



**New Meadowlands**  
Meadowlands, NJ



**Hunts Point Lifelines**  
South Bronx, NYC



**Resist, Delay, Store, Discharge**  
Hoboken, NJ



**The BIG U**  
Lower East Side, NYC



**Living with the Bay**  
Nassau County, NY



**Living Breakwaters**  
Staten Island, NYC

# Rebuilding with Resilience

## Lessons from the Rebuild by Design Competition After Hurricane Sandy

REBUILD  
BY  
DESIGN



GEORGETOWN CLIMATE CENTER  
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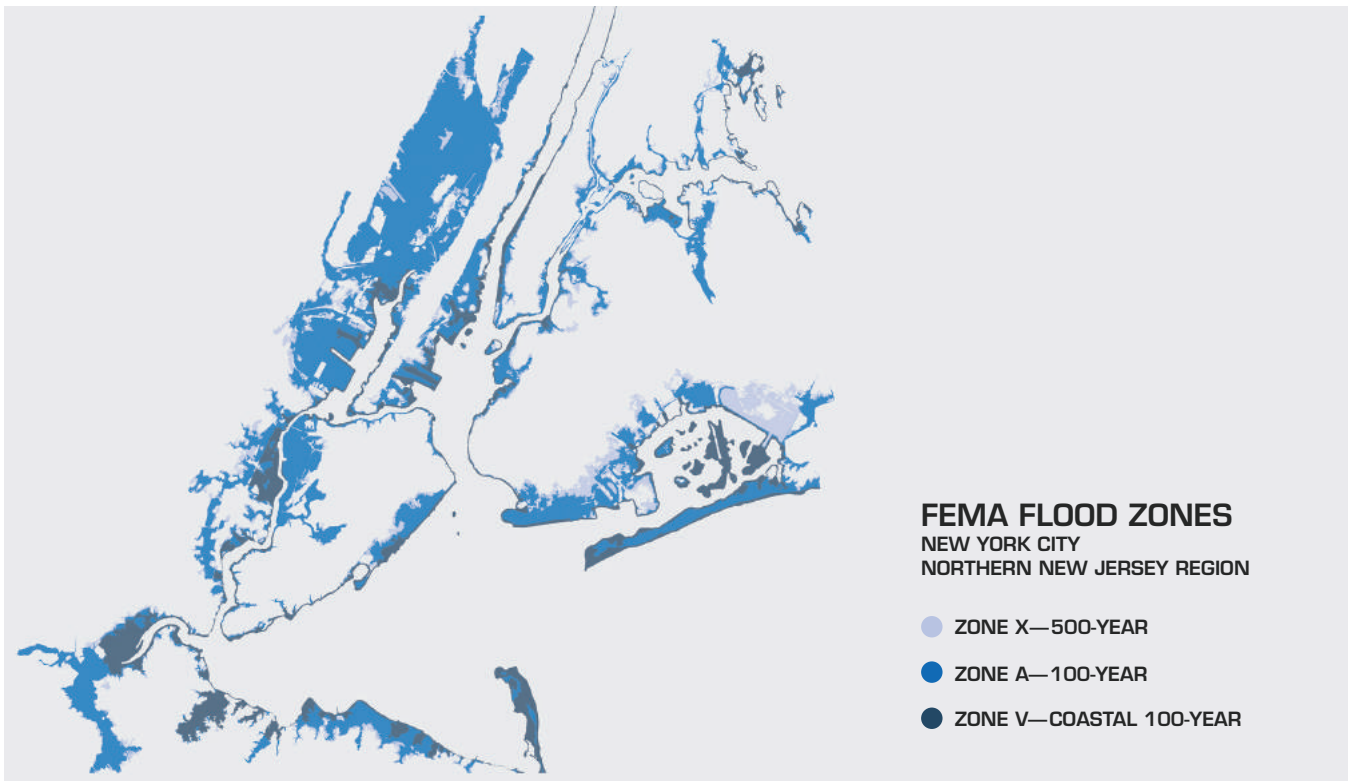
# Summary of Lessons Learned

## INTRODUCTION

In the aftermath of Superstorm Sandy, the Obama administration, in partnership with The Rockefeller Foundation, launched the innovative Rebuild by Design (RBD) competition, which sought to inspire affected communities to rebuild differently in ways that would enhance their physical, economic, social, and environmental resilience. This report aims to capture and share lessons learned from the innovative process for developing the RBD proposals and the novel projects that were generated through this competition.

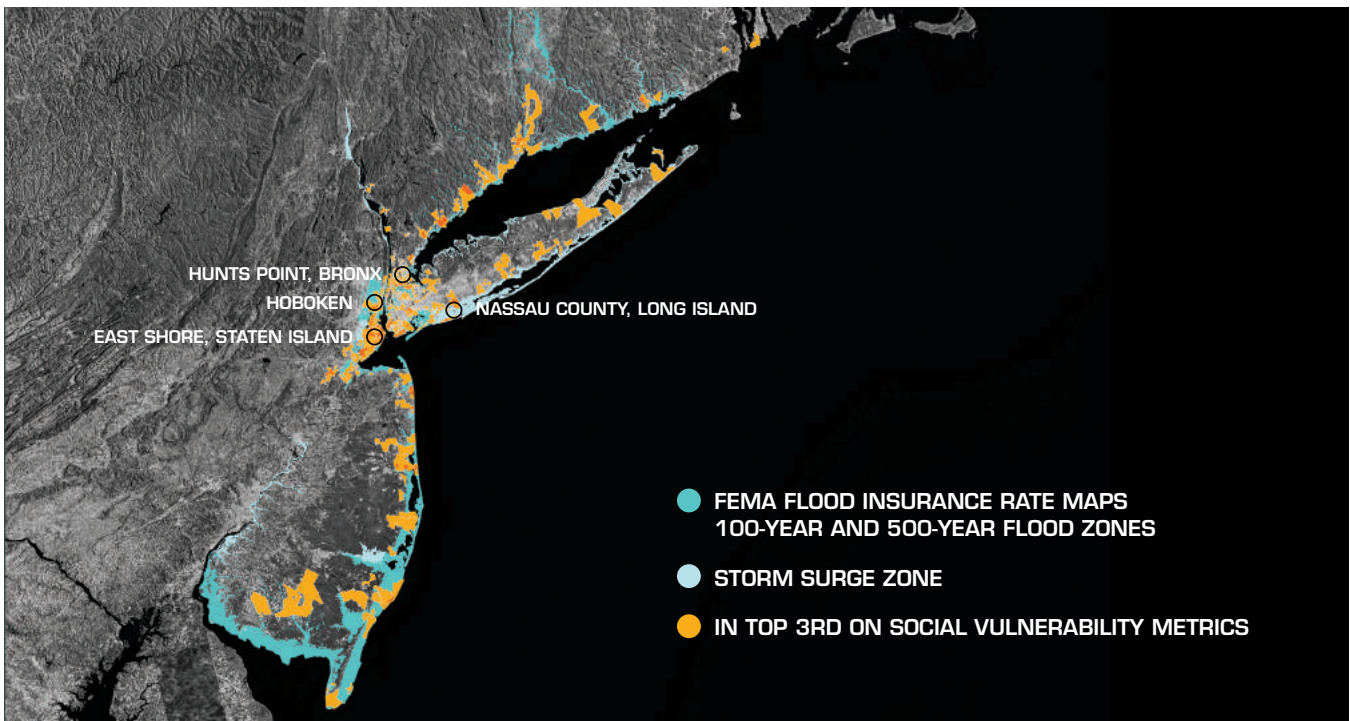
Superstorm Sandy exposed the region's vulnerability to extreme weather: Sandy's 14-foot storm surge overtopped sea walls; city blocks were inundated with 2 to 3 feet of flood water; damaging waves destroyed whole towns along the New Jersey shore; and the storm knocked out power and wastewater treatment facilities across the region.<sup>1</sup> Sandy also provided a glimpse of the impacts the region can expect with additional climate change. Sea levels in this region already have risen 1 foot over the last century (which contributed to the storm's devastation), and are expected to rise by 4 feet or more by the end of this century. The National Climate Assessment estimates that a 2-foot rise in sea levels would triple the frequency of coastal flooding in the Northeast.<sup>2</sup> In addition, the region is anticipated to experience an increase in rainfall and heavy downpour events, causing more interior flooding, combined sewer overflows, and attendant water pollution. These forces will combine to greatly increase flood risks across the Sandy-affected region and along the North Atlantic coast.

Sandy also exposed the role that chronic societal stressors—such as poverty, lack of mobility, and lack of social cohesion—can play in both increasing community vulnerability and hindering a region's ability to recover from a disaster. Sandy's flooding and power outages trapped people in high-rise apartment buildings and public housing; hospitals had to be evacuated; people were unable to travel to work; small businesses were forced to permanently close; and the region lost already scarce affordable housing. Existing social and economic stressors made it much more difficult for frontline communities to bounce back after the storm.



**Flood Risk in the New York and New Jersey Region**

Using FEMA floodplain maps the MIT CAU + ZUS + URBANISTEN team analyzed flood risk in the New York and New Jersey metropolitan region showing that 2.5 million people are at risk of flooding during the 100-year flood event. This map shows parts of the region that are vulnerable to the 100- and 500-year flood events based upon historical data.



**Social Vulnerability to Flooding**

This map overlays flood and storm surge risk for the region with six indicators of social vulnerability developed by HUD: poverty rate, population under 10 years of age, population over 65 years of age, English language proficiency, immigrant population percentage, and rate of disability.



Recognizing the need and the opportunity to build the region back stronger, HUD sought to use the Rebuild by Design competition to not only inspire innovative approaches for rebuilding after Sandy, but also to transform how federal agencies fund disaster recovery. Federal disaster recovery programs were originally designed to help communities rebuild what had been in place before a disaster. As a result, these programs have historically limited the rebuilding of damaged infrastructure and facilities to their *pre-disaster* designs and footprints.<sup>3</sup> The President’s Hurricane Sandy Rebuilding Task Force (Sandy Task Force), acknowledging the deficiencies of these historical practices, developed the Rebuild by Design competition to inspire a new form of resilient disaster recovery—one where communities were encouraged to build back better and more resilient to future impacts. The competition was designed to stimulate innovation in how federal agencies coordinate disaster recovery efforts horizontally across federal agencies and vertically with state and local partners, both in the administration of disaster recovery funds and in how projects are approved and permitted.

## THE REBUILD BY DESIGN COMPETITION

In June 2013, the RBD competition was launched through a partnership between the Sandy Task Force, the U.S. Department of Housing and Urban Development (HUD), and the Rockefeller Foundation, among others.<sup>4</sup> The RBD competition was a ground-breaking approach designed to spur innovation in the disaster recovery process and to catalyze cutting-edge projects that could demonstrate how communities can rebuild with resilience. In the first stage, 148 interdisciplinary teams (including experts in planning, design, engineering, sociology, hydrology, finance, etc.) applied to participate in the competition. Ten design teams were selected as finalists to develop resilience approaches for reducing the physical and social vulnerabilities of communities that were affected by Superstorm Sandy.<sup>5</sup>

In subsequent stages of the competition, the design teams worked in collaboration with local governments, community organizations, and the public to understand each region’s vulnerabilities and to develop proposals for how communities in the region could rebuild with increased resilience. The design teams were required to develop innovative approaches that were both locally appropriate and also regionally scalable. The design teams were also required to address financial and legal feasibility. Proposals had to scope the projects into severable components where the disaster recovery funds could be used to implement one component of the project, with pathways for permitting and funding future phases of work.

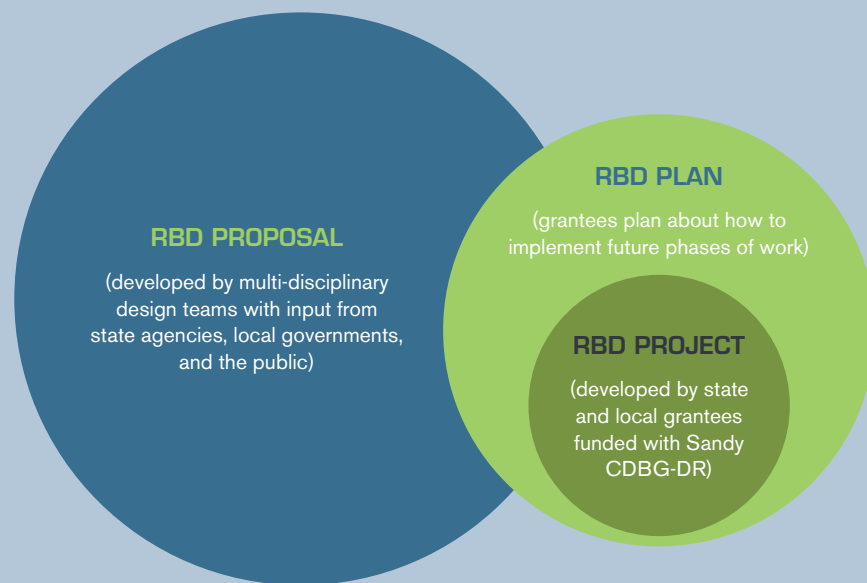
From the ten competing teams, a competition jury selected six winning proposals for implementation. HUD awarded \$920 million in Community Development Block Grant—Disaster Recovery (CDBG-DR) funding<sup>6</sup> to New York, New Jersey, and New York City to help implement specific projects identified in the RBD proposals:<sup>7</sup>

- **The BIG U**—\$335 million was allocated to build a mix of structural and nature-based flood defenses and recreational amenities in the Lower East Side of Manhattan in New York City, where large blocks of affordable and public housing were affected by the storm. The BIG U proposal called for the integration of nature-based flood defenses into city parks and structural flood defenses (e.g., deployable flood walls) in areas where site constraints limit the feasibility of larger permanent structures. It also called for recreational amenities (like greenways, bike paths, and nature trails) that would enhance these public spaces and improve access to, and connectivity along, the waterfront.

