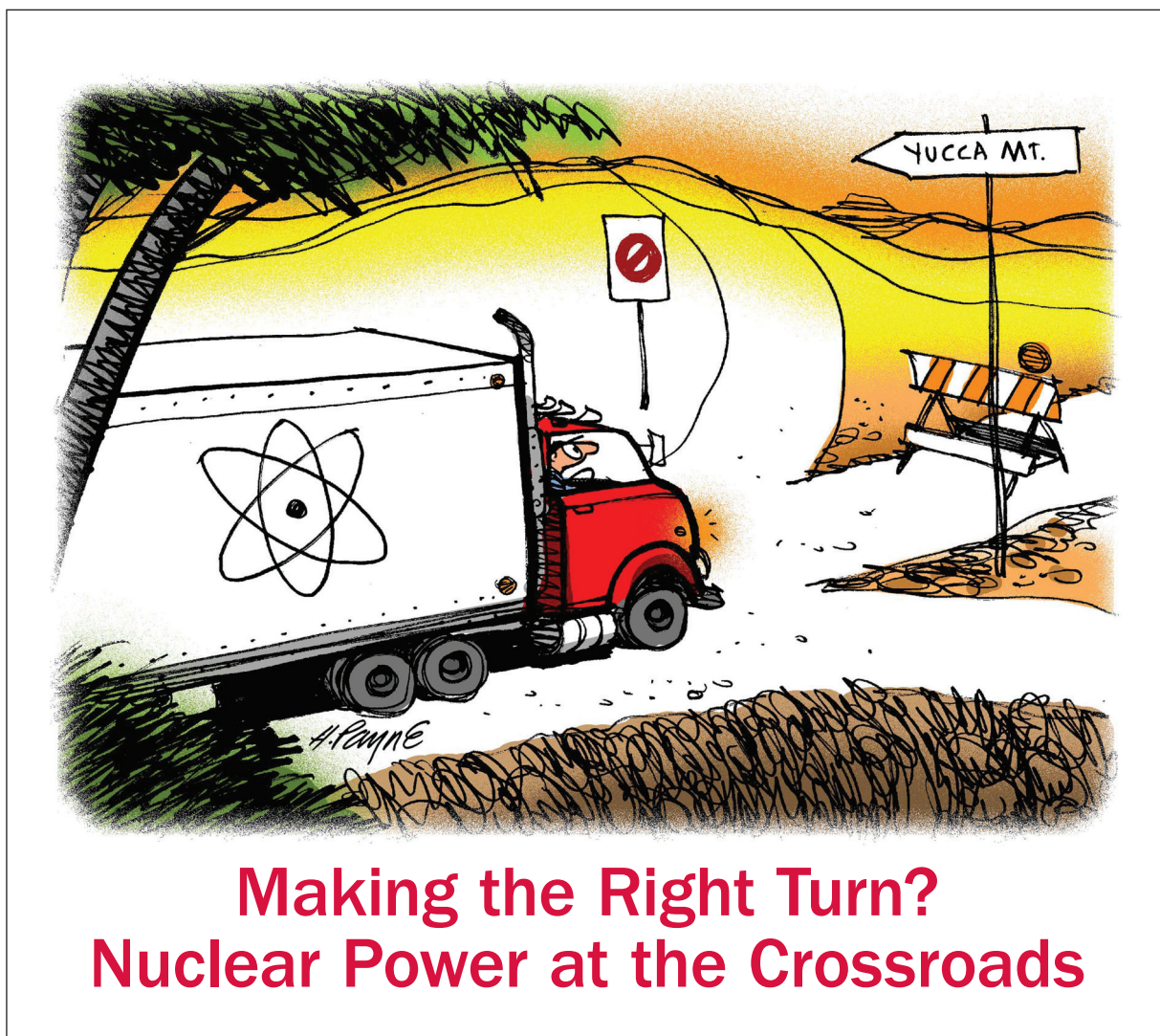


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*Planning Utilizing  
Principles of SAGE*



## THE FORUM

# Starting Before Sandy, and in Response to Even Worse Storms Predicted, a Gathering Movement Known as SAGE

**F**or just over a year, a group of engineers, environmental scientists, and public policy specialists in government and the private sphere has been meeting under the banner of SAGE — Systems Approach to Geomorphic Engineering. As these experts opine in the following pages, the SAGE methodology is just what is needed to alleviate storm damage, predicted to worsen with global warming and sea-level rise over the coming decades. As SAGE

proclaims, these experts' vision is a blend of gray and green infrastructure, using natural systems and "living shorelines" to absorb wind and stormwater. The group is using the best available science to predict the future of storm impacts and plan accordingly, bridging political and institutional divides into an approach known as hybrid engineering, an approach that will cost less and provide more protection than traditional reliance on hard infrastructure.



