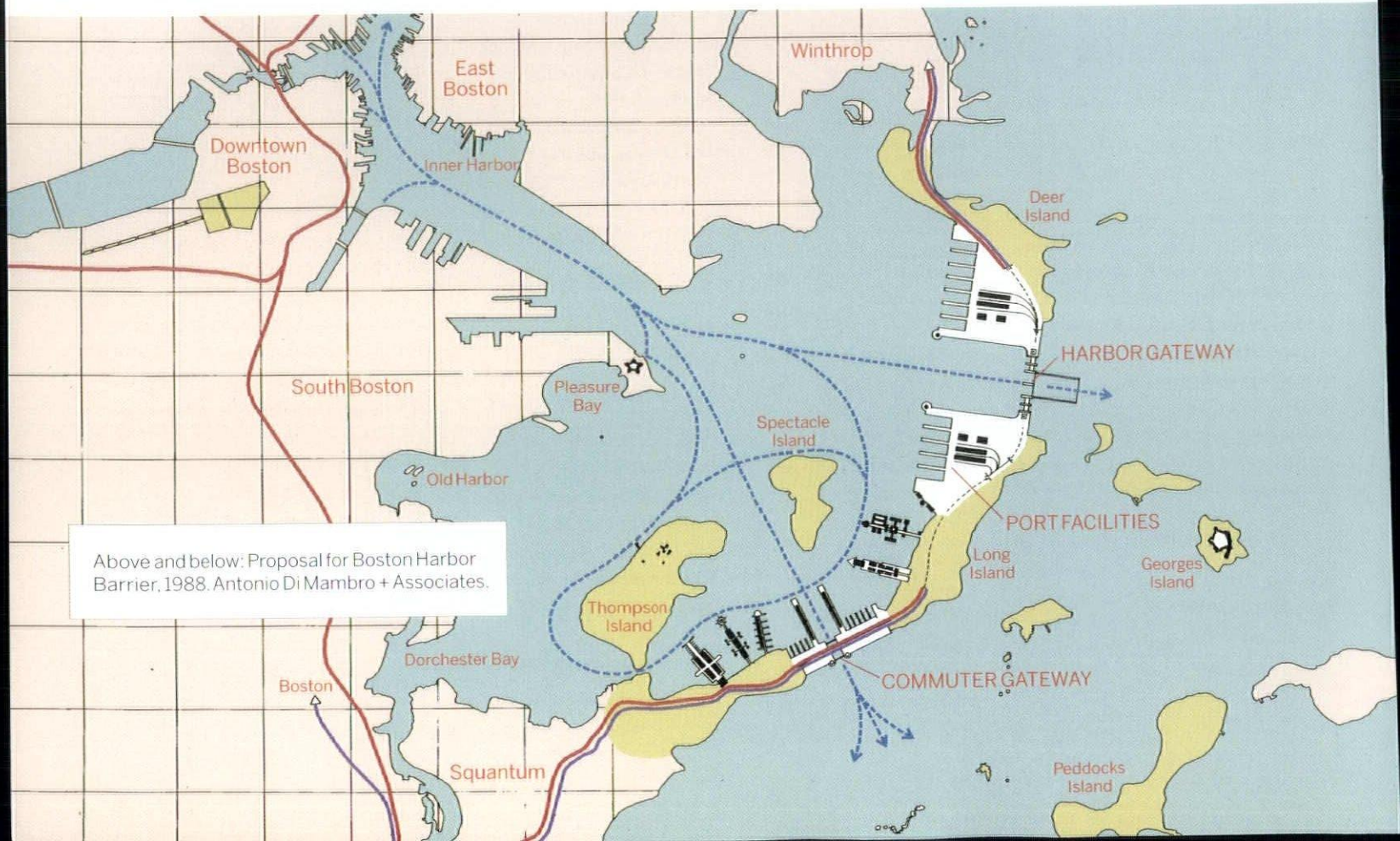
GEI Consultants
GerrityStone
Gerry Sullivan IT Consulting
GF Rhode Construction
GZA GeoEnvironmental
HomeCo
Horiuchi & Solien Landscape Architects
Howard/Stein-Hudson Associates
Hull Forest Products
Iaccarino & Son
Infrared New England
Institute for Human Centered Design
INSURANCE for MEMBERS
International Masonry Institute New England, Boston Office
J. Calnan & Associates
Jacobs Engineering Group
Jeff Adams Photography
Jones Lang LaSalle
Keith LeBlanc Landscape Architecture
Kochman Reidt + Haigh Cabinetmakers
KR Associates
Lee Kennedy
lux lighting design
M.E. O'Brien & Sons
Maloney Geospatial
Marc Truant & Associates
Marvin Windows and Doors/ A.W. Hastings
McGraw-Hill Construction
McGraw-Hill Construction/Dodge
MicroCAD Training & Consulting
Metric Construction
Microdesk of New England
Midland Construction
Munson3d
National Grid USA
Nitsch Engineering
North American Professional Liability Insurance
North Atlantic Corporation/ Horner Millwork
Northeast Masonry Distributors
Ocean Coast Construction
Omni-Lite
Owens Corning
Parallel Edge
Pavestone
Pella Windows & Doors of Boston
Perfection Fence
Phoenix Construction Group
Poole Professional
R.G. Vanderweil Engineers
R.W. Sullivan Engineering
Raymond Property
RDK Engineers
RF Walsh Collaborative Partners
Richard White Sons
Robert Megerdichian & Associates
Roll, Barresi & Associates
RPF Associates
Runtal North America
Service Point
Shadley Associates
Shannon Corporation
Shawmut Design and Construction
Silverscape
Simpson Gumpertz & Heger
Skanska USA Building
Souza, True and Partners
Speed
SR Consulting
Stantec
StoSS Landscape Urbanism
Syska Hennessy Group
Tavac Energy Services
The Reflex Lighting Group
The Remodeling Company
The Whiting Turner Contracting Company
Tocci Building Companies
TOTO USA
Towers|Golde
United Benefit Services/BCBS
Universal Window and Doors
Verne G. Norman Associates
VHB/Vanasse Hangen Brustlin
VJ Associates
WB Engineering | Consultants
Weidlinger Associates
Whitney-Veigas Architectural Products
William A. Berry & Son
Woodmeister Master Builders
WSP Flack + Kurtz

BSA architects.org



THE HIGH TIDE OF OPPORTUNITY



Above and below: Proposal for Boston Harbor Barrier, 1988. Antonio Di Mambro + Associates.

Working with water is a lot better than working against it.

by Hubert Murray FAIA, RIBA and Antonio Di Mambro FAIA

In the space of four centuries, Boston has increased its land area by 39 times, from 1.2 square miles in 1630 to 48 square miles today. The entire area of the city is now 90 square miles, of which 54 percent is land and 46 percent water. Over the past century, the sea level has risen a little over 10 inches. By a conservative estimate, it will have risen a further 30 inches by 2100.

Why Does This Matter?

Boston, no less than Amsterdam, is a water city. In topography and climatology, as in history and culture, the past is prologue. If, as forecast, there is a significant rise in the level of the ocean, the expansionist narrative of the city's development will be reversed so that by the year 2100, absent immediate and radical action, Bostonians will be revisiting the shoreline of the 1880s.

Boston, much like other coastal cities, has become increasingly aware of the challenges that sea-level rise poses for both existing and future development and the choices to be made — technical, economic, and social. In 2009, the San Francisco Bay Conservation and Development Commission held an international design competition for ideas responding to sea-level rise in San Francisco Bay and beyond. This year, the Museum of Modern Art and PS1 have joined forces to address the challenge of sea-level rise as it would affect New York City: project proposals by architects, artists, engineers, and others are the subject of a workshop and exhibition, *Rising Currents*. As stimulating as such events may be for ambitious designers, without political leadership, they are simply tinkering at the edge. To understand the gravity of the situation, imagine a replication of the inundation caused by Hurricane Katrina visited upon every coastal community in the United States. The tragedy of New Orleans in 2005 laid bare not only the vulnerability of the city's physical infrastructure and its critical part in the economy of the nation, but also the social inequities sustained within that fragile crucible.

Facing the Facts

Published jointly by Allianz, a global financial services provider, and the World Wildlife Fund, *Major Tipping Points in the Earth's Climate System and Consequences for the Insurance Sector* provides the most recent evaluation of the effects of climate change and the likely effects on the insurance industry. Combined sea-level rise is one of four critical areas addressed in the report, with a focus on exposed assets in port megacities and specifically those on the northeast coast of the United States.

The financial stakes for Boston are not trivial. Assuming low and high projections of a 20-to-26-inch rise in sea level by 2050 (by the time today's infant is in mid-career), the report projects an "exposed risk" to property damage and consequential loss ranging from $409 billion to more than $460 billion (think of 20 Big Digs or half the cost of the Iraq war).

In trying to imagine how such a flood might look and feel in Boston, there is some instruction in looking back to the flooding of Paris in 1910. Weeks of heavy rain and swollen watercourses upstream caused the Seine to overflow its banks and submerge the city, including the Île de la Cité and Notre Dame. This had happened 250 years earlier, in 1658, but the difference in modern Paris was that the flood water found new conduits in the sewers laid by Haussman and in the recently constructed Metro lines. So in addition to filling the cellars, the floods permeated the underground infrastructure of the city, water gushing in at every orifice, issuing forth into major railway stations such as the Gare D'Orsay and bringing the city to a halt.

Transpose this scenario to Boston. A relatively modest 12-inch rise in sea level is projected to happen, at the latest, by 2046 and, at worst, by 2016, a mere six years from now. Combined with a stiff northeaster of some days' duration, the waves of the Atlantic are likely to top the threshold of subway stations such as Aquarium and South Station and to rush down the access ramps of the Central Artery and the Tip O'Neill tunnel to Logan Airport. In most readers' lifetimes, and within the space of a few hours, high tides, aided and abetted by a full moon and high winds, could drown the modern city of Boston in the bathtub of the Atlantic. The floods of February 1978 (the "Great Blizzard") and October 1991 (the "Perfect Storm") not only presage the magnitude of what can be expected, but as "extreme events" they are also predicted to occur with increasing frequency.

What Are the Choices?