- **Living Breakwaters**—\$60 million was allocated to implement a living breakwater project along the South Shore of Staten Island in Tottenville, New York. The proposal called for natural and nature-based flood protection—including oyster-seeded breakwaters and living shorelines—which together would reduce risks for communities along the southern tip of Staten Island and improve habitats and the environment. The proposal also called for amenities to improve the social resilience of the region by creating “hubs” that could provide recreational, educational, and emergency response functions.
- **Living with the Bay**—\$125 million was allocated to implement stream restoration and green infrastructure improvements along the Mill River in Nassau County on Long Island, New York. The proposal called for a “buffered bay” approach to protect against the region’s multiple water-based threats: sea-level rise, excessive stormwater and wastewater spills, and storm surges. The proposal recommended different interventions for different parts of the watershed to protect against storm surge and coastal erosion at the oceanfront and in the bay, and to better manage stormwater and interior flooding in upland parts of the river system that drain into the bay.
- **Resist, Delay, Store, Discharge**—\$230 million was allocated to implement flood risk reduction measures in Hoboken, New Jersey. The proposal called for construction of a comprehensive water management strategy for reducing the city’s flood risk, including: engineered and landscape-based coastal defenses (or *resist* strategies) to reduce storm-surge flooding, and green and gray infrastructure approaches (*delay, store, and discharge* strategies) to manage stormwater runoff and excess rainwater during heavy rainfall events. When combined, the four lines of defense would reduce flood risks for residential and commercial development as well as for critical assets, such as wastewater and transportation infrastructure.
- **New Meadowlands**—\$150 million was allocated to implement flood risk reduction measures in the towns of Little Ferry, Moonachie, Carlstadt, Teterboro, and a portion of South Hackensack in the Meadowlands region in New Jersey. To rebuild and protect the region from storm surges, the New Meadowlands proposal called for an integrated and linked system of berms (the “Meadowband”) with restored wetlands (the “Meadowpark”) to provide flood protection across the Meadowlands region.
- **Hunts Point Lifelines**—\$20 million<sup>8</sup> was allocated to assist with continued study, analysis, planning, community engagement, design, and engineering for a pilot project considered in the RBD proposal in the Hunts Point region of the South Bronx in New York City, New York. The proposal called for four integrated components, called “Lifelines,” to build the physical, economic, and social resilience of the Hunts Point peninsula. The proposed components included green and gray flood protection; measures to protect critical economic assets in the region (like the food distribution center); and transportation improvements to increase safety, connectivity, and environmental quality.

While the proposals were developed by the multidisciplinary competition design teams, the funding to implement the projects was allocated by HUD to state and local “grantees” (the State of New York, the State of New Jersey, and New York City). It is these grantees who must now turn the innovative *conceptual designs* (the “RBD proposals”) into *capital projects* (the “RBD Projects”) that can be built with the allocated funding.<sup>9</sup>

**FIGURE 1: Relationship of the RBD Proposal to the RBD Projects**



This graphic is intended to visualize the relationship of the winning proposal to the actual project that will be implemented with HUD funding:

- The RBD project will be smaller in scope and have a more limited budget than the series of projects identified by the design teams in the RBD proposals.
- The RBD project may also be somewhat different than the projects that were proposed, due to physical, legal, technical, or other constraints.
- As a condition of the funding, the grantee must also develop an RBD implementation plan for how they will implement and finance future phases of work as described in the RBD proposal.

## RESILIENCE VALUE

One important innovation that was stimulated by the competition was the “resilience values” that the proposals aim to deliver for these communities. Unlike traditional disaster recovery projects, the proposed RBD projects were not intended to merely reduce risks from extreme “shock” events, like Sandy, but to also provide *everyday* environmental, social, and economic benefits for residents. To this end, the design teams looked across government services and systems to develop more holistic disaster recovery projects that reduced risks while also alleviating long-term stressors (e.g., crime, pollution, poverty, lack of open space). In addition to reducing risk from flooding and climate change, the proposals sought to deliver multiple resilience benefits, including improved air and water quality, increased social cohesion, new job opportunities, increased access to waterfronts and recreational amenities, among other benefits.

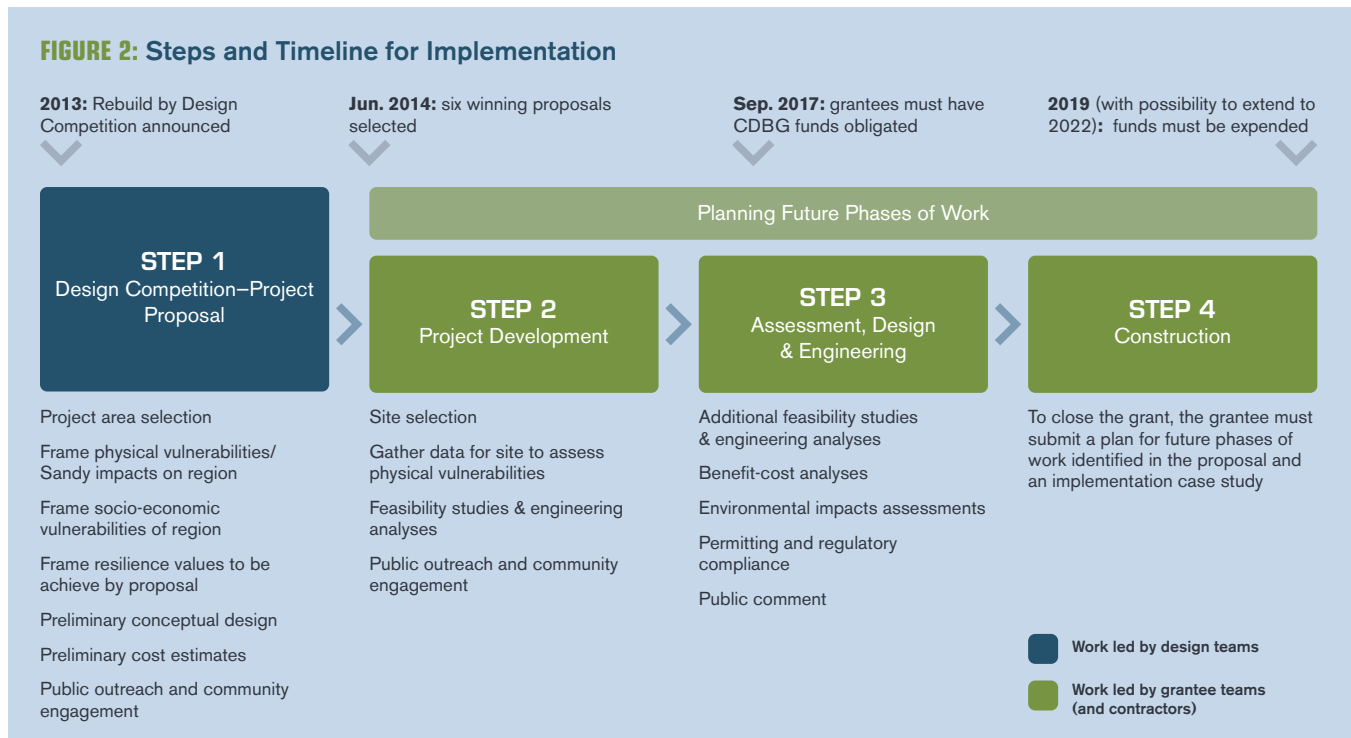
However, as these proposals move into implementation, the grantees are having to work hard to ensure that the resilience values of the project are not lost in translation. Everyday systems and government processes (like cost benefit analysis, permitting, and procurement) are not well equipped to deliver projects that provide multiple benefits across a number of government silos. As a result, implementation of these innovative RBD projects is requiring unprecedented coordination among agencies at all levels of government to ensure that these projects can truly deliver the resilience benefits promised by the proposals.

## TRANSITIONING TO IMPLEMENTATION

The structure of the competition and the source of the funding to implement the projects also created two big challenges for the grantees:

- **Funding Gap**—The proposals resulted from a 9-month design competition where the design teams were encouraged to be visionary and “think big” without constraints on the level of ambition. Invariably the funding allocated by HUD to the grantees to implement a specific project was a fraction of the total budget called for in the proposal. As a result, the grantees must make difficult choices about how to scale and scope the ideas envisioned by the proposal into a project that can be feasibly implemented while still delivering the resilience values envisioned by the proposal. The grantees and other beneficiaries are also having to consider longer-term strategies for raising funds to support future phases of work.
- **Tight timelines**—The grantees are under tight timelines to construct the projects and spend their Sandy CDBG-DR funding. The Supplemental Appropriation Act allocating the funds included language requiring that the funds be obligated by no later than September 30, 2017 and expended by 2019, with the possibility of an extension through 2022<sup>10</sup>. To obligate the funds, the grantees must have a project design that is sufficiently detailed for HUD to complete an environmental assessment pursuant to the National Environmental Policy Act (NEPA)<sup>11</sup> and sign the grantees’ CDBG-DR grant agreement.

In making the transition to implementation, the grantees are facing other project- and site-specific legal, political, and policy challenges. Each grantee is developing inventive approaches for overcoming these challenges (described below), which can be instructive to other state and local decisionmakers who want to implement similar projects in the future.<sup>12</sup> The proposals and the competition process can also be instructive to other federal agencies that support state and local resilience initiatives.



This graphic visualizes the steps and timelines for implementing different Phases of the RBD work – from the RBD proposal phase through the design and construction of an RBD project. Note that in some instances the team that developed the RBD proposal has been hired by the grantee to lead implementation of the project.

## PURPOSE & ROADMAP

2016 is the two-year anniversary of the announcement of the winning RBD proposals. It marks an opportunity to take stock of the challenges that the grantees are encountering as they work to implement these ambitious and visionary projects, and to examine the lessons they are learning along the way. The success of these projects will depend on a number of factors:

- **The ability of grantees** to move these projects from concept to implementation, to deliver the range of resilience values described in the RBD proposals, and to develop a longer-term vision for achieving the broader goals of the RBD proposals; and
- **The ability of federal, state, and local decisionmakers** to learn from these projects and to institute broader legal and policy reforms so that these practices can be replicated and scaled throughout these communities and regions, and in other places.

To that end, this report is designed to help others learn from the obstacles and opportunities exposed by implementation of the RBD projects, including:

- **Needed legal and policy reforms**—This report documents how the grantees are navigating and overcoming legal and policy barriers. The hope is that local, state, and federal decisionmakers can use the lessons the grantees are learning to make reforms to laws, policies, and regulations, where needed, so that these types of innovative projects will have easier pathways forward in the future.
- **Opportunities to institutionalize, scale up, and replicate**—To have the broad effect envisioned by the competition, decisionmakers at all levels of government will need to determine how to institutionalize, scale up, and replicate the innovative practices developed through the RBD competition and identified in the RBD proposals. Additionally, to achieve the more holistic resilience visions laid out in the proposals, each of the grantees will need to find other ways to fund and implement future phases of work. The state and community beneficiaries can scale up implementation with other sources of funding and through other regulatory pathways.<sup>13</sup> State and federal policymakers will also need to figure out how to learn from these RBD projects so that the practices can be encouraged and replicated in other cities, regions, and states. For example, the competition can inform how federal agencies administer disaster recovery programs and other funding sources, and these projects can help regulators at all levels of government improve and streamline permitting of resilience projects.

This report first describes the common resilience interventions that were proposed in each of the winning proposals (e.g., nature-based coastal defenses, green infrastructure, and land-use approaches) and the shared challenges and lessons learned for each of these interventions. It then provides a summary of the legal and policy challenges that the grantees are facing as they work to implement their RBD projects and describes how the grantees are working to overcome those challenges.