*“Deploying multiple lines of defense and addressing the Gulf Coast as a system that extends beyond geographic and political boundaries are key factors in building resilience.”*

**Chuck Barlow**

Vice President, Environmental Policy & Strategy  
ENERGY



*“SAGE looks at the entire coastal system, not just one component, and implements solutions that anticipate changes to the environment.”*

**James Dalton**

Chief, Construction and Engineering  
U.S. ARMY CORPS OF ENGINEERS



*“This concept uses hybrid engineering, linking soft, ecosystem-based approaches with hard infrastructure approaches to develop innovative techniques.”*

**Margaret A. Davidson**

Director Office of Ocean and Coastal Resource Management (acting)  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



*“Communities are the first and last line of defense in reducing vulnerability to floods and the harmful impacts of climate change.”*

**Samantha A. Medlock**

Policy Counsel  
ASSOCIATION OF STATE FLOODPLAIN MANAGERS



*“These initiatives represent voluntary, collaborative approaches to changing the nation’s response to coastal and inland storms and flooding.”*

**Erik J. Meyers**

Vice President  
THE CONSERVATION FUND



*“If we really want to protect our residents and the ecosystems in which we live, we must universally adopt more resilient approaches. We need to start now.”*

**Kevin Shafer**

Executive Director  
MILWAUKEE METROPOLITAN SEWERAGE DISTRICT

# Overcoming Barriers To Resilience

CHUCK BARLOW

**W**e all share common aspirations: Ensuring our families' safety, preserving our quality of life, and enhancing prosperity. The livelihoods of 12 million people who live near the Gulf Coast, the sustainability of rich natural resources that support \$634 billion in annual GDP, and the security of residential, commercial, and industrial assets valued at over \$2 trillion are increasingly vulnerable to storm surge, flooding, and wind damage.

Entergy is a utility headquartered in New Orleans, providing electric service to 2.8 million customers who live in Louisiana, Mississippi, Texas, and Arkansas. In 2005 and 2008, Entergy was hit with devastating hurricanes. Most recently we found ourselves in the cross-hairs of Hurricane Isaac. Our customers, our employees, and our families living in these coastal communities are concerned about managing the risks of extreme weather. Regardless of our individual positions on the causes of extreme weather, sea level rise, subsidence, or coastal erosion, we can contemplate what life will be like if we fail to build more resilient, sustainable communities that can stand up to a changing climate. The picture is not pretty.

In 2010 Entergy published the "Gulf Coast Adaptation Study" to provide a factual base to quantify climate risk in the Gulf Coast and to help inform sensible approaches for avoiding losses. We found that the Gulf Coast is vulnerable to growing environmental risks and currently faces average annual expected losses of \$14 billion. Assuming no change in climate factors, average annual losses are expected to rise to \$18 billion per year by 2030 as the economy grows,

more development takes place in at-risk areas, and we continue to lose the natural protections to storm events that are provided by our diminishing coastal wetlands. There is a non-trivial risk that these losses could be much higher if the climate change that many predict brings higher sea levels and a higher number of more intense storms.

Partnering with America's Wetlands Foundation, Entergy participated in 11 Blue Ribbon Resilient Community Leadership Forums to create awareness, identify vulnerabilities, and plan for ways to build more resilient Gulf Coast communities. We also held two Technical Conferences with our customers at local universities to discuss the coordination and prioritization of Entergy's utility infrastructure resilience investments in ways that align with our customer's own resiliency efforts. The goal of this coordinated action is the minimization of business interruption losses.

This outreach confirmed for Entergy the importance of a risk management frame of thinking about these issues — of testing ourselves against future scenarios that consider climate change, discovering where we are vulnerable, and identifying what cost effective measures exist for managing these risks. We also confirmed that collective, community-wide, and cost-effective action is necessary to build resilient communities.

