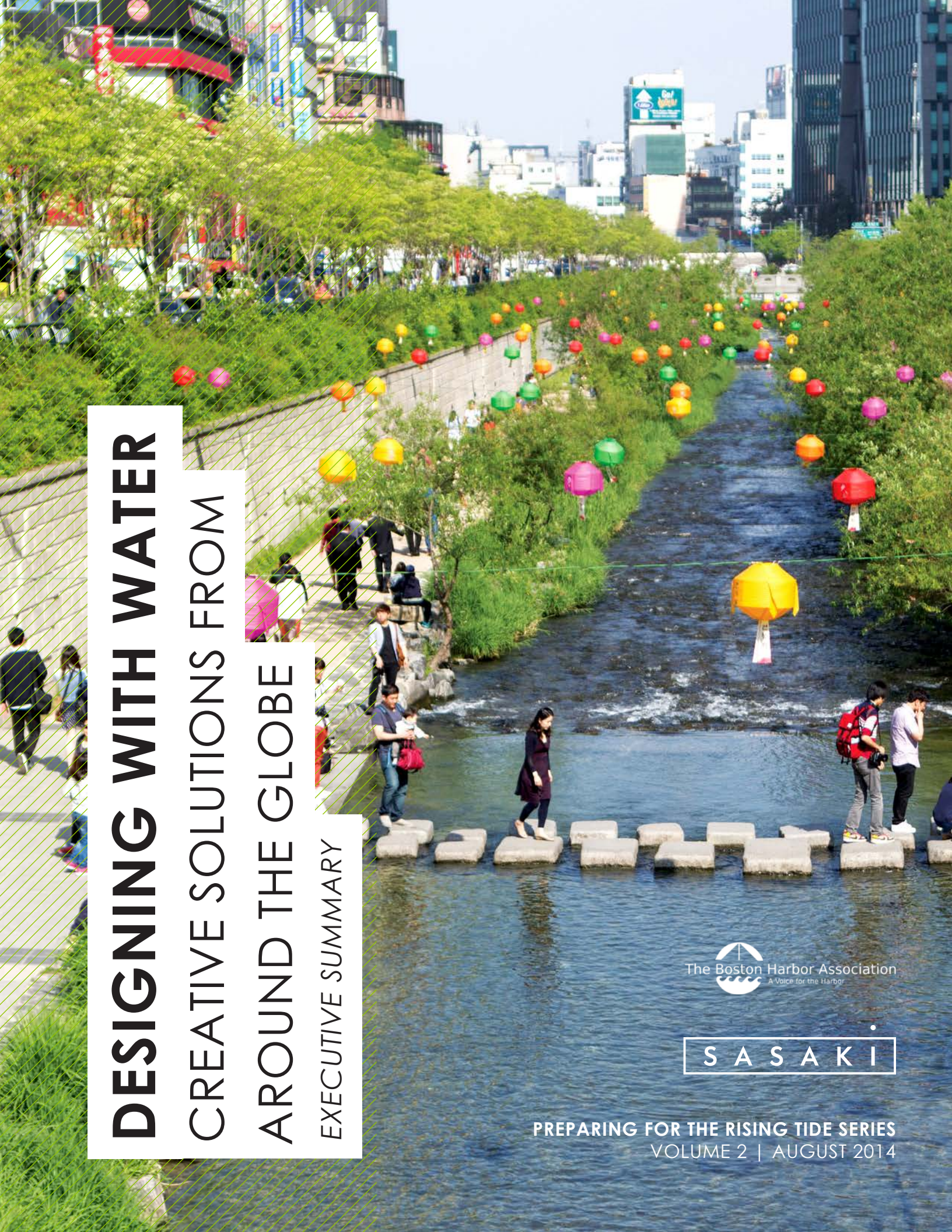

# DESIGNING WITH WATER

## CREATIVE SOLUTIONS FROM AROUND THE GLOBE

*EXECUTIVE SUMMARY*

The Boston Harbor Association
A Voice for the Harbor

SASAKI

**PREPARING FOR THE RISING TIDE SERIES**
VOLUME 2 | AUGUST 2014

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# DESIGNING WITH WATER: CREATIVE SOLUTIONS FROM AROUND THE GLOBE

*Preparing for the Rising Tide* (2013) provided an initial assessment of Boston's vulnerability to coastal flooding due to storm surges and sea level rise. This second volume in the *Preparing for the Rising Tide* series focuses on the concept of Designing with Water flood management. This concept considers coastal flooding not only a threat, but an opportunity to address multiple goals while making necessary new investments in our buildings, communities, and infrastructure.

This report provides 12 case studies describing how cities around the world are using Designing with Water strategies to decrease potential flood damage without losing the vibrancy and livability of their communities.