After this summary chapter, the report includes individual case studies of each of the winning RBD proposals to describe how each of the grantees are transitioning to develop specific capital-improvement projects that can be implemented with the CDBG-DR funding. These case studies include discussion of the legal and policy challenges particular to each project and the pathways the grantees are exploring for overcoming challenges and scoping future phases of work. The lessons included in this summary are derived from these case studies.<sup>14</sup>

## RESILIENCE INTERVENTIONS

The RBD proposals included many similar approaches for increasing the physical resilience of communities and addressing the water-based threats common to communities in the New York and New Jersey region. This section describes these approaches (or “resilience interventions”), which include natural and structural flood defenses, green infrastructure approaches for managing stormwater, and land-use (or “nonstructural”) strategies for ensuring that public and private development is designed and sited to be more resilient to flooding. This section discusses the common legal and policy challenges that the grantees are facing as they work to implement these resilience interventions, and describes opportunities for scaling and replicating these approaches throughout the project areas, and more broadly across these cities, the region, and beyond.

### FLOOD DEFENSES<sup>15</sup>

Most of the damage from Sandy resulted from storm surge; consequently, all of the RBD proposals focused, in one way or another, on interventions to reduce impacts from extreme storms. Sandy brought 12- to 14-foot storm surges, which overtopped flood defenses, battered beaches and wetlands, and inundated communities up and down the coast with several feet of floodwaters. This region is also anticipated to see 4 feet or more of additional sea-level rise over the next century, which will increase flood risks.<sup>16</sup>

As a result, all of the winning proposals developed innovative ideas for building “berms with benefits” — flood control structures that can provide other important everyday environmental, social, and economic benefits:

- **The BIG U proposal** called for integrating flood protection into a city park and using deployable flood walls underneath raised highways where space is constrained;
- **The Living Breakwaters proposal** called for the construction of breakwaters that would double as oyster reefs to dampen storm surge, enhance marine habitats, and reduce or reverse erosion of beaches; and
- **The Living with the Bay proposal** called for living shorelines, restored marshlands, and constructed barrier islands to provide natural defenses to storm surge.

The RBD proposals also often called for combining “gray” structural flood protection devices (such as berms or breakwaters) with “green” natural and nature-based approaches (such as restoring wetlands) to reduce impacts from storm surges. “Green” or “natural” defenses refer to approaches that restore, mimic, and enhance natural coastal features to reduce coastal flooding and erosion risk, including beach nourishment, dune management, living shorelines,<sup>17</sup> and wetland restoration. Natural defenses are a more ecologically beneficial way of addressing coastal flood risk compared to traditional “gray” or “structural measures,”<sup>18</sup> which rely on engineered structures designed to decrease shoreline erosion, dampen wave action, and protect against flooding. Structural measures include levees, storm surge barriers, sea walls, revetments, groins, and breakwaters.

**FIGURE 3: Structural or "Gray" Coastal Defenses**



#### Levees

Levees are man-made structures, often earthen embankments, designed to control or divert floodwaters to reduce flood risks.



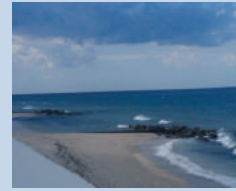
#### Storm Surge Barriers

Storm surge barriers are often included within a levee system and include movable gates that stay open during normal conditions to allow natural water flow, but that can be closed to protect against storm surges.



#### Seawalls & Revetments

Seawalls are onshore structures built parallel to the shoreline with the purpose of preventing flooding. Revetments are onshore structures designed for the purpose of reducing erosion.



#### Groins

Groins are structures built perpendicular to the shoreline for the purpose of stabilizing the shoreline, reducing erosion, and capturing sediment.



#### Breakwaters

Breakwaters are offshore structures built parallel to the shoreline with the purpose of reducing wave energy to reduce shoreline erosion.

**FIGURE 4: Nature-based or "Green" Coastal Defenses**



#### Dunes & Beaches

Beaches can be nourished, dunes can be built, and sediment can be managed to create beach systems that dissipate wave energy.



#### Restoration

Restoration of coastal wetlands and ecosystems can provide important flood risk reduction benefits. Wetlands vegetation slows storm surges and improves water quality. Living shorelines combine natural coastal features and structural components (such as low rock sills).



#### Reefs

Oyster and coral reefs attenuate wave action and can reduce shoreline erosion. Oyster reefs can be restored to provide offshore living breakwaters.



#### Barrier Islands

Barrier islands provide a first line of defense against storm surge. Management of barrier islands can preserve the important flood risk reduction benefits provided by barrier island systems.

Hybrid “green-gray” approaches to flood protection, however, can be complicated and time consuming to design, permit, and build. Natural-defense projects can trigger onerous permitting involving federal, state, and local regulators.<sup>19</sup> These projects can encounter state and federal regulatory barriers because they often involve “in-water” components (such as low rock sills or the placement of fill), which can affect navigability, sensitive aquatic habitats, water quality, and wetlands. For example, in New York, the placement of fill in a tidal wetland is considered a “presumptively incompatible use” under state law. To receive a permit, the grantees will need to show that the project will protect, preserve, and enhance tidal wetlands.<sup>20</sup> To implement the natural-defense

components of the RBD proposals, many of the grantees will need to navigate complicated and time-consuming federal and state permitting requirements. But regulators can learn from implementation of these projects to reform regulatory programs to ensure more streamlined permitting for natural-defense projects in the future.

In addition to the legal obstacles, both green and gray approaches raise interesting policy challenges. While green approaches are more environmentally friendly and can provide valuable natural amenities for residents, the level of storm-surge protection provided by green approaches alone may in some cases be insufficient for certain types of critical infrastructure (e.g., wastewater treatment facilities), and the environmental benefits they provide can be difficult to quantify with existing data and tools.<sup>21</sup> In contrast, while gray approaches are thought to provide a more certain level of protection, they can have environmental impacts on habitats and ecosystems, are not visually appealing, can obstruct views and access to the waterfront, and are costly to build and maintain. The grantees are balancing both the legal and policy trade-offs as they seek to design, permit, and get public support for different approaches for building coastal flood defenses. Once constructed, the RBD projects will provide important data on the performance of these approaches.

Other challenges that the grantees are navigating to implement innovative flood-defense projects are described in the legal challenges section below and in the individual case studies.

## GREEN INFRASTRUCTURE<sup>22</sup>

In addition to the challenge of reducing impacts from sea-level rise and coastal storms, local governments in the Sandy-affected region face serious challenges managing urban stormwater (surface water runoff resulting from rainfall or snowmelt). Climate change will cause more intense storms and heavy downpours. These changing precipitation patterns—when combined with aging infrastructure, watershed deforestation, and increasing amounts of impervious surfaces such as roadways and parking lots—will exacerbate urban flooding and the pollution of waterways.

In response to these challenges, cities across the country are beginning to innovate with a wide array of new “green infrastructure” approaches that reintegrate natural elements into traditionally impervious urban environments to retain and treat stormwater where it falls. Green infrastructure approaches utilize nature-based strategies instead of the century-old practice of relying exclusively on centralized “pipes and pumps” to capture and channel rainwater away as quickly as possible. These approaches also provide an attractive alternative to traditional concrete (or “gray”) infrastructure by replacing paved and hard surfaces with surfaces that are vegetated or permeable. Permeable pavements and green roofs both capture rainfall and retain it on site, keeping it out of the stormwater system.

Several of the RBD proposals recommended use of green infrastructure to manage stormwater and interior flooding while also providing other amenities:

- **The Resist, Delay, Store and Discharge proposal** for Hoboken called for the broad deployment of green roofs, bioswales, and permeable pavement;
- **The BIG U proposal** called for “Green Streets” and integration of green infrastructure into public housing; and
- **The Meadowlands proposal** called for a “green infrastructure berm,” green roofs, and enhancement and creation of open space.

Such green infrastructure approaches can provide multiple co-benefits that are not delivered by traditional gray approaches. In addition to managing stormwater, green infrastructure can reduce the urban heat island effect,<sup>23</sup> improve air quality, provide wildlife habitat, double as recreational and open space, and help sequester greenhouse



gases. Many cities also are linking their programs with workforce development and local hiring policies to ensure that investments in green infrastructure are leading to job opportunities for economically disadvantaged residents.<sup>24</sup> Green infrastructure also provides an opportunity to educate the public about water quality and other environmental issues.

**FIGURE 5: Green Infrastructure Approaches**



**Street Features**

Green infrastructure approaches can be incorporated into street design with permeable pavements, bioswales, tree pits, green streets, green alleys, and green parking.



**Building Features**

Buildings can be “greened” with green roofs, downspout disconnections, and rain barrels.



**Landscape Features**

Landscapes can be used to manage stormwater with rain gardens, urban tree canopy, land conservation, stream buffers, and stormwater parks.

While most of the grantees are currently exploring capital projects to install green infrastructure on publicly owned lands and right-of-ways, green infrastructure must be deployed broadly throughout a watershed in order to be an effective method for managing stormwater. To ensure this broad deployment, local governments in the project areas will need to require or encourage the use of green infrastructure on both public and private lands. Many of the communities where RBD projects will be implemented are already experimenting with and planning for green infrastructure. New York City and Hoboken, in particular, have created green infrastructure strategic plans, and New York City has made significant progress in designing and building green infrastructure pilot projects and studying the effectiveness of current installations. In all cases, however, more opportunities exist to fully integrate green infrastructure into regular government operations, such as street design, and into regulatory processes such as building and zoning codes, and landscaping and stormwater ordinances, among others.<sup>25</sup> Local governments in both New York and New Jersey have authority over zoning codes and general government functions such as street paving and design. Therefore, the state grantees (i.e., all but New York City) will need to work closely with their local government partners in the project areas to help them implement policies that can ensure a broader deployment of green infrastructure over the longer term.

**LAND-USE APPROACHES<sup>26</sup>**

Many of the RBD Proposals also called for the use of land-use approaches to reduce flood risks to private development, direct new development out of harm’s way, and generate tax revenues by allowing higher density development in “high and dry” areas:

- **The Living Breakwaters proposal** called for structures near the shore to be elevated and designed to withstand flood impacts;
- **The BIG U proposal** called for public housing retrofits using a “wet feet” strategy where the first floor would be designed to be floodable;
- **The Living with the Bay proposal** called for buying out structures in flood-prone areas and allowing additional density (i.e., upzoning) in “high-and-dry” areas that have lower risk of flooding and are close to transit.

**FIGURE 6: Land-Use (or “Non-Structural”) Approaches**



### Floodplain Management

State and local governments can implement comprehensive floodplain management planning and regulations to preserve and enhance natural floodplains



### Elevation

Governments can require that structures be built to withstand greater flood impacts through land-use regulations and building codes. For example, residential structures can be elevated with additional height to account for future sea-level rise.



### Floodproofing

Governments can require non-residential structures to be floodproofed with deployable floodwalls, flood-resistant materials, or by elevating utilities.



### Relocation

Flood-prone properties can be acquired and relocated out of harm's way

These types of strategies must, however, be implemented by local governments. Both New York and New Jersey are “home rule”<sup>27</sup> states where land-use authority has been delegated to local governments. Thus, similar to the green infrastructure approaches, the state grantees will need to work with the individual municipalities within each project area to facilitate implementation if these approaches are to be adopted. The good news is that municipalities have many tools in their toolbox to ensure that new development and redeveloped areas are more resilient to flooding. Municipalities can use zoning and floodplain ordinances to require private development to be built or retrofit to be more resilient to flood impacts. Municipalities can also provide incentives, grants, and tax breaks to encourage landowners to design structures to be more resilient to flooding or to preserve floodplains as natural open space. Some Sandy-affected communities, like New York City, have already taken steps to remove barriers in zoning rules to allow structures to be rebuilt to be more resilient to flooding.<sup>28</sup> Although large cities, like New York City, have the needed technical capacity to undertake these legal changes, smaller cities in the region may need technical assistance and funding to help them design and adopt the “flood-smart” land-use approaches identified in the RBD proposals (as described in more detail below).

## SUMMARY OF LESSONS

The challenges the grantees have worked to overcome on their paths to implementing these innovative RBD projects provide important lessons for others seeking to build resilience across the country. Their work also offers important lessons for federal agencies administering funding programs or providing technical assistance. This section of the report summarizes the key lessons from all of the RBD projects.

### THE DESIGN COMPETITION MODEL

The RBD competition showcased an innovative approach for allocating federal disaster recovery funds and bringing the expertise of multi-disciplinary design teams to disaster-affected communities. The process captivated the public’s imagination, generated excitement, and inspired new ideas for building community resilience. However, the design competition approach created some challenges when the grantees transitioned from concept to implementation.