In the near term, we have attractive, cost effective options for increasing resiliency, bolstering our economy, and restoring our environment. Examples include improved building codes, coastal wetlands restoration, and stronger levee systems in strategic locations. The "Gulf Coast Adaptation Study" has identified \$49 billion in investments over the next 20 years that would effectively avert \$137 billion in losses over the lifetime of the measures.

Deploying multiple lines of defense and addressing the Gulf Coast as a system that extends beyond geographic and political boundaries

are key factors in building resilience. An excellent example of this is the Louisiana Coastal Protection Master Plan that was approved in 2012. We will need to ensure that all levels of government enact policies and set funding priorities that support and maintain the security of critical at-risk coastal infrastructure and ecosystems. We must establish the financial capacity to act by blending reliable, long-term funding streams that are dedicated to coastal restoration and protection. One potential example of this funding stream, developed by Sarah Mack of Tierra Resources with funding assistance from Entergy, is a first-of-its-kind methodology that allows the calculation, verification, and marketability of carbon sequestration benefits from coastal wetlands. This methodology is now certified by the American Carbon Registry.

Along the way, we must keep in mind the human dimensions of climate adaptation. We must recognize the importance ecosystem services from coastal wetlands play in our cultural and economic well-being. Importantly, we cannot forget the implications of climate change on the poor. We must help those who are most vulnerable become more resilient while at the same time helping them escape poverty.

Our old friend Noah had to rely on inside information regarding catastrophic climatic changes facing his society. His motivation was not obvious to those around him, and because of that he faced ridicule. But, he acted boldly for the protection of his family and, ultimately, humanity. To the contrary, the evidence of our current need for action is all around us. Ours is not a difficult, ambiguous call to act on faith, but a call to react to what the eye can see and the mind can know.

**Chuck Barlow** is vice president of environmental policy & strategy at Entergy. He was assisted in the preparation of this article by **Jeff Williams**, who is Entergy's Director of Climate Consulting.

# Sandy Shows We Must Use Holistic Approach

JAMES DALTON

Every level of government has a stake and role in promoting resilient coastal systems, an issue the U.S. Army Corps of Engineers has been actively engaged in since 1930. Our nation is now confronted with an increased frequency and intensity of storms, changes in the climate, and severely restrained funding. Superstorm Sandy is demonstrative of the storms and resulting damage we'll likely experience more frequently. Sandy was the third storm system in the past 20 years that merged a nor'easter and a hurricane, creating a much larger, more intense storm than those in the past and impacting coastlines from Chincoteague, Virginia, to Montauk Point, New York.

A NASA comparison of hurricane Katrina and extra-tropical cyclone Sandy found both storms brought winds over 110 miles per hour, but that Katrina's winds affected about a 300 mile area, while Sandy brought the same intensity to a 900 mile area. Enormous storm systems like Sandy touch numerous coastal communities, towns, governments, people, and ecosystems with high intensity at the same time. This phenomenon of larger, more intense storms with far-reaching damage will continue to occur and causes us to consider what restoring resilience to the mid-Atlantic coast could look like, an area now home to nearly one-quarter of the U.S. population, and the base of the national economy.

The Corps is a part of a collaborative effort that provides a unique solution and opportunity to address these emerging and persisting challenges called SAGE. SAGE, or

Systems Approach to Geomorphic Engineering, is a community of practice composed of engineers, physical and environmental scientists, educators, and public policy specialists who work together to advance the knowledge and application of hybrid solutions and practices to restore coastal resilience. Hybrid solutions combine green measures, such as sand dunes and grasses that are softer and more natural, with gray solutions, which tend to be harder structures such as a sea wall, providing an economical solution that promotes a healthy environment while creating a more resilient shoreline.

The SAGE approach looks at the entire coastal system, not just one component, and works to implement hybrid engineering solutions that anticipate changes to the natural environment and provide protection for the coastline. SAGE was initially envisioned by the Corps, the National Oceanic and Atmospheric Administration, and the Federal Emergency Management Agency but has since added experts from states, academia, non-governmental organizations, private sector engineering organizations, and other agencies.

This community of federal, state, academic, non-profit, and private sector experts and practitioners will continue to pursue advanced and comprehensive views of the changing shoreline to make those communities more resilient to consequences of urbanization, climate change, increased storminess, and other changes.

