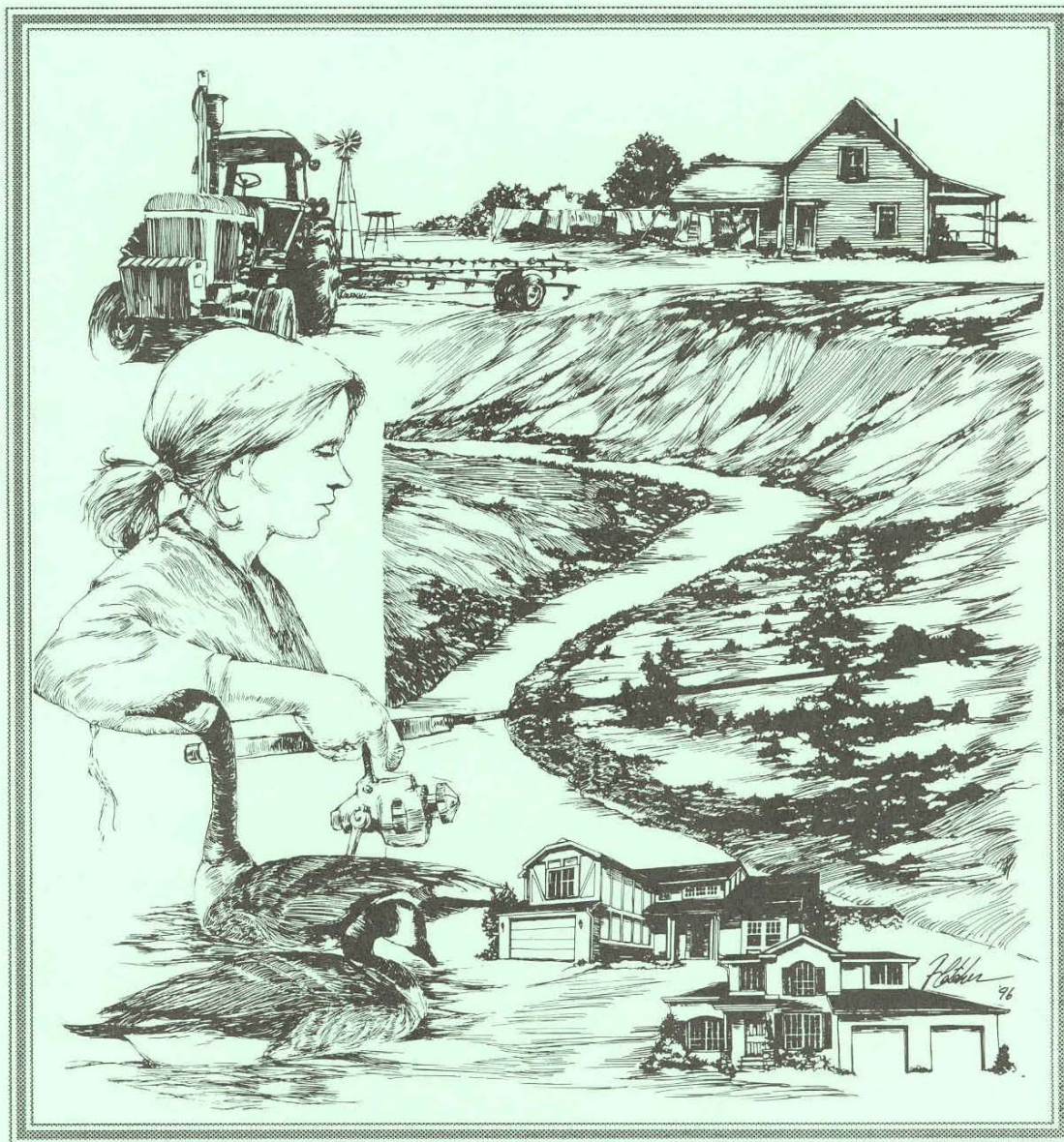


Using Multi-Objective Management to Reduce Flood Losses in Your Watershed



Prepared by the **Association of State Floodplain Managers, Inc.**
for the **U.S. Environmental Protection Agency**
1996

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This guidebook is a general introduction to multi-objective management and the planning process that helps a community select the flood loss reduction measures most suitable for its situation. To determine the best measures for specific sites, a community should obtain additional guidance from engineers, planners, emergency managers, and other professionals experienced in flood loss reduction.

Cover art by Bob Fletcher, Arvada, Colorado

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Contents

Acknowledgments.....	iv
Executive Summary	v
1. Introduction.....	1
So You Have a Flood Problem.....	1
What is M-O-M?	1
Why use M-O-M?.....	2
How to Use This Guide.....	3
2. Understanding Your Watershed.....	5
Riverine Flooding.....	5
Coastal Flooding.....	8
Other Flood Hazards.....	9
What Information Do You Need?	10
3. Flood Loss Reduction Measures.....	13
Prevention.....	13
Property Protection.....	19
Emergency Services.....	21
Structural Projects.....	23
4. M-O-M Opportunities.....	25
Recreation.....	25
Fish and Wildlife.....	27
Water Supply.....	29
Water Quality.....	31
Urban Redevelopment.....	32
Economic Development.....	33
Housing Improvement.....	34
Agriculture.....	36
Historic Preservation.....	38
Education.....	39
Transportation and Infrastructure.....	42
5. Preparing a M-O-M Plan.....	45
Organize.....	45
Involve Other Local People.....	47
Involve Agencies and Organizations.....	48
Define the Problems.....	50
Agree on Goals and Objectives.....	52
Review Alternatives and Select the Best Ones.....	53
Prepare a Written Document.....	55
Get Public and Official Acceptance.....	56
Implement and Follow Through.....	57
Appendix A. National Agencies and Organizations.....	A-1
Appendix B. References.....	B-1
Appendix C. Terms and Acronyms.....	C-1

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Executive Summary

This guidebook was written for citizens and local officials who have a flood problem but have not yet found a solution. It capitalizes on the realization that the traditional, single-issue approach to flood protection has not always been efficient or effective, and can take years to implement. Furthermore, people pursuing single issues-like flood control-have often found themselves competing with other local interests and may increase related problems or create new ones.

This guidebook explains a proven approach to reduce flood losses and simultaneously address other community concerns. The approach is called “multi-objective management” or “M-O-M.” It succeeds because it coordinates flood loss reduction with other community needs and goals to develop a stronger, more comprehensive program.

There is nothing magical about the multi-objective management approach. The basic idea is to get together everyone with a concern or problem that has the potential to affect or be affected by the flood problem. It requires communication between different parties and it capitalizes on the technical and financial help that is already available from government agencies and private organizations.

There are six basic guidelines to the M-O-M approach:

- Keep your effort locally based.
- Understand your flood problem and its relationship to the watershed.
- Think broadly about possible solutions to reduce flood losses.
- Coordinate flood loss reduction with other community needs, plans, and activities.
- Obtain expert advice and assistance.
- Build a partnership by developing a plan.

There are four basic strategies for reducing flood losses, and each incorporates different measures that are appropriate for different conditions.

- Prevention measures like planning, land acquisition, and regulations help modify development on floodplains and watersheds to reduce susceptibility to flood damage. Preventive measures are usually administered by the building, zoning, planning, and/or code enforcement offices of your local government.
- Property protection measures are usually undertaken by property owners themselves. They include elevating a building, building small barriers, floodproofing, raising utilities, and buying insurance.
- Emergency services minimize the impact of a flood that is already happening. They are the responsibility of city or county emergency management staff and the operators of major or critical facilities. They include warnings and emergency response.
- Structural projects keep flood waters away from an area with a levee, reservoir, or other measure that controls the flow of water. Structural projects are usually designed by engineers and managed by public works staff.

The floodplain is not just a hazardous area. The floodplain, the watershed, wetlands, and other flood-related areas have many different uses, most of them beneficial to the community. The multi-objective management approach brings together the people and groups that have interests related to all these water-related uses. It helps reduce conflicts and increase the opportunities for mutual support. Your flood loss reduction measures become tools to meet other objectives, too. By allying yourself with these other interests, you gain longer-lasting, broader support for your common concerns.

The number and types of special interest groups and opportunities for cooperation will vary from community to community. The more common ones, covered in this guidebook, are:

- Recreation
- Fish and wildlife
- Water supply
- Water quality
- Urban redevelopment
- Economic development
- Housing improvement
- Agriculture
- Historic preservation
- Education
- Transportation and infrastructure.

There are literally hundreds of government agencies and programs, private clubs and other organizations, businesses, and individuals that can provide advice, assistance, and funding for flood loss reduction when it is combined with other activities. Some of them are: local, state, and federal agencies for parks, environmental protection, recreation, economic development, housing, engineering, conservation, planning, community affairs, or natural resources; neighborhood associations; conservation and outdoor groups (Izaak Walton League, Audubon Society, Boy and Girl Scouts, Ducks Unlimited, Trout Unlimited, The Nature Conservancy, The Land Trust Alliance); recreational businesses (marinas, sporting goods stores); local water departments and private water companies; farmers dependent on irrigation; industries and economic developers; chambers of commerce and business or manufacturers' organizations; garden clubs; Urban Land Institute; and the National Community Development Association.

A proper planning process is the key to determining what is best for your community and building consensus for what should be done. Planning is educational and it brings people together. And many state and federal programs require a plan as a prerequisite to providing you with assistance. Funding organizations want to know how their money fits into the community's goals. These are the basic steps for multi-objective planning:

- (1) Get organized.
- (2) Involve other local people and groups.
- (3) Contact agencies and organizations that have an interest or can provide advice and/or assistance.
- (4) Define the community problems.
- (5) Agree on goals and objectives for community planning and action.
- (6) Review alternatives to reduce flood losses and meet other needs.
- (7) Prepare a written document.
- (8) Get public and official acceptance of the plan.
- (9) Implement and follow through on the steps specified in the plan.

Success stories in this guidebook give examples of how other communities have used the M-O-M approach. Additional information can be found by contacting the agencies and organizations noted in Appendix A or by checking the references in Appendix B.

Chapter 1

Introduction

This guidebook is a general introduction to multi-objective management and the planning process that helps a community develop a flood loss reduction strategy most appropriate for its situation. It is for citizens and local officials who have a flood problem but have not yet found a solution.

So You Have a Flood Problem

A flood problem simply means that you are getting too much water where you don't want it. Because water does not respect property lines or city limits, in most cases the solutions to your flood problem will involve not just the people who suffered damage most recently, but rather the whole neighborhood, the entire community, and even the rest of the watershed.

It's hard to find a solution to a flood problem if you're using a single-minded approach. You may be the only one who cares about flooding, but you're certainly not the only person talking to City Hall about a problem or wanting to improve your neighborhood. There are other interests out there and if everyone focuses only on their own concerns, you are all really competing with each other.

This guidebook shows you a proven approach to reduce flood losses and simultaneously address other community concerns. It is called "multi-objective management" or "M-O-M." It succeeds because with it you build alliances with other interest groups in your area, use financial and other resources that already exist, and look at the whole watershed that affects your flooding problem.

In the end you will have coordinated flood loss reduction with some of the other goals and needs of your community. Your solutions to flooding will be more effective, more sensitive to the environment, have broader support, be part of a more comprehensive program, and accomplish more than one objective.

What is M-O-M?

There is nothing magical about the multi-objective management approach. The basic idea is to get together everyone with a concern or problem that has the potential to affect or be affected by the flood problem. It requires communication between different parties and it capitalizes on the help that is offered by government agencies and private organizations.

There are six basic guidelines to the M-O-M approach:

- (1) Keep your effort locally based. Your solutions must be acceptable to you, your neighbors, and others in the area. They must fit in with other local concerns and goals.
- (2) Understand your flood problem and its relation to the watershed. Your problem is not isolated. Neither is it limited to your stream or your

neighborhood. If you think in terms of the whole watershed (where the water comes from and where it goes), you will come up with more possible solutions and they will not cause problems for someone else. Chapter 2 covers understanding your flood problem and watershed.

- (3) Think broadly about possible solutions to reduce your flood problem. There are more ways to do things than conventional wisdom may suggest. Don't get locked into wanting a floodwall or other single-purpose project without first checking out all the alternatives. The basic ways of reducing flood losses are introduced in Chapter 3.
- (4) Identify the other community concerns and goals that could have a bearing on the flood problem. Get people who are interested in those other concerns to meet with you. Together, brainstorm the possible solutions that can reach more than one of your objectives. Chapter 4 discusses some of the issues (and the people and organizations behind them) that could be coordinated with flood loss reduction. Chapter 5 describes ways to help you and the others reach agreement and work together.
- (5) Obtain expert advice and assistance from government agencies and private organizations. Find out what financial assistance and advice are available. Don't put all your eggs in one basket and wait for that big "cure-all" project that may never be funded. There are literally hundreds of programs out there, you just have to pick them. The more commonly used ones are identified in Chapters 3 and 4. Their national contacts are listed in Appendix A.
- (6) Build a partnership among all the private and public groups and individuals you can enlist to work on the objectives. More minds and hands mean that better ideas will result, people will be more likely to follow through, and there will be more people to do the work. It will help if you follow a systematic process to develop a M-O-M plan. Preparing a written plan helps keep you all organized, clarifies your solutions, and formalizes everyone's participation. The planning process is described in Chapter 5.

Why Use M-O-M?

If you have a flood problem, you may ask "Why bother with this M-O-M stuff? Why not just stop the flooding?" This is not as easy as it sounds, especially if you are on a large river or the ocean. Structures to "stop" or control the floods can be very expensive to build and maintain; take a long time to plan, fund, and build; and can cost more than the value of the property they would protect. They may adversely affect other properties, the environment, and other people's plans for the area. As shown by the Mississippi River flood of 1993, they don't always work, especially if a flood is larger than was anticipated.

If you have only one objective—“stop the flooding”—you may spend a lot of time and money on your one problem and you may create more problems for other people. You will be competing with other communities that want funds for expensive structural projects. You will even be competing with others in your own community who have different goals in mind. The M-O-M approach helps you take charge of your future by looking at all the things your community needs and seeing how they can be combined with possible ways to reduce flood losses. You do not put all your eggs in one basket, you are less dependent on outside agencies, and you have more sources of funding and technical advice.

With M-O-M, you join forces with other people who are just as devoted to their goals—be they parks and recreation, economic development, tourism, or environmental education. You can all reach your objectives in a cheaper, faster, and less disruptive manner by using M-O-M. The M-O-M approach results in more permanent, less expensive flood loss reduction than trying to control the natural forces that cause floods.

One reason the M-O-M approach gets such good results is that, with M-O-M, you treat the river’s floodplain and its watershed as a resource. The floodplain need not be just a place with a flood hazard, it is also an area that is important to your community and to plant and animal life. The M-O-M process makes sure that flood projects don’t undermine other community objectives and the need to protect the natural environment.

Take the case of Kampsville, a town of 400 residents on the Illinois River (see box, next page). Its residents could have continued to endure flooding, waited for a flood control project that would not be built, or looked for alternative ways to reduce flood losses. They chose the third option, and it paid off during the 1993 flood.

AN EXAMPLE OF THE M-O-M APPROACH

You want farmers and subdivisions in the watershed to reduce the amount of runoff that goes to your stream. The Soil and Water Conservation District wants agricultural practices that reduce erosion and soil loss. An environmental group wants more wetlands preserved from development. And the parks department needs more open space to serve a growing population.