## BOSTON'S WET FUTURE

Over the last century, sea level in Boston Harbor has increased by approximately one foot. Low lying areas of Boston, including Long Wharf and Morrissey Boulevard, already flood multiple times each year during astronomical high tides (known locally as wicked high tides).

What's more, storms in the Northeastern US are getting significantly worse. With increases in sea levels anticipated to rise an additional 1 to 2 feet by 2050 and 3 to 6 feet by 2100, the extent of today's 100-year storm flood waters could become an annual storm around midcentury and the twice-daily high tide by 2100 .

On October 29, 2012, Superstorm Sandy slammed East Coast communities from the Mid-Atlantic through the Northeast, most severely in New York and New Jersey. What was an unprecedented flood event in New York, however, caused only minor flooding 200 miles to the north in Boston.

Superstorm Sandy's peak storm surge of 9.4 feet hit New York City during a full-moon at high tide, flooding the city with seas nearly 10 feet above average high tide. In Boston, Superstorm Sandy peaked near low tide with a 4.6-foot storm surge, causing only minor flooding. Because of this, Boston's maximum sea level during Sandy was only 2.5 feet

> *IF WE DO NOTHING, UP TO ONE-THIRD OF BOSTON COULD FLOOD BY 2100.*

above average high tide. Had Superstorm Sandy's storm surge peaked at high tide 5.5 hours earlier, Boston would have experienced a 100-year flood event.

Less widely recognized is the fact that Boston experienced three additional near-misses in the 18 months after Sandy when storms peaked hours before or after astronomical high tides, narrowly missing 100-year flood events. In addition, NOAA's Boston tide gauge recorded 15 instances of wicked high sea levels (high tide plus 2.5 feet) between January 2012 and April 2014. For comparison, these sea levels had been observed just 21 times between 1920 and 1990.

In the face of rising waters and increased storm-related flooding, we cannot ignore the need to make hard decisions about how to equitably manage flood-prone areas. If we do nothing, up to one-third of the city of Boston (by land area) could flood by 2100. Our challenge is to prepare Boston's people, buildings, and infrastructure to manage increasingly-frequent coastal flooding while maintaining and enhancing the economic and social vitality of this historic city. By taking a proactive approach, triggered by actual changes in coastal flooding, Boston's residents, businesses, and policy makers can better prevent flood damage even as sea levels increase.

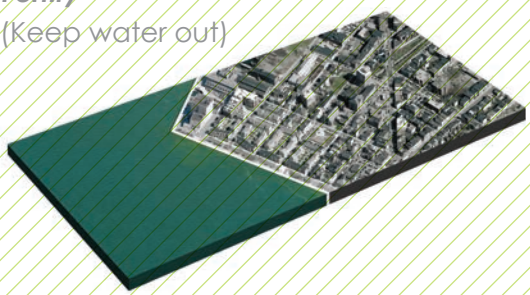
Strategies include short-term preparedness as emergency response to severe storms, and long-term flood preparedness as response to sea level rise. Long-term responses could include fortification and adaptation to repeated flooding, or managed retreat when preparedness and rebuilding costs become too high.

After devastating coastal flooding in 1953, the Netherlands invested $40 billion into a massive national flood protection system called the Delta Works. Constructed to provide flood protection while allowing the continuation of the fishing industry and protection of important estuaries, Delta Works has so far successfully prevented major flood damage. As sea level projections continued to rise, however, the Dutch determined that continuing to fortify against water was both economically and socially infeasible.

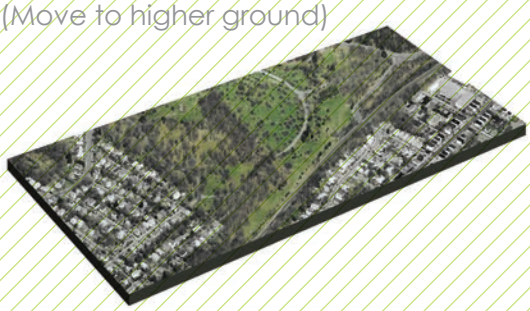
Dutch planners and designers coined the phrase "Leven met Water" — translated as "Living with Water" —

**WHAT ARE THE OPTIONS?**

***Fortify***
(Keep water out)



***Retreat***
(Move to higher ground)



***Adapt***
(Design with water)

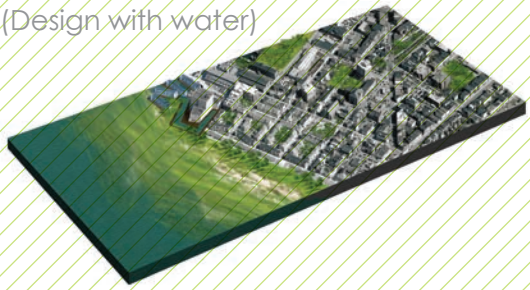


*Figure 6. Designing with Water urban design and planning options (© Sasaki Associates)*

> *TODAY, THE PARADIGM IS SHIFTING AWAY FROM KEEPING WATER OUT, TO DESIGNING TO LET WATER IN.*

to describe their shift in focus. Today they are planning and implementing flood resiliency projects that are making room for flood waters in urban settings, designing extensive floating neighborhoods, and putting nature to work by mimicking resilient natural coastal ecosystems.