- **Mismatch with city and regional priorities**—The competition brought experts from a diversity of countries and disciplines (engineering, architecture, hydrology, sociology, etc.) to help inspire innovation in the rebuilding process. While the competition sought to encourage close coordination among the design teams, state and local officials, and the public, the designs were judged based upon their creativity and innovation.<sup>29</sup> This has proved challenging for the grantees who are responsible for implementation but who did not lead development of the proposals. Some are now struggling with how to reconcile these projects with other existing community priorities and goals. The design teams that worked closely with state and local government officials and the public developed proposals that were easier to implement because they built upon and were consistent with established community priorities and plans (developed before or in the immediate aftermath of Sandy). With future competitions or other competitive grants, federal agencies should continue to encourage and require design teams and contractors to coordinate closely with state and local decisionmakers and consult existing plans to ensure that the projects they develop are easier to implement and consistent with local priorities.
- **Community engagement and public expectations**—The design competition appropriately emphasized community engagement and outreach; in the design phase, many teams worked closely with community stakeholders using creative approaches for engaging with residents. Extensive public engagement successfully brought new people and groups into the conversation and generated excitement and interest in resilience. It also increased the level of understanding around current and future vulnerability as well as the need to address it.<sup>30</sup> As a result of this engagement, however, public expectations were raised, and the grantees now face challenges managing expectations as they work to implement the projects with constrained budgets. Because the available funding will only support construction of a piece of the larger vision, grantees face the difficult task of delivering the news that the project may be reduced in scale or scope, and that the direct benefits of the project may flow to smaller geographic areas, fewer jurisdictions, or fewer residents. Nevertheless, some communities, like Hoboken and New York City, have used the competition as inspiration to find funds for future phases of work and to adopt policies to support additional implementation. And all of the grantees reported that going through the iterative design process and evaluation of alternatives with the community has led to better projects with stronger public support. State and local grantees and federal agencies can learn from the engagement processes inspired by the competition to encourage replication of these approaches in the development of future projects and plans—approaches that move beyond historic practices of “checking” the public outreach box to practices that result in true collaboration with community partners.

## FUNDING CHALLENGES

As described above, the funding allocated to the grantees was, in most cases, a fraction of what it would take to implement the grand visions laid out in the RBD proposals. The grantees’ efforts to nonetheless implement ambitious and visionary projects provide many lessons for improving project design and the administration of funding programs generally.

- **Need for a long-term view**—The RBD competition demonstrates the importance of developing projects that can be phased over time as one way for designers and agencies to manage the funding gaps inherent in any large-scale infrastructure project. The RBD funding was never intended to fully fund the ideas put forth in the proposals. Instead, it was intended to catalyze investment in these innovative proposals, applying the concept: “If you build it, they will come.” During the RBD process, the design teams were required to anticipate funding limits and develop project “components” or “compartments” that could be implemented progressively as grantees identified additional funding. By taking a longer-term view when designing these comprehensive resilience projects, designers and states can theoretically lay the groundwork for successive stages of work. This approach has proven particularly helpful for New York City’s BIG U proposal, which the

design team divided into three compartments that could be constructed individually. New York City is using its RBD funding to implement Compartment 1 in the Lower East Side. The city is drawing on funding from the National Disaster Resilience Competition and city sources to support an additional phase of work. Still, New York City and other grantees will need to figure out how to fund and implement future phases of work. At these early stages of implementation, many grantees are still struggling to raise additional resources. In some cases, the full resilience value of the original proposals may go unrealized because the grantees are not able to raise the needed funds during these critical early stages of design, engineering, and construction. For example, without additional funds, some grantees may have to build smaller scale flood-defenses, which will mean that the community foregoes protection from higher-intensity storms or greater sea-level rise. This suggests that the grantees need assistance from partners (federal or state agencies, universities, and non-profits) to help them identify funding sources and financing strategies both in the short term, to implement the intended resilience benefits during this current phase of work, as well as longer-term strategies to allow them to phase in additional project components over time. Federal agencies should also monitor these projects to test assumptions and determine whether additional sources of funds in fact flow to these projects over the longer term and how the grantees are able to develop additional resources.

- **Quick timelines**—The funding challenge is compounded by the fact that the grantees are on tight timelines to spend their disaster recovery dollars, which is forcing the grantees to focus on designing projects quickly and limiting their capacity to identify other sources of funding. Although it was hoped that the grantees would be able to leverage other public and private sources of funding, grantees have struggled to do so. Public sources (such as local or state funds) are constrained and often pre-committed through capital-budgeting processes that lock in budgets many years in advance.<sup>31</sup> Additionally, the grantees lack capacity to seek out other philanthropic or private sources of funds or apply for competitive federal grants under these time frames.
- **Disaster recovery funding sources**—The RBD process also brought attention to the challenges of using federal funding programs, specifically disaster recovery programs, to fund large-scale resilience projects. Despite HUD’s creative allocation of CDBG-DR funding through the RBD competition, federal disaster recovery funding programs are not well suited for these types of holistic community rebuilding efforts. Federal recovery programs were designed largely to provide funds to restore communities as they were *before a disaster*, not to rebuild them to be more resilient to future catastrophes. Disaster recovery programs also tend to be reactive and backward looking, flowing only to those areas immediately affected by the disaster. This limits the ability of grantees to fund interventions that could more holistically reduce the full suite of future risks faced by the region or community.<sup>32</sup> This challenge raises two lessons from Rebuild by Design. First, grantees will need to identify other funding mechanisms and pathways for implementing additional phases of work if they are to holistically reduce risks—the RBD funding alone will be insufficient. For example, grantees focusing on building storm-surge protection with their RBD funding will also need to find ways to ensure that drainage and green-infrastructure improvements are made in the project areas either through other funding sources or through land-use approaches (e.g., zoning code or stormwater ordinances). Second, federal agencies and Congress must find ways to give grantees more flexibility to use disaster recovery dollars in ways that do not merely react to the last disaster but, instead, allows them to rebuild differently in more holistic ways and with climate change in mind.
- **Administrative mismatch between federal funding programs**—Grantees are also facing challenges combining funds from multiple federal (or state) programs because each program comes with its own procedural and administrative requirements. This is particularly challenging for disaster recovery efforts, which are funded through many different federal programs.<sup>33</sup> Each of these has different rules and

timelines for how and when the funds are made available to state and local grantees, making it difficult for grantees to combine streams to support comprehensive rebuilding visions. For example, FEMA’s benefit-cost analysis (BCA) process is different from HUD’s and the Army Corps of Engineers’.<sup>34</sup> As a result, the BCA developed for one agency may not meet requirements of another. These challenges are exacerbated by the fact that these innovative, large-scale projects require more complex permitting and environmental review, and better coordination across agencies and jurisdictions. Federal agencies should try to coordinate administrative requirements to the maximum extent possible to allow grantees to combine different sources of funding to support more comprehensive resilience initiatives.

- **Programmatic silos of different funding sources**—In addition to having different rules, federal funds are often constrained by programmatic silos where certain sources can only be used for certain types of projects. These funding silos have limited the ability of the grantees to use other federal funds to support implementation of the RBD projects. For example, FEMA funds are often limited to projects that demonstrably reduce flood risks. So grantees often struggle, for example, to justify the use of hazard mitigation funds to support investments in green infrastructure approaches for managing stormwater.<sup>35</sup> EPA funds, in turn, are often limited to improving water quality, which complicates their use for hazard mitigation. As a result, it is difficult for grantees to justify the higher costs of larger-scale green infrastructure projects that will both reduce flood risks during higher-intensity, lower-frequency storms and improve water quality. If these funding sources could be more easily combined, or if grantees could use co-benefits to justify investments in these types of multi-benefit projects, grantees could implement more holistic approaches that deliver a wider range of resilience benefits (e.g., improved water quality and flood-risk reduction benefits).<sup>36</sup>
- **Limitations with CDBG-DR funding**—Although CDBG-DR is more flexible than other disaster recovery programs, it also comes with its own limitations that can inhibit implementation of large-scale resilience projects. In keeping with CDBG-DR’s statutory mandate to provide assistance to low- and moderate-income (LMI) communities, 51 percent of the grantees’ expenditures must benefit these groups.<sup>37</sup> This requirement has been challenging because the grantees received “pre-packaged” projects that were selected by the competition jury. As a result, the grantees have limited flexibility to redirect the projects to areas with higher percentages of LMI residents. Moreover, the benefits of these types of large-scale infrastructure projects, like the RBD projects, flow to geographically and economically diverse areas, which often dilutes the percentage of LMI residents benefited.<sup>38</sup> Federal agencies should consider how they can give grantees more flexibility in the expenditure of the funds (through waivers or other mechanisms) so that the grantees are not penalized for implementing the project that was selected through the design competition or for having an ambitious project that benefits a large area.
- **Long-term operations, maintenance, and monitoring**—Long-term maintenance, operations, and monitoring are not eligible expenses under the CDBG-DR program (nor under many other federal programs) and grantees must therefore identify funding or financing options for this work on their own. Monitoring is especially important for these types of innovative resilience projects because data can help demonstrate the efficacy of novel approaches and inform the deployment and refinement of future projects. To support monitoring, many of the grantees are trying to develop early relationships with academic institutions as they collect baseline data and set up monitoring programs. It is hoped that these relationships will make these institutions more competitive for other federal grants that could be used to support long-term monitoring of the projects. Grantees could also use support from partners (federal and state agencies, universities, and non-profits) to help identify sources of funding or financing strategies that can be used to support long-term maintenance, operations, and monitoring.

- **Incentives for pre-disaster planning and mitigation**—The RBD proposals show that pre-disaster plans can set a foundational vision for how a community can rebuild more resiliently in the aftermath of a disaster. However, communities only receive these large influxes of federal money *after* a disaster. Far fewer resources are available for pre-disaster planning and mitigation, which can help to prevent or reduce impacts before a disaster strikes. State and local governments should dedicate more funds to planning and mitigation *before* a disaster occurs. And federal agencies, Congress, and even the private sector (e.g., insurance companies and bond-rating agencies) should consider ways that they can provide incentives and reward communities that proactively take steps to reduce their vulnerabilities. This would facilitate more thoughtful and holistic post-disaster rebuilding and could spur projects that deliver multiple community benefits and reduce future losses.

## LEGAL CHALLENGES

Innovative resilience projects raise many legal challenges related to permitting, intergovernmental coordination, and procurement, among others. The RBD experience has identified opportunities to reform regulatory programs and improve coordination among jurisdictions and levels of government.

- **Permitting barriers**—Many of the RBD proposals called for innovative hybrids of natural and structural flood defenses. By integrating environmental components (e.g., seeding breakwaters with oysters in the Living Breakwaters project), flood defense projects can be engineered to provide multiple benefits in addition to reducing flood risks. However, these types of hybrid approaches are new and untested in this region and, as a result, will trigger complicated and time-consuming state and federal permitting requirements. The RBD projects are offering lessons that can be instructive for both design teams and regulators. Design teams can ease implementation of innovative natural defense projects by anticipating legal barriers and exploring design alternatives that avoid those barriers (e.g., the BIG U flood protection could be built without “in-water” elements to avoid permitting requirements). They can also ease implementation by working early with regulators to ensure that the project is being designed to meet the permitting criteria used by the different regulatory agencies (e.g., the Living Breakwaters team used the Technical Coordinating Teams (described below) to address regulatory concerns about potential impacts to shipping channels and marine habitats early in the design phase. Regulators, in turn, can learn from these RBD pilots to refine and streamline permitting processes across federal and state agencies, remove legal barriers, and ensure that these types of multi-benefit approaches can be permitted more easily in the future.
- **Interagency coordination**—Because of the number of agencies involved and the diverse interests of those agencies, permitting nature-based projects has historically been time-consuming and challenging in many parts of the country.<sup>39</sup> In most states, permitting a natural-defense project requires the iterative review of the various agencies charged with managing impacts to specific resources, including the Army Corps (navigation), EPA (water quality), and the National Marine Fisheries Service (habitat and fish species). And any individual agency can raise objections late in the permitting process. To preempt these types of delays in obtaining permits for the RBD projects, HUD convened local, state, and federal regulators through Technical Coordinating Teams (TCTs) to get early input from the full range of officials and regulators who will need to approve these projects.<sup>40</sup> It is hoped that the TCTs will help streamline and coordinate review across the relevant agencies for the RBD projects. The benefits and challenges of the TCT model for facilitating Sandy recovery should be explored and communicated. The TCT model could also be continued and expanded as a way to coordinate and speed up permitting generally and for future disaster recovery efforts specifically.

