The NAI Approach to Floodplain Management

Mitigation & Floodplain Management

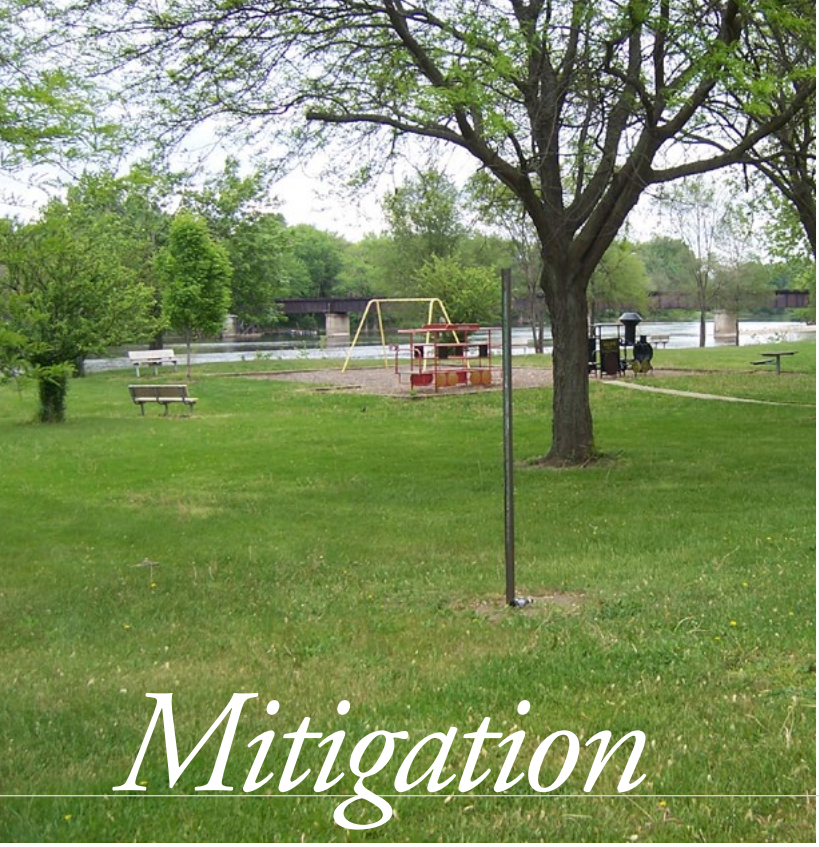
Mitigation Tools

Case Studies

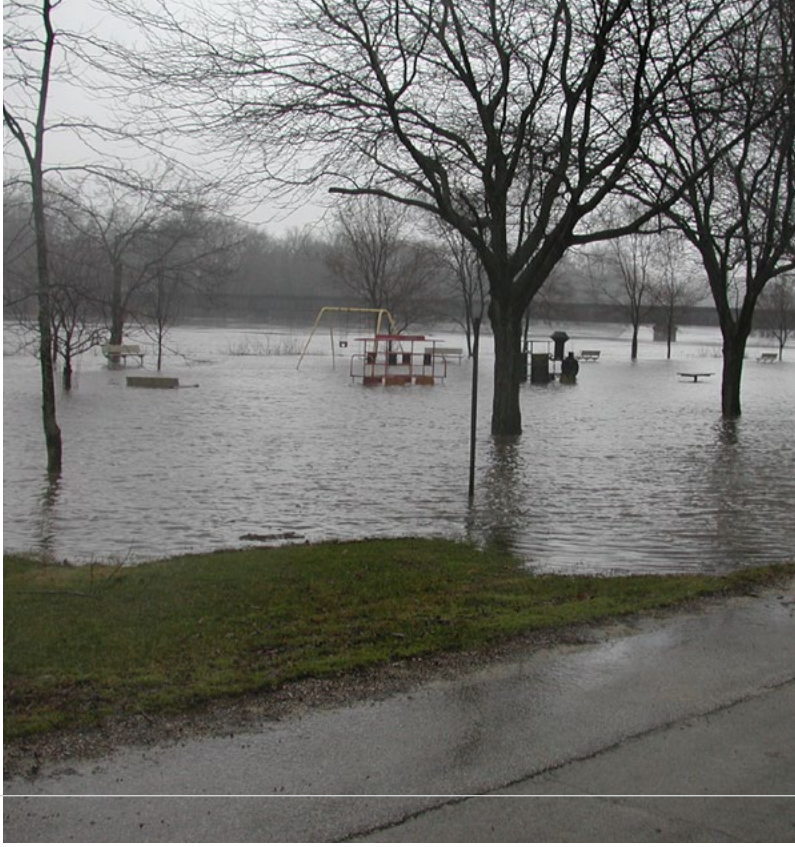
NAI How-to Guide for Mitigation

How-to Guide for No Adverse Impact Mitigation • July 2013/Updated 2016

Mitigation



Mitigation



This park in Aroma Park, IL, illustrates the NAI approach. Waterfront properties serve the community with open, green space, but damage is limited during a flood. Photo credits: "Dry" photo by French & Associates, "Wet" photo by Kankakee County Planning Department.

SECTION ONE
The NAI Approach

SECTION TWO
Mitigation & Floodplain Management

SECTION THREE
Mitigation Tools

ON THE COVER:

Photo courtesy of the FEMA media library.

This playground equipment was built using natural materials while providing fun features for kids to explore. Cedar River at the Charles City Riverfront Park, IA. Photo courtesy of the city of Charles City, IA.

SECTION FOUR
Case Studies

SECTION FIVE
Resources & Fact Sheet

Contents

Acknowledgements

The approach taken to develop the NAI How-to Guides was truly a partnership effort. Special appreciation is extended to the following who assisted in creating this publication:

- Association of State Floodplain Managers' No Adverse Impact Committee, especially project leads Terri Turner, AICP, CFM, Development Administrator, Augusta (GA) Planning & Development and Christy Miller, CFM, Progam Manager, Tetra Tech, Anchorage, AK
- ASFPM Mitigation Committee, especially Deb Mills with Dewberry who served as the overall technical editor
- ASFPM Executive Office, especially Drew Whitehair, CFM, as project lead, and Michele Mihalovich who edited the update
- Michael Baker International, especially George Riedel and Benj Korson as project leads
- ASFPM Foundation

Technical Reviewers (Alphabetical Order):

- Chad Berginnis, CFM, Executive Director, ASFPM
- Kimberly Berginnis, CFM, Wisconsin Department of Emergency Management
- Bill Brown, P.E., Stormwater Executive Manager, Arlington, TX
- Larry Buss, Retired U.S. Corps of Engineers, IA
- Dave Carlton, P.E., D.WRE, CFM, Principal, dkcarlton& associates, WA
- Steve Ferryman, CFM, State Hazard Mitigation Officer, OH
- Dave Fowler, Senior Project Manager at Milwaukee Metropolitan Sewerage District, WI
- Al Goodman, Principal, AWG Consulting, MS
- Larry Larson, PE, CFM, Senior Policy Advisor, ASFPM
- Jen Marcy, Project Manager, Atkins, NY
- Steve McMaster, Senior Hazard Mitigation Specialist, MN
- Jeanne Ruefer, Regional Program Management Lead, Tetra Tech, NV
- Darrin Punchard, Senior Project Manager, AECOM, MA
- Ranko Pudar, PMP, P.E., CFM, President, Pudar Mitigation Consulting, GA
- Katrien Werner, Publications Specialist, ASFPM, WI
- Paul Woodward, Groundwater Management Engineer, Papio-Missouri River NRD, NE
- Andy Yung, P.E., CFM, Principal, Walter P. Moor, The Woodlands, TX

Introduction

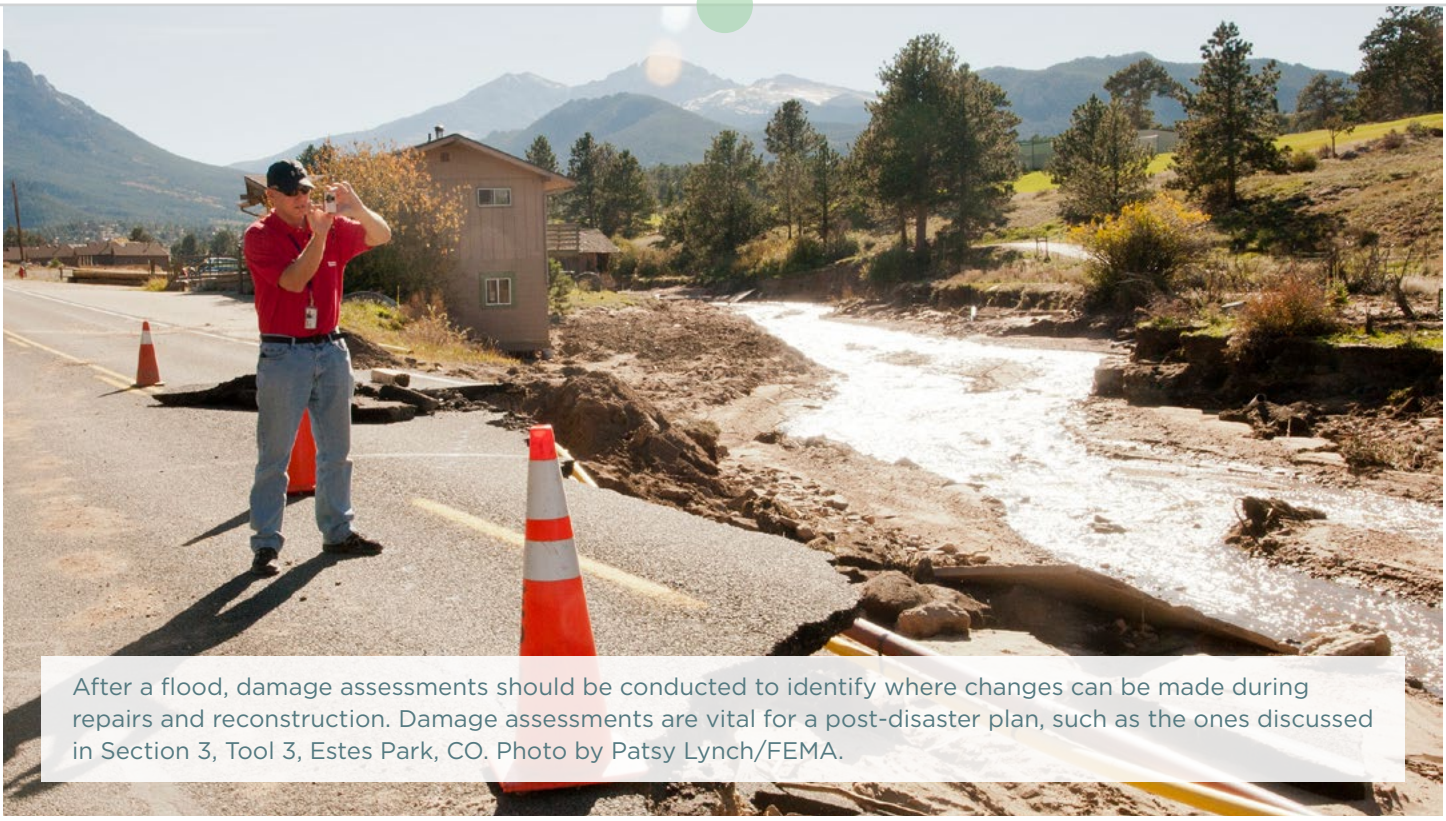
As a nation, we continue to build at-risk structures in or near floodplains, yet we don't spend as much time or effort considering the adverse impacts of these developments on adjacent properties or elsewhere in the watershed. The minimum standards we follow today – if, indeed, there are standards being utilized at all – are resulting in increasingly difficult flood issues and higher flood risk to our nation's communities and its citizens.

Some of these persistent flood risk issues are historical. Towns and cities were settled near watercourses for transportation, while others, especially in the arid west, were settled where precious water was available as a resource. However, today, poorly designed and constructed development and redevelopment, and a changing climate, are increasing flood risk to these communities. Many communities are dealing with persistent flood problems. Some of those same communities have residents and business owners attending board meetings after a heavy rain, complaining of flooding and demanding that the flood problems be fixed.

Communities can get ahead of these flooding issues, avoid causing problems for themselves and others, and ultimately lessen their flood risk, by embracing a new approach to managing their flood problems – the No Adverse Impact approach. In essence, NAI floodplain management takes place when the actions of one property owner are not allowed to adversely affect the rights of other property owners.

continued on page 3

Who Should Use this Guide?



After a flood, damage assessments should be conducted to identify where changes can be made during repairs and reconstruction. Damage assessments are vital for a post-disaster plan, such as the ones discussed in Section 3, Tool 3, Estes Park, CO. Photo by Patsy Lynch/FEMA.

Anyone who wants a more resilient community that can withstand a major flood event should use this guide. That could mean anyone, from local officials, to elected officers, decision makers, floodplain managers, coastal managers, stormwater managers, emergency managers, planners, hazard mitigation specialists, public works and engineering staff, design professionals, concerned citizens, and various other groups in the community.

This *Guide* is one of a series of how-to guides that expand on the knowledge base within the *No Adverse Impact Toolkit* (link below), a 108-page document prepared by the Association of State Floodplain Managers. The *Toolkit* is ASFPM's reference on implementing the NAI approach. It identifies tools for incorporating NAI floodplain management into local regulations, policies and programs; while the *How-to Guides* break down, by subject matter, that information into compact, usable information communities can apply.

Link: No Averse Impact Toolkit: www.floods.org/NoAdverseImpact/NAI_Toolkit_2003.pdf

This *Guide* reviews only five tools, but there are many more NAI tools for mitigation, and for each of the other building blocks found in the *NAI Toolkit*. The Toolkit, additional references, and more information can be found by clicking on the NAI icon at the bottom of ASFPM's homepage: www.floods.org

When the *How-to Guides* series is completed, there will be one guide for each of the seven building blocks found in the *NAI Toolkit* (hazard identification and floodplain mapping; education and outreach; planning; regulations and development standards; mitigation; infrastructure, and emergency services (links below).

The *How-to Guides'* ultimate goals are to have communities take a different approach to managing development that prevents increasing flood risk, and to incorporate NAI concepts into other community activities. This *Guide* identifies just a few ways a community can incorporate the concepts into its mitigation activities.

Users should view NAI as a continuum – every community is somewhere on the path between not addressing minimum flood standards at all, addressing only the minimum standards of the National Flood Insurance Program, and being 100 percent resilient and sustainable in the face of a flood threat. The more NAI steps a community takes, the better prepared it is for the next flood.

THIS HOW-TO GUIDE IS DIVIDED INTO FIVE SECTIONS:

SECTION ONE: The NAI Approach to Floodplain Management

SECTION TWO: Mitigation and Floodplain Management

SECTION THREE: Mitigation Tools

SECTION FOUR: Case Studies

SECTION FIVE: Resources & Fact Sheet

After reading this *Guide*, it is recommended that a community conduct an assessment of its mitigation activities. A gap analysis would identify what is being done and what is not being done from an NAI perspective. It would lead to strengthening existing programs and implementation of new ones that can help reduce the community's flood risk. Similar assessments should be conducted after reviewing the other *Guides* in this series.

Link:
Mitigation How-to Guide: www.floods.org/NoAdverseImpact/NAI_How-to-Guide_Mitigation.pdf
Infrastructure How-to Guide: www.floods.org/NoAdverseImpact/NAI_How-to-Guide_Infrastructure.pdf
No Adverse Impact Toolkit: www.floods.org/NoAdverseImpact/NAI_Toolkit_2003.pdf
Education & Outreach How-to Guide: www.floods.org/ace-files/NAI/EdcOutHowToGuideSept2015.pdf
Planning How-to Guide: www.floods.org/NoAdverseImpact/NAI_Planning_How_to_Guide_Final.pdf

Common Terminology used throughout this Guide

This is an example of following the NAI floodplain management approach, letting nature follow its course with no threat to life or property. The waterfront is a community asset, of open green space and parks, where people can relax and enjoy the view. Photo from the CRS Coordinator's Manual.

NFIP: National Flood Insurance Program. Most community floodplain maps and floodplain management standards have been adopted to meet the NFIP's criteria. Learn more at www.fema.gov.

Community: The NFIP definition of a community is a political subdivision that has authority to adopt and enforce floodplain management regulations for the areas within its jurisdiction. The term usually means cities, counties, and Indian tribal governments. For the purposes of this *Guide*, a "community" also includes a neighborhood, unincorporated settlement, or other non-governmental subdivision where people live or work together.

CRS: NFIP's Community Rating System is a program that provides reduced flood insurance premiums for policyholders in communities that go above and beyond the NFIP criteria. For more information see www.FloodSmart.gov/crs or www.CRSResources.org. This *Guide* identifies how communities can receive CRS credits for implementing NAI tools and standards.

Floodplain: Nature's floodplain, which includes the Special

Flood Hazard Area (defined below), and other areas subject to flooding, includes:

- Areas subject to greater than the 1 percent annual chance flood, often referred to as the 100-year flood;
- Areas subject to smaller, more frequent, or repetitive flooding;
- Areas subject to shallow flooding, stormwater flooding, or drainage problems that do not meet the NFIP mapping criteria (but where 20 percent of flood insurance claims occur);
- Areas affected by flood-related hazards, such as coastal and riverine erosion or subsidence; and
- Areas that will be flooded when future conditions are accounted for, such as sea level rise and upstream watershed development.

For these reasons, "floodplain" is the term that best reflects a community's true flood risk, and is used in this *Guide* instead of "SFHA."

Natural floodplain functions: The functions associated with the natural or relatively undisturbed floodplain that moderate flooding, maintain water quality, recharge groundwater, reduce erosion, redistribute sand and sediment, and provide fish and wildlife habitat. One goal of NAI floodplain management is to preserve and protect these functions, in addition to protecting human development.

Resilient: "Able to adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies," as defined in FEMA's National Disaster Recovery Framework (*link below*).

SFHA: A Special Flood Hazard Area mapped on an NFIP Flood Insurance Rate Map that shows the area subject to the 1 percent annual chance flood caused by rivers, lakes, oceans, and other larger sources of flooding.

Sustainable: "Able to meet the needs of the present without compromising the ability of future generations to meet their own needs," as defined in FEMA's National Disaster Recovery Framework.

The *Toolkit*, additional references, and more information can be found by clicking on the NAI icon at the bottom of ASFPM's homepage: www.floods.org

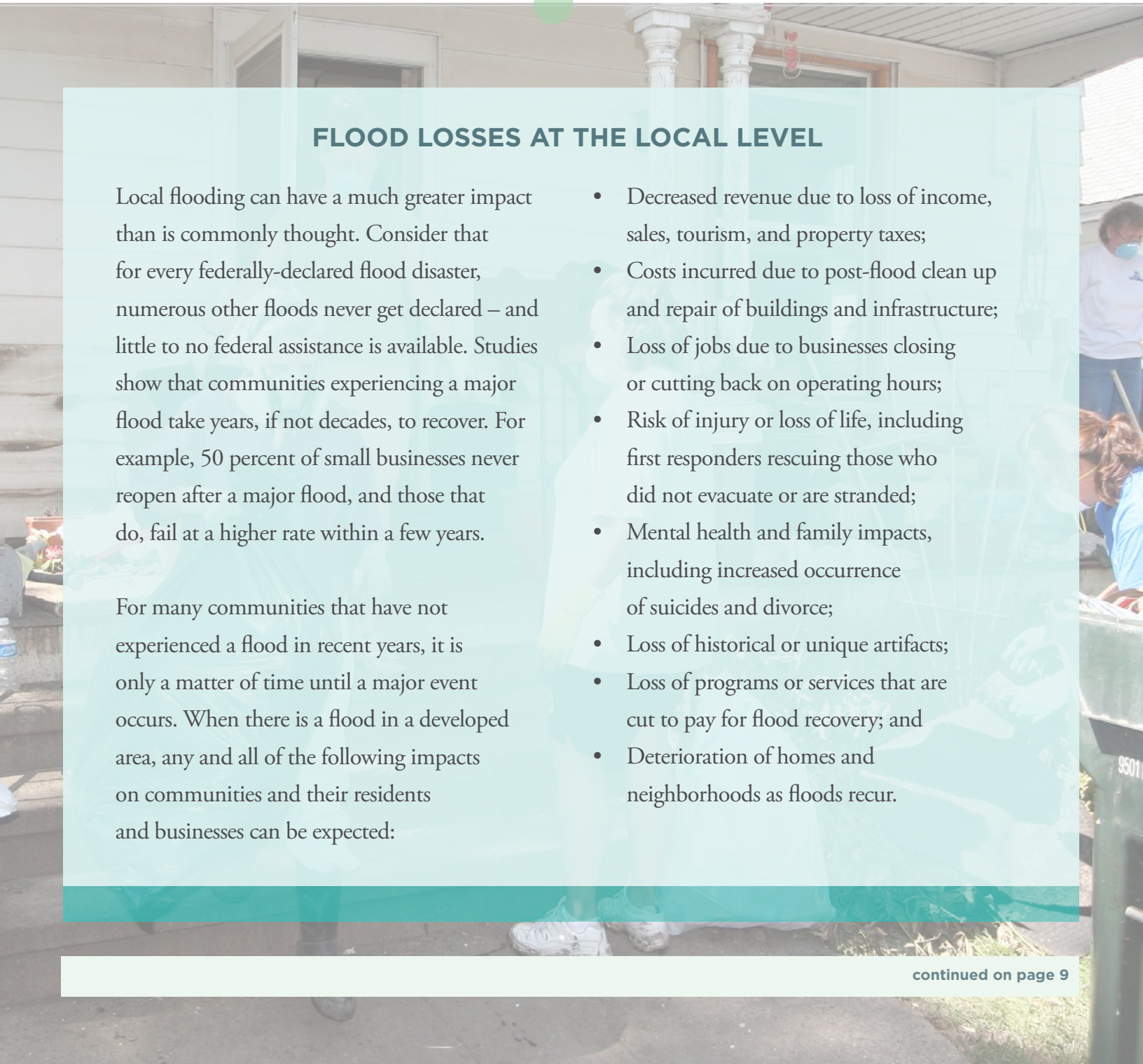
Link: FEMA's National Disaster Recovery Framework: www.fema.gov/media-library/assets/documents/24647

SECTION ONE

The NAI Approach to Floodplain Management

Cleaning up a flooded home can be a long and expensive process. Cedar Rapids, Iowa, June 2008. Photo from FEMA library. www.fema.gov/media-library/assets/images/52962