## DESIGNING WITH WATER PRINCIPLES

In 2013, *Preparing for the Rising Tide* mentioned the concept of "Living with Water" in the context of Boston's flood preparations. Since then, we have compiled over 100 examples of successful flood adaptation measures from around the world. During this research process, five key Designing with Water principles emerged and informed the final selection of the 12 case studies excerpted here and presented in more detail in the full report.

DESIGN FOR RESILIENCE
Resilience implies adapting to or bouncing back from a disturbance quickly. Resilient planning and design incorporates redundancy and anticipates change over time.

CREATE DOUBLE-DUTY SOLUTIONS
Double-duty solutions provide multiple benefits to maximize economic, ecologic, and cultural gain.

STRENGTHEN COMMUNITY RESILIENCE
Community resilience maintains and enhances the cultural identity that defines a city through resiliency networks and social support systems. Strategies that strengthen social resilience can both cost less and provide meaningful benefits to participants.

INCENTIVIZE AND INSTITUTIONALIZE PREPAREDNESS
Citywide and regional adaptation plans are necessary to guide resiliency efforts. Insurance standards, zoning laws, construction codes, and policy are tools that local and state governments should consider to encourage adaptation within their communities.

PHASE PLANS OVER TIME
Designing with Water requires design and planning for flexibility and adaptability over time. Planning efforts that address sea level rise should be phased and have the ability to change based on external conditions.

# CUISINART CENTER FOR CULINARY EXCELLENCE

JOHNSON & WALES UNIVERSITY, PROVIDENCE, RHODE ISLAND

## APPLICATION TO BOSTON: FLOODABLE FIRST FLOOR

The Cuisinart Center's sacrificial first floor strategy seeks to prevent flood damage to both the building itself and its fragile, expensive equipment. Its resilient design and construction are relevant to Boston, especially to new buildings in the Seaport District and in East Boston.

Sacrificial (or less dramatically, floodable) first floors make sense, especially in areas in downtown Boston where vibrant public streetscapes are desired. Techniques include using submergible materials such as tile and concrete, prohibiting first-floor residential housing, relocating heating, electrical, and other vulnerable equipment to higher floors, and elevating electrical outlets and wiring to above anticipated flood levels.