- **Land ownership**—Project designers need to consider land ownership when they propose large flood-protection systems, particularly when the land needed is not already publicly owned and where there is not funding or political support for the use of eminent domain to acquire needed parcels. With the BIG U project, the design team facilitated implementation by purposefully limiting the proposed project site to government-owned land (city parks and rights-of-way). The Meadowlands design team also sought to maximize sites on publicly owned land, but the team had to consider sites that were privately owned in the proposal because most of the waterfront land in the Meadowlands region is in private ownership. This is making it challenging for the grantee, given the deadlines for spending the RBD funding, because acquiring the private lands needed to construct the proposed berm system would be costly and time consuming. As a result, the grantee is having to reevaluate a variety of different alternatives for the Meadowlands project to identify an approach that can be feasibly implemented given land, budgetary, and time constraints.
- **Levee certification**—For projects involving the construction of levees, berms, or other flood defenses, HUD is requiring that the grantees “take action”<sup>41</sup> to pursue levee certification from FEMA. FEMA certifies levees that provide flood protection from a 100-year flood event.<sup>42</sup> Properties protected by a FEMA-certified levee can be exempted from having to carry flood insurance, providing significant cost savings to homeowners and businesses. HUD worked to ensure that the design teams and grantees were in frequent and ongoing contact with FEMA to discuss the proposed designs and project alternatives. However, FEMA has not been able to provide any definitive guidance to the grantees on whether the innovative RBD designs will be certifiable once constructed. FEMA should update guidance to establish clear criteria for how innovative green-gray flood defense projects (like the RBD projects) can be designed and constructed to receive FEMA-certification and what kind of modeling is required to demonstrate the protectiveness of nature-based, flood-risk-reduction projects. Proponents of nature-based approaches need more certainty that the project they build can be certified, so that they are not pushed to more conventional gray approaches to ensure certification.
- **Wetlands restoration**—Contamination has been a challenge for implementing several of the RBD projects that proposed wetlands restoration activities to improve ecosystems and provide nature-based protection from storm surges. For example, the Hoboken and Meadowlands proposals both called for the restoration of wetlands, which is not being pursued because of regulators’ concerns that restoration efforts could stir up contaminated sediment with consequences for water quality and public health. Regulators should help find ways to promote restoration projects that reduce contamination over the long term, while also providing the important ecological, recreational, and flood-risk-reduction benefits that will accrue from restoring these systems. EPA, the Corps, and others should promote research on strategies for restoring contaminated wetlands in ways that reduce potential short-term impacts to water quality and public health.
- **Local opposition and environmental review**—Environmental reviews required by the National Environmental Policy Act (NEPA) are also making it difficult for the grantees to implement these complex infrastructure projects on tight timelines. To comply with NEPA, grantees must identify feasible project alternatives and analyze environmental impacts. Most of this work will need to be completed in order to obligate project funds by 2017. Because NEPA allows for citizen enforcement through litigation, the grantees must work closely with the public to ensure that opposition to the project does not delay implementation. A lengthy legal challenge could make it difficult to spend the funding by 2022 (as required by the Appropriation Act). A benefit of the RBD process has been the focus on extensive and ongoing community engagement. In most instances, this engagement has helped build public support and created stronger project alternatives, which may ease the NEPA process for these projects.

- **Procurement**—Inflexible procurement rules can also limit the ability of the grantees to hire the multi-disciplinary teams of experts needed to implement these complex resilience projects. State rules have historically created separate processes for procuring design and construction services. Whereas state agencies can contract for *design* services based upon the expertise and qualifications of the contractors, *construction* of “public works” contracts (i.e., contracts for the construction of public buildings and facilities) often require state agencies to hire contractors through a competitive process where the contract must be awarded to the *least-cost* responsible bidder.<sup>43</sup> While these state procurement rules were put in place to ensure competition and the responsible use of taxpayer dollars, this traditional system of procurement can restrict innovation and increase the time and budgets needed to implement complex infrastructure projects. Because of the unique process for developing the RBD projects, HUD issued a waiver allowing the grantees to hire the design teams without competition,<sup>44</sup> and in some instances the grantees were able to use “sole source”<sup>45</sup> procurement rules to hire the design teams, easing contracting and allowing these grantees to begin work more quickly. However, in other cases, state competitive bidding rules limited the ability of the grantees to hire the competition design team. In New Jersey, for example, the grantee felt compelled to competitively bid the RBD project.<sup>46</sup> As a result, the grantee was not able to bring on the design team that had the greatest institutional knowledge about the project and it took many months to hire a contractor to begin work, which compounded the state’s challenge of implementing the RBD projects under the tight timelines. In order to facilitate these types of innovative infrastructure projects, state procurement rules need to allow agencies more flexibility to hire contractors based upon cost and other factors including specialized expertise and qualifications, while also maintaining fairness in the contracting process and ensuring sound use of taxpayer dollars. Nonprofits and other institutions could develop model procurement rules or bid documents that states could adopt to give public entities greater flexibility.

## LAND-USE CHALLENGES

Many of the elements in the RBD proposals also called for land-use changes—flood resilient development and green infrastructure approaches for managing stormwater—that will need to be implemented by local governments using their powers to regulate the use and development of land. In these early stages of implementation, many of the grantees are primarily focused on implementing the capital-improvement components of projects. However, land-use and other legal changes will be critical for achieving comprehensive resilience in these communities. To fully realize the resilience value promised by the RBD proposals, the grantees (working with other partners) will need to empower local governments to adopt necessary land-use or other policy changes.

- **Flood resilience through zoning**—The RBD capital projects will reduce some flood risk, but will not eliminate all risk in these communities (nor could any public infrastructure project). Land-use regulations, including regulations to direct higher-density uses out of floodplains and to require flood-resilient construction, will be critical to addressing the residual flood risks that these communities face. To facilitate implementation of the proposed “flood-smart” land-use practices, state agencies or federal partners could increase efforts to provide models, technical assistance, financial support, or other incentives to encourage or require local governments to adopt more robust land-use regulations in flood-prone areas.
- **Managing community opposition to zoning changes**—Land-use policies can also face community opposition (particularly with policies like upzoning<sup>47</sup> that allow additional density or more intensive uses). To effectively address community concerns, local governments need to have dynamic community engagement processes for identifying and resolving problems, and building community support, which requires staff capacity and resources. State and federal partners could provide support and technical assistance to help local officials meaningfully engage with the community on an ongoing basis.



- **Land use as a financing tool**—Land-use policies can also be used to generate tax revenue to finance resilience investments. The RBD projects will provide tangible benefits to the surrounding areas by reducing flood risks, creating new recreational amenities, improving access to waterfront areas, and more. These types of capital improvement projects will often increase property values in surrounding neighborhoods. Many of the proposals called on local governments to try to capture this value through tax increment financing (TIF) or other financing models.<sup>48</sup> For example, because of Hoboken’s proximity to New York City and transit, the RBD proposal called on the city to implement a TIF district to capture the value of additional development and increases in property taxes. To use these types of financing tools, however, local governments often need help from state and local partners to craft and pass the ordinances needed to implement these types of measures.<sup>49</sup> If successful, revenues developed could be used to support future phases of work and additional resilience investments.
- **Affordable housing**—Sandy exacerbated the affordable housing crisis in New York City and surrounding communities. Many lower-income homeowners could not afford to fix their homes. In addition, some landlords were forced to leave basement apartments vacant due to enhanced or newly enforced floodplain regulations.<sup>50</sup> To address this challenge, many RBD proposals called for the development of new affordable housing in “high-and-dry” areas (e.g., Living with the Bay). These types of strategies will, again, require local government action and state and federal support. While there are existing models for using land use to ensure that development is designed and sited to be more resilient to flood impacts and other models for providing affordable housing, there are few existing models combining these two strategies. State, federal, and other partners could help local governments develop zoning regulations or other land-use incentives to require or encourage development of resilient affordable housing in appropriate areas (e.g., out of flood zones, around transit, etc.) or retrofits to existing housing. These groups can also help develop protections for tenants who might face rent increases as a result of new or newly enforced building codes requiring resilient construction.
- **Regional coordination**—Sandy demonstrated that the impacts of climate change will not respect jurisdictional boundaries and that solutions often need to be implemented at a regional scale. Regional coordination can help communities pool resources to implement more holistic and cost-effective resilience projects. It can also help jurisdictions avoid solutions that will exacerbate risks to their neighbors. To address this need, many of the RBD proposals developed resilience approaches at a watershed or landscape scale crossing multiple jurisdictions. The Living with the Bay proposal, for example, included projects spanning several different small municipalities and the county. Implementation at this scale, however, is uncommon and uniquely difficult. Smaller municipalities, in particular, have limited capacity and resources, which makes coordination even more challenging. To manage these difficulties, New York convened Executive Steering Committees to provide a forum for regular “check-ins” with local leaders to deliver updates, hear feedback, and address problems. The state is also using the CDBG-DR funding as a “carrot” to build local capacity to manage, maintain, and scale-up resilience investments after project completion. Local public works officials will receive training on the use and maintenance of green infrastructure. Federal agencies could encourage more regional coordination by providing funding and other resources to help state and local governments develop regional governance models for building resilience. In one successful example, HUD provided support for regional planning through its Sustainable Communities Initiative, however this program has not received funding from Congress in recent years.

## DATA AND INFORMATION NEEDS

State and local policymakers also need data and information to help them assess their risks and design projects to effectively address vulnerabilities, which will be compounded by climate change and existing social and economic stressors. This information must be detailed enough to help inform the design and engineering of projects that

address both extreme shocks and chronic stressors. They also need tools and resources to help them monitor the efficacy of resilience approaches once implemented.

- **Projecting future risk**—In order to prepare for climate change, communities need good data, tools, and maps to understand how sea-level rise and changes in precipitation will likely affect their region and exacerbate their flood risks. This information must be translated so that it can affect the engineering and design of projects on the ground. For example, the primary tool that state and local governments currently use to assess flood risks are the Flood Insurance Rate Maps (FIRMs) developed by FEMA, which are based on *historical* flood data only. In the aftermath of Sandy, a variety of federal agencies worked together to overlay sea-level-rise projections on the FIRMs for the region to inform state and local rebuilding efforts. In addition, over the past several years federal agencies have rolled out a series of new tools and portals such as the US Climate Resilience Toolkit and NOAA’s Climate.gov, Digital Coast, and sea-level rise viewer.<sup>51</sup> Federal agencies should evaluate how grantees and others are using these maps and tools to determine whether they are providing the right information at sufficient levels of detail to inform the design and construction of resilience projects that account for future climate risk. If not, federal agencies should continue to work with state and local partners to improve and enhance these tools and other products to ensure that they are effectively informing local resilience planning and project implementation.
- **Long-term monitoring**—As described above, to build support for these types of innovative resilience approaches, grantees will need to assess the effectiveness of the RBD projects across the range of benefits that they are intended to deliver. In addition to funding long-term monitoring after the project is complete, the grantees must also develop innovative programs that include new metrics for evaluating the economic, social, and other ecological benefits of these projects. Grantees and other partners will also need to package monitoring data in ways that can help demonstrate the effectiveness of the RBD projects. Such monitoring data will be invaluable for communicating the return on investment that these approaches deliver to elected officials, federal agencies, and the public. Monitoring data can also be used to inform future benefit-cost analyses that will determine what future projects are funded and implemented. Grantees should consider online platforms or other ways to make monitoring data available to the public so that other researchers can access this information for broader analysis and evaluation.

## CONCLUSION

The RBD competition was not merely a unique process for facilitating disaster recovery at the federal level, it also inspired innovative proposals for how disaster-affected communities can rebuild in ways that will reduce their risks to future disasters while increasing social, economic, and environmental resilience. Implementing the visions articulated in these proposals, however, is not an easy task. These types of innovative projects test the bounds of government rules, processes, and capacity. The challenges that the grantees face as they seek to transform the RBD conceptual designs into feasible projects, and the innovative ways they are overcoming challenges provide instructive lessons for how policymakers at all levels of government can facilitate and ease implementation of resilience projects in the future. This summary was informed by the following case studies of each of the winning RBD proposals, the projects they inspired, and the specific legal and policy challenges that the grantees are facing in implementing these projects.

