NO ADVERSE IMPACT

A Toolkit For Common Sense Floodplain Management

ASSOCIATION OF STATE FLOOD PLAIN MANAGERS

No Adverse Impact

2003

Acknowledgements

The watchword for the development of the inaugural No Adverse Impact Toolkit has been "While awaiting perfection, just do the possible". This document is, in fact, a work in progress and updates will continually be added to the version posted on the ASFPM website.

This publication resulted from the cooperation of many people, several of whom gave much valuable time to provide project examples and explain their programs. Vast appreciation is extended to the local, state and national experts who provided information for this Toolkit. Without their contributions and insightful comments, this report would not have been possible. The initial draft was developed by French Wetmore, French & Associates, Ltd., under support from FEMA's Community Rating System program. Numerous members of the ASFPM and the NAI Steering Committee were instrumental in reviewing drafts throughout the process.

The NAI Steering Committee consists of:
Chad Berginnis, Ohio
Scott Choquette, Massachusetts
Ed Copeland, West Virginia
Ted DeBaene, Louisiana
Larry Larson, Wisconsin
Dale Lehman, Maryland
Mark Matulik, Colorado
Christy Miller, Alaska
Doug Plasencia, Arizona
Pam Pogue, Rhode Island
George Riedel, Missouri, Committee Chair
Mona Shoup, Texas

Vital detailed comments were provided by:
Leslie A. Bond, New Mexico
Hope Croskey, Michigan
Lois Forster, FEMA
Bret Gates, FEMA
Tom George, Virginia
Karen Kabbes, Illinois
Jerry Louthain, Washington
Mike Robinson, FEMA
Leslie Sagehorn, Missouri
Dan Sagramoso, Arizona

ASFPM wishes to thank the following sponsors for their funding support:
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South Carolina Association for Hazard Mitigation
Illinois Association for Floodplain and Stormwater Management
FEMA Community Rating System Program

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Additional information about NAI activities can be obtained from the ASFPM Office.
Association of State Floodplain Managers
2809 Fish Hatchery Road • Madison, WI 53713
608-274-0123 • Fax 274-0696
www.floods.org • asfpm@floods.org

Edited by Larry A. Larson, Michael J. Klitzke and Diane A. Brown
Produced by Synergy Ink, Ltd.

Table of Contents

Section **Page**

A. Introduction **5**
- The Problem 5
- No Adverse Impact 7
- This Toolkit 9
- The Community Rating System 11

B. NAI Building Blocks

1. Hazard Identification and Floodplain Mapping **13**
- Basic: The FIRM 13
- Better: Filling the Data Gaps 16
- NAI: Higher Mapping Criteria 20
- For More Information 24

2. Education and Outreach **25**
- Basic: Answer Questions 25
- Better: Outreach Projects 25
- NAI: Education 27
- For More Information 29

3. Planning **31**
- Basic: Land Use Planning and Zoning 31
- Better: Plans that Address Flooding 32
- NAI: Multi-Objective Management (M-O-M) and Sustainability 34
- For More Information 38

4. Regulations and Development Standards **39**
- Basic: NFIP Regulations 39
- Better: Higher Regulatory Standards 40
- NAI: Enhanced Watershed Protection 48
- For More Information 55

5. Mitigation **57**
- Basic: Structural Flood Control 57
- Flood Insurance 58
- Better: Nonstructural Measures 59
- NAI: Master Planning and Monitoring 62
- For More Information 63

Section Page

6. Infrastructure 65
Basic: Response and Replacement 65
Better: Protection Measures and Procedures 67
NAI: Plans and Alternatives 69
For More Information 72
7. Emergency Services 75
Basic: Generic Response Plan 75
Better: Flood Preparedness 75
NAI: Pre and Post-Disaster Preparedness 78
For More Information 80
8. Toolkit Matrix 83
Appendix A. The Community Rating System 89
For More Information 93
Appendix B. Additional Resources 95
Contacts 95
No Adverse Impact Publications 95
ASFPM Publications 96
Federal Publications 96
Appendix C. Legal Questions and Answers 97
Common Legal Questions About Floodplain Regulations in the Courts 97
Legal Questions: Government Liability and No Adverse Impact Floodplain Management 103

Introduction

The Problem

Your community has a flood problem and it isn't getting any better. You're not alone. Flood damage in the United States continues to escalate. From the early 1900's to the year 2000, flood damage in the United States has tripled, approaching $6 billion annually. This has occurred despite billions of dollars spent on flood control and other structural and non-structural measures.

Why is this happening? Because as a nation we continue to build at risk on floodplains and to ignore the impacts of watershed development on other properties. Often, buildings, streets, utilities and other components of modern development that we thought were protected get flooded because of the actions of others. Communities are often confused about how to deal with legal challenges in the development process (see Legal Q and A in **Appendix C** pages 97-108).

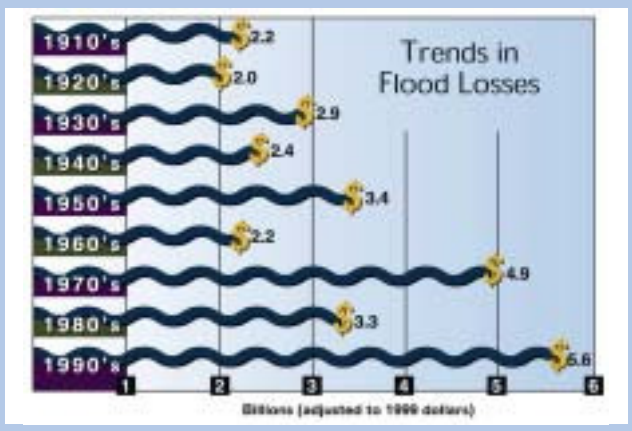
What are we doing about it? Seventy years ago, we focused all our efforts on structural projects, such as levees, reservoirs and channelization to control floodwaters. Forty years ago, we realized that this one-dimensional approach didn't do the job. We couldn't control Mother Nature and we were just asking for more trouble by building in harm's way. Many developments in the watershed increased the amount of runoff flowing to our rivers and developments in the floodplain obstructed flows or displaced areas needed for flood storage, making things worse.

The No Adverse Impact (NAI) Vision

"In your community, the National Weather Service predicts record rainfall. It rains, the rivers rise, but no homes or businesses are flooded, no roads are closed, no businesses shuttered. Emergency rescue teams are not deployed, no citizen is injured in the event, and rescue workers are not put at risk. Erosion and sedimentation are at a minimum because your community counts on natural floodplain systems to store and dissipate floods with no adverse impacts on humans or the built infrastructure. Natural floodplains provide opportunities for open space, parks, recreation, habitat for wildlife and fish, hiking and biking trails, alternative agricultural crops and add to quality of life. Flood levels do not increase over time in your community, because you use NAI approaches. Increases caused by any development are mitigated so they do not impact others. Development is done in a manner that does not pass the cost of flooding on to other properties, other communities or to future generations."

Federal Efforts to Address the Problem

In the 1960's a more balanced strategy was instituted. We would look at both floodwater and the damage-prone development and try to manage both. This broader approach that includes both structural and nonstructural measures is known as "floodplain management." The nation's major floodplain management effort is the National Flood Insurance Program (NFIP) which maps floodplains and provides federally backed flood insurance in return for local regulation of development in those mapped floodplains.



The NFIP has had an impact on the problem. Nearly 50,000 communities now manage floodplain development and new buildings are better protected from damage. The NFIP has slowed the increases in flood damage, but it has not stopped or reversed it. The reason is that most communities adopt and enforce only the minimum national and state floodplain management requirements, which focuse on protecting new buildings, not what the impact of that construction will do to others.

The NFIP's minimum requirements are just that—minimums! The minimums set construction standards that often do not provide sufficient protection from all local flood hazards nor do they account for the effects of urbanization on future flood levels. They will allow floodwater conveyance areas to be reduced; essential valley storage to be filled; or velocities to be increased; all of which can adversely affect others in the floodplain and watershed. It is important that local communities recognize the need to go beyond national and state minimums and take charge of their own flooding issues.

Huntsville (AL) *Times*

The NFIP floodplain mapping program uses standardized mapping techniques for 20,000 communities that may not be appropriate for all situations. Sedimentation, erosion, channel meander and ice jams in rivers, and coastal erosion, may cause flood hazards that are not adequately reflected in floodplain maps. Ground subsidence may create different flood problems in the future, even if the maps are accurate when they are drawn. The NFIP regulatory standards may not work adjacent to lakes where the water levels may remain high for months or years. These hazards are discussed on page 18.

The NFIP does have an incentive program, which does not require but encourages more effective local programs. The NFIP Community Rating System (CRS) can reduce flood insurance premiums in communities with programs that exceed the NFIP's minimums.

In addition to the NFIP's impact on addressing flooding, for coastal states, the national Coastal Zone Management (CZM) Act addresses coastal flooding through various components of the federal program. The National Coastal Zone Management Program (CZMP) is a voluntary partnership between the federal government and U.S. coastal states and territories authorized by the Coastal Zone Management Act of 1972. Since 1974, a total of 34

coastal states and five island territories have developed CZM Programs. Together these programs cover more than 99 percent of the nation's 95,331 miles of ocean and Great Lakes coastlines, encompassing a total area of 2,020,755 square miles within CZM program jurisdiction. States manage competing coastal uses though their planning and regulatory authority over a specific use or area.

State coastal managers use many different management techniques to protect and preserve coastal resources. Regulatory measures such as permits, zoning ordinances and building codes are the primary elements of state coastal programs to protect coastal resources. Other measures used by state CZM programs include resource assessments; inventory and mapping; geographic information systems (GIS); sea level rise research; beach profile assessments; land acquisition; conservation easements; coastal property disclosures; local land-use plans, special area management plans, regional plans, disaster preparedness plans; setbacks/buffers; shoreline stabilization restrictions; local zoning ordinances; compensatory wetland mitigation; wetland permits; and technical assistance to landowners and government. Specific state CZM examples of these measures will be given in the appropriate NAI building block descriptions.

Environmental Protection Agency (EPA) has expanded stormwater management requirements through its Phase II regulations. The regulations have two major components. Now, all construction sites over one acre in size must take steps to control construction site runoff. And designated MS4's (Municipal Separate Storm Sewer Systems) in urban areas have five years to develop a stormwater management program. The program must include six minimum measures: education and outreach, public participation and involvement, illicit discharge controls, construction site runoff controls, post-construction runoff controls, and pollution prevention/good housekeeping. A comprehensive, effective, stormwater management program can help reduce future flood damages while reducing erosion, sedimentation and pollution transport.

MS4s (serving a population of less than 100,000 and located in an urbanized area or designated by the permitting authority), are included in Phase II. In Phase 1, only Medium (100,000–250,000) and Large MS4s (greater than 250,000) were included.

By now, it should be clear it is up to local officials to assume responsibility for their flood problems and floodplain management programs. That is where this Toolkit can help.

No Adverse Impact

"No Adverse Impact" (NAI) floodplain management is a managing principle developed by the Association of State Floodplain Managers (ASFPM) to address the shortcomings of the typical 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."

No adverse impact (NAI) floodplain management 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. An adverse impact can be measured by an increase in flood stages, flood velocity, flows, the potential for erosion and sedimentation, degradation of water quality, or increased cost of public services. No Adverse Impact floodplain management extends beyond the floodplain to include managing development in the watersheds where floodwaters originate. NAI does not mean no development. It means that any adverse impact caused by a project must be mitigated, preferably as provided for in the community or watershed based plan.

For local governments, No Adverse Impact (NAI) floodplain management represents a more effective way to tackle their flood problems. The concept offers communities a framework to design programs and standards that meet their true needs, not just the requirements of a federal or state governmental agency. The NAI floodplain management initiative empowers communities (and their citizens) to work with stakeholders and build a program that is effective in reducing and preventing flood problems. NAI floodplain management is about communities being proactive—understanding potential impacts and implementing prevention and mitigation activities before the impacts occur.

Community's approaches to guiding development often are dictated by their understanding of their ability to legally guide development. To bring communities up-to-date on how the courts view their legal authority, a Q&A on legal issues is included in **Appendix C** (pages 97–108). An understanding of this will help communities do the right thing for those developing and for those impacted by development.

NAI has many benefits. By developing activities that really address your local situation and that do not harm others, your community can:

- Prevent flooding from increasing or damaging others;
- See a reduction in flood losses over time;
- Avoid challenges and lawsuits over causing or aggravating a flood problem; and
- Receive recognition for your efforts through the Community Rating System.

This Toolkit

No Adverse Impact (NAI) is a principle, not a specific set of standards, requirements or practices. The objective is to incorporate the NAI concept into all ongoing local community activities. There are many ways your community can do this. You can incorporate the approaches into your community plans, adopt specific regulatory or policy language, initiate individual projects, start or revise entire programs or prepare a master plan that addresses all activities that impact flooding.

This Toolkit is designed to help you as a local official or concerned citizen incorporate the NAI principle into your community's ongoing programs. The tools consist of a variety of activities that can improve your floodplain management program. The tools are identified by the wrench icon: and are highlighted in **bold print**.

These tools are organized under seven **"building blocks:"**

1. Hazard identification and floodplain mapping
2. Education and outreach
3. Planning
4. Regulations and development standards
5. Mitigation
6. Infrastructure
7. Emergency services

<u>There are three levels of effort under each building block:</u>

1. The **Basic** level summarizes what is usually done to meet the minimum requirements of the National Flood Insurance Program (NFIP) or other State or Federal rules.
2. The **Better** level lists floodplain management activities that are more effective than the basic in protecting floodprone properties. Many may be requirements mandated by your state, so your community may well be implementing some of them now. **Better** level tools usually prevent or minimize adverse impacts on other properties.
3. The **NAI** level identifies the most effective ways under each building block to protect everyone's property *and* prevent increased flood problems. ASFPM recommends use of **NAI** tools over the "better" level of activities. Effective implementation is done through sound planning, in addition to buy-in by all community stakeholders.

This Toolkit is a reference document, not a "how-to" manual. It identifies various tools and shows where more information can be obtained. You can pick and choose which tools or building blocks would best help deal with your specific situation.

As a first step, it is recommended that you conduct a comprehensive assessment of your community's flood hazard, what is being done now to protect people and property, and what new activities should be undertaken. This leads to your floodplain management plan and is discussed in the Planning section.

The Community Rating System and NAI

The CRS and NAI go hand in hand. Most of the tools in this Toolkit are recognized by one of the CRS activities. The matrix on pages 83-87 shows which tools are credited by the CRS and note the section of the *CRS Coordinator's Manual* where more information about them can be found.

The Community Rating System (CRS) is a part of the NFIP. It is designed to encourage communities to implement floodplain management programs above and beyond the minimum NFIP criteria. This is done by scoring the community's activities according to formulas that measure their impact on flood losses and flood insurance rating. Flood insurance rates are received according to a CRS classification.

The scoring of a community's program is done by 18 activities, organized under four series. These are shown in the box to the right. The community is given a classification based on its score. There are 10 classes, 1 through 10, with a Class 1 community receiving the greatest flood insurance premium rate reduction, 45%. A Class 9 community receives a 5% reduction. Communities that are not in the CRS are Class 10 and receive no rate reduction.

A summary of the scoring and instructions for applying to the CRS are in the *CRS Application*. The detailed scoring formulas and descriptions of the credit criteria are in the larger *CRS Coordinator's Manual*. Both can be seen on or downloaded from FEMA's CRS website, **www.FEMA.gov/nfip/crs/shtm**, or can be ordered free by calling 317/848-2898, or sending an e-mail to NFIPCRS@iso.com.

The CRS premium rate reduction has been shown to be an effective way to motivate communities to initiate, improve and/or maintain better floodplain management programs. Over 960 communities are now in the CRS and they represent over 66% of the NFIP insurance policy base.

CRS Activities

300 Public Information Activities
- 310 Elevation Certificates
- 320 Map Information
- 330 Outreach Projects
- 340 Hazard Disclosure
- 350 Flood Protection Information
- 360 Flood Protection Assistance

400 Mapping and Regulatory Activities
- 410 Additional Flood Data
- 420 Open Space Preservation
- 430 Higher Regulatory Standards
- 440 Flood Data Maintenance
- 450 Stormwater Management

500 Flood Damage Reduction Activities
- 510 Floodplain Management Planning
- 520 Acquisition and Relocation
- 530 Flood Protection
- 540 Drainage System Maintenance

600 Flood Preparedness Activities
- 610 Flood Warning Program
- 620 Levee Safety
- 630 Dam Safety

By implementing these tools, your community can gain the double advantage of having a better flood protection program and lower insurance premiums for your residents. This Toolkit also lists other CRS references and guides. These can be very helpful, whether your community is in the CRS or not.

More information on the CRS is provided in **Appendix A** page 89.

Hazard Identification and Floodplain Mapping

Floodplain management depends on good floodplain mapping and related flood hazard data. A floodplain map's accuracy depends on the data behind it and the resources put into it. Local communities, states and the private sector need accurate detailed maps to guide development, prepare plans for community economic growth and infrastructure, utilize the natural and beneficial function of floodplains, and protect private and public investments. Due to limited resources, some maps just show general areas subject to flooding. Added procedures to correctly identify the flood hazard should be used in those instances.

The purpose of flood maps is to show which property in a community is subject to flooding, the expected flood levels and the different risks within the flooded area. This information is essential for a community to be able to reduce the risk to new and rebuilt structures, and to protect itself from damage to its infrastructure and from community liability. The maps show the area that will be flooded during a flood which has a 1% chance (often, but erroneously, called the 100 year flood) of occurring or being exceeded in any given year. Flood hazard areas are divided into zones, each of which carries a different risk and consideration for wise use. The entire 1% flood hazard area is the high-risk floodplain. Within riverine floodplains there is a **floodway** (not only is it high risk, but also structures and obstructions here increase flood levels on other property), the **flood fringe** (subject to slower moving water, but where structures and infrastructure will be damaged and loss of flood storage will increase flood levels). Coastal areas have **V zones** (where storm waves and surges generate high velocities in coastal areas). Moderate or unknown flood risk areas are called **B, C, D or X zones**.

Basic: The FIRM

Most communities in the NFIP have a Flood Insurance Rate Map (FIRM). FIRMs were prepared for the purpose of insurance rating, land use regulations, and for lenders in determining where the flood insurance must be purchased. Using it in your floodplain management program is a minimum requirement of the NFIP. FEMA's mapping criteria are spelled out in *Flood Insurance Study Guidelines and Specifications for Study Contractors* **(www.fema.gov/fhm/dl_scg.shtm)**. These are minimum national standards that may not reflect all of your area's flood problems.

FIRMs serve several very important purposes. First, they provide "due public notice" where regulations will be enforced. This is a very important legal principle. In order for local government to adopt and enforce land-use regulations the people whose property will be regulated must be provided with "due public notice." FIRMs meet that legal test.

The other purpose served by the FIRM is to identify for lenders where flood insurance must be purchased. Federally regulated lenders must require that flood insurance be purchased

to at least the limits of the loan for all insurable property within the Special Flood Hazard Areas. Special Flood Hazard Areas (SFHA) are the areas designated by the letter "A" or "V" on FIRMs.

Flood Insurance Rate Maps have evolved since the NFIP was first passed by Congress. Most communities initially received a Flood Hazard Boundary Map (FHBM) that was generated by approximate study methods based on limited information. Some community's FIRMs contain little new information.

Most participating communities have received FIRMs that are based on detailed hydrologic and hydraulic analyses of their rivers, lakes or ocean coasts to replace or supplement the original FHBM. Detailed studies calculate the 1% chance (100 year) flood level [the Base Flood Elevation (BFE)], which is used to establish and/or revise the SFHA delineation.

Rivers and streams are mapped differently than coastal areas. For rivers the floodplain is comprised of the floodway and the flood fringe. The floodway is that portion of the floodplain where the depths are the greatest and the velocities are the highest. Buildings or fill material placed in the floodway will obstruct floodwaters and cause an increase in the BFE.

The flood fringe is that portion of the floodplain outside of the floodway. It represents lands that will be inundated by a flood event. Buildings or fill placed in the flood fringe result in the loss of flood storage taken up by the building, its fill, roads, etc., which can result in increased flood levels elsewhere.

Coastal areas may include V zones. V zones, or "velocity zones," are areas subject to storm surge or wave action. V zones are particularly hazardous. Buildings constructed in the V zones may not cause an increase in the BFE, but will likely be demolished or damaged by the surge or wave action unless constructed to withstand the forces.

Flood Insurance Rate Maps may also show:

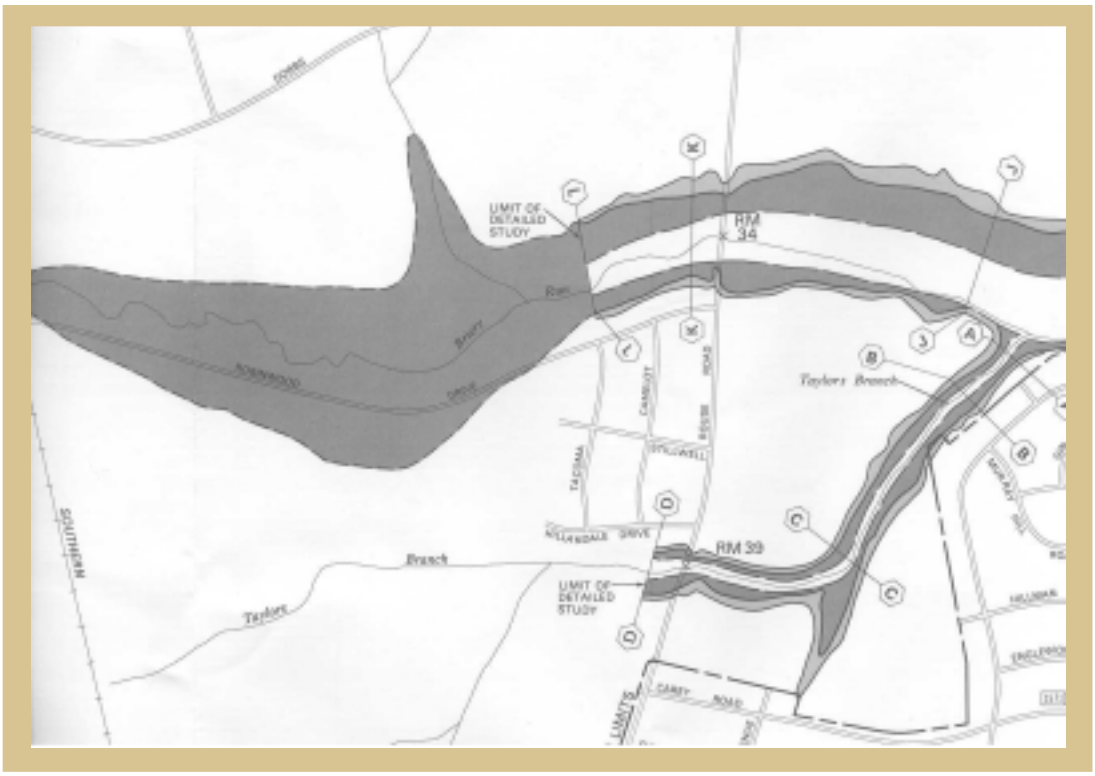
- B-Zone: lands above the BFE but below the 0.2% chance (500-year) flood event.
- C/D/X-Zone: lands outside the A-Zone and B-Zone for which the flood hazard has not been determined.

It should not be assumed that lands identified as B, C, D, or X-zones will not flood; however, flood insurance is not required to be purchased, nor are land-use regulations required to be imposed under the NFIP minimum criteria.

FEMA also publishes Letters of Map Amendment (LOMA), Letters of Map Revision (LOMR) and Letters of Map Revision – Fill (LOMR-F). Collectively these letters are called Letters of Map Change (LOMC). Due to limited funds for mapping, FEMA has used LOMAs to document clarifications of map interpretations and LOMRs and LOMR-Fs to document physical changes that would cause a map to be modified.