As evident in Sandy, we can no longer approach coastal resilience piecemeal by looking at one community at a time. We have to implement projects in an integrated way that considers regional factors such as the physical setting, geology, geomorphology, watershed, habitat, economy, community at risk, and the surrounding communities. This systems approach could lead to a

coastal system more capable of withstanding more intense storms and other effects of climate change.

The federal government cannot afford to implement all the solutions needed; we must work with our state, local, and nongovernmental partners to utilize the SAGE approach to better protect the coast. SAGE works with the natural system and maximizes green and gray solutions over an entire region to employ solutions that protect coastal communities and minimize impacts to the environment under changing conditions.

Sandy is an opportunity to apply SAGE principles to restore resilience to the mid-Atlantic region and to transform the way we think about building coastal infrastructure. In order to do so, we must look at the whole coast, instead of pockets and parcels. Secondly, areas between major federal projects must be protected with green, less expensive, and separately financed solutions. Third, measures along the coast must be integrated so that we use natural systems to maximize green and gray solutions over an entire region. Lastly, restoring resilience to the coast following Sandy requires multiple levels of government, new partners, and new ways of collaborating. We must work with our state, local, and nongovernmental partners to utilize the SAGE approach to better protect the coast.

**James Dalton** is chief of construction and engineering for the U.S. Army Corps of Engineers.

# A Varied Response Builds in Resiliency

MARGARET A. DAVIDSON

**T**he infrastructure needed to protect our communities from future events like Hurricane and Post-Tropical Cyclone Sandy is more varied than concrete sea walls and other hard structures. Wetlands, dunes, coral and oyster reefs are more than places that animals and fish call home; they protect water quality and are also a vital natural buffer providing physical protection against coastal inundation and surge. Investments in green infrastructure are a cost-effective way to protect coastal communities, while also providing additional benefits, such as opportunities for recreation and enjoyment, improved aesthetics, and nursery habitat for fish species, that are not provided by traditional gray infrastructure.

Small communities like Point Lookout, Lido Beach, and Atlantic Beach in New York, which all invested in enhanced sand-dune buffer habitats, suffered relatively little damage from Sandy compared to nearby Long Beach, which decided against maintaining a sand dune buffer and suffered \$200 million in property and infrastructure damage according to initial estimates. On Staten Island, a restored wetland served as a giant sponge, absorbing the flood waters and reducing height and duration of flooding. Damages on the bay side of the island were much less severe than on the ocean side, which had no such natural protection.

With the idea that healthy, intact habitats provide protection to the lives and property behind them, over the past year the National Oceanic and Atmospheric Administration has partnered with the U.S. Army Corps of Engineers, the Federal Emergency Management Agency, and The Na-

ture Conservancy to develop the Systems Approach to Geomorphic Engineering, or SAGE, initiative. The purpose is to collaboratively pursue and advance a comprehensive view of shoreline change and to employ integrated approaches for coastal landscape transformation to slow, mitigate, adapt to, and perhaps even prevent adverse impacts to coastal communities and the ecosystems they rely on from the consequences of extreme weather and climate change.

This concept uses a holistic approach in exploring the idea of hybrid engineering, linking soft, ecosystem-based approaches with hard infrastructure approaches to develop innovative techniques to aid in adaptation to our changing coastlines. This coastal landscape transformation initiative looks at capturing various elements of the “living shoreline” concept by looking at processes and appropriate actions to minimize impacts to coastal communities and shorelines, while also maximizing economic benefits.

While this initiative is being developed between these initial partners, early discussions have confirmed broader interest in collaboration across the academic community, various non-governmental organizations, the private sector, and other federal partners.

NOAA’s unique combination of information and tools help everyone from homeowners to neighborhood associations to government at all levels prepare for, respond to, and recover from extreme events and other coastal changes in resilient and sustainable ways. The Digital Coast ([www.csc.noaa.gov/digitalcoast](http://www.csc.noaa.gov/digitalcoast)) serves up a range of useful data and tools (from a wide range of trusted sources) and the training needed to use them — including coastal Lidar elevation data, a sea level rise and flooding impact viewer, and tutorials on climate adaptation and a roadmap for adapting to coastal risk.

Recovery efforts must consider more than reacting to impacts; they must also include efforts that enhance resiliency so that coastal communities and economies bounce back

easily from disruptive events. Instead of repeated damage and continually escalating demands for federal disaster assistance, resilient communities proactively protect themselves against extreme events, build self-sufficiency, and become more sustainable. Recent support for incorporating resilience as a key recovery concept has been supported at the federal, state, and local level. NOAA’s coastal resource and fishery habitat programs work with communities to reduce risk, pinpoint vulnerabilities, and use technologies to prepare for and minimize hazards.