These other interests can help you: The farming practices promoted by the Soil and Water Conservation District will reduce runoff and sedimentation. Wetlands store water before it reaches the stream. The most productive wetlands and watershed storage areas can make very attractive and interesting parks and provide water quality benefits.

By identifying the concerns of others, you can find opportunities for the different groups to work together. You may not have the same goals, but you have common interests that can support each other.

How to Use This Guide

This guidebook is an overview of the multi-objective management approach as it relates to flood loss reduction. Chapters 2–5 cover the M-O-M approach in chronological order.

- Chapter 2 is about understanding your watershed and how your flood problem fits into it.

A M-O-M Success Story

After the town was flooded in 1979 and again in 1982, Kampsville, Illinois, residents and local officials decided they wanted to do something about this recurring problem. They knew that they were not going to stop the Illinois River from flooding and that to build a levee large enough would require removing many of the buildings they wanted to protect.

Therefore, they began a systematic planning process to review alternative ways to reduce flood losses. One of the first things they did was ask for help. The state floodplain management agency provided them with staff support. During a series of planning meetings, other agencies were invited to explain their ideas and tell how they could help. It soon became apparent that the best solution was to purchase and relocate the worst-hit buildings. Because this would leave the town with a large open area, folks started talking about what they would do with it. They were also concerned that they would lose some businesses when the flood-prone properties were bought out. During this process, they realized that they had to think about more than just flooding; they had to consider the future of their village and its economic base.

After that, they expanded their planning process to encompass other goals, including redeveloping the acquired area, designing a park, and building a base for tourism. The Village started sponsoring recreation activities, including an annual celebration that brings in hundreds of people. They now view the riverfront as a resource, not a problem area.

Kampsville received over \$1 million to buy 50 properties and convert flooded and dilapidated buildings to open space. The money was also used to elevate some buildings that were not flooded very deeply, to floodproof the water treatment plant, and to relocate the fire station. A new ferry landing and all-weather access into town were also built. In all, financial assistance was provided by three state agencies, two federal agencies, and the Village's largest employer.

Although it took almost 10 years to plan, fund, and complete, Kampsville's approach paid off during the 1993 Midwest flood. The town suffered some damage because flood waters exceeded the 100-year flood elevation. But Kampsville did not make the news because its damage was relatively minor compared to that of its neighbors.

- Chapter 3 covers the variety of flood loss reduction measures you will want to consider.
- Chapter 4 lists some other problems or needs your community may have and explains how they can relate to the watershed, your flood problem, or the solutions to your flood problem.
- Chapter 5 describes a process that uses a formal partnership to prepare a plan to achieve your and others' goals.

Throughout this guide there are references to government agencies and private organizations that can help you prepare or implement a M-O-M program. Their local offices can often be found in your phone book. Their national offices are listed in Appendix A. Remember, one of the key parts of the M-O-M approach is to ask for help—these programs are designed to provide that help. Appendix B lists references that can help you and your planning partners. Appendix C defines some common terms and acronyms used by flood specialists.

Chapter 2

Understanding Your Watershed

There are many types of flood problems. You could have overbank flooding from large rivers, coastal flooding during storms and hurricanes, flash flooding on small streams, basement flooding from sewer backups, or a combination of those. The first step in tackling your flood problem is understanding what causes it.

To begin, it is important to note that flooding is a *natural* occurrence. Rivers, lakes, and salt-water bodies have always overflowed their normal beds to inundate the nearby land. The land adjacent to these bodies of water is called the *floodplain*.

Floodplain lands look dry most of the time, but nature intends that they be covered with water periodically. As long as we can live with this, there will be no problems. *Flood problems* arise when we interfere with the natural process of riverine, coastal, and other types of flooding.

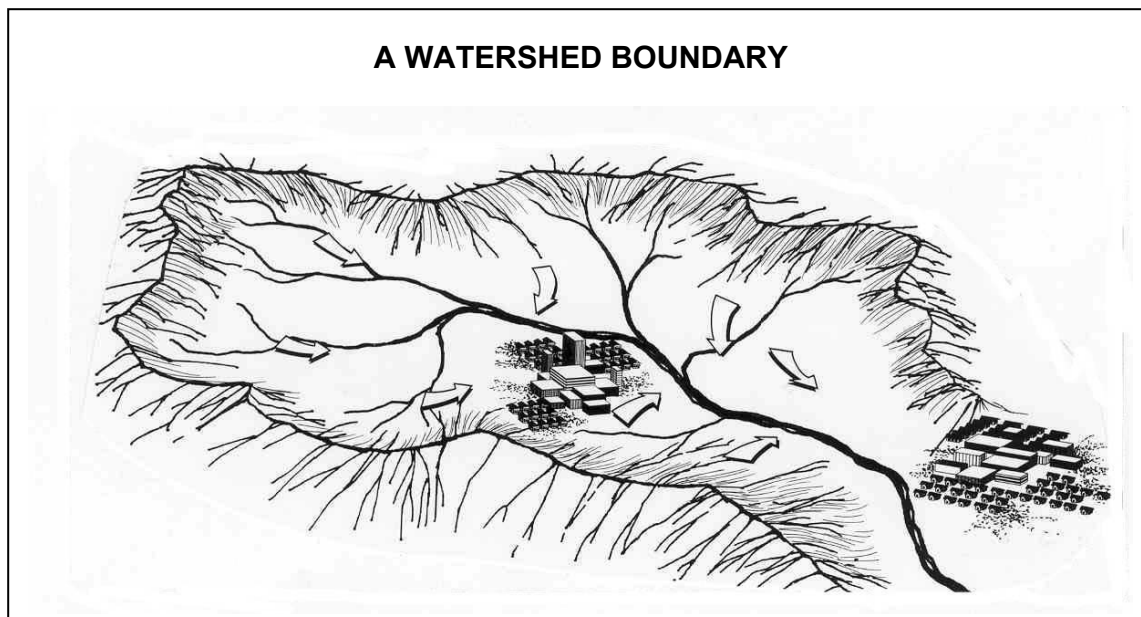
Riverine Flooding

Riverine flooding simply means flooding of a river, stream, or other channel. To understand riverine flooding, you need to be aware of your watershed.

The watershed

A *watershed* is the area that drains to a lake, stream, or other body of water. It is also called a basin or catchment area.

The boundary of a watershed is a ridge or *divide*. The divide is the high ground and the river or lake is the lowest ground. Rain and snowmelt flow from the divide to the receiving stream.



Watersheds vary in size. They can be divided into smaller subwatersheds. The important thing is that the stream and its watershed are connected. What happens in the watershed—even in the higher elevations up near the divide – affects things both in the low-lying lands near the stream or lake and also farther downstream.

The floodplain

The size of a river depends on how much water it collects from the watershed. Most of the time, a river stays within its banks. However, after heavy storms or snowmelt, the extra amount of water can be too much for the channel, causing it to overflow onto normally dry land.

A floodplain can be defined according to the frequency of the flooding that

covers it. An area that is flooded every year (a 1-year floodplain) is smaller than the floodplain that is inundated less frequently (a 15-year, 75-year, or even larger floodplain).

The base flood—The national standard for floodplain management is the *base* or *one percent chance* floodplain. This is the floodplain that has at least one chance in 100 of being flooded in *any* given year. It is also called the *100-year* floodplain. This is the area shown on the Flood Insurance Rate Map (FIRM) for your town issued by the Federal Emergency Management Agency.

The term “100-year flood “ has caused a lot of confusion. Some folks think that it will only happen once in 100 years, but that is definitely not true. Instead, “100-year flood “ is a statistical term that refers to the odds of a flood of that size happening in any given year (see box). It is possible to have 100-year floods two years in a row.

The floodway—Another term you will see is *floodway*. This is the river channel and the overbank area near the channel that carry the deeper and faster-moving flood waters. Some maps show a

regulatory floodway, an area where construction regulations require special provisions to account for this extra hazard.

Flood problems

As noted above, *flooding* is a natural occurrence but *flood problems* are the result of human development. Floods may be acts of God, but flood damage results from human actions. Flood problems result from:

WHAT ARE THE ODDS OF A 100-YEAR FLOOD?

The term “100-year flood” has caused much confusion for people not familiar with statistics. Another way of looking at it is to think of the Odds that a 100-year flood will happen sometime during the life of a 30-year mortgage (26% chance).

Chance of Flooding over a Period of Years

Time Period	10-year	25-year	50-year	100-year
1 year	10%	4%	2%	1%
10 years	65%	34%	18%	10%
20 years	88%	56%	33%	18%
30 years	96%	71%	45%	26%
50 years	99%	87%	64%	39%

Even these numbers do not convey the true flood risk because they focus on the larger, less frequent, floods. If a house is low enough, it may be subject to the 10- or 25-year flood. During the proverbial 30-year mortgage, it may have a 26% chance of being hit by the 100-year flood, but the odds are 96% (nearly guaranteed) that it will be hit by a 10-year flood. Compare those odds to the only 5% chance that the house will catch fire during the same 30-year mortgage.

- Inappropriate development in the floodplain (e.g., buildings too low, too close to the channel, or blocking flood flows),
- Development in the watershed that increases flood flows and creates a larger floodplain, or
- A combination of these two.

Here is a typical example of how riverine flood problems develop: A watershed of 10 square miles drains to Small Creek. The watershed originally had many natural depressions and wetlands that stored rain and snowmelt.

For the last 1,000 years, the creek has flooded periodically onto the floodplain. When the area was first settled, the floodplain was only used for farming—the farmers would lose a crop every 20 to 30 years due to a flood.

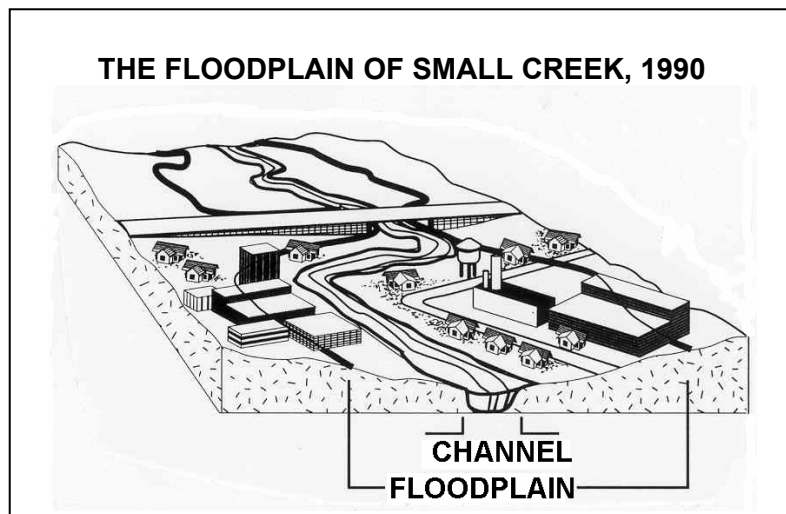
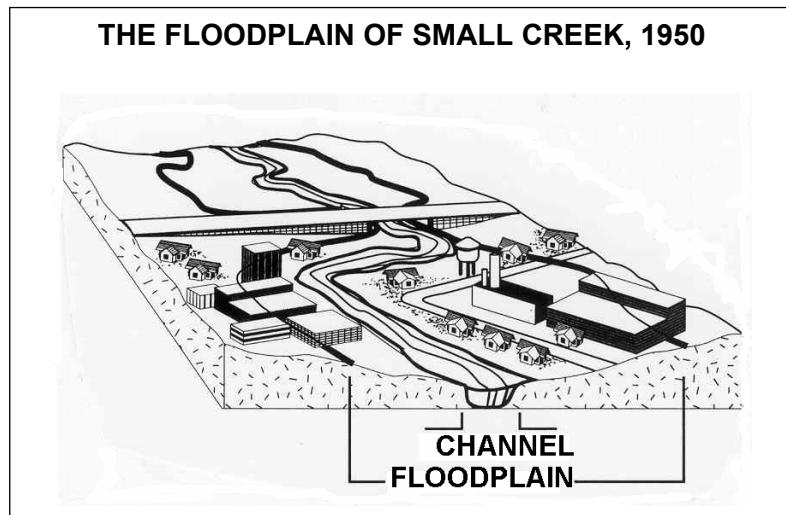
During the 1950s and 1960s the area began to be developed as suburban subdivisions grew out from an expanding metropolitan area. Bridges were built across Small Creek, but their

openings were only large enough to carry the 10-year flood. The channel was moved and straightened to make way for development.

The people who had owned the land since the 1940s had not seen any floods. There was a general sense that dry land would stay dry, so parts of the floodplain were converted from farming to residential and commercial uses. Parts of the floodplain were built on, using normal construction practices. The first floors were only a foot above ground level.

The watershed was gradually changing. Lands that were once forests and farm fields were covered with streets and buildings. Less rain water and snowmelt could soak into the ground, so more of it ran off into the stream.

To get the extra surface water away from the buildings, the developers built storm sewers and drainage ditches. The wetlands were drained or filled to allow more buildings or larger farms. Now more



water is running off the land into Small Creek and human development helps it get there even faster.

The amount of water that used to come downstream once every 20 or 30 years now comes down about every 10 years. Because of the buildings, roads, and small bridge openings, there is less room in the floodplain to carry the extra water. Flood waters rise higher, cover a larger area, and flood farmlands, roads, utilities, buildings, and other development that had never been flooded before.

In addition, the channel banks are exposed to faster-moving waters and have become more susceptible to erosion. Higher flood waters running across bare construction sites and tilled farm lands cause more erosion and carry sediment into the streams and lakes.

Pollutants from lawn fertilizers, pesticides, farm chemicals, street surfaces, and industrial areas are also delivered to the rivers and lakes. Many beneficial plants and animals are harmed or exterminated by these pollutants and sediments. The original species are being replaced by different ones that may not be desirable or beneficial to the rivers, lakes, or environment.

It can be seen that there is a close relationship between natural flooding, development in the floodplain, and what happens in the rest of the watershed. As a general rule, the smaller the watershed, the more quickly it reacts to changes. As one experienced floodplain manager has put it, “You don’t solve flood problems by working at the bottom of the hill.” You must look at the whole picture—where the water comes from *and* where it goes.

Coastal Flooding

Areas along the seashore or lakeshores are prone to coastal flooding and erosion. Coastal flooding happens during storms that drive water onto adjacent land. These can be hurricanes, “nor’easters,” or tropical storms, but even a severe winter storm or thunderstorm can cause flooding.

Flooding

Coastal flooding or *storm surge* is caused by high water from wind and the air pressure differences that accompany a storm. A storm surge is not a tidal wave or sudden rush of water; it is more of a gradual increase in water level. While this may sound harmless, a surge can be as high as 20 feet above normal water levels, flooding normally dry areas far inland. Most of the damage and deaths caused by a hurricane are the result of flooding, not high winds.

Like communities with riverine flooding, most coastal communities have a Flood Insurance Rate Map that shows their base floodplains. The maps also show the parts of the floodplain subject to high damage potential from waves, known as *velocity zones*.

Another form of coastal flooding may or may not be shown on the map. A *tsunami* is a wave that is caused by an earthquake under the ocean. Tsunamis are not tidal waves nor are they related to storms, because they can happen on a clear day as a result of seismic activity hundreds of miles away. They can produce flood levels far above the mapped base floodplain. In this country, they are most common on the Pacific coast, especially in Alaska, Hawaii, and the Northwest.