## CHAPTER 1 END NOTES

- 1 Federal Emergency Management Agency (FEMA), *Mitigation Assessment Team Report: Hurricane Sandy In New Jersey and New York, Building Performance Observations, Recommendations, and Technical Guidance*, FEMA P-942 (Nov. 2013), <https://www.fema.gov/media-library/assets/documents/85922>.
- 2 “Northeast”. *2014 Nat’l Climate Assessment*, GlobalChange.gov; <http://nca2014.globalchange.gov/report/regions/northeast>.
- 3 The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) governs presidential disaster relief declarations and the administration of federal disaster relief funds. 42 U.S.C. § 5122 (2006). A presidential declaration makes funds available to state and local governments to help them respond to and recover after a catastrophe. 42 U.S.C. § 5122 (2006). Disaster relief funding is appropriated to a variety of federal programs administered by different federal agencies, and each program has its own rules and limitations. The Stafford Act created two programs for supporting the long-term recovery, the Public Assistance (PA) program and the Hazard Mitigation Grant Program (HMGP), both administered by the Federal Emergency Management Agency (FEMA). Disaster relief appropriations often provide funds to other programs, such as the Community Development Block Grant program administered by HUD, which was the source of funds for the Rebuild by Design competition. See Jessica Grannis, Aaron Ray, Vicki Arroyo & Sara Hoverter, *Preparing Our Communities for Climate Impacts: Recommendations for Federal Action* Ch. 2, Georgetown Climate Center (Sep. 4, 2014); Jeffrey Thomas & James DeWeese, *Reimagining New Orleans Post-Katrina: A Case Study in Using Disaster Recovery Funds to Rebuild More Resiliently*, Georgetown Climate Center (August 2015); Justin B. Clancy & Jessica Grannis, *Lessons Learned from Irene: Climate Change, Federal Disaster Relief, and Barriers to Adaptive Reconstruction*, Georgetown Climate Center (December 2013); Nicole Smith & Jessica Grannis, *Understanding the Adaptation Provisions of the Sandy Disaster Relief Appropriations Act (H.R. 152)*, Georgetown Climate Center (May 2013). All Georgetown Climate Center adaptation reports listed above can be found at: <http://www.georgetownclimate.org/reports/adaptation.html>.
- 4 With the philanthropic support, U.S. HUD Secretary Donovan launched Rebuild by Design. Four key organizations to help administer the competition: The Institute for Public Knowledge at NYU, The Municipal Art Society, the Regional Plan Association, and The Van Alen Institute. Additional support during the Hurricane Sandy Design Competition came from Deutsche Bank, Hearst Foundation, the JPB Foundation, Surdna Foundation, and the New Jersey Recovery Fund. <http://www.rebuildbydesign.org/what-is-rebuild-by-design/>.
- 5 Rebuild by Design, *Promoting Resilience Post-Sandy Through Innovative Planning and Design* at 3 (Jun 21, 2013), <https://portal.hud.gov/hudportal/documents/huddoc?id=REBUILDBYDESIGNBrief.pdf>.
- 6 The funding for these projects came from HUD-administered Community Development Block Grant Disaster Recovery (CDBG-DR) funds appropriated through the Hurricane Sandy Disaster Relief Appropriations Act (hereinafter the “RBD” or “Sandy funding”). Following Hurricane Sandy, Congress appropriated \$16 billion (\$15.18 billion after sequestration) to the CDBG program (\$15.18 billion after sequestration). Disaster Relief Appropriations Act of 2013, Pub. L. No. 113-2, 127 Stat. 4 (H.R. 152, 113th Cong., Jan. 29, 2013) [hereinafter “Sandy Relief Act”] (West 2013). HUD allocated \$930 million of its \$16 billion in appropriated CDBG-DR funds to implement projects developed through the RBD competition. U.S. Dep’t of Housing and Urban Development (HUD), *Third Allocation, Waivers, and Alternative Requirements for Grantees Receiving Community Development Block Grant (CDBG) Disaster Recovery Funds in Response to Hurricane Sandy*, 79 Fed. Reg. 62182 (Oct. 16, 2014) [hereinafter HUD, *Third Allocation*]. HUD conducted the competition pursuant to Section 105 of the America COMPETES Reauthorization Act of 2010 (15 U.S.C 3719), which authorizes federal agencies to carry out programs to award prizes competitively to “stimulate innovation that has the potential to advance the mission of the agency.”
- 7 The Resilient Bridgeport proposal was a runner-up and the state of Connecticut was allocated \$10 million, however, to manage the scope of this report, we only analyze the implementation challenges and pathways for the six winning projects. Connecticut received additional funding under the National Disaster Resilience Competition and will be able to implement components of the Resilient Bridgeport Design. Press Release. U.S. Dep’t of Housing and Urban Development, *HUD Awards \$1 Billion Through National Disaster Resilience Competition* (January 21, 2016).
- 8 Full implementation of a phase of work was not funded by this allocation, however the city has contributed an additional \$25 million of CDBG funding to this project.

- 9 See *supra* note 6. HUD’s Third Allocation Notice awarded \$930 million of the total \$15.18 billion of Community Development Block Grant Disaster Recovery (CDBG-DR) funds appropriated through the Hurricane Sandy Disaster Relief Appropriations Act to the State of New York, the State of New Jersey, and New York City. The Notice provided that the grantees have to use their CDBG allocation to implement a RBD Project consistent with the RBD Proposal “to the greatest extent practicable and appropriate, considering the technical, fiscal, environmental, legal and other constraints or opportunities that may be encountered.” Funds can be used to conduct additional research, studies, analysis, planning, stakeholder engagement, design, engineering or other “pre-development activities” necessary to implement the RBD Project, as well as to prepare the site and construct the project. The grantees were required to amend their CDBG Action Plans for HUD approval to describe how the funds will be used to implement an RBD Project implementing the winning RBD Proposal (to the extent feasible). The Sandy Relief Act requires each state or local grantee to submit an “action plan” for using the funds to the HUD Secretary for approval. The plan must demonstrate how the intended use of the funds will address the “long-term recovery, restoration of infrastructure and housing, and economic revitalization in the most impacted and distressed areas.” Sandy Relief Act, Pub. L. No. 113-1, 127 Stat. at 38 (Jan. 29, 2013). Fifty percent of the funds must be used to support activities benefitting persons of low or moderate income, unless the Secretary waives this requirement based upon a finding of compelling need. *Id.* at 38. The Action Plan amendments were required to include: a general description of the proposed RBD project; a description of how the grantee will partner with other public entities (e.g., state agencies, municipal governments) to implement the RBD project; a description of the grantee’s citizen engagement strategy; a timeline for development and implementation of the project; a description of additional funds that will be leveraged to support project implementation; a benefit-cost analysis for the project; and a monitoring plan. (HUD, Nov. 18, 2013 Notice).
- 10 Disaster Relief Appropriations Act of 2013, Pub. L. No. 113-2, 127 Stat. 4 at Ch. 9, pp. 36-37 (H.R. 152, 113th Cong., Jan. 29, 2013) [hereinafter “Sandy Relief Act”] (West 2013). See also HUD, *Third Allocation*, 79 Fed. Reg. 62,182, 62,185 (Oct. 16, 2014). HUD can grant waivers to this deadline if the grantee can demonstrate a compelling legal, policy or operational challenge justifying an extension of the deadline, but in the Third Allocation HUD warns that waivers may not be approved.
- 11 The National Environmental Policy Act (NEPA) requires federal agencies to assess the environmental consequences of “major federal actions significantly affecting the environment.” NEPA provides three main pathways for complying with environmental review requirements: (1) statutory exclusions, (2) categorical exclusions, and (3) Environmental Impact Statements (EISs). Actions that do not significantly affect the quality of the human environment may be statutorily or categorically excluded from NEPA review. All other actions that do not fit into one of the two exclusions must complete an environmental review document (EIS or Environmental Assessment). National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq.* (1970). This can be problematic for projects on quick timelines because EISs require lengthy and sometimes expensive analysis and processes such as the identification and evaluation of alternatives, disclosure of environmental impacts, and public scoping and comment periods. Memorandum from Nancy H. Sutley, Chair, Council on Env’tl. Quality, to the Heads of Fed. Dep’ts & Agencies, Memorandum from Nancy H. Sutley, Chair, Council on Env’tl. Quality, to the Heads of Fed. Dep’ts & Agencies, Improving the Process for Preparing Efficient and Timely Environmental Reviews Under NEPA (Mar. 6, 2012); Executive Order 13604, Improving Performance of Federal Permitting and Review of Infrastructure Projects (Mar. 22, 2012); Linda Luther, CRS Report for Congress RL34650, Implementing the National Environmental Policy Act (NEPA) for Disaster Response, Recovery, and Mitigation Projects; Memorandum from Nancy H. Sutley, Chair, Council on Env’tl. Quality, to the Heads of Fed. Dep’ts & Agencies, Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions (Feb. 18, 2010). Each of the RBD projects are likely to require an Environmental Impact Statement (EIS) pursuant to NEPA. Once the grantee has completed a draft EIS, they must submit another Action Plan Amendment to reflect the final RBD project that will be implemented with the Sandy funding. The Amendment must describe the RBD project scope, and how the project is consistent with the winning proposal. If, as the grantee finalizes the EIS, material changes are made to the project, the grantee must submit an additional Action Plan Amendment reflecting the changes to the project. After approval of the amended Action Plan, funds will be made available to the grantee for construction of the project. HUD, *Third Allocation*, 79 Fed. Reg. at 62,187.
- 12 To close out the grant, the grantees are also required to develop an implementation case study and lessons-learned document to describe new and creative coordination structures, decisionmaking processes, or other innovations deployed to implement these projects to inform future disaster recovery efforts. HUD, *Third Allocation*, 79 Fed. Reg. 62,186 (Oct. 16, 2014).
- 13 Recognizing that the Sandy funding would be insufficient for the grantees to fully build out the RBD Projects, HUD is requiring the grantees to develop an “Implementation Strategy” for future phases of work, including potential funding sources and financing mechanisms, and an “Implementation Case Study” describing the barriers the grantees encountered in implementing the project. Each grantee’s Implementation Strategy must also consider potential displacement of residents, businesses, and other entities due to

increasing costs of rent and property ownership in the years following completion of the RBD Project, and ways to mitigate those impacts. Meanwhile, the “Implementation Case Study” must describe the lessons learned and process for implementing the RBD Project, including discussion of any new coordination structures, partnerships, and decisionmaking processes that are developed to implement the project. HUD, *Third Allocation*, 79 Fed. Reg. at 62,186 (Oct. 16, 2014).

- 14 The lessons described in this report were informed by the winning RBD proposals, RBD project documents, interviews with and comments received from each of the grantees and HUD staff, and the Rockefeller-supported RBD staff who are helping to facilitate implementation of these projects. The thoughtful comments provided by all of the parties who are working tirelessly to implement these innovative and inspirational projects were invaluable to the development of this report.
- 15 This report applies the Army Corps of Engineers’ definition of natural and nature-based flood risk reduction strategies: “Natural features are created through the action of physical, biological, geologic, and chemical processes operating in nature, whereas nature-based features are created by human design, engineering, and construction,” including dunes and beaches, vegetated features such as wetlands and submerged aquatic vegetation (SAV), oyster and coral reefs, barrier islands, and maritime forests. US Army Corps of Engineers Civil Works Directorate, *Coastal Risk Reduction and Resilience 2-3* (Jul. 2013), [http://www.corpsclimate.us/docs/USACE\\_Coastal\\_Risk\\_Reduction\\_final\\_CWTS\\_2013-3.pdf](http://www.corpsclimate.us/docs/USACE_Coastal_Risk_Reduction_final_CWTS_2013-3.pdf).
- 16 “Northeast”. *2014 Nat’l Climate Assessment*, GlobalChange.gov; <http://nca2014.globalchange.gov/report/regions/northeast>.
- 17 Living shorelines are nature-based approaches that combine restoration of natural features (such as wetlands) with some structural measures (such as low rock sills) to dampen storm surges and reduce erosion on waterfront properties while maintaining tidal connectivity. See Nat’l Oceanic and Atmospheric Admin., *Guidance for Considering the Use of Living Shorelines* (2015), <https://coastalscience.noaa.gov/news/climate/noaa-releases-guidance-for-the-use-of-living-shorelines/>.
- 18 As defined by the Corps, “structural measures reduce coastal risks by decreasing shoreline erosion, wave damage and flooding.” Army Corps, *Coastal Risk Reduction and Resilience*, *supra*.
- 19 No single entity has complete regulatory control over activities that affect intertidal areas (areas where the land meets the sea). Local governments typically have authority over the uplands under traditional land-use authorities. State agencies often have oversight or permitting authority over intertidal activities under state water quality, wetland, and coastal management laws. At the federal level, permitting decisions must comply with Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act (RHA) as administered by the Army Corps of Engineers (Corps). The Corps must coordinate its review of Section 404 permits with the US Environmental Protection Agency (EPA) and the National Fish and Wildlife Service (FWS) and National Marine Fisheries Services (NMFS).
- 20 N.Y. Environmental Conservation Law § 25-0401 (McKinney); 6 NYCRR 661.9; and New York State Department of Environmental Conservation, *Tidal Wetlands Permit Program: Do I Need a Permit?* (2015), <http://www.dec.ny.gov/permits/6359.html>.
- 21 Many organizations are beginning to gather the data necessary to establish the efficacy and economic value of these types of interventions. For example, The Nature Conservancy (TNC) has established its Return on Investment Project to help quantify the economic value of conservation in areas ranging from fisheries improvement to the reduction of coastal erosion and associated property damage. <http://www.nature.org/science-in-action/the-roi-project-making-conservation-even-smarter.xml>. In April 2016, TNC also established the Center for Sustainability Science. Among other things, the center aims to produce case studies and science-based metrics and tools for businesses to assess the value of using nature-based solutions for things such as flood protection. <http://www.nature.org/science-in-action/center-for-sustainability-science.xml>. The National Wildlife Federation recently released a compilation of case studies demonstrating how communities across the United States are using nature-based infrastructure to mitigate natural hazards. See NWF, *Natural Defenses in Action* (June 21, 2016), [http://www.nwf.org/~media/PDFs/Global-Warming/Reports/NWF\\_Natural-Defenses-in-Action\\_Report.pdf](http://www.nwf.org/~media/PDFs/Global-Warming/Reports/NWF_Natural-Defenses-in-Action_Report.pdf). Meanwhile, the federal government also has begun the difficult task of quantifying environmental benefits from green and other nontraditional infrastructure. FEMA recently developed a benefit-cost analysis tool to calculate the ecosystem services benefits of hazard-mitigation projects based on green infrastructure or nature-based design as part of its *Climate Resilient Mitigation Activities* (CRMA) agenda. FEMA, *Climate Resilient Mitigation Activities*, <https://www.fema.gov/climate-resilient-mitigation-activities-hazard-mitigation-assistance>, see also Office of Management and Budget, *Incorporating Ecosystem Services Into Federal Decision Making* (Oct. 7, 2015), <https://www.whitehouse.gov/blog/2015/10/07/incorporating-natural-infrastructure-and-ecosystem-services-federal-decision-making>.