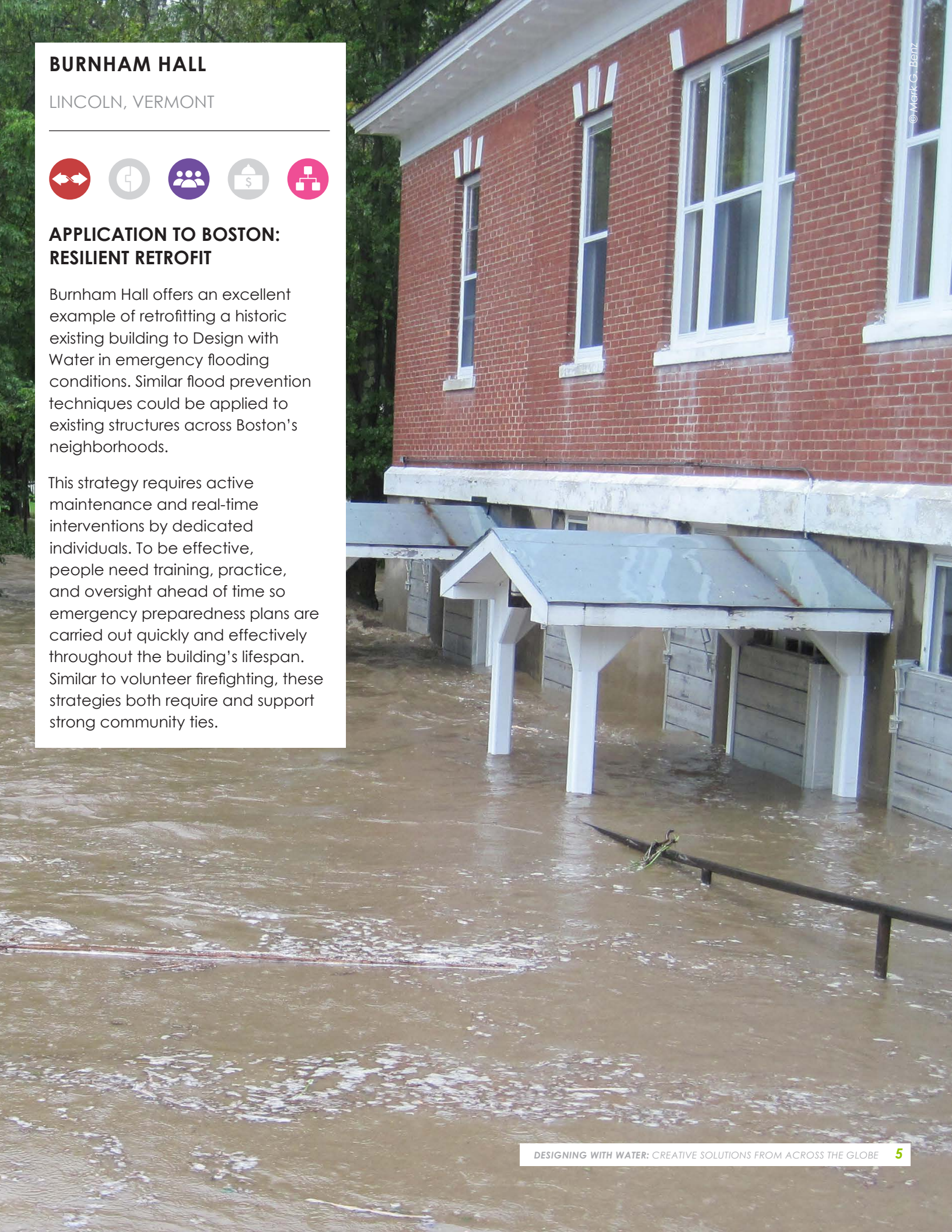
## BURNHAM HALL

LINCOLN, VERMONT

### APPLICATION TO BOSTON: RESILIENT RETROFIT

Burnham Hall offers an excellent example of retrofitting a historic existing building to Design with Water in emergency flooding conditions. Similar flood prevention techniques could be applied to existing structures across Boston's neighborhoods.

This strategy requires active maintenance and real-time interventions by dedicated individuals. To be effective, people need training, practice, and oversight ahead of time so emergency preparedness plans are carried out quickly and effectively throughout the building's lifespan. Similar to volunteer firefighting, these strategies both require and support strong community ties.