Rebuilding wisely and with resilience in mind just makes sense. According to the U.S. Chamber of Commerce Business Civic Leadership Center, “Pre-crisis investment in upgrading physical urban infrastructure can save countless dollars in post-crisis rebuilding efforts, particularly in coastal urban areas with dense populations and significant GDP concentrations. While fiscal pressures and competing pent-up demand for new infrastructure projects present limitations on government, investment in infrastructure maintenance, land use management, and resilience can make an enormous difference.”

Innovative approaches are critical and necessary as our coastal communities and shorelines are facing escalating risks from more frequent and more powerful storms, sea-level rise, and changing precipitation patterns that can have dramatic impacts on coastal communities, economies and ecosystems around the country. While the threats of these events may be inevitable, our ability to understand how to best adapt to the impact by utilizing a blend of natural systems and hard infrastructure, will be important as we explore best practices and appropriate solutions to ensure the resiliency of our coastal communities and shorelines.

**Margaret A. Davidson** is the acting director of NOAA’s Office of Ocean and Coastal Resource Management and lives in Charleston, SC at 8.5 feet above the adjacent marsh.

# Low-Hanging Fruit Ready for the Harvest

SAMANTHA A. MEDLOCK

**F**lood risk in the United States is projected to continue to rise due to persistent development in flood-prone areas and the impacts of a changing climate. This trend is particularly stark and undeniable along the nation's coasts, as illustrated most recently by Hurricane Sandy. Recognition of the lower costs, multiple benefits, and aesthetic advantages of green infrastructure has brought about renewed interest in alternatives to the costly and brittle approaches of levees and coastal floodwalls. However, significant policy and social barriers continue to drive unsound and unsustainable decisionmaking at the state, regional, and local government levels for all but a bold and brave few who adopt standards to prevent future flood losses and better prepare their communities for climate change impacts.

Communities are the first and last line of defense in reducing vulnerability to floods and the harmful impacts of climate change. Although the federal government plays an important role through making data and funding available to support decisionmaking, development planning and permitting is performed by states and, most often, local governments through comprehensive land use plans, zoning and land use regulations, and building codes. Technical assistance programs such as the U.S. Army Corps of Engineers programs for Planning Assistance to States, Floodplain Management Services, and the Silver Jackets program support innovative management of flood risk along with other water resources challenges. However, demand for this technical assistance far exceeds program capacities. Significant ex-

pansion of the authorities for PAS and FPMS would help promote SAGE concepts, educate local leaders on the benefits of green infrastructure strategies, and ultimately help reduce flood losses and costs to the nation's taxpayers in the form of disaster relief.

The Principles and Guidelines for Water and Land Related Resources Implementation Studies, which guide federal water resources projects and planning, have remained largely unchanged for 30 years. Numerous studies have noted the current P&G bias favoring structural measures, unwieldy treatment of environmental and social values that are difficult to quantify, and misalignment with national goals of public safety and environmental protection. The Water Resources Development Act of 2007 directed that the 1983 P&G be revised for use in the formulation, evaluation, and implementation of water resources projects.

The revised P&G needs to integrate opportunities to apply green infrastructure approaches wherever possible and account for uncertainties associated with climate impacts, while more fully leveraging state and local authorities in land use, infrastructure maintenance, and building codes.

Executive Order 11988 seeks to minimize actions that result in "adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative." Recent research has identified a pattern of uneven and incomplete implementation of EO 11988 across departments and programs. New guidance to apply to all agencies would help ensure a unified approach to ensure that federally supported activities in flood-prone areas help reduce flood losses. Key areas for consideration include the following.

First, definition of areas of flood risk need to apply best available data

to account for sea-level rise and other hydrologic changes associated with climate change, as well as non-climate-related changes that are reasonably foreseeable.

Second, the issue of applicability for publicly owned treatment works needs to be addressed. Federally funded water and wastewater facilities are often placed in special flood hazard areas. When these systems are damaged in flood events, populations lose access to potable water supplies and these systems require costly repair or replacement. To qualify for federal funding, these critical facilities need to be placed outside special flood hazard areas and floodproofed.