There are several types of floodplain data (see example next page) shown on FIRMs:

- **Detailed mapping**—these areas show the base flood elevations needed to set minimum protection levels for new buildings. In riverine situations, detailed mapping of the high risk hazard areas are shown as an AE or numbered A zone (e.g., "A4") and may include a floodway delineation.



In coastal areas, detailed mapping may include delineation of the high-risk velocity or V Zone. In some coastal areas CBRS designations are depicted. In 1982 the Coastal Barrier Resources System (CBRS) was established and restricts federal expenditures and financial assistance that could encourage development to occur on coastal barrier islands. While it does not prohibit privately financed development, it does prohibit federally backed financing for the development of public infrastructure such as roads, bridges, highways, wastewater treatment systems and utility construction. Additionally, federally offered flood insurance is prohibited. Any building located within a CBRS area that is constructed or substantially improved after October 1, 1983 (or the date of designation for the areas added to the system in 1991), is not eligible for federal flood insurance or other federal financial assistance. The same restriction applies to substantially damaged buildings in a CBRS area that are repaired or renovated after those dates.

- **Approximate mapping**—the high-risk flood area is shown as an unnumbered "A" Zone on the FIRM. "A" Zones simply show an outline of the floodplain, but do not include the flood elevation or floodway data needed to guide new development to reduce damages or to determine accurate insurance rating. In these zones the NFIP requires all those who propose developments larger than 50 lots or 5 acres to provide the

needed detailed flood data so communities can appropriately guide development in these areas.

- **Outside the high-risk regulatory floodplain**—shown as B, C, D, or X Zones on the FIRM, are areas where regulation is not required by the NFIP, thus the maps have little flood information. Other than showing the 0.2% chance (500-year) floodplain boundary, these FIRM zones will have no information on small streams, local drainage, storm sewers and other problems that still present a flood hazard to your community.

Better: Filling the Data Gaps

FEMA has had a limited budget for mapping, so FIRMs may not show every flood problem that has been reported or that could exist in your community. In many areas, the FIRMs do not provide flood elevations, do not map small watersheds, may not map localized drainage problems, and may not provide floodway boundaries. Map changes (LOMCs) may have been issued that are not reflected on your community FIRM.

A good floodplain management program will have procedures and requirements to obtain the data necessary to manage new development in approximate A Zones and outside the mapped floodplain. You may also have occasions when the detailed data is incorrect or out of date and should be revised. Here are some tools that communities around the country have used.

Require that the developer provide **detailed flood data** needed in approximate A Zones for all developments, regardless of size. The NFIP only requires developments larger than 50 lots or 5 acres to provide the needed data. Smaller projects can get just as wet, so many communities require a base flood elevation from the developer of any size project. Some communities or states help calculate the data, especially for non-commercial use.

A better technique is to use **future condition hydrology** to determine the floodplain. See discussion on page 20.

Require developers in **X Zones** to map the floodplains for all drainage areas over a certain size (e.g., 40 acres). It is simply a development cost, like many other such costs.

> The City of Tulsa, Oklahoma, requires all developments in drainage areas as small as 40 acres to conduct a study to show the 1%-chance floodplain and floodway.

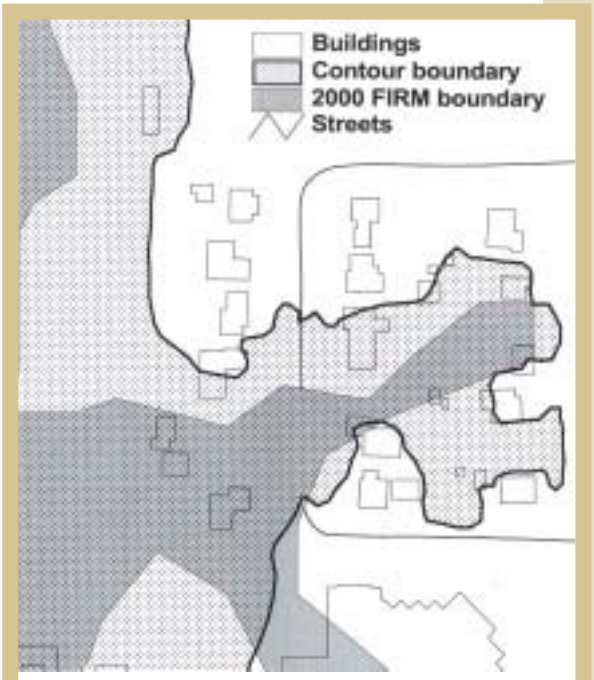
Use a new or **better base map** (e.g., with a smaller contour interval or new streets so citizens see a map depicting what actually exists) to delineate the floodplain boundaries. The example on page 17 shows one possible outcome of poor maps: significant differences between your more accurate ground elevation information and the FIRM's floodplain boundaries. Note that the flood contours and the flood boundaries do not match.

If you find these kinds of discrepancies, you must ensure that all new flood data and floodplain maps are sent to FEMA so the FIRM can be updated to reflect the more recent information. This is a minimum requirement of the NFIP. It will enable the insurance part of the

NFIP to reflect the new data and to be consistent with your regulatory program.

Overlay the state coastal zone management program boundary onto the FIRM. These boundaries of CZM jurisdiction vary from state to state. For example, in Florida the coastal zone of jurisdiction encompasses the entire state; however, in Rhode Island the coastal zone is delineated from the water up to and including 200 feet landward from all coastal features. Overlaying the CZM boundary would give a better depiction as to the areas where there is more than one jurisdictional authority within the coastal zone. Awareness of these overlapping areas would hopefully be the first step to improving coordination among the agencies to address coastal flooding issues.

Become a **Cooperating Technical Partner** to update your map and help share the costs with FEMA; your community will have a higher priority for a new flood study (see page 23).



This community put the FIRM's flood elevations onto its more accurate base map and found these descrepancies. A FIRM revision will improve the map used for flood insurance rating.

Village of Gurnee, Illinois

Mapping other flood-related hazards. Your FIRM is likely based on the FEMA's generalized national mapping standards that address the typical flood situation, which is sometimes called "clear water" flooding. There are many local situations in which flooding or flood-related problems do not fit the national norm. Therefore, there are situations where a FIRM does not show all the flood or flood-related hazards that your community is exposed to (see the publication on "unique flood hazards").

Hawaii's coastline is threatened by coastal erosion, tsunamis, hurricanes, sea level rise, flooding, subsidence, earthquakes, and lava flows. One objective from the Hawaii Coastal Zone Management Program (HCZMP) is to reduce the hazard to life and property from tsunami, erosion, storm waves, stream flooding erosion and subsidence. Under the HCZMP, a coastal hazard atlas was developed by researchers at the University of Hawaii. The Atlas depicts the intensity of seven potentially hazardous coastal processes in Hawaii including: tsunami inundation; coastal stream flooding; seasonal high waves; high winds and marine overwash; coastal erosion; sea-level rise and volcanism and seismicity. These maps depict coastal sections, at a scale of 1:50,000, in 5-7 mile segments with color bands ranking the relative intensity of each coastal hazard at the adjacent shoreline. Each map also depicts the geology of the coast using a simple alphabetical code. Additionally, the coastal slope is mapped from sea level to an elevation of approximately 200 feet, or the first major change in slope. Both geology and slope are important variables in determining the hazardous character of the coastal shoreline.

If you want to protect development from damage by these or related hazards, they need to be identified and mapped. Here are some of the other hazards that may affect your community but are not usually reflected on a standard floodplain map. Check this list and see if your community should map one or more of these flood-related hazards.

- **Uncertain flow paths:** alluvial fans, moveable bed streams and other floodplains where the channel moves during a flood (see *CRS Credit for Management of Areas Subject to Uncertain Flow Path Hazards*). See also *Guidelines for Determining Flood Hazards on Alluvial Fans* at **www.fema.gov/fhm/ft_alfan.shtm**.

- **Closed basin lakes:** lakes that have a small or no outlet that may stay above flood stage for weeks, months, years or decades (see *CRS Credit for Management of Areas Adjacent to Closed Basin Lake Hazards*).

- **Ice jams:** flooding caused when frazil ice builds up in a stream, or by a "dam" created when warm weather and rain break up a frozen river. The broken ice floats down river until it is blocked by an obstruction, such as a bridge or shallow area, creating a dam (see *CRS Credit for Management of Ice Jam Hazards*).

- **Debris and sediment blockage:** flooding caused by debris, log jams, driftwood, gravel, silt and other material (nature or human made) that moves during the flood and obstructs flood waters, causing added flooding.

- **Land subsidence:** lowering of the land surface caused by withdrawal of subsurface water or minerals or by compaction of organic soils (see *CRS Credit for Management of Floodprone Areas Subject to Land Subsidence Hazards*).

- **Mudflow hazards:** a river, flow, or inundation of structures or land by liquid mud down a hillside. Usually occurs as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of heavy or sustained rain (see *CRS Credit for Management of Mudflow Hazards*).

A floodplain management program that addresses only "clear water" flooding may not adequately protect people and property from all flood-related hazards.

French & Associates

- **Dam failure inundation:** areas that would be flooded if an upstream dam were to fail or overtop. This may happen due to structural failure or improper operation. Such maps may already be prepared for the larger dams and dams that are federally or state operated or regulated (e.g., hydropower dams). These hazard areas below dams should also show the flood hazard that will exist if and when the dam is removed due to age, economics or other reasons. The map of dam failure zones should be part of the flood hazard map. Dams must be periodically inspected to ensure they meet current dam safety standards, are properly operated and have an adequate Emergency

Evacuation Plan. If these conditions are not met, the area should be mapped as if the structure does not exist.

Coastal erosion

Berry Williams

Riverine erosion

FEMA

Long term erosion rates can be estimated and areas subject to future erosion can be mapped so appropriate land use regulations or programs will keep new buildings or move existing buildings out of areas that will soon go underwater

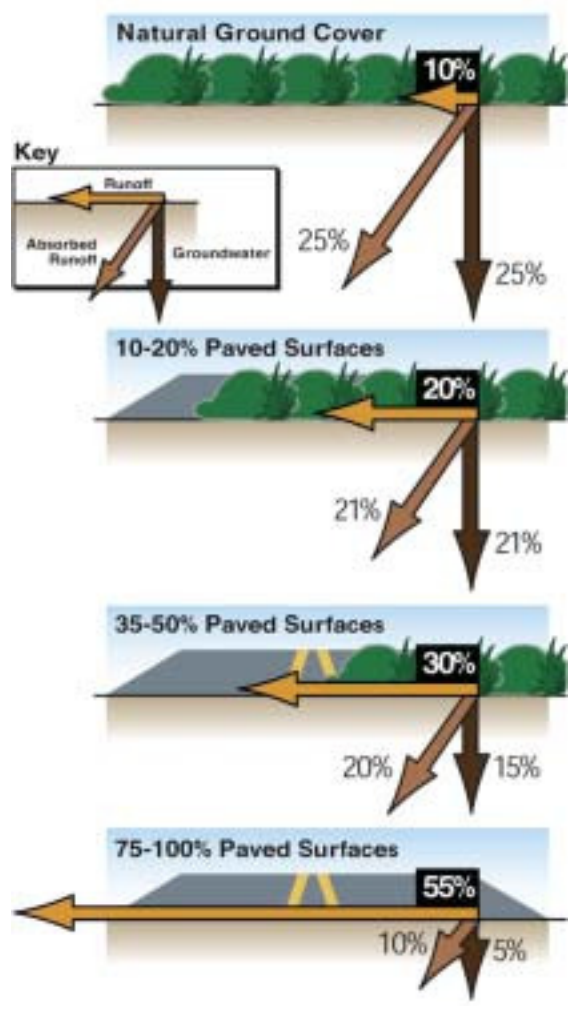
- **Tsunamis:** A series of great waves most commonly caused by violent movement of the sea floor. It is characterized by tremendous wave speed (up to 590 miles per hour), long wave length (up to 120 miles), long periods between successive crests, and low height in the open sea. (*see CRS Credit for Management of Tsunami Hazards*).
- **Coastal erosion:** areas subject to the wearing away of land masses caused primarily by waves on the Atlantic or Pacific Oceans, Gulf of Mexico, and the Great Lakes (*see CRS Credit for Management of Coastal Erosion Hazards*).
- **Riverine erosion:** areas subject to scouring or loss of streambank due to stream velocity, usually along the outside meanders of a channel.
- **Channel Modification:** natural or human induced changes to the location of the channel of the stream and its floodplain.
- **Levee failure inundation:** if a levee is rated as adequate for a 1%-chance flood, the FIRM will show the area protected by the levee as an X Zone. If it is not shown as an X Zone, the community should show that residual risk area on their map so the community and property owners know what would be flooded when the levee fails or is overtopped. Levees must be periodically inspected to ensure they meet current levee safety standards, are properly operated and have an adequate Emergency Evacuation Plan. If these conditions are not met, the area should be mapped as if the structure does not exist.
- **Sea level rise:** global warming is contributing to a rise in the sea level, a problem that is compounded in coastal areas subject to subsidence. Community maps can reflect the anticipated sea level rise.

NAI: Higher Mapping Criteria

An NAI-based program must have maps that accurately and realistically depict the flood hazard, now and in the future.

The five most frequently identified shortcomings of the NFIP minimum mapping criteria are (1) the maps become outdated as watersheds develop, (2) the NFIP floodway standard automatically allows for an increase in flood heights, (3) once the floodway is established, minimum regulations and methods for calculating impacts will not prevent an increase in flood heights and flood damages, (4) the maps do not consider geomorphologic changes in streams, and (5) the maps do not depict areas of coastal erosion or coastal erosion rates. Using higher, more effective mapping criteria can overcome these shortcomings.

The first shortcoming is especially a major problem in smaller watersheds. As land surfaces, such as farms and forests, are converted to impervious surfaces, the amount of stormwater runoff increases, resulting in a corresponding increase in downstream flood heights and frequency. A flood study based on today's development will understate tomorrow's flood hazard.



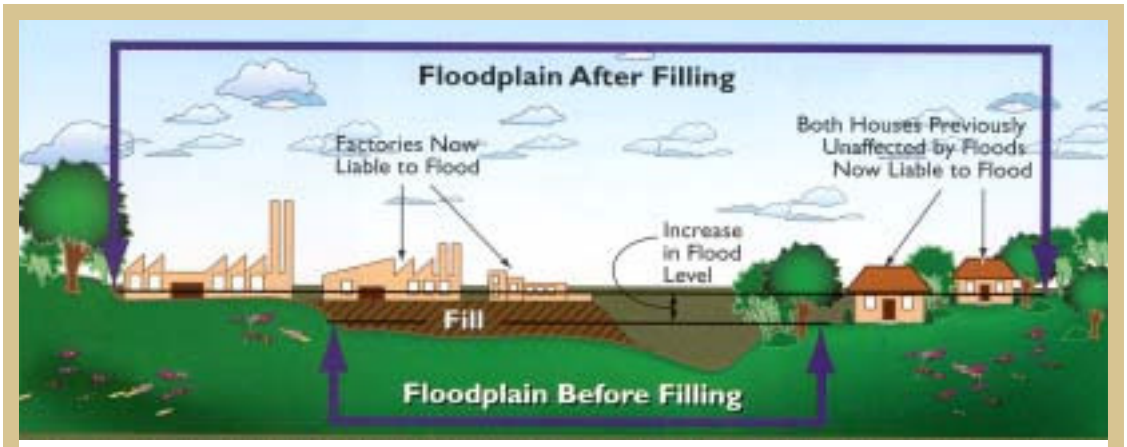
Increases in impervious surfaces increase water-shed runoff.

One way to avoid this shortcoming is to prepare flood studies using **future conditions hydrology**. This means that flood discharges are not developed according to current conditions, but according to projected land-use conditions, usually based on a community's zoning map or land-use plan. When the hydrologic study is based on future land use conditions, discharges will be higher than those from a study based on current development conditions. The use of future conditions hydrology is closely related to watershed master planning. To control the runoff from watershed development, a hydrology study must be done to see what the effects of this development are on flooding. From that study, a community can require the development to control the runoff, build regional detention facilities to control it, or use the future condition runoff for floodplain mapping.

The NFIP regulations include definitions for future-conditions hydrology and indicate that such floodplains may be shown on the FIRMs, for informational purposes, at the request of the community. [see also **www.fema.gov/fhm/ft_futur.shtm**]

Bartlesville, Oklahoma, DuPage County, Illinois, and Charlotte-Mecklenburg County, North Carolina require that floodplain maps and developer's flood studies be modeled assuming the watershed is fully developed. The State of New Jersey adds 25% to the 100-year flood discharge to help account for the impact of future development.

A true NAI approach goes beyond last use future conditions hydrology and puts in place **plans and regulations that prevent future flood discharges**. This will not only protect new development, but will protect existing development.



Allowing a floodway rise, in nature's floodway, or, ignoring the impacts of watershed and flood fringe development will result in higher flood levels.

The second shortcoming is that FEMA uses a one-foot surcharge when mapping the floodway. The BFE and floodplain limits are determined by hydraulic modeling of the river based on existing physical conditions. The floodway limits are then calculated by assuming encroachments occur equally on both sides of the river (this is equal degree of hydraulic conveyance, not equal distance) until the calculated BFE rises one foot. Thus, a portion of nature's actual floodway is now identified as part of the flood fringe. Since FEMA's regulations allow for the placement of fill in the flood fringe, a portion of the natural floodway will, over time, be obstructed by development, causing a real increase in the BFE of 1 foot. This adversely impacts properties already subject to flooding and extends the boundary of the floodplain to new areas (see graphic above). In flat country, the floodplain boundary can be extended outward several blocks, subjecting many more properties in the area to flooding and regulation. Unfortunately, the flood elevation profile shown on the FIRM and used to guide development is the lower elevation, not the "one-foot rise" elevation, putting development at certain risk.

Several states and many communities have a floodway mapping standard that is more restrictive than FEMA's. These may range from 0.5 foot to 0.1 foot to requiring "no rise" floodways. Not allowing the base flood elevation to increase over time goes a long way toward not allowing adverse impacts on others.

The State of Wisconsin requires floodways to be mapped with no rise (measured by 0.01foot). Michigan, New Jersey, Illinois and Indiana establish floodways based on a 0.1 foot surcharge while Colorado, Montana, Minnesota and Ohio use a 0.5 foot standard.

It should be noted that these higher mapping standards do not prevent development. "No rise" does not mean "no development." It means that development must be more careful about its impacts on others. Instead of assuming that existing and proposed structures in an area can absorb a one-foot increase in the base flood, a no-rise floodway means that a development cannot cause any increase in flood heights that will adversely affect others.

An alternative to mapping floodways to a different standard is treating the entire floodplain as a floodway. Floodway standards are in effect across the entire floodplain and no development is allowed that would result in any increase in the base flood.

King County, Washington does not map floodways. Instead, it treats the entire floodplain as a floodway and each development project must demonstrate that there will be no increase in flood levels. (It is important to define the method of analysis that must be used to demonstrate no rise.)

The third shortcoming is that standard NFIP floodway mapping and management criteria will not prevent increases in flood heights and damages. Two aspects of the mapping and management program result in increased flood heights and damages in mapped floodways. First, the approach allows development to cause obstructions in the floodway, as long as an engineer certifies that the development will cause "no rise" in flood levels. The problem occurs when engineers are allowed to calculate the "no rise" assuming a "spot" obstruction in the floodway. The fallacy of this approach is that it does not provide for equal treatment under the law (at what point does an increase occur—when the 5th, 14th, or 18th person wants to develop? If so, how can a standard that allows that many people in the same "zone" to develop, be used to prevent the next one from developing?) First come, first served is not equal treatment under the law. This same equity argument applies to all property in that reach of the floodway, and on both sides of the river in that reach. The regulatory floodway is originally determined under FEMA's study guidelines by assuming an "equal reduction of conveyance on opposite sides of the stream." (Reference: *"Guidelines and Specifications for Flood Hazard Mapping Partners"*) Unfortunately, the procedures to determine if a proposed development in a floodway will result in an increase in the BFE often ignores this basic principle of equal conveyance.

Secondly, filling anywhere in the floodway also results in loss of storage. On smaller streams, that cumulative loss becomes significant and will increase flood levels and damages. In flat areas especially, floodplain *storage* can be very important. As a result, states and communities can require that floodway delineation be based on preventing a **loss of storage and/or increase in velocity**. This will result in wider floodways and less or no increase in flood heights due to development over the years.

The State of Illinois requires floodways to be mapped using a 0.1 foot allowable rise, a maximum of 10% increase in velocity, and a maximum of 10% loss of floodplain storage.

The fourth shortcoming is that maps do not account for unstable streams (geomorphic changes in streams over time). Streams naturally meander and change and will do so more rapidly in reaction to human manipulation in the watershed or channel. Changes in unstable streams should be taken into account to predict where meanders and sediment may move or increase the flood risk.

The fifth shortcoming of the minimum criteria is that the maps are not required to show areas of coastal erosion. States and communities should map coastal erosion areas and manage them for damage prevention and sustainability.

The FEMA 2000 Coastal Construction Manual defines an additional hazard zone— **coastal A zone**—which is not established by the NFIP regulations. Although the NFIP regulations do not differentiate between coastal and non-coastal A zones, the Coastal Construction Manual recommends that buildings in the coastal A zones be designed and constructed to be more resistant to coastal flood forces. In this manual the coastal A zone is the portion of the special flood hazard area of a V zone or landward of an open coast without mapped V zones (e.g., the shorelines of the Great Lakes), in which the principal sources of flooding are tides, storm surges, seiches or tsunamis, not riverine sources. Like the flood sources in V zones, those in coastal A zones are highly correlated with coastal winds or coastal seismic activity. Coastal A zones may therefore be subject to wave effects, velocity flows, erosion, scour, or combinations of these forces. The forces in coastal A zones are not as severe as those in V zones but are still capable of damaging or destroying buildings on inadequate foundations. The CRS program recommends these areas be designated AE Zones and apply VE Zone standards.

In Maine, the risks from coastal hazards are mostly the loss of public and private property near the shore caused by a combination of shoreline erosion, storms and sea level rise. The Maine Geological Survey (MGS) prepared maps showing predicted erosion rates for developed beaches in southern Maine. The maps are now used by MGS to advise the Department of Environmental Protection (DEP) in its permits issued under the Sand Dune Rules of the Natural Resource Protection Act. Under these rules, new construction is not permitted if it is located in an area that is likely to erode within 100 years.

FEMA's **Cooperating Technical Partner** program allows FEMA to reach agreements with state or local partners to more quickly update maps with data or cost sharing on studies that vary from the standard techniques. The result may well be moving your restudy needs to a higher slot on FEMA's or your state's study priority list. The Cooperating Technical Partner website: **www.fema.gov/fhm/ctp_main.shtm**.

For More Information

- Check with your State NFIP Coordinator and FEMA Regional Office on minimum requirements for regulatory flood data in your state. State Coordinators are listed at **www.floods.org** and FEMA offices can be found at **www.FEMA.gov**.
- *Flood Insurance Study Guidelines and Specifications for Study Contractors*, FEMA-37 (3-0152), 1999 (**www.fema.gov/fhm/ctp_main.shtm**). This book describes FEMA's current mapping criteria.
- *Use of Flood Insurance Study (FIS) Data as Available Data*, FEMA Floodplain Management Bulletin 1-98 (9-1305), 1998. This bulletin provides guidance on using data contained in preliminary and draft Flood Insurance Studies as available data, and when and how to use flood data better than what is shown on the current FIRM.
- *Managing Floodplain Development in Approximate Zone A Areas*, FEMA-265 (9-0070), July 1995, can provide guidance on technical standards for studies in areas where base flood elevations were not provided with the FIRM (**www.fema.gov/fhm/dl_zonea.shtm**). The hard copy includes the "Quick 2" software "Computation of Water Surface Elevations in Open Channels," which was promoted to calculate approximate base flood elevations. That software is now outdated and should not be used. Instead, communities should require qualified professionals to calculate flood levels.
- Check FEMA's mapping and Cooperating Technical Partner websites (**www.fema.gov/fhm/** and **www.fema.gov/fhm/ctp_main.shtm**).
- Check with your State NFIP Coordinator for information on other hazards that your community may be exposed to and whether there are maps or studies available for those hazards.
- *Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials*; Association of State Floodplain Managers, FEMA 116 (3-0131), 1987.
- The special hazards credited by the CRS are addressed in the listed publications. Each has a brief summary of the research findings on the nature of the hazards, mapping and regulatory techniques being used across the country, and the goals of the mapping and regulatory standards for which CRS credit is offered.
- *Coastal Construction Manual: Principles, Practices, Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas*, FEMA 55 (8-0373), 2000.
- Fletcher, C.H. (2000) The Hawaiian Islands Coastal Hazards Atlas, University of Hawaii, Oahu, Hawaii.
- NRCS Technical Bulletin No. 55 addresses urban hydrology.