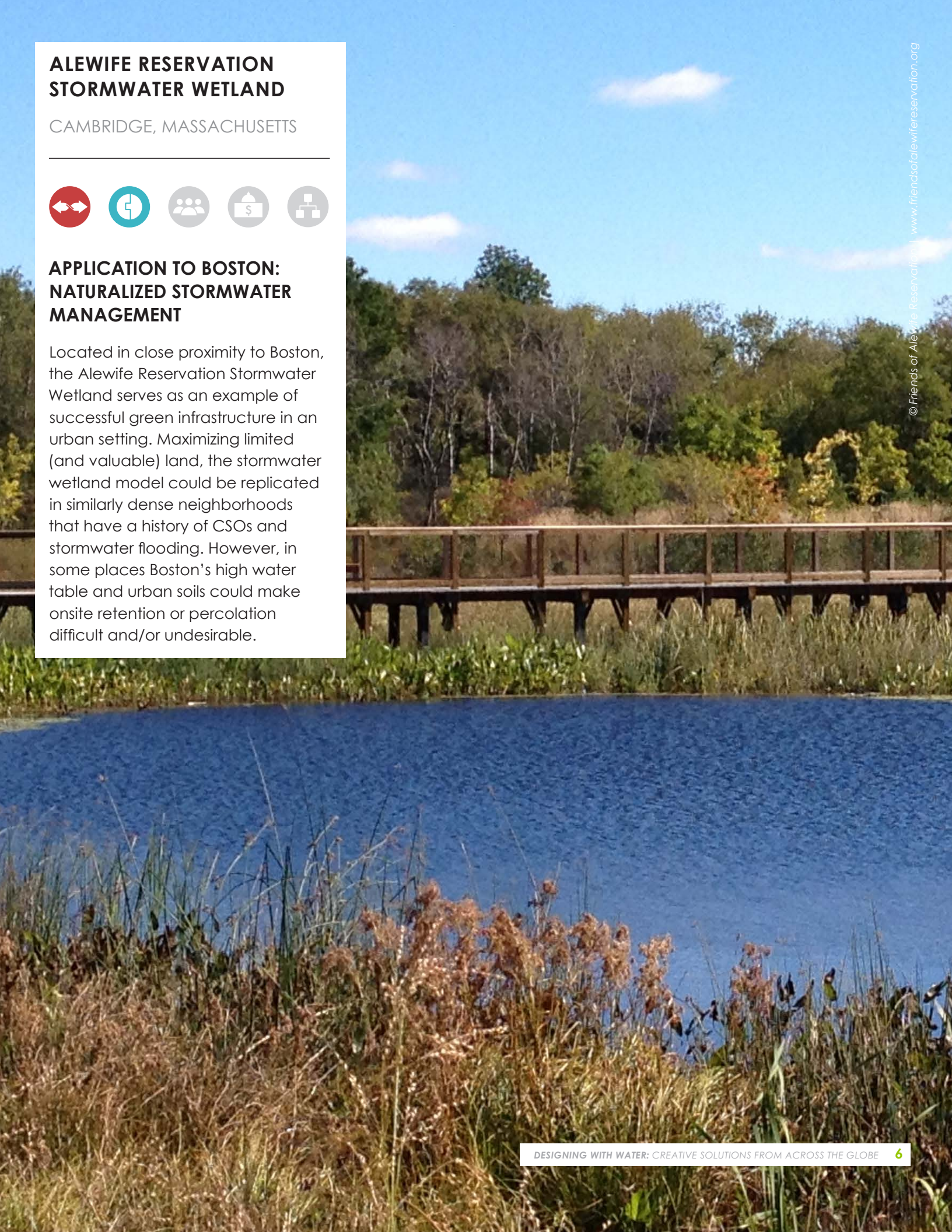


# ALEWIFE RESERVATION STORMWATER WETLAND

CAMBRIDGE, MASSACHUSETTS

## APPLICATION TO BOSTON: NATURALIZED STORMWATER MANAGEMENT

Located in close proximity to Boston, the Alewife Reservation Stormwater Wetland serves as an example of successful green infrastructure in an urban setting. Maximizing limited (and valuable) land, the stormwater wetland model could be replicated in similarly dense neighborhoods that have a history of CSOs and stormwater flooding. However, in some places Boston's high water table and urban soils could make onsite retention or percolation difficult and/or undesirable.



## THE CITADEL

NAALDWIJK, THE NETHERLANDS

### APPLICATION TO BOSTON: HIGH DENSITY FLOATING HOUSING

With Boston's sheltered harbor, floating apartments could play a role in preparing for Boston's wet future. A caveat, however, is that Massachusetts currently has strict wetland regulations that could make building beyond the current harbor edge difficult.

With waterfront development at a premium, nearly all new housing in Boston's Seaport District has been beyond the budget of many middle- and working-class residents. Floating high-density housing could be designed to better accommodate residents of varying income levels.

© Architect Koen Olthuis — Waterstudio.NL | developer: ONW/BNG GO

## VILLAGE AGENTS

GLOUCESTERSHIRE, ENGLAND

### APPLICATION TO BOSTON: CULTURAL RESILIENCE

Strengthening and supporting existing social networks can greatly enhance Boston's ability to prepare for increased flooding while improving other socioeconomic goals. Such networks connect neighbors to each other and to policy makers and service providers. They can also help engage community members in the development and implementation of flood preparedness plans and provide a conduit for emergency response information and support.

Photo property of Gloucestershire Rural Community Council

# HAFENCITY MASTER PLAN

HAMBURG, GERMANY

## APPLICATION TO BOSTON: INDUSTRIAL FLOODPLAIN REUSE

HafenCity provides an innovative example of how to accommodate chronic flooding while creating or redeveloping a new neighborhood. Boston is undergoing a post-industrial waterfront renaissance similar to Hamburg.

In neighborhoods such as East Boston, Charlestown, and the Seaport District, reuse of industrial land is occurring along the waterfront. Notably, the Seaport District offers opportunities to pair elevated structures with floodable public spaces to mitigate flood risk. The dense, transit-oriented development that defines HafenCity would also help relieve traffic congestion in Boston's rapidly expanding neighborhoods.

# CHEONGGYECHEON STREAM RESTORATION

SEOUL, SOUTH KOREA

## APPLICATION TO BOSTON: MULTI-FUNCTIONAL INFRASTRUCTURE

The Cheonggeycheon channel represents an example of infrastructure that serves multiple functions: flood control, habitat creation, economic growth, and recreational amenities.

Coastal flood control channels connected to Boston Harbor are feasible, though they would need to be constructed more like tidal marshes, with water levels rising and falling twice daily. Such channels — sited perpendicular to the harbor on pedestrian side streets — could provide many functions, including beautiful water features, cultural amenities, and below-grade areas to manage periodic storm floods.