There are two choices before us as a city and as a country: to do nothing (or too little, too late); or to do what has to be done, and fast. Contrary to the conclusions of the *Tipping Points* report, damage to property would in some sense be the least of our problems, the greater being social abandonment, as we have seen in New Orleans.

Consider the do-nothing or "proceed cautiously" approach. Absent government intervention, decisions will be left to individuals and corporations. Some may choose to ignore the warnings, some may take adaptive measures, and others may choose to move inland out of trouble. And some, the poor, will have no choice at all except to bear witness to a generation of disinvestment followed by a catastrophic failure of the infrastructure. In other words, to do nothing is to make an undemocratic and unjust choice. Every man for himself and let the devil take the hindmost is not a strategy — it would be an abdication of leadership and social justice.

This leaves us with having to do something and, if the facts are faced, doing it fast.

What Are Others Doing?

While other cities and metropolitan areas have already taken action, it is worth noting that they have also taken time to accomplish their goals. The most common form of protection is the flood barrier. The floating barriers of Venice will protect the lagoon from storm surges of up to 10 feet. With completion scheduled for 2012, the project has been 25 years in the making.

If Bostonians want to preserve their quality of life for the next generation, they had better act now.

London's Thames Barrier was a mere 10-year project, completed in 1984 — but in response to the devastating floods of 1953. The Delta Works in the Netherlands is a series of 250 miles of dams, dikes, locks, and barriers started in 1950, accelerated after the same North Sea flooding of 1953, and completed in 1997.

The Dutch Delta Commission Report of 2008 is a deeply impressive document outlining the next phase of that country's defenses through the year 2100. The commission spells out and embraces principles of humanism and sustainability as fundamental values driving its recommendations, committing an average of $2 billion per year through the end of this century.

What Can Boston Do?

Climate scientists and actuaries have spelled out the probabilities and the consequences of sea-level rise for metropolitan Boston. Other port cities faced with similar challenges have shown us a range of strategies that are transferable to this city. We have learned from these examples that it takes a generation, say 35 years, to see a major civil project through from inception to completion. Within that span, by 2045, the water level of Boston Harbor will have risen somewhere between 12 and 36 inches. If, like the Dutch, Bostonians want to preserve and enhance the quality of life that

they have enjoyed to bequeath to the next generation, then they had better act now.

Meeting this challenge requires forceful and visionary leadership at all levels of government to articulate a strategy that looks decades into the future. It is also clear that Boston cannot face this alone but must find common cause, nationally, with other coastal cities and towns.

We propose three parts to an effective strategy to "work together with water," as the Dutch have put it:

■ **Articulate the Vision.** The crisis of sea-level rise obliges us to reexamine the value of the city as the crucible of our economy, our culture, and our community. While Boston may be a world center for medical research, the city is also a leader in social inequality. A vision for preemptive reconstruction is an opportunity to right that wrong. In the words of Governor Winthrop, "the only way to avoid this shipwreck and provide for our posterity…we must be knit together in this work as one man."

■ **Establish the Scale.** Antonio Di Mambro's 1988 scheme for a protective harbor barrier running from Quincy to Winthrop is as important for establishing the scale and complexity of the response as it is for its physical vision. This multi-layered proposal combines a tidal-surge barrier, reconfigured harbor facility, transit line, highway, reclaimed land, and industrial, commercial, and residential redevelopment. It is an infrastructure that both protects the present and promotes the future.

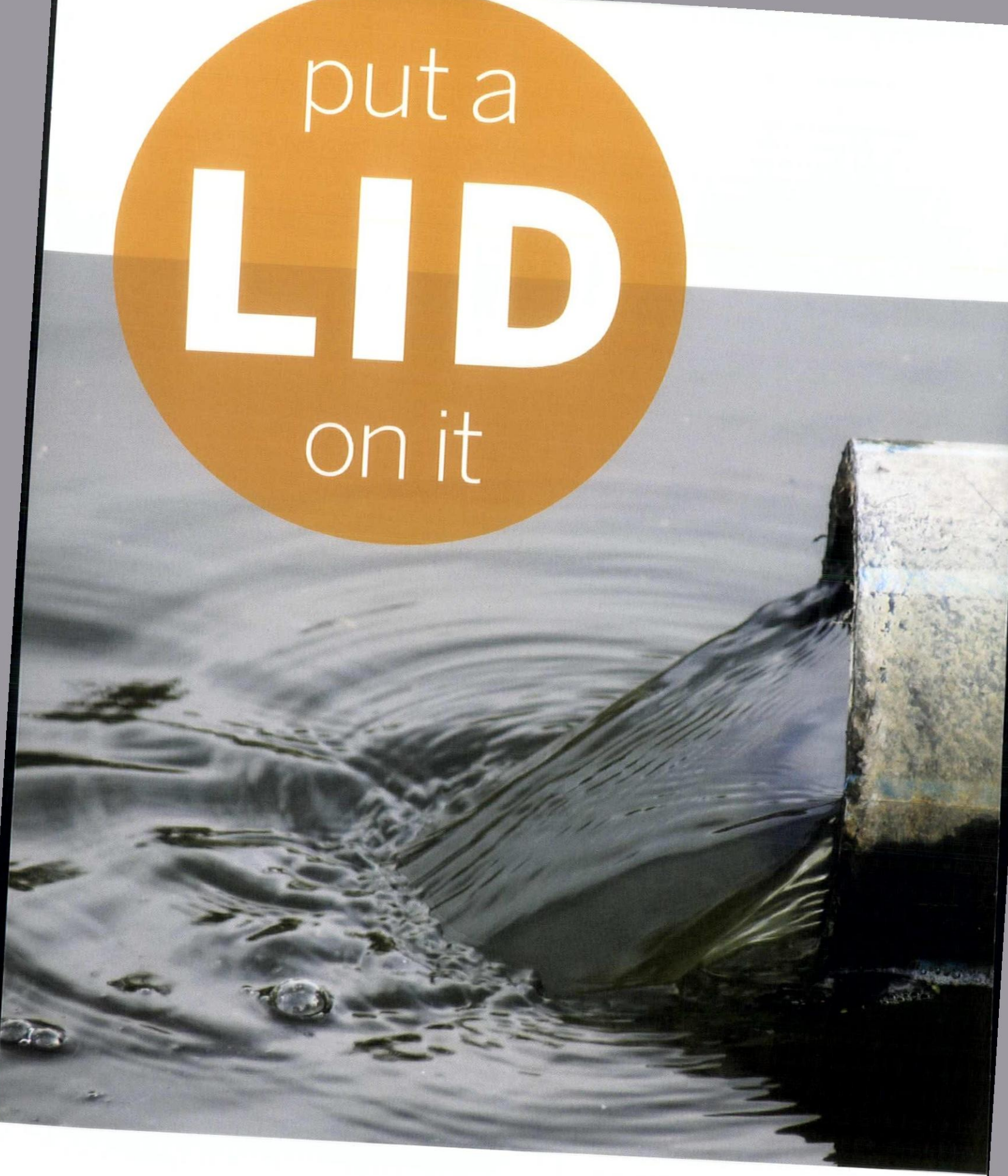
■ **Act Now.** With a clear vision and a long-term goal, there are myriad actions that can be undertaken immediately: protect highway and subway entrances; raise the Harborwalk and create seawalls; establish an elevated datum for buildings; relocate electrical and mechanical equipment out of basements and above the flood levels; and develop storm-surge reservoirs with windmill pumping stations in the lowlands of the South Boston seaport.

The threat of sea-level rise is not immediate but it is urgent. The idea is not to respond to disaster but to preempt it. The challenge is not to succumb to fears (of inundation, decline, or increased taxes) but to see opportunities (of employment, urban revitalization, and social equity). Viewed with vision and discipline, sea-level rise presents the opportunity of a generation to refloat the city, its economy, and its people. ■

Hubert Murray FAIA, RIBA is manager of sustainable initiatives at Partners HealthCare in Boston.
Antonio Di Mambro FAIA is president of Antonio Di Mambro + Associates in Boston.

An expanded version of this story, including a slideshow and bibliography, is available online at: www.architectureboston.com.

put a LID on it



^ Photo © Steven Pike | Dreamstime.com.

It's time to think of stormwater as a natural resource. Low Impact Development (LID) offers an alternative to old drain-and-dispose techniques.

by Sara Cohen

New Englanders do not generally think about water scarcity when they look around. Massachusetts receives about 45 inches of precipitation annually — an abundant water supply by national standards. In fact, people are likely to be concerned about too much water, especially when managing stormwater. Over the last century, as development grew more intensive, both in urban centers and suburban shopping areas, the major stormwater problem was how to get water off surfaces during major storms. It was, essentially, a waste-disposal problem. Accordingly, codes, technologies, and standards of practice all coalesced behind methods of moving stormwater offsite, quickly and in large quantities.

By the 1980s, people began connecting downstream flooding, erosion, and pollution problems with the high volumes of stormwater being flushed off developed landscapes. In response, new codes and regulations were established to reduce "peak flows" during storm events. Artificial ponds and other detention structures were built to temporarily store stormwater during heavy rains and release it at a pace that caused less flooding and erosion and filtered out some of the pollutants. These centralized structures relied on networks of drain pipes to collect the runoff from across the property.

Over the last decade, however, concern has been raised about stormwater's role in a different problem: some of our rivers, streams, and wetlands are exhibiting new, dangerously low water levels between storms. In the Northeast, groundwater is the critical component of streams that enables them to be perennial (continuing to flow during dry weather). Groundwater is water contained in saturated layers of soil and bedrock below the land surface. Where these saturated layers intersect the surface of the land, water seeps out and either pools on the surface, forming wetlands, or runs downhill, forming streams. The frequent replenishment of groundwater by precipitation ("groundwater recharge") enables a continual feed to streams ("baseflow").

However, when forests and fields are replaced with roads, buildings, and parking lots, rain and snow have fewer places to soak into the ground. The proficient flushing of stormwater and meltwater off vast areas of pavement — a point of pride for engineers for decades — is now understood to contribute to a drop in groundwater levels. Hydrologists have long understood this connection, but as it has become clear to a wider audience, the importance of groundwater recharge has come to the fore of Massachusetts water policy. Suddenly, the paradigm of treating stormwater like waste is turned on its head. How do we treat stormwater coming off our built landscapes like the important resource it truly is?