Third, the issue of applicability for programs that facilitate community development needs to be addressed as well. Particular emphasis is needed on those programs that support transportation, housing, economic development, utilities, and other infrastructure that drive local planning and development decisions.

While land use and development decisions are largely nonfederal functions, federal standards and funding — including the \$50.5 billion aid package enacted for Sandy and other disasters — play a significant role in shaping those decisions. Federal policies and programs are already in place to prevent unwise use of the nation's floodplains and coasts and to promote SAGE principles; they are only in need of modernization to apply the many lessons learned over a generation of mounting flood losses. Coastal and flood risk professionals across all relevant disciplines and levels of government stand ready to support the administration in its mission to respond to Hurricane Sandy, while preparing the nation for the floods to come.

**Samantha A. Medlock, J.D., CFM**, is policy counsel for the Association of State Floodplain Managers, and has more than 20 years of experience in land use planning and law, hazard mitigation, and environmental policy.

# The First Wave of Change

ERIK J. MEYERS

To prevent placing American lives, property, and the economy in peril, fundamental change is needed in our approach to flood protection. NOAA's 2012 update on relative sea level change along U.S. coastlines showed levels increasing by eight inches or more along the Atlantic and Gulf coasts during the past half century. Precipitation is also changing. While 2012 saw deep drought in parts of the United States, 2010 and 2011 were among the two wettest years on record and produced record floods.

In *The Emperor's New Clothes*, the monarch's vanity blinds him to the fact that he had purchased nothing but an illusion. As he preens before his subjects, a child loudly describes the obvious while adults pretend otherwise. Like that child, last fall's Hurricane Sandy laid bare the consequences of societal self-deception about the impact of a changing climate. Although it serves us poorly, too much of our present approach to coastal protection relies on science and engineering designs that are decades out of date. Continuing to rely on illusion will cause needless suffering for those directly in the path of storms and inflict unnecessary financial burdens on all taxpayers. It's time to face reality and implement approaches that will work for waterfront communities.

The need to refresh our approach to flood protection and minimization is not limited to the coasts. During 2011's Hurricane Irene, places such as Vermont and upstate New York suffered some of their worst flooding on record. Intense rains overflowed long-compromised natural river and stream floodplains. And even ordinary rain-

fall causes many of the nation's largest population centers to suffer severe flood damage and polluted water.

How have we gotten to this point? One answer can be found in the nation's growth and concentration. Coasts and waterfronts have attracted over 80 percent of the nation's population. Other answers lie in excessive development and development in the wrong places. But, overwhelmingly, the reasons are too little investment in flood and stormwater protection generally and very little investment at all in approaches that will stand up to increased demands imposed by a changing climate. Instead of designing with nature and using natural infrastructure elements such as productive wetlands, functioning dune systems, and intact floodplains, to the extent funds have been available, we have continued to lean too heavily on structural approaches that are expensive to build and maintain and yet do not provide resiliency to extreme events.

Are there prospects for change? In fact, there are several promising initiatives. Three national efforts are promoting greater use of green or natural infrastructure better integrated with engineered or gray infrastructure solutions. Engineers and marine and geophysical scientists have begun rethinking coastal protection measures through a collaborative initiative, the Systems Approach to Geomorphic Engineering. SAGE has brought together experts from Army Corps of Engineers, National Oceanic and Atmospheric Administration, Federal Emergency Management Agency, academia, conservation organizations, and professional engineering groups. The initiative sees integrating traditional structural or "gray" coastal protection measures such as sea walls, breakwaters, and engineered dunes more effectively with natural or "green" nonstructural elements such as living shorelines and restored coastal marsh and mangroves to deliver more resilient protection for American coastal areas facing higher sea levels and damaging storms.

Organized by the Association of State Wetland Managers and the Association of State Floodplain Managers, the Natural Floodplain Function Alliance is focused on restoration of floodplains. Participation includes agencies, organizations, and individual experts who are sharing information, building best practices, and encouraging policies and practices that integrate natural floodplain management into development codes, stormwater ordinances, watershed management, greenways, local and regional parks, and green infrastructure and mitigation plans.

A growing consortium of regional and local governments, professional associations, and voluntary water organizations, known as the Urban Water Sustainability Council, is working with EPA and the Council on Environmental Quality on identifying best practices and promising approaches in deploying green infrastructure techniques blended with engineered systems. A late 2012 White House working session convened a broad cross-section of experts from these interests to propose ways green infrastructure could improve municipal stormwater management and reduce future environmental hazards and localized flooding damage.