## STRATEGIC PLAN FOR THE UNITED HOUMA NATION

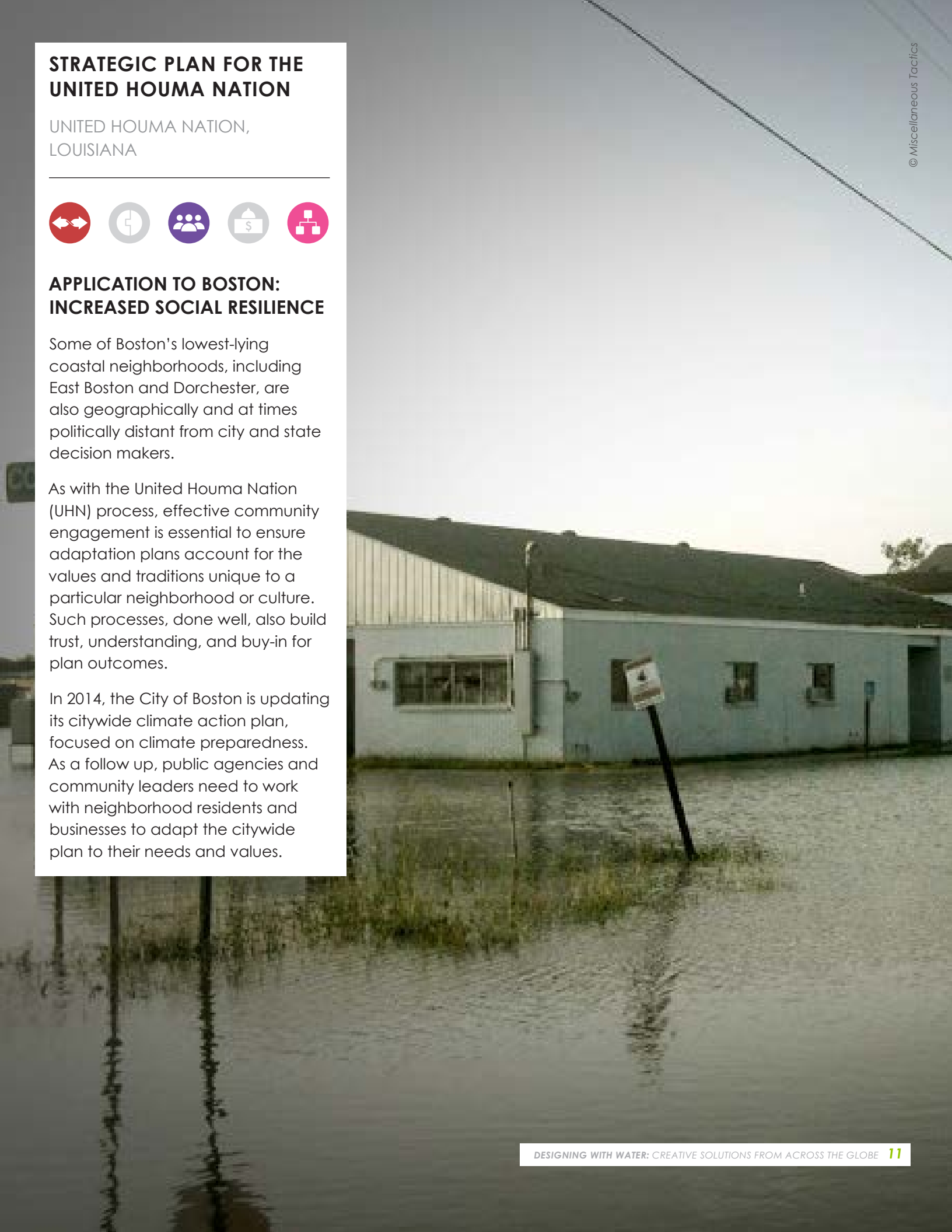
UNITED HOUMA NATION, LOUISIANA

### APPLICATION TO BOSTON: INCREASED SOCIAL RESILIENCE

Some of Boston's lowest-lying coastal neighborhoods, including East Boston and Dorchester, are also geographically and at times politically distant from city and state decision makers.

As with the United Houma Nation (UHN) process, effective community engagement is essential to ensure adaptation plans account for the values and traditions unique to a particular neighborhood or culture. Such processes, done well, also build trust, understanding, and buy-in for plan outcomes.

In 2014, the City of Boston is updating its citywide climate action plan, focused on climate preparedness. As a follow up, public agencies and community leaders need to work with neighborhood residents and businesses to adapt the citywide plan to their needs and values.