Education and Outreach

NAI can be called an attitude or a mindset – don't cause an adverse impact on others. It is important to convey this message to the general public, property owners, decision makers, design professionals and developers. Your message should be: "know your community's hazards, know how to protect yourself, and understand how your actions could impact others".

Basic: Answer Questions

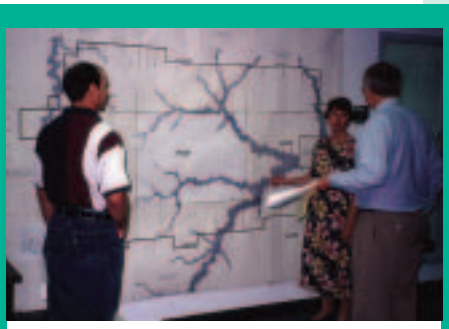
At a minimum, communities need to answer inquiries about whether a property is subject to a flood hazard ("Am I in the floodplain?") and what regulations will apply when developing the property. Communities must also make public documents available for review, such as the FIRM and past permit records.

Answering questions helps. Residents and businesses who find out about the potential flood hazards can take steps to avoid problems and reduce their exposure. Real estate agents and house hunters can find out if a property is subject to flooding and whether flood insurance may be required later by the lender.

Better: Outreach Projects

A more effective floodplain management program will not wait for questions. Through various media, a community can reach out to residents and businesses and advise them of the flood hazard, what the community is doing about it, and what they can do to protect themselves. The FEMA mitigation division has implemented the concept of **risk communication** [**see www.fema.gov**].

Here are some other examples:



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First, make it easier for people to learn about their flood hazard. FEMA flood maps can be obtained off FEMA's web site, **www.fema.gov**, at a small cost per panel, but many people have trouble reading maps. Accordingly, the NFIP and the CRS encourage communities to have a formal program of **providing map information** to inquirers, with publicity so everyone knows of and is invited to use the service.

Many communities are automating this service using their geographic information systems (GIS). Some have **map websites** that allow users to determine their FIRM Zone and other property information. Some websites have links to gages that provide real-time water levels and National Weather Service flood crest predictions. Maps can also be viewed on FEMA's website **www.fema.gov**.

Check the website of Palo Alto, California for a list of all floodprone properties in the city, **www.city.palo-alto.ca.us/cgi-bin/floods.cgi**. Users can also see current stream levels at certain creek monitoring devices.

Communities can often show **additional data** than what is shown on the FIRM with maps that complement and clarify the FIRM (e.g., with aerial photographs that show buildings) and with information on additional hazards, flooding outside mapped areas, and zoning and development regulations.

Most local services are not of much use if no one knows they exist. An outreach project can remedy this. Sending notices to property owners after a flood can help introduce the idea of floodproofing and identify sources of assistance.

Outreach projects can include:

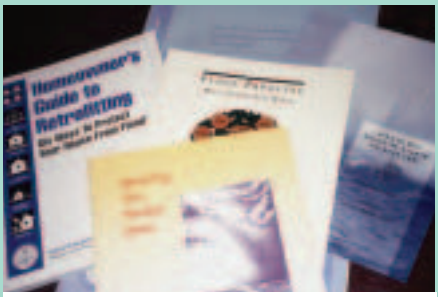
- **Brochures** set out in public places
- **Mailing** a notice to floodprone property owners or to everyone in the community (some communities send the notice annually with tax notices)
- **Displays** in public buildings or shopping malls
- **Articles** and special sections in newspapers
- Flood protection **video** for cable TV programs or to loan to organizations
- **Signs** in the floodplain showing the base flood elevation or historical flood heights
- **Presentations** to neighborhood, civic or business groups
- Development and updating **Emergency Action Plans**, and coordinating them with local and state emergency management offices.

Outreach projects make people aware of the hazard and what they can do about it. Design the project to pique people's interest. Those people will want more information. Historically, **libraries** have been the first place people turn to when they want to research a topic. Interested property owners can read or check out **handbooks** or **other publications** that cover their situation or log on to the Internet to search for helpful websites. Libraries also have their own public information campaigns with displays, lectures, and other projects, which can augment the activities of the local government.

Today, **websites** are becoming more popular as research tools. They provide quick

access to a wealth of public and private sites and sources of information. With very little effort, a community's website can incorporate links to many different sources of flood hazard and flood protection information.

Calumet City, Illinois, added some basic flood protection information to its website, but has links to more details on FEMA and Red Cross websites. **www.calumetcity.org**



Information can be provided through open houses and publications.

Local building department staff are experts in construction. They can provide free **flood protection advice**, not to design a project, but to steer the owner onto the right track. Some building department or public works staff visit properties and offer suggestions. Most can recommend or identify qualified or licensed companies, an activity that is especially appreciated by owners who are unsure of the project or the contractor.

NAI: Education

Outreach projects provide information to people to make them aware of the flood hazards and protection alternatives. Education goes one step further—its objective is to change attitudes and behavior. Start your education of your local staff, then educate your elected officials, educate the public and educate other professionals, like real estate agents, insurance agents, surveyors, etc.

Start with staff. There are many opportunities for **training and education** of staff through FEMA, States, and professional associations. The Association of State Floodplain Managers administers the **Certified Floodplain Manager (CFM) Program** to ensure that floodplain management staff are trained and that they keep their skills up through continuing education. This program works to ensure local officials are knowledgeable on reducing flood losses, and stay up to date on the NFIP and other flood programs. The CFM program is supported by FEMA, The Corps of Engineers, NOAA and NRCS. Information about the Certification program, how to apply, and available training is at **www.floods.org**.

FEMA offers the Coastal Construction Manual Training in two forms: on-site at the Emergency Management Institute (EMI) in Emmitsburg, Maryland for a 5 day comprehensive course; or a 2-3 day "on the road" course designed to suit the specific issues to be addressed within your community. The course which offers a newly updated 2000 Coastal Construction Manual—prepared by FEMA with assistance from other agencies, organizations, and professionals involved in coastal construction and regulation—is intended to help the designer, contractor, and community official identify and evaluate practices that will improve the quality of construction and reduce the economic losses associated with coastal disasters.

Local officials interested in incorporating the NAI approach in their programs need to convince others, such as elected officials, floodplain residents and developers, about why this principle should be followed. **Educating staff and decision makers** can take a variety of forms, including:

- **Distributing NAI materials,** like the poster and brochures produced by ASFPM
- Attending or hosting floodplain management **workshops and conferences** where they can network with other communities about their programs, successes and lessons learned
- Including the **NAI message** in local flood protection publications or made for TV presentations (Clark Co, Nevada produces half hour videos on flood programs)
- **Models or presentations** that show what happens when future adverse impacts caused by development are not accounted for, and the benefits of planning, higher mapping and regulatory standards

> Staff of the Mecklenburg County, North Carolina, Stormwater Services office studied what would happen if the County used the basic mapping and regulatory standards. They found that in some areas, flood heights would increase from 2 to 7 feet due to watershed and floodplain development. Staff prepared a PowerPoint presentation as well as a short report for Council members. It worked. The County's program has been revised to be more effective in preventing increased flood problems.

Environmental and safety education programs can teach children about flooding, the forces of nature, the factors that cause problems, and the significance of protecting the natural and beneficial functions of watersheds and floodplains. These programs educate the floodplain property owners and elected officials of the future and build an attitude of stewardship.

The City of Boulder, Colorado, has established a series of informative plaques along the Boulder Creek Bike Path. Walkers, skaters, and bikers stop by and read about the flood hazard, the natural and beneficial functions of local floodplains, and floodplain management. They get a better idea about what causes floods and things that can be done about flooding.

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These programs can be undertaken by schools, park and recreation departments, conservation associations, and youth organizations, such as the Boy Scouts, Campfire Girls and summer camps. An activity can be as involved as course curriculum development or as simple as an explanatory sign near a river. The important thing is the message - the floodplain is a special place that needs proper care.

For More Information

- CRS Credit for Outreach Projects, FEMA, 2002.
- Check on local public information activities that may be conducted by your county emergency manager, Red Cross chapter, utility company, school district, park department, youth groups, etc.
- See what your local librarian and webmaster are doing.
- Many soil and water conservation districts have staff assigned to help prepare and present educational programs.
- ASFPM's Certified Floodplain Manager Program can be found at **www.floods.org.**
- FEMA's and the Corps' websites have a variety of flood protection references that can be ordered, downloaded or linked to a community website. They are found at **www.fema.gov/nfip/libfacts.shtm** **and** **www.usace.army.mil/inet/functions/cw/cecwp/NFPC/nfpc.htm.**
- Check agency websites for things like "FEMA For Kids".
- Project WET (Water Education for Teachers) provides guides and workshops for teachers on many water resources issues. **www.montana.edu/wwwwet/.**
- Check the web site for the city of Tulsa, Oklahoma, which has an excellent outreach program for educating its citizens about flooding and flood loss reduction programs.
- Check website of Association of State Dam Safety Officials (ASDSO) **www.damsafety.org**, and for the National Watershed Coalition **www.watershedcoalition.org**, for educational materials on dam safety.

Planning

The term "planning" covers a variety of activities that communities pursue to direct future development and publicly funded projects. Planning can prevent many future flood problems, if done right. Good planning avoids unplanned development in the wrong places, and leads to wise use of floodplains and other lands. Planning is a key piece of any community NAI effort.

Basic: Land Use Planning and Zoning

Comprehensive land use plans define how a community should be developed (and where development should not occur). Generally, a plan has limited authority. It reflects what the community would like to see happen. Its utility is that it guides other local measures, such as capital improvement programs, zoning ordinances, and subdivision regulations. In some states, comprehensive plans are mandated and in a few states the plan must address natural hazards.

Plans should relate the use of the land to the land's hazards, typically by reserving hazardous areas for parks, greenways, golf courses, wildlife refuges, natural areas, or similar open space compatible uses. In too many plans there is no relationship between where development and even intensive development is encouraged with the flood hazard areas. By starting the land use planning process with identified hazard areas, appropriate uses can be pre-planned, avoiding the conflicts which otherwise arise when development is already proposed for permit, and then the issue of flood hazard is discovered.

In a few states, a land use plan has regulatory authority. However, more often, it's the **zoning ordinance** that provides the teeth to a land use plan. Zoning regulates development by dividing a community into zones or districts and setting development criteria for each zone or district. As with land use plans, sometimes the uses allowed in those districts are appropriate for floodplains and sometimes they aren't.

A comprehensive plan will usually set broad goals and objectives. Special subject plans are often prepared to provide more detailed guidance on particular aspects of community life or for certain locations in the community. **Special subject plans** include, but are not limited to:

- Transportation plans
- Economic development plans, downtown improvement plans, etc.
- Housing plans, neighborhood improvement plans, historic district plans
- Habitat protection plans
- Coastal zone management plans

- Watershed management plans
- Beach management plans

Often, when these plans are prepared, the authors focus only on the immediate subject and neglect to check whether the area under discussion includes a flood hazard. For example, it does not make sense to invest in housing improvements for buildings in a floodway. As noted in the next section, the NAI approach would be to have a plan that would use housing improvement funds to relocate occupants out of hazardous areas and clear the flood-prone sites for open space use.

Better: Plans that Address Flooding

Land use plans and zoning ordinances have the potential to **restrict damage-prone development** in hazardous or sensitive areas. The floodplain should be designated as one or more separate land use or zoning districts that permit only those uses or activities that are not susceptible to damage by flooding or flood-related hazards (e.g., conservation, recreation, or agriculture).

All land use plans produced by the Southeast Wisconsin Regional Planning Commission have identified river corridors and their entire floodplain to be used as greenways and open space where no development is allowed. The State of Oregon requires local plans to inventory and protect riparian areas.

A land use plan or zoning ordinance should designate flood-prone lands for agricultural, conservation, or other uses that suffer minimal damage from a flood.

Illinois Department o f Natural Resources

The Community Rating System credits **low-density zoning** in floodplains. To the CRS, it doesn't matter if an area is zoned conservation, agricultural, or large lot residential. If fewer structures are allowed in the floodplain, it warrants CRS credit.

Some plans are developed specifically to deal with the flood threat or other hazards. They assess the problem, review alternative approaches, and recommend appropriate measures to manage flooding, prevent adverse impacts, and/or mitigate the problem. These include floodplain management plans, stormwater management plans, hazard mitigation plans, coastal zone plans, and waterfront revitalization plans.

The impact of a flood is directly related to the value and use of a property. A flooded fire station or lost access by emergency vehicles has an impact on the entire community, so these vulnerable facilities deserve greater levels of protection than basic plans and regulations usually provide.

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All these plans need to be based on sound information on the impact of flooding on the community, i.e., who is or could be adversely affected by flooding? A **vulnerability analysis** identifies properties affected by flooding and estimates the impact of flooding on them and the community. This can be an involved, manual job, or one which uses computer based tools.

The planning work can be greatly assisted with **geographic information systems** (GIS). Numerous GIS tools, including a Flood Loss Estimation Model and a new planning tool from FEMA, **HAZUS**, will allow users to estimate flood depths, estimate damage and losses, and define floods of varying magnitudes for different development scenarios. Users may also assess riverine, coastal and alluvial fan flooding, and estimate potential damage to buildings, essential facilities, transportation and utility lifelines, and agricultural areas. It will help users simulate the effects of a disaster and determine the level and type of damage and economic loss people may suffer based on current and proposed development.

Floodplain management plans focus on the community's flood problems. They review past flooding and identify floodprone areas, including those not shown on the FIRM. After a vulnerability analysis, they evaluate various measures to prevent and reduce flood damage and recommend actions for the community to pursue. Floodplain management plans address mapping needs, repetitive loss areas, regulatory standards and procedures, sites that should be acquired and cleared, possible corrective actions, outreach projects, and a host of other flood protection measures.

A floodplain management plan follows a proven process to help a community determine how to prevent and reduce flood losses.

University of Colorado, Boulder - Natural Hazards Center

Special Area Management Plans (SAMPs) are plans that are developed for areas where, due to the multiplicity of local, state, and federal authorities, there is ineffective coordination and cooperation in addressing coastal development on an ecosystem basis. SAMPs provide for increased specificity in protecting significant natural resources, address reasonable coastal dependent economic growth, consider improved protection of life and property in hazardous areas, and include predictability in government decision-making. These are all objectives of state and territorial CZM programs. State SAMP activity can include seven general areas of management: (1) regulatory; (2) non-regulatory; (3) planning; (4) acquisition and designation; (5) wetlands and dune restoration; (6) research and assessment; and (7) outreach and education.

Stormwater management plans focus on the watershed that drains into the community. They may cover a broader subject matter than just flood losses, such as water quality and habitat protection. Many stormwater management plans include detailed hydrologic and hydraulic studies that model runoff volume and flow rates, the same as flood studies, and if done comprehensively, can become an NAI tool. Often, the models are used to revise the FIRM. They are also used to simulate different scenarios, so the planners can see the impact of various flood control approaches, such as channel improvements and detention basins.

While a floodplain management plan will typically cover the community's entire flood problem, stormwater management plans are usually conducted one watershed at a time because of the expense of mapping and modeling. They are also more complicated because they may cover a larger area and can involve several different jurisdictions. But stormwater plans can be very important to preventing future increases in flood damages. If stormwater plans are done properly, they can be a NAI tool. To do that, they must include an analysis of future impacts, and measures to mitigate those impacts.

Hazard mitigation plans and **pre-disaster mitigation plans** are like floodplain management plans except that they look at all the natural hazards facing a community, such as hurricanes, tornadoes, earthquakes, landslides, breach inundation areas below dams and behind levees, and winter storms. They follow a similar planning process and review similar damage reduction measures.

Headlands divide the Oregon coast into compartments, or littoral cells. Within each littoral cell, features such as inlets, jetties, and rocky outcrops define the boundaries of even smaller compartments, or sub cells. As many as 21 littoral cells have been identified along the Oregon coast ranging from less than 10 km to over 100 km in length. One method Oregon uses to manage coastal hazards is through littoral cell planning. A littoral cell management plan is a comprehensive, integrated, area-wide hazards management strategy unique to different physical and social settings found along the Oregon coast. It is focused on the reduction of risk to new and existing oceanfront development from chronic coastal natural hazards. A littoral cell management plan includes the following: littoral cell inventories; a chronic hazards management strategy; and implementing mechanisms. The plans are built as map and inventory projects using Geographic Information System [GIS] software.

NAI: Multi-Objective Management (M-O-M) and Sustainability

Land use plans and zoning are in place to balance public and private concerns. They work to ensure that one person's activities do not adversely affect others or the general public. This is the goal of NAI. Therefore, at the NAI level, all planning that involves flooding should **identify *all* the impacts** of the hazard *and all* of the alternative measures to address the impacts. What happens? and who really pays? should be specifically identified and discussed so the planners and decision makers are aware of all the ramifications.

Often floodplain management or mitigation plans focus on the hazard —something to avoid or get away from. Such plans can help prevent or reduce flood losses, but if they have only one concern, it is difficult to build broad support for them. To be really effective, plans need to address many concerns and to be proactive toward building a more viable and sustainable community.

Under the minimum NFIP approaches, neither FEMA nor the state may check other important matters like septic tanks and wells. A multi-objective approach at the local level will fold these concerns into other watershed concerns like flood risk.

Hillsborough County, Florida—Hazard Mitigtion Section

All plans that address flooding can benefit from the **multi-objective management** approach or "**M-O-M**." This approach promotes public involvement and coordination of floodplain management with other community concerns, such as economic development, housing, water quality, habitat protection and recreation. For example, while those managing the floodplain see the floodplain as a hazardous area that reduces flood damage if it is cleared, the environmental organization sees it as a habitat that needs to be preserved, the schools see it as a teaching resource, and the parks and street department may want a greenway to keep pedestrians and bikes away from traffic.

The M-O-M approach has proven to gain a larger constituency to support the plans and longer-term interest in seeing them implemented. It also helps when an agency or organization can fund only part of a project, but other agencies can support other elements. Often, they favor those projects that have other sources of funding. In other words, they prefer to support multi-objective projects, and this is where coordination with other community goals and objectives can pay off.

In Clarke County, Georgia, supporters of the Heritage Trail and North Oconee River Greenway obtained funds from the Intermodal Surface Transportation Efficiency Act (ISTEA), the Georgia Department of Transportation, and a special purpose local sales tax to purchase buffer lands to protect sensitive riparian resources (and preserve floodplain open space).

Land Use Economics—far too many land use decisions are made without full knowledge or awareness of the long-term economic consequences of those decisions.

As the Governor's Growth Management Study Commission observed in its Final Report, February 2001, "Time for Bold Change," p.15, "By failing to address the true costs of population growth, both past and future, we continue to borrow against future revenues, while the quality of life in our communities slowly dissipates. As we respond to new growth and address our existing infrastructure deficits, communities must [have the tools available to] evaluate their choices in a fiscally responsible manner."

Another NAI concept that should be incorporated throughout all planning is **sustainability**. The classic definition of sustainability is meeting "the needs of the present without compromising the ability of future generations to meet their own needs." Similar concepts include "sustainable development," "smart growth," and "sustainable ecosystems." **Sustainable development** is then "the process of change, development and economic progress that meets the needs of the present generation without compromising the ability of future generations to meet their own needs".

"Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs"
– *United Nations World Commission on Environment & Development*

This is all done in a process that balances ecological, cultural historic aesthetic values with economic development.

The concept of "sustainable development" recognizes the relationship between economic growth, environmental protection and social equity. The synergy of these three goals promotes a healthy economy, a clean environment, and an involved citizenry.

Both floodplain management and coastal zone management encourages sustainable development by following these six principles of sustainability to guide a community's planning effort:

1. Maintain and, if possible, enhance, residents' quality of life.
2. Enhance local economic vitality.
3. Ensure social and intergenerational equity.
4. Maintain and, if possible, enhance, environmental quality.
5. Incorporate disaster resilience and mitigation into daily local and regional land use decision making.
6. Use a consensus-building, participatory process when making decisions.

This is all done in a process that balances ecological, cultural, historic and aesthetic values with economic development. Comprehensive, land use, floodplain management and other plans can all benefit from keeping the principles of sustainable development and smart growth in mind. As with M-O-M, they will help build a larger constituency for better floodplain management and they will better address the needs of the future.

The City of Glen Cove, New York, implemented a "brownfields" cleanup and redevelopment initiative to revitalize its waterfront and attract new business to the traditional center of the community. Supported by NOAA, and the New York Coastal Program, the city brought together federal, state and local players to focus financial and technical support on its waterfront revitalization effort.

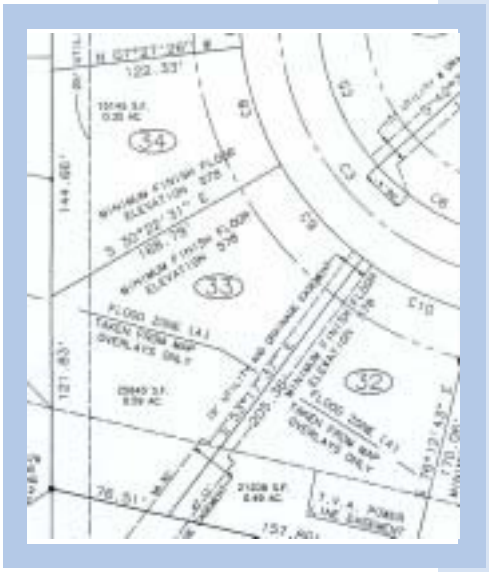
For More Information

- Your state planning or community affairs agency can tell you about state planning requirements and guidance. Contact your state NFIP Coordinator or emergency management office for more information and state requirements for hazard mitigation plans.
- Your local planning office or regional planning council can help with a variety of planning questions and needs.
- Many regional agencies, such as planning commissions, sanitary districts and water management districts are involved in stormwater management planning.
- The National Park Service's Rivers, Trails and Conservation Assistance Program can provide technical assistance to communities in planning and implementing M-O-M projects. Check it out at **www.nps.gov/rtca/**.
- Stay tuned on the development of HAZUS at **www.fema.gov/hazus/**.
- *Flood Mitigation Planning*—The First Steps, ASFPM and the Public Entity Risk Institute (PERI), 2001. This is a floodplain management planning kit. It consists of reference materials, masters for handouts, and a two-part video that explains the 10-step M-O-M planning process to the general public. It is designed to be shown at the first meeting of a planning committee. Order from **www.floods.org**.
- *Example Plans* provides guidance for both CRS-credited floodplain management plans and hazard mitigation plans recognized by FEMA's mitigation funding programs. **www.fema.gov/nfip/crs.shtm.**
- FEMA has a series of detailed "how-to" guides for mitigation planning which can be found at **www.fema.gov/fima/planresource.shtm.**
- *Using Multi-Objective Management to Reduce Flood Losses in Your Watershed*, ASFPM and U.S. Environmental Protection Agency. 1996. This publication reviews the 10-step M-O-M planning process and coordination of a hazard mitigation plan with other community goals and objectives. It includes examples, references, and lists of sources of assistance. It can be viewed at **www.floods.org**.
- *Planning for a Sustainable Future: the Link Between Hazard Mitigation and Livability*, FEMA 364 (9-0395). A short, illustrated overview of the principles involved. This booklet includes a list of federal technical assistance and funding sources. It can be downloaded from **www.fema.gov/fima/planning_toc.shtm**.