The NAI Approach to Floodplain Management



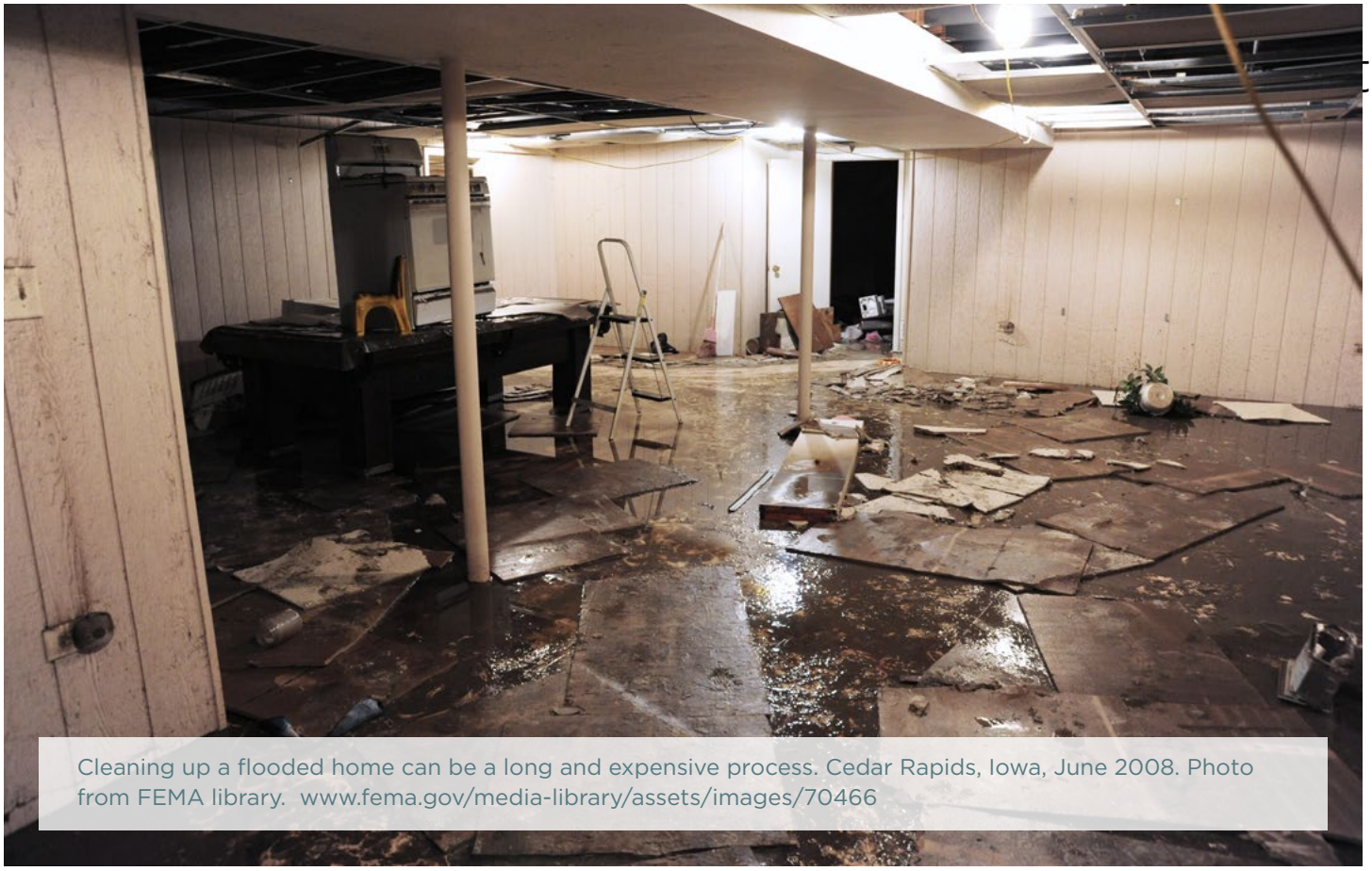
FLOOD LOSSES AT THE LOCAL LEVEL

Local flooding can have a much greater impact than is commonly thought. Consider that for every federally-declared flood disaster, numerous other floods never get declared – and little to no federal assistance is available. Studies show that communities experiencing a major flood take years, if not decades, to recover. For example, 50 percent of small businesses never reopen after a major flood, and those that do, fail at a higher rate within a few years.

For many communities that have not experienced a flood in recent years, it is only a matter of time until a major event occurs. When there is a flood in a developed area, any and all of the following impacts on communities and their residents and businesses can be expected:

- Decreased revenue due to loss of income, sales, tourism, and property taxes;
- Costs incurred due to post-flood clean up and repair of buildings and infrastructure;
- Loss of jobs due to businesses closing or cutting back on operating hours;
- Risk of injury or loss of life, including first responders rescuing those who did not evacuate or are stranded;
- Mental health and family impacts, including increased occurrence of suicides and divorce;
- Loss of historical or unique artifacts;
- Loss of programs or services that are cut to pay for flood recovery; and
- Deterioration of homes and neighborhoods as floods recur.

continued on page 9

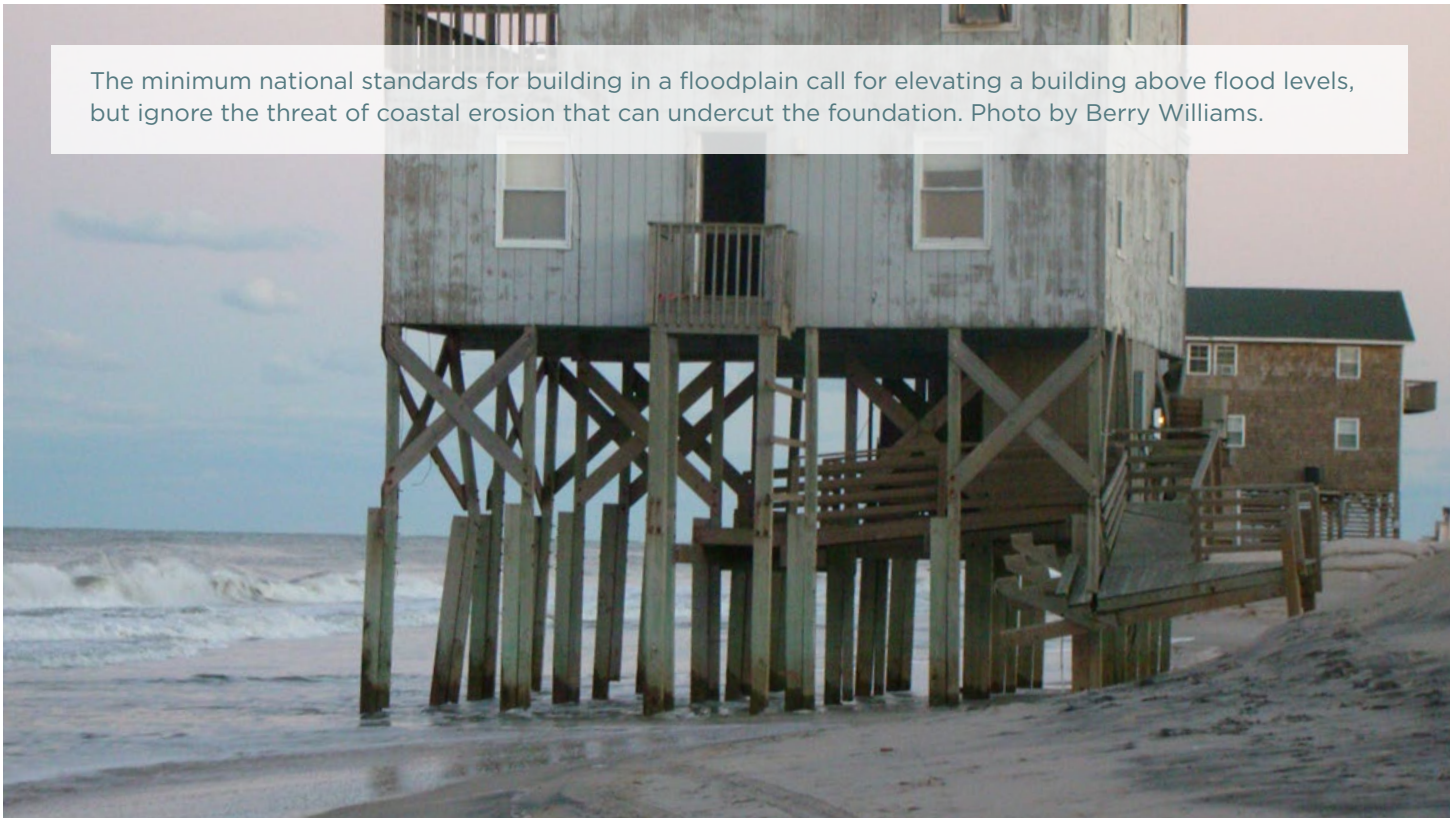


Cleaning up a flooded home can be a long and expensive process. Cedar Rapids, Iowa, June 2008. Photo from FEMA library. www.fema.gov/media-library/assets/images/70466

NATIONAL STANDARDS

The NFIP's *minimum* standards have been accepted by many as the default standards for communities' floodplain management programs. However, they were designed for the purposes of an insurance program and not to control our escalating flood losses. The NFIP sets minimum construction standards for communities' regulations in the mapped SFHA. These minimum standards are inadequate to stop and reverse the long-term trend toward increasing flood damage because:

- They do not address the entire floodplain. In other words, they neglect the potential for larger floods, other unmapped local flood hazards, or the effects of urbanization and a changing climate on future flood levels.
- They focus on how to build in a floodplain rather than how to avoid unsafe locations.
- They allow floodwater conveyance areas to be reduced, essential valley storage to be filled, and/or velocities to be increased – all of which can adversely affect others.
- The standards are flood-oriented and some construction techniques may increase exposure to damage from other hazards, such as wind and earthquakes.



The minimum national standards for building in a floodplain call for elevating a building above flood levels, but ignore the threat of coastal erosion that can undercut the foundation. Photo by Berry Williams.

- They assume the ground is stable, and that if a building is high enough, it will be protected from damage. This is not the case in areas subject to erosion or mudslides.
- There are no accepted national flood loss reduction standards for levees.
- While standards for dam safety are good as they relate to the protection level of the dam from failure or overtopping, there is a continued problem of increasing development downstream, necessitating a dam to be retrofitted to a higher protection standard.
- There are no commonly-applied flood loss reduction standards for infrastructure and critical facilities, such as wastewater treatment plants and emergency operations centers.
- Sedimentation, erosion, channel migration, ice jams in rivers, and coastal erosion, often cause flood hazards that are not adequately reflected in the NFIP's Flood Insurance Rate Maps.
- In areas subject to subsidence, floodplain maps lose their accuracy when the ground settles over the years.
- NFIP regulatory standards may not work adjacent to lakes where water levels may remain high for months or years.

For these reasons, relying on minimum national standards will not reduce flood losses or even stop the increases in flood losses.

continued on page 11

The NAI Approach to Floodplain Management, cont.

FLOOD LOSSES IN THE NATION

Local flood losses add up to very large numbers at the national level, and those numbers are getting bigger. Since the early 1900s, the nation's flood losses have increased five-fold. Since 2000, that figure has averaged $10 billion annually. Hurricanes Katrina and Sandy occurred within seven years of each other. They were the two largest flood-related disasters in U.S. history and together caused more than $200 billion in direct losses (see the graph on page 12).

This continued pattern of destruction has persisted despite the investment of billions of dollars in structural flood control projects during the last 100 years, as well as the development of many other flood protection measures. Yet, even in the face of increasing flood losses, development continues in high risk locations. For example, it is predicted that the U.S. population near the water will increase by 50 million more people by 2050 – putting more people and property in harm's way. The federal government's programs are not curbing the increases in flood losses as floodprone areas keep developing at what many believe to be an alarming rate. Consider the following:

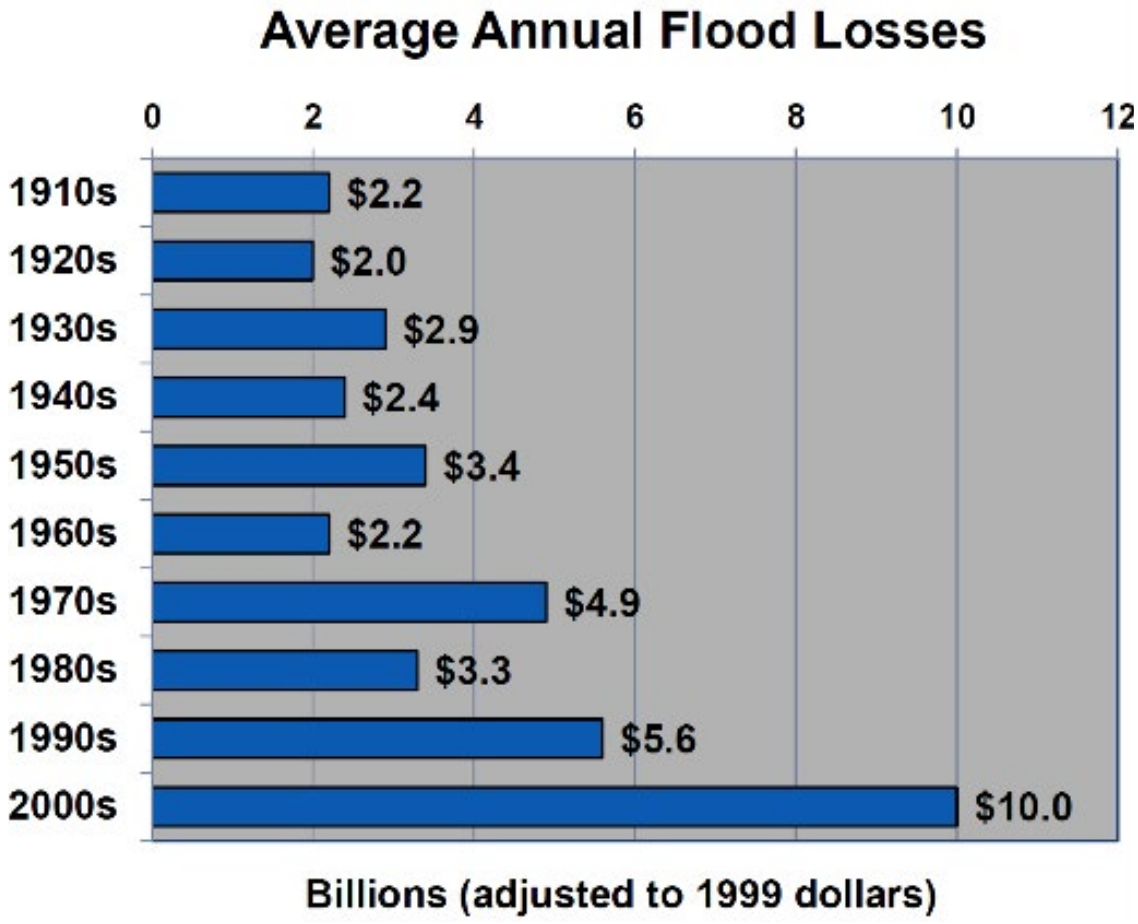
Comic created by Rob Pudim, and appeared in Natural Hazards Observer, May 2014.

- Funding for flood protection programs, especially structural flood control projects, has declined over recent years.

- Tax incentives and funding for disaster assistance have encouraged, and often subsidized, floodplain occupancy and development and reduced local and individual accountability for flood losses.

- The NFIP's national standards for managing floodplain development have not changed in more than 20 years and are assumed by many communities to be adequate for their floodplain management program, without regard to implementing other or higher standards that would address the hazard(s) they face.

The NAI Approach to Floodplain Management, cont.



Jeff Stone with ASFPM's Science Services Dept. created the graph above. Source: Flood Loss Data, National Weather Service, Hydrologic Information Center (www.nws.noaa.gov/hic/).

Further Information: Flood Damage in the United States 1926-2003 A Reanalysis of National Weather Service Estimates (www.flooddamagedata.org/).

The No Adverse Impact Approach

NAI floodplain management is a principle that is easy to communicate and, from legal and policy perspectives, tough to challenge. In essence, ***No Adverse Impact floodplain management takes place when the actions of one property owner are not allowed to adversely affect the rights of other property owners.*** The adverse effects or impacts of unwise community development decisions can be measured by increased flood peaks, increased flood stages, increased flood volumes, higher flood velocities, increased erosion and sedimentation, deterioration of natural floodplain functions, or other impacts to a community's well-being.

NAI philosophy can shape a community's floodplain management approach if the community:

- Identifies acceptable levels of impact;
- Specifies appropriate measures to mitigate adverse impacts; and
- Establishes a plan for implementation of multiple tools to reduce or eliminate those impacts.

> "…insisting that landowners internalize the negative externalities of their conduct is a hallmark of responsible land-use policy…" – Justice Samuel A. Alito Jr., in the majority opinion for the Supreme Court's ruling in Koontz v. St. Johns River Water Management, 133 S. Ct. 2586 (2013). The Koontz case is very important to floodplain management. For more information on it, see www.americanbar.org/content/dam/aba/administrative/state_local_government/land_use.authcheckdam.pdf

continued on page 14

The No Adverse Impact Approach, cont.

THE COMMUNITY'S ROLE

NAI principles give communities a way to promote *responsible* development measures through community-based decision making. Under NAI floodplain management, communities identify potential impacts of new development proposals, and implement actions to mitigate those adverse impacts before they occur.

A community's approach could be specific to flood damage or encompass related objectives, such as water quality protection, groundwater recharge, and protection of wetlands and riparian zones. NAI criteria can be extended to entire watersheds to support regional stormwater management methods to mitigate the adverse impacts caused by increased runoff from urban areas. At the community level, the NAI floodplain management approach and implementation plan should be comprehensive and address all the NAI building blocks:

- Hazard identification and floodplain mapping
- Education and outreach
- Planning
- Development standards and regulations
- Mitigation
- Infrastructure
- Emergency services

NAI ADVANTAGES:

Local empowerment: The NAI approach removes the impression that floodplain management is something imposed by federal or state government. Communities become accountable and accept responsibility for what happens. It also encourages development of a better informed public and a constituency for wise development.

More effective programs and projects: Floodplain management programs and flood mitigation projects are better tailored to local needs and conditions with the NAI approach. Communities are able to better utilize federal and state programs to support their own local initiatives.

Lower long-term costs: Over time, the NAI approach will reduce local government expenditures. For example: a mitigation project that relocates buildings out of a floodprone area not only can result in a community open space amenity, but in less maintenance of roads and public utilities, less risk to first responders who must conduct search and rescue operations when it floods, and lower disaster recovery costs.

Improved partnerships: Informed local officials can make the right decisions about protecting their community. Economic development organizations, transportation and public works departments, and local utilities do better when they work with planners and floodplain managers to implement an NAI based approach. This is especially true when everyone realizes that they have a role and a responsibility to address their own flood problems. Once people agree that flooding is a local problem and their department is affected, they are more willing to work together and share the workload.

continued on page 15

The No Adverse Impact Approach, cont.

Source: Natural Hazards Informer, July 1999, Natural Hazards Center, University of Colorado.

Reduced liability: NAI doesn't take away property rights – it protects them by preventing one person from harming another's property. One of the most important options a government typically has for reducing liability for flood losses is the prevention of increasing flood levels and erosion hazards due to government actions (or inaction). To do this, governments can adopt NAI standards for private development (through its regulations) and public infrastructure (through its design standards).

Meet community needs. NAI floodplain management is about communities being proactive toward understanding potential impacts and implementing preventive measures and mitigation activities. The NAI concept offers communities a framework to design programs and standards that meet their true needs, not just the minimum requirements of a federal or state governmental agency.

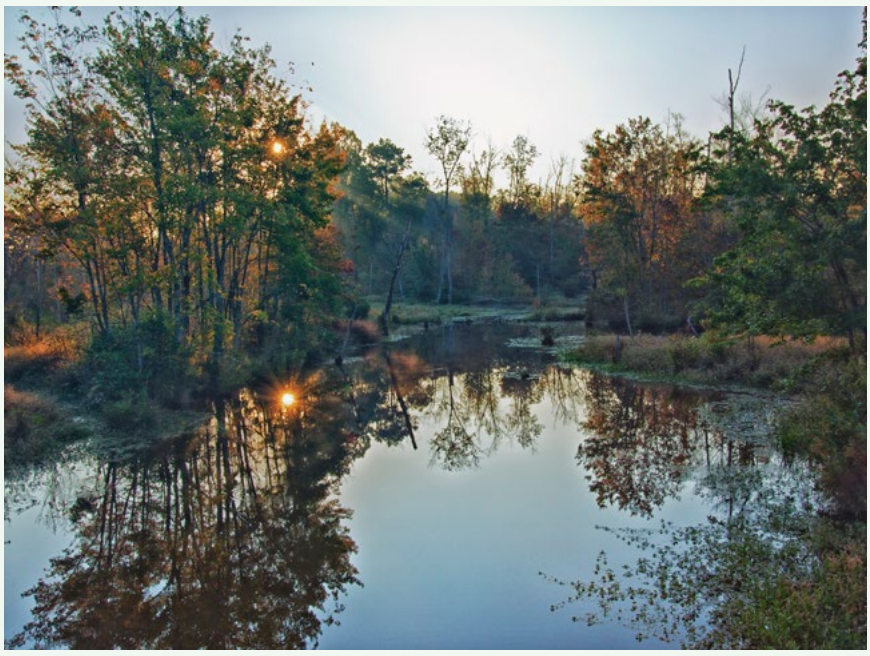
Greener floodplain: Flooding is a natural phenomenon and one goal of NAI floodplain management is to preserve and protect natural floodplain functions in addition to protecting buildings and infrastructure. An NAI emphasis will result in protection of natural buffers and environmentally sensitive areas, improvement in the biological, ecological and geomorphologic functions of riverine and coastal areas, improved water quality, more open spaces,

The No Adverse Impact Approach, cont.

protected fish and wildlife habitat, and similar benefits that come with maintaining an environmentally sustainable ecosystem.

CRS credits: By continually seeking to meet local needs, a community will implement programs and projects that are above and beyond the minimum requirements of the NFIP. Such activities are encouraged by the NFIP because they do a more effective job of preventing and reducing flood losses. This encouragement is accomplished through the CRS, which provides reduced flood insurance premiums in communities that implement NAI floodplain management activities.

On the whole, the NAI approach has many benefits at the local and national levels. With these benefits in mind, the remainder of this *Guide* explores how to take advantage of the NAI approach in a community's planning programs.



Franklin County, N.C. wetland. Photo by Jim Liestman via Flickr.