Erosion

The problem of coastal flooding can be made worse by erosion. Along sandy coastlines, the dunes and open beaches provide natural protection by causing the waves to break close to shore, away from development. But these natural protective features can be worn down by erosion, exposing areas farther inland to storm damage.

Erosion causes its own damage when it undercuts the foundations under buildings. Structures above the base floodplain can be damaged during or after a storm when the underlying sand is washed away, removing the support for the foundations.

Damage from coastal flooding and erosion

Under natural conditions, coastal flooding and erosion cause little or no permanent damage. Plant life restores itself after a storm. Sandy areas, such as barrier islands, move back and forth as the water and wind move the sand. Coastal dunes and barrier islands migrate naturally and rebuild themselves from storm to storm.

The problem arises when people build on coastal floodplains, putting property and lives in the path of storm surges and the natural erosion process. People want the sand to stay still so it will protect their buildings from damage. Structures, like seawalls, that are intended to protect buildings from water and erosion, can make things worse by concentrating the water forces in front of the wall or by transferring the problem to the properties at the end of the structure.

Damage from coastal flooding is increasing just as riverine flood damage is. This is primarily because of the great increase in coastal development over the last 40 years: there are more and bigger structures built close to the shore. In some areas, erosion has left these structures closer to the flood hazard than they used to be.

Other Flood Hazards

Riverine and coastal flooding are the two most common flood hazards. Most scientific studies of a community's flood risk delineate the anticipated extent of a flood of a certain frequency, and describe its hazards in terms of depth and velocity of the flood water. Some types of flooding have additional hazards, such as sediment loads that can reroute stream channels. These additional hazards include:

- **Sheet flow**—In places where there are no defined channels, the flood water spreads out over a large area at a uniform depth.
- **Ponding**—In flat areas, runoff collects or ponds in depressions and cannot drain out. Flood waters must infiltrate slowly into the soil, evaporate, or be pumped out.
- **Closed basin lake flooding**—This occurs on lakes with either no outlet or a relatively small one. Seasonal increases in rainfall cause the lake level to rise faster than it can drain. The water may stay at flood stage for weeks, months, or years.

- **Flash flooding**—This is flooding that occurs in a short period of time. It is most common when intense local rains fall on areas with steep slopes or on built-up areas where impervious surfaces, gutters, and storm sewers speed up the flow of runoff.
- **Alluvial fans**—In mountainous areas, high velocity flood flows pick up sediment as they move downhill. At the base of the valley the slope flattens out. The flood waters slow and spread out, as in sheet flow, and drop the sediment over a wide fan-shaped area.
- **Ice jams**—Ice jam floods occur when warm weather and rain break up frozen rivers. The broken ice floats downriver until it hits bottom at a shallow spot or is blocked by an obstruction, such as a bridge. An ice dam forms and blocks the channel, causing flooding upstream.
- **Moveable bed streams**—These are most common in the arid West, where steep slopes and lack of vegetation result in a lot of erosion. During a flood, a channel may be eroded more deeply or it may become filled with sediment and move to a different location.
- **Sewer backup**—During heavy rains, stormwater may overload a community’s sanitary or storm sewer system. If the water levels in the receiving streams are high, the storm sewers can’t drain. The water will back up in the system, usually into basements and other low-lying areas.

Just as with riverine and coastal flooding, flood problems arise when development does not take these special hazards into account. An additional concern is that many flood hazard maps and flood loss reduction programs, such as building codes, do not reflect the additional danger and damage potential that accompany these other types of flooding.

To Find Out More >> For more information on these “special” hazards, see *Reducing Flood Losses in High Risk Flood Hazard Areas* and *CRS Commentary Supplement for Special Hazards Credit* (see Appendix B).

What Information Do You Need?

It is important to remember that every flood is different. The next flood could be worse than the floods you have already experienced. If you want protection from flood damage, don’t think only in terms of the last flood or the worst one you or your neighbors remember. You will need to collect some information on the actual *risk* of flooding in the future.

The floodplain and flood levels

Most regulatory programs deal with the base flood. As discussed earlier, this is a statistical concept that takes into account both the severity of a flood and the likelihood of it occurring. Most of the nation’s base floodplains have been mapped

by the Federal Emergency Management Agency on Flood Insurance Rate Maps or “FIRMs.”

If you want to know what parts of your community are at risk of being flooded, your community’s FIRM will show the base floodplain for larger watersheds. You can see the FIRM at your local building, planning, or zoning office. The maps do not include the floodplains from smaller watersheds, such as those that drain less than one square mile.

In some cases, you should use a higher standard than the base flood. For example, if your community suffered a flood that was bigger than the mapped base flood, you should use the higher flood levels in your planning. (The highest flood recorded is called the *flood of record*.)

In addition, facilities whose operation is critical to human health and safety, such as a hospital, fire station, power substation, or hazardous materials storage yard, should be protected from the 500-year flood or the flood of record, whichever is larger. Most FIRMs show the 500-year floodplain.

Other flood data

After you find out what areas would be affected by a flood, and how high the flood waters are predicted to be, you should also look for this information:

- A map of your watershed,
- Areas that have been flooded repeatedly,
- The amount of warning time that can be expected,
- How long the flood-prone area will stay under water (*duration*),
- Velocities, sediment, debris, and other perils that may accompany a flood,
- Whether there are any flood protection projects underway, and
- Other hazards that affect the area, such as earthquakes, wildfire, or releases from nearby chemical plants.

To Find Out More >> The best source of local flood data may be your municipal or county engineer. This office or the local permit office should have the community’s Flood Insurance Rate Map and its accompanying Flood Insurance Study. They also should have copies of other studies that have been done on the local flood hazard. The municipal or county office may be the only place for data on flooding from watersheds that are too small to be mapped by a state or federal agency.

Other possible sources of information about your flood problem are:

- State Flood Insurance Coordinator (see Appendix A),
- State natural resources or water resources agency,

YOUR COMMUNITY’S FIRM

The base floodplain is shown as The “Special Flood Hazard Area” on the Flood Insurance Rate Map (FIRM) provided to your community by the Federal Emergency Management Agency. The base floodplain is designated as an A Zone. In coastal areas, the base floodplain with a wave hazard is designated as a V Zone.

The 500-year floodplain is shown as a B Zone and areas above the 500-year flood level are shown as C Zones. On newer maps, the B and C zones are called X zones.

Even though it is designated as a B, C, or X Zone, an area still may be subject to local drainage problems or flooding from streams or ditches not mapped on the FIRM.

- Regional planning, sanitary, drainage, or water management districts,
- County emergency manager,
- County or state highway or transportation department,
- U.S. Department of Agriculture's Natural Resources Conservation Service, which is usually co-located with your local soil and water conservation district (check the government listings in the phone book for your county seat),
- U.S. Army Corps of Engineers, and
- The geography, engineering, or natural sciences department or library of your local university.

Flood Loss Reduction Measures

There is more than one way to reduce flood losses. One of the key ingredients in multi-objective management is to review all possible options before arriving at a solution. This chapter reviews the techniques that are available (usually called “measures”) to help reduce flood losses. It also lists the agencies and organizations that can help you with each one. The next chapter shows how other interest groups can support these measures.

There are four basic strategies for reducing flood losses. Each strategy incorporates different measures that are appropriate for different conditions. In many communities, a different person may be responsible for each strategy. Each strategy is covered in a separate section of this chapter:

- **Prevention** measures keep flood problems from getting worse. Planning, land acquisition, and regulations help modify development on floodplains and watersheds to reduce their susceptibility to flood damage. Preventive measures are usually administered by the building, zoning, planning, and/or code enforcement offices of your local government.
- **Property protection** measures are usually undertaken by property owners themselves.
- **Emergency services** minimize the impact of a flood that is already happening. These measures are the responsibility of city or county emergency management staff and the owners or operators of major or critical facilities.
- **Structural projects** keep flood waters away from an area with a levee, reservoir, or other measure that controls the flow of water. Structural projects are usually designed by engineers and managed or maintained by public works staff.

Prevention

Preventive measures are intended to keep a flood problem from occurring or getting worse. They ensure that future development does not increase flood damage. They include:

- Planning and zoning
- Open space preservation
- Floodplain development regulations
- Watershed management
- Wetlands protection
- Drainage system maintenance
- Real estate disclosure laws or policies.

Planning and zoning

Comprehensive plans and land use plans specify how a community should be developed (and where development should not occur). Through these plans, uses of the land can be tailored to match the land's hazards. For example, flood hazard areas can be reserved for parks, golf courses, backyards, wildlife refuges, natural areas, or similar uses that are compatible with the natural flooding process.

Plans like these usually have limited authority. They reflect what the community would like to see happen. But they can be powerful because they shape the character of other local measures, such as capital improvement programs, zoning ordinances, and subdivision rules.

A community's capital improvement program identifies where major public expenditures will be made over the next 5 to 20 years. Capital expenditures may include acquiring land for public uses, such as parkland, wetlands, or natural areas, and extension or improvement of roads and utilities. These publicly funded projects should not aggravate flooding. In fact, they can reduce flooding by, for example, enlarging a culvert opening while a road is being repaired.

A zoning ordinance regulates development by dividing the community into zones or districts and setting development criteria for each district. The floodplain can be designated as one or more separate zoning districts in which development is prohibited or allowed only if it is not susceptible to flood damage. Some districts that are appropriate for floodplains are those designated for public use, conservation, agriculture, and cluster or planned unit developments that keep buildings out of the floodplain, wetlands, and other risky or sensitive areas.

To Find Out More >> Technical advice about planning and zoning can also be found at your local, regional, or state planning agencies. The American Planning Association and its state chapters can provide technical assistance to its members.

For more information on the agencies and organizations, check the *M.O.M. Resource Directory* or see Appendix A. See Appendix B for more information on the references listed.

Open space preservation

Keeping the floodplain free from development is the surest way to prevent flood damage. Open space preservation should not be limited to floodplains, because some sites in the watershed (but outside the floodplain) may be crucial to controlling runoff that adds to the flood problem. Areas that need to be preserved in a natural state should be listed in land use and capital improvement plans.

Existing undeveloped areas can be preserved as open space through zoning ordinances. Lands that ought to be set aside as open space but are already being put to other uses can be converted to public ownership (acquisition) or to public use (easement). Once the land is owned by the county, municipality, or state, buildings and other development subject to flood damage can be removed or prohibited. With an easement, a private owner is free to develop and use the property, but agrees to not build on the flood-prone part or the part set aside in the easement. In exchange, property taxes are reduced or a payment is made.

Open space lands and easements do not always have to be purchased outright. Developers can be required to dedicate land to the public for a park and/or to provide easements for flood flow, drainage, or maintenance. These are usually linear parcels along property lines or channels. Maintenance easements

also can be provided by streamside property owners in return for a community channel maintenance program.

After the 1993 Midwest floods, easements were used on a large scale. Federal programs funded the purchase of flood easements to reserve areas for uses that are not affected by flooding—grazing, wildlife habitat, and hunting clubs.

To Find Out More >> Technical advice about preserving open space can be found at the local, regional, or state planning, parks, conservation, and recreation agencies. The Land Trust Alliance or local or regional land trust organizations can help, too.

Floodplain development regulations

Zoning and open space preservation work to keep damage-prone development *out* of hazardous or sensitive areas. Floodplain development regulations impose construction standards on what is allowed to be built *in* the floodplain. They protect buildings, roads, and other projects from flood damage and also prevent the development from aggravating the flood problem. The three most common types of floodplain regulations are subdivision ordinances, building codes, and “stand-alone” floodplain ordinances.

Subdivision regulations—Subdivision regulations govern how land will be subdivided into individual lots, often requiring that every lot have a buildable area above the flood level. These regulations set construction and location standards for the infrastructure built by the developer, including roads, sidewalks, utility lines, storm sewers, stormwater retention or detention basins, and drainageways. These standards, especially the stormwater and drainage requirements, should require the subdivider to account for local drainage and flooding hazards.

Building codes—Flood protection standards for all new and improved or repaired buildings can be incorporated into the local building code. They should include criteria to ensure that the foundation will withstand flood forces and that all portions of the building subject to damage are above, or otherwise protected from, flooding.

Floodplain ordinances—Most communities with a flood problem participate in the National Flood Insurance Program (NFIP). The NFIP sets minimum requirements for the communities’ subdivision regulations and building codes. Sometimes these are spelled out in a separate ordinance. The NFIP minimum requirements are summarized in the box on the next page. Remember, many states, regions, and communities have additional regulatory standards.

To Find Out More >> Technical advice about floodplain regulations can be found at local, regional, or state planning agencies, the Federal Emergency Management Agency, and the State NFIP Coordinator’s office.

Watershed management

Several measures can help reduce the runoff of stormwater and snowmelt throughout the watershed.

Retention and detention regulations—Usually part of a subdivision ordinance, these regulations require developers to build retention or detention basins to minimize the increases in runoff caused by new impervious surfaces and new drainage systems. A typical requirement is that no development may allow stormwater to leave the property at a rate higher than it did before the parcel was developed.

MINIMUM NATIONAL FLOODPLAIN REGULATION REQUIREMENTS

The National Flood Insurance Program is administered by the Federal Emergency Management Agency. As a condition of making flood insurance available for their residents, communities that participate in the program agree to regulate new construction in the base floodplain.

There are four major floodplain requirements; additional regulations may be set by state or local law.

- All development in the base floodplain must have a permit from the community. "Development" is defined as any human-made change to the land, including new buildings, improvements to buildings, filling, grading, mining, dredging, etc.
- Development should not be allowed in floodway. The floodway is the channel and central portion of the floodplain that is needed to convey the base flood. It is usually the most hazardous area of a riverine floodplain and the most sensitive to development. At a minimum, no development in the floodway can cause an obstruction to flood flows. An engineering study is usually needed to see if this will happen.
- New buildings may be built in the floodplain, but they must be protected from damage by the base flood. The lowest floors of residential buildings must be elevated to or above the base flood elevation. Nonresidential buildings must be elevated or floodproofed. Because of the restrictions described above, buildings that are built in the floodplain are usually located outside the floodway.
- When an addition, improvement, or repair of damage to an existing building is valued at more than 50% of the value of the original building, than it is considered a substantial improvement. A substantial improvement is treated as a new building.

Communities are encouraged to adopt local ordinances that are more comprehensive or provide more protection than the state or federal criteria. This is especially important in areas with older maps that may not reflect the current hazard. Stricter standards could include prohibiting certain damage-prone uses from the floodway or requiring structures to be elevated one or more feet above the base flood elevation.

Watershed planners can identify the most effective location for a detention or retention basin. The community then can require developers to contribute funds for a regional basin in lieu of constructing on-site detention. Some state and regional agencies have stormwater standards that all communities and developers must follow. In some places, stormwater projects are funded with utility or user fees. Each property in the watershed pays according to the amount of runoff it generates.

Best management practices—Best management practices (BMPs) reduce nonpoint source pollutants that enter the waterways. Nonpoint source pollutants are those carried by stormwater. They include lawn fertilizers, pesticides, farm chemicals, and oils from street surfaces and industrial areas.