Regulations and Development Standards

One of the benefits of properly prepared land use plans and zoning ordinances is that they usually reduce the amount of at-risk floodplain development. Where floodplain development cannot be avoided, it is important to have regulatory programs and standards that can fully protect it from flood damage and help reduce the impact of that development on others. That is the theme of this section of the Toolkit.

Because states and local governments are vested with the authority to regulate land use and development in the United States, state coastal management program responses to CZMP mandates are potentially very important to the overall coastal hazard mitigation picture. States use a variety of tools to manage coastal hazards including: building construction setbacks (23 states); regulation of shore protection structures (28 states); and mandatory land-use planning to restrict development in hazardous areas (9 states).



One frequent criticism of coastal zone and floodplain management programs is the relatively poor coordination between state CZM efforts and the implementation of the NFIP. This is particularly true where local land use planning plays only a minor role in state CZM efforts. Generally, the NFIP has been concerned with insurance and building practices at the level of municipalities and property owners, while CZM programs have been oriented to hazard assessment, large scale planning projects, state-level regulation, and in some states, local land use planning.

Basic: NFIP Regulations

The NFIP establishes minimum floodplain management requirements for participating communities. Communities generally will either incorporate these requirements into their subdivision, zoning, and other land use ordinances and building code or adopt a separate floodplain management ordinance. There are four basic parts to the regulations that a community must enact and enforce to participate in the NFIP:

1. All development in the high-risk (1% chance) floodplain must have a permit from the community. The NFIP regulations define "development" as any manmade change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials.

2. Development and human habitation in the floodway is discouraged, although not prohibited. At a minimum, development in the floodway may not cause an increase in flood levels. An engineering study must be performed to determine whether an obstruction will cause an increase. Unfortunately those studies are performed in various ways, often incorrectly concluding no increase would occur.

3. New buildings may be built in the flood fringe, but they must be protected from damage by the base flood. In riverine floodplains, the lowest floor of residential buildings must be elevated to or above the base flood elevation (BFE). Nonresidential buildings must be either elevated or flood proofed to the BFE. In coastal areas, the bottom of the lowest horizontal structure of a building must be at or above the BFE.

4. A "substantially improved" building is treated as a new building in that further construction must meet the NFIP minimum standards for new construction. The NFIP regulations define "substantial improvement" as any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement. This requirement also applies to buildings that are substantially damaged, whether by flood or other means.

Enforcing these regulations does have an impact on flood losses. The NFIP has calculated that buildings built to these standards suffer 70% less damage than unprotected buildings, saving over $1 billion/year in flood damages. However, they can still suffer damage, so higher protection levels are warranted in most instances. For example, floods can be higher than the base flood elevation for various reasons, including larger storms, downstream obstructions, increased watershed development and floodplain filling. Setting higher standards protects against these risks. People often say "floods were never this big or came this often", and they are probably right. Things do change, and without locals taking charge, flooding will get worse.

Better: Higher Regulatory Standards

It should be stressed that the NFIP sets *minimum* requirements for new construction in a floodplain, and has no regulations for development outside the mapped floodplain. The NFIP encourages higher standards. This section reviews a broad array of regulations where standards higher than the minimum requirements are beneficial. Most of them receive Community Rating System credit (see also the **Toolkit Matrix** on pages 83-87).

NFIP Regulations

...community officials may have access to information or knowledge of conditions that require, particularly for human safety, higher standards than the minimum criteria set forth in...this part. Therefore, any floodplain management regulations adopted by a State or a community, which are more restrictive than the criteria set forth in this part are encouraged and shall take precedence. [emphasis added] 44 CFR 60.1(d)

Coastal Zone Enhancement Program

Dramatic population growth along the coast brings new challenges to managing national coastal resources. These challenges include protecting life and property from coastal hazards and protecting coastal wetlands and habitats while accommodating needed economic

growth. In 1990, to meet mounting public concern for the well-being of the nation's coastal resources, Congress amended the CZM Act to include a new Coastal Zone Enhance-ment Grants Program-Section 309. The Coastal Zone Enhancement Program provides incentives for states and territories to make changes in any of eight areas of national significance. These are: wetlands protection; coastal hazards; cumulative and secondary impacts of development; special area management planning; public access to the coast; ocean governance; marine debris; and government and energy facility siting.

With regard to coastal zone hazards enhancement objective, the CZM Act provides enhancement funding for "prevention or significantly reducing threats to life and destruction of property by eliminating development and redevelopment in high-hazard areas, managing development in other hazard areas, and anticipating and managing the effects of potential sea level rise and Great Lakes level rise."

In 1992, coastal states and territories developed assessments that examined their management of the eight enhancement areas. The NOAA's Office of Coastal and Resource Management (OCRM) reviewed the assessments and came to agreement with the states and territories on high priority enhancement areas. States and territories then developed five-year strategies to enhance the management of these areas. The strategies included projects that resulted in changes to the state's management program, i.e. a new or revised law, set of regulations, or administrative guidelines. The strategies were ranked and states and territories were awarded funds based on this ranking. In 1997 and 2002, states and territories updated their assessments and strategies to reflect their current priorities.

Based on the premise that flood insurance and other federal benefits may encourage development on coastal barrier islands, Congress enacted the Coastal Barrier Resources Act (P.L. 97-348). This Act designates a Coastal Barrier Resource System, within which federal incentives to new development would be prohibited. This system comprises nearly 200 segments of coastal barriers, that are neither developed nor in preserved status. Within these areas, the Act prohibits the issuance of new flood insurance coverage and also suspends other federal assistance for public infrastructure such as bridges, highways, causeways, sewer and water systems, and shore protection projects.

Building standards

Freeboard is an additional height requirement above the base flood elevation that provides a margin of safety against risks that are known but difficult or costly to identify. When constructing a new elevated building, the additional cost of going up another foot or two is usually minimal. Freeboard is the most common higher regulatory standard adopted by states and communities (over half of the CRS communities receive freeboard credit). It has the following advantages:

- Reduces the risk of flood damage
- Accounts for some future flood increases due to upstream watershed development, and for the one foot rise in flood levels allowed by the FEMA floodway standard.

- Accounts for future increases in flood stages when additional development in the floodplain reduces flood storage capacity.
- Acts as a hedge against backwater conditions caused by ice jams and debris dams.
- Reflects uncertainties inherent in flood hazard modeling, topography and mapping limitations.
- Results in significantly lower flood insurance rates due to the lower flood risk. The table at the right shows the insurance rates for a post-FIRM single-family dwelling. Note that the higher the building is above the BFE (base flood elevation), the lower the rate. These rates are based on the true or actuarial cost of insuring a building in the floodplain. This shows how each extra foot reduces the potential for flood damage.

Lowest floor vs. BFE	AE, A1 – A30 Zones	
	Building	Contents
+4	.16	.21
+3	.16	.21
+2	.22	.21
+1	.43	.42
0	.74	.90
-1	1.88	2.68

Flood insurance rates show the economic benefit of freeboard. Rates are the premium per $100 coverage on a 1 story post-FIRM single-family house (no basement) for the first layer of insurance coverage.

Without a safe and sound foundation, an elevated building can suffer damage from a flood due to erosion, scour or settling. To prevent this, consider requiring that an engineer or architect certify the adequacy of elevated building foundations or adopt standards for **foundation protection**, such as on the placement, compaction and protection of fill when it is used in building elevation. See also *Ensuring That Structures Built on Fill in or Near Special Flood Hazard Areas are Reasonably Safe From Flooding*, FEMA TB 10 - 01, 2001 **www.fema.gov/fima/techbul.shtm**.

Often owners of buildings that are elevated eight feet above grade will enclose the lower area, ostensibly to improve appearances or to provide an enclosed area for parking, building access or storage. One problem that arises is that this area may later be finished for habitation, greatly increasing the potential for flood damage. Regulations to **limit enclosures** below the base flood elevation discourage finishing the area below the base flood elevation and storing valuable or hazardous items in that area.

This house was supposed to have all damage-prone components above the flood level, but the lower area was later finished off by the owner. If the community required the lower area to be kept open, there would have been much less damage from this flood.

Paul Osman

In a coastal V zone, the space below all newly constructed, substantially improved and substantially damaged buildings must either be free of obstructions or enclosed only by **non-supporting break-away walls,** open wood lattice work, or insect screening intended to collapse under

water loads without causing structural damage to the elevated portion of the building or the supporting foundation system. To make this minimum requirement better (or even effective), active local inspections and enforcement are needed.

The NFIP's substantial improvement regulations allow each improvement project valued at up to 50% of the building's pre-improvement value to be permitted without meeting the flood protection requirements. Over the years, a community may issue a succession of permits for different repairs or improvements to the same structures. This can greatly increase the overall flood damage potential.

To counter this, some communities **count improvements cumulatively**, so that when the total value of all improvements or repairs permitted over the years (life of the structure, or 10 to 20 years) exceeds 50%, the original building must be protected according to the requirements for new buildings. A variation is to have a **lower threshold for substantial improvements** to less than 50%.

> In the 1980's, the State of Indiana had a 40% threshold for substantial improvements. The state requirement has been repealed, but many Indiana communities still have 40% in their ordinances because it requires more building projects to meet flood protection standards, thus reducing flood damages.

An option to regulating for cumulative substantial improvements is requiring that all **additions** meet the building protection standards. Additions outside the footprint of the original building would have to be elevated (or, for non-residential structures, floodproofed) above the base flood elevation. Of course, additions cannot obstruct flood flows in the floodway.

Especially in flat areas, the floodplain provides a valuable function by storing floodwaters. When fill or buildings are placed in the flood fringe, the flood storage areas are lost and flood heights will go up because there is less room for the floodwaters. This is particularly important in smaller watersheds where the flood fringe stores a greater portion of the floodwater, so it will respond sooner to changes in the land.

For this reason, some communities adopt more restrictive standards that regulate the amount of fill or buildings that can displace floodwater in the **flood fringe**. Communities might require structures to be elevated on columns, not fill, in order to reduce loss of storage. However, this approach results in vulnerability of people and rescue workers during a flood, and damage to infrastructure.

Encroachments in the floodway cause increases in flood elevation, both upstream and downstream.

(Pascagoula, Mississippi)
Robert Durrin, DHS, FEMA Region IV

On the other hand, some communities prefer buildings on fill because it provides safety for property owners above flood levels outside the building walls. For these communities, **compensatory storage** offsets the loss of

flood storage capacity. The developer is required to offset new fill put in the floodplain by excavating an additional flood-able area to replace the lost flood storage area, preferably at "hydrologically equivalent" sites. In some cases the developer must remove 1.5 or 2 times the amount of fill that is proposed to be placed in the flood fringe.

Areas below dams should be zoned in the dam failure area to prevent the hazard class of the dam increasing from low hazard to high hazard. Developers should upgrade all dams to current standards prior to any upstream or downstream development.

Building codes are not required by the NFIP, but the NFIP does now include some building standards and many states have such requirements. Experience has shown many benefits to coordinating floodplain development regulations with building code enforcement. Inspections tend to be more frequent and more thorough and the quality of construction is higher. Because of these benefits, the CRS provides credit for adopting the current version of the International series of codes, which incorporates flood reduction standards. States and communities that adopt the International Building Code (IBC) will have NFIP building standards within that code.

> Wisconsin requires the dam failure area below the dam to be zoned to prevent further "at risk" development which would increase the hazard rating of the dam. This requires the dam owner and the community to work together to reduce future risk.

Just as important as your community's regulatory standards is how well the code enforcement staff administers them. There is a program that measures local building code natural hazard protection standards and code administration. **The Building Code Effectiveness Grading Schedule** (BCEGS) is used by the insurance industry to determine how well new construction is protected from wind, earthquake and other non-flood hazards. BCEGS is similar to the 10-year old Community Rating System and the century-old fire insurance rating scheme: community programs are reviewed and scored, a class 1 community is the best, and a class 10 community has little or no program. Practically all communities in the country with building codes have a BCEGS rating. Find out what yours is and get the detailed report that shows where your code enforcement program is strong and where your community could use improvement.

Mapping flood-related hazards, such as alluvial fans and areas subject to subsidence, is discussed on page 18. Many of the "clear water" flood protection standards will not protect property from these hazards. **Special hazard regulations** are needed. These are discussed in more detail in the CRS series on special hazards (see pages 18-19).

Subdivision and development standards

Subdivision regulations govern how land will be subdivided into individual lots and set the construction and location standards for the infrastructure the developer builds to serve those lots. This infrastructure includes the new roads, sidewalks, utility lines, storm sewers, and drainageways that your community will have to maintain after the subdivision is approved. Subdivision regulations often have jurisdiction over larger projects, such as

shopping centers and planned unit developments. Sometimes development standards are in separate ordinances, which are referred to in the subdivision regulations. Subdivision regulations may allow concentration of structures outside the hazard area and can include the following provisions:

- Allowing emergency **vehicle dryland** access during a flood by requiring streets to be at or above the base flood elevation.
- Setting aside maintenance **easements along all drainageways** (see example in the plat to the right).
- Requiring every lot to have a **building site above the flood level** or on natural high ground (see example in the plat to the right).
- Requiring that final **recorded plats** show hazardous areas (see example in the plat to the right).

Example of a subdivision plat easement and flood hazard disclosure

Huntsville, AL

- **Compensatory storage** offsets the loss of flood storage capacity. The developer is required to offset new fill put in the floodplain by excavating an additional floodable area to replace the lost flood storage area, preferably at "hydrologically equivalent" sites. In some cases the developer must remove 1.5 or 2 times the amount of fill that is proposed to be placed in the flood fringe.
- **Green Infrastructure**—Green infrastructure looks at green space as a form of infrastructure just like roads, water lines and sewers. It includes large metro parks as well as neighborhood parks, riparian buffers or linear parks and greenways, trees, farms, residential landscape and urban gardens. Green infrastructure is a proactive, systematic, multifunctional model that views open space on a large scale and better integrates open/green space planning with other efforts to manage growth and development. It essentially uses stormwater storage areas, water conveyance areas and other natural flooded areas as part of the community infrastructure for stormwater and food damage reduction, as well as for parks, trails and other recreation areas.

What is Green Infrastructure?

- Green space is often viewed as something that is nice to have (i.e. if we have the money, if residents demand it). The term "green infrastructure" implies something that we **must** have—green space is a necessity rather than an amenity.
- Green space is often viewed as self-sustaining. Green infrastructure implies something that must be **actively maintained and, at times, restored**.

Planned Development and Transfer of Development Rights (PUD, TDR)
A description of these tools in on page 51.

Stormwater regulations (If done comprehensively these can be NAI level tools)

Development outside a floodplain can contribute significantly to flooding problems. Runoff is increased by 10% to over 100% when natural ground cover is replaced by urban development (including streets, parking lots, rooftops and other impervious surfaces). As an example, the St. Louis Metropolitan Sewer District (MSD) calculates the change in flow based on pervious and impervious area, intensity of rainfall and area. As a result, for a 5-acre basin the flow would be 8.5 cfs pre-development, whereas post-development, for the same basin it more than doubles to 17.3 cfs. To prevent stormwater from flooding roads and buildings, developers construct storm sewers and improve ditches to carry the water away more efficiently.

This combination of increase in the flood peak and increase in duration and volume, especially if combined with more efficient stormwater channels, will lead to increases in downstream storm peaks and changes in the timing when storm peaks move downstream. These increases cause the stream to react to accommodate them. As a stream reacts, sediment is generated and deposited in poorly designed culverts and wetland areas. Unconstrained watershed development often will aggravate downstream flooding and overload a community's drainage system. A second problem with stormwater is its impact on water quality. Runoff from developed areas picks up pollutants on the ground, such as road oil and lawn chemicals, and carries them to the receiving streams.

The potential adverse impact of new development can create the following problems:

1. Interruption of watershed flows—In a natural watershed, overbank and stream flows cross the area to be developed. The location of these flow lines may be inconvenient to the development process. This results in a relocation of drainage systems.

2. Reduction of pervious soils—Typical subdivisions convert about 30% to 50% of open space to impervious condition. According to St. Louis MSD—1/4 acre lots have 50% impervious area, 1/2 acre lots have 40% impervious area, 1 acre lots have 35% impervious area and greater than 1 acre lots have 30% impervious area. In many places, more 1/4 to 1/2 acre lots are being constructed than the greater than 1 acre lots. This results in more than doubling the total runoff.

3. Efficiency of drainage network—Open space consists of rough, uneven and highly vegetative surfaces. Overland flow is generally quite shallow, producing significant contact with surface and vegetation, so overland flow is slow. Subdivision drainage reduces the length of the overland flow path and utilizes ditches and pipes to move the flow more quickly. This results in shorter travel times and higher peak flows on downstream properties and communities.

4. Reduction of storage—Natural floodplains consist of open space containing multiple depressions, hollows and swamps that store water naturally during storm events. Developments fill in these low-lying areas and depressions for economic gain, thus resulting in higher peak flows.

5. Reduction of conveyance—In a natural state, floodwater flows through the channel and across the overbank adjacent to the channel. Developments fill in these overbanks, reducing the cross sectional area available to convey the floodwater, which will increase the upstream flood elevations

Thus, new developments have the potential of producing serious adverse drainage impacts. This potential occurs anywhere in the watershed not just in the floodplain.

Usually a subdivision ordinance requires developers to build **retention or detention basins** to reduce the increases in runoff caused by impervious surfaces and new drainage systems. Often, the requirement is that stormwater must not leave the site at a rate higher than that under pre-development conditions. This approach can actually make the problem worse, if done wrong. This approach is being replaced over time by requirements based on a stormwater management plan (see page 33).

Runoff from bare ground causes erosion and fills in drainageways.

French & Associates

Slowing surface water runoff on the way to a drainage channel increases infiltration into the soil and reduces the volume of topsoil eroded from the site and can recharge groundwater. Runoff can be slowed down by measures such as terraces, contour strip farming, no-till farm practices, sediment fences, hay or straw bales, constructed wetlands, and impoundments (e.g., sediment basins and farm ponds). **Erosion and sedimentation control regulations** mandate that these types of practices be incorporated into construction plans, reducing the potential for adverse impacts downstream.

Stormwater runoff can erode the soil that is laid bare at construction sites sending sediment into downstream waterways. Sediment tends to settle where the river slows down and loses power, such as where it enters a lake or a wetland. Sedimentation will gradually fill in channels, lakes, and retention basins, reducing their ability to carry or store floodwaters.

One method to remove sedimentation impacts is the use of RUSLE, the Revised Universal Soil Loss Equation (RUSLE). RUSLE was developed by the US Department of the Interior, Office of Surface Mining and Reclamation for Mined Lands, Construction Sites, and Reclaimed Lands. RUSLE is an equation that takes into account rainfall/runoff erositivity, soil erodibility, hill/slope length and steepness, cover-management and support practices. Use of tools like this could be instrumental in helping develop approaches to reduce erosion on land before it accelerates erosion on stream banks and the stream itself. Many states and communities have developed erosion and sediment control models.

Not only are the drainage channels less able to do their job, but the sediment in the water reduces light, oxygen, and water quality and often brings chemicals, heavy metals and other pollutants. Sediment has been identified by the US Environmental Protection Agency as the nation's number one non-point source pollutant for aquatic life.

Health and safety standards

Hazardous materials like these should be kept out of floodplains.

French & Associates

Septic and similar on-site waste disposal systems depend on low groundwater levels for sewage to infiltrate into the ground. Floodplains often have high groundwater levels. Water quality is also degraded when septic systems malfunction or when septic water and surface water mix during a flood. In coastal high hazard areas, mounded septic systems generally require a significant volume of fill and therefore constitute an obstruction if placed under or near an elevated coastal building. Septic systems should not be directly connected to the foundation. It's a good idea to keep potential **public health hazards**, such as septic systems and landfills, out of the floodplain to protect both the health of people and the flora and fauna that live there. In coastal area V zones, septic systems should not be allowed on fill because of the high potential of erosion of this fill in such a dynamic area characterized by wave velocity.

Hazardous materials, such as gasoline, pesticides and chemicals, can have major adverse impacts on others during a flood. They should be restricted in areas subject to flooding. This can be done by prohibiting them altogether or requiring that they be kept on floors above the base flood elevation.

NAI: Enhanced Watershed Protection

Preserving beneficial floodplain functions

Floodplains are supposed to carry and store floodwater. Preserving the floodplain's ability to do this is a central step in ensuring that development will not have an adverse impact on others. One essential tool to protect the carrying capacity of the floodplain is mapping and regulating the floodway. Higher floodway mapping criteria is discussed on page 21.

Protecting the floodway's ability to carry and store floodwater is also important. The NFIP allows development in the floodway, provided an engineer demonstrates that it will not increase flood heights. Unfortunately, this approach results in increased flood damages and increased flooding on other property. Allowing one property owner to build in the floodway restricts the ability of a community to stop others from doing the same, due to the "equal protection under the law" legal issue. **Floodway protection** regulations keep the floodway open by prohibiting development, especially habitable development, and limiting re-development. Communities should also address this issue by specifying in their ordinance or guidelines that the engineering analysis will be done to "address the

cumulative effect of the proposed development, when combined with all other future and anticipated development" (NFIP regs 60.3 (c) (10)).

> The States of Washington and Wisconsin do not allow any habitable structure to be built or rebuilt in the floodway. The State of Illinois allows only "appropriate uses" in the floodways in the six counties around Chicago. The list of "appropriate uses" specifically excludes filling and new buildings. Michigan does not allow new habitable structures or additions in the flood way. Within the floodway, Indiana will not permit the repair or replacement of any structure that suffers structural damage.

Preserving important areas

One very important part of the floodplain is the shoreline. This area, where water and land meet, is home to many special species and is subject to erosion when disturbed. **Setback** standards establish minimum distances that structures or construction work must be positioned (set back) from river channels or shorelines. Setbacks can be defined by vertical heights or horizontal distances. Setbacks keep buildings from obstructing views, keep on-site sewage disposal systems from polluting public waters, prevent disruption to the channel bank, and can protect riparian habitat.

> Michigan's Natural River Act designates a river or portion of a river as a natural river area for the purpose of preserving and enhancing its values for water conservation, its free flowing condition, and its fish, wildlife, boating, scenic, aesthetic, floodplain, ecologic, historic and recreational values and uses. Local zoning ordinances and state zoning rules require structures to be setback at least 100-150 feet from the Ordinary High Water Mark (OHWM) on designated tributaries and 100-200 feet from the OHWM on designated mainstreams. Setback requirments are outlined in management plans developed for each designated river and are incorporated in zoning ordinances and rules. Vegetative buffers on state designated streams range from 25-100 feet on private land and up to 200 feet on public land. Federally designated rivers have restricted vegetative cutting zones on federal lands of up to 1/4 mile from the OHWM.
>
> The State of Oregon requires local governments to adopt a 75 foot setback, unless they can justify a different number. Marion County, Oregon, requires all septic tanks and drain fields to be set back 100 feet from the high water line.

A more comprehensive alternative to a setback, which may just prohibit buildings, is a **buffer zone**, which requires certain things be done in sensitive areas between two different land uses. A properly vegetated buffer zone along a stream or lakefront will protect the bank from erosion and filter stormwater, cleaning the runoff that enters the water body.

> The Fairfax County, Virginia Comprehensive Plan establishes an Environmental Quality Corridor (EQC) system that includes 100 year floodplains, slopes greater than 15% adjacent to a floodplain, wetlands in stream valleys and a buffer zone along stream channels. The policy is to avoid development of the EQC by dedication to the Fairfax County Park Authority if it is in the public interest or as separate undeveloped lots with commitments for preservation. The policy allows a transfer of some of

density from the EQC portion of the site to less sensitive areas on the site. (The plan is available on the Fairfax County website. See the Plan subsection on the "Environment".)

In Michigan, the Shorelands Protection and Management directs the State Deparment of Environmental Quality (DEQ) to conduct studies along the coastal areas and determine the long-term average rate of shoreline movement. Areas that are found to be receding at a rate of one foot per year or greater are designated as high risk erosion areas, and setback requirements are estalished which are based on the average rate of recession for the area. Therefore, setbacks along the shoreline of Michigan vary greatly. In addition, there are 30-year and 60-year setback requirements; structural characteristics of the structure and site dictate which setback applies to the project. A permit from the state is required for new construction, including additions and substantial improvements to existing structures, and the installation of septic systems. The geomorphic reference feature from where the setback is measured also depends on the conditions of the site. Without the benefit of a site inspection, an applicant is told that the farthest landward feature the setback would be measured from is the top of the lakeward facing slope. Depending on the site characeristics, the reference feature may actually be lakeward of that location.