SECTION TWO

Mitigation and Floodplain Management

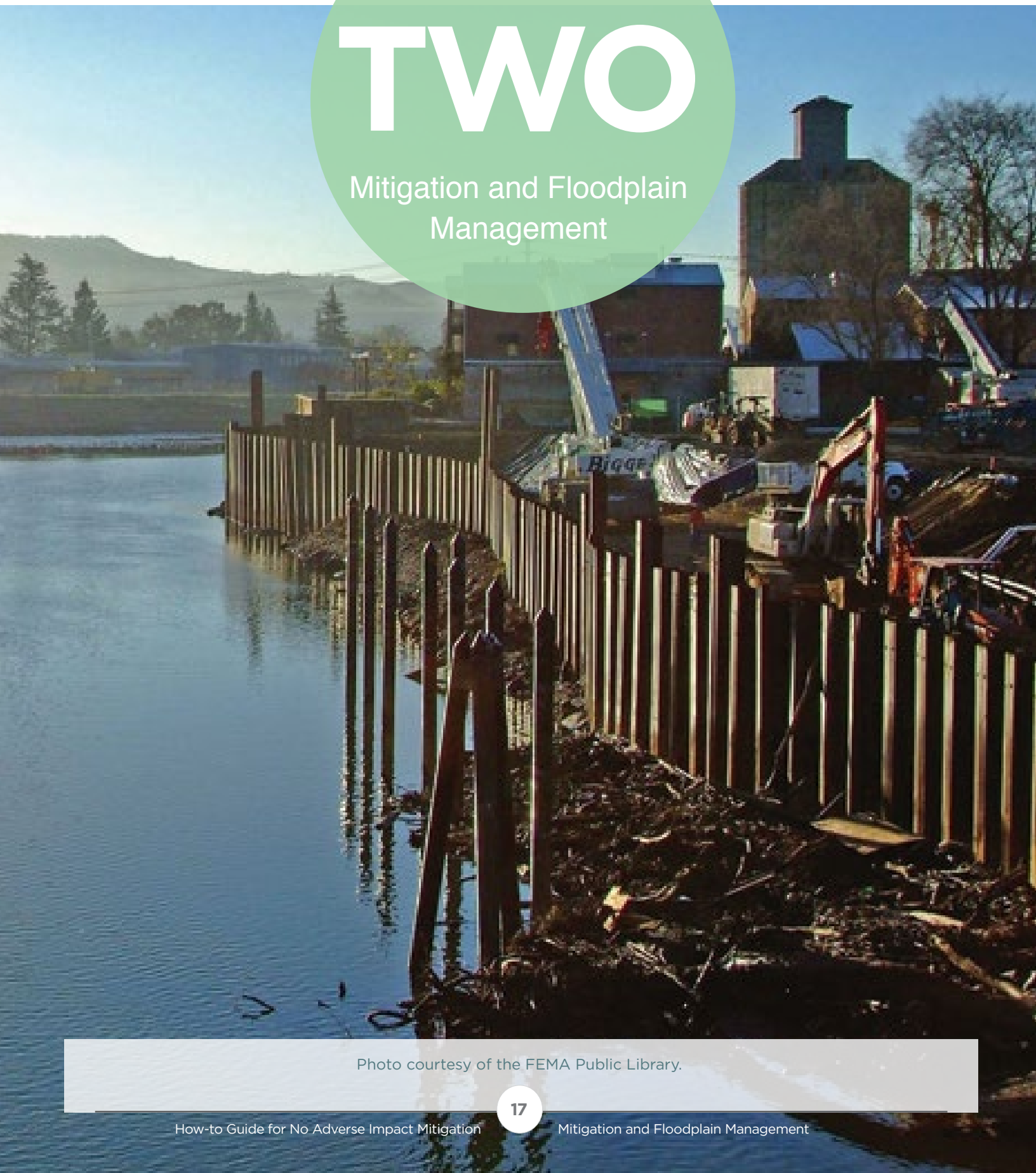


Photo courtesy of the FEMA Public Library.

What is Mitigation?

How mitigation is defined and discussed matters because it has an impact on how the professionals working in floodplain management connect with and support others doing the same work. Indeed, professionals who work in financial risk mitigation, floodplain management, fire suppression, chemical spill mitigation and water remediation often find themselves rubbing shoulders ineffectively, doing very different jobs and all calling it "mitigation."

HAZARD MITIGATION IS...

A dictionary definition of "mitigate" says, "to cause to become less harsh or hostile; to make less severe or painful." Language in *Title 44 of the Code of Federal Regulations (44CFR)*. § 201.2 defines **hazard mitigation** as *any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event.* The CFR definition is a good operational definition of hazard mitigation when it comes to flooding.

Hazard mitigation activities provide a critical foundation to reduce the loss-of-life and loss-of-property from natural and/or manmade disasters by avoiding or lessening the impact of a disaster and providing value to the public by creating safer communities. Mitigation seeks to interrupt the cycle of disaster damage, reconstruction and repeated damage.

What is Mitigation?, cont.

These activities or actions, when performed effectively in most cases, will have a long-term sustained effect. However, they will not necessarily result in No Adverse Impact.

Because mitigation is generally used to make something less harmful, it stands to reason that mitigation is most often thought of as being applied to existing, at-risk environment. Existing homes, businesses, critical facilities and infrastructure are all candidates for hazard mitigation. Common flood hazard mitigation activities include: floodproofing, elevating, relocating or demolishing at-risk structures; retrofitting existing infrastructure to make it more flood resilient; developing and implementing Continuity of Operations Plans (COPs), structural mitigation measures such as levees, floodwalls and flood control reservoirs; detention/retention basins; and beach and dune restoration. Obviously, mitigation that is utilized in new or planned development can be the most cost effective approach a community can take to reduce future flood losses.

HAZARD MITIGATION IS NOT...

To further clarify what hazard mitigation is, it is helpful to look at what it is not. First, hazard mitigation must be a sustained action. So, responding to a flood is not a sustained action; however, developing, exercising and implementing a COP is. Preparedness activities by themselves are not sustained actions and are not mitigation, although they can make mitigation more effective. Second, mitigation must reduce or eliminate long-term risk. This is why temporary measures such as a sandbag levee that must be built preceding every single flood event is not considered hazard mitigation. Such measures are removed after the event, thereby, leaving at-risk areas vulnerable to the next event. Thirdly, hazard mitigation is not routine maintenance or the replacement in-kind of failed or destroyed infrastructure due to poor maintenance practices.

THE BIG PICTURE

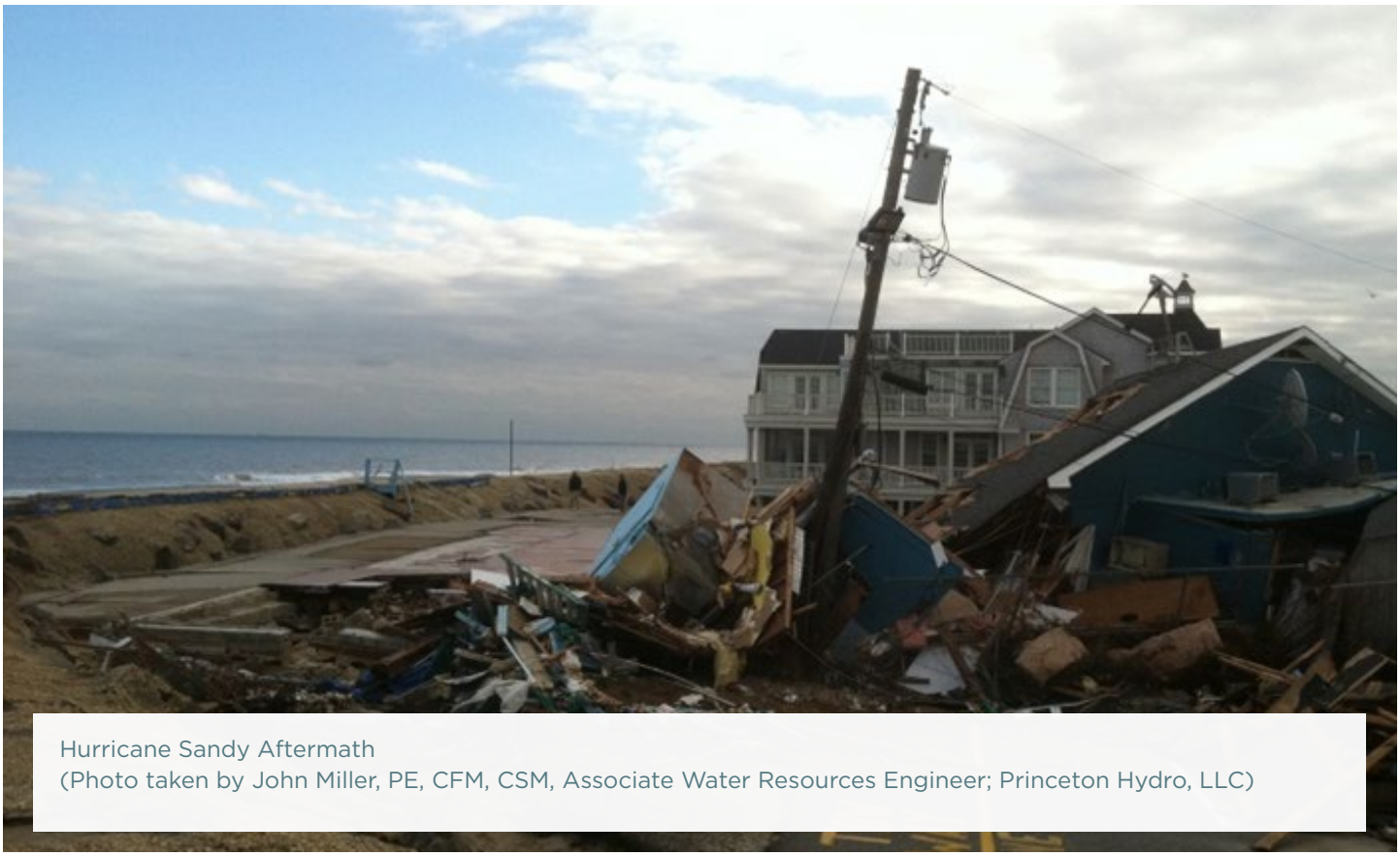
This IS the central message – *that development activity within communities continues to induce flood damage even while compliant with the minimum standards of the NFIP.*

Current management systems that have been designed to reduce flood losses are costly and often allow development, while permitting processes fail to thoroughly evaluate or require mitigation of current and future adverse impacts on other properties. The NAI approach improves upon these drawbacks and leads to more resilient communities by reducing flood losses throughout flood-prone communities while continuing to promote and reward strong local watershed stewardship and mitigation.

Also, the world is changing. Recent scientific findings about changing world conditions such as sea-level rise (projected to rise by another 1.5 to 6 feet in this century alone), is very alarming, especially since nearly five

continued on page 20

What is Mitigation?, cont.



Hurricane Sandy Aftermath
(Photo taken by John Miller, PE, CFM, CSM, Associate Water Resources Engineer; Princeton Hydro, LLC)

million Americans live within 4 feet of the local, high-tide level. State level climate change reports are identifying that precipitation patterns are going to change as well, some areas becoming wetter, some dryer, and most reports concluding that there will be an increase in "extreme" events.

Increasingly, intense rain occurrences, more frequent devastation from wildfire events (which is always followed by flooding), melting glaciers and sea ice, decreasing air quality, and worsening storms are resulting in intense climatic disruption that effects health, economies, natural resources and daily life. The entire nation should be working toward developing and refining approaches that enable decision-making and increased flexibility, robustness and resilience to address ongoing population growth in high-risk areas and future climate impacts that will ultimately increase exposure to hazards in those areas. NAI floodplain management does just that.

IDEAL PARTNERS: NAI/MITIGATION

In order to enhance mitigation at the local level, NAI principles could be incorporated into the community's mitigation activities and each daily activity the community undertakes. To incorporate NAI principles into the community's mitigation processes, a community or watershed-based management plan is essential. The community or watershed-based management plan should include:

continued on page 20

What is Mitigation?, cont.

- A technical analysis to quantify current and future conditions;
- Exploration of all mitigation options;
- Incorporation of the most effective mitigation techniques to minimize impacts in the community;
- Identification of implementation measures to manage all of the hazard factors identified;
- Inclusion of strong citizen involvement so the plan is equitable; and
- A vision for future use of the community's land within and outside of the floodplain.

Hurricane Sandy Aftermath
(Photo taken by John Miller, PE, CFM, CSM, Associate Water Resources Engineer; Princeton Hydro, LLC)

The community or watershed-based management plan defines the process by which all future development will be analyzed. It requires that the effects of proposed development activity anywhere within a watershed could or would have on flood stages, velocity, flows, and erosion or sedimentation, elsewhere within that same watershed be considered prior to approval of the proposed development activity.

The plan should also ensure that future development activity, in and out of the floodplain, remain part of the community's locally-adopted comprehensive, floodplain and hazard mitigation management plans. This will further ensure that the action of one community does not adversely affect the flood risks for other communities unless the impact is mitigated as provided for in the community or watershed-based plans. This NAI approach will lead to flood-loss reduction across the nation while promoting and rewarding strong management, planning, and mitigation actions at the local level.

SECTION THREE

Mitigation Tools

No Adverse Impact is a set of principles, not a specific set of standards, requirements or practices. There is no model ordinance, code or specific set of regulations that a community can adopt to "be NAI." Rather, the objective is to incorporate the NAI concepts into all ongoing local community activities. There are many ways a community can do this - through incorporation of NAI approaches into community plans, adoption of specific regulatory or policy language that include NAI principles to address or deal with current or anticipated flooding issues, initiation of individual NAI-related projects, starting or revising entire programs (such as the stormwater program) to include NAI practices, or by preparing a master plan that addresses all activities within the community that impact flooding.

How to Mitigate at the NAI Level?, cont.

Hurricane Sandy Aftermath
(Photo taken by John Miller, PE, CFM, CSM, Associate Water Resources Engineer; Princeton Hydro, LLC)

NAI level activities (or tools) identify some of the most effective ways to protect everyone's property within the community and to prevent adverse impacts, which can include or cause increased flooding problems if not done correctly.

This *Guide* will only highlight five of the many NAI tools that can be utilized for mitigation. There are other NAI level tools for mitigation (and for each of the seven building blocks) that can be found in the *NAI Toolkit* (*link below*).

Effective implementation of NAI tools featured in this *Guide* is done through sound planning, in addition to buy-in by all community stakeholders.

This *Guide* identifies various tools within the mitigation building block that may help your community deal with its specific flood-related needs, depending on the community's flood risk and desired outcomes. These tools may also address the shortcomings of a community's "typical" (minimum standards) local floodplain management program. Rather than depending on minimum requirements of federal or state programs, NAI provides tools for communities to provide a higher level of protection for their citizens and to prevent increased flooding now and in the future."

Link: http://www.floods.org/NoAdverseImpact/NAI_Toolkit_2003.pdf

Tool 1: Flood Acquisition & Relocation Mitigation Projects

Most types of flood mitigation projects are effective in their efforts toward reducing damage amounts, but still leave some element of flood risks. However, floodplain acquisition and relocation projects completely eliminate future flood risk to people and buildings since the flood-prone structure is either moved outside of the floodplain or acquired and demolished, with perpetual deed restrictions placed on the cleared land. In addition to eliminating risk, acquisition projects provide economic, environmental and social benefits – the three core values of sustainability. Because of this broad range of benefits, flood-prone structure acquisition represents the best NAI mitigation action possible for existing flood-prone buildings.

For any acquisition project that is completed using FEMA's Hazard Mitigation Assistance (HMA) funds, all project applications must demonstrate that the future benefits (currently limited to dollar losses avoided calculations) outweigh the total-project costs as a basic eligibility requirement. In its 2005 study *Hazard Mitigation Saves*, the Multi-Hazard Mitigation Council's (MMC) analysis of FEMA mitigation project applications determined that flood hazard mitigation projects returned an average of $5 for every $1 spent over the lifetime of the project. This is higher than for other hazards considered. In 2013 FEMA conducted an analysis of 11,000 acquisition projects around the nation and found that the average benefits were $276,000. As a result any acquisition project with a cost under $276,000 is now considered automatically cost effective – no BCA required.

Tool 1: Flood Acquisition & Relocation Mitigation Projects, cont.

SCALE-UP OF RESULTS TO ALL FEMA GRANTS

	Project Grants			Process Grants			Total† †
	Quake	Wind	Flood	Quake	Wind	Flood	
Total grant cost ($M)	867	280	2,204	80	94	13	$3,538
Total grant benefit ($M)	1,194	1,307	11,172	198	161	14	14,049
Total benefit-cost ratio (BCR)*	1.4	4.7	5.1	2.5	1.7	1.3	4
Standard deviation of BCR	1.3	7	1.1	n.a.**	n.a.	n.a.	n.a.

*Row 2 (benefit) divided by row 1 (cost) equals row 3 (benefit-cost ratio) ** Not applicable because of estimation method used † All $ figures in 2004 constant dollars

After an acquisition project has been completed, a Loss Avoidance Study (LAS) can be completed to determine how much damage was prevented from an actual flood event. Since the acquired land will no longer feature an at-risk structure, loss avoided benefits will continue to accrue as future floods occur since the land will remain undeveloped in perpetuity. LASs have shown that an acquisition project can pay for itself after just one flood event. Table 1 provides a summary of acquisition project LAS reports.

The Loss Avoidance Ratio is similar to a Return on Investment calculation. A value greater than 1.0 means that a project has paid for itself in losses avoided as of the year the report was completed. A value less than 1.0 means a project has not paid for itself yet. The Tillamook project included a mix of acquisition, elevation and relocation flood mitigation projects.

In addition to the direct losses avoided, acquisition projects eliminate the following economic costs:

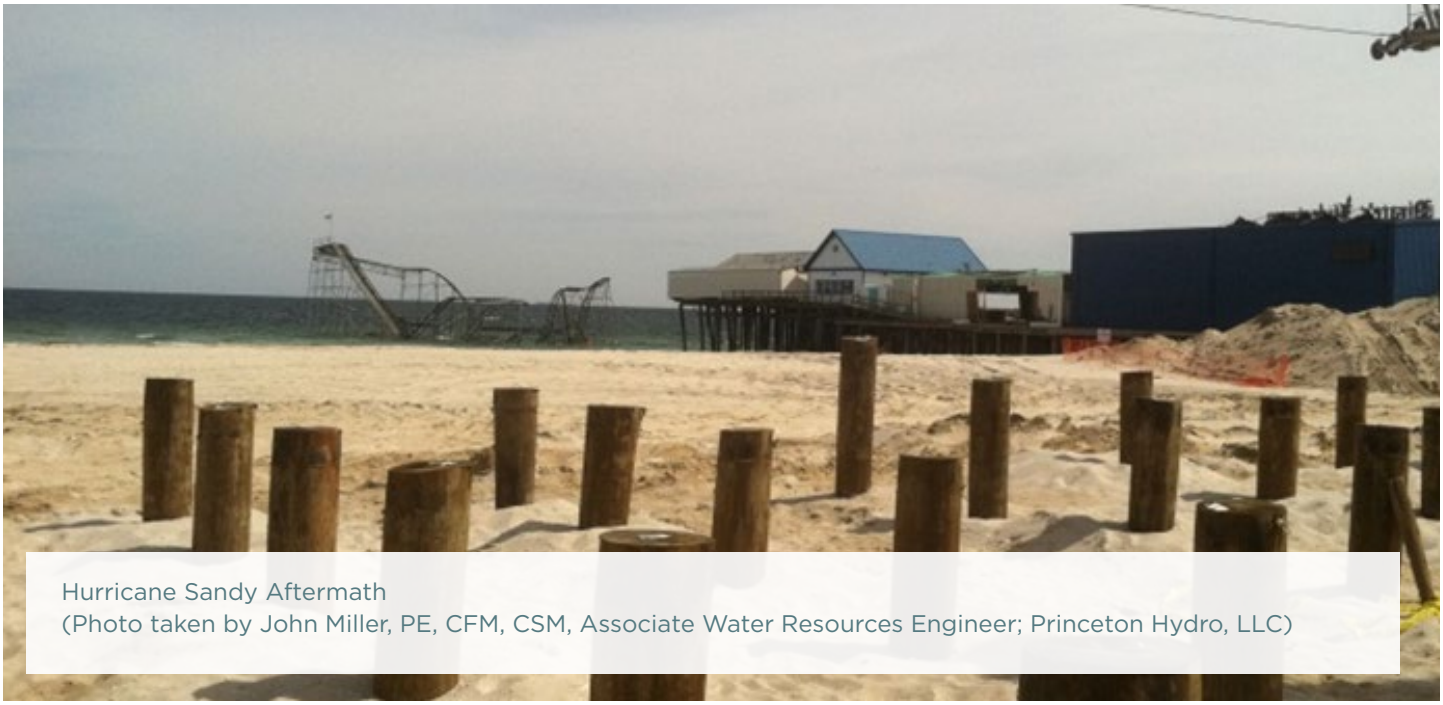
- Future disaster assistance, including Individual Assistance and Households Program and Public Assistance (IAHP and PA) funds;
- Non-governmental disaster services needs for emergency shelter and subsistence;
- National Flood Insurance Program and Increased Cost of Compliance (ICC) claim administration;
- Future operations and maintenance costs when entire neighborhoods are acquired and the transportation

continued on page 26

FINDINGS FROM ACQUISITION PROJECT LAS REPORTS

Location	Projects Completed	LAS Completed	LA_R
Birmingham, AL	1989-1994	2000	1.50
Georgia	1997-2009	2010	0.56
Missouri	1999-2008	2009	2.12
Austin, MN	1978/1988/1993	2001	0.80/1.24/0.37
Tillamook, OR	2000-2007	2009	0.66
Wisconsin	1989-2008	2009	1.32

Tool 1: Flood Acquisition & Relocation Mitigation Projects, cont.



Hurricane Sandy Aftermath
(Photo taken by John Miller, PE, CFM, CSM, Associate Water Resources Engineer; Princeton Hydro, LLC)

infrastructure and utilities are removed;

- Emergency evacuation, response, recovery and other emergency management costs; and
- Lost productivity costs for volunteer flood fighting, such as sandbagging.

In addition to this list, acquiring groups of structures can reduce flood levels by opening conveyance and storage areas, thereby reducing future flood-damage costs to larger areas.

ENVIRONMENTAL BENEFITS

Environmental benefits attributable to acquisition projects include reduced flood debris from acquired structures that must be disposed in a landfill. "Ecosystem services," or the natural, inherent amenities provided by the land, are also created when a structure is cleared from the floodplain and the parcel is allowed to revert back to its natural function. For example, the open green space created by an acquisition project can increase the filtration of pollutants, which improves overall water quality. Allowing the land to re-vegetate (or proactively restoring it with natural, self-sustaining erosion control vegetation) results in increased woody vegetation that can dissipate the energy associated with floodwaters. Riparian areas can also reduce flood damage by retaining and storing floodwater, while the natural barrier provided by coastal wetlands can reduce a coastal storm's intensity and reduce damage, including the destructive forces of a storm surge. Riparian areas also function to reduce erosion, provide habitat and biological control, improve biodiversity, reduce greenhouse gasses, improve air quality and other environmental benefits.

continued on page 27

Tool 1: Flood Acquisition & Relocation Mitigation Projects, cont.

FEMA recognizes the benefits acquisition has on ecosystem services and now allows the inclusion of environmental benefits in benefit cost analyses associated with acquisition projects.

SOCIAL BENEFITS

Social benefits from acquisition projects include improved life safety for residents and first responders, especially in high-velocity flash flood and deep flooding hazard areas. Another significant social benefit is the elimination of stress and anxiety of residents having to repeatedly evacuate their homes or business owners having to take other emergency protective measures in response flood threats. There is also an added social dimension of avoiding neighborhood blight in repetitive flood areas and helping to make the entire community become more sustainable. Natural open areas adjacent to water bodies also provide cultural values, such as improved aesthetic and recreational value. These created natural areas can also link wildlife corridors, connect greenway trails and provide a wealth of recreational benefits.