Many measures that combat nonpoint source pollution also yield flood protection benefits. For example, one of the most important nonpoint source

pollutants is sediment. When soil is eroded, sediment accumulates in downstream waterways, settling out where the river slows down, such as where it enters a lake. Sedimentation will gradually fill in channels and lakes, reducing their ability to carry or store flood waters.

BMPs reduce erosion and sedimentation by two techniques: minimizing erosion with vegetation, and capturing sediment before it leaves a site. Slowing runoff on its way to a drainage channel increases infiltration into the soil and minimizes the loss of topsoil from erosion and the resulting sedimentation. Runoff can be slowed down with vegetation, terraces, contour strip farming, no-till farm practices, and impoundments (sediment basins, farm ponds, wetlands, etc.).

BMPs can also be incorporated into retention and detention basins, drainageways, and other parts of new developments. They clean stormwater runoff by filtering it or letting pollutants settle to the bottom of a basin before it is drained.

Because of the need to improve the water quality in our rivers and lakes, several state and federal laws mandate the use of best management practices for new developments and various land uses. Specific BMPs and structural measures may be required on industrial sites, mined lands, construction sites, farms, forested areas, and intensively used public lands.

To Find Out More >> Local and regional stormwater or sanitary agencies can give you information about stormwater management. Soil and Water Conservation Districts and their Natural Resources Conservation Service staff have both the expertise in watershed measures and the contacts with watershed landowners. State environmental protection or natural resources agencies can provide guidance on best management practices. Know Your Watershed is another group that can help.

Wetlands protection

Wetlands is the collective term for marshes, swamps, bogs, and similar areas found in flat vegetated areas, in depressions in the landscape, and between dry land and water along the edges of streams, rivers, lakes, and coastlines. Wetlands filter runoff and adjacent surface waters to protect the quality of lakes, bays, and rivers, and protect many of our sources of drinking water. They can store large amounts of flood waters, slowing and reducing downstream flows. They can protect shorelines from erosion. Wetlands serve as a source of many commercially and recreationally valuable species of fish, shellfish, and wildlife.

Section 404 of the Clean Water Act regulates the discharge of dredged and fill material into waters of the United States, including wetlands. For purposes of the regulatory program for Section 404, wetlands are defined as areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Activities in waters of the United States that are regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways), and conversion of wetlands to uplands for farming and forestry.

The Section 404 program is jointly administered by the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency. The Corps administers the day-to-day program, including permit decisions. The EPA develops and interprets the environmental criteria used in evaluating Section 404

permit applications. These environmental criteria are known as the Section 404(b)(1) guidelines. The U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the state resource agencies have important advisory roles. Under a Memorandum of Agreement, the U.S. Department of Agriculture's Natural Resources Conservation Service is the lead federal agency for making wetlands determinations on agricultural lands.

Many states and some communities also have their own wetland protection programs. Local programs can fill the gaps in the federal or state regulations, particularly for smaller wetlands and unregulated activities.

To Find Out More >> City and county permit and engineering offices; state, county, and regional stormwater agencies; the state natural resources agency; the U.S. Fish and Wildlife Service; the U.S. Environmental Protection Agency; the Natural Resources Conservation Service; and the U.S. Army Corps of Engineers can provide information about wetlands protection. You can get copies of the U.S. Environmental Protection Agency's *Wetlands Fact Sheets* and other help by calling the EPA Wetlands Information Hotline at (800) 832-7828.

Drainage system maintenance

Ongoing maintenance programs are needed to clean out channels and detention basins blocked by overgrowth or debris. The work is usually done by a public works or drainage district crew. These activities normally do not affect the shape of the channel or basin, but they do affect how well it performs.

Many people do not realize the consequences their actions have on the drainage system. They may, for example, fill in the ditch in their front yard, not realizing that it is needed to drain street runoff. They may not understand how regrading their yard, filling a wetland, or dumping leaves or branches into a stream or ditch can cause problems both big and small.

A drainage system maintenance program should, therefore, include regulations preventing regrading, filling, dumping in, or altering watercourses or storage basins. Public information materials should be available to explain the reasons for the rules as well as the penalties. Regular inspections to catch violations also should be scheduled.

To Find Out More >> Agencies that can provide technical advice about drainage system maintenance include local drainage districts, the state natural or water resource agency, the U.S. Army Corps of Engineers, and the Natural Resources Conservation Service.

Real estate disclosure

After a flood, people often say they would have taken steps to protect themselves if only they had known they had purchased a flood-prone property. All federally regulated lending institutions must tell people who apply for a mortgage or other loan whether or not the building that secures the loan lies in a floodplain as shown on the Flood Insurance Rate Map.

Because the deadline for meeting this requirement is only five days before closing, often the applicants are already committed to purchasing the property when they first learn of the flood hazard. State laws and local practices by real estate boards can overcome this deficiency and advise newcomers about the hazard earlier. They may also require disclosure of past flooding or sewer problems, regardless of whether the property is in a mapped floodplain.

To Find Out More >> The Federal Emergency Management Agency can explain the details of the federal disclosure requirement on lenders. Your local Board of Realtors® or state real estate regulatory agency can explain your state laws and local practices.

Property Protection

Property protection measures reduce a building's susceptibility to flood damage. They are often inexpensive for the community because they are implemented by or cost-shared with property owners. In many cases the buildings' appearance or use is unaffected, so these measures are particularly appropriate for historical sites and landmarks. These measures include:

- Relocation and acquisition
- Floodproofing
- Insurance
- Community programs.

Relocation and acquisition

Moving a building to higher ground is the surest and safest way to protect it from flooding. This is especially true in the floodway and areas subject to erosion, ice jams, flash flooding, deep water, or other special hazard. Relocating a building is also preferred for large lots with portions outside the floodplain or in cases in which the owner has another flood-free lot available.

Acquisition of flood-prone property is undertaken by a government agency, so the cost is not borne by the property owner. After any structures are removed, the land is usually converted to public use, such as a park, or allowed to revert to natural conditions. There are a variety of funding programs that can support a local acquisition project (over 8,000 homes were acquired or relocated by the Federal Emergency Management Agency after the 1993 Midwest flood).

To Find Out More >> The Corps of Engineers has information on relocation techniques. The Federal Emergency Management Agency and your State NFIP Coordinator can provide advice on funding for acquisition programs.

Floodproofing

If a building cannot be removed from harm's way, it can often be protected on site. In areas subject to slow-moving, shallow flooding, buildings can be elevated or barriers can be constructed to block the water's approach to the building. These techniques have the advantage of being less disruptive to the neighborhood.

It must be remembered, however, that during a flood, a floodproofed building may be isolated and without utilities and therefore unusable, even though it has not been damaged. The streets, utilities, and other infrastructure that serve the property will still be exposed to flood damage. This is also a risk to any occupants who may try to get in and out of the building during a flood.

Elevation—Raising a house above the flood level is the best on-site property protection method. Water flows under the building, causing little or no damage to the structure or its contents. Another alternative is to raise the building and place fill under it before the building is lowered back down.

Barriers—Levees, floodwalls, and berms keep flood waters from reaching a building. They are useful only in areas subject to shallow flooding. They can surround the entire building, tie into high ground, or be as small as a low floodwall built around an exterior stairwell to a basement.

Care must be taken in locating barriers. They must be placed so as not to create flooding or drainage problems on neighboring properties. All barriers must be kept out of regulatory floodways.

Dry floodproofing—A dry floodproofed building is sealed against flood waters. All areas below the flood protection level are made watertight. Walls are coated with waterproofing compounds or plastic sheeting. Openings like doors, windows, sewer lines, and vents are closed, either permanently, with removable shields, or with sandbags. The flood protection level should be no more than 2 or 3 feet above the top of the foundation because the building's walls and floors cannot withstand the pressure of deeper water.

Wet floodproofing—This approach is usually a last resort. Flood waters are intentionally allowed into the building to minimize water pressure on the structure. Wet floodproofing can include moving a few valuable items to a higher place or completely rebuilding the floodable area.

Wet floodproofing has an advantage over other approaches: no matter how little is done, flood damage will be reduced. Thousands of dollars in damage can be avoided just by moving furniture and appliances out of the flood-prone area.

Sewer backup protection—Houses with downspouts, footing drain tile, and/or a sump pump connected to the sanitary sewer service may be inundated when heavy rains overload the system. If the local code allows, these should be disconnected. Rain and groundwater should be directed out onto the ground, away from the building.

Overloaded sewers can be prevented from backing up into a home by using a variety of alterations to plumbing, including a floor drain plug, a floor drain standpipe, an overhead sewer, or a backup valve.

To Find Out More >> The State NFIP Coordinator and the Corps of Engineers have more information on elevation, barriers, and floodproofing.

Insurance

Insurance has the advantage that, as long as the policy is in force, property losses will be minimized, and no human intervention is needed for it to work. Although most homeowner's insurance policies do not cover flood damage, there are two ways an owner can insure his or her building: through the National Flood Insurance Program or by purchasing basement flooding insurance.

National flood insurance—A community must join the National Flood Insurance Program (NFIP) before its residents can buy flood insurance. Community participation allows local insurance agents to sell a separate flood insurance policy under rules and rates set by the Federal Emergency Management Agency. Rates do not change after claims are paid; they are set on a national basis.

Basement flooding insurance—Policies under the NFIP can cover seepage and sewer backup as long as there is a general condition of flooding in the area that was the proximate cause of the basement's getting wet. Several private insurance companies offer coverage for damage incurred if a sump pump fails or a sewer line backs up. Most of them exclude damage from surface flooding that would be covered by the NFIP. Each company has different amounts of coverage, exclusions, deductibles, and arrangements.

To Find Out More >> Local insurance agents have information on both the NFIP and private insurance. You can also contact your State NFIP Coordinator (see Appendix A) or call the NFIP's toll-free number, 800-611-6123.

Community programs

Property owners usually implement their own property protection measures. However, communities can provide three kinds of help and encouragement.

Information—A community can inform residents about flood hazards and loss reduction techniques. This can be done with references in the public library, elementary and high school programs, park lectures and education programs, outreach projects, cable television shows, notices in public buildings, booths at shopping centers, distribution of handbooks and videos, and public meetings.

Technical assistance—In one-on-one sessions with property owners, community officials can provide advice and information on such matters as identifying flood hazards at the site, correcting local drainage problems, floodproofing, dealing with contractors, and funding.

Financial assistance—Some communities have provided financial assistance for property protection measures in the form of low-interest loans, rebates, and grants. Some have fully funded the design and implementation of property protection projects, especially if they are shown to be more economical than other flood protection measures. The local staff can also provide information on financial assistance available from state and federal programs.

To Find Out More >> The State NFIP Coordinator, the Federal Emergency Management Agency, and the Corps of Engineers can often provide advice and examples of community programs in your area. Ideas on information programs can be found in *CRS Credit for Outreach Projects*. Guidance on financial assistance is covered in *Local Flood Proofing Programs*.

Emergency Services

Emergency services protect people during and after a flood. Most counties and many cities have emergency management offices to coordinate warning, response, and recovery during a disaster. Emergency services measures include:

- Flood warning
- Flood response
- Post-flood activities.

Flood warning

The first step in responding to a flood emergency is knowing that one is coming. A flood threat recognition system provides early warning to emergency managers. On large rivers and in coastal areas, the flood threat recognition work is done by the National Weather Service. Communities on smaller rivers must develop their own systems with their own rain and river gauges.

Once the system tells the emergency manager that a flood is coming, the next step is to notify the public and staff in other agencies and critical facilities

WATCHES AND WARNINGS

Most flood warning programs have two levels of notification:

Flood watch—Conditions are right for flooding.

Flood warning—A flood has started or is expected to occur.

The National Weather Service may issue a “flash flood watch” for urban areas. This means the amount of rain expected will cause ponding and other flooding on small streams in urbanized watersheds.

that a flood is imminent. The earlier and the more accurate the warning, the greater the number of people who can take protective action.

A flood warning may be disseminated via sirens, radio, television, cable television, mobile public address systems, telephone trees, and even door-to-door contact. Multiple or redundant systems are most effective: if people do not hear one warning, they may still get the message from another part of the system.

To Find Out More >> Obtain information about warnings from the local, county, and state emergency management offices and the National Weather Service.

Flood response

After people are notified of a flood threat, the next step is to respond with actions to prevent or reduce damage or injury. Such actions (and the responsible parties) could be:

- Activating the emergency operations center (emergency manager)
- Sandbagging certain areas (public works or road department)
- Closing streets or bridges (police or sheriff’s department)
- Shutting off power to threatened areas (utility company)
- Releasing children from school (school district)
- Ordering an evacuation (mayor)
- Opening evacuation shelters (churches, schools, or the Red Cross)
- Monitoring water levels (engineer)
- Guarding sandbag walls and other protection measures (police).

A flood response or emergency action plan is the best way to ensure that all bases are covered and that the response activities are appropriate for the flood expected. The plan is developed in coordination with the agencies or offices that will be responsible for carrying it out.

Most critical facilities should have their own emergency response plans. Critical facilities fall into two categories: (1) buildings or sites vital to the flood response effort, such as emergency operations centers and police and fire stations, and (2) buildings or sites that, if flooded, would create secondary disasters, such as hazardous materials facilities and nursing homes.

To Find Out More >> Assistance on flood response is available from the local, county, and state emergency management or civil defense offices and the local chapter of the American Red Cross.

Post-flood activities

The flood response plan should identify appropriate measures to take after the flood. They would include such measures as:

- Patrolling evacuated areas to prevent looting
- Providing safe drinking water

- Vaccinating residents for tetanus
- Clearing streets
- Cleaning up debris and garbage.

The plan also should identify which agencies will be responsible for carrying out these measures. Usually they are the police, sheriff, or public health authorities.

To Find Out More >> Obtain assistance and information about post-flood activities from local, county, and state emergency management offices.

Structural Projects

Structural projects are used to prevent flood waters from reaching properties. These measures are “structural” because they require building structures to control the flow of water. They can be grouped into three types:

- Levees and floodwalls
- Reservoirs and diversions
- Channel and drainage modifications.

Most structural projects are very expensive. They have other shortcomings, too:

- They disturb the land and disrupt natural water flows, often destroying habitats.
- They require regular maintenance that, if neglected, can have disastrous consequences.
- They are built to a certain flood protection level that can be exceeded by larger floods, causing extensive damage.
- They can create a false sense of security, because people protected by a structure often believe that no flood can ever reach them.

Levees and floodwalls

Probably the best known structural measure is a barrier of either earth (*levee*) or steel or concrete (*floodwall*) erected between the watercourse and the property to be protected. Levees need considerable room to fit between the river and the area to be protected. If space is a constraint, more expensive floodwalls are used.

Levees and floodwalls should be set back out of the floodway so they will not push flood waters onto other properties. Their design also should compensate for the flood storage they will displace and for access through or over the barrier.

To Find Out More >> The U.S. Army Corps of Engineers, the Natural Resources Conservation Service, and state natural or water resources agencies can provide information on construction criteria and funding assistance.

Reservoirs and diversions

Reservoirs and diversions control upstream water to reduce the amount that reaches an area at one time. A *reservoir* holds high flows behind a dam or in a

storage basin. After a flood peaks, water is released or pumped out at a rate that can be handled downstream. Reservoirs are most efficient in deep valleys with more room to store water, or on smaller rivers where there is less water to store.