A second Michigan DEQ program establishes a setback from the crest portion of the Great Lakes shoreline. Along with other restrictions, it prohibits development and contour changes lakeward of the crest in designated critical dune areas. While construction may occur close to the crest, there are standards in the statute which work to minimize the impact of that development, including limitations on vegetation removal and the requirement to re-plant areas with indigenous species. Permits from the state are required for all construction, terrain alteration and vegetation removal in critical dune areas.

Coastal vegetative buffers can be done through regulation (wetlands permits, compensatory mitigation, setbacks or buffers) planning (mitigation banking, local land use plans (SAMPs) and land and water management (land acquisition, restoration and enhancement).

The Rhode Island Coastal Resources Management Program (RICRMP) mandates the use of vegetative buffers in all coastal development. Coastal vegetative buffers are implemented in order to both protect the water body from runoff and erosion as well as provide the property owner with some measure of protection from the devastating impact of coastal storms. Depending upon lot size and the water use category of the adjacent water body, a determination is made by RICRMP on the size and width of the vegetative buffer.

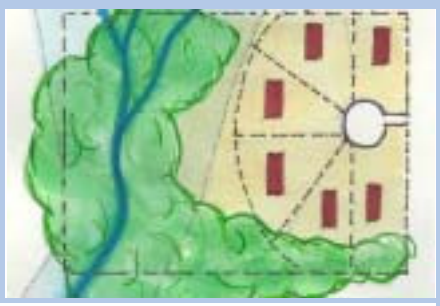
Many communities require larger developments to set aside a certain percentage of the land as open space for park, recreation or stormwater storage purposes. Why not make that the land in the floodplain? It's usually more expensive for the developer to build on the floodplain, so setting it aside to meet the **open space dedication** requirement is a win-win for the developer and the community. This can be the subdivision's common ground that is maintained by the property owners.

King County, Washington, requires developers to set aside native growth protection easements.

Developers are finding that **linear parks and greenways** that connect the open space areas through a community are becoming more and more popular and help sell new developments. Again, why not put them along the streams and lakefronts, where it's aesthetically pleasing and where construction will stay away from the most hazardous and sensitive part of the floodplain?

One alternative to the usual method of subdividing land into similar parcels is the **planned development** approach. Developers are allowed more flexibility in their design, as long as they meet certain requirements for the zoning district. Communities may provide incentives, such as allowing higher density development on a portion of the land, in return for setting aside the floodplain as open space. An example is shown below.

Traditional Approach



Planned Development Approach

Subdivision and other development regulations could allow developers to have the same or larger number of building sites while preserving the floodway, floodplain or natural stormwater storage areas for open space. The planned development site plan has the added advantage of a shorter street, which reduces construction costs for the developer and maintenance costs for the community and results in less impervious surface.

Transfer of Development Rights

In certain communities, the developer is allowed to **purchase development rights** from property owners in special areas, such as the high risk floodplain. Purchase of those rights means those lands will remain open space forever. In return, the developer is allowed to use the units that would have been allowed on that flood hazard land to increase the number of units on non-floodplain land. In that way the developer maintains economic return, and the community reduces flood disaster costs, flood damages, infrastructure repair costs and obtains open space that may be the wisest use of the floodplain in the community.

Protecting coastal resources

Natural Resources in Coastal Areas

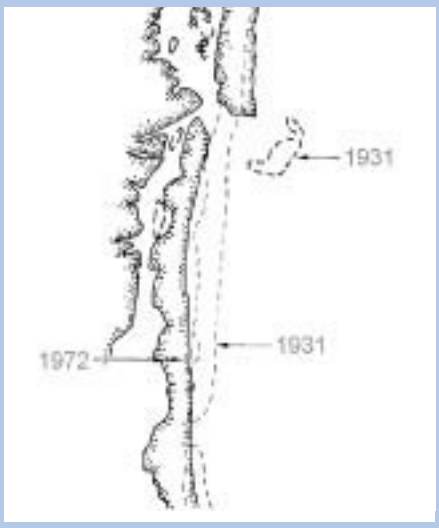
Coastal areas require management because of the richness, diversity and sometimes scarcity of resources, such as wetlands, beaches dunes and barrier islands, estuaries and other coastal waters and their economic importance to the nation. The coast is home to over half the nation's population, is a popular vacation destination, provides key transportation avenues for over 90% of the U.S. international trade and supports over $56 billion in commercial and recreational fishing each year (NOAA, 2000).

Coastal wetlands (tidal and non-tidal) are among the most stressed natural ecosystems. Since 1780, nearly half of all coastal wetlands, excluding those in Alaska, have disappeared through draining, diking, filling, mining, excavating and other alterations for agriculture, port expansion, urban expansion and recreational uses such as marinas.

Beaches and dunes provide protection for inland natural coastal features and man-made structures. Beaches are also important for coastal recreation. Many states are experiencing significant loss of beaches and bluffs as a result of constant wave action. Severe storms, rising sea level and man-made shoreline "stabilization" structures often accelerate this gradual, long-term erosion (1 to 3 feet per year, Kaufman and Pilkey, 1983). Chronic or episodic erosion, as well as the force of high winds, waves and coastal flooding, pose significant hazards to coastal residents, visitors and property.

Coastal barriers include islands and shoreline landforms that are made mostly of sand. Coastal barriers are the "first line of defense" for inland properties against coastal storms and flooding. At the same time, they are low-lying and highly vulnerable to coastal flooding and storms themselves. They can move over a period of a few decades in response to the forces of winds and waves (see map), which is the very means by which they protect the mainland. Barrier islands provide enclosures for estuaries and marshes that are home to a variety of plant and animal life, including a number of endangered species. Coastal barriers provide recreational and aesthetic benefits.

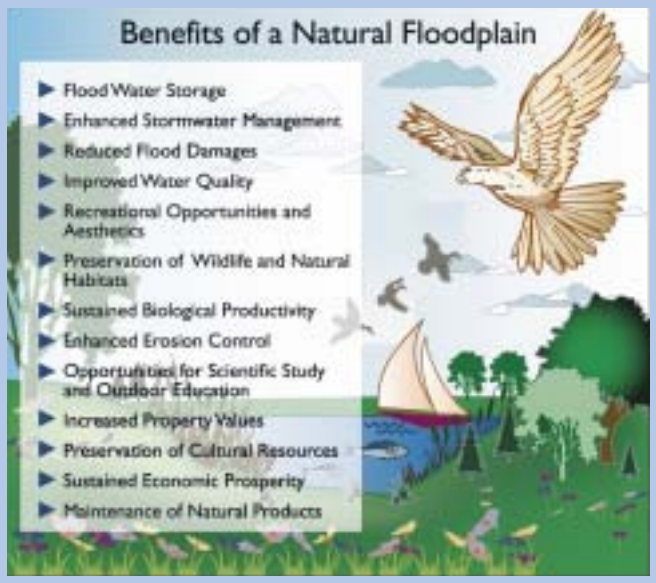
Because of their location, coastal barriers are subject to some of the strongest development pressures in the country. However, such development can interrupt their natural tendency to move with the ebb and flow of coastal forces. **Protecting coastal barriers** from development is important to reduce public disaster costs, and to both habitat and inland human development.



This historical map of a Maryland barrier island shows how erosion can move or remove entire islands over a period as short as 40 years.

Managing Coastal Erosion, National Research Council

The Coastal Barriers Resources Act (known as "CoBRA") is a Federal law that identifies undeveloped coastal barriers. Once designated, federal assistance for buildings and facilities is severely limited and NFIP flood insurance is denied for buildings built or substantially improved after a specified date.



Communities are still free to allow construction, although the owners take a big risk without Federal assistance or flood insurance. This has reduced, but not stopped, construction on undeveloped coastal barriers, so your community should consider regulations that restrict development on coastal barriers to uses that will not detract from their ability to protect other properties.

Sand dunes and wide beaches also protect inland properties by providing a barrier and breakwater for coastal storms. **Dune and beach protection** regulations guard these areas from disruption by foot and vehicle traffic or construction. Stairs and boardwalks over dunes should be required in order to protect the sand and the plants that help keep the sand in place. There should be regulations against removing vegetation or altering sand dune fences.

> The state of Florida began regulating shoreline development in 1971. Along the shore, Florida imposes stricter construction standards to minimize damage to the natural environment, private property and human life. The Coastal Construction Control Line (CCCL) was established in 1978 to preserve and protect Florida's coastal beach-dune system from imprudent construction and yet still provides reasonable use of private property. Construction in the V zone can jeopardize the shoreline's stability, accelerate erosion, provide inadequate protection to upland structures, endanger adjacent properties or interfere with lateral public beach access. In the CCCL zone, there is a 30-year erosion setback based on shoreline change rate information obtained from historical measurements for each permit application. Within the boundaries of the CCCL, no person, firm, corporation or governmental agency may construct any type of facility or building without a CCCL permit, unless it is exempted or grandfathered in.

Protecting natural resources

Natural resource protection activities are aimed at preserving natural areas such as wetlands, habitat protection and protecting water quality. In so doing, these activities enable the naturally beneficial functions of floodplains and watersheds to be better realized.

A basic level of wetland regulations are those administered by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. Before a "404 permit" is issued, the plans

are reviewed by several State and Federal agencies. There are also nationwide permits that allow small projects that meet certain criteria to proceed without individual permits.

Local regulations are needed to protect wetlands threatened by development.

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Generally, these agencies want to protect wetlands by preventing development that will adversely affect them. If a permit is issued, the impact of the development is typically required to be mitigated. Wetland mitigation can include creation, restoration, enhancement or preservation of wetlands. The appropriate type of wetland mitigation is addressed in each permit.

If the mitigation action is to preserve or develop an equivalent or larger wetland on another site, there are two drawbacks. First, it takes many years for a new wetland to approach the same quality as an existing one. Second, a new wetland in a different location (especially if it's in a different drainage basin) will not have the same flood or water quality protection benefits as the original one.

Another concern is that 404 jurisdiction is limited to the "waters of the United States," which may not include smaller isolated wetlands. Your community may want to adopt its own **local wetland regulations** to fill in the gaps in the Federal program or State wetland program.

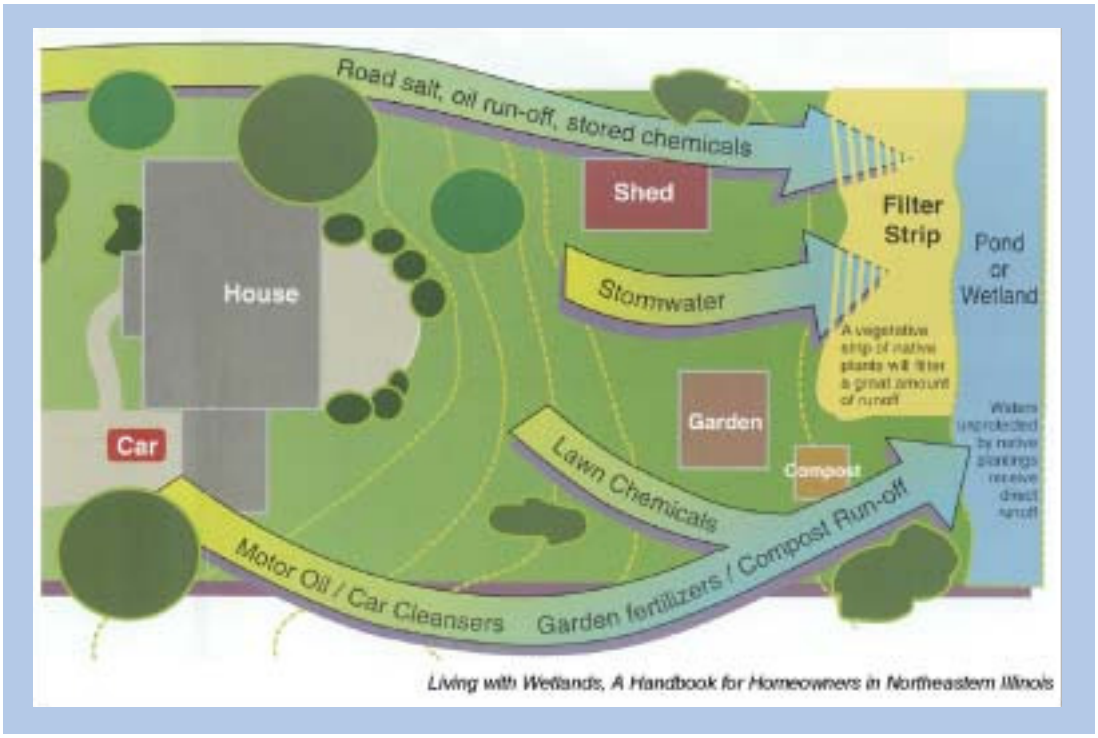
> After the 2000 SWANCC court case restricted Federal authority in isolated wetlands, Lake County, Illinois, adopted its own wetland regulations. The County's program covers all development that "creates a wetland impact." "Wetland impacts" include actions that cause a wetland to become "hydrologically disturbed or otherwise adversely affected by flooding, filling, excavation, or drainage." A wetland impact is presumed whenever development significantly alters the amount of storm water flowing into a wetland—even if the development does not actually encroach on the wetland.

Wisconsin adopted state wetland regulations when Federal protection was lost under the SWANCC court decision. Michigan had previously assumed 404 regulations from the Federal government. They require conservation easements for wetland migration sites.

Point source pollutants come from pipes such as the outfall of a municipal wastewater treatment plant. *Non-point source* pollutants come from non-specific locations and are harder to regulate. Examples of non-point source pollutants are lawn fertilizers, pesticides, farm chemicals, animal wastes, oils from street surfaces and industrial areas and sediment from agriculture, construction, mining and forestry. These pollutants are washed off the ground's surface by stormwater and flushed into receiving storm sewers, ditches and streams and other public waters.

Best management practices (BMPs) are measures associated with programs like stormwater management that reduce nonpoint source pollutants that enter the waterways.

BMPs can be implemented during construction or as part of a project's design to permanently address nonpoint source pollutants. Check with your state environmental protection or natural resources agency for guidance and publications on BMPs that are appropriate for your area.



In addition to improving water quality, BMPs can have flood related benefits. By managing runoff, they can attenuate flows and reduce the peaks after a storm. Combining water quality and water quantity measures can result in more efficient multi-objective stormwater facilities.

Stream Restoration

For More Information

- Talk to your state NFIP Coordinator, FEMA Regional Office or regional planning council for their suggestions about where the minimum requirements are not sufficient to protect property from damage by flooding that occurs in your area.
- Your state NFIP coordinating office (see ASFPM website for contacts) may have a model floodplain management ordinance that includes higher regulatory standards.
- Check with your local or regional planning office to verify that your regulations encourage clustering, planned developments and similar approaches and to see if there are some recent examples in your area.

- Check with your state environmental protection or natural resource agency for guidance and any requirements on retention of stormwater runoff and controlling erosion and sedimentation.
- Your state coastal zone management agency will know which coastal areas need protection and whether current state and local regulations are sufficient.
- *CRS Credit for Higher Regulatory Standards,* FEMA, 2002, includes example ordinance language for many of the provisions described in this section.
- *Coastal Construction Manual*, FEMA-55, 2000.
- Subdivision Design in Flood Hazard Areas, American Planning Association, 1997, Planning Advisory Service Report # 473.
- *Reducing Losses in High Risk Flood Hazard Areas—A Guidebook for Local Officials*, FEMA-116 (3-0131), 1987.
- *Ensuring That Structures Built on Fill In or Near Special Flood Hazard Areas Are Reasonably Safe From Flooding*, FIA-TB-10, FEMA, 2001.
- CRS Credit for Stormwater Management, FEMA, 2002.
- For more information on the Certified Floodplain Manager Program, check the Association of State Floodplain Managers' website, **www.floods.org**.
- Numerous programs are available from NRCS (USDA) that provide either technical or financial assistance protection of wetlands, conservation easements, buffers, etc. NRCS also has soil maps throughout the nation.
- More information on the Building Code Effectiveness Grading Schedule (BCEGS) can be found at **www.iso.com/products/2400/prod2409.html**.
- The "Stormwater Manager's Resource Center" is administered by the Center for Watershed Protection at **www.stormwatercenter.net**.
- The National Park Service Rivers, Trails and Conservation Assistance Program can provide technical assistance. This program has developed its own tool box for protecting and improving natural areas, historical sites and other community assets. Check it out at **www.nps.gov/rtca/**.
- There are many local or regional natural resources groups like "Friends of the Wolf River," the Nature Conservancy and the Izaak Walton League which can help you determine what measures are needed to better protect natural floodplain resources.
- The National Wildlife Federation has a directory of conservation organizations at **www.nwf.org/conservationdirectory/**.

Mitigation Actions (corrective actions)

While the previous section discussed ways to prevent flood problems from occurring through proper planning during land development, this section covers activities that can reduce damage to existing buildings that are exposed to flooding. These measures are usually divided into two categories: structural—measures which adjust natural river, stream, coast and floodplain systems in an effort to reduce flood damages to human built infrastructure and non-structural—measures, which adjust human activities to accommodate nature's flooding in an effort to reduce flood damages to human built infrastructure. Non-structural measures could include changes to an individual structure, such as floodproofing.

Basic: Structural Flood Control and Flood Insurance

Structural projects have traditionally been used by communities to keep flood waters away from an area by modifying the flow, velocity or direction of a river. These measures are popular because many people believe they will "stop" the flooding problem. They include:

- **Reservoirs** that control flooding by holding high flows behind dams or in storage basins. The theory is that water is released or pumped out after a flood, at a calculated rate that the river downstream can accommodate.
- **Levees, floodwalls, seawalls and other barriers** are erected between a river, lake or ocean and the properties proposed to be protected.
- **Groins** are structures (usually built perpendicular to the shoreline) to trap littoral drift that is being carried by the cross shore currents or retard erosion of the shore.
- **Channel modifications** increase the conveyance of a stream channel or drainage ditch by making it wider, deeper, smoother or straighter, in order to move the water downstream more quickly.
- **Bridge and culvert improvements** include the replacement, enlargement or removal of existing bridge decks and culverts at road and railroad stream crossings.
- **Dredging** removes sediment from the bottom of the stream channel in an effort to move water downstream faster.
- A **diversion** is a new channel that allows floodwaters to by-pass part of the flow to a different location, thereby reducing flooding along that portion of a watercourse.

As with most structural projects, channel modifications can have an adverse effect on habitat and human connection to the river.

(Rome , Georgia)
Robert Durrin, DHS, FEMA Region IV

These structural projects were built because they were projected to reduce flood damages, provide water supply and/or recreation or produce hydropower. However, they can also have the following **potential adverse impacts**:

- They disturb the land and disrupt natural water flows, often destroying habitats.
- They are built to a certain flood protection level that can be exceeded by a larger flood, causing even more damage than might have occurred without the structure.
- They can create a false sense of security when people protected by a structure believe that no flood could ever reach them.
- They require regular maintenance to ensure that they continue to provide protection, something that is often neglected over the years. On structural projects, operation and maintenance is usually a local cost.
- They are expensive, requiring cost sharing from local, regional or state agencies, and sometimes requiring capital bond issues
- Levees and floodwalls can divert flood flow onto other properties and reduce the floodplain's storage capacity.
- They are often not sustainable and cause instability and reaction from the stream.
- Seawalls and groins can adversely impact adjacent, unprotected properties by interrupting littoral drift and starving adjacent beaches of needed sand. Loss of life and property, reduced recreational opportunities, loss of environmental quality and alteration of traditional coastal uses are just a few of the detrimental impacts of shoreline erosion and coastal flooding.
- Projects can alter the timing of flood peaks, causing increased flooding on other properties.
- Where flood control structures already exist, communities must ensure that they are properly operated and maintained (O&M). If the costs of O&M exceed the value they provide, such structure should be removed.

Flood Insurance

All property owners (individuals, businesses and public entities) should purchase flood insurance on their structures as well as for contents in those structures that are in flood hazard areas. Flood insurance covers losses caused from most flooding. This coverage is not available in the standard homeowners policy. Flood insurance not only covers the damage from flooding, but can:

- Be used to cover part of the cost of acquisition/relocation, elevation or other mitigation measures.

- Provide added mitigation funding through the increased cost of compliance (ICC) coverage in the policy (see page 80).
- Provide coverage for contents as well as structures.

Better: Human Adjustment to Flooding

Nonstructural Measures

Because of the expense and adverse impacts of the structural flood control measures listed in the previous section, many communities have turned to nonstructural approaches to reduce flood losses. Instead of trying to control water, they focus on altering the development and human behavior that is exposed to flood damage.

Moving this local landmark shows that nearly any building, no matter how big, can be relocated.

Hollis Kennedy House Movers, Athens, Alabama

A major tool is **enforcement** of the community rules, regulations and procedures. The lack of enforcement has the domino effect of increasing flood damages. When one property owner is allowed to violate community standards, others follow. This makes it difficult for courts to order compliance because all violations are not treated equally. Cumulative violations lead to loss of flood storage or conveyance, thus increasing damages & disaster costs (to taxpayers) because buildings are too low or poorly protected. Immediate enforcement action, with significant fines, prevents other violations. CZM programs often find an illegal seawall, jetty or other structure, and force the owner to take it out. Other means of enforcement include wetland mitigation banking, fines associated with illegal activity, restoration of coastal resources, land acquisition, etc.

Moving a building to higher ground is the surest and safest way to protect it from flooding and reduce the liability and cost to the community for providing services and infrastructure which support it. While most buildings can be protected through **relocation**, the cost goes up for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings. However, experienced building movers know how to handle any job.

In areas subject to flash flooding, deep waters, high velocity or other high hazard, relocation is the safest approach. Relocation also works where large lots include buildable areas outside the floodplain or where the owner has a new flood-free lot available.

Like relocation, **acquisition** of buildings in a hazard prone area ensures that they will no longer be subject to damage. The major difference is that acquisition is undertaken by a government agency so the cost is not borne by the property owner, and the land is usually converted to public use, such as a park or open space. Acquiring and clearing buildings is not only the most effective protection measure available, it is also a way to convert a problem area into a community asset and obtain environmental benefits.

While acquisition is appropriate for any type of hazard, it is more cost-effective than other property protection measures in areas subject to flash flooding, deep waters, steep slopes, sinkholes, coastal erosion or other severe hazards. Acquisition, followed by demolition, is most appropriate for buildings that are difficult to move-such as larger slab foundation or masonry structures, and for dilapidated structures where moving them is not cost effective.

Buildings subject to deeper, fast moving, or repetitive flooding are prime candidates for acquisition. Older buildings are usually demolished.

Lake County (Illinois) Stormwater Management Commission

Using FEMA mitigation funds, the small town of Vernonia, Oregon, protected 24 buildings by elevating 20 and acquiring 4. Gurnee, Illinois, sets aside enough money in each annual budget to purchase a floodplain property as owners put it up for sale.

This Illinois home was elevated one foot above the base flood elevation in a shallow floodplain. The site has been flooded several times since the project was completed, but water did not damage the home.

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Elevating a building above the flood level is often a good on-site property protection method for flooding. It should be designed to keep floodwater below the high damage-prone part of the building. Alternatives include elevation on continuous foundation walls (creating an enclosed space below the building), elevation on compacted earthen fil and elevating on piles or piers.

Raising a building above the flood level is cheaper than moving it and can be less disruptive to a neighborhood. With landscaping and other measures, elevated buildings can look attractive and be readily accepted by owners and neighbors. Software programs are available to show property owners how their elevated structure will blend in with their neighbors. However, the elevated building will be surrounded by water during a flood and may not be usable.

Barriers close to the building will have a minimal impact on loss of flood storage, but still must account for openings (Calumet City, IL).