These initiatives represent voluntary, collaborative approaches to changing the nation's response to coastal and inland storms and flooding. While it may take generations to reduce the level of greenhouse gases in the atmosphere — and many years to alter congressional gridlock on comprehensive climate policy — we can move now on improving our climate adaptation responses. Science-based approaches that better integrate natural and engineered protection systems can shape safer, more productive communities that are more resilient to the next wave of storms.

**Erik Meyers** is Vice President at The Conservation Fund in Arlington, Virginia. He is also a member of the SAGE initiative and the Urban Water Sustainability Council.



# Our Experience Implementing Resiliency

KEVIN SHAFER

It's not if, it's a question of when the next megastorm hits. So, how are we going to deal with it? How do we prepare our infrastructure systems? How do we take steps now to minimize the impacts of that storm on our residents and the environment? These are all critical questions that water utility managers around the country are considering.

It is these types of questions to which Hurricane Sandy opened all our eyes. Through the hindsight of this storm, we learned that we must consider more than simply regulatory compliance. This storm moved us closer to thinking about the bigger role that infrastructure plays in our futures. No longer do we need to just convey a drop of water or provide a road to move vehicles. Sandy has invigorated a discussion about looking more broadly at how infrastructure interrelates with nature and our communities.

What we all have to understand is that the planning and preparation needs to start now, even if we don't see another Sandy-like storm for 50 years. It can take up to 10 years simply to plan, design, and build major urban infrastructure. Then, once built, these projects can have an operational life of up to 50 years. So, projects built now must meet their intended goals for the next 60 years while also providing resiliency to our changing climate. In simple terms, we need to make sure that we squeeze multiple benefits from our infrastructure. We will need to go beyond our engineering design criteria and develop an expanded set of criteria that reduces and maybe even reverses our ecosystem impacts.

In Milwaukee, we dealt with a

similar megastorm in July 2010; seven inches of rain fell in a very short amount of time, about four inches in one hour. Flooded homes and businesses, sinkholes, and damage to public and private infrastructure resulted. Fortunately, the Milwaukee Metropolitan Sewerage District had already initiated a green infrastructure program to add resiliency to our infrastructure program.

Initiated in 2000, the first endeavor to come from this new approach is the Greenseams Program. Greenseams is a land purchasing effort that protects environmental corridors adjacent to our waterways. These lands help to reduce flooding and also reduce rural stormwater pollution and provide ecosystem improvements such as habitat restoration. Greenseams is a huge success, and we have protected over 2,500 acres of vital ecosystems. Combine this with an extensive, award winning county park system, and we start to see the green seams that are connecting our developed world with nature.

Building from this success, MMSD initiated a residential rain barrel program. Through our rain barrel efforts, we divert 55-gallon food grade barrels from landfills and employ inner city youth to convert them to catchment vessels. We sell these to homeowners who catch and reuse their roof runoff for landscape plants. Not only does this reduce runoff, but it also reduces the amount of energy needed to convey and in some cases treat water. Even in a region of plentiful water, we have sold over 16,000 rain barrels.

MMSD also initiated a funding program that helps to reduce the costs of rain gardens, green roofs, porous pavement, bioswales, and other green features. The purpose of the effort is to reduce the volume of rainwater that reaches the sanitary and combined sewer systems. The added benefits include reduced heat island effects, pollutant removal from runoff, and reduced energy usage.

As utilities, we also must consider our energy footprints. It takes a great deal of energy to clean and convey water. Efficient energy usage is critical. Efficiency reduces our greenhouse emissions, and our ratepayer costs. Beginning this year, Milwaukee will go one step further: we will begin capturing landfill gas, transporting it to one of our water reclamation facilities, and producing energy from what was once considered a waste product. This project reduces our ratepayers' financial burden, our use of fossil fuels, and our greenhouse gas emissions.

Milwaukee started these efforts in 2000. We are 13 years down this resiliency path, and there are many other cities moving forward with us. Even with this unified effort, resilient planning is still just a novelty. If we really want to protect our residents and the ecosystems in which we live, we must universally adopt more resilient approaches. We need to start now.

**Kevin Shafer, P.E.**, is Executive Director of the Milwaukee Metropolitan Sewerage District.