IMPLEMENTING AN ACQUISITION PROJECT OR PROGRAM

STEP 1: IDENTIFY POTENTIAL ACQUISITION PROJECT SITES

Potential acquisition sites exist in nearly every flood-prone community, although it may take work in the form of documentation, such as flood insurance claims, to convince community leaders of this fact. The first reference source is the community's Hazard Mitigation Plan. This plan may identify the priority of acquisition/relocation in comparison to other mitigation alternatives, location of potential acquisition sites and relative priority of acquisition sites. If a community does not have an HMP or specific repetitively flooded areas identified, then the mitigation plan may be useful in identifying the highest flood risk areas in the community. Using the plan as a starting point, community representatives can also talk to long-time residents, research flood history, get historical data from the local newspaper and research flood mapping data. FEMA's new RiskMAP program, for those communities where it has already been implemented, offers data in such a way that a community can do a very good analysis of their highest flood risk areas.

Floodways and velocity zones are particularly high risk areas that should be analyzed for potential property acquisition projects.

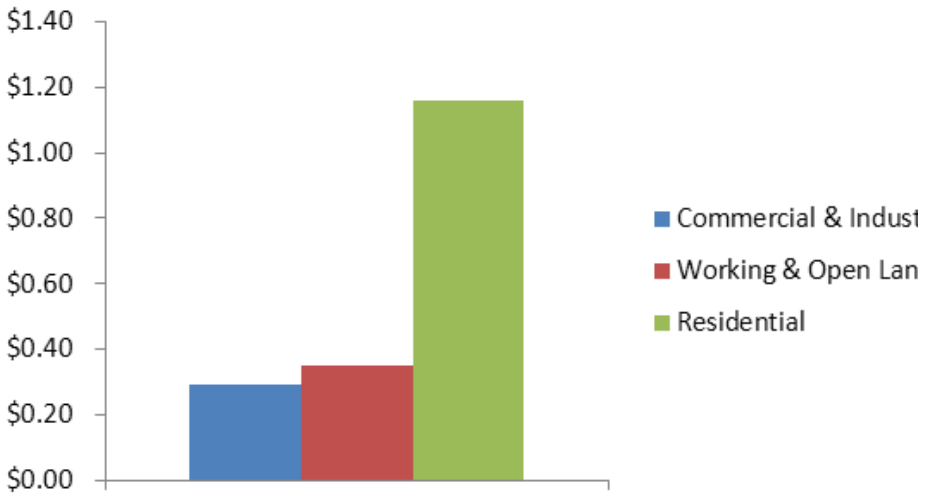
STEP 2: IDENTIFY POTENTIAL RELOCATION SITES AND REUSES OF ACQUIRED LAND

The number one concern by most communities considering acquisition projects is the loss of tax base on the property that will be acquired. FEMA mitigation programs wisely include a deed restriction that limits reuse of the acquired property to open space compatible uses. This loss of tax base is not as impactful as it may seem. Open lands may ultimately generate less revenue than residential, commercial or industrial properties, but they require little, or no, public infrastructure and few,

Tool 1: Flood Acquisition & Relocation Mitigation Projects, cont.

MEDIAN COCS RESULTS

Median cost per dollar of revenue raised to provide public services to different land uses according to the AFT COCS 2010 study.



if any, community-based services. A "study of studies" performed by the American Farmland Trust in 2002 showed that residential development "costs" $1.15 for every $1. in revenue generated. In other words, because residential land uses do not cover the costs of community services provided, residential land use within a community must be subsidized by other land uses.

The second concern by communities considering acquisition projects is losing residents. This is where communities must plan ahead to have prospective sites for those individuals being acquired to relocate to. In communities with available lots and/or land to annex, relocation can be done relatively easily. In landlocked communities where there are few if any relocation sites, then alternatives such as increasing density in non-flood risk areas and other innovative uses within infill areas is necessary. Even in such areas, the benefits of small or larger tracts of contiguous open spaces generated by acquisitions projects can become a community amenity and serve to increase property values surrounding the acquired property.

Acquired land, even if it is deed restricted to open-space compatible uses, does not have to simply become a maintenance chore for a community. It can serve a number of functions including parkland, active recreational use area (sports practice fields or soccer fields), rain gardens or some other stormwater management feature, etc.

STEP 3: IDENTIFY POTENTIAL FUNDING SOURCES

Traditionally, many post-disaster acquisition and relocation projects have been funded with federal cost sharing assistance provided by FEMA's HMA programs. Information about the FEMA HMA grant program can be found at the link below, which includes a description of each grant program, eligibility, application development and grant resources. To access this funding source, local

Link: www.fema.gov/hazard-mitigation-assistance

Tool 1: Flood Acquisition & Relocation Mitigation Projects, cont.

governments must work with their State Hazard Mitigation Officer (SHMO) or state NFIP coordinator to complete an acceptable grant application. In most situations, a non-federal cost share is required to participate in a FEMA hazard mitigation project. Additionally, proposed mitigation projects must be included in or consistent with the community's adopted HMP.

Each flood insurance policy also has an ICC provision. If a structure is severely damaged or meets other conditions, as much as to $30,000 in ICC funding can be used to assist with the demolition portion of the acquisition project. Demolition helps to bring a substantially damaged building into compliance with the community's floodplain management ordinance.

Through the Department of Housing and Urban Development's (HUD) Community Development and Block Grant Program (CDBG), acquisition/demolition projects also match funds and can supplement community acquisition programs if Congress has appropriated CDBG funds to areas impacted by disasters. More information on this program is available through state housing departments.

Locally-funded programs have been developed to complete acquisition and relocation projects without – or with limited – federal funding. Some of these communities and their programs have been highlighted in the "Case Studies" section of this publication. The biggest advantage of not using federal funding is that communities can move quickly and don't have to depend on, or wait for, state and federal reviews.

STEP 4: DEVELOP, SUBMIT AND IMPLEMENT THE PROJECT

The grant application for a FEMA-funded mitigation project is robust and a good model to follow regardless of funding source. FEMA project applications must have a scope of work that includes a detailed cost estimate. For a typical acquisition and relocation project, this would include costs for:

- Building and land appraisals;
- Legal costs for the real estate transaction, including a title search;
- Purchase and relocation costs to move the structure out of the floodplain; and
- Demolition and site restoration costs.

Additionally, the grant application must demonstrate that the project is cost-effective and that there are no environmental or historic preservation concerns involving the land to be acquired. Cost-effectiveness is determined by using FEMA's benefit-cost analysis (BCA) software for the proposed project. Exemptions to the BCA requirement may be given by the federal coordinating officer for any buildings substantially damaged by a presidentially-declared disaster. Flood proofing or the relocation of historic structures may be preferred instead of acquisitions due to a

Tool 1: Flood Acquisition & Relocation Mitigation Projects, cont.

community's desire to preserve valuable historic resources. However, if historic structures are damaged beyond repair or renovation, acquiring and demolishing these structures can be done in coordination with the State Historic Preservation Officer (SHPO). All environmental concerns, such as leaking underground storage tanks, asbestos or other site contamination must be identified on the parcel. And if any problems are found, they must be remediated prior to participating in a FEMA-funded acquisition or relocation project

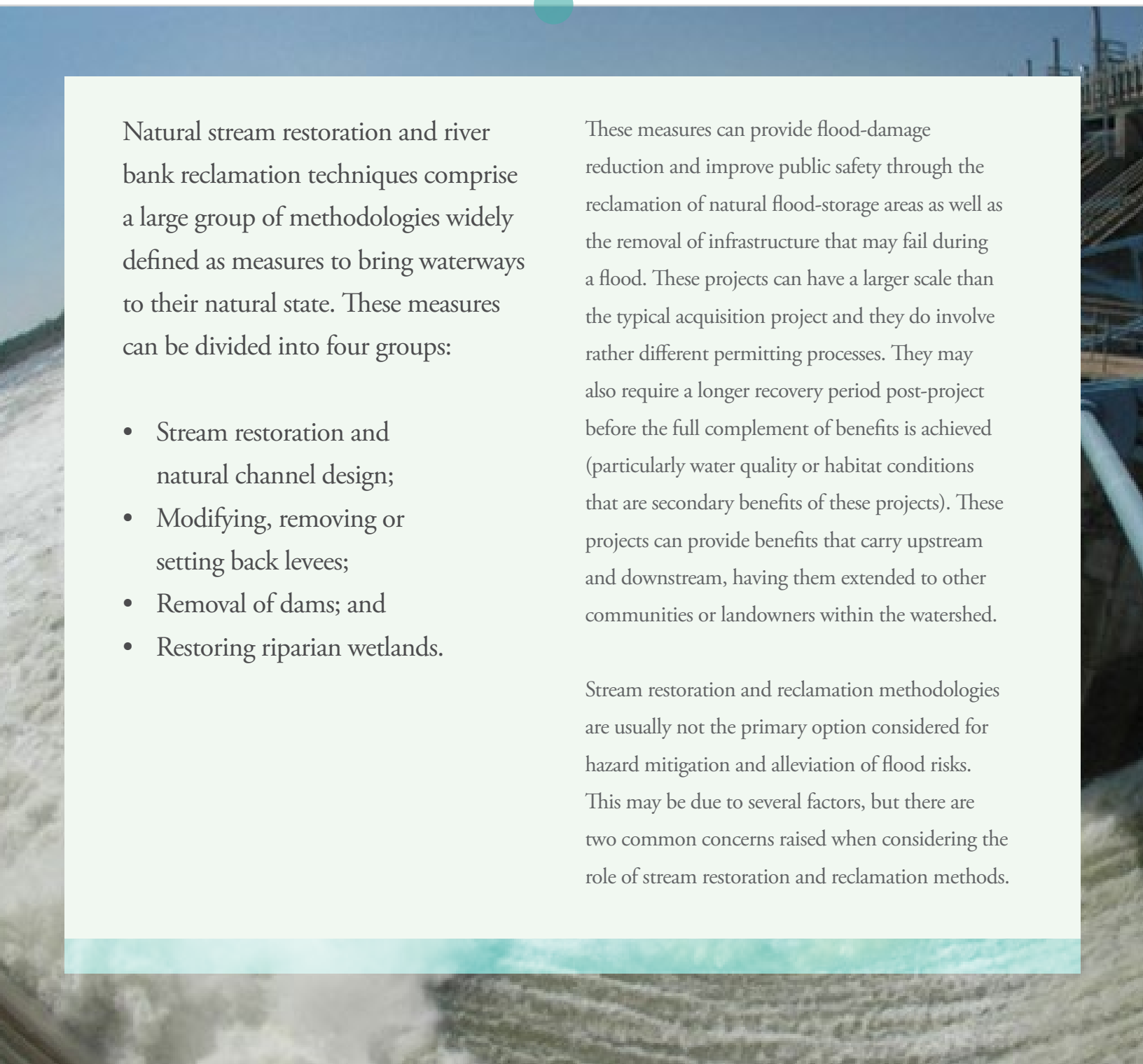
Hurricane Sandy Aftermath
(Photo taken by John Miller, PE, CFM, CSM, Associate Water Resources Engineer; Princeton Hydro, LLC)

Assuming a FEMA grant application is successful and funding is awarded, the local government must administer the award to complete the project. After the project has been completed, the project is closed-out per grant administration requirements, and a deed restriction is placed on the parcels to only allow open space compatible uses in perpetuity.

Acquisitions are a winning, multi-objective solution for property owners and local government. There are few, if any, disadvantages attributed to an acquisition project, although some communities are concerned with the potential for loss-of-property tax revenue. Generally, these areas are often blighted and the transition to a natural, open area benefits communities in other ways. Communities can also work with property owners to move them to other locations in the community. The advantages of acquisition projects far outweigh any conceived disadvantages.

Communities interested in acquisition and relocation projects should contact their State Hazard Mitigation Officer (SHMO) or National Flood Insurance Program State Coordinator.

Tool 2: Waterway Restoration through Dam Removal



Natural stream restoration and river bank reclamation techniques comprise a large group of methodologies widely defined as measures to bring waterways to their natural state. These measures can be divided into four groups:

- Stream restoration and natural channel design;
- Modifying, removing or setting back levees;
- Removal of dams; and
- Restoring riparian wetlands.

These measures can provide flood-damage reduction and improve public safety through the reclamation of natural flood-storage areas as well as the removal of infrastructure that may fail during a flood. These projects can have a larger scale than the typical acquisition project and they do involve rather different permitting processes. They may also require a longer recovery period post-project before the full complement of benefits is achieved (particularly water quality or habitat conditions that are secondary benefits of these projects). These projects can provide benefits that carry upstream and downstream, having them extended to other communities or landowners within the watershed.

Stream restoration and reclamation methodologies are usually not the primary option considered for hazard mitigation and alleviation of flood risks. This may be due to several factors, but there are two common concerns raised when considering the role of stream restoration and reclamation methods.

Tool 2: Waterway Restoration through Dam Removal, cont.

First, it has been challenging for communities, consultants and hazard managers to quantify the benefits from these practices and to evaluate their role in an overall framework of flood hazard reduction measures. Second, these projects suffer from the perception that they are less effective than structural measures; offer less gratification than acquisition/removal projects; require a much larger project footprint and they are expected to be quite complex. While this may be true for some projects, good planning and coordination can get these projects implemented in an efficient and timely manner and can provide benefits that extend beyond a single community. Moreover, these projects are uniquely positioned to meet community objectives for MS4 compliance, parkland/open space needs and flood-damage reduction when used as part of a hazard mitigation toolkit.

While there are many stream restoration and reclamation practices utilizing NAI principles that could be explored, in this section, dam removal will be introduced briefly, outlining how flood-damage reduction benefits may be quantified, in addition to how projects may be completed more efficiently as part of an HMP.

DAM REMOVAL

The process of decommissioning and removing dams has been called in literature (Conyngham et al.) arguably the most powerful tool and largest opportunity for restoration of aquatic ecosystems and communities that currently exists. Dams alter the fundamental river processes that control river health, form and function. For the purposes of flood-damage reduction, hazard mitigation and public safety, the most important among these are disrupted sediment and nutrient transport and modified hydraulic and hydrologic conditions.

There are approximately 84,000 dams in the USACE National Inventory (2011), of which approximately 66,000 are located along rivers (the remainder impound water off-river). These are considered large dams, with perhaps as many as 2,500,000 smaller structures in existence. Removal of dams can occur for many reasons, but mainly when the functional, economic, social and environmental impact costs outweigh the continued dam benefits.

ECONOMIC CONSIDERATIONS

Dam removal is often approached as an infrastructure decommissioning project, performed when the design function of the dam has diminished or when operation becomes too expensive (Doyle et al.). It has been estimated (FEMA 2001), that by 2020, 85 percent of large dams will have exceeded their design life span. The Association of State Dam Safety Officials (2011) reports the number of identified deficient dams has significantly increased in the past decade. Many dams built on the largest rivers serve important purposes including hydroelectric power or navigation. However, hydroelectric (2.6 percent), navigation (0.3 percent) and water supply (8 percent) functions account for a

continued on page 33

Tool 2: Waterway Restoration through Dam Removal, cont.

Livingston Dam
(FEMA Photo Library: Dam weakened by Hurricane Rita is forced to release pressure to prevent failure)

relatively small amount of the nation's dam inventory (NID, 2011). Flood-control dams constitute a slightly larger percentage (16 percent), but a large number of smaller, aging dams that would be economically viable to remove remain. Experience has shown that most dam-removal projects were the result of dam safety and economic considerations. Economic studies (Born et al.) have demonstrated that the cost of repairing and maintaining a dam to state and federal regulations exceeds the cost of removal by at least three times. Economic considerations vary depending on dam size, age, original and present use along with environmental factors. Additional factors that need to be considered are dam ownership and available sources of funding for removal.

HAZARD MITIGATION CONSIDERATIONS

Dam-removal projects can reduce flood damages in two primary ways. First, a dam that is removed no longer causes a threat of dam failure – an important consideration given the age and state of repair of many dams. Secondly, dam removal reduces upstream water levels to pre-dam conditions, which restores stream and near-channel storage areas to reduce localized flooding. This storage area is provided by removing a typical-sized dam (3-10' in height) and can also provide modest reductions in the frequency and extent of out-of-bank flooding. Hydraulic analyses can be used to compare changes in localized flooding in dammed and undammed conditions in order to measure the potential flood-damage reduction impacts to adjacent properties. Reductions in flood frequency can also reduce nuisance flooding, such as a case from Pennsylvania where flood frequency decreased from a 3-year event to a 13-year event for a low-lying road that paralleled a dammed creek (American Rivers, 2012).

continued on page 34

Tool 2: Waterway Restoration through Dam Removal, cont.

The hydraulic model shown on page 35 shows the extent of 100-year flood with a dam (green dot) in place and after the dam was removed. The red area shows the 100-year flood extent prior to the dam's removal while the grey area shows the same flood extent after the dam was removed. The yellow circle depicts a neighborhood containing two repetitive loss properties (image by Barr Engineering).

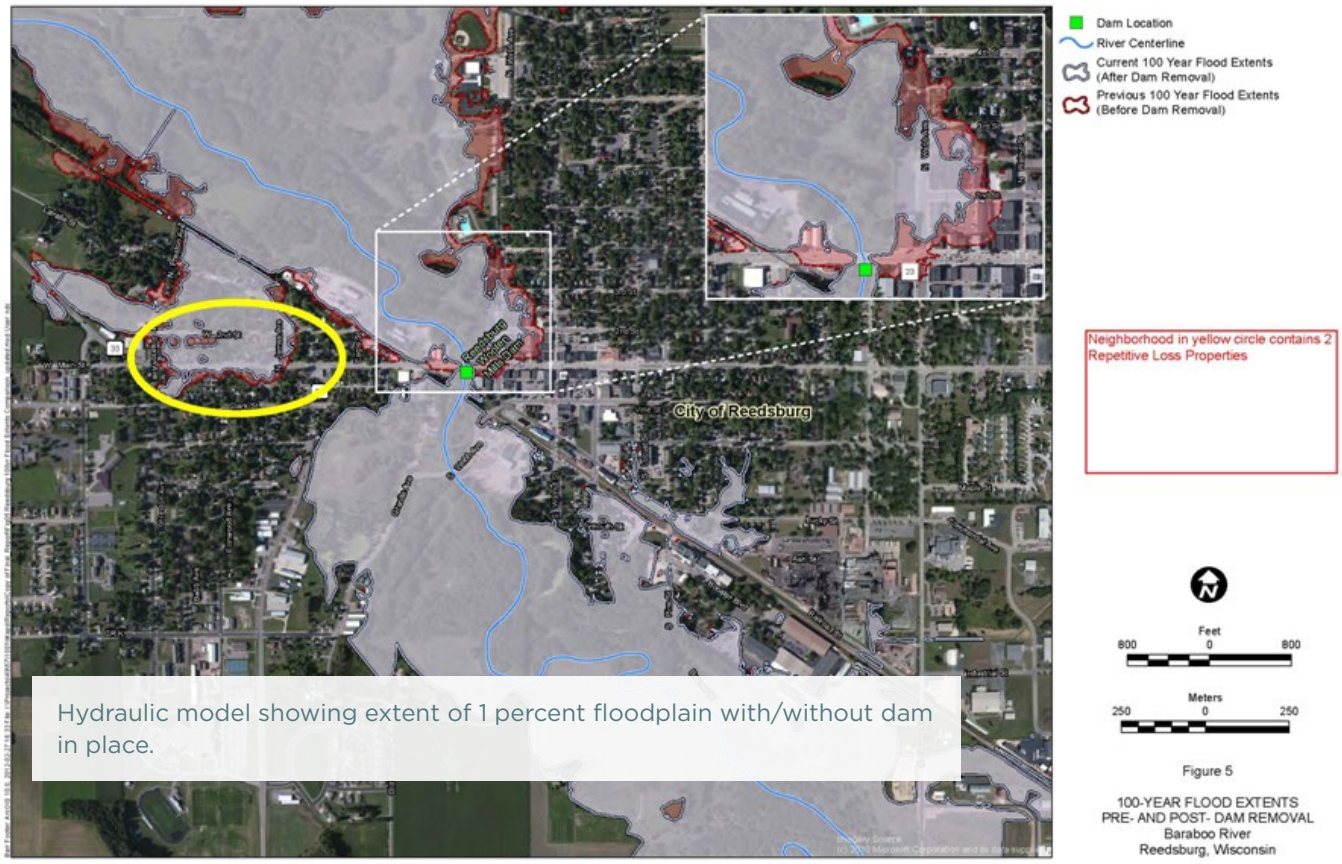
A second consideration in relation to hazard mitigation is the removal of a structure that can create hazardous rescue conditions during a flood. Low-head dams create strong hydraulic rollers that are notorious for trapping unsuspecting swimmers or boaters in a recirculating flow that is difficult to escape. In high flows, low-head dams become harder to spot as water levels begin to submerge the structures and these flows also create very powerful hydraulics.

ENVIRONMENTAL CONSIDERATIONS

It is well documented in literature (American Rivers, 2002 Poff et al., Conyngham et al.) that environmental considerations of dam removal are complicated and far-reaching. The dam removal process can be viewed from several environmental perspectives:

- Flow regime change: Removal of a dam reestablishes the river's natural flow and reconnects the stream with riparian areas, then enabling floodplains, in particular riparian wetlands, to absorb excess flows and fulfill natural functions of flood absorption.
- Water quality (including temperature and dissolved oxygen): Water quality considerations include the environmental impact of disrupted thermal and chemical regimes, especially for older, deeper stratified reservoirs. Intermittent release of considerably colder, oxygen-depleted water from the reservoir can temporarily negatively impacts the downstream water quality and water habitats. Removal of a dam reestablishes thermal and chemical equilibrium along the stream.
- Sediment release and transport: By design, a dam and its reservoir disrupt the natural river morphology and prevent transport of sediment along the stream. As a result, downstream reaches frequently sustain bank and channel erosion due to lack of incoming sediment from the watershed's headwaters. Removal of a dam will reestablish sediment transport, with some immediate short-term negative impacts.
- Aquatic life connectivity: Without fish ladders or similar conveyances, artificial barriers like dams disrupt aquatic ecosystem continuity and migration of species. This is problematic for migratory fish, such as salmon, and resident fish that need to access different habitats throughout their life cycle. Freshwater aquatic organisms are the most imperiled group in the United States and extensive fragmentation of habitat is a significant problem.

Tool 2: Waterway Restoration through Dam Removal, cont.



Hydraulic model showing extent of 1 percent floodplain with/without dam in place.

Dam removal is also associated with some negative environmental impacts. Proactive dam-removal projects can greatly reduce or minimize the potential impacts that would occur during dam failures through sediment management, project timing/phasing, sensitive-species relocation and other measures. However, adverse impacts associated with dam removal can include:

- Release of excessive sediment, negatively impacting downstream ecosystems;
- Release of toxic sediments, especially from the older reservoirs;
- Release of nutrients, resulting in elevated phosphorous loads and algae growth downstream;
- Temporarily destabilized river morphology and bank erosion;
- Reconnection of two previously separated bio-environments, and allowing access to undesirable species; and
- Increased risk of downstream ice-damming on ice-prone rivers.

In general, most of the negative impacts listed are short-term and diminish over time, with the exception to the release of toxic sediments such as mercury and heavy metals, which is a critical issue that needs to be addressed and can impact the decision on dam removal.

continued on page 36

Tool 2: Waterway Restoration through Dam Removal, cont.