French & Associates

Barriers keep surface floodwaters from reaching a building. A barrier can be built of dirt, soil, concrete or steel. Barriers must be placed so as not to create flooding or drainage problems on neighboring properties and can not be constructed in the floodway.

Dry floodproofing involves sealing a building to ensure that floodwaters cannot get inside. All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting.

Doors, windows and vents are closed permanently. While openings could be covered with removable shields or sandbags, this requires human intervention. NOTE: Dry floodproofing is generally feasible only in shallow flooding areas (2 feet or less).

The Village of South Holland, Illinois, administers a program that gives property owners a 25% rebate after they have constructed and installed an approved floodproofing project. This program has resulted in over 400 homes being protected from shallow flooding and sewer backup.

In this dry floodproofed Louisiana house, plastic sheeting is covered by thin facing brick. The building's walls become a watertight barrier to shallow flood waters.

French & Associates

Wet floodproofing means letting the water in and removing everything that could be damaged by a flood. There are several ways to modify a building so that floodwaters are allowed inside, but minimal damage is done to the building and its contents. These techniques range from moving a few valuable items to rebuilding the flood-able area. Wet floodproofing is a technique most often used to protect existing buildings. It is used in new construction only for enclosed areas below BFE under elevated buildings.

In the latter case, structural components below the flood level must be of materials that are not subject to water damage. For example, concrete block walls instead of wooden studs and gypsum wallboard. The furnace, water heater and laundry facilities are permanently relocated to a higher floor. Where the flooding is not deep, these appliances can be raised on blocks or platforms.

Ongoing coastal erosion and flooding present complex problems that must be addressed by coastal residents, coastal users and all levels of government.

The New York Division of Coastal Resources is undertaking key actions which will correct past human mistakes and improve decision-making. These include implementation of sand bypassing at inlets to restore the natural system of shore protection, erosion monitoring to enrich the coastal processes database for making informed coastal management decisions and technical assistance to all levels of government to ensure best management practices in addressing site-specific problems. To accomplish this, the Division of Coastal Resources provides erosion and flooding mitigation planning assistance, technical support and data collection/interpretation aid to coastal property owners, private industry and local, state and federal agencies.

Wet floodproofed garage in Wrightsville Beach, NC.

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It was explained that measures discussed under the basic level (structural flood control projects) can have many adverse impacts on people and natural floodplain functions. Nonstructural measures can also have concerns that need to be addressed, including:

- Acquisition/relocation is often done piecemeal, leaving what is called a checkerboard pattern of vacant lots and buildings that either didn't qualify for the program or whose owners did not want to move.
- Elevation and floodproofing projects still leave buildings surrounded by floodwaters during a flood. Occupants often try to ride out the flood or get to or from their properties during high water, requiring police and fire protection costs.
- The building may be isolated and without utilities, therefore temporarily unusable.
- If allowed, owner-designed measures, especially dry floodproofing, may not adequately account for all forces that floodwaters place on a building. This can result in severe structural damage to the building.
- The streets, utilities and other infrastructure that serve an elevated or floodproofed building are still exposed to flood damage and public costs for those damages.

It's important to remember that existing buildings should not be protected at the expense of other properties. Don't let your corrective actions create new flood problems.

Nonstructural measures can be accomplished or enhanced through the use of numerous NRCS programs for easements, buffers, etc. Information can be obtained from your local NRCS office or their website.

NAI: Master Planning and Monitoring

A cursory review of what CZM and Corps of Engineers programs offer in this area of floodplain management shows that a greater emphasis is being placed on monitoring the impact or significance of "past mistakes" In order to implement a corrective action, many programs must undergo a monitoring program in order to justify the expense/effort to implement the costs associated with corrective actions.

The best way to overcome the shortcomings of both structural and nonstructural measures is through **master flood protection planning**. Floodplain management, hazard mitigation, watershed and stormwater management plans are discussed in the earlier section on planning and are all integral to the master planning.

Under the NAI approach, these plans identify all the impacts of each alternative measure for reducing flood losses and identify exactly how those impacts will be mitigated. Again, the impacts to flood flows, flood levels, erosion and sedimentation are considered along with impacts the community considers on water quality and the environment.

If the planning process involves the owners of the properties that need to be protected, they may well become more supportive of nonstructural measures. Projects that were well

planned with a lot of public involvement can have a higher participation rate by involving those affected. Plans that follow the multi-objective management approach and principles of sustainability usually find more supporters for them and more sources of funding. As a result, acquisition projects can buy more properties and the area will be redeveloped to truly benefit the long term interest of the community.

Through a master plan, the City of Darlington, Wisconsin, was able to protect downtown buildings by acquiring some and wet floodproofing others. Instead of clearing out this area entirely, floodproofing helped the City to preserve the business district in its historic location.

Tulsa, Oklahoma, prepared a master plan for Audubon Creek. The result was a combination of acquisition of floodprone homes and channel improvements. The channel design included recreation areas as part of a greenway. A multi-purpose detention facility was built to offset adverse impacts of the channel project.

For More Information

- Your state NFIP Coordinator, emergency management agency and FEMA all may manage mitigation grant programs that can fund acquisition and, sometimes, elevation projects.
- The Corps of Engineers has references on relocation, elevation and floodproofing techniques at **www.usace.army.mil/inet/functions/cw/cecwp/NFPC/nfpc.htm**
- Local house moving companies know the techniques and costs for relocation and elevation projects.
- **www.louisianafloods.org/** is a great website administered by Louisiana State University that covers a variety of sources for help on protecting buildings.
- *Homeowner's Guide to Retrofitting Six Ways to Protect Your House From Flooding,* 1998, FEMA 312 (9-1371), provides an overview of nonstructural measures. It is at **www.fema.gov/hazards/floods/lib312/shtm**.
- *Flood Proofing Programs, Techniques and References*. U.S. Army Corps of Engineers, 1996, introduces elevation and floodproofing measures and programs that can help property owners and local officials. It is at **www.usace.army.mil/inet/functions/cw/cecwp/NFPC/nfpc.htm**.
- *Local Flood Proofing Programs. U.S. Army Corps of Engineers*, 1994, reviews ways communities can fund elevation and floodproofing measures. It is also at the Corps of Engineers website listed above.
- The U.S. Army Corps of Engineers, the Natural Resources Conservation Service, the Tennessee Valley Authority and the Bureau of Reclamation all have programs that help design and fund structural projects.

- Regional or county flood control or sewer districts often build or help fund projects.
- EPA has funding programs for watershed/source water protection. To view them, go to **http://cfpub.epa.gov/fedfund/index.cfm**.
- *The Natural and Beneficial Functions of Floodplains*, a report for Congress by the Task Force on the National and Beneficial Functions of the Floodplain. Copies of this report are available from FEMA publications, P.O. Box 2012, Jessup, Maryland, 20794-2012 or call: 1-800-480-2520.

Infrastructure

A community's infrastructure, such as roads, bridges, water and power systems, public buildings, parks and other open areas, are vital to its operation and quality of life. Protecting them from flood damage is often seen as more important than protecting private property, since they are paid for with public dollars.

Basic: Response and Replacement

The basic level of treatment for infrastructure is to do the minimum to maintain it and repair it after a flood or other disaster. Here are some examples:

Roads, bridges, culverts and public utilities: When a new development goes in, the community responds and extends services to meet the demand. When a flood problem is reported, such as a washed out culvert, public works crews replace it in like condition at public expense. These facilities are usually designed to meet federal or state requirements, which may not be adequate to prevent increased flood levels and damage. Communities must be aware the Federal Highway Administration will sometimes propose to replace a bridge in such a way that it causes and increase of one foot in flood levels–because they incorrectly believe FEMA standards "require" a one foot rise. *The Federal Executive Order #11988, Floodplain Management*, actually requires new and replacement structures to cause no flood elevation increases. Communities must work to avoid this problem, by requiring that replacement structures do not increase flood levels, and could even reduce flood levels and erosion.

Many communities extend roads and utilities wherever development occurs, without regard to the flood hazard.

Kane County (Illinois) Development Department

Private utilities: At the basic level of effort, local governments leave locating, extending and maintaining private utilities up to the utility companies.

Public property: There is often no special flood protection attention given to public buildings and other publicly-owned property, unless they have been flooded. After a flood, some minimal flood protection measures may be put in place.

If a public building located in the regulatory floodplain was substantially damaged from any cause, it would have to be protected from the base flood. This does not always happen for two reasons. First, the high value of some public buildings means it takes a lot of structural damage to exceed the 50% substantial damage threshold. Second, many communities don't understand that under the NFIP, public property must meet the same rules as private development. Often public agencies do not seek or obtain building permits or have their

plans reviewed by the local or state office responsible for enforcing the floodplain regulations. This is in violation of the community's obligation to the NFIP and could be grounds for probation or suspension from the program.

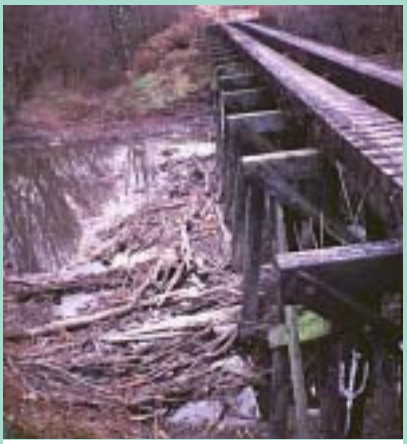
Parks: Park programs and construction of park buildings may or may not account for the hazard or the special opportunities presented by the waterfront location.

In Wisconsin, state parks along the Mississippi River have toilets which can be moved out of the floodplain during flooding.

Drainage system: Most communities will respond to complaints or calls when dumping occurs, a tree falls or an obstruction is placed in a channel or retention basin. Public works crews will remove the obstruction, although some communities will not work in channels that are on private property. Sometimes debris is only removed after enough collects to cause a problem (sometimes only after a flood).

Critical facilities: Critical facilities are defined differently in each community, but include:

- Structures or facilities that produce, use or store highly volatile, flammable, explosive, toxic and/or water-reactive materials;
- Hospitals, nursing homes and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a flood;
- Police stations, fire stations, vehicle and equipment storage facilities and emergency operations centers that are needed for flood response activities before, during and after a flood;
- Access roads and public and private utility facilities that are vital to maintaining or restoring normal services to flooded areas before, during and after a flood; and
- Water supply and waste water facilities that provide public health and safety.



Allowing trash, logs or debris to collect at choke points can dam up a channel.

French & Associates

As with public property and private utilities, a community at the basic level may not devote any special attention to its critical facilities until after they are damaged. They may have been inventoried by the emergency manager and listed in a disaster response plan, but they may not have any flood protection measures in place.

This private utility's critical facility is in a floodway.

French & Associates

Wastewater treatment plants are often located in floodplains, or worse yet, floodways and subject to damage, causing pollution.

Lake County Stormwater Management Commission

Better: Protection Measures and Procedures

The basic level simply maintains the status quo, responding to flood problems and repairing or replacing damaged facilities in the same condition they were before a flood. A better approach is a more proactive one that inventories what infrastructure is exposed to damage, takes steps to protect it and sets protection standards for new facilities. Maintenance activities should have formal procedures that account for flooding.

Roads, bridges, culverts and public utilities: A community should have routine procedures that require examination of the potential for flood damage to a road, bridge, culvert, water line or sewer line. Often a culvert is sized inappropriately or the road or pipe was not designed for high water. At the time of repairs or scheduled maintenance or replacement, **corrective measures** such as correctly sizing the culvert should be taken to reduce future damage.

Some communities and state transportation agencies have set higher **flood standards** for new construction, requiring bridges to pass the base flood with no flood elevation or velocity increase, or maybe allow a crossing to be flooded without obstructing flows or increasing flood levels.

Public property: An inventory of all public buildings should be made to determine which are exposed to flooding. Those that are should be given a **flood audit**. An audit is a review of the hazard at the site, low entry points, warning times and similar factors, along with a recommended series of steps that the building owner can take to prevent damage by future floods.

A series of culverts in Orland Hills, Illinois, obstructed flood flows, causing local flooding and necessitating repairs after every heavy rain. The Village used FEMA disaster assistance funds and State Motor Fuel Tax funds to enlarge and improve the culverts over several years. This systematic approach saved local funds and reduced flooding.

French & Associates

At a minimum, all public buildings in the mapped floodplain should be covered by **flood insurance**. As a recipient of federal financial assistance, your community may have been subject to the mandatory purchase requirement. You should determine if there are any insurable publicly owned or leased buildings in your floodplain. If so, see if they received federal aid in the past. Likely prospects include:

- A wastewater treatment plant (almost always located near a body of water but need not be) which received a grant from your environmental protection agency.
- Public housing or neighborhood center funded with help from the Department of Housing and Urban Development (HUD) or the Community Development Block Grant (CDBG) Program.
- Any facility that received disaster assistance after a flood or other disaster declaration.

Whether there was a requirement to buy insurance or not, you should advise your risk manager or other appropriate office about the buildings exposed to flooding. Ask them to verify whether your "all risk" insurance policy specifically covers flooding.

Congress has taken steps to encourage public agencies and private property owners to purchase flood insurance instead of relying on disaster assistance for help after a flood. Disaster assistance for a public building is reduced by the amount of insurance coverage (structural and contents) a community *should* carry on the building (regardless whether the community is carrying a policy).

In effect, disaster assistance for public agencies now has a very large deductible equal to the insurance policy it should carry. Why wait for the disaster to be caught short? You should advise the appropriate people of the need to purchase flood insurance coverage on your community's buildings.

Drainage system: There are adverse impacts when a drainage system loses a portion of its carrying or storage capacity: overbank flooding occurs more frequently and flows reach higher elevations. Even where floodplain regulations prevent construction from encroaching, channels and detention basins can lose their carrying capacities due to debris accumulation, sedimentation and the growth of vegetation.

Jefferson Parish, Louisiana, has effective formal drainage inspection and maintenance procedures built on its NPDES program.

French & Associates

Why wait for the problem to happen? A regular program of drainage system inspections can catch problems in the channels and detention basins before they turn into major obstructions and when they are still small enough to remove without heavy equipment and disruption of the area. This work can be limited to removal of log jams, trash, fallen trees, shopping carts, trees growing in the channel and similar debris that can dam a stream and cause flooding, even during small storms.

Maintenance activities normally do not alter the shape of the channel or pond, but they do affect how well the drainage system can do its job. Sometimes it is a very fine line that separates debris that should be removed from natural material that supports habitat. To avoid mistakes and challenges to the maintenance effort, written and publicly adopted **drainage system maintenance procedures**, based on state and federal regulations, are recommended.

Critical facilities: Protecting critical facilities serves several purposes: it reduces damage to vital public facilities, it reduces pollution of flood waters by hazardous materials and most importantly, it ensures that the facilities will be operable during most flood emergencies.

As with publicly owned buildings, it can be well worth the cost to conduct a **flood audit** to determine ways to protect the facilities through retrofitting or a flood protection project.

Your emergency manager should help the managers of the facilities prepare **emergency action plans** to ensure maximum protection during a flood. Public flood response efforts should be coordinated with those action plans. For example, a little early flood warning could give public and private property owners enough time to move hazardous materials or sensitive machinery and equipment to high ground. Such plans need to be tied to regular inspections and funding for repairs of any structural protection measures.

NAI: Plans and Alternatives

The previous section on the better floodplain management approach for infrastructure focused on protecting the facilities from flood damage. The NAI approach also considers the impacts that constructing, improving and even protecting these facilities have on other properties, the environment and natural systems.

Where a community locates or improves its infrastructure can have an impact on flood losses and floodplain development.

(Kentucky)
Robert Durrin, DHS, FEMA Region IV

Roads, bridges, public utilities, public buildings: Capital expenditures may include acquisition of land for public uses, such as parkland, wetlands, or natural areas, and extension or improvement of roads, utilities, channels and drainage structures. Many communities adopt a capital improvements plan and/or budget that specifies what will be built or replaced in the near future. Such plans and budgets should be examined to ensure:

- Major investments, such as a new fire station, police station or emergency center, are not located in a flood hazard area where equipment cannot get to the fire during flooding or not be in operation during a flood, and that the flood will not separate part of the community from the equipment.
- Public services such as road, sewer or utility improvements encourage more development or more intense development in a floodplain. Not putting water or sewer lines into

a floodplain may not halt development, but it can deter it or result in less dense development if the buildings must rely on wells and septic systems. Flood impacts, along with pollution impacts of septic systems, must be mitigated.

- Current road, bridge or culvert which obstruct flood flows and need to be replaced incorporate flood damage reduction as part of the project under the NAI approach.
- Development occurs in a manner that will not result in an increase of hazard classification and risk from upstream dams.
- **Bridge and culvert improvements** would include the replacement, modification or removal of existing bridge decks and culverts at road and railroad crossings over streams in a way that will reduce flood levels, velocities, erosion and sedimentation on other properties and the stream.

Parks: The best use of floodplains is generally considered to be open space. Keeping the area natural means no damages from flooding and no adverse impact on others. Communities wanting to follow the NAI approach expand their ownership or control over open floodprone areas in order to continue the natural and beneficial functions floodplains provide.

Comprehensive plans and capital improvement programs should ensure that areas that will be flooded now and in the future are preserved by **acquisition** and other means, such as purchasing an easement. With an easement, the owner may undertake some development and use the private property, but property taxes are reduced or a payment is made to the owner in exchange for an agreement to hold part of the property as open space. There are several programs that can help acquire or reserve open lands.

> In Bartlesville, Oklahoma, 43% of the floodplain has been preserved as open space. Broken Arrow, Oklahoma, has an ongoing program to purchase floodplain properties when they go up for sale. It also encourages owners to donate the lands as a tax write off. In the 1920's, the Cook County, Illinois, Forest Preserve District made a conscientious effort to acquire lands along the larger rivers. This paid off when floods in the 1970's and 1980's inundated large areas in the Chicago metropolitan area that were still mostly undeveloped, which stored water to protect other property.

A master **greenway plan** can follow the streams and river corridors. Often, existing parks form the start of a greenway. Over the years, lands along the greenway are purchased and developers are encouraged or required to dedicate streamside land to connect the open spaces. Often developers view these parcels as undevelopable or too expensive to build on. See also the regulatory approaches reviewed under "preserving important areas" on page 49. There are a number of federal programs which provide cost sharing to create green space and to link green spaces, especially in urban areas (National Park Service, Urban Forestry Program and others).

Greenways and riverfront parks have an added benefit over other types of open space. They attract people to the water. People learn to appreciate the natural and beneficial functions

of the floodplain and develop an interest in protecting them. The Boulder Creek streamside path on page 28 is a good example of a community taking advantage of this natural attraction and erecting explanatory signs and informational material.

Huntsville, Alabama, has a master greenway plan with the majority of the paths planned along streams.

French & Associates

This golf course is one of many privately-owned open space uses that can be considered no adverse impact development.

Illinois Department of Natural Resources

Drainage system: One way to reduce maintenance costs and improve the appearance of the drainage system is knows as **"green infrastructure."** The NAI approach uses grassy swales or natural vegetation instead of concrete. The design must ensure adverse impacts are mitigated, just as in any other approach. Studies have shown that after establishing the right vegetation, long term maintenance costs are lower than if the banks were concrete. The Natural Resources Conservation Service estimates that over a ten year period, the combined costs of installing and maintaining a natural landscape may be one-fifth of the cost for conventional landscape maintenance, e.g., mowing turf grass.

Orland Hills, Illinois, has opted for alternatives to concrete channels and parks with mowed grass, resulting in reduced maintenance costs and less impervious surfaces.

French & Associates

Green Infrastructure looks at green space as a form of infrastructure just like roads, water lines and sewers. It includes large metro parks as well as neighborhood parks, riparian buffers or linear parks and greenways, trees, farms, residential landscape and urban gardens. Green infrastructure is a proactive, systematic, multi-functional model that views

open space on a large scale and better integrates open/space planning with other efforts to manage growth and development.

Green infrastructure emphasizes interconnected systems of natural areas and open spaces that are protected and managed for the ecological benefits they provide to people and the environment. Green space is often viewed as self-sustaining. Green infrastructure implies something that must be actively maintained and, at times, restored.

There is a growing movement that has several names, such as "stream conservation," "bio-engineering" or **"stream restoration."** The objective of these approaches is to return streams, streambanks and adjacent land to a more natural condition, including the natural meanders, so the stream is self-sustaining. Another term is "ecological restoration", which restores native indigenous plants and animals to an area.

A key component of these efforts is to use appropriate native plantings along the banks that resist erosion. This may involve "retrofitting" the shoreline with willow cuttings, wetland plants and/or rolls of landscape material covered with a natural fabric that decomposes after the banks are stabilized with plant roots.

Critical facilities: Under the NAI approach, communities do not expose such important properties to flooding. These communities set **higher regulatory standards for new critical facilities**. The Federal standard is to protect critical facilities from the 0.2% chance flood (500-year) . Some communities prohibit them from the 0.2% chance floodplain. NAI communities prohibit critical facilities from the 0.2% chance floodplain hazard areas and require existing critical facilities to be protected and accessible during a 0.2% chance flood.

For More Information

- Your planning, public works, finance and risk management offices can explain current plans and procedures and whether they account for flooding or have flood protection standards.
- Your emergency manager should have an updated list of critical facilities and contacts for your community.
- For more information on flood insurance, ask a local property insurance agent or call 800/638-6620. See also **www.fema.gov/nfip/cost1.shtm**.
- Check with your state water resources or environmental protection agency to verify what you can and can't do in channels and what activities need a state permit.
- *CRS Credit for Drainage System Maintenance*, FEMA, 2002.
- State parks agencies often have funds for acquiring or preserving open spaces.

- Agencies and organizations that provide open space acquisition funding and technical assistance include the National Park Service Rivers, Trails and Conservation Assistance Program (**www.nps.gov/rtca/**), the Trust for Public Land (**www.tpl.org/**), the Land Trust Alliance (**www.lta.org/**) and the Nature Conservancy (**www.nature.org/**).
- *Banks and Buffers B A Guide to Selecting Native Plants for Streambanks and Shorelines*, Tennessee Valley Authority, 1997.
- *Restoring Streams to Reduce Flood Loss*, National Park Service and Trout Unlimited, 2000 (brochure).
- *Stream Corridor Restoration Principles, Processes and Practices*, Federal Interagency Stream Restoration Working Group, 1998. Copies available through the USDA Natural Resource Conservation Service.

Emergency Services

Emergency services measures protect people and property during and after a disaster. They can involve every department of the community and many non-governmental agencies, like the Red Cross.

Basic: Generic Response Plan

Most communities have a disaster response or emergency preparedness plan. Often these are prepared at the county level and individual municipalities may or may not have much of a role in coordinating disaster response and recovery.

Too often, communities and counties adopt generic response plans. Many times these are not much more than verbatim copies of state model plans, so they have generic descriptions of the hazards and no detailed information on the threat that the community faces. These plans treat all disasters alike and do not have specific actions for different types of hazards. For example, after the disaster occurs, these plans may call for a meeting of a committee to determine what steps should be taken next.

Sandbagging is a popular flood response effort, but a sandbag wall will divert floodwaters onto other properties. A good flood response plan will identify more efficient uses of available resources that will not adversely affect others.

Lake County Stormwater Management Commission

If the disaster is a flood, a typical response is to issue sandbags and encourage people to build sandbag walls. However, people may or may not be aware of how high the flood is predicted to go and whether an effective sandbag wall can be built in time. Sandbagging may not be a very efficient use of resources during a flood. This approach also does not account for the adverse impact that sandbag walls or other barriers may have by pushing floodwaters onto neighboring properties.

Better: Flood Preparedness Plan

Generic or multi-hazard response plans do help. In particular, preparing the plans and exercising them for different incidents allows staff who would respond to the real thing to meet each other and train together. However, these plans frequently miss two key factors that make floods different:

- We can usually get some advance warning of a flood. Even in flash flood situations, heavy rains are an indication of a coming problem.
- We know where floods will go. We have maps of the floodplain.

Because of these two factors, when and where a flood occurs should not be a surprise to local emergency managers. Therefore, a community should have a flood-specific response plan that better prepares for the expected hazard. Emergency managers should not wait for the disaster to hit before they take action.