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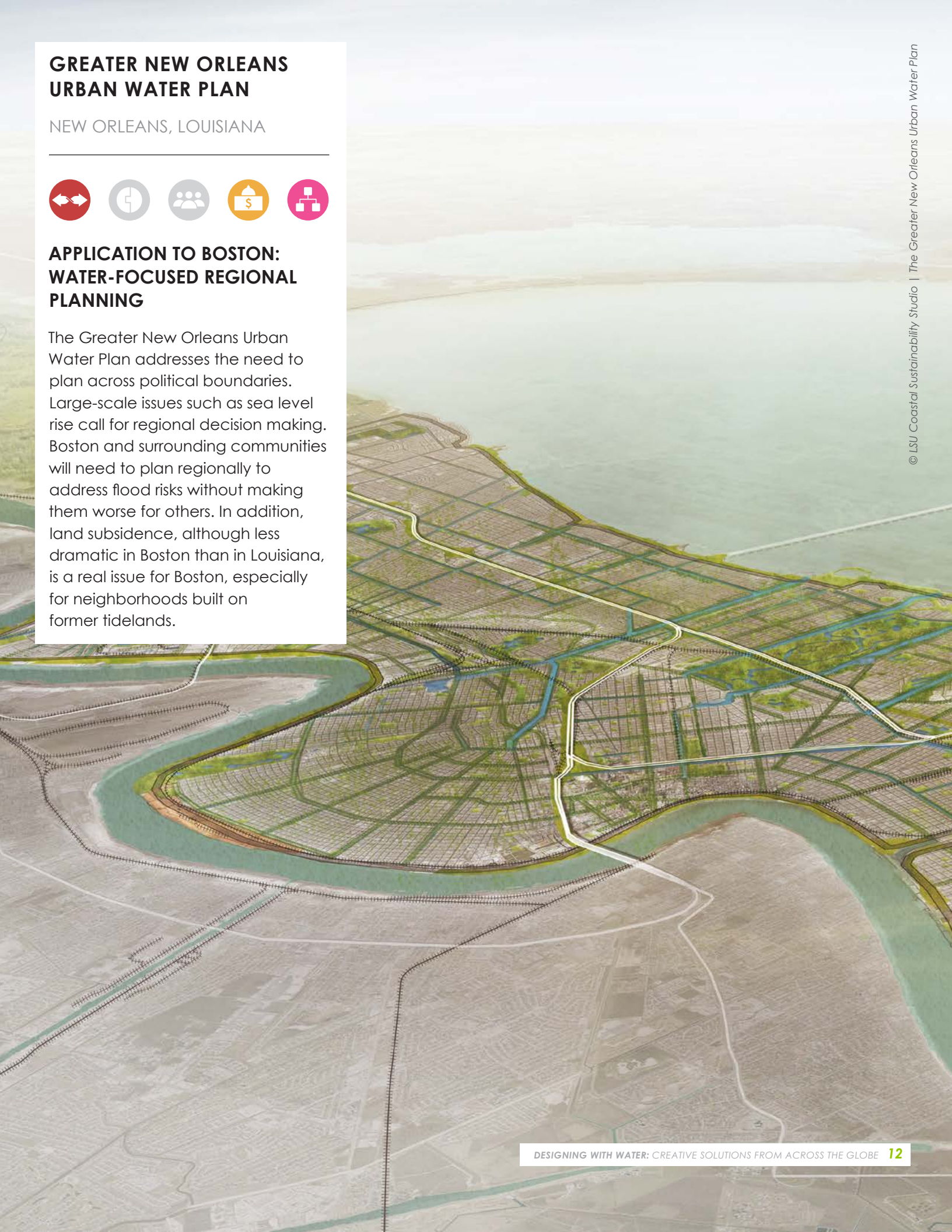
# GREATER NEW ORLEANS URBAN WATER PLAN

NEW ORLEANS, LOUISIANA

## APPLICATION TO BOSTON: WATER-FOCUSED REGIONAL PLANNING

The Greater New Orleans Urban Water Plan addresses the need to plan across political boundaries. Large-scale issues such as sea level rise call for regional decision making. Boston and surrounding communities will need to plan regionally to address flood risks without making them worse for others. In addition, land subsidence, although less dramatic in Boston than in Louisiana, is a real issue for Boston, especially for neighborhoods built on former tidelands.



## THE THAMES ESTUARY 2100 PLAN

LONDON, ENGLAND

### APPLICATION TO BOSTON: PHASED PLANNING

Large-scale issues such as coastal and inland flooding call for regional decision-making. However, the issue of climate change is often paired with unpredictable change. The TE2100 plan is an example of a regional plan that addresses this uncertainty and plans for adaptability.