REGULATORY CONTEXTS AND AGENCY CONSIDERATIONS

Federal agencies including USACE, Federal Energy Regulatory Commission (FERC), U.S. Environmental Protection Agency (EPA), National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (USFWS) and the Natural Resources Conservation Service (NRCS) have an interest and role in dam removal actions, as do state and local governments, and a wide variety of non-governmental organizations. USACE is involved in dam removal through a variety of authorities, including regulatory, small Continuing Authorities Projects, and Support for Others. USACE is usually involved in dam removals through its regulatory authorities such as Sections 401 and 404 Clean Water Act permitting requirements, and its jurisdiction requires a public interest review be carried out, as well as a determination of the effects of dam removal on wetlands, fish and wildlife, water quality, water supply, energy conservation, navigation, economics, historic, cultural, scenic, conservation and recreational values.

Environmental benefits and detriments along with mitigation measures are also considered as part of the permit process. Many other regulations may be included in a dam-removal plan. The most common among these are the National Historic Preservation Act, Endangered Species Act, Clean Water Act and state-level water, floodplain and wetland statutes. Local authorizations or coordination may be conducted for floodplain, erosion control or other issues.

FUNDING SOURCES

There are a number of funding sources for dam removal and each source provides funding based on a particular benefit to be achieved through the removal. For most funders, the primary interest is ecological restoration, though there are some funds available for public safety or hazard reduction. There are a number of federal agencies that provide funding through various grants ranging from $10,000 to $5 million (Funding Sources for Dam Removal, 2008, Dam Mitigation Funding Sources, 2008). In many cases, the removal has been financed by the dam owner, local, state and federal governments and private funders. In some cases, agreements are made whereby multiple stakeholders contribute to cover the costs. Many state dam safety offices offer small grants for dam repair or removal. Non-profit conservation groups are often partners in dam removal projects and can provide grants and/or fundraising assistance.

Tool 3: Non-structural Erosion Control and Shoreline Stabilization

Unlike hard coastal engineering structures, non-structural shoreline stabilization projects dissipate wave energy rather than reflecting waves onto beaches or neighboring properties. Reflected waves can erode beaches in front of and next to the structure, eventually undermining and reducing the structure's effectiveness and leading to costly repairs. Hard armoring also results in a loss of dry beach at high tide, reducing the beach's value for storm damage protection, recreation and wildlife habitat. Non-structural alternatives will enhance the beneficial functions of the landforms to provide greater storm damage protection and flood control. Additionally, because of their more natural appearance, non-structural measures are typically easier to permit and more aesthetically pleasing than hard structures.

Like all erosion control and shoreline stabilization options, non-structural alternatives can negatively impact the natural ecosystem, particularly if improperly sited or designed. This guidance identifies the design considerations that need to be considered to avoid and/or mitigate any adverse impacts, thus raising these options to an NAI level.

BEACH AND DUNE NOURISHMENT

A beach is composed of unconsolidated sediment deposited by waves, tides and currents and forms a sloping shore adjacent to a body of water. The sediment that forms beaches typically ranges from sand- to gravel- and cobble-sized material in different coastal areas around the country. A dune is a hill, mound or ridge of sediment deposited by wind or waves landward of a coastal beach. Nourishment is a shoreline-protection option where a clean, compatible sediment (of similar size or slightly coarser), is brought in from an offsite source and added to the beach and/or dunes. Beaches and dunes provide a physical buffer

Tool 3: Non-structural Erosion Control and Shoreline Stabilization, cont.

Photo courtesy of MA CZM

between the sea and inland areas – a buffer that can naturally shift during storms. As waves hit the beach or dune, sediments move and shift, the wave energy is absorbed, ultimately protecting landward areas from the full brunt of the storm. The size of the beach and dune system (i.e., its height, length and width) relative to the predicted size of the storm waves and storm surge (water buildup above the average tide level) determines the level of protection coastal landforms can provide. The beach and dune size recommended for a project will depend on the desired level of protection, the predicted wave energy and storm surge for the area, and site constraints such as proximity to sensitive resource areas.

Building and nourishing beaches and dunes not only increase the direct level-of-protection to inland areas, but the added sediment supports the protective capacity of the entire beach system (i.e., dune, beach and near shore area). Sand eroded from the beach and dune during a storm is not "lost" or "wasted," it is added to the surrounding beach and near shore area where it dissipates wave energy, reducing the strength of incoming storm waves. To maintain the designed protective capacity of the beach and dune for each new storm, sediment must be added to maintain the design height, width and volume at appropriate levels.

Beach and dune nourishment projects can negatively impact the natural system, particularly if improperly sited or designed. The most significant factor in determining the potential impact is proximity of the project to sensitive habitats (e.g. salt marshes, endangered or threatened species habitats). Other potential impacts from nourishment projects can be caused by using sediment of an inappropriate grain size or building a dune with a slope that's too steep.

continued on page 38

Tool 3: Non-structural Erosion Control and Shoreline Stabilization, cont.

Hurricane Sandy Aftermath
(Photo taken by John Miller, PE, CFM, CSM, Associate Water Resources Engineer; Princeton Hydro, LLC)

If the sediments brought in are finer than the existing beach and dune sediments, they can erode quickly and may smother nearby sensitive areas, such as shellfish and eelgrass. If the introduced sediments are too large, they may not move and shift as intended and can therefore reflect wave energy, causing erosion of the beach in front of or near the dune. As for the slope, steep dunes are unstable and erode rapidly. This can cause a scarp, which looks like a carved out area in the dune with an almost vertical slope. Scarps can make beach access dangerous and impede the movement of wildlife over the dune. Beach and dune nourishment projects should be designed to avoid adverse impacts by modifying the footprint, slope, grain size and color of sediments brought in to nourish the beach and dunes. The modifications needed for specific projects will be site-specific. Coordination with local, state and federal agencies to identify sensitive habitats can help potential applicants identify issues before investing in a design.

Planting dunes with native vegetation to help hold sediments in place is highly recommended to prevent erosion. Sand fencing can also be installed to trap windblown sand to help maintain and build the volume of a dune.

VEGETATION

Dunes, banks (also known as bluffs) and other coastal landforms are susceptible to erosion from tides, currents, wind and coastal storms. Additionally, overland runoff –the water from rain, snowmelt, sprinklers and other sources that does not soak into the ground or evaporate, but instead flows over the ground surface – can cause erosion by dislodging soil and sand. Native plants with extensive root systems can help address both kinds of coastal erosion problems. Plant roots hold sand,

continued on page 40

Tool 3: Non-structural Erosion Control and Shoreline Stabilization, cont.

gravel and other soils in place, helping to stabilize areas where they are planted. By absorbing water, breaking the impact of raindrops or wave-splash, and physically slowing the speed of overland flow and avoiding concentration of flow, plants reduce runoff erosion.

Vegetation also helps trap windblown sand, which is particularly important for building dune volume. Finally, high grasses, shrubs and other vegetation can be planted to limit foot traffic in erosion-prone areas.

Planting native vegetation with extensive root systems is recommended for stabilizing any un-vegetated dune or bank along the coast. It is likely to be more difficult to get vegetation established in areas where there is a relatively narrow dry beach because the site can be easily over-washed or reached by tides and waves on a regular basis. To reduce erosion and storm damage in these vulnerable areas, it is recommended that vegetation be combined with other shore protection measures, such as bioengineering and nourishment.

PLANT SELECTION

Specific site conditions – including wind, soil type and quality, moisture, shifting sands, frequency of coastal storms and exposure to waves and over-wash – dictate the plant species that can successfully grow. When selecting plants for coastal use, native species are recommended because they are well adapted to harsh coastal conditions, require less maintenance to grow and thrive, and provide better food and shelter for wildlife. In addition, only plants with extensive root systems should be selected for erosion-control projects.

Invasive species (i.e., introduced species that thrive at the expense of native plants) should never be planted in coastal areas. Many invasive plants such as oriental bittersweet and Phragmites are particularly problematic coastal invasive plants because they have shallow roots, spread rapidly and can secrete toxic compounds that prevent the growth of other plants. Because of these growth characteristics, even dense stands of invasive plants do little to reduce erosion by storm waves, runoff and wind. Consequently, invasive plants often require removal and replacement with appropriate native plants if they are preventing establishment of erosion-control vegetation. Because of their tenacity, successful control of invasive plants can take years to accomplish and may require perpetual monitoring and management. This effort is particularly warranted when bank stability is severely compromised by the invasive plant or when unruly and overgrown invasive plants can be replaced with lower-growing native species to stabilize the bank and improve coastal views.

Finally, it is important to plant a diversity of native species because a stand of only one plant is more susceptible to complete die-out from drought, disease or pests.

Tool 3: Non-structural Erosion Control and Shoreline Stabilization, cont.

DESIGN CONSIDERATIONS TO MAXIMIZE EFFECTIVENESS

Only live plants should be used – brush, lawn clippings and other dead plant materials prevent live plants from establishing roots to bind soils. Discarded Christmas trees are a particular problem because they leave large, destabilizing holes when they are ripped out by waves. Sand fencing is a much more effective option and does not impede the natural growth of live plants.

Other techniques that help stabilize dunes and banks while plants get established include:

- Installing natural-fiber blankets on the ground surface before planting to hold soils in place while roots get established;
- Using temporary baffles of natural-fiber material to shelter plants from wind; and
- Installations of sand fencing to help slow wind, trap sand and reduce erosion.
- Combining these techniques is more effective than using only one method.

Photo courtesy of New England Environmental, Inc.

Banks with an unstable slope are extremely vulnerable to slumping or collapse, even when they have been heavily planted with erosion-control vegetation. If the bottom of the bank has eroded and its slope is steeper than the upper portion of the bank, the bank is likely unstable. If the unstable bank collapses, the top of bank will end up closer to the house or building. Before planting vegetation, the bank slope should be stabilized. Fill (i.e., soil of a similar type to that on the bank) can be added to the bottom of the bank to create a slope that matches, or is less steep than the upper slope. When the dry beach is so narrow that adding sediment would bring the toe of the bank within the reach of high tides, removing sediment from the top of the bank is a better option for stabilizing the slope. Otherwise, the new bank fill will erode quickly, undermining the rest of the bank. The farther landward the toe, the lower the probability it will be eroded and the bank will be destabilized.

continued on page 41

Tool 3: Non-structural Erosion Control and Shoreline Stabilization, cont.

Dune Beach Nourishment Project (Photo taken by Rebecca Haney)

To ensure the success of erosion control and shoreline stabilization projects, the sources of erosion including waves and upland runoff, should be identified as part of the site evaluation and design process. Runoff should be reduced or redirected to enhance the longevity of the stabilization project. Finally, it can be difficult to get plants established in areas subject to regular erosion from waves, tides, currents, wind and coastal storms. In these cases, additional techniques can be used to improve site protection. For example, beach nourishment (i.e., adding sediments, such as sand, gravel and cobble to widen the beach) can protect vegetation projects by widening beaches in areas with relatively narrow beaches at high tide. For bank projects, dense rolls of natural fiber called coir rolls and hay bales can be staked at the base of the bank to provide a short-term buffer from tides and waves, and artificial dunes can be constructed with sediment from an off-site source to buffer the base of the bank.

POTENTIAL IMPACTS AND HOW TO MINIMIZE THEM

In a habitat for endangered or threatened species, vegetation projects (including planting native plants) can have significant impacts, such as removing open sand areas that are necessary for successful nesting of endangered shorebirds. Selecting different types of vegetation (e.g., grass vs. shrubs) and increasing the spacing between plantings can minimize these impacts. Detailed guidance is available from the U.S. Fish and Wildlife Service (link below) and the appropriate state agency regarding locations and important habitat characteristics that need to be protected for endangered and threatened species.

Link: www.doi.gov/hurricanesandy/usfws

Tool 4: Sustainable Stormwater Management

Sustainable stormwater management, otherwise known Low-Impact Development (LID), are activities that mimic how a natural, undeveloped landscape would handle rainwater. LID techniques are implemented to reduce the amount of runoff coming from streets, buildings and parking lots that cover the ground during a rain event. Rain washes over hard surfaces and results in stormwater runoff that carries sediment, oil and other pollutants to rivers and streams. This runoff can also cause erosion and flooding that ultimately harm properties and the community. Natural or "green" stormwater management systems are meant as alternatives to the pipes and ponds of typical construction and development. These natural systems can be designed to use natural systems and landscapes to mitigate flooding impacts, while at the same time improving the quality of life within the same project area.

STORMWATER AND FLOODPLAIN MANAGEMENT CONNECTION

Floodplains and stormwater are sources of flooding in individual communities. Floodplains are associated with land directly adjacent to rivers, streams, embankments, wetlands and tributaries, while stormwater is associated with drainage networks, smaller pipes and localized areas. Stormwater also has a direct impact on natural and manmade infrastructure (streams and stormwater infrastructure); therefore, healthy streams are better at handling larger stormwater events. Sometimes, local floodplain managers have no involvement in stormwater management since most stormwater concerns are centralized in more urban areas. However, these two water sources collide for floodplain managers and other community officials who want to incorporate NAI principles as part of their overall strategy to reduce flood losses.

Tool 4: Sustainable Stormwater Management, cont.

Practitioners need the proper tools and guidance to help implement NAI principles and LID strategies.

BEWARE! LID DOESN'T ALWAYS EQUAL NAI

LID practices do not always align with NAI principles. For example, one common LID practice is the use of rain gardens to address site specific stormwater. Although this is a good stormwater practice, it is not an NAI-aligned principle if constructed on top of unstable bluffs. This is due to the fact that water infiltration into the bluff would reduce the bluff stability and increase the potential for bluff failure. Large capacity rain barrels would be a more appropriate LID practice in this setting.

SCALES OF SUSTAINABLE STORMWATER MANAGEMENT

LID practices can be viewed many different ways. One of the easiest ways to examine LID is to consider the implementation on various scales. For instance, when evaluating a parcel or a particular site that has a stormwater issue, the LID concept's positive impacts on stormwater issues are often obvious and apparent. Secondly, when the stormwater concerns are elevated to a larger area such as a neighborhood, larger scale considerations come into play. Asking questions such as, "what is contributing to the overall stormwater problem?" and "can it be addressed by considering neighborhood LID implementation?" and "would the LID practices work together to solve the problem?" are necessary in evaluating potential solutions. Lastly, on a large scale, watershed health depends on thoughtful planning and implementation strategies that should include sustainable stormwater management. All three of these specific implementation strategies are connected by NAI principles that encourage problem solving without compromise of another property, neighborhood or watershed.

SITE-SPECIFIC LID IMPLEMENTATION

Site-specific LID typically facilitates mitigation of localized flooding concerns generated by impervious areas on or close to the site with the stormwater management challenge. Common site-specific techniques include rain gardens, rain barrels, pervious pavement, infiltration trenches, French drains and tree wells.

The key to site-specific LID implementation is selection of appropriate green infrastructure practices while considering NAI principles that will not adversely impact other parts of the site or adjacent property owners.

continued on page 45

Photo courtesy of URS

Tool 4: Sustainable Stormwater Management, cont.

SITE SPECIFIC CASE STUDY IMPLEMENTATION

Situation: A property owner has some standing water that has worsened over time due to increased development in the surrounding area.

Solution: A good LID/NAI solution considers options that address standing water without directing the water elsewhere. Evaluating the stormwater source is one of the first things that should be done. Once this is determined, the stormwater coming into the flooded area can be intercepted with a specific green infrastructure technique or GI solutions can be applied to the inundation area. There are many documents available on the Internet to help evaluate on-site flooding and determine appropriate GI solutions for specific situations and scenarios.

Stormwater Low Impact Development (LID) Image from Russian River Watershed Association

MEDIUM (NEIGHBORHOOD) SCALE IMPLEMENTATION

Medium-scale LID implementation typically uses the same green infrastructure solutions that are appropriate for small-scale installations with more applied to address a much larger stormwater problem. Medium-scale LID opportunities also include the use of stormwater parks, medians and larger defined green spaces. An added benefit of medium-scale implementation is *neighborhood beautification* that is intentional, visual or hidden to address stormwater runoff while allowing the space to be used for other purposes such as recreation. Redeveloping vacant or abandoned properties with stormwater management facilities is something many proactive communities are doing as they implement urban renewal strategies. An innovative way to address vacant land issues and stormwater concerns following NAI principles is to develop stormwater management solutions that provide attractive solutions enhancing the property's use while mitigating stormwater flows.

Photo courtesy of URS

continued on page 46

Tool 4: Sustainable Stormwater Management, cont.

Photo courtesy of URS

MEDIUM (NEIGHBORHOOD) SCALE CASE STUDY IMPLEMENTATION

Situation: A neighborhood area has been plagued with standing water at several street intersections. The local floodplain manager and the community engineer have determined that flooding has worsened due to a new commercial development directly upstream.

Solution: Community options include continued flooding inconvenience if the situation is not addressed, or they can implement a solution to minimize intersection flood impacts. Typically, a hydraulic and hydrologic study is needed to determine the source(s) of increased stormwater and to determine the types of LID or GI that would best solve the problem. There are many LID practices implemented as stormwater solutions that also require minimal maintenance. If maintenance is a concern, it is recommended that the solutions proposed consider ease of maintenance as a high priority is selecting solutions.

LARGE (WATERSHED) SCALE IMPLEMENTATION

Large (watershed) scale LID implementation is most compatible with NAI principles because it addresses a holistic approach to stormwater management. Large-scale implementation can be more pragmatic, since stormwater is addressed for the whole watershed as opposed to smaller "problem areas." This also further demonstrates the connection between stormwater and floodplain management. In communities without stormwater management regulations, it is common to see a direct connection between development and increased stormwater challenges downstream of development. This expands to the floodplain and causes increased and more severe

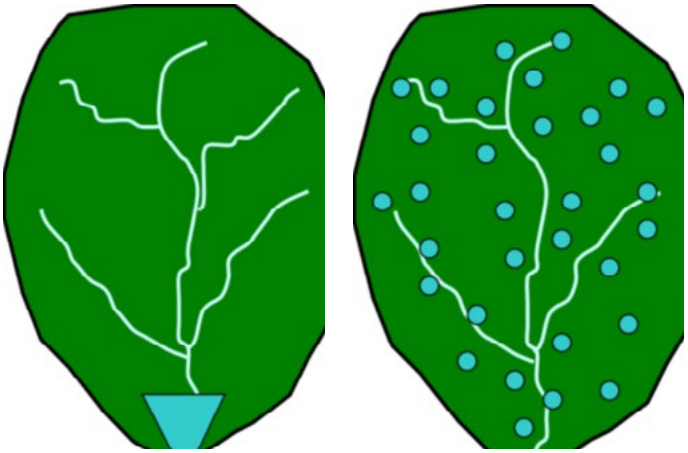
Tool 4: Sustainable Stormwater Management, cont.

flooding. By combining stormwater and floodplain management principles into one management strategy, communities can address with less effort and expense. It is recommended that communities develop a comprehensive stormwater plan in addition to a comprehensive floodplain management plan that inter-relates concentrated resources on areas of overlap.

Large-scale LID implementation typically consists of an effort to evaluate the current problems within the watershed connected to the flooding concerns of the basin (watershed). The illustrations (at the right) show a traditional stormwater management approach compared to sustainable stormwater design approach. Traditional stormwater management prescribes detention or retention facilities placed strategically to capture, hold or attenuate flow stormwater flows. Large-scale LID implementation examines how a watershed is currently managing stormwater as well as how LID can be implemented within the watershed to manage more stormwater runoff at its source.

COASTAL VS. RIVERINE SUSTAINABLE STORMWATER DESIGN

Controlling overland runoff to reduce coastal erosion is an increasing challenge but many communities have traditionally thought of coastal zones as the perfect location for stormwater routing. Many communities have worked to protect shorelines from the ocean wave actions but have not addressed shoreline stormwater protection. Many coastal properties are threatened by erosion and storm damage. Inappropriate shoreline stabilization methods can actually do more harm than good – exacerbating beach erosion, damaging neighboring properties, impacting marine habitats and diminishing the capacity of beaches, dunes, and other natural landforms to protect inland areas from storm damage.



Watershed Runoff

GENERAL APPROACHES TO RUNOFF CONTROL

Controlling runoff from upland sources helps to reduce a significant cause of erosion on many beaches, dunes and banks and helps protect property from storms and flooding. Runoff is controlled by reducing the quantity and velocity of water flowing across a property and changing the direction of flow as necessary to address specific erosion problems.

Runoff-control approaches include:

- Removing and reducing impervious surfaces (i.e., pavement, concrete and other impermeable materials) and planting natural vegetation

continued on page 48

Tool 4: Sustainable Stormwater Management, cont.

to help slow the flow of runoff and allow the water to naturally seep into the ground;

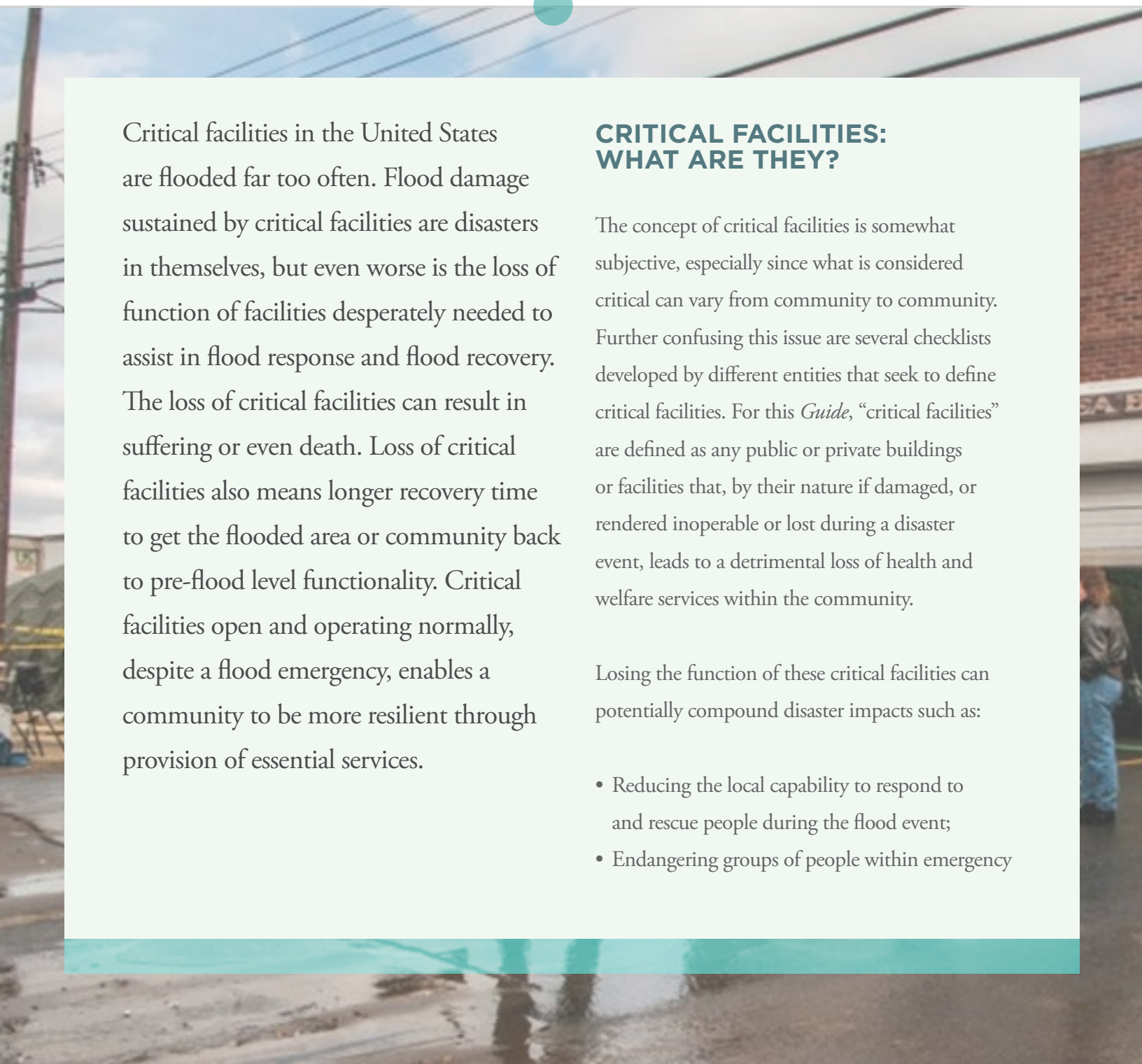
- Planting vegetated buffers;
- Replacing lawn with natural plantings;
- Capturing runoff so that it can be infiltrated into the ground or reused for irrigation;
- Redirecting the flow of water away from erosion-prone areas by regrading the ground surface, constructing physical barriers and removing landscaping elements that channel runoff; and
- Maintaining natural absorption by preventing saturation from irrigation.