Enter LID

Some answers come from looking back at how stormwater was managed before the emphasis on centralized collection. Picture a rural road — no curbs, no catch basins, no detention ponds. The road is simply crowned to shed water off to the sides, into the trees, shrubs, or grass. In retrospect, we call this, quaintly, "country drainage." The two factors that make this design effective at groundwater recharge are decentralization and the use of planted areas as stormwater receptacles. Decentralizing the places where stormwater is directed makes maximum use of pervious area for recharge. Plants help keep soils loose, which aids infiltration. As it turns out, soils and plants are at least as good at filtering out pollutants as most structural devices designed for this purpose.

The problem, of course, is that this type of design becomes difficult to duplicate when development intensifies and the ratio of paved to unpaved surface increases significantly. But with some design and engineering ingenuity, these older practices form the underpinnings of a new approach to land development called "Low Impact Development" (LID): minimize the area of impervious surface (through cluster designs, narrower roads, shared parking areas, smaller setbacks); use permeable materials for paving (such as porous asphalt and grass pavers); and use open, decentralized planted drainage

instead of curbs, catch basins, and detention ponds.

In greenfield development (conversion of forests or fields to developed use), the LID process begins by characterizing a site's natural grading, laying out a design that uses existing low-lying planted areas for stormwater collection, and minimizing land disturbance overall. Avoiding soil compaction by heavy construction equipment is particularly important, to retain permeability of the soils. This approach contrasts with the conventional practice of beginning a project by clear-cutting and grading a site down to the known quantity of a flat, blank slate. It also means that LID projects are inherently harder to replicate in cookie-cutter fashion. This can add time and expense in the design phase, but often saves money in infrastructure and materials costs during construction. In redevelopment projects, the LID approach may have to rely more on imported soils, newly planted areas, and conversion of pavement to permeable alternatives in order to increase groundwater recharge.

In both greenfield and redevelopment contexts, studies comparing the cost of LID to conventional approaches attempt to balance the higher costs of design and specialized materials often associated with LID against the higher costs of stormwater infrastructure, land alteration, and overall area of impervious surface often associated with conventional development. A recent study from the US Environmental Protection Agency demonstrated that, project-for-project, the LID approach can usually hold its own from a profit perspective and is frequently a cost advantage for developers. As material availability, design know-how, and consumer awareness about the environmental advantages of LID expand, these cost advantages can be expected to grow.

However, LID developers currently face an additional set of hurdles that, in Massachusetts and elsewhere, can trump these advantages. They often have to factor in increased project costs associated with obtaining waivers from local boards and conducting sometimes extensive engineering studies to demonstrate to local boards and officials the advantages of the LID alternative over the "by-right" approach dictated by codes.

In recognition of the substantial obstacles posed by existing laws and regulations, Massachusetts state government has been working with stakeholders over the last several years to revise state stormwater regulations to promote LID, implement incentives, and fund demonstration projects. Government agencies have also been working with nonprofits and private-sector advocates to develop educational materials and provide technical assistance to local communities interested in becoming more LID-friendly.

Next Steps

Outreach efforts, especially those targeting municipal boards and decision-makers, will remain important, as Massachusetts land-use practices are still primarily determined at the local level. Simultaneously, general education is needed to help shift the public aesthetic away from some of the conventions that have come to characterize typical development, such as large lots and setbacks, wide roads, and extensive curbing.

A recent study demonstrated that the LID approach can usually hold its own from a cost perspective and is frequently a cost advantage for developers.

Perhaps just as important, however, is pursuing answers to some of the outstanding scientific questions about LID — especially those that might refine the message itself. How significant are impervious surfaces compared to other factors contributing to low flows in streams and rivers, such as over-pumping of groundwater wells and structural barriers such as dams? Are there places or conditions that are more and less appropriate for the LID approach? How will various LID techniques function in the extreme climate conditions of New England? And perhaps most importantly, how can we be sure that we are not inadvertently creating new problems as we are fixing the old, much as we discovered with the stormwater management philosophies that drove development through most of the 20th century?

New studies are starting to address some of these questions. For example, a recent state-funded analysis by the Horsley Witten Group (with Bridgewater State College) of the Taunton River watershed found that loss of groundwater recharge due to impervious surfaces accounts for a 4 percent drop in annual baseflow over the entire watershed, but caused up to a 25 percent drop in baseflow for some of the small tributaries surrounded by substantial development. A recent study by the US Geological Survey similarly identified scale as an important factor in the impact of impervious surfaces on streamflow. Using a model to simulate the impacts of extensive implementation of LID throughout the Ipswich River watershed, researchers found that even converting half of the impervious surface runoff from all developed areas of the watershed back into soil infiltration would not appreciably improve flows in the river and large tributaries. However, they found that LID could significantly improve flow in small streams in the immediate vicinity of development.

Meanwhile, new research from the University of New Hampshire Stormwater Center has reduced concerns about the effects of cold climate conditions by monitoring a variety of LID features, including porous asphalt, at a demonstration site in Durham, New Hampshire over several winters of freeze-thaw conditions, conventional road sanding/salting regimes, and normal wear-and-tear. Other studies are looking at pollutant removal rates, infiltration rates, groundwater quality impacts, and the effects of varying levels of maintenance.

Paradigm shifts are slow, but momentum is a big factor. As LID starts to enter the mainstream consciousness, the ideas will gain increasing traction and in turn be tested by time, research, and practice — a case study in science shaping politics and policy. ■

Sara Cohen is a water resources specialist at the Massachusetts Department of Conservation and Recreation.

Photographs by Alex S. MacLean

We all know the tale of the three pigs and their homebuilding projects. Maybe you sang the camp song about the wise man who built his house upon the rock while the foolish man chose a nice sandy beach site. As children, we thus learned the basics about how and where to build. But, as with many lessons taught in childhood, we figured we knew a better way. Architects and engineers are perhaps most susceptible to this pattern — they are, after all, taught how to design their way around any problem.

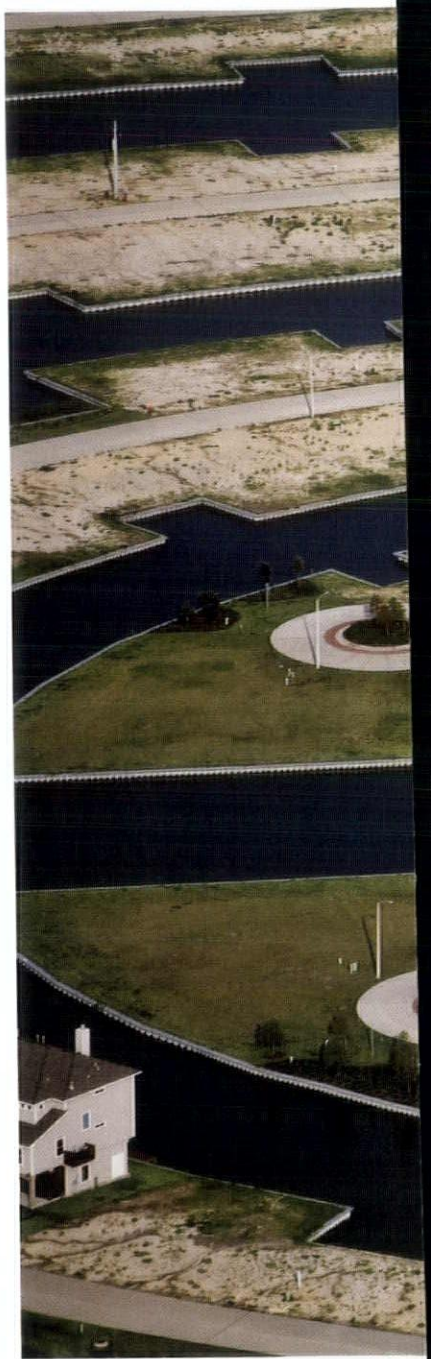
And so, through a combination of incremental individual decisions and a shared focus on short-term gain, we have sometimes built in places that really make no sense, in ways that defy the greater forces of nature. We drive by them, perhaps we visit them on vacation, and we take advantage of their contributions to today's economy. We don't see the big picture.

But Alex MacLean does. From his plane, thousands of feet up, the details recede. Patterns emerge. Folly is revealed. "Mitigation packages" become unimportant. An internationally celebrated photographer, MacLean takes advantage of this rare vantage point, his aesthetic sensibility, and his deep knowledge of environmental issues to promote a better understanding of the American landscape and wise land-use.

The following images are drawn from MacLean's new book, *Over: The American Landscape at the Tipping Point*. Even more than his previous books, this collection of photographs has an urgency, focusing on topics such as water use, sea-level rise, waste, automobiles, and electric generation to demonstrate the vulnerability of our built environment and the fragility of the natural environment.

What's wrong with these pictures? Nothing. They tell you everything you need to know.

— Elizabeth S. Padjen FAIA



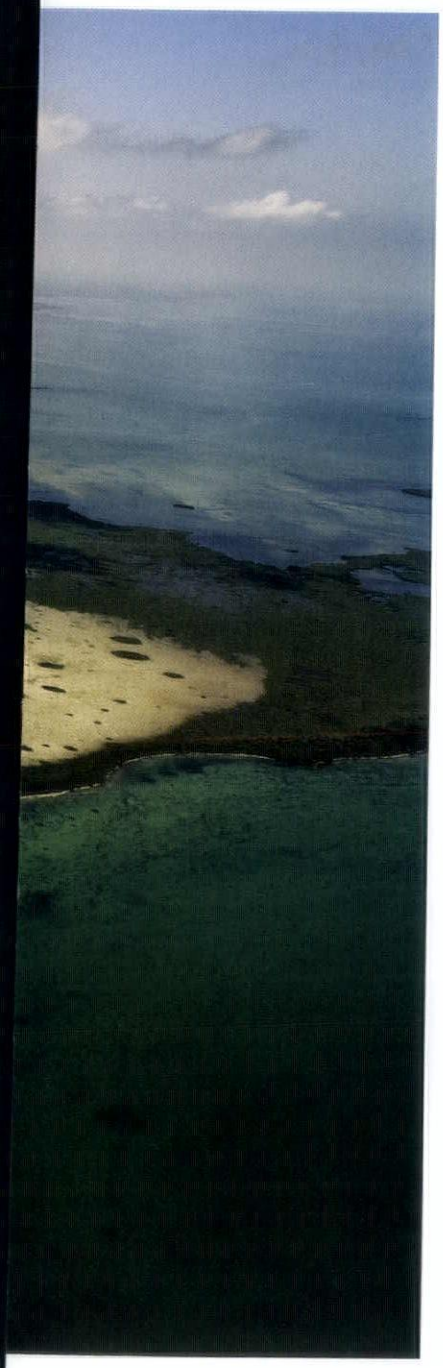
Alex S. MacLean is a photographer in Lincoln, Massachusetts. The co-author of seven books, he has had numerous solo and group exhibitions around the world and is a recipient of the Rome Prize in Landscape Architecture from the American Academy in Rome. For more information: www.alexmaclean.com.