A *diversion* is a new channel, overflow weir, or tunnel that sends flood waters to a different location, thereby reducing flooding along a watercourse. During normal flows, the water stays in the old channel. During flood flows, the stream spills over to the diversion channel or tunnel, which carries the excess water to a lake or another river.

Reservoirs and diversions should be implemented after a thorough watershed analysis that identifies the most effective and efficient location for one or more structures and to ensure that they will not increase flooding somewhere else. Because they involve more than one community and are so expensive, they are typically implemented with the help of state or federal agencies, such as the U.S. Army Corps of Engineers or the Natural Resources Conservation Service.

To Find Out More >> The U.S. Army Corps of Engineers, the Natural Resources Conservation Service, and state natural or water resources agencies can provide information on construction criteria and funding assistance. In western states, the Bureau of Reclamation can help.

Channel and drainage modifications

When the conveyance of a channel, drainage ditch, or storm sewer is increased, more water can be carried away. However, care must be taken to not increase a flooding problem downstream.

Channel modifications include making a channel wider, deeper, smoother, or straighter. Some smaller channels can be lined with concrete or even enclosed in underground pipes.

Dredging is one form of channel modification. It is often too expensive to be practical because the dredged material must be disposed of somewhere and the stream will usually fill back up with sediment in a few years. Dredging is usually undertaken only on larger rivers to maintain a navigation channel.

Drainage modifications include human-made ditches and storm sewers that help drain areas where the surface drainage system is inadequate or where underground drainageways are safer or more attractive than above-ground ones. Drainage and storm sewer projects usually are designed to carry the runoff from smaller, more frequent storms. They are particularly appropriate for depressions and low spots that will not drain naturally.

Storm sewer improvements can increase the sewer's capacity or prevent overloading from flooding in certain areas. These measures include installing new sewers, enlarging pipes, modifying storm sewer inlets, and preventing back flow.

Street modifications may help because streets in many developments are used as part of the drainage system to convey runoff to a receiving sewer, ditch, or stream. Streets can also be designed to store water from larger, less frequent storms. Allowing water to stand in the streets and then draining them slowly can be more effective and less expensive than building bigger sewers and ditches.

To Find Out More >> The U.S. Army Corps of Engineers and the Natural Resources Conservation Service can provide information on projects for larger channels. Public works departments and engineers are the best sources of information on local drainage and sewer projects.

M-O-M Opportunities

A person concerned with a flood problem is apt to look at the floodplain only as a hazardous area—a place to avoid. However, the floodplain, the watershed, wetlands, and other flood-related areas can have many different uses, most of them beneficial to the community. Where you may see a stream as a nuisance, a developer may see a recreational asset or an amenity that can increase the value of a subdivision. A fisherman may see a resource that should be set aside for people to enjoy.

The multi-objective management approach brings these interests together to reduce conflicts and increase the opportunities for mutual support. Your flood loss reduction measure may also be a tool that will meet other objectives.

Other groups have one advantage over those promoting flood loss reduction: their concerns usually last year-round. While interest in flooding often wanes as time passes and memories of the flood fade, there is always interest in economic development or improving recreation. By allying yourself with these other interests, you gain longer-lasting support for your common concerns.

The number and types of interest groups and opportunities will vary from community to community. This chapter reviews the ones that are most likely to affect a flood problem:

- Recreation
- Fish and wildlife
- Water supply
- Water quality
- Urban redevelopment
- Economic development
- Housing improvement
- Agriculture
- Historic preservation
- Education
- Transportation and infrastructure.

Recreation

Often the best recreational land lies in the floodplain. Boating, fishing, and other waterfront activities need to be on or near the river, lake, or other source of flooding. Hunters as well as fishermen understand that their game supply depends on wetlands, rivers, lakes, or other floodplain or watershed features that can also be important to storing or conveying runoff and flood waters.

Hiking and biking trails are more attractive and interesting when they follow a stream or shoreline. People enjoying more passive recreation, such as picnicking, strolling, bird watching, and just plain sightseeing, want the views and variety of terrain that a waterfront setting provides.

Opportunities

The following list gives examples of how some flood loss reduction measures (discussed in Chapter 3) can also provide opportunities for recreation:

- **Planning and zoning**—Certain areas in the watershed and the floodplain can be set aside for outdoor recreation. This has the effect of leaving the drier areas available for more damage-prone types of development. It also helps avoid adverse impacts on stormwater runoff and flooding that can be caused by development in flood-prone or sensitive areas.

For more information on the agencies and organizations mentioned, check the *M.O.M. Resource Directory* or other sources listed in Appendix A.

- **Open space preservation**—Acquiring recreational sites and developing greenways along streams and around lakes prevents hazard-prone development on those sites and can preserve watershed storage areas.
 - **Relocation and acquisition**—Clearing damage-prone properties can expand existing parks.
 - **Community programs**—Public information programs can combine descriptions of recreation and flood loss reduction programs and explain how they are interrelated.
 - **Reservoirs and diversions**—A lake or storage basin may be a recreational asset. Many basins are located in parks and serve as aesthetic amenities, fishing areas, boating sites, and ice skating rinks.
- **Channel and drainage modifications**—A channel improvement project can incorporate a trail or greenway that can also be used by maintenance vehicles.

Related interests

The following interests often have concerns linked to recreation. They are discussed elsewhere in this chapter.

- Fish and wildlife
- Water supply
- Water quality
- Education
- Historic preservation
- Transportation and infrastructure (trails, bikeways).

Advice and assistance

These agencies and organizations can provide advice and/or assistance on a recreational program. They could also support flood loss reduction measures.

- Local and state park, recreation, or conservation agencies
- National Park Service

- The Nature Conservancy
- The Land Trust Alliance
- Neighborhood associations
- Conservation and outdoor groups (e.g., Izaak Walton League, Audubon Society, Boy and Girl Scouts)
- Hunting and fishing organizations (e.g., Ducks Unlimited, Trout Unlimited)
- Recreational businesses (e.g., marinas, sporting goods stores).

Fish and Wildlife

Preserving open space and restoring wetlands are prime goals of supporters of fish and wildlife. Setting development back from streams, wetlands, and shorelines protects important habitats and keeps damage-prone activities out of the most hazardous parts of the floodplain.

Fish and wildlife interest groups are very concerned about water quality and quantity. Watershed management practices that improve the quality of stormwater runoff can also control the amount of the runoff. Erosion management means cleaner water downstream and less sediment to fill in channels. Fish and wildlife advocates are also concerned about minimum flows that are needed for fish and other aquatic animals.

Opportunities

The following are ways to protect fish and wildlife habitats and simultaneously reduce flood losses:

- **Planning and zoning**—Setting aside appropriate areas for habitats in the floodplain and the rest of the watershed can reduce the adverse impacts of development on stormwater runoff and flooding.
- **Open space preservation**—Acquiring wetlands and other natural areas and requiring setbacks along streams and around lakes prevent hazard-prone development and can also preserve places for watershed storage.
- **Watershed management**—Stormwater detention basins, best management practices, erosion and sediment control measures, contour plowing, and no-till farming all enhance water quality and reduce runoff. With careful design and management, these measures can enhance natural flows.
- **Wetlands protection**—Wetlands are vital habitats for many species and can be very effective and inexpensive storage basins.
- **Drainage system maintenance**—Often the most effective and least expensive drainageway is a natural one rather than a human-made ditch that must be constantly maintained.

A M-O-M Success Story

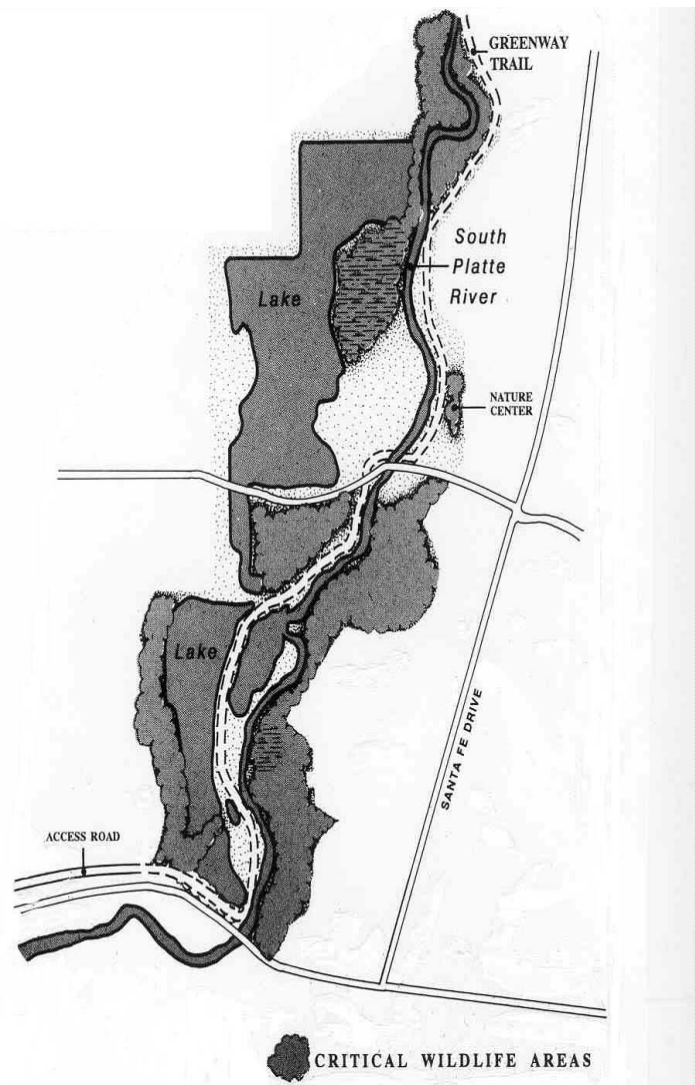
In 1969, residents of Littleton, Colorado, were told that the South Platte River would be channelized to reduce flooding. They were concerned that the project would destroy a natural area. The residents mounted a public information campaign and gained the support of local newspapers and environmental groups.

The residents also initiated and passed a \$400,000 bond issue to buy the land for a park. The city got matching open space acquisition grants from two federal programs. The Corps of Engineers provided support with funds earmarked for the channelization project.

A gravel company was allowed to continue its operations on part of the site. Seven ponds formed by gravel excavation were eventually reworked to be natural ponds and were stocked with fish. A private group, Trout Unlimited, helped restore the habitat.

South Platte Park is now a 625-acre natural area along 2.5 miles of the river. It can absorb and store flood waters more efficiently than the channelization project would have.

South Platte Park is the largest remaining example of the South Platte River ecosystem. It is home to 60 species of plants, six times the number normally found in an urban Colorado wetland. It is now a class I cold-water fishery, home to wildlife, and a resting area for migrating birds and bald eagles. The park has nature trails and paths that connect to the 45-mile South Platte Greenway that runs through the Denver area. There is a nature center and educational programs are conducted by the schools for students and adults. This flood loss reduction project has protected a hazardous area from development. At the same time, the community has gained an invaluable resource for recreation, education, and fish and wildlife habitat.



- **Community programs**—Public information programs can address both the flood hazards and the natural and beneficial functions of floodplains; this can encourage citizens and students to protect these sensitive areas.
- **Reservoirs and diversions**—A lake or storage basin could support a hatchery and riparian wildlife.

Related interests

The following interests often have concerns that can be linked to protecting fish and wildlife and their habitats. They are discussed elsewhere in this chapter.

- Recreation
- Water supply
- Water quality
- Historic preservation
- Education.

Advice and assistance

The following agencies and organizations can provide advice and/or assistance on protecting and restoring fish and wildlife habitats. They could also support flood loss reduction measures.

- State fish and wildlife agencies
- U.S. Fish and Wildlife Service
- U.S. and state environmental protection agencies
- Natural Resources Conservation Service
- U.S. Army Corps of Engineers
- Local and state park, recreation, or conservation agencies
- Soil and Water Conservation District
- Conservation and outdoor groups (e.g., Izaak Walton League, Audubon Society, Boy and Girl Scouts)
- Hunting and fishing organizations (e.g., Ducks Unlimited)
- Recreational businesses (e.g., marinas, sporting goods stores)
- Wetlands Information Hotline.

Water Supply

Many communities' water supplies are drawn from the same river or lake that is flooding you. Water supply is also important to farmers who irrigate their fields. Everyone has an interest in seeing the water managed properly: they want to be sure there is enough of it and you don't want too much.

Opportunities

Here are some examples of how people concerned with water supply and those wanting flood losses reduced can reach compatible goals:

- **Planning and zoning**—Guiding higher density development to areas that can best be provided with water service may direct the development to flood-free areas.
- **Open space preservation**—Wetlands and open floodplains can help recharge groundwater supplies.
- **Watershed management**—Water supply agencies are concerned about the quality of runoff that enters their rivers and reservoirs. They often have special legislation or zoning restrictions on development in the watersheds that drain to their reservoirs. Such regulations can be coordinated with regulations that manage the quantity of runoff.
- **Community programs** -Some communities have extensive public information programs to promote water conservation. These same programs can also address the flood hazards and the natural and beneficial functions of floodplains.
- **Flood warning** -Water supply agencies may have their own gauging systems that can provide early notice of flooding.
- **Reservoirs and diversions** -Reservoirs often serve several purposes: flood control, recreation, and water supply.

Related interests

The following interests often have concerns that can be linked to protecting water supplies. They are discussed elsewhere in this chapter.

- Recreation
- Water quality
- Economic development
- Agriculture
- Education
- Transportation and infrastructure.

Advice and assistance

The following agencies and organizations can provide advice and/or assistance on protecting water supply. They could also support flood loss reduction measures.

- State natural resource agencies
- U.S. Army Corps of Engineers
- U.S. and state environmental protection agencies
- Natural Resources Conservation Service
- Soil and Water Conservation District
- Community water departments and private water companies
- Farmers dependent on irrigation
- Industries and economic developers.

Water Quality

The environmental benefits of clean water are well known. Recreation, fish and wildlife, and water supply interests are all concerned about the quality of the water they depend on. As with flood loss reduction, there is more than one way to improve water quality. For example, the cost of treating public drinking water can be significantly reduced by controlling watershed development to keep runoff as clean as possible. New York City saved over \$8 billion in new treatment facilities by managing the rivers that feed its reservoirs.

Opportunities

The following are examples of how people concerned with water quality can help support flood loss reduction and vice versa:

- **Watershed management**—Best management practices can readily combine water quantity and water quality objectives. A detention basin can store peak flows and let the pollutants settle out at the same time.
- **Wetlands protection**—Wetlands naturally filter and store surface waters, making them cleaner as well as reducing peak flows. Water leaving a wetland is cleaner than the water that enters it.
- **Community programs**—Many organizations have public education programs about protecting water quality. These programs can easily include information about flood hazards and the natural and beneficial functions of floodplains.

Related interests

The following interests often have concerns that can be linked to protecting water quality. They are discussed elsewhere in this chapter.

- Recreation
- Fish and wildlife
- Water supply
- Agriculture
- Education.

Advice and assistance

The following agencies and organizations can provide advice and/or assistance on protecting water supply. They could also support flood loss reduction measures.

- State natural resource agencies
- U.S. and state environmental protection agencies
- Natural Resources Conservation Service
- Soil and Water Conservation District
- Community water departments and private water companies
- Farmers dependent upon irrigation.