The first step in responding to a flood is knowing that one is coming. A **flood threat recognition system** provides early warning to emergency managers. A good system will predict the time and height of the flood crest. This can be done by measuring rainfall, soil moisture and stream flows upstream of the community and calculating the subsequent flood levels.

A siren can reach many people but does not tell them what do to. A flood preparedness plan needs a public information component to ensure people will know how to respond to a warning.

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In Roseville, CA a new flood warning system was implemented. Before the system was implemented, during multiple 100-year events, the community made over 300 emergency rescues of people. Following a similar 100-year flood event after the system, there were zero flood rescues necessary.

On larger rivers and the coast, the measuring and calculating is done by the National Weather Service through its river forecast offices, using streamgage information from USGS or the National Hurricane Center. These offices issue predictions as much as several days in advance, giving communities time to get ready and a good idea on how high the floodwaters may go. On smaller rivers, locally established rainfall and river gages are needed to establish a flood threat recognition system. Many communities working with USGS have such systems, especially in mountainous areas where the flash flood threat to life safety warrants the expense.

If your community has a dam upstream, your emergency management office should be in touch with its operator. There should be periodic communication checks and clear criteria for when a dam appears threatened and when downstream properties should be notified. A **dam failure "Emergency Action Plan (EAP)"** should be prepared by the operators of each dam so you can prepare a community plan in response to the hazard. There should also be a dam failure inundation map which shows the area that would be flooded if there were a catastrophic failure. This EAP should be tied to the "flood stage forecast map" mentioned below, which shows the different areas and structures that will be flooded as waters rise.

After the threat recognition system tells the local emergency manager that a flood is coming, the next step is to issue a **flood warning** to the staff of other agencies, critical facilities and the general public. The earlier and the more specific the warning, the greater the number of people who can implement protection measures.

Just as important as the warning is telling people what to do. A warning program should have a **public information aspect**. For example, people need to know the difference between a tornado warning (when they should seek shelter in a basement) and a flood warning (when they should stay out of basements).

www.nws.noaa.gov/stormready

The National Weather Service established the **StormReady and TsunamiReady** programs to help local governments improve the timeliness and effectiveness of hazardous weather related warnings for the public. Qualifying for this program is a definite step toward improved flood preparedness, and it's credited by the CRS.

Concurrent with threat recognition and warnings issuance, your community should respond with actions that can prevent or reduce threats to life, health and property. Typical **flood response actions and responsible parties** include the following:

- Activating the emergency operations center (Chief elected official and emergency manager);
- Providing early warning to certain critical facilities (dispatcher);
- Closing streets or bridges (police or public works);
- Providing people with directions to safe emergency evacuation routes (public works and media);
- Monitoring water levels (engineering);
- Holding children at school/releasing children from school (school district);
- Opening evacuation shelters (Red Cross);
- Security of evacuated areas (police);
- Clearing streets, cleaning up and disposing of debris and garbage (public works); and
- Informing the public about health and safety precautions (health department).

A good flood preparedness plan identifies which streets and bridges will go under water. Emergency managers can close them before they become a threat to drivers and pedestrians.

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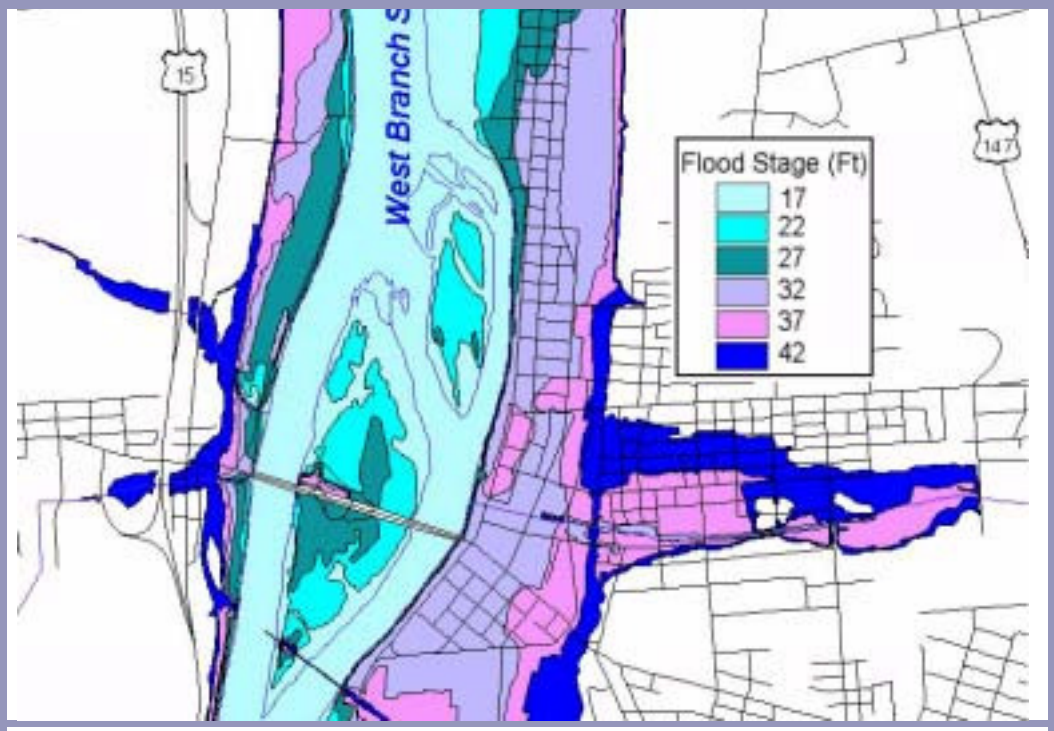
Which flood response steps should be taken when? That's the benefit of a good flood preparedness plan, prepared before the disaster, not whipped together during the excitement of an emergency. One of the best tools to help predict what will happen is a **flood stage forecast map**, which shows what areas will be affected at different flood heights. Such a map is prepared on a good topographic map by highlighting areas flooded at different flood levels (see example, next page). When the Weather Service predicts that a flood will crest at a certain level, the emergency managers will know exactly what to expect and can take appropriate response actions. A structure inventory will identify each structure in the flood hazard area, with the first floor elevations and the flood elevation at which they will no longer have access to the structure. In progressive communities, automated phone systems call specific houses with warnings to evacuate or act, based on predicted flood levels and the data on their specific structure.



A flood stage forecast map shows what areas of a community will be under water at different flood stages. This helps emergency managers make the most efficient use of their resources. For example, a flood predicted to go as high as 27 feet will completely cover the islands in this community.

SEDA-COG, Lewisburg, Pennsylvania

NAI: Pre and Post-Disaster Preparedness

Pre-Disaster: Sometimes adverse impacts result from efforts to protect properties during a flood. Flood preparedness planning needs to make sure that these actions don't make things worse for someone else. For example an emergency barrier will divert floodwaters onto other properties in the same way a permanent levee will.

NAI communities pre-plan their emergency operations. The location, size and implementation of any emergency action is evaluated to determine if it will cause any adverse impact on other properties. Any such adverse impacts are mitigated through modifications in location or size of implementation, or through other means, such as flooding easements, etc. Emergency action plans are periodically updated to assure names and contact information are current.

Post-Disaster: Being prepared for what follows the disaster can help you take important steps to protecting and redeveloping your community following a flood. After a disaster,

everyone wants to get "back to normal." The problem is, "normal" means the way they were before the disaster, exposed to repeated damage from future floods.

This is the time when people are thinking about flooding and when damaged buildings and other facilities could be removed or retrofitted at a lower cost. It is also the time when some disaster assistance funds, as well as FEMA mitigation funds, become available and can best be used to protect the structures and your community infrastructure from future damage, suffering and public costs. Your community's flood preparedness plan should have pre-planned post-disaster **mitigation procedures** that would include:

- Determining which structures are substantially damaged. (substantially damaged structures in floodplains must be built compliant with new construction standards);
- Regulating reconstruction to ensure that it meets all code requirements;
- Substantially damaged structures can also bring in added mitigation funds from FEMA (Flood Mitigation Assistance FMA), Increased Cost of Compliance [see below] other FEMA programs, as well as use of monies from other agencies, such as CDBG, etc);
- Conducting a public information effort to advise residents about floodproofing measures they can incorporate into their reconstruction work;
- Evaluating damaged public facilities and incorporating protection measures during repairs;
- Acquiring substantially or repeatedly damaged properties from willing sellers;
- Preparing or updating a long term mitigation plan; and
- Applying for post-disaster mitigation funds based on the community comprehensive mitigation plan.

The first item is one of the hardest—determining whether a floodprone building has been substantially damaged. One new tool that can help you is FEMA's **Residential Substantial Damage Estimator** program, which makes determinations easier and more objective. After large disasters, FEMA can help bring in teams of building code experts to assist your community in the many assessments and determinations you have to make.

After Hurricane Floyd in 1999, the City of Conway, South Carolina, used FEMA's Residential Substantial Damage Estimator software and the help of building officials from other communities to assess the condition of over 100 flooded buildings. The findings were plotted on a map and reviewed by a citizen's mitigation planning committee. Within two weeks of the flood, a mitigation plan was drafted and reviewed at a public meeting. It drew broad support and formed the basis for funding that purchased 18 homes and converted the lots to public open space.

Because substantial damage is not always readily visible, all flooded buildings must be inspected to determine if they can be repaired. This house in Conway, South Carolina, was "red-tagged" after the inspection concluded that it was substantially damaged. It was later acquired with help from FEMA mitigation funds.

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Requiring permits, conducting inspections, and enforcing your community's substantial damage regulations can be very difficult for understaffed and overworked offices after a disaster. However, if these activities are not carried out properly, not only would your community miss a tremendous opportunity to redevelop or clear out a hazardous area, it may be violating its obligations under the NFIP and/or cause additional damage.

Having **mitigation funding** to help property owners bring their buildings into compliance can help tremendously. Funds from FEMA's Hazard Mitigation Grant Program (HMGP) may be made available after a disaster declaration. Each year, FEMA's Flood Mitigation Assistance (FMA) program gives your state cost-share funding to acquire and clear flooded properties.

Another, and potentially larger, source of post-flood mitigation funding is the **Increased Cost of Compliance** (ICC) provision in the standard flood insurance policy. When an insured building is damaged by a flood and your permit office declares the building to be substantially or repetitively damaged, ICC will help pay for the cost to elevate, floodproof, demolish or relocate the building up to a maximum of $30,000 (limit established May 1, 2003). This coverage is in addition to the building coverage for the repair of actual physical damage from the flood.

An ICC claim can be filed whether or not your community has received a Presidential disaster declaration. The funds can also count toward the non-FEMA match for HMGP and FMA mitigation grants.

> Rock Island, Illinois, has used strict enforcement of cumulative damage to elevate dozens of repetitive loss properties in the floodplain of the Mississippi River. ICC had the added benefit of providing financial assistance relatively quickly compared with other traditional mitigation programs, plus it allowed local officials to encourage at-risk structures to be rebuilt in compliance with local regulations.

As with pre-disaster floodplain management and mitigation plans, incorporating multi-objective management (M-O-M) and **sustainability principles** will improve your community in the long run and will bring more and broader support in the short run. *Holistic Disaster Recovery—Ideas for Building Local Sustainability after a Natural Disaster* is a new publication that can help you with this approach (see page 81).

For More Information

- Talk to your local emergency manager to see if the disaster response plan has a true flood preparedness element.
- ASFPM publication, *Mitigation Planning Guidebook* , 1994 and 1997.
- Visit the National Weather Service website, **www.nws.noaa.gov** and USGS site **www.usgs.gov/themes/factsheet/093-99/usreal.html**. You can surf through the pages to find things like river gages near your community.

- The National Hydrologic Warning Council is an association of community officials who have established their own flood threat recognition systems. **www.udfcd.org/Nhwc/nhwc.htm**.
- *CRS Credit for Flood Warning Programs*, FEMA, 2002.
- Your building department or association of building officials may have mutual aid agreements or support that can be provided by other communities after a disaster. They may also have model post-disaster building inspection procedures.
- *Answers to Questions about Substantially Damaged Buildings*, FEMA 213 (3-0164). 1991. **www.fema.gov/hazards/floods/lib213.shtm**.
- Coming Soon! FEMA's *Residential Substantial Damage Estimator* software can help determine whether buildings are substantially damaged. **www.fema.gov/fima/floodplain_new.shtm**.
- *Repairing Your Flooded Home*, FEMA 234 (3-0178). 1992, provides guidance on flood protection measures that can be taken during repairs. **www.fema.gov/hazards/floods/lib234.shtm**, Bulk quantities may be available through the FEMA Publications Center.
- *Planning for Post-Disaster Recovery and Reconstruction*, American Planning Association and Federal Emergency Management Agency, PAS Report No. 483/484. 1998. This report contains planning and administrative tools that can be used to facilitate recovery that integrates mitigation and other planning goals, and includes a model ordinance. To order: **www.planning.org/store/**.
- Check with your state emergency management office on mitigation funding sources and prerequisites
- For more information on Increased Cost of Compliance Coverage see **www.fema.gov/nfip/icc.shtm**.
- *Holistic Disaster Recovery—Ideas for Building Local Sustainability after a Natural Disaster*, Natural Research and Applications Information Center, University of Colorado, 2001. To order, call the Center at 303/492-6818. For more information visit: **www.colorado.edu/hazards**.

Toolkit Matrix

This matrix lists the various tools that are discussed in this book. They are arranged under the seven "building blocks" that form the seven chapters, along with the page where each can be found in this Toolkit. The next column ("CRS") is the section in the Community Rating System's *Coordinator's Manual* where more information can be found.

The last three columns identify whether help is available from the State NFIP Coordinator, the State emergency management agency and FEMA. Additional sources of assistance are noted in the "For more information" sections at the end of each chapter.

Building Block/Tool	Toolkit Page #	CRS Section #	Source of Help		
			State NFIP	State EMA	FEMA
Hazard Identification					
Filling the data gaps					
Detailed data in approximate A Zones	16	411.a	X		X
Detailed data in X Zones	16	411.a	X		
Better base map	16	441.a	X		
Cooperating Technical Partner	17	411.f	X		X
Mapping other flood-related hazards	17	411.e	X		X
Higher mapping criteria					
Future conditions hydrology	20	411.b	X		
More restrictive floodway standard	20	411.c	X		
Prevent loss of storage/increase in velocity	21			X	
CTP cost-sharing on studies	22	410.f	X		X
Education and Outreach					
Outreach Projects					
Provide FIRM information	25	321	X		

Building Block/Tool	Toolkit Page #	CRS Section #	Source of Help		
			State NFIP	State EMA	FEMA
Map information on websites	25	321	X		
Additional flood data	26	361.a	X		
Outreach projects	26	331	X		X
Libraries	26	351.a			
Handbooks and Publications	26		X	X	X
Resources on websites	26	351.c	X	X	X
Flood protection advice	27	361	X		X
Education					
Staff training	27	431.n	X		X
Certified Floodplain Manager program	27	431.n	X		
Educating decision makers	28		X	X	X
Environmental/safety education	28	331.c	X	X	
Planning					
Plans that address flooding					
Restrict damage-prone development	32	431LD	X		
Low density zoning	32	431LD			
Vulnerability analysis	32		X		X
GIS & HAZUS	33		X		X
Floodplain management plan	33	511.a	X		X
Stormwater management plan	33	451.b	X		
Hazard mitigation plan	34	511.a	X	X	X
MOM and sustainability					
Plans identify all impacts	34		X		

Building Block/Tool	Toolkit Page #	CRS Section #	Source of Help		
			State NFIP	State EMA	FEMA
Multi-objective management approach	36		X		
Plans incorporate sustainability concepts	36		X		
Regulations and Development Standards					
Higher Regulatory Standards					
Building Standards					
Freeboard	41	431.a	X		X
Foundation protection	42	43.b	X		X
Limits on enclosures	42	431.h	X		X
Cumulative substantial improvements	43	431.c	X		X
Lower substantial improvement threshold	43	431.d	X		
Protection of additions to buildings	43	431.c	X		
Building Code	44	431.m	X		
Building Code Effectiveness Grading Schedule	44	431.m			
Special hazard area regulations	44	431.k	X		
Mitigation Actions					
Nonstructural measures					
Relocation	59	521.a	X	X	X
Aquisition	59	521.a	X	X	X
Building elevation	60	531.a	X		X
Barriers	60	531.a	X		
Dry floodproofing	60	531.a	X		X
Wet floodproofing	61	531.a	X		X

Building Block/Tool	Toolkit Page #	CRS Section #	Source of Help		
			State NFIP	State EMA	FEMA
Master Planning					
Master flood protection planning	62	511.a	X		
Infrastructure					
Protection measures and procedures					
Corrective measures	67		X		X
Higher flood standards	67	431.i	X		
Flood audit	67		X		
Flood insurance	68		X		X
Drainage system maintenance procedures	69	541.a	X		
Critical facility flood audits	69		X	X	
Critical facility emergency action plans	69	611.c	X	X	
Plans and alternatives					
Capital improvements plans	69	541.a			
Park and open space acquisition	70	421.a	X	X	X
Greenway plans	70				
Green infrastructure	71	541.a			
Stream restoration	72				
Prohibiting new critical facilities in hazard areas	72	431.e	X		
Emergency Services					
Flood preparedness plan					
Flood threat recognition system	76	611.a	X	X	
Dam failure action plan	76	631.b	X	X	
Flood warning	76	611.b	X	X	

Building Block/Tool	Toolkit Page #	CRS Section #	Source of Help		
			State NFIP	State EMA	FEMA
Public information	76	331	X	X	
StormReady/TsunamiReady	77	611.e	X	X	
Flood response actions	77	611.c	X	X	
Flood stage forecast map	77		X	X	
Post-disaster preparedness					
Post-disaster mitigation procedures	79	511.c	X	X	X
Residential Substantial Damage Estimator	79				X
Mitigation funding	80		X	X	X
Increased Cost of Compliance	80		X		X
Sustainable principles during recovery	80		X		

Appendix A. The NFIP Community Rating System

Background: The objective of the NFIP Community Rating System is to reward communities for what they are doing, as well as to provide an incentive for new flood protection activities. The reward is a reduction in flood insurance premium rates. This is provided in the form of a CRS classification. There are 10 classes, as shown in this chart.

Credit Points	CRS Class	Credit		
		SFHA*	Non-AFHS*	A99/AR Zones
4,500+	1	45%	10%	10%
4,000 - 4,499	2	40%	10%	10%
3,500 - 3,999	3	35%	10%	10%
3,000 - 3,499	4	30%	10%	10%
2,500 - 2,999	5	25%	10%	10%
2,000 - 2,499	6	20%	10%	10%
1,500 - 1,999	7	15%	5%	5%
1,000 - 1,499	8	10%	5%	5%
500 - 999	9	5%	5%	5%
0 - 499	10	0	0	0%

CRS Classifications

*SFHA: Special Flood Hazard Area, the floodplain shown on the community's Flood Insurance Rate Map.

Community participation in the CRS is voluntary. To date, approximately 990 communities are participating as CRS class 9 or better.

The rating formulas, verification procedures, credit criteria and documentation requirements are described in more detail in the *CRS Coordinator's Manual*. The *CRS Application* discusses only the procedures, scoring and documentation that is needed for an initial application.

Application: To apply, a community submits documentation that shows what it is doing and that its activities deserve at least 500 points. The documentation is attached to the appropriate worksheet pages in the *CRS Application*.

The application is submitted to the ISO/CRS Specialist. The ISO/CRS Specialist is an employee of the Insurance Services Office, Inc. (ISO). ISO works on behalf of FEMA and the insurance companies to review CRS applications, verify the communities' credit points and perform program improvement tasks.

No fee is charged for a community to apply for participation in the CRS. All CRS publications and software are available at no cost by calling 317/848-2898 or e-mailing to NFIPCRS@iso.com.

Verification: The ISO/CRS Specialist reviews the community's application documents to confirm that there are enough credit points to warrant a Class 9 or better. If so, a verification visit is scheduled.

During the visit, the community's program is reviewed in detail and verified both in the office and in the field. ISO submits the findings to FEMA.

FEMA sets the credit to be granted and notifies the community, the state, insurance companies and other appropriate parties. The community's CRS classification takes effect on either May 1 or October 1.

Recertification: Each year the community must recertify that it is continuing to perform the activities that are being credited by the CRS. Recertification is an annual activity that includes copies of projects conducted during the year, progress reports and similar items that document continued implementation of the credited activities. At least once every five years, the community must also verify its program again.

Community Responsibilities: As part of its application, the community's Chief Executive Officer (CEO) must designate a staff person as the CRS Coordinator. The Coordinator is the point of contact for FEMA and the ISO/CRS Specialist on CRS matters.

The CRS Coordinator should be someone familiar with the operation of all community departments that implement the credited activities.

Specifically, a community is responsible for:

- designating its CRS Coordinator,
- cooperating with the ISO/CRS Specialist and the verification procedures,
- continuing to implement its credited activities,
- recertifying each year that it is continuing to implement its activities,
- submitting the appropriate documents with its recertification,
- advising FEMA of modifications in its activities,
- maintaining elevation certificates, other permit records and old Flood Insurance Rate Maps forever, and
- maintaining other records of its activities until the next verification visit.

Communities will receive periodic updates to the *CRS Coordinator's Manual* and other CRS materials. They are encouraged to order other background publications, attend CRS workshops, and ask their ISO/CRS Specialists for help in understanding the CRS credit criteria for their current and planned activities.

CRS Activities: There are 18 floodplain management activities credited by the Community Rating System, organized under four series as shown in the box to the right.

Activity 310 (Elevation Certificates) is required of all CRS communities. Designated repetitive loss communities have additional responsibilities. The rest of the 18 activities are optional.

Communities should undertake activities that deal with their particular flood problems, regardless of whether they are credited by the CRS. Communities with good floodplain management programs may already be implementing several activities that deserve CRS credit.

The CRS welcomes innovative ways to prevent or reduce flood damage. Communities that are implementing floodplain management activities not listed in the *CRS Application* or the *CRS Coordinator's Manual* are encouraged to request a review to determine if they should be credited.

In a number of states with better state standards, all communities automatically qualify as class 9 or better because of state requirements for floodplain regulations, dam safety, building codes, etc.

Why Apply?

When your community participates in the CRS, everyone benefits. Even if you don't live or own property in a floodplain, your community's public information and floodplain management efforts can improve the quality of life, make people safer and save everyone money.

CRS Activities

300 Public Information Activities
- 310 Elevation Certificates
- 320 Map Information
- 330 Outreach Projects
- 340 Hazard Disclosure
- 350 Flood Protection Information
- 360 Flood Protection Assistance

400 Mapping and Regulatory Activities
- 410 Additional Flood Data
- 420 Open Space Preservation
- 430 Higher Regulatory Standards
- 440 Flood Data Maintenance
- 450 Stormwater Management

500 Flood Damage Reduction Activities
- 510 Floodplain Management Planning
- 520 Acquisition and Relocation
- 530 Flood Protection
- 540 Drainage System Maintenance

600 Flood Preparedness Activities
- 610 Flood Warning Program
- 620 Levee Safety
- 630 Dam Safety

Not only do CRS activities save money, they protect the environment and improve the quality of life in your community - even when there's no flood. For example, when your community preserves open space in the floodplain, you get to enjoy the natural beauty of the land.

If there is a flood, CRS activities:

- Save lives;
- Prevent property damage;
- Avoid lost jobs and economic devastation caused by flooding of offices, factories, farms, stores, and other businesses; and
- Prevent damage and disruption to roads, schools, public buildings, and other facilities.

To earn CRS credit, your community can do things like:

- Preserve open space in the floodplain;
- Enforce higher standards for safer new development;
- Maintain drainage systems; and
- Inform people about flood hazards, flood insurance and how to reduce flood damage.

Your community is probably already doing many of these things. To get credit, you simply prepare an application showing what's being done. Once the information is verified, FEMA provides the flood insurance premium discounts. The amount of your discount depends on what your community does.