HOW TECHNIQUES DIFFER ON THE COAST

LID planning in coastal zones has to be more thoughtful. The Massachusetts Office of Coastal Zone Management's (CZM) StormSmart Coasts program offers a menu of strategies for reducing erosion and storm damage while minimizing impacts to shoreline systems. These are available at: www.mass.gov/czm.

Photo courtesy of URS

Tool 5: Mitigating Critical Facilities



Critical facilities in the United States are flooded far too often. Flood damage sustained by critical facilities are disasters in themselves, but even worse is the loss of function of facilities desperately needed to assist in flood response and flood recovery. The loss of critical facilities can result in suffering or even death. Loss of critical facilities also means longer recovery time to get the flooded area or community back to pre-flood level functionality. Critical facilities open and operating normally, despite a flood emergency, enables a community to be more resilient through provision of essential services.

CRITICAL FACILITIES: WHAT ARE THEY?

The concept of critical facilities is somewhat subjective, especially since what is considered critical can vary from community to community. Further confusing this issue are several checklists developed by different entities that seek to define critical facilities. For this *Guide*, "critical facilities" are defined as any public or private buildings or facilities that, by their nature if damaged, or rendered inoperable or lost during a disaster event, leads to a detrimental loss of health and welfare services within the community.

Losing the function of these critical facilities can potentially compound disaster impacts such as:

- Reducing the local capability to respond to and rescue people during the flood event;
- Endangering groups of people within emergency

Tool 5: Mitigating Critical Facilities, cont.

evacuation centers, medical facilities or elderly care facilities; and
- Denying provision of essential and emergency services such as law enforcement and fire.

TYPICAL CRITICAL FACILITIES ARE:

- Police, fire and rescue, 9-1-1 call centers and Emergency Operations Centers;
- Hospitals and other medical and health care facilities;
- Retirement homes and senior care centers;
- Schools (elementary and secondary schools, vocational schools, colleges and universities);
- Hazardous materials storage areas;
- Water and wastewater treatment facilities;
- Transportation hubs that house or support transportation systems essential to access and evacuation during flood events;
- Buildings housing vital data storage;
- Communication networks such as radio, telephone and television;
- Electrical lines, transformers and power plants;
- Airports;
- Commuter rail lines and stations;
- Detention facilities and jails;
- Local government offices and facilities necessary for provision of essential services;
- Emergency shelters; and
- The community's local government IT server.
- NAI principles for dealing with electrical utilities, oil storage facilities, natural gas supply lines and distribution centers, and natural gas, propane and fuel oil storage and conveyance lines is addressed in the NAI How-to Guide on Infrastructure (link below).

CRITICAL FACILITY NAI STANDARD

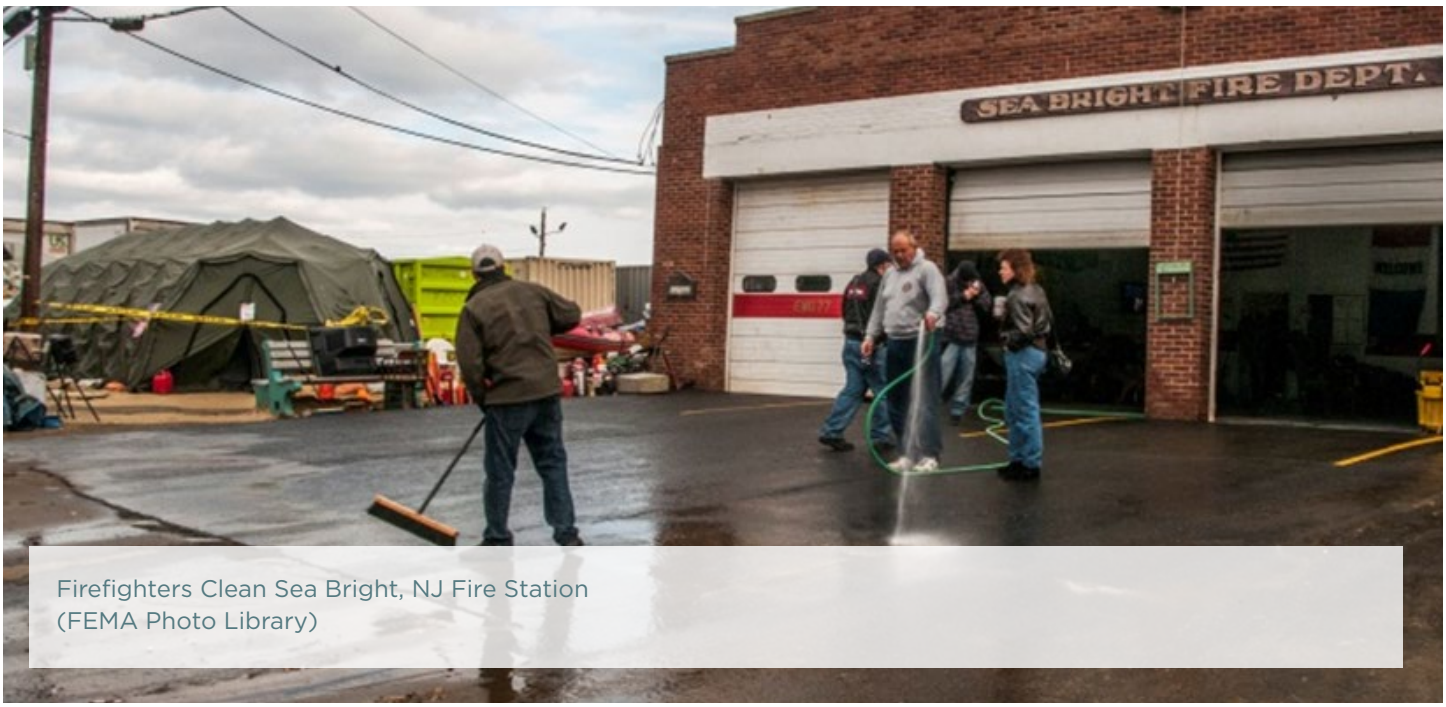
For a critical facility to be considered NAI, the following three items should be addressed:

1. Protection of the facility itself. Structures or utilities considered critical for provision of essential services should not be built in a floodplain because the risk of impacts from flooding is too great. However, if a critical facility already exists, it should be retrofitted to the 0.2 percent standard, or flood of record, whichever is greater. In fact, Executive Order 11988 was written to reduce the potential for federal government expenditures in a 0.2 percent annual probability floodplain area. Many communities restrict critical facility locations to areas entirely outside of the Special Flood Hazard Area (SFHA), otherwise more commonly known as the "floodplain."
2. Access to the critical facility. If critical facilities are located in the 1 percent annual chance floodplain, access is required during a 0.2 percent annual chance flood. These restrictions are necessary to ensure critical facilities are accessible and operable ina 0.2 percent annual chance flood event.
3. Operation of the critical facility. An operations plan that has contingencies for staffing, evacuation, alternative sites and critical facility operations must

continued on page 51

Link: http://www.floods.org/NoAdverseImpact/NAI_How-to-Guide_Infrastructure.pdf

Tool 5: Mitigating Critical Facilities, cont.



Firefighters Clean Sea Bright, NJ Fire Station
(FEMA Photo Library)

be developed and regularly exercised for a probable maximum event flood.

IMPLEMENTATION

To accomplish having an NAI critical facility, communities must analyze flood risks and appropriately site facilities that provide critical functions. Other facilities in low risk flood hazard areas that may support flood response efforts are included in this analysis. Ideally, this will entail consultation with the planning, zoning and building departments prior to site design and construction. Local comprehensive, floodplain management and hazard mitigation plans should holistically define the siting of future critical facilities necessary to support community growth and welfare outside of high hazard areas. So a comprehensive community vision includes protection of critical facilities.

The community's HMP will provide insights into hazard vulnerabilities for current and future development and may highlight critical facility vulnerability. Communities should also be aware that siting a critical facility immediately adjacent to the SFHA still places the facility at significant risk to flooding since "rare" floods are occurring with increased frequency, and floodplains often expand or change course over time. For these reasons, communities may opt to use a "future conditions" hydrology floodplain map for siting critical facilities to increase the level of protection for critical facilities built outside a flood zone accounting for future watershed development and increased flood events. The community's emergency management staff is crucial in critical facilities planning, siting and assimilation into emergency operations plans.

continued on page 52

CRITICAL FACILITY MITIGATION OPTIONS

The best solution is to ensure that critical facilities are not built in a flood-prone area. However, significant critical facilities buildings and utilities presently inhabit high risk areas. Flood fighting with sandbags is often the first course for reducing damage and the loss of function of critical facilities during a flood event, but this is not sustainable. Several mitigation options support more permanent, resilient solutions. The following is a list of mitigation options eligible for funding under FEMA's HMA programs.

BEST OPTIONS

- Acquisition – Acquiring and demolishing critical facilities is not often highly prioritized by communities since they may depend upon them for everyday function or the facility may not lend itself to acquisition (power lines). However, if a critical facility reaches its design life or is damaged in a flood event, communities should consider demolishing the facility and rebuilding outside of the floodplain. Disaster damage also presents the opportunity to "harden" the facility through application of appropriate mitigation measures ranging from building hardening with door and window shields, foundation membrane systems, internal drainage backflow valves and generators. Many of these mitigation options can be funded through FEMA's PA or HMA programs.
- Relocation – Communities may desire to move a functional critical facility outside of the high-risk area. This is often and allowable expense under the PA program after a disaster or can be proactively addressed through certain FEMA HMA programs.

For more information about acquisition and relocation, see the acquisition and relocation section of this document.

OTHER OPTIONS

- Elevation – Most critical facilities are large buildings for which elevation is seemingly infeasible or cost prohibitive. However, innovations in elevating equipment have made it possible to successfully elevate large structures. In some cases, elevating critical facilities will reduce damage, but the lack of accessibility during a flood event will result in a loss of function. This means that elevation may not be an appropriate mitigation option for those critical facilities that absolutely cannot lose function.
- Dry flood-proofing – When a critical facility cannot be moved or elevated, flood proofing is often a viable option. Dry flood-proofing projects should be designed and constructed in accordance with the American Society of Civil Engineers Structural Engineering Institute's (ASCE/SEI) publication 24-05, *Flood-Resistant Design and Construction*. This technique is only viable for shallow water

Tool 5: Mitigating Critical Facilities, cont.

Hurricane Sandy Aftermath
(Photo taken by John Miller, PE, CFM, CSM, Associate Water Resources Engineer; Princeton Hydro, LLC)

depths, usually less than 2 or 3 feet. Like elevation, dry flood-proofing can reduce damage, but may not prevent loss of function during a flood event, since the facility may be inaccessible due to flood waters.

- Wet flood-proofing – This practice is used for pre-FIRM structures which can endure low velocity floodwaters passing through the structure or building. Usually interior contents are elevated or otherwise protected and adequate flood vents are installed to allow floodwaters to pass through the building. After the flooding subsides, the interior of the building is cleaned and sanitized and returns to normal operations. This method is often employed for large warehouses where contents can be placed on elevated pallets or shelving. As with dry flood-proofing, the mitigation design should be performed by a licensed architect or engineer using methods consistent with the ASCE/SEI publication 24-05, *Flood-Resistant Design and Construction*.

COMMUNITY RATING SYSTEM

There are credit points available in the Community Rating System (CRS) in the three activities found in its *600 Series: Warning & Response.* *In Activity 610: Flood Warning and Response*, up to 75 points are available in the Critical Facilities Planning (CFP) element. These credit points are focused on flood warning and response planning. In *Activity 620: Levees*, up to 30 points are available in the levee failure critical facilities planning (LCF) element. This element should be tied to the *Activity 610 CFP* element. These credit points are focused on having information in the community's levee failure response plan about all critical facilities that could be affected by a levee failure. Lastly, *Activity 630: Dams*, up to 20 points are available in the dam failure critical facilities planning

continued on page 53

(DCF) element. This element should also be tied to the *Activity 610 CFP* element. The community's dam failure response plan must list the facilities considered critical in a dam failure emergency.

SPECIAL CONSIDERATIONS: FUNDING MECHANISMS FOR MITIGATION

Since the mid-20th century, federal programs have largely supplanted private funding for community flood control, disaster assistance and mitigation activities. While the eligibility requirements and individual programs of FEMA, USACE, DOC, HUD and USDA are subject to change, programs are expected to remain in some form. However, in the current budget climate there can be expected to be more demand for funds than there are funds available. So it is important federal programs place responsibility on funding recipients to ensure actions taken in one area do not harm other properties.

There are myriad funding mechanisms available for individuals, communities, tribal governments and states to mitigate flood risk and flood losses. This section includes non-federal and federal programs that provide disaster and non-disaster funds for mitigation projects that result in No Adverse Impact.

LOCAL MITIGATION RESOURCES

Local Stormwater Utility

Stormwater Utilities (SWUs) can be a sustainable option for funding not only a community's stormwater management program, but also the community's floodplain management program, water quality management, ecological preservation and management of annual pollutant loads contained in stormwater discharges (NPDES).

SUs are generally a "stand-alone" service unit with the local government or service area. SUs generate constant and equitable funding through "user fees" typically based on a formula that looks at the amount of impervious surface (rooftops, accessory buildings, driveways, parking lots, roadways, etc.) on a particular piece of property with that stormwater district. This method of calculating SU fees is thought to be based on the "demands" the property puts on the overall stormwater/drainage system. Other communities may use a "flat" stormwater fee for developed residential and non-residential properties. SU fees are generally billed annually as part of the tax bill or may be billed monthly and included on a water or sewer bill.

Revenues generated from the SU are placed in a dedicated fund and are then used to implement a specified stormwater program that can include upgrades to and maintenance of the existing stormwater infrastructure system, development of drainage or watershed plans, long-term planning for and construction of capital improvement projects, implementation of water quality programs, floodplain management,

facilitation of flood control measures and administrative costs associated with running the SU and various programs that fall within its scope .

Many communities have incentive programs that reduce user fees by allowing the property owner to improve stormwater management on their own particular piece of property. Use of Low Impact Development practices would be an example of a way in which a property owner could improve their watershed stewardship.

SUs have become common across the nation and have withstood legal challenges and years of scrutiny since their inception. Case law has consistently supported that a stormwater fee based on usage is not a tax and "all should pay" (even those entities within the community that may traditionally be exempt from all other taxes). Overall, of the more than 1,300 SUs nationwide (as of June 2012), most are thriving. Some have been repealed and others are battling collection of unpaid fees in court, but, in general, SUs still remain a fair and equitable way to support a viable and workable stormwater management program.

LOCAL MITIGATION PROGRAMS FUNDED BY SALES TAX, PROPERTY TAX OR OTHER ASSESSMENT

A local option sales tax (LOST) is a voter-approved funding mechanism used at the city of county level to fund specific local or area capital improvement projects such as street and road improvements. In general, the most common rate of LOST funding is 1 percent and is added on top of the state's sales tax and is applicable only within the city or county it is enacted in. The LOST has a specified time period (usually five years) and often communities that utilize this as a funding mechanism present another list of projects to a vote of the public before the expiry of the current LOST. Much needed and costly stormwater projects are often the target of LOST funding, along with the associated floodplain management components to those projects.

SPECIAL PURPOSE LOCAL OPTION SALES TAX (SPLOST)

A special purpose local option sales tax is a funding mechanism used by some communities in Georgia to fund capital outlay projects. In general, it is a 1 percent sales tax (and can be up to a 2 percent tax) levied by the county for the purpose of funding a well-defined specified list of voter approved community projects and can include public facilities, roads/streets/bridges, parks and other projects of a "permanent and long-lived nature." Unlike an SU, funds collected through SPLOST cannot be used for operating expenses and most, but not all, maintenance projects. Although maintenance of roads, streets and bridges is specifically allowed. Much like a LOST, the SPLOST is for a specified time period and a new set of projects must be put out to the public for voter approval prior to the current SPLOST expiring.

Of interest: Augusta, Georgia has used SPLOST funding as a match to PDM and HMGP funding and also used SPLOST funding to purchase

continued on page 56

a large number of repetitively-flooded structures within its jurisdiction, eliminating the need for a costly regional detention pond in two areas of the community.

REGIONAL FUNDING MECHANISMS/ SPECIAL ASSESSMENT DISTRICTS

A Special Assessment District (SAD) is used when only a portion of the properties in the municipality are affected by a particular stormwater or floodplain management project, or when multiple communities are brought together (such as communities within the same watershed) to form a SAD to undertake a particular stormwater or floodplain management project. Generally, a regional authority is developed to oversee the projects – their planning, funding, implementation and ongoing maintenance.

STATE MITIGATION RESOURCES

Resources provided by the state for hazard mitigation projects is an important contribution a state's overall effort to reduce adverse impacts and to leverage mitigation funds made available at the federal or local level. In a 2010, a survey by ASFPM in conjunction with the *State and Local Programs in Review 2010* document indicated that 24 percent of states had state funds reserved for carrying out flood hazard mitigation projects. However, few state governments have stable, ongoing programs. Typically, funding occurs in the following ways:

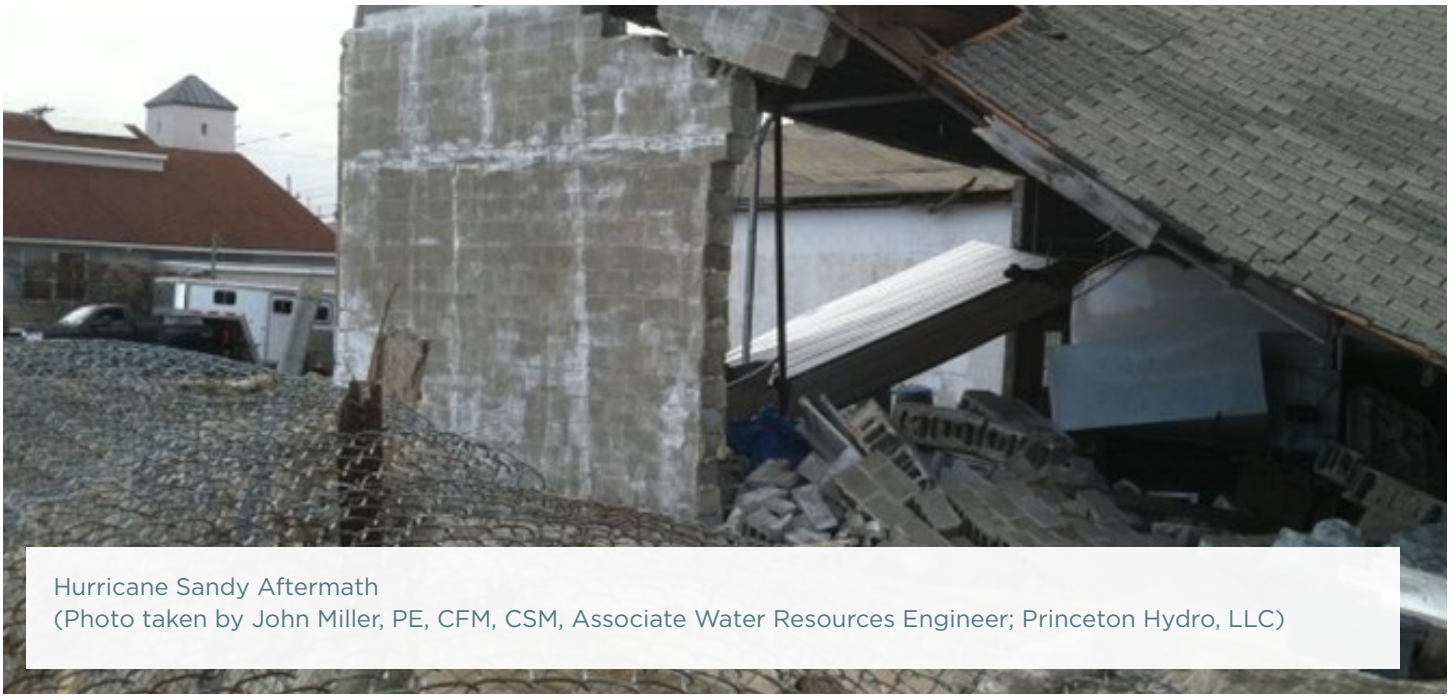
SPECIAL APPROPRIATIONS

After a disaster, states that do provide mitigation funds tend to appropriate "one time" funds to help with the non-federal share of federal hazard mitigation funds. Fund availability is usually reflective of the state budget at the time and in recent years, with state budgets being challenged, such appropriations have been rarer. For example, in the last three federal disaster declarations, Ohio's General Assembly has provided an amount equal to 12.5 percent of available HMGP funds to help cost-share the non-federal matching amount. In past years, the special appropriation has gone as high as matching the federal mitigation funds available dollar for dollar. The 2006 floods in New York led to the state setting priorities for using Hazard Mitigation Grant Program (HMGP) funds as well as a state allocation of $15 million for the buyouts of flood damaged properties.

ONGOING PROGRAMS/ AUTHORITIES

Ongoing state mitigation funding programs tend to be focused on particular hazards or mitigation techniques. These programs can be extremely varied including providing technical assistance, funding, planning assistance and even tax credits. Similar to Ohio above, Wisconsin provides funding after federal disaster declarations. However, Wisconsin's matching funds and formula are in state law, which provides for the state to split the non-federal match for any available federal disaster programs. In this way, it is an ongoing authority. Other ongoing state programs include:

Tool 5: Mitigating Critical Facilities, cont.