- 22 In its *Notice of a Second Allocation* of CDBG-DR funding from the Sandy Supplement, HUD expressly required grantees to include in their Action Plans a summary of the green infrastructure projects and activities they plan to construct. 78 Fed. Reg. 222 at 69107 (Nov. 18, 2013). In the Notice, HUD defined green infrastructure broadly as “the integration of natural systems and processes, or engineered systems that mimic natural systems and processes into investments in resilient infrastructure. Green infrastructure takes advantage of the services and natural defenses provided by land and water systems such as wetlands, natural areas, vegetation, sand dunes, and forests, while contributing to the health and quality of life of those in recovering communities.” The notice seems particularly focused on green infrastructure such as wetlands and dunes for coastal protection; we generally use the term nature-based coastal protection for these practices throughout this report. For purposes of clarity, this report applies the more limited definition of green infrastructure adopted by EPA: “Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water.” EPA, *What is Green Infrastructure*, [http://water.epa.gov/infrastructure/greeninfrastructure/gi\\_what.cfm](http://water.epa.gov/infrastructure/greeninfrastructure/gi_what.cfm). From this definition we separate out natural and nature based approaches for reducing flood and erosion risks along coastal shorelines (which we collectively refer to as “green” or “natural defenses”).
- 23 The EPA defines the term heat island as “built up areas that are hotter than nearby rural areas. The annual mean air temperature of a city with 1 million people or more can be 1.8–5.4°F (1–3°C) warmer than its surroundings. In the evening, the difference can be as high as 22°F (12°C). Heat islands can affect communities by increasing summertime peak energy demand, air conditioning costs, air pollution and greenhouse gas emissions, heat-related illness and mortality, and water quality.” *Heat Island Effect*, Environmental Protection Agency, <https://www.epa.gov/heat-islands> (last updated March 30, 2016).
- 24 For example, the Milwaukee Metropolitan Sewerage District (MMSD) has a Workforce and Business Development Resource Program through which it works to hire consultants, contractors, vendors, and local workers within its service area. *Workforce & Business Development*, Milwaukee Metropolitan Sewerage District, <http://www.mmsd.com/procurement/workforce-and-business-development>. Washington DC is another example of a city that is encouraging local hiring through green infrastructure investments. DC Water (Washington DC’s water and sewer authority) launched the “DC Water Works!” initiative to boost local hiring on infrastructure projects being constructed with ratepayer dollars. The program includes a targeted campaign to advertise DC Water jobs to local residents, a job training and apprenticeship programs, and an incentive-based program to encourage DC Water contractors to interview and hire District residents. The programs are estimated to have created 7,090 jobs created per year. DC Water Works! [https://www.dewater.com/employment/water\\_works.cfm](https://www.dewater.com/employment/water_works.cfm); *Economic Impact of Utility Operations at the District of Columbia Water and Sewer Authority (DC Water)*, (Aug. 2014), [https://www.dewater.com/site\\_archive/news/documents/DC\\_R01.PDF](https://www.dewater.com/site_archive/news/documents/DC_R01.PDF).
- 25 For a discussion of strategies for scaling up green infrastructure approaches see Sara Hoverter, Georgetown Climate Center, *Green Infrastructure Toolkit* (Sep. 2016), <http://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/introduction.html>. Stormwater ordinances generally dictate how much rainfall a property must retain. Seattle’s Stormwater Code, for instance, imposes retention requirements on residential properties that vary according to several factors, including the type of sewer system or water body to which the site discharges and the size of the land disturbance or impervious surface on that site. Seattle, Wash., Stormwater Code ch. 22.805.050; ch. 22.805.080.B.2. (2009). Like Stormwater ordinances, zoning codes can integrate green infrastructure. Binghamton, NY, requires property owners seeking permits for construction to submit an Urban Runoff Reduction Plan (URRP) to show how they will manage stormwater after construction. The URRP must show how the development will manage a 10-year, 24-hour storm event and include green infrastructure techniques. City of Binghamton, NY Code of Ordinances § 227-10.
- 26 As defined by the Army Corps as “complete or partial alternatives to structural measures, including modifications in public policy, management practices, regulatory policy and pricing policy.” Nonstructural measures essentially “modify the impacts” of the flood hazard, as compared to structural measures, which “modify the flood hazard.” The impacts of the flood hazard can be modified by reducing susceptibility to flood and coastal storm damage and disruption and by reducing the flood and coastal storm impact on individuals and communities. Nonstructural measures include structure acquisitions or relocations, flood-proofing of structures, implementing flood warning systems, flood preparedness planning, establishment of land-use regulations, development restrictions within the greatest flood hazard areas, and elevated development. Nonstructural measures can be blended well with the natural and nature-based features of the coastal environment, as well as structural measures. USACE, *Coastal Risk Reduction and Resilience* (Sep. 2013), available at: [http://www.corpsclimate.us/docs/USACE\\_Coastal\\_Risk\\_Reduction\\_final\\_CWTS\\_2013-3.pdf](http://www.corpsclimate.us/docs/USACE_Coastal_Risk_Reduction_final_CWTS_2013-3.pdf).

- 27 The term “home rule” refers to the majority of states that have delegated autonomy to local governments (through statutes or state constitutions) to manage local affairs when the locality adopts a home-rule charter. Statutes granting home rule often grant local governments the power to pass laws to regulate the health, safety and welfare within their boundaries, determine the structure of local government and hire staff, tax, provide services to its citizenry, acquire property etc. State legislatures will also often make specific delegations to local governments to plan for and regulate the use and development of land through zoning enabling acts. Courts also interpret these powers broadly to find that localities possess both the express powers included in the delegation, but also all implied powers needed to implement those powers. Laws granting home rule authority to local governments both grant authority to localities, but they also often protect local governments from intrusion by state agencies and the legislature. This means that although state legislatures can pass laws requiring localities to meet state minimum standards, or preempting local authority over certain matters of state concern, often there are requirements that the laws be generally applicable to all local governments of similar size or classes, and in some states certain laws must be passed by supermajority (e.g., 2/3 of legislature must approve). David J. McCarthy, Jr. & Laurie Reynolds, *LOCAL GOVERNMENT LAW IN A NUT SHELL* (5th ed. 2003).
- 28 In the aftermath of Sandy, the New York City mayor issued Executive Order No. 230 suspending height and other zoning restrictions that prevented property owners from rebuilding structures to complete with updated FEMA flood standards. The City of New York Office of the Mayor, *Executive Order No. 230, Emergency Order to Suspend Zoning Provisions to Facilitate Reconstruction in Accordance with Enhanced Flood Resistant Construction Standards* (Jan. 31, 2013), [http://www.nyc.gov/html/om/pdf/eo/eo\\_230.pdf](http://www.nyc.gov/html/om/pdf/eo/eo_230.pdf). In October 2013, the City Council adopted an amendment to the city’s zoning ordinance to facilitate flood-resilient reconstruction, including requiring 1- or 2-feet of additional elevation based upon FEMA’s updated flood elevations, accommodating building access, requiring mechanical systems be located above flood levels, accommodating off-street parking, improving streetscape requirements, among other provisions. *New York City Flood Resilience Text Amendment to the Zoning Resolution* (Oct. 9, 2013), [http://www1.nyc.gov/assets/planning/download/pdf/plans/flood-resiliency/flood\\_resiliency.pdf](http://www1.nyc.gov/assets/planning/download/pdf/plans/flood-resiliency/flood_resiliency.pdf). New York City also updated its local Waterfront Revitalization Program (LWRP) to require development and redevelopment projects to consider and mitigate against the risks posed by climate change and sea level rise. The updated LWRP includes several policies to encourage projects to incorporate resilience measures: development and redevelopment must consider and minimize risks of flooding posed by climate change and sea-level rise over the project’s lifetime (Policy 1 and Policy 6); maritime and industrial development projects must minimize impacts to nearby neighborhoods and ecological resources (Policy 2); smaller sites of ecological significance may be targeted for restoration and enhancement (Policy 4); and green infrastructure strategies can be used to capture and retain stormwater and improve water quality (Policy 5). The NYC LWRP was approved by the City-council in December 2014, and adopted in June 2016 after being approved by state and federal agencies. NYC Planning, *The New York City Waterfront Revitalization Program* (June 2016), <http://www1.nyc.gov/site/planning/applicants/wrp/wrp.page>.
- 29 Henk Ovink, *Rebuild by Design: Redesigning the Design Competition*, URBAN SOLUTIONS, Issue 9 (Jul. 2016), [http://www.clc.gov.sg/documents/publications/urban-solutions/issue9/us\\_i9\\_8\\_EssayRedesigningtheDesignCompetition.pdf](http://www.clc.gov.sg/documents/publications/urban-solutions/issue9/us_i9_8_EssayRedesigningtheDesignCompetition.pdf).
- 30 Ovink, *Redesigning the Design Competition* at 48.
- 31 Municipal budgets forecast both the revenues that a city will take in (from property taxes, sales taxes, and other sources) and the expenditures it will incur to provide city services and to build and maintain capital improvements (like roads, bridges, and other public facilities). As part of its budgeting process, a city will often develop an operating budget (for expenses providing services) and a capital improvement budget (for costs to build projects to maintain or improve the city). Whereas the operating budget is generally paid out of the city’s general fund (annual tax revenues and other fees and payments), capital improvement projects can be financed, meaning that the city can let bonds to borrow money to pay for the costs to construct the project and then pay back the costs (plus interest) over the life of the improvement using special assessments, taxes, or fees. Municipalities often develop a capital improvement plan (CIP) to set priorities for funding needed capital improvement projects over a 3 to 5 year period. The CIP will analyze available funds and city needs, and compare and rank projects against each other. The city then develops a capital budget, which identifies appropriate funds and authorizes expenditures on priority projects identified in the CIP. Cities typically adopt a capital budget on a 1 or 2 year cycle. For a detailed description of municipal budgeting processes see Vicki Elmer, *Capital Improvement Plans and Budgets*, Univ. of Cal. Berkeley Dept. of City & Reg. Planning (undated).
- 32 For example, Sandy’s impacts were primarily caused by storm-surge-driven flooding (i.e., flood waters that piled up on the shore due to hurricane force winds offshore). As a result, many of the RBD grantees are focusing primarily on projects to build flood defenses. However, storm surges are just one of this region’s risk and the track and character of the next storm will differ from that of Sandy. Rain-driven flooding is also a threat in this region, as heavy downpours can easily overwhelm aging sewer systems and cause floodwaters to

back up into homes, basements, and streets. Those flood risks will be exacerbated by projected increases in precipitation due to climate change. Responding to stormwater flooding, however, requires different approaches. While storm-surge flooding is addressed through coastal defenses, rain-driven flooding is often addressed with green infrastructure and pumping stations.