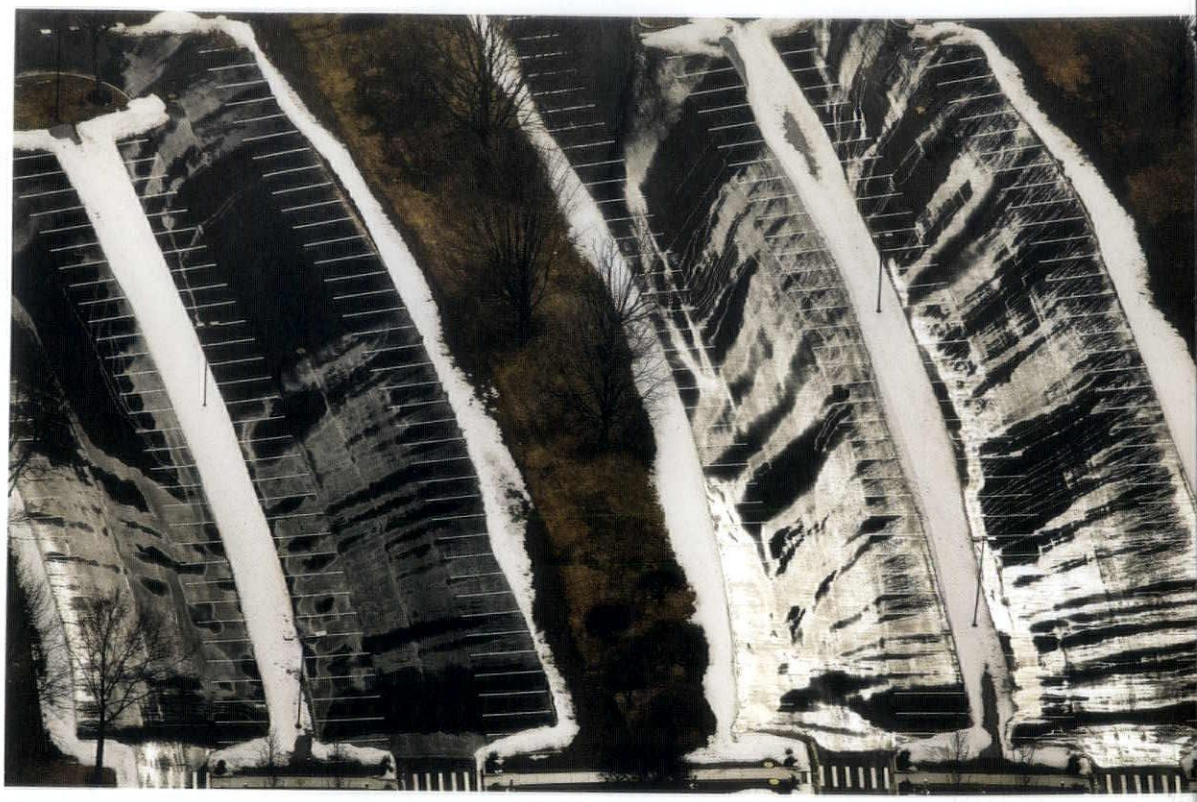
Photographs and captions adapted from *Over: The American Landscape at the Tipping Point* by Alex S. MacLean (Abrams, 2008).

What's Wrong With This Picture?

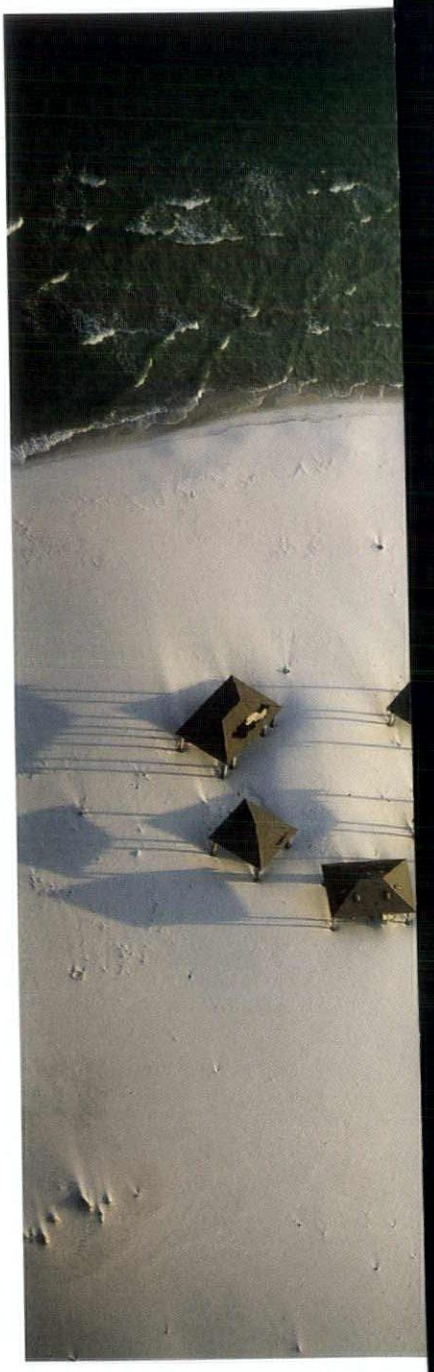
Galveston, Texas
Built on wetlands in Galveston Bay, the new community of Harborwalk takes advantage of high waterfront property values, despite its vulnerability to sea-level rise and hurricanes.

Homestead, Florida
Canals cut into coastal wetlands act like a giant radiator to cool water from the Turkey Point nuclear plant before it is returned to the condenser for reuse.





Waltham, Massachusetts
Parking lots paved with impermeable materials send runoff with surface contaminants into streams and sewers, and prevent rainfall infiltration and groundwater recharge.



Boulder City, Nevada
The Cascata Golf Course, outside Las Vegas, features a 418-foot waterfall. Golf courses in the Las Vegas metropolitan area account for 5 percent of the region's water use.

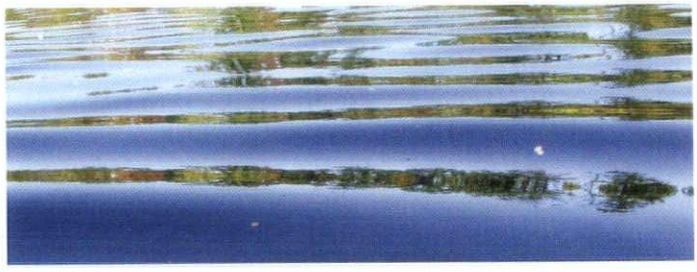
Santa Rosa Island, Florida
Beach erosion on this barrier island has brought the ocean closer to a parking lot and picnic shelters that have been partially covered by shifting sands.

Political Science

Bob Zimmerman talks with **Jay Wickersham FAIA**

Bob Zimmerman is the executive director of the Charles River Watershed Association, where he has initiated groundbreaking ecosystem analyses and land-planning studies, helped rewrite land and water regulation, developed restorative technologies, and served as a leading advocate for more-effective water management policy across the entire region. Prior to joining CRWA, he was a founder and headmaster of the National Sports Academy in Lake Placid, New York. He has degrees in history, English, and Middle English from Central Michigan University, and worked for two years as a consultant to the energy industry.

Jay Wickersham FAIA is a partner in Noble & Wickersham, a law firm specializing in design, construction, environmental, and land-use law, and is a lecturer at the Harvard Graduate School of Design. From 1998 to 2002, he served as assistant secretary of environmental affairs for the Commonwealth of Massachusetts and as director of the state's environmental impact review program. He previously worked as an architect and urban planner in Boston.



Can one river change the world? With the science and political skill behind the Charles River Watershed Association, you wouldn't bet against it.

Jay Wickersham: As a former headmaster with a degree in Middle English, you have certainly followed an unusual career path. You are now one of the leading authorities on water issues in this region, and your organization, the Charles River Watershed Association, is similarly known today for its leadership in statewide environmental policy. How did that transition occur?

Bob Zimmerman: Curiosity, I guess. That and the fact that there were about six jobs available in the US at the time. I got into water policy after I joined CRWA as executive director in 1990. Looking back, I would say that I was fairly naïve as far as environmental nonprofits were concerned. I thought that everybody knew what was wrong with the environment, that the only question was finding the will and the funding necessary to go out and fix it. I quickly became aware that that's not the case.

I attended lots of extremely contentious meetings with federal and state agencies, municipalities, and consulting firms about combined sewer overflows [CSOs], a function of stormwater and wastewater using the same pipes and overflowing into the river and harbor when the stormwater volume is too great for the pipes to handle. It became very clear that there was this notion that the Charles River had always been dirty — the "ambient pollution" theory — so it wouldn't really matter if the CSOs were cleaned up because the river would still not meet any water-quality standards. It occurred to me that perhaps we needed to take a broader look, so we launched the Integrated Monitoring, Modeling, and Management project in late 1994, to figure out how the Charles watershed really works. Where does the water come from? How does it get in the river? Where are the sources of its pollution? How do they all mix? When things go bad, why do they go bad? That's remained the focus of the organization ever since.

CRWA has become a unique regional watershed organization; I don't believe there's another like it in the country. It has its own engineering and science staff and legal capability, and virtually all of the work we do is based on our own science and computer-modeling capabilities. Since 1995, we've been monitoring every two miles of the Charles River every month, so we have a fairly deep and broad dataset. It's pretty easy for us to figure out whether our actions are making the river better or worse, or if things are staying the same.