Hurricane Sandy Aftermath
(Photo taken by John Miller, PE, CFM, CSM, Associate Water Resources Engineer; Princeton Hydro, LLC)

MINNESOTA FLOOD HAZARD MITIGATION GRANT ASSISTANCE

The Minnesota State Legislature established this program in 1987 to provide state technical and financial assistance to local governments for flood hazard mitigation projects. Eligible projects include flood damage reduction studies for planning and implementing structural and non-structural measures including: acquisition of structures in the flood plain, relocations, flood-proofing, development of flood warning systems, public education, floodplain restorations, dams, dikes, levees, flood bypass channels, flood storage structures, water level control structures and other related activities, maximum of 50 percent of total eligible project costs up to $150,000. Grant requests for more than $150,000 must be approved by the Legislature. Costs must be incurred and paid before reimbursement can be made.

NEW JERSEY BLUE ACRES PROGRAM

Created in 1961, New Jersey's Green Acres Program and its spin-off, the Blue Acres Program (created in 1995), serve as shining examples of statewide mitigation initiatives in providing funding to local governments, counties and non-profits in the protection of nearly 1.2 million acres of open space and farmland, some of which once was privately owned, and voluntarily acquired, floodway property along the Delaware, Passaic and Raritan Rivers and their respective tributaries. Properties (and their structures) acquired include those that have been damaged by, or are subject to damage by, storms or storm-related flooding, and/or those properties that buffer or protect other properties from storms or storm-related flooding. Once acquired the property becomes environmentally-protected open space, natural or historical open

continued on page 57

space, forest land, urban wildlife preserves, wildlife management areas, conservation areas or one of hundreds of outdoor recreational facilities located around the state.

Blue Acres funding has also been successfully used as leverage for federal money for a number of years, covering the match, or cost-share, for the 75-90 percent federal grant money traditionally allocated by FEMA for property acquisition post-disaster. Additionally, these state funds help reduce long-term local and federal costs such as those borne by local communities during and post-disaster and those borne by the NFIP in claims after a flood event. Many public benefits result, as well, as homes are removed from the floodplain and land is able to return to a more natural state — better able to provide recreational opportunities to the public and better able to absorb the ebb and flow of water along rivers and coastal areas.

CALIFORNIA LEVEE HAZARD MITIGATION PROGRAM

Two bond measures (Propositions 1E and 84) from 2006 appropriated roughly $4.9 billion to mitigate levee hazards. This money has been allocated for immediate measures to address levee failure mitigation backlogs as well as long-range planning. One example is the Delta Risk Management Strategy (DRMS), a program to develop a comprehensive assessment of levee risk in the Delta. Under DRMS, the Department of Water Resources is inventorying the existing levee system, compiling existing and new subsurface data, building a GIS-based platform containing all relevant levee information and developing a risk-based framework to rank levee hazards so bond money can be spent cost-effectively.

SOUTH CAROLINA MITIGATION GRANT AND TAX CREDIT PROGRAMS

The South Carolina Hurricane Damage Mitigation Program, also known as the SC Safe Home Grant Program, offers grants for South Carolinians to strengthen their homes against the damaging effects of high winds from hurricanes and severe storms. The program was established by the Omnibus Insurance Reform Act of 2007. As of December 2010, more than 1,429 grants have been awarded totaling approximately $6.1 million. This program is subject to annual legislative appropriations.

The Omnibus Coastal Property Insurance Reform Act of 2007 also provides certain state income tax credits for the costs a homeowner incurs in making their home more resistant to losses due to hurricane damage. Section 12-6-3660 provides an income tax credit for the costs incurred to retrofit a structure qualifying as the taxpayer's legal

continued on page 59

residence to make it more resistant to loss due to hurricane, rising floodwater or other catastrophic windstorm event. The tax credit for any taxable year is limited to 25 percent of the total costs incurred or $1,000, whichever is less.

FEDERAL MITIGATION RESOURCES

The Federal Emergency Management Agency is the federal agency dedicated to enhancing the capability of the United States to prepare for, respond to, recover from and mitigate the emergencies or disasters that affect citizens and first responders throughout the country. As such, it is responsible for a wide variety of programs intent on providing post-disaster assistance for those in declared disaster-zones, as well as pre-disaster assistance intent on aiding those in hazardous areas regardless of immediate danger.

The NFIP was established by the federal government to offer flood insurance to communities in exchange for sound floodplain management and the planning and implementation of flood mitigation measures. Because many building policies include flood-loss exclusions that prevent homeowners, renters or building owners from seeking compensation for damages related to flooding or surface water damages, the program is intended to provide an insurance alternative to help bridge the gap between the escalating costs of flood damage and the owner's ability to pay. Administered through private insurance companies, NFIP coverage is available for buildings and contents to homeowners, renters and business owners in communities that participate in the NFIP program.

ICC is provided as part of an NFIP policy to provide coverage for additional costs incurred when a home or building owner is required to spend additional funds to meet local floodplain ordinances. If a home or building is declared substantially damaged by a local community, the ICC provides coverage up to $30,000 of additional funding for actions required to bring the home or building up to community or state floodplain management standards, to include elevation, dry or wet flood-proofing, and demolishing or moving a structure. This enables homeowners to not only recover the costs of damages, but also recover costs associated with making the building less flood-prone and, ultimately, safer.

Funding for pre-disaster and post-disaster mitigation activities is available through FEMA's HMA grant programs.

HMGP is available after a presidential disaster declaration. The Pre-Disaster Mitigation (PDM) program has provided funds for natural hazard mitigation measures, just as HMGP does, but on an annual basis and has an undetermined future as of May 2013. Although more activities are eligible for funding through HMGP, both programs provide funding for long-term flood risk reduction activities, including:

- Property acquisition, demolition or relocation to mitigate flood loss or damage;
- Elevation of flood-prone structures (residential and non-residential);

continued on page 60

Tool 5: Mitigating Critical Facilities, cont.

- Dry flood-proofing of historic residential and non-residential structures;
- Wet flood-proofing of non-residential structures;
- Wind retrofit;
- Minor localized flood reductions projects; and
- Retrofitting buildings.

The FEMA Flood Mitigation Assistance (FMA)--Repetitive Flood Claims (RFC) and Severe Repetitive Loss (SRL)-- programs also provide funding annually to reduce or eliminate flood damage. These programs are being combined through the direction of the 2012 National Flood Insurance Reauthorization legislation and new FEMA HMA guidance will define the program and eligible mitigation activities. Historically, each of the HMA grant programs include a federal portion and non-federal share which range from 75-100 percent federal for the RFC program.

The PA program provides funding for damaged public infrastructure following a presidentially declared disaster in designated areas. This includes, but is not limited to, emergency protective measures, repair,and replacement of government or qualifying non-profit infrastructure and facilities. This program is essential to community post-disaster recovery as it can bolster mitigation through incorporation of eligible infrastructure mitigation within the PA program. Further assistance is provided for mitigation measures through the PA program for damaged facilities through Section 406. This program is under utilized and yet provides a unique opportunity for communities to bolster infrastructure resiliency during repair or replacement of damaged public facilities. Many mitigation options are pre-approved through a FEMA policy memo, making addition of mitigation measures to a project worksheet a straightforward process.

Disaster assistance is also provided through loans administered by the Small Business Administration (SBA) through its Office of Disaster Assistance (ODA). The SBA provides low-interest and long-term loans to businesses and homeowners. Loans can support mitigation for businesses and property owners not eligible through the other FEMA programs, so this program can offer impacted property owners long-term resilience at a very competitive interest rate.

FEMA's Community Disaster Loan Program provides funding for areas hit by a disaster that have lost significant tax or other revenue and can demonstrate a need for financial assistance. Funding is provided in the form of loans, which cannot exceed 25 percent of the jurisdiction's annual operating budget. Projects for these loans include funding for maintaining water or wastewater services. The maximum amount is $5 million.

Through HUD's Disaster Recovery Program, funding is available for the acquisition and relocation of low-income, flood-prone homes. These programs include

continued on page 61

Tool 5: Mitigating Critical Facilities, cont.

the Community Development Block Grant (CDBG) and the HOME Investment Partnerships.

CDBG funds may be available for flood mitigation activities for states, jurisdictions and tribal governments following a disaster if they have significant unmet recovery needs through special congressional appropriation. Eligible activities for funding include housing, economic development, infrastructure and other activities that prevent further damage. CDBG can be combined with FEMA funds to help meet local funding or the non-federal grant share for some programs. Activities include relocation, rehabilitation, construction, code enforcement, acquisition and other public services.

HOME funding is often used in partnership with non-profit groups. Activities include those that acquire or rehabilitate low-income housing. The purpose of this source of funding is to create affordable housing for low-income households. Activities include acquiring, improving, demolishing or rehabilitating housing.

The Economic Development Administration (EDA) facilitates assistance to governments for activities such as reconstruction, relocation, redevelopment, long-term community recovery planning and activities that increase resiliency.

Generally funding through the EDA is through the following activities:

- Planning and technical assistance, such as funding to develop recovery plans;
- Infrastructure design and development, which includes funding for retrofitting, constructing or overall improving existing facilities to increase economic development; and
- Capital or alternative financing through the Revolving Loan Fund (RLF) for business recovery activities where applicants have been denied an SBA loan or need funding in addition to an SBA loan.

The USDA is the nation's leader in food, agriculture and natural resource development, focused largely on promoting sustainability and conservation while promoting development and economic growth, particularly in rural areas.

Through Water and Waste Water Grants, households in communities with a population of 10,000 people or fewer can receive government funds to install plumbing and key fixtures in kitchens and bathrooms with the purpose of developing, replacing or repairing water and water disposal systems. Grants also include funding for storm drainage systems.

The B&I Guaranteed Loan program helps improve economic and environmental conditions in rural communities affected by a disaster by bolstering the private credit structure. Assistance through this program can be used to purchase and develop land, easements, buildings or facilities.

Within the USDA framework, the National Resource Conservation Service (NRCS) is the leading steward of conservation, particularly on private lands, working with landowners in conservation generally intended to benefit soil, water,

continued on page 62

Tool 5: Mitigating Critical Facilities, cont.

air and plants. As such, its role during the mitigation phase of emergency management is to assist landowners, including farmed and other organizations, implement conservation and control practices, to protect soils and watersheds from damages that have been incurred or could be incurred from a disaster.

The Environmental Quality Incentives Program (EQIP) assists farmers in implementing conservation practices such as improving soil and water conditions. Through this program farmers or producers are able to identify and implement conservation practices to natural resource concerns and meet state and federal environmental regulations. This is a voluntary program that provides contracts for up to 10 years.

The Small Watershed Program assists local organizations in water conservation and management, flood control, protection and planning. The purpose of the program is to prevent damage, increase conservation development and assist communities in utilizing land properly. The watershed must be 250,000 acres or smaller to be eligible for activities, including watershed surveys, planning, flood prevention and construction. Activities include watershed restoration such as measures that reduce runoff from farms.

The Emergency Watershed Protection Program provides assistance to flood-prone landowners, including easements and funds to set back levees. Projects must safeguard lives and property or reduce or eliminate natural hazards that suddenly impair a watershed. Importantly, this program does not require the declaration of a disaster or an emergency for funding to become available. Water conservation, flood control, soil conservation and land acquisition are all eligible activities. This includes watershed improvements such as removing debris from stream channels, supporting unstable stream banks and enforcing water control structures.

The Wetlands Reserve Program (WRP) provides landowners with the opportunity to establish long-term conservation practices through the protection, restoration and enhancement of wetlands on their property as long as the wetlands are farmed and under natural conditions or have the potential to become a wetland as a result of flooding. Activities include the acquisition of easements to restore wetlands and the floodplain habitat.

USACE is comprised of civilian and soldier engineers intent on providing public engineering services meant to reduce the risk of disasters. USACE focuses largely on the technical expertise and project management required for public works, to include those required for floodplain and wetland management.

The purpose of the Floodplain Management Service Program is similar to the goals of HMGP, but is specifically limited to protecting life and property from flood damage. This program provides technical assistance and

continued on page 63

Tool 5: Mitigating Critical Facilities, cont.

general planning guidance for non-structural floodplain programs under the broad goal of providing options for mitigating the flood hazard by promoting responsible use and management. Unlike FEMA's HMGP funding, this program funds studies, including evaluation studies, dam break analyses, flood warning and preparedness, stormwater management studies, flood proofing, comprehensive flood management studies, flood-damage reduction and regulatory floodway studies in addition to studies on dam removal and mitigation.

Through the PL 84-99 Program, USACE can assist in three main areas: preparedness, response and rehabilitation. This includes flood response emergency operation, dam mitigation activities, rehabilitation of flood control works that are either at risk for damage from a flood or have been destroyed by a disaster, restoration to damaged levees or acquisition of flooded land protected by a levee. After a disaster, the community can consider options to rebuilding a levee or other structure. After the 2011 Missouri River flood, the Corps used this program to set the levee back and rebuild it rather than build it in place right next to the river where it would again be subject to erosion and failure.

If assistance is requested, USACE may assist or provide funding for planning and designing activities that improved the quality of the environment after the development of feasibility study through its Section 206 Program. These activities include dam mitigation efforts to help restore aquatic habitats, including the floodplain habitat.

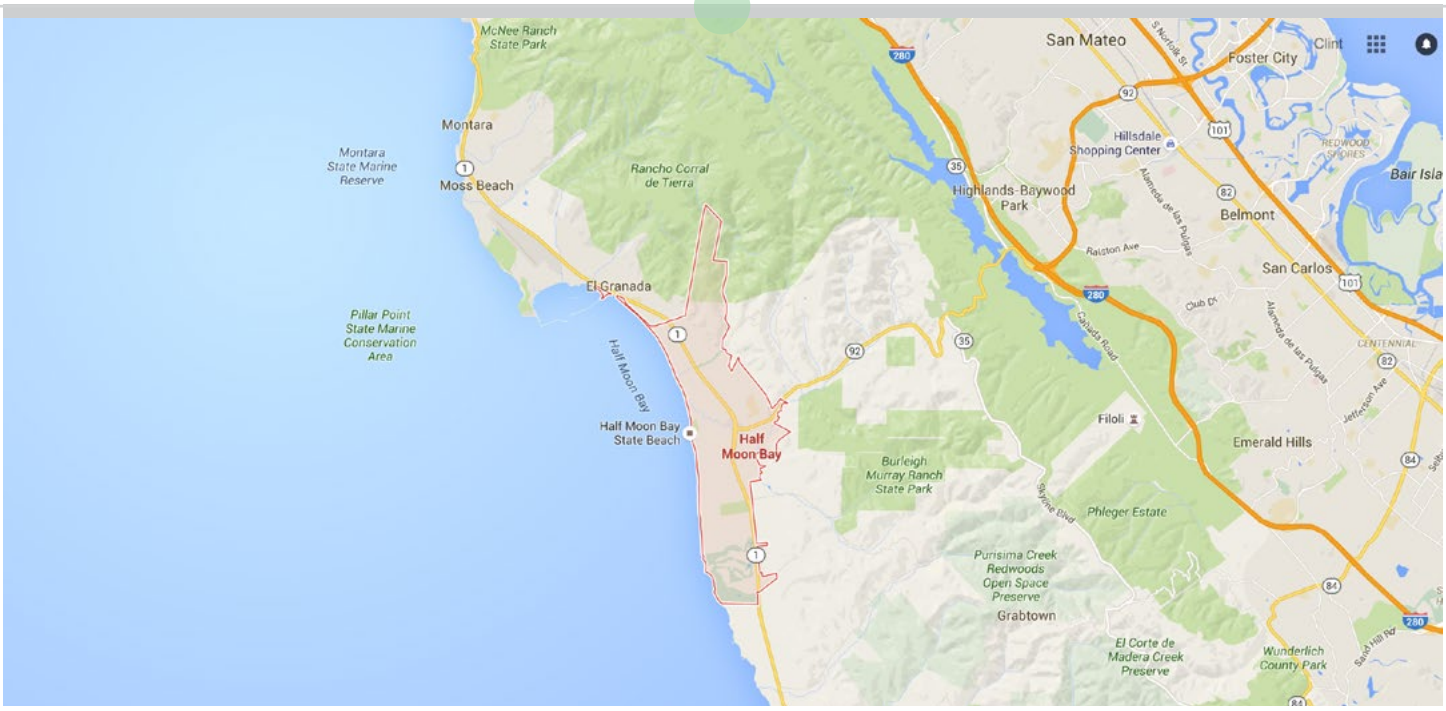
The Section 1135 Program authorizes USACE to improve the quality of the environment through modifications to operations or structures for civil works projects if previously constructed by USACE. The purpose is to modify projects that restore ecosystem habitats, such as restoring wetlands or floodplain habitats.

SECTION FOUR

Case Studies

In this section, we share the stories of a few communities on the East and West coasts that illustrate best practices and lessons learned in using (or not using) No Adverse Impact approaches.

Case File 1: Half Moon Bay, California



This story begins in Half Moon Bay – a coastal city located in San Mateo County with a rich history and a proud citizenry. The community's website cites it as "a place where neighbors care about each other, schools are important, and there is a sense of real community." The 2010 census estimates the population of Half Moon Bay at around 11,000 people. The city boasts a historic downtown area and several area attractions such as an annual outdoor festival, surfing and hiking at nearby Montara Mountain, in addition to access to nearby state parks, beaches and other amenities. It could be any quiet, home town in the United States.

This story involves a 24-acre, undeveloped parcel of land known as Beachwood. Historical maps from the 1970s to mid-1980s showed no depressions or other topographic characteristics that would lead to the conclusion that the area was a wetland. In fact, testing in the mid-1970s found the water table was at least 3 feet below grade. As of the date of this writing, the area is not shown within the SFHA on the Flood Insurance Rate Map. When a developer purchased the property for $1 million in 1993, there was no indication the property was undevelopable due to the presence of wetlands, but that is exactly what ensued.

Case File 1: Half Moon Bay, California, cont.

The developer purchased the property in the middle of a seven-year moratorium on new building permits requiring new wastewater extensions, which temporarily halted development on the property.

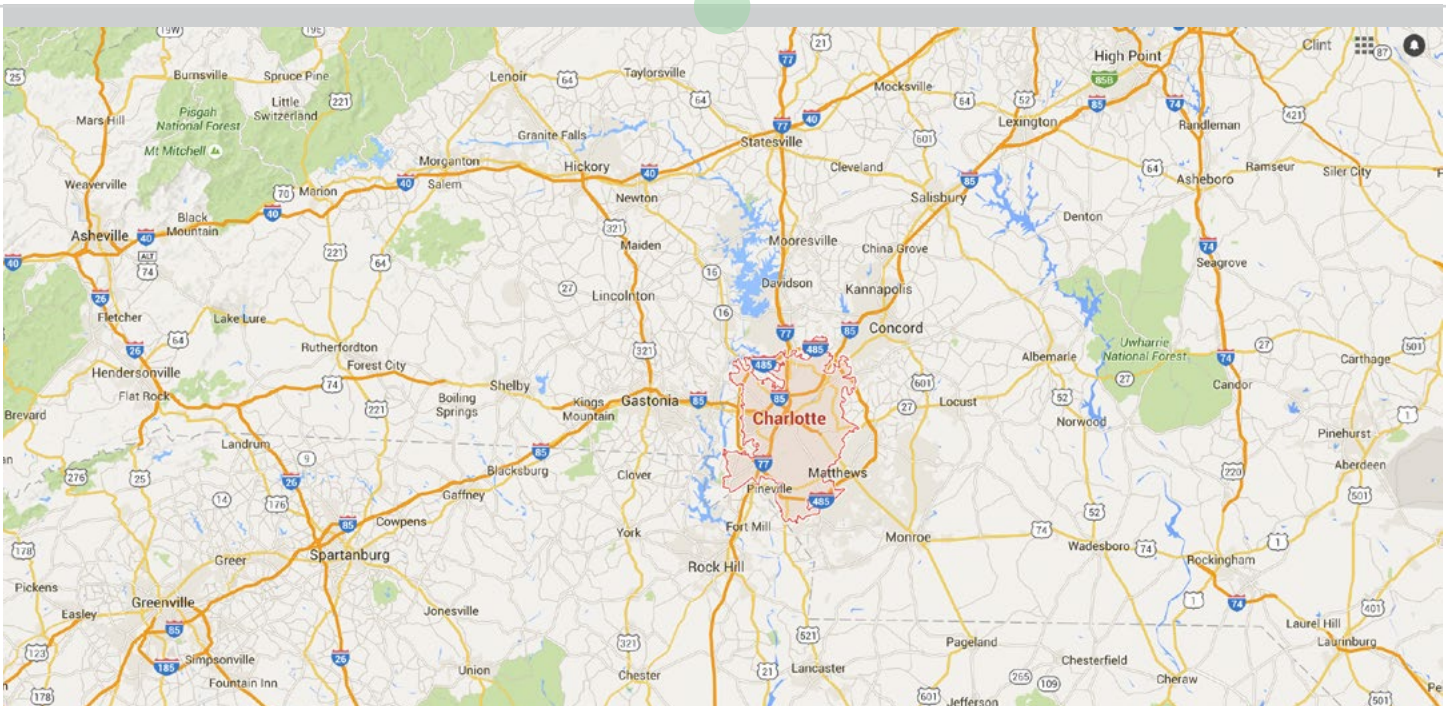
The moratorium was lifted and in 2000 the developer submitted an application to build 83 new homes on the property. A potential subdivision on the site had been tentatively approved in 1974 and again in 1990, so the developer had reason to be confident that the application would be approved once the development moratorium was lifted. However, the city denied the developer's permit application to develop Beachwood due to the fact that the area was a wetland and could not be developed.

In the seven-year legal battle that followed, it was brought to light that the city had built a stormwater drainage system in the early and mid-1980s, which included drainage pipes running along two sides of the parcel, and authorized the removal of more than 10,000-cubic-yards of fill from the property. In a 2007 inverse-condemnation judgment against Half Moon Bay, the court found that the city's work on the site allowed water to pool, thus creating the wetlands that made the site undevelopable. **Had the community planned its stormwater drainage system and other activities impacting the Beachwood property with an NAI mindset, they could have avoided this fate.**

The articles about Half Moon Bay and the ensuing hardships it faced are painful to read. The city grappled with many difficult decisions after the court found they were liable for $37 million as compensation for the taking that occurred, plus another $4 million in legal fees in 2007 (a judgment more than three times its annual budget). Though in the end, they successfully won a 2012 case against its insurer to cover the damages, it was not before the community went through several years of lawsuits, appeals, settlement agreements and various legislative proposals (to exempt Beachwood from wetlands restrictions, to make Beachwood a public park, to give or loan the city $10 million), which all failed to pass; the outsourcing of its services; and the constant question of disincorporation.

An NAI mindset might have changed the recent history of Half Moon Bay and saved them from going through the turmoil of these last several years.

Case File 2: Charlotte-Mecklenburg County, North Carolina



This story takes place in Mecklenburg County, in the offices of the Charlotte-Mecklenburg Storm Water Services division, which manages storm water runoff and works to eliminate sources of water pollution in the city of Charlotte and Mecklenburg County. The county is home to almost one million people, most of which reside in the city of Charlotte. Charlotte and its surrounds encompasses North Carolina's largest metropolitan area and boasts many aesthetic benefits for its citizens, including greenways, nature preserves, recreation centers and more than 17,000 acres of parkland in addition to cultural and historical attractions.