- 33 Congress funded the Sandy recovery through more than 23 different federal programs, administered by more than 18 federal agencies or departments. These include: CDBG-DR, the Public Assistance and Hazard Mitigation Grant programs administered by FEMA, the Emergency Relief Program administered by the Department of Transportation, and the State Revolving Funds overseen by the Environmental Protection Agency, among others. Georgetown Climate Center, *Understanding the Adaptation Provisions of the Sandy Disaster Relief Appropriation* (H.R. 152) (May 2013) <http://www.georgetownclimate.org/reports/understanding-the-adaptation-provisions-of-the-sandy-disaster-relief-appropriations-act-h-r-152.html>.
- 34 FEMA HMGP expenditures must be “cost-effective,” and to determine cost effectiveness FEMA requires Benefit-Cost Analysis (BCA) that shows a benefit to cost ratio of greater than 1. 44 C.F.R. § 206.2. FEMA uses a benefit-cost worksheet that relies on historical flood data to calculate the cost effectiveness of a project. In past recovery efforts, this has limited the ability of grantees to factor in the long-term benefits of adapting to future impacts, in addition to other non-economic benefits such as recreational and ecosystem benefits provided by a project. Post-Sandy, FEMA has issued policies and tools that allow communities to consider future climate impacts and ecosystem services in their calculation of benefits. However, it is unclear whether states and localities will have the technical capacity to allow them to effectively leverage these new policies without further guidance on how to quantify future and non-economic benefits. FEMA guidance also only apply to FEMA programs and cannot be used to support any BCA requirements for programs administered by other federal agencies. FEMA, *Mitigation Policy – FP-108-024-01, Consideration of Environmental Benefits in the Evaluation of Acquisition Projects Under the Hazard Mitigation Assistance Programs* (Jun. 18, 2013), <https://www.fema.gov/media-library/assets/documents/33295>; FEMA, *Incorporating Sea Level Rise (SLR) into Hazard Mitigation Assistance (HMA) Benefit Cost-Analysis Frequently Asked Questions (FAQs)*, <https://www.fema.gov/media-library/assets/documents/89659>; see also FEMA, *Benefit Cost Tool Version 5.0 New Features* (Apr. 2014), <https://www.fema.gov/benefit-cost-analysis>.
- 35 See e.g., Jeffrey Thomas & James DeWeese, *Reimagining New Orleans Post-Katrina: A Case Study in Using Disaster Recovery Funds to Rebuild More Resiliently* (Aug. 2015); <http://www.georgetownclimate.org/reports/reimagining-new-orleans-post-katrina.html>.
- 36 “Co-benefits” generally refer to ancillary benefits that accrue from projects beyond their primary purpose. For example, depending on how it is constructed, a project primarily intended to reduce interior flood hazards by using natural systems to capture and retain rainfall may also provide additional environmental benefits, such as water filtration, infiltration to replenish aquifers and reduce subsidence, and cleaner air. When such an intervention also includes landscaped open space, it can also provide recreational amenities that also promote public health and wellbeing. FEMA has recently revised its Hazard Mitigation Assistance guidance and policies to explicitly encourage the incorporation of green infrastructure and nature-based systems into hazard-mitigation proposals. To facilitate the required benefit-cost analysis for funding applications, FEMA also has created a tool quantify so-called ecosystem services, including aesthetic value, air quality, recreational space and water filtration. See FEMA, *Hazard Mitigation Assistance Climate Resilient Mitigation Assistance Benefit Cost Analysis Tools Policy Clarification* (May 27, 2016), <https://www.fema.gov/media-library/assets/documents/110202>; see also Thomas, *Reimagining New Orleans Post-Katrina*, *supra* note 2.
- 37 In addition to the Stafford Act programs described above, Congress often appropriates disaster relief funds through the Community Development Block Grant (CDBG) program. The CDBG program is authorized by the Housing and Community Development Act of 1974 and administered by HUD. CDBG was originally created as a formula block grant program to support economic development activities of state and local governments. However, in disaster relief appropriations bills since Hurricane Andrew in 1992, Congress has appropriated funding to the CDBG program to also support disaster response and recovery (CDBG-DR). 42 U.S.C. § 5306(d) (2006); 42 U.S.C. § 5172(c)(1)(A) (2006), amended by Sandy Relief Act, sec. 428, 127 Stat. at 41. Brown, note 33 at 12; GAO-09-541, *Gulf Coast Disaster Recovery: Community Development Block Grant Program Guidance to States Needs to Be Improved* at 2 (Jun. 2009). The purpose of CDBG-DR funding is to provide long-term disaster recovery assistance to low- and moderate-income communities in the most “impacted and distressed areas.” Fifty-one percent of the grantees’ total CDBG-DR expenditures (including their RBD funding) must go to benefit low- and moderate-income (LMI) residents (unless this requirement is waived by HUD). 42 U.S.C. § 5306(d) (2006). For the purposes of the CDBG program, a “low- and moderate-income person” means a member of a family having an income equal to or less than the Section 8 low-income limit established by HUD every year. 24 C.F.R. § 570.3 (2012). Generally, a Section 8 low-income family is one whose annual income does not exceed 80 percent of the median income for the area, adjusted for family size. 42 U.S.C. § 5302(a)(20)(A).



- 38 HUD regulations also require the calculation of area-wide benefit based upon census block data. Where, for example, a project will benefit a whole city, the area-wide benefit of the project is calculated based on the median income of the census blocks in that city. 24 C.F.R. § 570.208. With the Hoboken project, for example, the flood defenses that the state plans to build with its RBD allocation will benefit almost all of the residents of the city of Hoboken. As a result, the grantee must calculate percentage of LMI across the city as a whole, and the LMI ratio is about 40 percent citywide. Additionally, HUD’s formulas for calculating LMI do not precisely capture the large regional differences in income and cost of living. In the New York and New Jersey counties that were affected by Sandy, the formulas calculate LMI as an income of approximately \$65,000 to \$75,000 for a family of four, but families in the greater New York metropolitan region face the highest costs of living to meet basic needs (housing, food, transportation, energy costs, etc.) in the country. HUD, Office of Policy Development and Research, *Data Sets, FY 2016 Income Limits Documentation System*, [https://www.huduser.gov/portal/datasets/il/il16/index\\_il2016.html](https://www.huduser.gov/portal/datasets/il/il16/index_il2016.html). While grantees can seek waivers from the LMI requirements, significant documentation is required to support a waiver request and LMI is one of the three core national objectives of the CDBG program. Additionally, where the area-benefit of the RBD projects to LMI residents will be less than 51 percent, this will make it more difficult for the grantees to show that 51 percent of their total Sandy CDBG-DR allocation is benefitting LMI residents.
- 39 In some cases, innovative green-gray projects have taken up to three years to permit. Kim Diana Connolly, et al., *Wetlands Law and Policy: Understanding Section 404* at 152 (ABA, 2005).
- 40 Based upon the specific needs in each region, the TCTs include officials from the Army Corps of Engineers (USACE), Federal Emergency Management Agency (FEMA), US Environmental Protection Agency (EPA), HUD, Fish and Wildlife Service (FWS), National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), the New York New Jersey Port Authority, transit agencies, state environmental agencies, etc.—all of the state, federal and other agencies that will need to be involved in permitting and funding recovery efforts.
- 41 “The grantee must certify in its Action Plan Amendment that it, or the local authority assuming ownership of a levee, will take action to ensure the levee is certified and meets FEMA standards at 44 CFR 65.10 and is subsequently accredited by FEMA, which allows for floodmaps to be re-drawn accordingly. HUD, *Third Allocation*, 79 Fed. Reg. 62182-01 (Oct. 16, 2014). HUD can also waive this requirement if the grantee is unable to get certification once the flood control structure is complete.
- 42 This certification can be used to justify remapping of a community’s floodplain maps, and areas protected by FEMA-certified levees are not subject to flood insurance purchase requirements or minimum floodplain regulations. This has a significant financial benefit for protected property owners, because it means that they would no longer have to carry flood insurance. FEMA, *Levees – Frequently Asked Question*, [http://www.fema.gov/media-library-data/20130726-1803-25045-4819/st\\_broomel.v.pdf](http://www.fema.gov/media-library-data/20130726-1803-25045-4819/st_broomel.v.pdf).
- 43 State procurement rules differ, however, all states have some form of rules requiring competitive bidding for certain types of contracts over a certain dollar amount. Amer. Bar Assoc., *Guide To State Procurement: A 50-State Primer on Purchase Laws, Processes and Procedures* (2011).
- 44 HUD, *Third Allocation* at 62190 [“Grantees should ensure that individuals with a strong working knowledge of both the RBD Project to be implemented and the overall proposal are among the consultants hired to advance the project. Given the unique knowledge and understanding that each RBD design team possesses regarding their respective proposal, grantees should consider how it may procure design team members noncompetitively... [T]he grantee is reminded of the provisions of 24 CFR 85.36, which set forth the conditions under which a grantee may engage in a non-competitive, single source procurement (§ 85.36(d)(4)). Grantees operating under part 85 are granted the authorization referenced under § 85.36 (d)(4)(i)(C) only regarding procurement of the design teams (or members of the design teams) that participated in the development of selected RBD proposals through the HUD-sponsored RBD competition.”].
- 45 Sole source procurement rules allow public entities to hire a contractor without competitive bidding, where only that one contractor has the expertise or skills needed to satisfy the agency’s contracting needs. Sole source procurement typically may only be used in “exceptional circumstances.” See *Government Contract Guidebook* § 3:7 (4th ed.). The federal government has specific rules for when and how sole source procurement can be used and states have their own rules, which can in some cases be more restrictive than the federal rules.
- 46 In New Jersey, for example, contracts for construction of public works projects over \$25,000 must be awarded through a competitive bidding process. N.J. Stat. Ann. § 52:34-7 (West). Bids must be evaluated by based upon pre-established criteria set in the bidding documents, and the contract must typically be awarded based upon cost (and in some cases conformance with evaluation criteria specified in the bid documents). In New Jersey, state agencies can bypass a lowest bidder by showing poor performance by the lowest bidder on a past contract. New Jersey also limits the ability of state agencies to award a contract without competition in the very limited

circumstances where the agency can show that the contractor is the *only source of supply available*. N.J. Stat. Ann. § 52:34-10 (West). For “professional services” contracts requiring specialized expertise, like architect and engineering services, state agencies can also use a request for qualifications process where the agency can select a contractor based upon qualifications and expertise rather than solely on cost. N.J. Stat. Ann. § 52:34-9.5 (West). However, contracts for the construction of “public works” project are subject to the competitive bidding requirements described above. Public works contracts involve contracts for the construction of public buildings or facilities. Bidders that are not awarded a contract can also protest the award of the contract through various administrative and civil proceedings. N.J. Admin. Code §§ 17:12-3.1 – 3.3.

- 47 “Upzoning” is an informal, but broadly understood, term of art that means “a rezoning or reclassification to a more intensive use category” allowing for increased densities or a broader range of permissible activities on a parcel or area of land. Rathkopf’s *The Law of Planning and Zoning* (4th Ed. 2016), §38:12.
- 48 Tax-increment financing (TIF) is a method of financing a project or development in a designated geographic area based on the anticipated increase in property tax assessments that will be generated by the project. Tax Increment Financing originally was utilized as a means of financing the redevelopment of “blighted” areas, but its use has expanded to include municipal or private financing of infrastructure improvements. The TIF model is appealing because it allows development or infrastructure projects to self-finance. The tax revenue from the increase in assessed property value (caused by the development) is used to repay the cost of the infrastructure development. This process allows a local government to finance a capital project without raising property tax rates or exceeding a municipal debt limit. See Smart Growth America, U.S. PIRG Education Fund, *Tax-Increment Financing: The Need For Increased Transparency and Accountability in Local Economic Development Subsidies* (2011).
- 49 For example, to use the TIF model, Hoboken must follow the requirements established in the state enabling law, the New Jersey TIF Revenue Allocation District Financing Act passed in 2002. NJ Stat. Ann. § 52:27D-459 *et seq.* Under the Act, the Hoboken City Council would need to pass an ordinance designating an area as a Revenue Allocation District. Non-contiguous areas may be included as part of a single district if the municipality can show that such areas comprise “part of a common development project or plan.” NJ Stat. Ann. 52:27D-462.
- 50 See generally Furman Center for Real Estate & Urban Policy, New York University, *Sandy’s Effect on Housing in New York City* (Mar. 2013), [https://s3.amazonaws.com/KSPPProd/ERC\\_Upload/0083708.pdf](https://s3.amazonaws.com/KSPPProd/ERC_Upload/0083708.pdf); see also Enterprise Community Partners, *Hurricane Sandy Housing Needs One Year Later* (Oct. 2013), [https://s3.amazonaws.com/KSPPProd/ERC\\_Upload/0083708.pdf](https://s3.amazonaws.com/KSPPProd/ERC_Upload/0083708.pdf).
- 51 The US Climate Resilience Toolkit (<https://toolkit.climate.gov/>), NOAA’s Climate.gov (<https://www.climate.gov/>), Digital Coast (<https://coast.noaa.gov/digitalcoast/>), and the Sea Level Rise Viewer (<https://coast.noaa.gov/digitalcoast/tools/slr.html>).