Jay Wickersham: Can you talk more about this concept of a watershed? People think of themselves as residents of a particular city or town, but most probably don't even know what watershed they live in. Why have you chosen a watershed as a territory to watch over and defend?

Bob Zimmerman: From an environmental perspective, a watershed is that area of land that can be expected to survive pretty much on its own as long as there is rain. In the case of the Charles, it's the 308 square miles of land that drains to the Charles River. The nice thing about the Charles is that it's only 80 miles long. So it's relatively easy to study and to understand the interactions between humans and nature and the issues that we create. A lot of the work that we do is applicable to virtually any urban river system in the world.

Jay Wickersham: The Charles has long been associated in the public mind with severe pollution. Back in 1995, EPA regional administrator John DeVillers announced a goal that within 10 years, the Charles River would be fishable and swimmable; a year later, then-governor William Weld made his famous dive into the river to underscore the state's commitment to the goal. We're now five years past DeVillers' deadline. How are we doing?

Bob Zimmerman: Currently, the river meets the swimming standard in the 10 miles of the lower basin up to 70 percent of the time, and the boating standard, which is five times lower than the swimming standard, virtually 100 percent of the time. Polluted runoff during wet weather is the remaining big issue.

Early on, assumptions about pollution in the river were driven by the mistaken notion that a tremendous amount of raw sewage from the entire watershed was coming over the Watertown Dam into the lower basin. Our monitoring showed that one outfall, slightly upstream in Watertown, was continuously dumping raw sewage into the river — a number of buildings had illegal cross-connections tying into a storm drain instead of a sanitary sewer. Once that was fixed, it became clear that most of the sources of the problems in the lower basin could be found in the lower basin itself: combined sewer overflows, sanitary sewer overflows, illegal cross-connections, collapsed interceptor pipes — failed infrastructure all. In the first three years of the DeVillers initiative, a million and a half gallons a day of raw waste dumping directly into the river was eliminated — a huge impact on water quality.

Jay Wickersham: Were those problems primarily the result of bad engineering or of inadequate maintenance over the years?

Bob Zimmerman: A combination of the two. Boston started laying large interceptor sewage pipes in 1854. And to save money, it was decided that, rather than put the storm drain and the sanitary sewer

in separate pipes, they'd be combined in the same pipe, which is great, as long as it doesn't rain. As the city grew, the capacity of those pipes was exceeded. A lot of the pipes were made of brick; brick has mortar; mortar fails over time. Nobody was checking the pipes: once you bury a pipe, it's easy to ignore it. And that led to another significant concern for the region. Once the pipes start to fail, they leak in — they don't leak out. So groundwater that the pipe passes through actually leaks into the pipe, because the pressure inside the pipe is so much lower than the pressure in the ground. In effect, what we've designed is a system that has created tremendous environmental problems for us.

Today, 60 percent of every gallon of water treated at Deer Island is otherwise potable groundwater or rainwater that has leaked into the system. We're not running out of water; we're throwing it away.
Bob Zimmerman

Now I have to admit that the technology available to us in 1850 and 1900 didn't really allow us to do much other than create large centralized systems to take the water that we use in our homes and throw it away someplace a long way away from us, to make sure that we protected ourselves against cholera and typhus. It made perfect sense. But it's not 1900 any more.

Jay Wickersham: You're critical of the idea of a large centralized wastewater treatment system. Yet the enormous Deer Island treatment facility is considered by most people to be an environmental success story, responsible for the cleanup of Boston Harbor. What's your concern about that kind of centralized system as a model?

Bob Zimmerman: One concern is the approach it promotes to the problems that we face with environmental issues. We tend to look at these problems in isolation. The Conservation Law Foundation and the Environmental Protection Agency brought suit in the early 1980s because of the condition of Boston Harbor, which violated the Clean Water Act. The issue was cleaning up Boston Harbor; and the solution was to create this enormous centralized system, the Massachusetts Water Resources Authority [MWRA], with this new enormous wastewater treatment plant. So we've ended up taking water from the Quabbin and Wachusett Reservoirs to serve communities in the MWRA district, using it, collecting it, and throwing it away, after treatment at Deer Island, nine-and-a-half miles out into the middle of Massachusetts Bay.

On top of that, half of the 43 communities that the MWRA serves actually pump their water locally instead of receiving it from the Quabbin and Wachusett Reservoirs. But that water also gets dumped it into the big pipe and thrown away, nine-and-a-half miles out into the middle of Massachusetts Bay.

And then there is the fact that 60 percent of every gallon of water treated at Deer Island is otherwise potable groundwater or rainwater that has leaked into the system; groundwater alone accounts for 47 percent of every gallon. So we're de-watering eastern Massachusetts. This has enormous consequences. We've all learned over the last decade or so that we're running out of water and there are going to be water wars. I've got to tell you, we're not running out of water; we're throwing it away. That 47 percent of the water in those pipes represents, every single year, the same flow as the Charles River. So there's the equivalent of one Charles River captured and thrown away. Then there's the stormwater that we collect off impervious surfaces in the 43 towns of the MWRA that gets thrown away. That amounts to a second Charles River. And if you add in the wastewater itself, there's a third Charles River. So every year, through Deer Island, we throw away three Charles Rivers from those 43 communities.

Jay Wickersham: And that must have huge implications, both for the environment and for our economy.

Bob Zimmerman: Yes. The bottom line is this: you've got parts of rivers like the Sudbury and the Ipswich that actually run dry in the summer because whatever groundwater is available is being taken for human demand. In urban rivers like the Neponset and the Charles, the impacts are in abnormally low flows, so what you get in the river is concentrated pollution. And when there's less water in a river, the temperature goes up, so its carrying capacity for fish and wildlife is reduced. Have we felt it at the tap, in our kitchens? No. Will we? Yes.

Jay Wickersham: So what would you suggest as an alternative to the large centralized systems?

Bob Zimmerman: At CRWA, the first part of our strategy is to buy time. It's going to take decades to effect broad change. In the meantime, we want to make sure that things get no worse than they are right now.

Associated with that is the work we've done in getting conservation-based water withdrawal permits and registrations,

Virtually all of the water problems that we suffer in urban areas are a direct result of the infrastructure we have built.
Bob Zimmerman

so that we cap the amount of water being taken from the ground, so that the rivers get no worse. With the new conservation-based permits, towns that would have had to seek new sources of water supply beginning this year, 2010, won't need to seek new sources of water supply until 2030. So we just bought ourselves 20 years.

Jay Wickersham: You mentioned earlier that CRWA takes a science-based approach. But you've also got an active and aggressive legal arm. How have you been trying to effect change through the law?

Bob Zimmerman: On the time-buying front, CRWA, representing the Ipswich River Watershed Association, the Essex County Greenbelt, and Mass Audubon, sued the state Department of Environmental Protection in 2003 under the Water Management Act for failure to balance human demand with natural resource need. When one-third of the Ipswich runs dry for more than a month every summer, something is clearly wrong in the way we allow water to be used. That suit was ultimately set aside because DEP agreed with us and started writing conservation-based permits. When those came out in early 2005, 11 of the 15 towns affected immediately appealed, and our general counsel remains in court defending DEP and continuing to make the case for the permits. So far, we've won in every venue, and I would expect that we'll win in the end. In the interim, those permits are in place and they do help.

We are also examining policy and regulation. We build these enormous centralized systems because somebody demands them. We know the environmental damage they create — virtually all of the water problems that we suffer in urban areas are a direct result of the infrastructure we have built. So we're looking at regulations that take a different approach, which over time mimics nature and eventually restores water bodies. We can restore trout streams, even the Charles River, and provide for human demand pretty much regardless of growth.

Jay Wickersham: What would that mimicry of nature look like? And how would it affect the way we build today?

Bob Zimmerman: First we need to understand how nature works here in New England. Nature wants to hold on to precipitation, so water infiltrates the soils and collects in underground aquifers with tremendous storage capacity. What we typically do instead is to collect the water off impervious areas — parking lots, buildings, roadways, sidewalks, heavily compacted soils — in a storm drain in the side of the road and then throw it away. And of course, in the process of running across all of this pavement, the water also gets pretty heavily polluted — a regular pollution cocktail. If we were to mimic nature, we would not let that water get away. We would use techniques such as swales, rain gardens, and porous paving — techniques associated with Low Impact Development (LID) — to let it run through the soil to clean up the vast majority of those pollutants. In the summer, it would support plant life and trees, which provide cooling and sequester carbon, and in the winter, it would percolate back into the ground to recharge the aquifers, as it would have 300 years ago.

The idea can be applied in other ways as well. When we pump water from town and private wells for use in our homes, we can cycle it back rather than throw it away. We've created a computer model at CRWA to locate areas in cities and towns where that water can be cleaned up and then discharged back to the ground, so it goes back to the surface water bodies it would eventually have fed if it had not been pumped. So you get a big recycling process that restores in-stream flow, protects us against drought, and reduces flooding.

Jay Wickersham: But you well know that local treatment can sometimes lead to local opposition.

Bob Zimmerman: No matter what you do in the United States, the "not in my back yard" attitude is going to remain a problem. In the end, however, we need this infrastructure. The nice thing about these wastewater treatment plants is that they're not the kinds of plants that currently dot the landscape — with the smells and the big surface water separators and tanks. These are, in effect, huge septic systems. Most of the discharge occurs underneath the ground. You could build playing fields over the surface. They're not huge. The other nice thing about groundwater discharge is that you eliminate the problem of releasing pharmaceuticals and personal care products into waterways. The University of California Berkeley has shown that, within 90 feet of filtration through the ground, that stuff is eliminated.

Jay Wickersham: So the ground serves as a natural filtration and cleaning system?

Bob Zimmerman: Absolutely. It allows you to replicate, technologically, the kinds of systems that nature created before we built Boston.

Jay Wickersham: What kinds of changes should we be asking for, as citizens and consumers, as homeowners or tenants? In the face of large, complex problems like this, people often think there is little they can do as individuals.

Bob Zimmerman: The first thing we need to do is buy time. We need to reduce water demand so that we have the time to test, investigate, and put in place water infrastructure that's restorative and sustaining.