The Charlotte-Mecklenburg Storm Water Services division has an ongoing program to purchase flood-prone structures including homes, apartment buildings and businesses in the floodplain. The program encompasses several methods to buyout at-risk structures, including:

- A **Quick Buy Program**, which is used occasionally after very destructive floods to purchase damaged buildings that are at high risk of flooding again. This program can be implemented faster than other buyouts because no federal funds are involved—they are paid for entirely with local dollars. While projects involving federal funds can take a year or more, these Quick Buy projects can be completed in a fraction of that time.
- The **Orphan Property Acquisition Program**, which seeks to purchase properties that have been "orphaned"—while their neighbors' properties were

Case File 2: Charlotte-Mecklenburg County, North Carolina, cont.

successfully purchased and converted to green space, these single-family homes did not meet the requirements for either a Quick Buy or a traditional HMGP buyout project.

- The use of **Hazard Mitigation Grant Program** funding, which states can use to acquire properties destroyed or damaged in a natural disaster. HMGP funds will pay for up to 75 percent of the total project cost.

As of the date of this writing, more than 275 flood-prone structures have been purchased under these programs in more than 15 neighborhoods in six watersheds in the city and county. In all cases, the structures are demolished or relocated and the floodplain is restored as permanent open space. Sometimes, the Charlotte-Mecklenburg Police or Charlotte Fire Department partners with the Storm Water Services Division to demolish the properties, conducting training exercises using the acquired buildings.

The buyout impacts are very real to the more than 575 families who now reside outside the highest-risk areas of local floodplains. Some of their stories are shared on the Storm Water Services division's website in a video that highlights the personal stories and struggles of individuals one year after Tropical Storm Fay's devastating flooding.

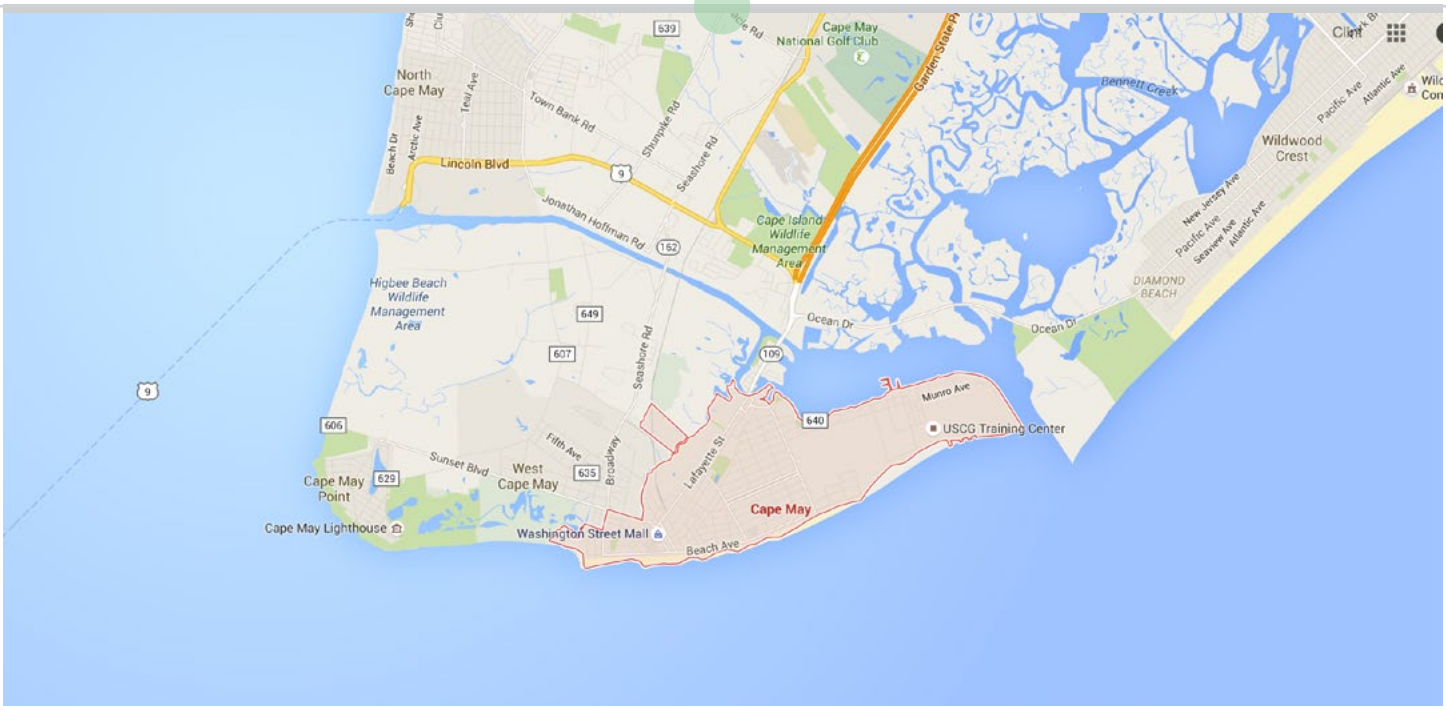
The impacts of the buyouts to the community as a whole are also outlined by Charlotte-Mecklenburg Storm Water Services Division on their website, including benefits such as:

- Providing food and shelter for animals;
- Providing temporary storage for floodwater;
- Pollution removal;
- Greenway trails for recreation and enjoying nature;
- Reduction of flood damage to surrounding properties;
- Storage and filtration of excess rainfall and storm water runoff;
- Elimination of emergency response, garbage collection and other services to that street; and
- Removing impervious areas (hard surfaces) from the floodplain

The buyout program incorporates the shift to a more NAI approach in Mecklenburg County, as a whole. The Charlotte-Mecklenburg Storm Water Services division outlines the way floodplains were managed in the 1990s (removing trees, channelizing streams, flood control works, etc.) to a newer, more NAI-friendly approach, which includes the buyout program among other tools, such as restoring streams to their natural state and an emphasis on strong floodplain development regulations.

Charlotte and Mecklenburg County have a lot to share in terms of best practices mitigation using NAI approaches. For more information, visit their website. Charlotte-Mecklenburg is also part of the Natural Hazard Mitigation Association's Resilient Neighbors network, which NHMA describes as a "peer-to-peer sharing network, so grassroots communities can work together directly to strengthen and expand local hazard-mitigation programs." More information can be found on the NHMA website.

Case File 3: South Cape May, New Jersey



Situated in the southwest tip of the Cape May Peninsula and established in the 1840s, the borough of South Cape May, NJ was once a Victorian resort (called Mount Vernon until 1894) with a small number of year-round residents and a modest number of vacation cottages – most of which were moved to the towns of West Cape May and Cape May City after a monstrous storm event in November 1950 ripped through the town with 88 mph winds and abnormal full moon tidal waves of such force that they devastated the tiny hamlet (or at least what was left after the Great Atlantic Hurricane of 1944) and swallowed up the vast majority of the town to lie serenely, much like a lost civilization, at the bottom of the nearby Atlantic Ocean.

"Many human settlements have been shaped by nature, but few have been erased so quickly and completely," said Richard Perez-Pena in an August 2010 *New York Times* article.

The remaining land not underwater of the once 21-block resort town turned cow-pasture after the town's destruction, became the 2004 target of a combined Nature Conservancy, Army Corps of Engineers and NJ Department of Environmental Protection (NJDEP) three-year effort to restore what is now called

Case File 3: South Cape May, New Jersey, cont.

the Meadows', freshwater wetland and beach ecosystems. "The goal was to return the degraded landscape to a more productive, and natural state to benefit both the wildlife and the residents of local communities by adding protection from coastal flooding. Elements of the project included replenishment of an eroded beach, building up of the dunes (to combat the 15 feet per year erosion loss which resulted in loss of 1,110 feet of shoreline since 1936 and 124 acres of wetlands since 1955), restoration of freshwater flow through the wetland, control of the highly invasive common reed Phragmites, creation of shorebird foraging and resting areas within the wetland, and installation of water control structures. While the process of re-engineering the wetland and beach was very intrusive, the ecosystem proved its resilience and has not only recovered, but flourished in the three years since the completion of the project."

"This is a classic example of retreat and restore," said ASFPM's Chad Berginnis.

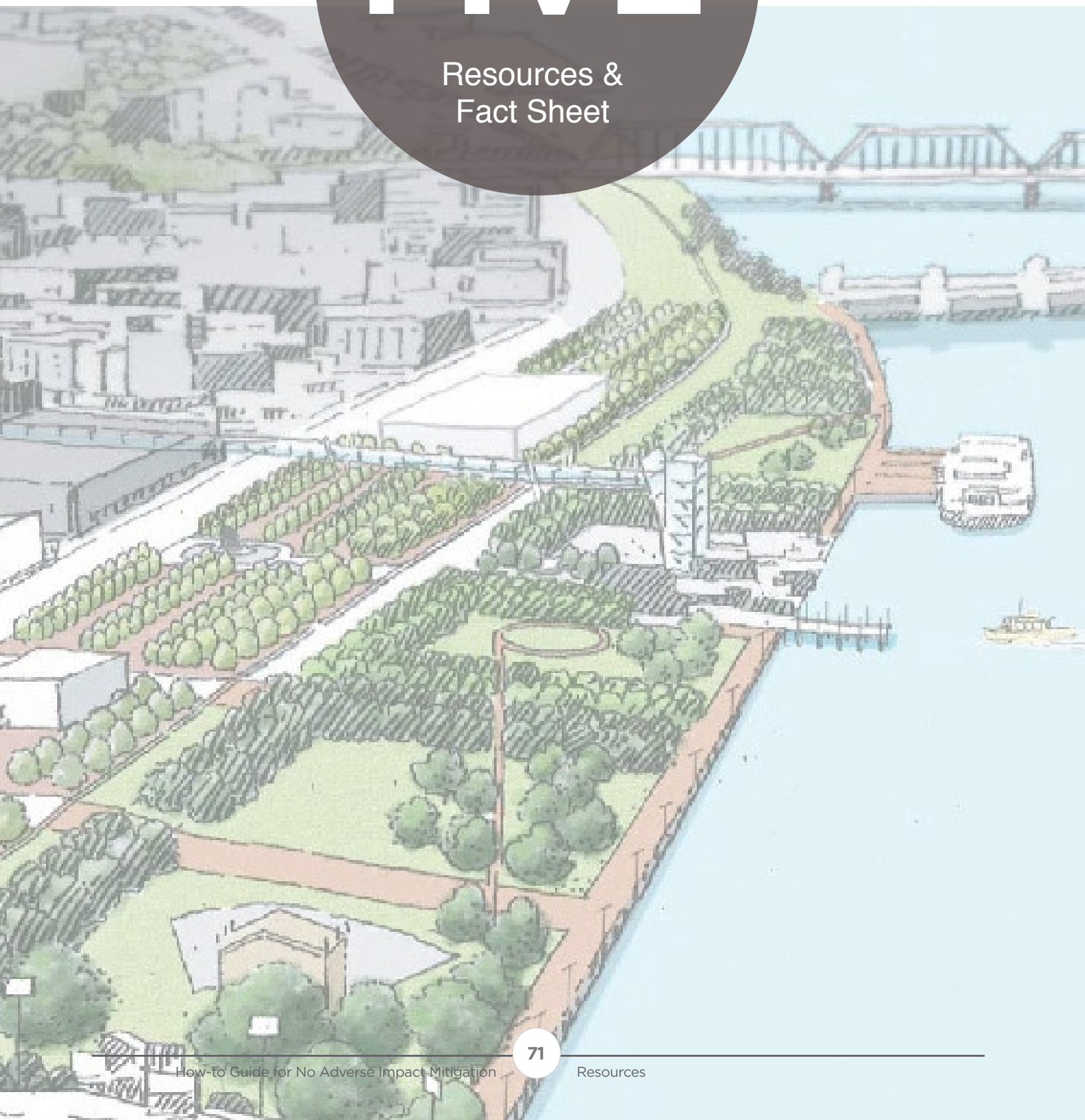
Any signs that a town once existed in this cove have long ago been swept out to sea – "in a little over a half century it was all gone" notes one of the last surviving residents. What remains is the 229-acre South Cape May Meadows Preserve. Currently owned by The Nature Conservancy (TNC), the preserve, tucked in a cove between Cape May and the Cape May Point Lighthouse, and adjacent to the Cape May Point State Park, is now restored dunes and marshes, a freshwater coastal wetlands area, ponds, forests and fields, and is considered by many to be "a globally renowned birders paradise" lush with meadows of head-high grasses and a full mile of protected beach. Adrianna Livingston, preservation coordinator for TNC, sums it up like this, "It's amazing to see just how quickly a natural ecosystem can recover," (The Philadelphia Enquirer, Jacqueline L. Urgo, Oct. 3, 2010) or perhaps, more aptly put, Mother Nature has taken back what was hers to begin with.

In late October 2012, the East Coast braced itself as Hurricane Sandy made landfall. In New Jersey, Gov. Chris Christie declared a state of emergency, and mandatory evacuations were issued up the coast. Residents pulled their boats out of the water and thousands of cars lined the Garden State Parkway fleeing coastal towns. Sandy devastated the coast from the Carolinas to New England. The heavily-developed coastlines of New Jersey and New York were hit the hardest with homes, boardwalks and businesses destroyed.

While most shore towns were quite literally underwater, several communities in Cape May seemed to withstand the storm surges and flooding better than others. The communities that fared better are bordered by South Cape May Meadows Preserve. The preserve's beaches, dunes and wetlands absorbed much of the rain, wind and surging ocean waters and protected nearby communities from the wrath of Sandy.

SECTION FIVE

Resources & Fact Sheet



Resources, cont.

Below is a compiled list of resources, references, sources, links and additional information.

TOOL 1:

- National Institute of Building Sciences [NIBS] (2005). "Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities," *Multihazard Mitigation Council Projects.* Retrieved from http://www.nibs.org/?page=mmc_projects#nhms
- Multihazard Mitigation Council [MMC] (2005). "Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities, Volume 2 – Study Documentation" (pp. 137, Section 6.4.1). Retrieved from http://bit.ly/1WpQHHe
- Congressional Budget Office [CBO] (2007, September). "Potential Cost Savings from the Pre-Disaster Mitigation Program." Retrieved from http://http://1.usa.gov/1WpQKTi
- Federal Emergency Management Agency (2010, June). "Hazard Mitigation Assistance" Retrieved from (http://www.fema.gov/library/viewRecord.do?id=6200)
- Contact information for SHMOs can be found at http://1.usa.gov/26u77CZ and a list of state floodplain managers at http://bit.ly/1pFeTrZ.

TOOL 2:

- American Rivers (2002). "The Ecology of Dam Removal - A Summary of Benefits and Impacts." Retried from http://bit.ly/21ffnTC
- American Rivers (2011). "2011 Dam Removal Resource Guide." Retrieved from http://bit.ly/1VSp5fm
- American Rivers (2012). "Combining Conservation & Hazard Mitigation: The case for dam removal and stream restoration in flood-damage reduction." Presentation at 2012 ASFPM National Conference.
- Born, S.M., K.D. Genskow, T.L. Filbert, N. Hernandez-Mora, M.L. Keefer, and K.A. White (1998). Socioeconomic and Institutional Dimensions of Dam Removals: The Wisconsin Experience. *Environmental Management* 22(3):359-370. Retrieved from http://bit.ly/1rj0XVR
- Water Resources Collections and Archives (n.d.). "Clearinghouse for Dam Removal Information (CDRI)."
- Commonwealth of Massachusetts (2008). "Funding Sources for Dam Removal."
- Conyngham, J. Fischenich, C., and White, D. (2006, September). "Engineering and Ecological Aspects of Dam Removal—An Overview." Retrieved from http://el.erdc.usace.army.mil/elpubs/pdf/sr80.pdf
- U.S. Fish and Wildlife Service (2008). "Dam Mitigation Funding Guide for New York State, Appendix D." Retrieved from http://1.usa.gov/1VVzrKN
- Kruse, S., & Scholz, A. (2007). "Preliminary Economic Assessment of Dam Removal: The Klamath River." Ecotrust Working Paper Series No. 2.
- Poff, N.L., Olden, J.D., Merritt, D.M., & D.M. Pepin (2007). "Homogenization of regional river dynamics by dams and global biodiversity implications." PNAS USA: 5732-5737.
- Doyle, M.W., et al. Aging Infrastructure and Ecosystem Restoration. 2008. Science. Vol 319: 286-287.

Resources, cont.

TOOL 3:

- StormSmart Properties: *Artificial Dunes and Dune Nourishment*. Draft guidance document to be published on the Massachusetts Office of Coastal Zone Management's StormSmart Coasts website.
- StormSmart Properties: *Beach Nourishment*. Draft guidance document to be published on the Massachusetts Office of Coastal Zone Management's StormSmart Coasts website.
- StormSmart Properties: *Sand Fencing*. Draft guidance document to be published on the Massachusetts Office of Coastal Zone Management's StormSmart Coasts website.
- StormSmart Properties: *Bioengineering – Coir Rolls on Coastal Banks and Bioengineering – Natural Fiber Blankets*. Draft guidance document to be published on the Massachusetts Office of Coastal Zone Management's StormSmart Coasts website.
- Seth Wilkinson, Wilkinson Ecological Services, presentation at EJP Erosion Control Workshop, April 12, 2012, Hyannis, MA.
- StormSmart Properties: *Bioengineering: Natural Fiber Blankets*. Draft guidance document to be published on the Massachusetts Office of Coastal Zone Management's StormSmart Coasts website.
- Michael Marcus, New England Environmental Case Study: Coastal Bank Restoration, Beach-Front Residence, Plymouth, MA.
- StormSmart Properties: *Sand Fencing*. Draft guidance document to be published on the Massachusetts Office of Coastal Zone Management's StormSmart Coasts website.
- StormSmart Properties: *Controlling Overland Runoff to Reduce Coastal Erosion*. Draft guidance document to be published on the Massachusetts Office of Coastal Zone Management's StormSmart Coasts website.

TOOL 4:

- StormSmart Properties: *Planting Vegetation to Reduce Erosion and Storm Damage*. Draft guidance document to be published on the Massachusetts Office of Coastal Zone Management's StormSmart Coasts website.
- The Massachusetts Office of Coastal Zone Management's (CZM) StormSmart Coasts program are available at: www.mass.gov/czm

TOOL 5:

- The definition and examples are taken from a white paper approved by the ASFPM Board in February 2011.
- Taken from the 2011 Unified Hazard Mitigation Assistance Guidance document
- FEMA 543: www.fema.gov/library/viewRecord.do?id=2441.

SPECIAL CONSIDERATIONS:

- www.dnr.state.mn.us/grants/water/flood_hazard.html
- www.state.nj.us/dep/greenacres/blue_flood_ac.html
- www.water.ca.gov/floodmgmt/dsmo/sab/drmsp
- www.scsafehome.com

Resources, cont.

CASE STUDIES:

HALF MOON BAY, CALIFORNIA:

Citations from the following articles found online:

- http://bayareane.ws/1SANfVo
- http://bit.ly/1SscMU2
- http://bit.ly/2430M2S
- www.half-moon-bay.ca.us
- http://bit.ly/1VVzyWH

CHARLOTTE-MECKLENBURG COUNTY, NORTH CAROLINA:

Citations from the following articles found online:

- US census website: www.census.gov
- http://charmeck.org/Pages/default.aspx
- http://bit.ly/1SK8y98

SOUTH CAPE MAY, NEW JERSEY:

Citations from the following articles found online:

- http://bit.ly/1MZopSd
- http://bit.ly/2430Wag

Practical Applications of NAI into Hazard Mitigation

"If we continue to encourage at-risk development and ignore the impact to others, can we accept the consequences and, are you willing to pay for it?"

-Larry Larson, ASFPM

"No adverse impact is an approach that ensures the action of any community or property owner, public or private, does not adversely impact the property and rights of others."

-NAI Toolkit, 2003

For case studies and specific examples of NAI success, visit http://bit.ly/1H5SeXL.

To speak to a No Adverse Impact expert, contact ASFPM at ASFPM@Floods.org or (608) 828-3000.

THE CONCEPT

Hazard mitigation activities provide a critical foundation to reduce the loss-of-life and loss of-property from natural and/or manmade disasters by avoiding or lessening the impact of a disaster and providing value to the public by creating safer communities. Mitigation seeks to interrupt the cycle of disaster damage, reconstruction and repeated damage. In order to enhance mitigation at the local level, NAI principles could be incorporated into the community's mitigation activities and each daily activity the community undertakes. While there are many flood risk mitigation tools, five are reviewed in this Guide, and have shown to be particularly useful for floodplain managers.

TOOL 1: FLOOD ACQUISITION AND RELOCATION MITIGATION PROJECTS

Most types of flood mitigation projects are effective in their efforts toward reducing damage amounts, but still leave some element of flood risks. However, floodplain acquisition and relocation projects completely eliminate future flood risk to people and buildings since the flood-prone structure is either moved outside of the floodplain or acquired and demolished, with perpetual deed restrictions placed on the cleared land.

Fact Sheet, cont.

TOOL 2:
WATERWAY RESTORATION THROUGH DAM REMOVAL

Natural stream restoration and river bank reclamation techniques comprise a large group of methodologies widely defined as measures to bring waterways to their natural state. These measures can be divided into four groups: stream restoration and natural channel design; modifying, removing or setting back levees; removing dams; and restoring riparian wetlands.

TOOL 3:
NON-STRUCTURAL EROSION CONTROL AND SHORELINE STABILIZATION

Unlike hard engineering structures, non-structural shoreline stabilization projects dissipate wave energy rather than reflecting waves onto beaches or neighboring properties. Non-structural alternatives will enhance the beneficial functions of the landforms to provide greater storm damage protection and flood control. Additionally, because of their more natural appearance, non-structural measures are typically easier to permit and more aesthetically pleasing than hard structures.

TOOL 4:
SUSTAINABLE STORMWATER MANAGEMENT

Sustainable stormwater management, otherwise known Low-Impact Development (LID), are activities that mimic how a natural, undeveloped landscape would handle rainwater. LID techniques are implemented to reduce the amount of runoff coming from streets, buildings and parking lots that cover the ground during a rain event.

TOOL 5:
MITIGATING CRITICAL FACILITIES

Critical facilities in the U.S. are flooded far too often. Flood damage sustained by critical facilities are disasters in themselves, but even worse is the loss of function of facilities desperately needed to assist in flood response and flood recovery. To accomplish having an NAI critical facility, communities must analyze flood risks and appropriately site facilities that provide critical functions. Other facilities in low risk flood hazard areas that may support flood response efforts are included in this analysis. Ideally, this will entail consultation with the planning, zoning and building departments prior to site design and construction.

IN SUMMARY

Much of the country's infrastructure and many buildings were constructed at a time predating many modern codes, standards and understanding of flooding impacts on them. More recently engineered structures have given way to techniques more compatible with nature. With the benefit of these lessons learned, communities should develop a plan to identify and then mitigate at-risk development. While there are many flood hazard mitigation techniques that will result in better protection, an NAI approach to mitigation is to use those techniques that, to the maximum extent possible, result in no adverse impacts on the development, its occupants or the floodplain resource.

RESOURCES

For more information refer to:

ASFPM:

www.floods.org

NAI Toolkit:

http://bit.ly/23VSf1n

NAI How-to-Guides:

http://bit.ly/1Ei2r19