Urban Redevelopment

Floodplains and waterfronts often coincide with areas that are dilapidated or in need of renewal or redevelopment. As warehouses and waterfront businesses close or repetitive flooding eats away at homes, buildings deteriorate and are abandoned. It has been said that the floodplain of today is the slum of the future.

Many communities have city departments and neighborhood organizations dedicated to preventing or reversing this trend. Other organizations address community beautification. They mobilize volunteers to clean up, plant flowers, monitor property maintenance, and otherwise improve the appearance of the community. They often give awards for well-kept yards or improved building maintenance.

Opportunities

The following are examples of ways in which people concerned with redevelopment of blighted areas, urban renewal, and beautification could combine their efforts with flood loss reduction measures discussed in Chapter 3:

- **Planning and zoning**—Land use plans and zoning regulations can redirect development, for example, allowing a vacant warehouse district to be converted to a multi-family housing area that reserves the high hazard waterfront for open space for the new residents.
- **Development regulations and drainage system maintenance**—People concerned with property maintenance and dumping can help monitor compliance with floodplain, construction, and dumping regulations as well.
- **Relocation and acquisition**—Clearing away dilapidated buildings directly supports both urban renewal and flood protection.
- **Floodproofing**—Elevating or otherwise floodproofing buildings can prevent their continued deterioration. Often the same funding program can support both redevelopment and flood protection if floodproofing is considered part of bringing a building up to a safe and sanitary condition.
- **Community programs**—Local assistance programs and funding for property improvement can also cover insurance, floodproofing, and even relocation costs.

Related interests

The following interests often have concerns that can be linked to redevelopment, urban renewal, and community beautification. They are discussed elsewhere in this chapter.

- Economic development
- Housing improvement
- Historic preservation
- Transportation and infrastructure.

Advice and assistance

The following agencies and organizations can provide advice and/or assistance on redevelopment, urban renewal, and community beautification. They could also support flood loss reduction measures.

- State community affairs and economic development agencies
- State planning offices
- U.S. Department of Housing and Urban Development
- Economic development agencies
- Housing authorities
- Community development and planning offices
- Chambers of commerce and business or manufacturers' organizations
- Neighborhood organizations
- Garden clubs, beautification groups
- Urban Land Institute, National Community Development Association.

Economic Development

Some of the strongest community concerns are those that relate to the local economy: jobs, business survival and expansion, tax base, and viability of the downtown. In some communities, the economic base was built on the waterfront. In other communities, the waterfront has potential for economic development of businesses like shipping, marinas, restaurants, and resorts.

Sometimes, economic development is seen as contrary to good floodplain management. Many people believe the best floodplain is an empty one. However, with adequate safeguards to protect against flood damage and to preserve natural floodplain functions, economic development can be very supportive of a flood loss reduction program.

A floodplain that attracts people can also have signs and educational materials that tell them about the flood hazard and benefits of good floodplain management. They will see that the area is worth their attention and will become concerned about protecting it. Another benefit of economic development is that the developers may help fund other flood loss reduction activities, such as a warning program or wetlands preservation.

Opportunities

The following are examples of ways in which economic development and waterfront revitalization could support some of the flood loss reduction measures discussed in Chapter 3:

- **Planning and zoning**—Land use plans and zoning regulations can prevent inappropriate floodplain development, such as industries that handle hazardous materials.
- **Open space preservation**—Waterfront renewal is most successful when plans include recreation, greenways, and economic development. Open space can support adjoining businesses like shops and restaurants with

views, picnic facilities, and playgrounds. Tourism is furthered by waterfront parks, trails, nature preserves, and similar appropriate floodplain uses.

- **Relocation and acquisition**—Acquiring run-down areas can clear the way for economic redevelopment.
- **Floodproofing**—Elevating or otherwise protecting buildings from flood damage can reduce business down time during and after floods, thereby reducing disaster assistance payments, unemployment compensation, and bankruptcies.

Related interests

The following interests often have concerns that can be linked to economic development and waterfront revitalization. They are discussed elsewhere in this chapter.

- Recreation
- Water supply
- Urban redevelopment
- Transportation and infrastructure.

Advice and assistance

The following agencies and organizations can provide advice and/or assistance on economic development and waterfront revitalization. They could also support flood loss reduction measures.

- State economic development agencies and tourism offices
- State planning offices
- U.S. Economic Development Administration
- Community development and planning offices
- Economic development and job training agencies
- Chambers of commerce and business or manufacturers' organizations
- Recreational businesses (e.g., marinas, sporting goods stores, restaurants, hotels)
- Water-dependent businesses, barge operators, warehouse
- Utility companies, railroads, and others that serve business and industry
- Urban Land Institute, National Community Development Association.

Housing Improvement

Every community has homes and every homeowner and renter wants a better place to live. Therefore, there are many people who support housing improvement activities that range from maintenance code enforcement, financial assistance to lower-income residents, public housing, and technical and financial assistance to maintain or upgrade buildings.

Opportunities

The following are examples of ways that those interested in housing improvement could support some of the flood loss reduction measures discussed in Chapter 3:

- **Open space preservation**—Recreation areas are desirable additions to a residential neighborhood and can enhance property values.
- **Real estate disclosure**—If they are advised of the hazard, newcomers can prepare, buy flood insurance, and retrofit their homes before a flood occurs.
- **Relocation and acquisition**—Relocating a family away from a hazardous area and a deteriorating building is one of the best housing improvement activities possible.
- **Floodproofing**—Elevating or floodproofing a home is a home improvement project. For example, by elevating a house eight feet, the owner gets a new garage and storage area on the lower level.
- **Insurance**—Well-insured flood victims have used their claims payments, their own labor, and/or additional funds to replace flood-damaged items with new and better ones.

A M-O-M Success Story

Frankfort, Kentucky, developed a flood hazard mitigation plan to cover areas that were not scheduled to be protected by a planned floodwall. The areas included residential, commercial, and industrial uses as well as historic buildings. A task force was formed in 1991 with representatives from each of the affected neighborhoods and advisors from state and local agencies.

The city has since implemented most of the task force's recommendations. The high-velocity floodway has been cleared. A loan program has helped residents finance floodproofing projects. Supporting agencies included the Federal Emergency Management Agency, the Department of Housing and Urban Development, the Kentucky Housing Corporation, Frankfort Housing Redevelopment, Inc., and Habitat for Humanity. The last three groups help obtain replacement housing for those whose properties were bought out.

"Spin-off benefits" from this project that were not related to the original flood problem include:

- increased open space and recreation opportunities,
- improved housing for those relocated from substandard homes,
- improvements to non-flood-prone houses that were purchased and brought up to standard as replacement homes,
- training of the youths who helped rehabilitate replacement homes, and
- an increase in the property values of the surrounding area.

- **Community programs**—Local guidance and funding for housing maintenance and property improvement can also address floodproofing, flood insurance, and other ways to protect the owner physically and financially.

Related interests

The following interests often have concerns that can be linked to housing maintenance and improvement. They are discussed elsewhere in this chapter.

- Recreation
- Urban redevelopment
- Economic development
- Education
- Transportation and infrastructure.

Advice and assistance

The following agencies and organizations can provide advice and/or assistance on housing maintenance and improvement. They could also support flood loss reduction measures.

- U.S. Department of Housing and Urban Development
- State housing and planning agencies
- Local housing authorities
- Community development, planning, and code enforcement offices
- Neighborhood associations
- Home improvement stores and contractors
- Urban Land Institute, National Community Development Association.

Agriculture

Agricultural interests include farmers, agribusiness, and rural communities that have farming, forestry, or ranching as their economic base. Their livelihoods are dependent on the land, the water, and the weather, so what happens in the watersheds and floodplains is important to them. Comprehensive resource planning that balances economic and environmental concerns would be well received by the agricultural community and benefit all interest groups.

Poor or inappropriate farming, ranching, and forestry operations can have as adverse an effect on runoff and flooding as urban development. Clear cutting, overgrazing, and poor farming and tillage patterns can contribute greatly to erosion and downstream sedimentation. Drainage modifications may increase runoff volumes. Many floodplains have been constricted by levees built to give farmers more “dry” and productive years. Livestock waste and farm chemicals add pollutants to rivers and lakes.

Opportunities

The following are examples of ways that agricultural interests can combine their activities with some of the flood loss reduction measures discussed in Chapter 3:

- **Planning and zoning**—Floodplains often contain very rich farmland. They can be preserved as farms with appropriate land use plans and zoning regulations.
- **Open space preservation**—In some states, preserving farmland is encouraged by property tax credits. Landowners can be paid from the Wetland Reserve Program to protect wetlands.
- **Watershed management**—Runoff loads are reduced, water quality (and irrigation supplies) are improved, and erosion and land loss are minimized through best management practices that reduce runoff from croplands, feed lots, and timbered areas; erosion and sediment control measures; contour strip farming; impoundment systems; farm ponds; and no-till farming.
- **Drainage system maintenance**—In flat areas, especially on the prairie and in deltas, good drainage of farm land is essential to make it productive. Maintaining the drainage system benefits both farmers and those concerned with flooding.

A M-O-M Success Story

Agricultural development in the Upper St. John's River basin in northeast Florida had reshaped the land since 1900. The historic floodplain had been shrunk by levees built to provide dry land for crops. Over 62% of the river's headwater marshes had been destroyed.

The St. Johns River Water Management District worked with the U.S. Army Corps of Engineers to devise a flood control plan that was also environmentally sensitive. They called the approach "semi-structural," meaning that it relies less on artificial controls and more on the function of the natural river floodplain to store and manage floodwaters.

Levees, spillways, and water control structures were built, but a large part of the water is stored in four marsh conservation areas. There are also several small reservoir storage areas built on former farmland. The reservoirs are relatively deep because the farmland had subsided due to groundwater pumping.

The system is managed to provide flood protection, agricultural, and environmental benefits. After heavy rains, the system stores excess water and lets it out slowly, protecting downstream areas from flooding. This approach also prevents high fresh water loads from damaging the shell fishery in the Indian River Lagoon.

The effluent from farm field and livestock pastures is segregated from the floodplain and reused for farm irrigation and freeze protection. In all, there are more than 125,000 acres of pristine and restored freshwater marshes, which help clean the river water. They also provide habitat for fish and wildlife which, in turn, provides recreational opportunities.

- **Reservoirs and diversions**—The lake or storage basin may provide water for irrigation.

Related interests

The following interests often have concerns that can be linked to agricultural matters. They are discussed elsewhere in this chapter.

- Fish and wildlife
- Water supply
- Water quality
- Economic development
- Transportation and infrastructure.

Advice and assistance

The following agencies and organizations can provide advice and/or assistance on matters of farming, forestry, and ranching. They could also support flood loss reduction measures.

- State agriculture departments
- U.S. Department of Agriculture
- Soil and Water Conservation District
- Farm organizations (e.g., Farm Bureau, Future Farmers of America)
- Agricultural businesses (e.g., chemical and seed companies)
- National Association of State Foresters.

Historic Preservation

Historic features include buildings, museums, archeological sites, historic landscapes, and collections. Sometimes they are identified by historic preservation agencies or local organizations. Sometimes there are enough of them in a concentrated area to constitute a designated historic district.

These features are irreplaceable. Most people responsible for their preservation or restoration recognize that if they were hit by a flood or other disaster a valuable community and educational asset would be destroyed. Even “minor problems” such as a flooded basement, high humidity, salt water, or loss of power can severely damage delicate or aged materials. Therefore, it is not uncommon for these features to have their own flood emergency plans.

Historic preservation personnel may also be concerned about the use of traditional structural measures. Reservoirs can flood historic or archeological sites. Levees and channel modifications can disrupt vistas. Accordingly, people concerned with historic features are natural allies for those looking at a variety of ways to reduce flood losses.

Opportunities

The following are examples of ways that those interested in historic preservation can support some of the flood loss reduction measures discussed in Chapter 3:

- **Relocation and acquisition**—Clearing neighboring properties can improve the surroundings of an historic site and even make it more closely resemble its original condition. Sometimes an archeological or historic inventory should be done before the site is redeveloped
- **Floodproofing**—Floodproofing an historic building is sometimes the only way to protect it without disrupting its appearance or setting.
- **Community programs**—Public information programs can cover the history of flooding and its impact on the site’s or the community’s past.
- **Flood warning**—Early warning may provide lead time to move collections and take other steps to protect historic features.

Related interests

The following interests often have concerns that can be linked to historic preservation. They are discussed elsewhere in this chapter.

- Recreation
- Urban renewal
- Economic development
- Education.

Advice and assistance

The following agencies and organizations can provide advice and/or assistance on historic preservation. They could also support flood loss reduction measures.

- State historic preservation office
- U.S. Department of the Interior, Preservation Assistance Division
- State and local historical societies
- Museums
- School and university history departments
- Community development and planning.

Education

A community’s most important asset is its children—the future generations who will inherit the resources, infrastructure, and development left to them. They will be facing the same natural forces that cause periodic flooding. The watersheds and floodplains will be theirs to farm, build on, and care for.

Therefore, it is important that today’s children know about flooding, the forces that cause it, the factors that cause flood problems, and the wisdom of protecting the natural and beneficial functions of watersheds and floodplains.

After economic development, education and schools are probably the most important issue in any community. Parent-teacher organizations are one of the strongest “grass roots” groups that reach out to many residents and have many active participants. They can be very useful in spreading the word and gaining

support for a M-O-M plan that includes both education and flood loss reduction elements.

Education is not limited to children. Adults, especially decision makers, elected officials, and those active in land development, benefit from a deeper knowledge of flood problems, their causes, and solutions. Closely allied to educational interests are those involved in public information and research.

Opportunities

The following are examples of ways that those interested in education, schools, public information, and research could support flood loss reduction:

- **Open space preservation**—Many parks and preserves provide opportunities for informational displays, nature and educational centers, interpretive trails, and field work for research, study, or class projects.
- **Acquisition and relocation**—Schools may be interested in converting adjacent floodplain properties into athletic fields or parking areas.
- **Community programs**—Some of the most effective public awareness projects include school programs. Parents are more likely to read what their children bring home than informational materials that may look like junk mail. Floodplains and wetlands have been used effectively as outdoor classrooms.
- **Flood warning and response**—Schools are required to have emergency drills. They can include flood warning and safety information.

Related interests

The following interests often have concerns that can be linked to education. They are discussed elsewhere in this chapter.

- Recreation
- Fish and wildlife habitats
- Housing improvement
- Historic preservation.

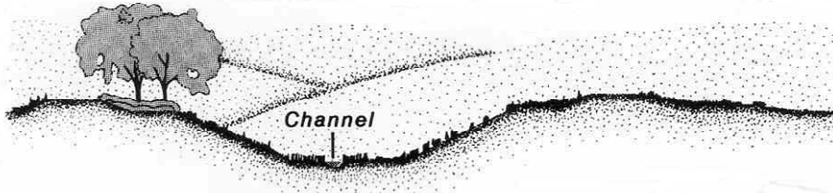
Advice and assistance

The following agencies and organizations can provide advice and/or assistance on education, schools, public information, and research. They could also support flood loss reduction measures.