We can demand that our municipal leaders and the consultants and contractors they hire think about the larger system instead of isolated one-off solutions. We can push for local zoning modifications to allow Low Impact Development. We can ask how we want our towns to function 20 years, 100 years from now. How do we provide for and sustain water resources? How do we provide for growth? Where do we want the growth to happen? Can we create infrastructure that causes smart growth?

One of the things we're working on now is a process we call "spot sewering." Many suburban and exurban communities don't have any wastewater treatment plants. And they want to guide and control growth; they want to create a walkable village center. So let's sewer that village center, but only the village center, to direct development to the core.

> We're looking at regulations that take a different approach, which over time mimics nature and eventually restores water bodies.
> *Bob Zimmerman*

Jay Wickersham: I've been working on a project in North Easton, Massachusetts, which is looking at a plan to redevelop a wonderful historic factory complex. And in order to support that, the developer, with funding from the town, would provide an onsite wastewater treatment plant with enough capacity to pick up the rest of the downtown in order to foster exactly that kind of redevelopment, while discouraging growth along the outer arterial roads.

Bob Zimmerman: And if they use an anaerobic treatment process to capture the methane, they can burn the methane, spin a turbine, and generate energy for that downtown district. Methane, by the way, is 23 times better at trapping heat than carbon dioxide, so burning it is actually a good thing because it removes it from the atmosphere, a form of climate-change mitigation. If they do this

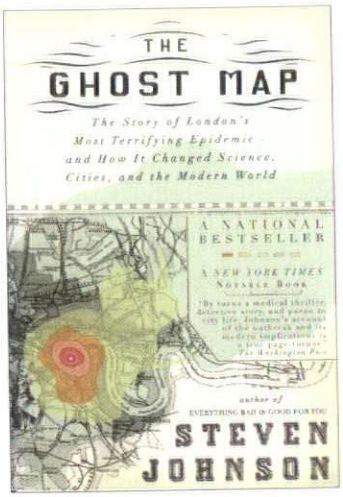
right, if they run our computer model and figure out the best spot to discharge that water to the ground, and if they use an anaerobic treatment process to generate energy, they will create a profit center for a town that's probably struggling with property taxes.

Jay Wickersham: Looking back over 20 years of stewardship of the Charles River watershed, are you optimistic about our ability to make the kinds of broad changes that you're talking about?

Bob Zimmerman: Sometimes I feel like we're just not moving fast enough. But then I reflect on what's actually been accomplished, which is remarkable. I think we're going to see some changes in the next three to five years in eastern Massachusetts that will show the way for the rest of the country and, in my opinion, the rest of the urban world. The rest of the world, particularly western Europe, is still pursuing perverse solutions, by which I mean human-managed river systems. I just can't go there. I'm for restoring wild rivers. This is America, you know? We don't want to go see a Yellowstone that's in a pipe. I would love to see a Charles River where unnecessary dams are removed in Hopkinton and Milford and Dover and Sherborne, where we can fish for trout again. And that's within our grasp. ■

For more information: www.crwa.org.
For online maps of New England watersheds and a discussion of the length of the Charles River: www.architectureboston.com.

Photos of the Charles River: page 38 (top and bottom), and page 43 by Alex Budnitz; page 38 (center), and pages 39 and 40 by Christine Fernsebner Eslao; page 41 by Paul Keleher.



THE GHOST MAP: THE STORY OF LONDON'S MOST TERRIFYING EPIDEMIC — AND HOW IT CHANGED SCIENCE, CITIES, AND THE MODERN WORLD
By Steven Johnson
Riverhead, 2006

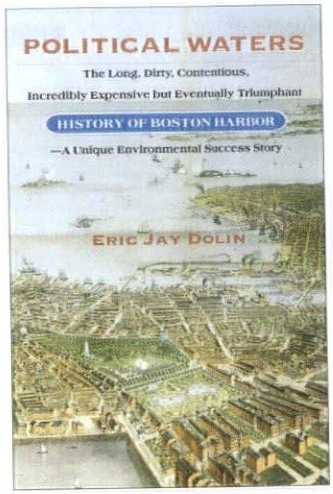
Set in 1850s London, *The Ghost Map* is a superb detective tale of urban density, disease, fortitude, and plumbing. Steven Johnson tells, with page-turning mastery of urban and scientific detail, how the great metropolis was saved from cholera by one doctor's pursuit of a microbe. Think *Nova* meets Sherlock Holmes, with Dickens providing local color.

Johnson brilliantly portrays London, the first modern mega-city. In 1854, the population density of the city's Soho district was 432 per acre, or 276,000 per square mile. Compare Boston's South End, with 21,000 per square mile, or New York's Lower East Side with 101,000. Triple that to approximate the human packing of Victoria's Soho, and still you'd be clueless of its malodorous, vomit-inducing stench: streets steeped in manure, shops teeming with livestock slaughter, tanneries, all manner of coal-fired industry — each emitting pungent airs. Worse was the reek of excrement pooling in fetid courtyards and cellars: as rural people poured into London, tripling its population in 50 years, human waste clogged the ancient system of cesspools and dung-handlers. Newly fashionable "water closets" made matters worse: the average household flushed 244 gallons daily into non-existent sewers. Enter the epidemic. Bacteria *Vibrio cholerae* had been around for millennia, checked by the human instinct against ingesting excrement, and widespread taste for the salutary antimicrobial effects of alcohol and tea. But London's lethal stew was a perfect host for cholera outbreaks that decimated neighborhoods every few years. Johnson describes London as "permanent, rolling disaster, a vast organism destroying itself by laying waste to its habitat."

The detective of the story, physician John Snow, discovered the truth that cholera is waterborne and becomes epidemic when drinking supplies mix with human waste. Victorian doctors correlated smelly streets with cholera and promoted "miasma" theories of airborne contagion. Noting that cholera attacked intestines and not lungs, Snow pursued his waterborne theory, though ridiculed by the medical establishment. Fearlessly visiting the dying to trace water supplies, he eventually linked the victims to a single well that abutted a hidden cesspool and convinced authorities to remove the pump handle. In that one act, he arrested a raging epidemic and founded the profession of epidemiology. (The John Snow pub marks this site today — high British honor.)

Johnson's epilogue flashes forward to post-9/11 terrors facing cities today: ebola, anthrax, H5N1 influenza, jihad. Johnson worries most for urbanism when the nuclear-armed "dirty bomb" terrorist arrives. City life would be destroyed, he says, lessened by each look over the shoulder. I wonder how true that is. Urbanites show grit in adversity, comrades in courage and civility, exemplified best by the author's subject, London. Cholera, the Blitz, smog, floods, the IRA, the 2005 Underground bombs — this great metropolis survives, and is greater for its trials. London calling.

Robert Taylor is a principal of Taylor & Burns Architects in Boston.



POLITICAL WATERS: THE LONG, DIRTY, CONTENTIOUS, INCREDIBLY EXPENSIVE BUT EVENTUALLY TRIUMPHANT HISTORY OF BOSTON HARBOR — A UNIQUE ENVIRONMENTAL SUCCESS STORY
By Eric Jay Dolin
University of Massachusetts Press, 2004

Boston has been profoundly affected by sewage. Though many histories have been written about Boston, most have failed to find drama in the history of its sewage. *Political Waters* recounts the roller-coaster of events that brought one of America's best-known harbors into and then, remarkably, out of environmental despair.

From Boston's earliest days, sewage was considered an unpleasant nuisance. Successful sewer management was measured by how quickly the wastes could be conveyed away from basements and streets — albeit to the shallow shoreline waters of Boston Harbor. But it wasn't long before this "very stinking puddle" became a health concern, and public outcry coupled with emerging medical evidence demanded regulatory action — and the unofficial start of a near-two-century battle with managing sewage discharge.

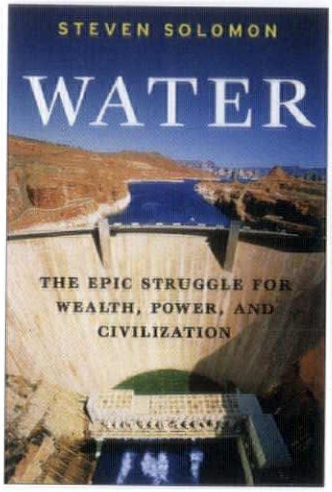
Early attempts to solve the sanitation issue pushed the issue further "downstream" (deeper into the harbor), and the degradation of Boston Harbor continued well into the 20th century with little notable progress made. Dolin successfully paints

the picture of the public's ignorance of a pending environmental crisis; after all, the sewers appeared to be doing their job and wastewater was "out of sight, out of mind." But when legal and political events began to converge and Boston's "harbor of shame" became a national laughingstock during the 1988 Bush-Dukakis election, sewage was brought back into the public eye.

The book provides a factual and seemingly unbiased account of the events that ultimately led to the successful cleanup of Boston Harbor. As Dolin recounts the political decisions and engineering responses implemented throughout the course of history, he also presents numerous opposing points of view and alternative recommendations. Interestingly enough, some of the concerns voiced even in the early 1800s presaged environmental concerns today. For example, when the question of solutions for sewer and stormwater flows arose, the decision to combine them was made in order to avoid the cost of constructing double sewer lines and to allow storm flows to periodically flush out the sewers — despite some objections. Today, nearly a decade after the completion of the Boston Harbor project, combined sewer overflows (CSOs) pose a lingering threat, and an expensive multi-year CSO project is still underway in Boston and surrounding communities.

Now that we have our Deer Island treatment plant, 43 communities flush their toilets without worry. And 51 communities continue to turn on their faucets knowing that clean water from the Quabbin Reservoir will arrive. Dolin's portrait of a public oblivious to impending crisis forces the question of whether the Greater Boston area today might be similarly oblivious to a looming crisis. Our waters are still impaired, and we have yet to solve the problems from stormwater runoff — CSOs, inflow/infiltration, nonpoint source pollution, and aquifer depletion. Are we doing enough?

Nicole Holmes PE, LEED AP BD+C is a civil engineer and project manager at Nitsch Engineering in Boston.



WATER: THE EPIC STRUGGLE FOR WEALTH, POWER, AND CIVILIZATION
By Steven Solomon
Harper, 2010

Subtitled "The Epic Struggle," *Water* is itself an epic work of anthropocentric political history in classic Western mode. Steven Solomon's research into the relationship between cultural evolution and water is massive and perhaps unprecedented. In the notes preceding his "selected" bibliography, the author describes the challenges he faced: on the one hand, a dearth of books similarly investigating the role of water in history and, on the other hand, a glut of recent literature addressing today's water issues — material too vast to include in a bibliography. Thus his many substantive chapter notes have an important role.