CRS Publications: The CRS Application provides summary information that is spelled out in more detail in the CRS Coordinator's Manual. Additional guidance is provided in other publications.

CRS publications can be downloaded from **www.fema.gov/nfip/crs.shtm** or ordered at no cost by contacting NFIPCRS@iso.com or calling 317/848-2898.

National Flood Insurance Program: Community Rating System (NFIP/CRS) B Coordinator's Manual, FEMA, 2002. The manual contains detailed information about CRS requirements and credits for a variety of floodplain management activities.

CRS Application, 2002. Instructions and worksheets for a community to apply for an initial CRS classification. The activities are summarized and the activity descriptions are combined with checklists which are submitted for application.

The National Flood Insurance Program's Community Rating System. These are several color brochures that summarize the CRS for distribution to elected officials, residents and others who want an overview of the program.

There are eight CRS publications on the special flood-related hazards that are listed on pages 18–19 that can also be ordered free from the office listed above. Additional CRS publications listed in the "For more information" sections include:

CRS Credit for Drainage System Maintenance

CRS Credit for Flood Warning Programs

CRS Credit for Outreach Projects

CRS Credit for Higher Regulatory Standards

CRS Credit for Stormwater Management

Example Plans

For More Information

Contact the ISO/CRS Specialist for your state.
Contact NFIPCRS@iso.com or call 317/848-2898 for his or her name and number.

Appendix B. Additional Resources

Contacts

The **Association of State Floodplain Managers** provides training and references on a variety of floodplain management topics (see publications list below and on the next page). Check the website, **www.floods.org**, for the latest information.

The current list of **State NFIP Coordinators** can be found at the ASFPM website **www.floods.org**. Many of these offices have state specific floodplain management manuals for local officials in hard copy or web available.

FEMA headquarters and regional offices can be located at **www.FEMA.gov**.

Several states and regions have formed associations for floodplain managers. These provide training, newsletters, conferences and other activities that can help bring the NAI message closer to home. For more information about an association for your state, contact your State NFIP Coordinator or check the ASFPM website, **www.floods.org** and click on State Contacts.

No Adverse Impact Publications

*Unless otherwise noted, these can be ordered from ASFPM at **www.floods.org** or by calling 608/274-0123.*

A variety of NAI publications and reports can be found on the ASFPM website, **www.floods.org**, including:

"No Adverse Impact White Paper", February 2002. This 2 page paper is a brief explanation of the principles of NAI, why it is important for communities to consider, and its benefits.

"No Adverse Impact: A New Direction in Floodplain Management Policy," Larry Larson and Doug Plasencia, Natural Hazards Review, November 2001.

No Adverse Impact: A Common Sense Strategy for Protecting Your Property, 2000. A full color, four-page tabloid style publication aimed at educating the public and local officials, includes examples from local programs. Single copy $1, Bulk orders 50¢ each.

No Adverse Impact Status Report: Helping Communities Implement NAI, ASFPM, June, 2002. This 16 page report explains how to incorporate NAI into ongoing, everyday community activities and provides detailed information on five community efforts, showing how they incorporated NAI.

No Adverse Impact: A Common Sense Approach for Community-Based Development, ASFPM, June 2002. This poster displays an image of what NAI "looks like" in a generic community. It also lists the activities that communities can implement to support the NAI concept.

ASFPM Publications

Addressing Your Community's Flood Problems: A Guide for Elected Officials, Association of State Floodplain Managers, ASFPM, 1996. This booklet provides a good explanation of why planning is needed, along with recommendations and first person testimonials. It is excellent background reading for elected officials.

Mitigation Success Stories. There are currently four books in this series profiling great local examples of flood hazard mitigation. Available free in Adobe .pdf format at **www.floods.org**.

The Nation's Responses to Flood Disasters: A Historical Account, 2000, ASFPM, 2000. A history of the forces and events that have changed floodplain management in the U.S. during the past 150 years.

Floods, Floodplains and Folks, 1996. Features 19 multi-objective project descriptions by the National Park Service, ASFPM, Association of State Wetland Managers and FEMA.

Using Multi-Objective Management to Reduce Flood Losses in Your Watershed. Prepared for the U.S. Environmental Protection Agency by ASFPM.

Federal Publications

Throughout this Toolkit are numerous references to publications from FEMA and the Corps of Engineers. **They can be ordered from the following offices:**

FEMA publications are available free by calling 1-800-480-2520. See also FEMA's publications website at **www.fema.gov/library/publicat.shtm** or go to **www.fema.gov** and scroll to Library.

Corps of Engineers flood protection publications can be found on the following website: **www.usace.army.mil/inet/functions/cw/cecwp/NFPC/nfpc.htm**.

Hard copies can be ordered from:
U.S. Army Corps of Engineers, Tulsa District
Flood Plain Management Services
1645 South 101st East Avenue
Tulsa, OK 74128
918-669-7197 Fax: 918-669-7546

Appendix C. Legal Questions and Answers

COMMON LEGAL QUESTIONS ABOUT FLOODPLAIN REGULATIONS IN THE COURTS 2003 UPDATE

Prepared by Jon A. Kusler, Esq.

for the

Association of State Floodplain Managers

Preface

This summary was prepared for the Association of State Floodplain Managers (ASFPM) by Jon Kusler, Esq., Associate Director of the Association of State Wetland Managers. Preparation involved a review of the legal literature on floodplain regulations as well as the last 15 years of federal and state case law concerning floodplain regulations. Detailed reviews of cases from the period 1960–1990 were prepared by Kusler in an earlier document.

Acknowledgements

Edward A. Thomas, Esq. provided extensive review of this document. Funding was provided by The McKnight Foundation and the ASFPM Foundation. Opinions expressed in the document are those of the authors and do not necessarily reflect the view of the sponsoring organizations.

COMMON LEGAL QUESTIONS

Have courts continued to uphold the overall constitutionality of state and local floodplain regulations?

Yes. Courts at all levels, including the U.S. Supreme Court, have broadly and repeatedly upheld the general validity of floodplain regulations in the last 15 years. They have, however, held regulations unconstitutional as "takings" of private property in several cases where certain regulations, not clearly based on principles of hazard prevention or "no adverse impact," denied all economic use of lands, Lucas v. South Carolina Coastal Council, 505 U.S. 1003 (1992) or permitted the public to enter private property, Nollan v. California Coastal Commission, 483 U.S. 825 (1987); Dolan v. City of Tigard, 512 U.S. 374 (1994).

Does general validity mean that regulations are valid for all properties?

No. A landowner may attack the constitutionality of regulations as applied to his or her property even where regulations in general are valid. Regulatory agencies need to be able to support the validity of the regulations as applied to particular properties. However, the overall presumption of validity for regulations and a presumption of correctness for regulatory agency information gathering and regulatory decisions help the agency meet its burden of proof. Courts have broadly supported state and local floodplain regulations as applied to particular properties. A court decision that regulations are unconstitutional as applied to specific property will not necessarily determine site-specific constitutionality or unconstitutionality as applied to other properties.

Has judicial support for floodplain regulations weakened in recent years?

No. Quite the contrary. The U.S. Supreme Court has recently issued a series of opinions strongly endorsing planning to prevent damage from hazardous development. State courts continue to strongly uphold floodplain regulations in the more than 125 appellate cases over the last decade, including many challenges to regulations as "takings" of private property. See, for example:

- Beverly Bank v. Illinois Department of Transportation, 579 N.E.2d 815 (Ill. 1991), in which the court held that the Illinois legislature had the authority to prohibit the construction of new residences in the 100-year floodway and that a taking claim was premature.
- State of Wisconsin v. Outagamie County Board of Adjustment, 532 N.W.2d 147 (Wis. App., 1995), in which a variance for a replacement fishing cottage in the floodway of the Wolf River was barred by the county's shoreland zoning ordinance.
- Bonnie Briar Syndicate, Inc. v. Town of Mamaroneck, et al., 94 N.Y. 2d 96 (N.Y., 1999), in which the court rejected the claim that the rezoning of a 150-acre golf course property important for flood storage from "residential" to "solely recreational use" was a taking of private property.
- Wyer v. Board of Environmental Protection, 747 A.2d 192 (Me., 2000), in which the denial of a variance to sand dune laws was held not to be a taking because the property could be used for parking, picnics, barbecues, and other recreational uses.

At the same time there is a national movement, referred to by some commentators as the "property rights movement," which supports landowners who challenge regulations. Courts are examining floodplain regulations with greater care than they did a decade ago.

What have been the most common challenges to regulations in the last 15 years?

The most common challenges to regulations have been claims that regulators permitted construction that later caused harm. There are dozens of cases that allege damage caused by development that caused problems. On the other hand, there are very few cases that allege unconstitutional over-regulation of property. Those few include:

1) challenges to floodway regulations and floodway restrictions; 2) coastal dune and high hazard area restrictions, and buffer and setback requirements; and 3) variances and regulations for nonconforming uses. Generally speaking, courts have broadly upheld these hazard prevention restrictions against claims that they take private property without payment of just compensation, have been adopted to serve invalid goals, are unreasonable (lack adequate nexus to goals) or discriminate.

May local governments regulate floodplains without express statutory authority to do so?

Yes. Courts have upheld local floodplain zoning regulations adopted as part of broader zoning. Courts have also, in some cases, upheld local floodplain ordinances adopted pursuant to "home rule" powers. But this is rarely an issue since states have broadly authorized local governments to adopt floodplain regulations.

May a local government adopt floodplain regulations that exceed State or Federal (National Flood Insurance Program) minimum standards?

Yes. Local government regulations may exceed both state and federal regulations. There is no preemption issue. The National Flood Insurance Program regulations specifically encourage state and local regulations that exceed federal standards (see 44 CFR §60.1(d)).

May states and local governments regulate some floodplains and not others?

Yes. Typically states and local governments only regulate mapped floodplains.

Are the factual determinations of federal, state, or local floodplain regulatory agencies (e.g., mapping of floodways and flood fringe boundaries) presumed to be correct?

Yes. The burden is on landowners to prove their incorrectness. Courts overturn agency fact-finding only if they find that such fact-finding lacks "substantial evidence." Courts are particularly likely to uphold factual determinations of federal and state "expert" agencies. However, courts look more closely at the adequacy of the information-gathering in instances where regulations have severe economic impact on specific properties.

How closely must regulatory standards (including conditions) be tailored to regulatory goals?

Courts have broadly upheld floodplain and other resource protection regulations against challenges that they lack reasonable nexus to regulatory goals. But, as indicated above, courts have required a stronger showing of nexus where regulations have essentially extinguished all value in the property. They also increasingly require a showing that conditions attached to regulatory permits are "roughly proportional" to the impacts posed by the proposed activity if dedication of lands is involved, see Nollan v. California Coastal Commission, 483 U.S. 825 (1987); Dolan v. City of Tigard, 512 U.S. 374 (1994).

Must a regulatory agency accept one mapping or other flood analysis method over another?

No. Not unless state or local regulations require the use of a particular method. Courts have afforded regulatory agencies considerable discretion in deciding which scientific or engineering approach to accept in fact-finding as long as the final decision is supported by "substantial" evidence. Also, courts have held that regulatory agencies do not need to eliminate all uncertainties in fact-finding.

Does an agency need to follow the mapping, floodway delineation or other technical requirements set forth in its enabling statute or regulations?

Yes. Agencies must comply with statutory, administrative, regulatory and ordinance procedural requirements. They must also apply the permitting criteria contained in statutes and regulations.

Are floodplain and floodway maps invalid if they contain some inaccuracies?

No. Courts have upheld maps with some inaccuracies, particularly if there are regulatory procedures available for refining map information on a case-by-case basis.

Can landowners be required to carry out floodplain delineations on impacts of proposed activities on flood elevations or provide various types of floodplain assessment data?

Yes. Courts have held that regulatory agencies can shift a considerable portion of the assessment burden to landowners and that the amount of information required from a landowner may vary depending upon the issues and severity of impact posed by a specific permit. And, agencies can charge reasonable fees for permitting. But the burdens must be reasonable and courts may consider the costs of such data gathering to be relevant to the overall reasonableness of regulations and whether a taking has occurred.

May a regulatory agency be liable for issuing a regulatory permit for an activity that damages other private property?

Yes, quite possibly. In fact a careful analysis of hundreds of cases in which the lawsuit involved permitting indicates that a municipality is vastly more likely to be sued for issuing a permit for development that causes harm than for denying a permit based on hazard prevention or "no adverse impact" regulations. The likelihood of a successful lawsuit against a municipality for issuing a permit increases if the permitted activity results in substantial flood, erosion or other physical damage to other private property owners. However, some states specifically exempt state agencies and local governments from liability for issuing permits.

Do local governments need to adopt comprehensive land use plans before adopting floodplain regulations?

Statutes authorizing local adoption of floodplain ordinances and bylaws do not require prior comprehensive planning. However, many local zoning enabling acts require that

zoning regulations be in accord with a comprehensive plan. Traditionally courts have not strictly enforced this requirement and have often found a "comprehensive plan" within the zoning regulations.

Courts have also endorsed comprehensive planning and regulatory approaches as improving the rationality of regulations although they have also upheld regulations not preceded by such planning in many instances.

Under what circumstances is a court most likely to hold that floodplain regulations "take" private property?

Courts are likely to find a "taking" in circumstances where: 1) the regulation is not clearly based on hazard prevention or "no adverse impact;" 2) regulations deny all "reasonable" economic uses of entire properties, that is, the value of the property is reduced to zero or very near zero; or 3) proposed activities will not have offsite "nuisance" impacts. Landowners are also more likely to succeed if the property owner purchased the land before adoption of the regulations.

Are highly restrictive floodplain regulations, including buffers and large lot sizes, valid?

Courts have upheld highly restrictive floodplain regulations in many contexts, particularly where a proposed activity may have nuisance impacts on other properties. However, courts have also held floodplain regulations to be a "taking" without payment of compensation in a few cases (mostly older) where the regulations denied all economic use of entire parcels of land and there was no showing of adverse impact on other properties.

Would a no adverse impact performance standard incorporated in local or state regulations be sustained by courts?

Yes. Courts are very likely to support this standard if it is reasonably and fairly applied and if government agencies take measures to avoid successful "takings" challenges where regulations deny all economic, non-nuisance-like uses for entire properties.

How can a local government avoid successful "takings" challenges?

Local governments can help avoid successful "takings" challenges in a variety of ways:

1. Apply a no adverse impact floodplain management performance standard fairly and uniformly to all properties.

2. In local regulations, include special exception and variance provisions that allow the regulatory agency to issue a permit in instances where denial will deprive a landowner of all economic use of his or her entire parcel and the proposed activity will not have nuisance impacts.

3. For floodplain areas, adopt large-lot zoning, which permits some economic use (e.g., residential use) on the upland portion of each lot.

4. Allow for the transfer of development rights from floodplain to non-floodplain parcels.

5. Fairly tax and levy assessments based on what development will actually be allowed.

LEGAL QUESTIONS:

GOVERNMENT LIABILITY AND NO ADVERSE IMPACT FLOODPLAIN MANAGEMENT

Prepared by Jon A Kusler, Esq.

for the

Association of State Floodplain Managers

Preface

This question and answer summary concerning legal issues associated with no adverse impact floodplain management was prepared for the Association of State Floodplain Managers (ASFPM) by Jon Kusler, Esq., Associate Director of the Association of State Wetland Managers. It is based upon a larger paper with extensive case law citations, also prepared by Jon Kusler for the Association: No Adverse Impact Floodplain Management and the Courts. The summary and the larger paper are based upon review of the legal literature as well as Federal and state case law concerning floodplain regulations.

Acknowledgements

Edward A. Thomas, Esq. provided extensive review to this document. Funding was provided by the McKnight Foundation and the ASFPM Foundation. Opinions expressed in the document are those of the authors and do not necessarily reflect the view of the sponsoring organizations.

COMMON LEGAL QUESTIONS

In 2000, the Association of State Floodplain Managers recommended a "no adverse impact" approach or goal for local, State, and Federal floodplain management to help control spiraling flood and erosion losses, new development which increases flood risks and additional flood losses. The "no adverse impact" goal could also potentially be applied to environmental and other impacts, if a community chooses to do so. The "no adverse impact" goal is not intended as a rigid rule of conduct. Rather, it has been suggested as a general guide for landowner and community actions in the watersheds and the floodplains which may adversely impact other properties or communities. It also could be incorporated as an overall performance standard into community and State floodplain regulations.

What major legal issues are raised by no adverse impact floodplain management?

Two major sets of legal issues arise with no adverse impact floodplain management.

1) **Can no adverse impact floodplain management reduce community liability for flooding and erosion problems?**

2) **Will a community that is adopting floodplain regulations incorporating a no adverse impact standard be subject to liability for taking private property or be subject to other successful legal challenges?**

These questions will be discussed individually in the following pages.

1) CAN NO ADVERSE IMPACT FLOODPLAIN MANAGEMENT REDUCE COMMUNITY LIABILTY FOR FLOODING AND EROSION?

Legally, no adverse impact floodplain management can reduce community liability for flood and erosion losses. More specific issues pertaining to this overall conclusion include the following:

Are successful suits against local governments for increasing flooding and erosion growing more common?

When individuals are damaged by flooding or erosion, they often file law suits against governments or other individuals, claiming that the governments have caused the damages, contributed to the damages or, in some instances, failed to prevent or provide adequate warnings of natural hazards. Successful liability suits based upon natural hazards have become increasingly expensive to governments, not only because of the increasing damage awards but because of the attorney and expert witness fees which may exceed the damage award.

Successful liability suits of all types have increased in the last two decades for several reasons:

- A growing propensity to sue on the part of individuals damaged by flooding or erosion (historically, members of society were more willing to accept losses from a broad range of causes).
- Large damage awards and the willingness of lawyers to initiate suits on a contingent fee basis.
- Propensity of juries to view governments as having "deep pockets".
- Expanded concepts of liability.
- Abrogation or modification of sovereign immunity in most jurisdictions.

- Uncertainties with regard to the legal rules of liability and defenses (e.g., “Act of God”) due to the evolving nature of the body of law and the site-specific nature of many tort actions.
- Limitation of the "Act of God" defense because most hazards are now foreseeable.
- Hazards are now, to a greater or lesser extent, "foreseeable" and failing to take such hazards into account may constitute negligence. See, e.g., Barr v. Game, Fish, and Parks Commission, 497 P.2d 340 (Col., 1972.)
- Advances in hazard loss reduction measures (e.g., warning systems, elevating structures) create an increasingly high standard of care for reasonable conduct.
- Advances in natural hazard computer modeling techniques, which can be used to establish causation.
- Reduction in the defenses of contributory negligence and assumption of risk.

All levels of government, Federal, State and local, may now be sued for negligence, nuisance, breach of contract or the "taking" of private property without payment of just compensation under certain circumstances, although vulnerability to suit varies.

In what situations are governmental units liable for increasing flood or erosion damages on private lands?

Courts have commonly held governments liable for increasing flood and erosion damages on private property by blocking natural drainage through grading, fill, culverts, bridges or structures; increasing the location and amount of runoff through channelization or drainage works; or constructing flood control works such as levees and dams. Courts have often held governmental units liable for inadequately maintaining or operating culverts, bridge crossings, channelization projects, and dams. Some courts have also held local governments liable for issuing permits and approving subdivisions which increase flood damages on other lands and for inadequate inspections. Courts have held governmental units liable under a variety of legal theories including riparian rights, nuisance, trespass, negligence, strict liability and “taking” private property without payment of just compensation.

Can a governmental unit protect itself from liability by arguing “sovereign immunity”?

The sovereign immunity defense has been dramatically reduced by the courts and legislatures in most states. In addition, sovereign immunity is not a defense to a “takings” claim.

Can a governmental unit protect itself from liability by arguing an “Act of God”?

Increasingly, no. To successfully establish an “Act of God” defense, a governmental unit must prove that a hazard event is both large and unpredictable. This is increasingly difficult because hazard events are at least partially foreseeable.

Will a governmental unit be protected from liability by following regulatory guidelines or using "standard" engineering approaches for flood and erosion control?

Not necessarily. A court may hold that a "standard" approach is not reasonable in the circumstances as technologies improve and the standard of care in floodplain management increases.

May a governmental unit be held liable for failing to reasonably operate and maintain flood loss reduction measures such as channels, levees, dikes and warning systems?

Yes. Courts often hold governmental units liable for inadequate operation or maintenance.

May a governmental unit be held liable for issuing permits for development or approving a subdivision which increases flood or erosion damages on other lands?

Yes, in some but not all states.

May a governmental unit be held liable for failing to remedy a natural hazard on public lands which damages adjacent private lands?

Perhaps. Courts have, with only a few exceptions, not held governmental units and private individuals responsible for naturally occurring hazards on public lands such as stream flooding or bank erosion that damage adjacent lands (e.g., erosion, flooding). However, they are liable if they increase the hazards. In addition, a small number of courts have held that government entities may need to remedy hazards on public lands which threaten adjacent lands.

Do governmental units have discretion in determining the degree of flood and erosion protection provided by flood and erosion reduction works?

Yes. Courts have held that the degree of protection provided by hazard reduction measures is discretionary and not subject to liability. However, courts have held governmental units responsible for lack of care in implementing hazard reduction measures once a decision has been made to provide a provide a particular degree of protection.

2) WILL FLOODPLAIN REGULATIONS INCORPORATING A NO ADVERSE IMPACT STANDARD BE SUSCEPTIBLE TO A "TAKINGS" OR OTHER CONSITUTIONAL CHALLENGE?

No. Courts are likely to provide strong support for a no adverse impact regulatory performance standard approach. However, no adverse impact regulations are subject to the same overall U.S. Constitution requirements as other regulations. These include the requirements that regulations be adopted to serve valid goals, be reasonable, not discriminate and not take private property without payment of just compensation. No adverse impact regulations are particularly likely to be supported

because they apply a regulatory goal which is well established in common law and in regulatory programs.

Will courts support a no adverse impact goal?

Yes. Courts have broadly endorsed floodplain management goals and no adverse impact is an extension of such goals. No adverse impact codifies the maximum which has been broadly endorsed by courts, "Sic utere tuo ut alienum non laedas," or "so use your own property that you do not injure another's property." See Keystone Bituminous Coal Association v. DeBenedictis, 107 S. Ct. 1232 (1987) and many cases cited therein. See, for example, Hagge v. Kansas City S. Ry Co., 104 F. 391 (W.D. Mo., 1900) (Court held that damage done to land by occasional overflow of a stream caused by a railroad was a nuisance.)

Will courts support the reasonableness of no adverse impact standards?

Yes. Courts have already supported a variety of more specific standards such as increased freeboard requirements and no rise floodways.

May a local government adopt floodplain regulations which exceed State or Federal (FEMA) minimum standards.?

Yes. Local governments regulations may exceed both State and Federal regulations. There is no preemption issue. In fact, the FEMA program encourages State and local regulations to exceed Federal standards through the Community Rating System.

May governmental units be held liable for uncompensated "takings" if they require that private development be elevated or floodproofed?

No. Courts have broadly and universally supported floodplain regulations against "takings" challenges. Courts have broadly held that regulations may substantially reduce property values without "taking" private property.

May governmental units be held liable for refusing to issue permits in floodway or high risk erosion areas because proposed activities will damage other lands?

No. In general, landowners have no right to make a "nuisance" of themselves. Courts have broadly and consistently upheld regulations which prevent one landowner from causing a nuisance or threatening public safety.

What can governments do to reduce the possibility of a successful "takings" challenge to regulations?

Local governments can help avoid successful taking challenges in a variety of ways:

1. Apply a no adverse impact floodplain overall performance standard fairly and uniformly to all properties.

2. Include special exception and variance provisions in regulations which allow the regulatory agency to issue a permit where denial will deny a landowner all economic use of his or her entire parcel and the proposed activity will not have nuisance impacts.

3. Adopt large lot zoning for floodplain areas which permits some economic use (e.g., residential use) on the upland portion of each lot.

4. Allow for the transfer of development rights from floodplain to non-floodplain parcels.

5. Reduce property taxes and sewer and water levees on regulated floodplains.