- State education, conservation, and recreation agencies
- U.S. Department of Education
- Local school districts, science teachers
- Municipal and county public information officers, emergency managers
- Parent-teacher organizations, teachers' unions/associations

**A M-O-M
Success
Story**

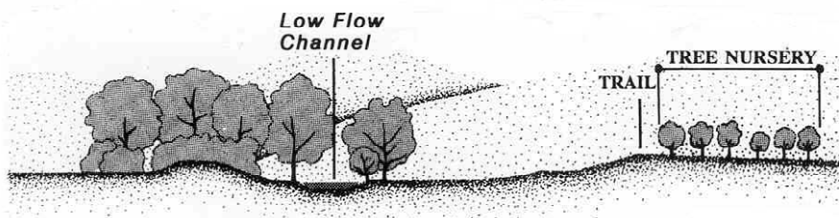
The Wildcat and San Pablo Creeks flow through Contra floodplains were developed to house the labor forces that served the nearby shipbuilding industry during World War II. Proposed flood control plans to modify the creeks' channels were turned down by the residents and others because they were too expensive, would destroy riparian habitat, and had no recreational or other community benefits.



1982 SELECTED PLAN (ORIGINAL)

A coalition was formed to prepare alternative plans. The coalition included a neighborhoods coordinating council, environmental groups, and a parks committee. A consensus plan was developed with support from the county government and staff support from state and federal conservation and recreation agencies.

The consensus plan incorporated natural channel geometry in the same area that had been reserved for the channel modifications, protection of wetlands from sediment loads, and restoration of riparian vegetation. A low flow channel is maintained using natural features and minimal human intervention.



1986 CONSENSUS PLAN (FINAL)

The channel and its floodplain provide recreational and educational opportunities with trails and recreation areas. A nature study area was established at an elementary school that is located along Wildcat Creek.

The plan was promoted as serving the multiple objectives of flood control, marsh restoration, educational opportunities, and environmental enhancement. While the earlier single-purpose channel project could not be funded, this plan was implemented with \$2.5 million from the local park district, the U.S. Army Corps of Engineers, and three different state agencies. The M-O-M approach paid off after working on flood control alternatives had been at an impasse for 29 years.

- Conservation organizations (Audubon Society, Izaak Walton League)
- Natural Resources Conservation Service
- Youth organizations (Boy and Girl Scouts, YMCA)
- Museums
- University and private research organizations
- Media: television, radio, newspapers
- National Project WET (Water Education for Teachers).

Transportation and Infrastructure

Many older communities in this country were settled on the floodplain because of the transportation advantages. Seaports, harbors, wharves, and docking facilities all require locating valuable development on or next to the source of flooding. Other development followed nearby and transportation systems were built to serve it all.

Railroads and roads were built in the floodplain because it provided vacant, flat land that facilitated right-of-way acquisition and construction. In mountainous areas, the river valleys provided the only access through rugged terrain. While railroads and roads are particularly exposed to flood damage, they can also be responsible for many local flooding problems where their fill and bridge openings disrupt drainage systems or obstruct flood flows.

Other parts of a community's infrastructure face deterioration that can be accelerated by flooding. Water, gas, and power lines can be exposed and broken by flooding and scouring. Sewer lines get overloaded as new development adds to the runoff. Sometimes the organic soils found in floodplains and wetlands facilitate the movement and breakage of the lines.

Communities are now faced with roads and utility lines that need improvement and upgrading. Many times, people do not want simple replacements. They want the concrete highways removed from blocking their waterfront vistas, larger water and sewer lines, and alternative facilities like bikeways and trails.

Transportation concerns include water transportation. Many structural projects, especially dams, must account for boat traffic. Even nonstructural projects can improve navigation (see the next success story).

Opportunities

The following are examples of ways in which water and land transportation, public works, and utility interests can support some of the flood loss reduction measures discussed in Chapter 3:

- **Open space preservation**—Parks, preserves, and linear greenways can incorporate hiking and biking trails. These alternative transportation corridors can relieve the hazards of pedestrians and bicycles on heavily traveled streets and also reduce air pollution.
- **Drainage system maintenance**—Keeping bridges, culverts, and overhead utility lines clear of debris will lengthen their life expectancy and minimize their obstruction of flood flows.

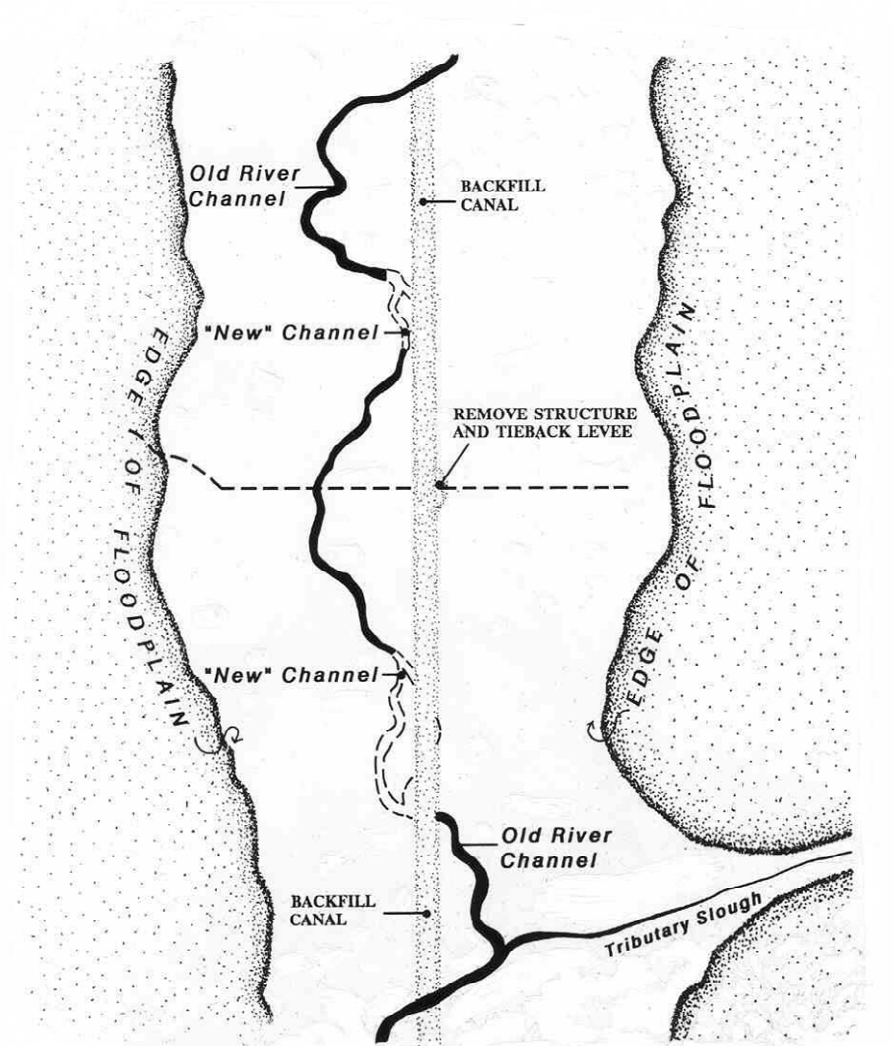
A M-O-M Success Story

The Kissimmee River in Florida had been channelized in the 1960s. Over 80% of the floodplain's wetlands were drained, filled, or converted to canals. Boats could travel during low flows because dams kept water levels up. However, they could only go through the locks during daylight.

The U.S. Army Corps of Engineers worked with state and local committees to restore the floodplain to something closer to its original condition. Nearly 2/3 of the original wetlands will be restored and the entire system that serves the Everglades will be improved.

The flood protection part of their plan involved purchasing floodplain properties and converting them to open space. Over 53,000 acres will eventually be purchased or reserved through flood flowage easements. Over 70,000 acres will be able to flood naturally, storing flood waters and reducing flows downstream.

The canal is being backfilled in segments to restore the river's natural flow pattern. Although boats cannot travel during low flows, they no longer need to rely on the locks. When there is enough water (90% of the year), they are free to move 24 hours a day.



- **Relocation and acquisition**—Removing buildings from the floodplain eliminates the need for the flood-prone roads and utilities that serve them.
- **Floodproofing**—Keeping flood waters out of buildings protects sanitary sewers from inflow.

Related interests

The following interests often have concerns that can be linked to water and land transportation, public works, and utility interests. They are discussed elsewhere in this chapter.

- Recreation (boating, trails)
- Water supply
- Urban redevelopment
- Economic development.

Advice and assistance

The following agencies and organizations can provide advice and/or assistance on transportation and infrastructure. They could also support flood loss reduction measures.

- State transportation and highway agencies
- State planning offices
- U.S. Department of Transportation
- U.S. Department of Housing and Urban Development
- Local public works, streets, water, and sewer departments
- Utility companies, regional or metropolitan sanitary districts
- Community development, economic development, and planning offices
- Transportation companies (truckers, railroads, barge operators).

Chapter 5

Preparing a M-O-M Plan

A multi-objective management plan is a written statement of the facts, a review of alternatives, and recommendations on how to meet community goals and objectives. Anyone can prepare a plan—a report with recommendations of what should be done. But only by following a proper planning process can you determine what is best for your community and get everyone to agree on what to do.

The process is the key. You may not need to produce a fancy document or follow every step in detail. However, keep in mind the overall process, which follows the headings for the sections in this chapter:

- Organize
- Involve other local people
- Involve agencies and organizations
- Define the problems
- Agree on goals and objectives
- Review alternatives and select the best ones
- Prepare a written document
- Get public and official acceptance
- Implement and follow through.

Although the main objective in preparing a plan is to formalize your work, there are other benefits, too. It is educational, because participants learn more about their own and others' concerns and learn about the techniques and measures that can improve your community.

In addition, planning brings people together. The act of working cooperatively to produce the document gives the participants “ownership” in the product. Many people will want to see that what they worked on actually gets implemented.

Finally, many state and federal programs require a plan as a prerequisite to providing you with assistance. Funding organizations want to know how their money fits into what the community wants to do. They also want to know how their share can “leverage” more action by other people or groups. The written plan explains what you're doing and shows others how much you're doing for yourselves.

Organize

The most efficient way to get people to work together is to be organized. Organizing gives each participant a specific responsibility, so the workload is distributed and carried out by those who are or will become experts in certain topics.

Organizing can be done informally by simply talking to the same people on a regular basis. However, a more formal organization can be more productive, especially as the issues expand and become more complex.

WHY ORGANIZE A GROUP?

- The participants in an organized group will recognize that they are involved and will be more willing to commit themselves to the process.
- Each participant can do some of the work, especially data gathering, thereby reducing the overall cost.
- A group or committee is an effective forum for discussing alternatives, debating goals and objectives, and matching the technical requirements of a program to your local situation.
- An organized approach gives participants a feeling of “ownership” of the plan and its recommendations, which helps build public support for it.
- Committee members form a constituency that will have a stake in ensuring that the plan is implemented.

The typical approach is to create a planning committee. This can be a self-appointed group of individual citizens; an organization created by your local government; another existing organization, like a neighborhood association; or part of a local comprehensive or community development planning effort.

Getting started

As long as there is more than one person interested in following the M-O-M approach to reduce flood damage, there is a reason to get organized. Often, only one active and vocal person can get the ball rolling. The key is to have people recognize that by working together, you have a better chance of reaching everyone’s goals.

If you are a person who wants to see the process begin, you should talk to others. Once you have 10–20 people who are willing to support you, you should discuss getting more formally organized. If the others agree, start with your elected representatives on the city council or town or county board.

Even though you may view your city or county government as part of the problem, it can pay off to work with them and have a planning committee with official government recognition. If your elected representatives realize that there is a flood problem and that there are alternatives for solving it, they should support you.

Being an official committee appointed by your local government not only gives legitimacy to your work, but also can give you some needed staff and office support. State and federal agencies are more likely to respond to requests for help from a representative of a local government (in fact, some agencies can only respond to a government request).

Your problem may extend beyond your community’s corporate limits. You may need to involve several cities or counties. In that case, one group can take the lead and ask other entities to appoint representatives. Check with an agency that covers the

entire watershed or affected area, such as the county, a multi-county planning commission, or a water management district.

If you find that you are just about the only person who cares and you cannot raise support from others, you may want to consider joining another planning body. For example, you may be more productive working on a recreation board or land use planning committee. Instead of those interest groups coming to your committee, you can take your concerns to them. Multi-objective management does not mean you have to manage a flood group. It means that other groups incorporate flooding into their concerns, too.

Running the committee

A committee needs a chairperson. If the committee is created by the local government or another organization, the creating body will probably select the chair. A self-appointed committee can elect its own chair.

The leader should be chosen for his or her ability to get people to work together and get things done.

The committee probably will need subcommittees so participants can spend more time on details that do not need to be discussed during the meetings of the main committee. Usually the chair is given the power to name subcommittees and appoint their members. Determining who has a vote usually is not necessary, because most issues are decided by consensus.

Schedule meetings to include as many people as often as possible. One key threat to the process is that it starts to drag and become boring. Nine months of monthly meetings with nothing to show but a draft piece of paper can discourage many committee members. Maintaining momentum throughout the process is important.

Field trips, for example, are both diverting and educational. They allow committee members to see the problems and examples of solutions first hand. Destinations may include floodproofing sites, reservoirs, emergency operations centers, restored wetlands, and similar sites to give participants a first-hand view of how the flood loss reduction measures work. Such field trips often change skeptical minds.

CONSENSUS

One of your goals is to have the various groups reach consensus on procedures, goals, and issues. Consensus does *not* mean majority vote. It means a general agreement or something “everyone can live with.”

Involve Other Local People

Your flood program will have to fit local needs. The only way to be sure that it does is to involve other local interest groups so their needs are recognized and built into the process and plan. Multi-objective management means getting people to support each other’s programs. If they are not involved in your work, other folks will be competing with you for scarce resources. They will be trying to get their own single-purpose projects funded. It is better for everyone if you become allies in support of mutual objectives.

The planning process will succeed only if the right people are involved. Two groups of people are important: those affected by the issues (see below) and the technical staff of the agencies and organizations involved in the solutions (see the next section). Those affected include:

- Owners and renters of flood-prone homes
- Homeowner or neighborhood organizations
- Managers of flood-prone businesses, power stations, schools, etc.
- Farmers and others who affect runoff conditions in the watershed

BENEFITS OF INVOLVING OTHER INTEREST GROUPS

- More local needs met
- Stronger local support
- A more realistic final plan
- Fewer misunderstandings
- A shared workload

- “River watchers,” “Friends of the _____ River,” and members of similar organizations
- Land developers, real estate agents, lenders, and others who affect the future of the floodplain and watershed lands
- Local watershed councils or associations
- People interested in other related causes, e.g., representatives of the agencies and organizations listed at the end of each section of Chapter 4.

Remember, “involvement” doesn’t mean that these people just sit on a committee or that they are expected to always support what the chair proposes. A good leader will make sure everyone is heard. You need them to make sure that committee proposals will be acceptable to their constituencies. These people have their own concerns and flooding may not be one of their main ones. They should not be viewed as a burden but as people who can help you design a broader, more effective program and also provide support for it. There are many ways for them to participate:

- They can serve on or send a representative to the planning committee.
- You can invite them to those meetings that address the issues that are most important to them.
- You can distribute a questionnaire or host a workshop to gather their input.
- You can conduct a “waterfront day” or a demonstration project to attract public attention and raise awareness and interest.
- They can be kept abreast of what’s going on through a newsletter or presentations at their own groups’ meetings.
- They may simply want to have a chance to review the draft plan.

The level of other people’s involvement depends on how much time they have available and how much the issues affect them. One of the most important things is that they are asked to participate, that they are offered a chance to have a say in your planning work.