In *Water*'s enjoyable and dense pages, I found myself wishing for a presentation in reverse timeline or in some multi-threaded format. This might have allowed his concluding discussion of today's global water science to complement the restatement of the history of "civilization" that is the focus of much of his attention. Solomon's use of the term "civilization" — and many other terms used to identify the phases of cultural evolution — is ambiguous. In cultural anthropology, "civilization" refers to a phase of culture energized by the invention of agriculture and evolved during the "agricultural revolution." The culture in which we have lived since the 18th-century "fuel revolution" might be termed a "post-civil culture of abundance" (enabled by fossil fuel and fossil water) — now in the process of morphing into a later phase, perhaps the "efficiency revolution." All of these cultural phases are threaded through Solomon's text but ultimately rolled into the catchall "civilization," as in his prologue: "[Future] civilization will be shaped as well by water's inextricable, deep interdependencies with energy, food and climate change." But it is useful to understand we are at least two evolutionary steps away from that cultural phase.

Water is a worthy companion to Jared Diamond's *Collapse*, similar in its effort to discover lessons of human history related to bioregional context. Oddly, *Water* does not deal with the powerful integrating force of current global culture, instead assuming that the planet will continue to encompass many semi-autonomous nations of water haves and have-nots. A striking example is the minimal inclusion of considerations of global trade in "virtual water" (embedded water), which dramatically alters local water use. Another is his light treatment of the challenges of bioremediation and restoration of natural biodiversity. The lack of discussion of the wholesale displacement of populations necessitated by rising sea levels and the effects of climate change is also significant.

Read *Water*. It takes the form of an evocative string of engaging historic narratives and carefully researched information. Although much of that information is limited to the standard Western bias of its historic sources, the book's anthropocentrism is innocent and readily identified. *Water* is an honest and scholarly effort both to remind everyone that water is the basis of all life on earth and to trace the history of human technologies and the societies using them.

Philip Norton Loheed AIA is a principal of BTA+Architects in Cambridge, Massachusetts and president of the nonprofit Earthos Institute in Somerville, Massachusetts.

BY GRETCHEN SCHNEIDER AIA, LEED AP

Covering the Issues

"Old is the New Green"... It's about time. Green building and historic preservation are starting to talk. Hanley-Wood debuts its redesigned ***Eco-Structure***, a quarterly focusing on environmental performance, with an issue on existing buildings, proclaiming on the cover, "The Past is Our Future" (January/February 2010). The new "Flashback" column — promising to visit structures to see how they've held up over time and explore lessons learned — is the strongest idea of the whole issue, though it needs greater analytical depth to be truly useful. Elsewhere, "The Height of Sustainability," Sudip Bose's cover story in ***Preservation*** (March/April 2010) on the comprehensive renovation of the Empire State Building, begins to provide that depth. This renovation is not about adding bamboo floors to the observation deck; this is about quantitative data on energy performance and economics. By reducing energy consumption by 38 percent, the developers predict they'll save $4.4 million annually, and the project team hopes that it will serve as a demonstration project for other commercial real-estate renovations. In this, *Preservation*'s third "green" issue, Blair Kamin also takes readers beyond the obvious in "Friends or Foes," as he explains and explores the tension between historic preservation and environmental conservation agendas. When environmentalists propose adding heat-reflecting silver paint to the iconic black Sears Tower, admittedly things get tricky.

Anybody home?... Kanbashi, a newly constructed district in China's Inner Mongolia, is designed to house one million people — and it's empty. Michael Christopher Brown's eerie photos prove it. Is this a sign of oversupply? Is China's building boom really a building bubble? In "Ghost City," Bill Powell poses these terrifying questions for ***Time*** (April 5, 2010). With residential and commercial real-estate investment approximately 22 percent of China's overall growth and China's GDP still rising significantly more than its European or American counterparts, Powell suggests that Chinese officials hope they can deflate the bubble without a pop. We do, too.

Urban magical thinking... Boston native Brendan Patrick Hughes offers a refreshing take on our favorite construction project in "Boston: The Big Dig's Benefit" for ***Next American City*** (Issue 26). He suggests that the building boom of the last three decades has left us a changed city that is profoundly different, and presents a fascinating argument that the Big Dig should be understood in conjunction with the Boston Miracle — the community policing initiative that led to a 40 percent reduction in violent crime during the 1990s. It's all about the *idea* of the city.

Green design and green business... In the wake of Copenhagen and in response to the 10 percent of Obama's stimulus package headed toward renewable energy, the business press is chattering. Buildings are known energy hogs, as the media like to point out. Published in London, ***CNBC Business*** (January/February 2010) offers a Euro-American view, discussing solar power, architecture, entrepreneurial pioneers, and promising "eco-business" concepts. Most intriguing is the air-conditioning system designed by London-based Artica that beats standard units by 90 percent. Better still, it requires no refrigerants, few moving parts, and it's intended for existing construction. In ***Entrepreneur*** (April 2010), Julie Bennett asks "Are We Headed Toward a Green Bubble?" Reporting that the February 2010 stock index for American clean energy companies is up 25 percent over a year ago, she conveys cautious enthusiasm along with a primer for her non-MBA readers. ***U.S. News & World Report*** (April 2010) enters the fray with its own energy cover story. A mix of articles attempt a balanced analysis of current technology, policy, and practices, including innovative urban planning approaches from Denver, and recommended residential upgrades. Author Maura Judkis identifies the essential rub, however: even in this climate, an energy retrofit will likely not raise a home's value. Finally, ***Harvard Business Review*** uses its latest "On Point" series (Spring 2010) to repackage articles around the theme of "Making Green Profitable." Michael Porter, Paul Hawken, and HBS faculty present trends and ideas influencing business operations. Architects, pay attention. ■

Gretchen Schneider AIA, LEED AP is the principal of Schneider Studio in Boston.

Index to Advertisers

WORLD WATER COUNCIL
www.worldwatercouncil.org

It's not about you. The WWC takes a global view, promoting a "water secure world."

URBAN HARBORS INSTITUTE
www.uhi.umb.edu

Based at UMass/Boston, this think tank is known for its policy, scientific, planning, and management expertise on marine and coastal issues, and offers a terrific set of downloadable publications.

THE BOSTON HARBOR ASSOCIATION
www.tbha.org

TBHA promotes "maritime industrial activity, environmental protection, and public access around Boston Harbor." Site resources include event calendars, info on water transportation, policy papers, downloadable audio tours, and a guide to safe shellfishing.

HARBOR ARTS
www.harborarts.net

This ambitious new organization promotes public art to bring global attention to ocean issues. Based in Boston, it recently launched the Boston Harbor Shipyard Gallery — which would explain the reports of a 40-foot floating copper cod.

WATER USE CALCULATOR
www.swfwmd.state.fl.us/conservation/thepowerof10

A shower, rinsing the breakfast dishes, watering the lawn…it all adds up. This easy-to-use site will help you calculate your household water use.

RAINWATER HARVESTING MANUAL
www.dcr.virginia.gov/documents/stmrainharv.pdf

It's written for Virginians, but it's a handy guide for New Englanders, too.

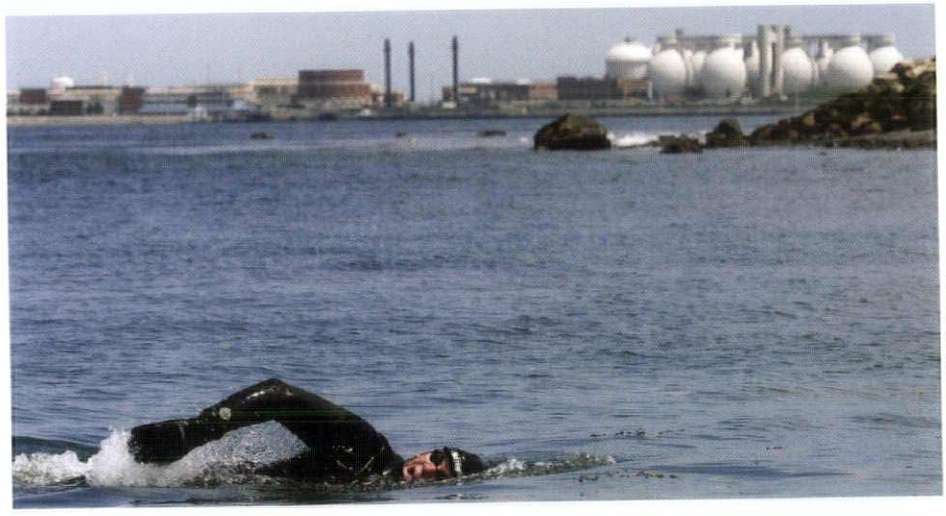
THE TSUNAMI SURVIVAL GUIDE
www.whoi.edu/home/interactive/tsunami

Tsunami waves can travel at 500 mph; on average, 10 occur annually. This site from Woods Hole Oceanographic Institution features videos, interviews, and research. It's fascinating stuff, even if you live in Worcester.

WATERFIRE
www.waterfire.org

Yes, you've seen it here before. And you may again, because we're suckers for one of the great urban experiences of all time. WaterFire celebrates its 15th anniversary this year. Have you made the trip to Providence? ■

Boston Harbor



v Photo of Christopher Swain by Leighton O'Connor.

In 2004, I swam the entire length of the Charles River. After snaking through 81 miles of discarded appliances, algae blooms, and bedroom towns, I rode the ebb tide into one of the most storied pieces of water on the East Coast: Boston Harbor.

I stroked under the Charlestown Bridge and toward Puopolo Playground in the North End. A light rain peppered the surface of the water. As I sloshed along, a cocktail of urban runoff slid from the streets into the waves around me. I tasted plastic, mud, gasoline, dog poop, and detergent. As a bonus, thousands of gallons of stormwater laced with untreated sewage belched out of Wet Weather Sewerage Discharge Outfall #203 and into the harbor, compliments of the Massachusetts Water Resources Authority.