MetroFuture, developed by the Metropolitan Area Planning Council (MAPC), is the regional plan for the Greater Boston area between now and 2030. While MetroFuture is robust in planning for the region's future, flooding and sea level rise are not the plan's main focus. We will need a regional organization such as MAPC to help develop sea level rise solutions that cross political boundaries. Such a regional forum can help bring together political leaders, scientists, economists, and the broader public to take on tough tradeoffs.

# ROOM FOR THE RIVER WAAL

NIJMEGEN, THE NETHERLANDS

## APPLICATION TO BOSTON: ALLOCATED SPACE FOR WATER

Room for the River Waal anticipates future flooding and provides adequate space for the flood water in an urban setting. In Boston, the Bay Back Fens historically served a similar purpose, allowing the Charles River to have space in the city. What are the possibilities of making more room for water? Could Boston make room for a Sapphire Necklace to complement our Emerald Necklace?

# CEDAR RAPIDS RIVER CORRIDOR REDEVELOPMENT

CEDAR RAPIDS, IOWA

## APPLICATION TO BOSTON: PUBLIC ENGAGEMENT

The Cedar Rapids flood recovery plan depicts an aggressive civic strategy by Sasaki Associates to invest in flood recovery at a regional scale. It included extensive community buy-in throughout the process. Structural improvements to protect the downtown paired with voluntary buyouts of destroyed properties. Other measures included improved evacuation planning, interim flood protection, flood-proofing, flood warning systems, and a larger civic initiative to address upstream Cedar River watershed issues.

As the City of Boston begins to contend with rising sea levels and chronic flooding, it will need to continue and deepen its engagement with private and non-profit sector leaders, residents, other municipalities, and state and federal agencies.

# RECOMMENDATIONS

The goal of this document is to describe a range of Designing with Water concepts and examples relevant to Boston and other coastal cities. Although coastal flooding is a new challenge for Boston, other major cities such as London, Rotterdam, and Seoul have centuries of experience upon which we can draw. We believe that ultimately Boston will need to implement multiple creative solutions to prevent costly damage.

The City of Boston is in the process of updating its Climate Action Plan to increase the city's resilience to climate change. Its plan appropriately addresses not only coastal flooding but also extreme precipitation and heat waves. Below are additional private and public sector recommendations focused only on preparing for flooding.

## PRIVATE SECTOR ACTIONS

1. Decrease structures' vulnerability to coastal flooding through new construction and retrofits (see Cuisinart Center, Burnham Hall cases).

2. Develop redundant, flexible strategies to decrease damage and recovery time from flooding (see Room for the River Waal, Greater New Orleans cases).

3. Create time-phased preparedness plans based on environmental triggers such as sea level or storm intensity to maintain or even reduce risk of flood damage over time (see Thames 2100 case). As possible, incorporate flood preparedness into capital maintenance schedules to minimize additional costs.

4. Look for opportunities to combine flood control with other business and institutional goals such as energy efficiency, sustainability, and livability (see Cuisinart Center case). Coordinate such strategies with neighboring properties to provide more effective, less costly solutions (see HafenCity case).

5. Anticipate future preparedness actions (e.g., floodable first floors) in new building construction to minimize expensive retrofits. The 2013 report *Building Resilience in Boston* is an excellent resource for such ideas (see Cuisinart Center case).

6. Develop and teach curricula focused on Designing with Water and other flood preparedness concepts. Local design schools could be a resource.

7. Lay the groundwork for effective emergency response to protect vulnerable community members (see Village Agents; Strategic Plan for the Unite Houma Nation cases). Neighborhood organizations could be a resource.

## PUBLIC SECTOR ACTIONS

1. In order to limit costly delays, dead-end investments, and exacerbated social inequalities, we strongly recommend the City of Boston and surrounding communities develop a phased master plan that protects our people and places over time as the tide rises (see Hafencity, Thames 2100 cases).

2. Integrate the citywide master plan with other city plans (e.g., plans associated with economies, housing, neighborhood development, public health) to identify and pursue co-benefits as much as possible (see Cedar Rapids case).

3. Secure significant new public and private investment to implement the master plan and accelerate private actions. Identify an appropriate coordinating body to manage these resources most effectively to address multiple goals (see Cedar Rapids, Thames 2100, Room for the River Waal cases).

4. Work with surrounding municipalities — especially those closely connected through transportation, power, water, and sewage — to develop the political will, regional planning, and resources needed to prepare for chronic coastal flooding (see Greater New Orleans case).

5. Work with stakeholders to align building codes, zoning regulations, insurance premiums, and other market-based incentives to align flood preparedness activities with profitability.

6. Continue to provide the data, technical support, leadership, and policy guidance needed to help public and private property owners decrease their risk of flood damage and recover quickly in case preparations are insufficient (see Cedar Rapids case).