I thrashed through a stew of pathogens to the finish. Millions of fecal coliform and enterococci bacteria, as well as assorted viruses and protozoans, vied to get into my mouth, eyes, and nose, take up residence, reproduce, and make me sick.

I climbed out of the water, gargled with hydrogen peroxide, and thought, *I'll never swim in Boston Harbor again.*

Of course, I was wrong.

Five short years later, I carved a big, wet turn around Deer Island and headed for the Boston skyline in one of the early segments of a 1,500-mile swim down the East Coast to Washington, DC. As I turned to breathe, I caught glimpses of the sludge digesters at the Deer Island Sewage Treatment Plant — a vine of fat white melons fed by the collective toilet flushes of 43 Greater Boston communities.

My mind said Boston Harbor was cleaner than it had been during my last visit. But as I threaded my way between bouquets of seaweed and trash, I knew in my heart there was still plenty of work to be done. Since my Charles River swim, I had upped the ante. In addition to photographing trash and combined sewer outfalls, I had spent my weekends arranging beach cleanups and hosting ethical electronics recycling events designed to keep toxic chemicals and heavy metals out of coastal waterways.

While I swam — on any given day I spend three to five hours in the water — my escort-boat crew tested the surface water temperature and pH of the ocean every 15 minutes to measure and map climate-change effects. At night, I stayed up too late embedding that water sampling data into publicly searchable online maps, in order to give the 50,000 students following my swim a glimpse of what was happening to their ocean planet.

Our findings, while not surprising, were not reassuring. For instance, sea surface temperatures were at or near historic highs. Good news for timid swimmers, but bad news if a hurricane arrived and gained energy from the warmer water.

When we tested the pH of Boston Harbor, we recorded values that were consistently below 8 — evidence of the ocean's absorption of man-made carbon dioxide. Before the Industrial Revolution, when man-made CO_2 was first released into our atmosphere in great quantities, the pH of the ocean was 8.179. Since then, the pH of the ocean has fallen to 8. (If it falls much further, the marine web of life as we know it will collapse.)

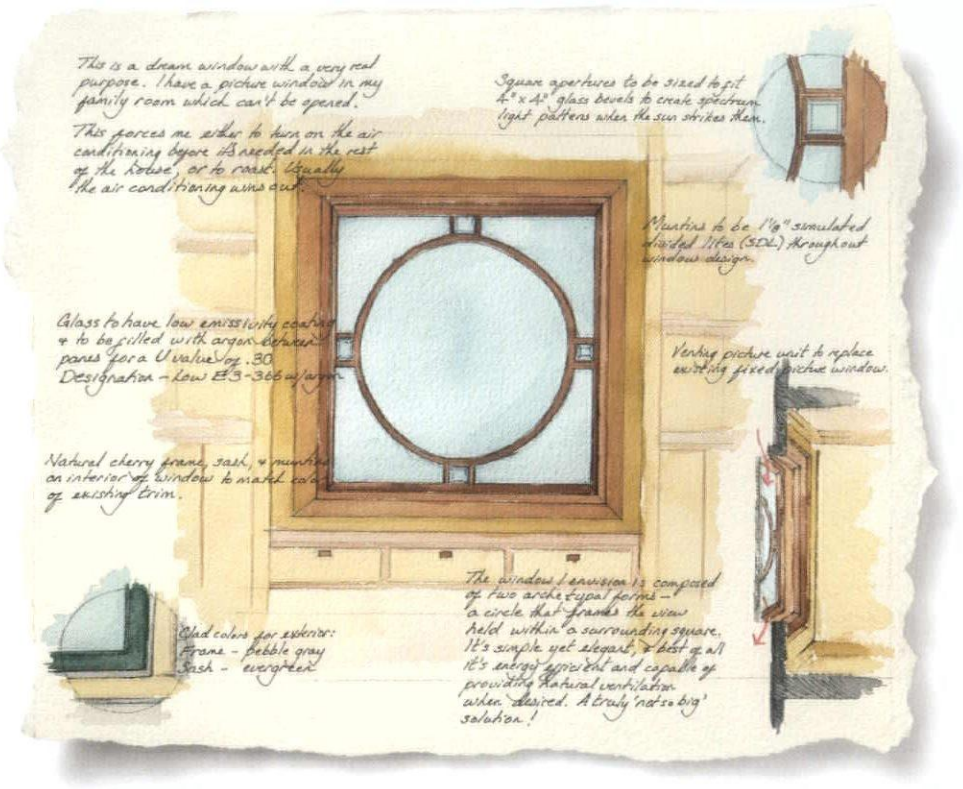
While this scientific news may be fascinating, it is not exactly inspiring. So the question remains: why am I out there, slogging through the darkening seas, dodging plastic trash and fuel slicks?

Part of the reason, of course, is that I hope to strike a spark in the minds of the 50,000 schoolchildren I will meet during my journey. And another part is that I hope our 5,000 water samples will help contribute to the body of knowledge needed to find a solution to the climate crisis.

But the real reason is a selfish one: I have two young daughters. Someday, they are going to look into my eyes and say, "Dad, you knew the ocean was a mess. What did you do about it?" ■

Christopher Swain was the first person to swim the entire lengths of the Columbia, Hudson, and Charles Rivers. He lives in Marblehead, Massachusetts. For more information about his ongoing swim from Maine to Washington, DC, visit: www.SwimForAHealthyWorld.org.

If you could design your dream window, what would it be?



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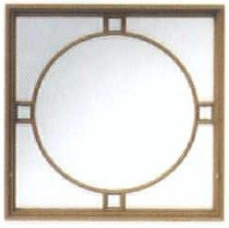

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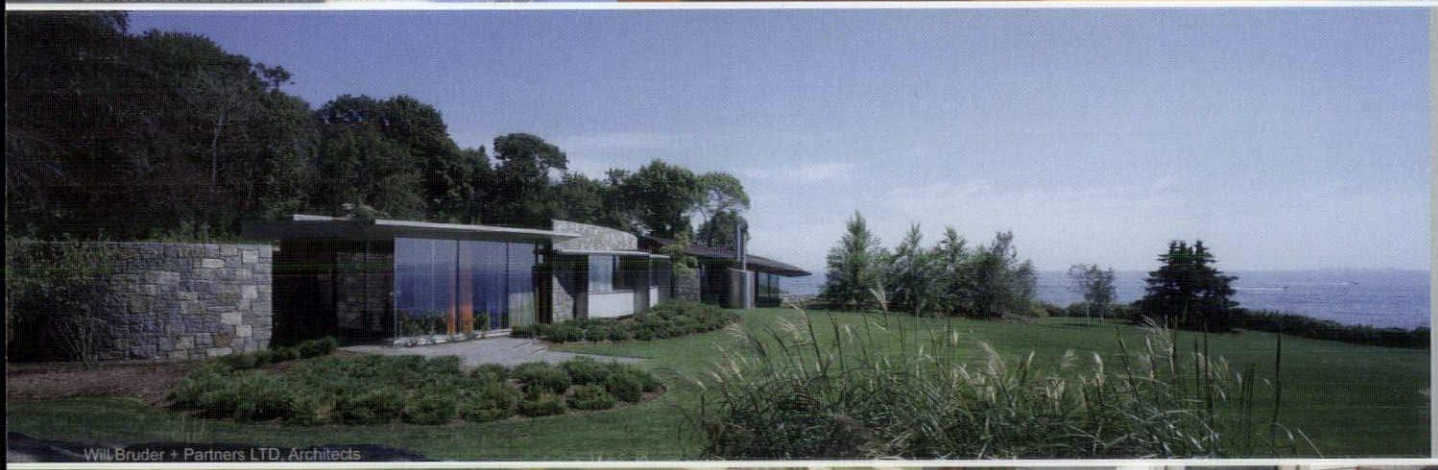
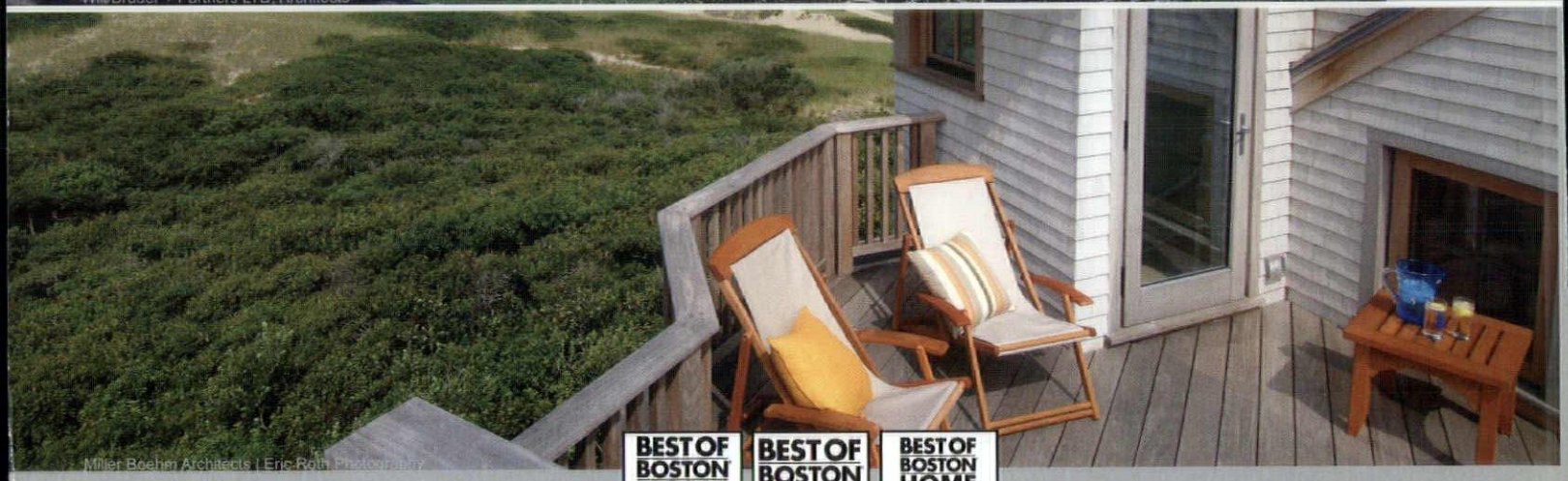


Will Bruder + Partners LTD, Architects



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