Involve Agencies and Organizations

There are two reasons to involve government agencies and private organizations in your planning efforts. First, they may be doing or planning something that can affect flood damage or some of your community’s other concerns. You want to avoid conflicting with a government program or duplicating the work of another organization. State, regional, and federal agencies may be doing flood control or watershed planning. Although they probably won’t incorporate all of your community’s concerns in their project, it is likely that they will do a thorough evaluation of flood control alternatives. That can save you a lot of work.

The second reason to involve outside agencies and organizations is to see if they can help. Help may be in the form of flood hazard data, technical information, guidance on regulatory requirements, advice and assistance in the planning process, carrying out a specific measure, and/or financial assistance to help you implement a recommended project.

Finding the right organizations

At a minimum, your committee should contact the planning or engineering offices in the cities, villages, towns, and county governments in your watershed. Find out who is the most appropriate local official for flood-related matters and talk to that person. Find out how interested they are in flooding issues and what they are doing.

Most of your recommended activities will be carried out at the community level, so the staff who will be responsible for implementing the plan should be involved in developing it. Which personnel to involve depends on the community's organization and the measures that will likely be reviewed and/or selected during the planning process.

Other flood-related agencies and organizations include:

- The local building department that issues permits for floodplain and watershed construction
- The soil and water conservation district
- The U.S. Department of Agriculture agencies that work with watershed property owners (e.g., the Natural Resources Conservation and the Cooperative Extension services)
- Regional or metropolitan water, sewer, or sanitary districts
- The city or county emergency management or civil defense agency
- The state natural resources or water resources agency
- Local watershed councils or associations
- The district office of the U.S. Army
- Corps of Engineers.

Check in the "To Find Out More" section under each flood loss reduction measure in Chapter 3 to find additional agencies to contact. Your committee should also contact the agencies and organizations listed at the end of each section in Chapter 4. For example, your committee may designate a representative from a parent-teacher organization to be the liaison with the school district and youth organizations.

Reaching the right offices

It can be hard to find the right people, especially if they are in a big agency or organization. Start with your local offices and ask who their contacts are in the regional, state, and federal agencies.

IDENTIFYING AGENCIES AND PROGRAMS

More references and contacts in floodplain management agencies and programs can be obtained through your State NFIP Coordinator (see Appendix A), the Association of State Floodplain Managers ((608) 274-0123) and the Floodplain Management Resource Center ((303) 492-6818)).

An excellent source of information is the *M.O.M. Resource Directory* prepared jointly by the Federal Emergency Management Agency and the National Park Service. It is a computer program that lists over 300 government and private programs. It is easy to install and use. The software is designed to run in Windows and is available free from:

Rivers, Trails and Conservation Assistance
National Park Service
P.O. Box 25287 IMFA-RM-S
Denver, CO 80225-0287
(303) 969-2781 fax: 303-987-6676

Assistance on wetlands issues can be obtained by calling the USEPA Wetlands Information Hotline at (800) 832-7828.

You can check the government pages in the telephone book and the names of private organizations in the white or yellow pages. If you can't find the right office, use the list of national offices in Appendix A. You may have to call Washington, but they can tell you the location and phone number of the office of their agency closest to you.

You can expect to have to explain your situation several times and be routed to different people. When possible, obtain the name as well as the telephone number of someone in the office you are referred to. Above all, be patient, follow leads, and line up alternative sources to talk to.

For example, if you want to know more about the rules for construction in wetlands, check the section of this guidebook on "wetlands protection" in Chapter 3. It notes that more information can be obtained from local permit and engineering offices. Those folks can tell you who to contact in a stormwater management agency or the Corps of Engineers.

M-O-M planning assistance

The agencies and organizations listed in each section of this guidebook can tell you about the more common assistance programs. And each one can give you leads to more programs.

Help in organizing and conducting the M-O-M planning may be available from a local, regional, or state planning agency or a private organization. The National Park Service's Rivers, Trails and Conservation Assistance Program provides staff support for local planning under certain conditions. If they can't help with the whole thing, they may be able to help with some tricky parts, like providing a facilitator for an all-day community input workshop.

Another source of assistance is a private consultant. Planning and engineering firms usually have personnel skilled in the various flood loss reduction measures and the planning process.

Define the Problems

The "problem" to be addressed by your plan is not just the flood problem. It includes all the concerns raised by the other groups involved in your effort. Getting everyone to agree on a problem statement is the first step in getting them to agree on goals and solutions.

The flood problem

First, identify your planning area. Is it your immediate neighborhood, the whole city, or everything in the watershed? There should be a written description of the location and types of flooding that occur in your area.

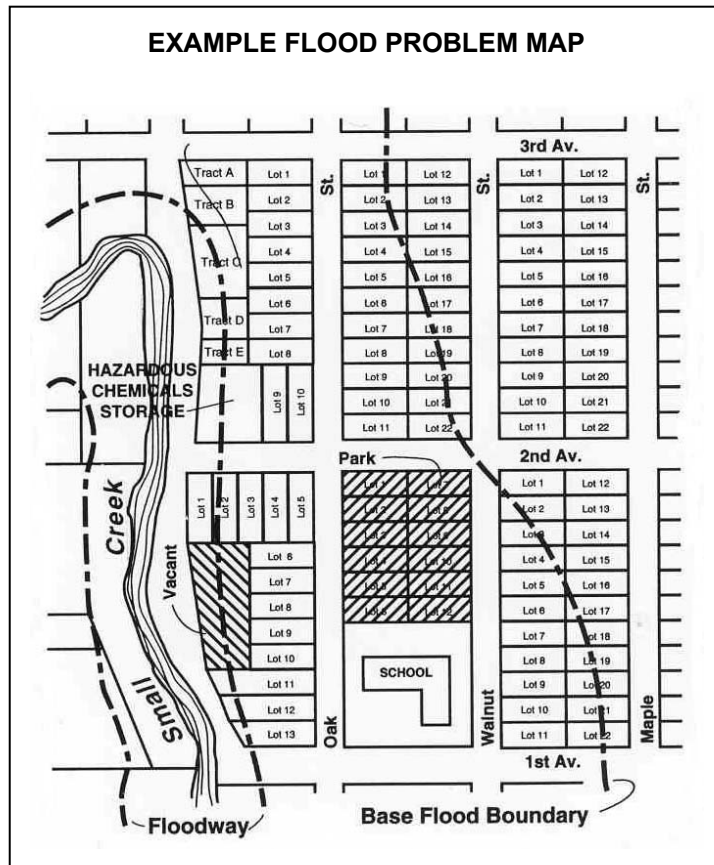
The flood data listed in Chapter 2 should be sufficient for planning purposes. Most of what is needed is available in existing studies, so you probably don't need to conduct studies to develop new flood maps or data.

However, if people get wet, they consider it flooding and they'll want you to address it. Therefore, this step should review flooding from small ditches, flooding in depressional areas, and sanitary or storm sewer backup that isn't shown on your Flood Insurance Rate Map or covered in existing engineering studies.

How much time and effort is spent on collecting data depends on the time and resources available. However, the planning process should not be delayed while waiting for more data just so you can develop a highly detailed problem description. It's more important to get moving.

The problem description should include a map or maps of the area of concern, which can be updated as more information comes in. It should also have a discussion of the impacts of flooding. The following should be mentioned:

- The number, types, and locations of buildings affected by the base flood
- The type of damage expected (are the buildings washed away or do they just get wet?)
- Roads, bridges, and transportation facilities closed during a flood
- Critical facilities affected (e.g., hospitals damaged or isolated)
- Areas of repetitive flooding
- Flood protection measures in effect or under construction
- What happened in past floods
- Undeveloped areas and wetlands that can provide “natural and beneficial functions.”



Other hazards

A good plan should integrate consideration of other hazards besides flooding. They can be natural hazards, such as hurricanes, earthquakes, tornados, ice storms, drought, and wildfire; and “technological” hazards, such as releases from nuclear power plants and hazardous materials spills.

Most of these hazards are not site specific. However, some technological hazard sites may be in the floodplain. When they are flooded, the danger and damage caused by a flood is greatly increased. The local and county emergency management office has more information on these hazards and what is being done to protect people from them.

Your written problem statement may devote just as much space to each of the other concerns as it does to flooding. To be a true multi-objective approach, you may have to suppress your desire to make flooding the number-one concern.

Other concerns

A M-O-M plan needs to discuss the other objectives besides protection from natural hazards. During this phase of the planning process, you should be involving representatives of the other interests discussed in Chapter 4. Some of them may already have written problem statements or plans that they can give you.

A final topic that should be addressed is the future. Your problem definition should review expected changes to the watershed and floodplain, especially the development potential of vacant land. It should also note the trends for redeveloping flood-prone areas.

Agree on Goals and Objectives

Up to now, the planning work has been relatively noncontroversial. You have been talking to agencies and organizations and collecting and recording facts. Now comes the tough part—getting people to agree on what should be done.

Goals and objectives

Goals are general statements of direction, such as “reduce flood damage to existing buildings” or “improve recreational opportunities.” Objectives are more specific targets. Examples of objectives that support these two goals could be “acquire and relocate the homes on Small Creek between 1ST and 3RD Avenues” and “double the number of boat slips so more people can use the lake.”

Community goals and objectives and other potentially controversial issues may already have been resolved if the community has prepared other plans in the past. But it is more likely that you will need to identify and clarify everyone’s concerns and goals so you can all agree on the wording of your statements of the goals and objectives.

Reaching agreement

It is often fairly easy to reach agreement on overall goals, but it is not unusual to take a long time to reach consensus on specific objectives as they relate to particular areas of the community or individual properties. However, the time spent is well worth it, because this is vital to gaining everyone’s agreement and cooperation.

It helps if goals are positive statements, something people can work for, rather than negative statements about the community’s deficiencies. Where possible, settle on goals and objectives that support more than one interest, e.g., “implement erosion reduction measures to sustain farmland, improve water quality, and reduce sedimentation in stream channels.”

Generally, “agreement” means consensus or something everyone can live with. You should strive for unanimous support or at least agreement that no one will oppose a goal or objective. Short of that, you have to judge for yourself if you must settle for a decision by majority vote on a particularly contentious issue.

You probably will have a good feel for whether agreeing on goals and objectives will be difficult. If it does not appear to be too divisive, try this simple approach:

1. Have everyone write their goals and objectives down.
2. Post them for all to see, combining those that are the same or similar.
3. Restate them in summary form, using positive statements.
4. Identify those that everyone can agree on.
5. Discuss what problems people have with the ones that are left.
6. See if agreement can be reached if some words are changed.

If this approach doesn't work, you have two options: either drop the more detailed statements and get consensus on the general goals or invite an experienced facilitator to help you move through a formal process of consensus building. You may want to line up a facilitator in advance so you don't lose your momentum or waste time arguing over details.

A trained facilitator can be very helpful. As a neutral outsider, he or she can be trusted by everyone to give all interests a chance to be heard. Facilitators also know numerous exercises and other ways to identify common concerns and minimize differences. They are skilled at separating issues and interests from discussions of people and positions. They can build an atmosphere in which give and take is easier and productive.

To Find Out More >> See also the *Guides for Watershed Partnerships Series'* booklets, *Building Local Partnerships*, *Leading and Communicating*, and *Managing Conflict* for additional guidance on building consensus.

Review Alternatives and Select the Best Ones

As shown in Chapters 3 and 4, many different measures can be brought to bear on the flood problem and help meet other goals. Many of them are inexpensive and easy to implement. The M-O-M approach won't work unless you examine all of the possible alternatives.

How to review

The section headings in Chapter 3 can be used as a checklist to ensure that everything is considered. No measure should be discarded until you are sure you understand what is involved. Although some measures may be quickly eliminated as inappropriate, most deserve careful consideration, especially to make sure everyone understands how they work and what their costs and benefits will be.

You and your fellow planners should systematically review each possible measure. Reject a measure only if you answer "no" to one or more of these questions:

- Is the measure technically appropriate for the flood hazard?
- Does it support any of your goals and objectives?
- Do its benefits equal or exceed its cost?
- Is it affordable?
- Do you know where the money will come from?

- Will it comply with all local, state, and federal regulations?
- Does it have a beneficial or at least neutral impact on the environment?

In some cases, answers will not be readily available—especially when a large structural project is being considered. Questions about technical matters or the details of agency programs should be directed to experts from the agencies or organizations.

Funding

Money is often the most important issue in reviewing alternatives. Two questions arise: “Is the project worth the expense?” and “Where can we get the money?”

Questions about the value of benefits gain significance as the cost goes up. In these cases, you may need an additional, more detailed analysis before you can recommend something. Your plan could recommend conducting a benefit-cost analysis before deciding on a project or you could condition your recommendation on the availability of funding.

Two documents about comparing benefits and costs are the Corps’ *Flood Proofing—How to Evaluate Your Options* and the Federal Emergency Management Agency’s computer software *Benefit/Cost Analysis of Hazard Mitigation Projects*. The latter is not only helpful, but also the Federal Emergency Management Agency uses it to determine if a project should be funded under several of its programs. Remember that an economic review of benefits and costs or a system used by one agency should not be the sole determinant of whether a project is right for your situation.

Sources of funding

Where can you get the money? This is where agencies and organizations can be of great assistance. There are literally hundreds of public and private programs that can help pay for worthy projects. They usually have several prerequisites, such as a written plan, a budget, and an explanation of the benefits—items that should be part of your M-O-M plan anyway.

Start by talking to the agencies listed at the end of each section in Chapters 3 and 4 and checking the *M.O.M. Resource Directory*. One project can be funded by several different parties, each of which is serving one or more goals. Often, they can fund only a part of the project and they give precedence to those projects that have other sources of funding. In other words, they want their money to go furthest, so they will support multi-objective projects. Every M-O-M Success Story in this guidebook was partially funded by several different outside sources.

Don’t forget local sources. Businesses and organizations will frequently support projects that benefit their customers, employees, or members or that make for good advertising. Lots of projects can be direct financial benefits. For example, why should a business build a lunch room for its staff if it can have a picnic area across the street?

And don’t forget “in-kind services.” You may not need cash to get some things done. Instead of paying for park maintenance, why not have a service organization maintain the area with volunteers? Often, in-kind services can be counted toward the local share needed to match an outside source of funds.

Go for a balanced program

The M-O-M approach ensures balance in tackling flood and other community problems. It should not be considered an excuse to justify someone's favorite project. Nor should you put all your eggs in one basket, such as a major structural project, and then wait years for it to be built. The odds are good that the area will be flooded before the project is completed.

Although most attention is usually focused on reducing flood losses to existing development, dealing with future development and preserving natural areas pays off in the long run and prevents small problems from becoming bigger ones. A balanced program with measures from each of the four flood loss reduction strategies (described in Chapter 3) will help to protect existing development, manage new development, and protect natural and beneficial floodplain functions.

Your first priority should be to develop a plan that meets your community's needs, not one designed just to obtain funds or meet the requirements of only one state or federal agency. This can be difficult, because some grant programs encourage certain measures. For example, after a flood there is a strong tendency to develop a mitigation plan because one is required to receive acquisition funding. With only one goal in mind, such plans tend to focus on acquiring the worst hit areas and ignore other opportunities.

Prepare a Written Document

Only after assessing the problem, setting goals and objectives, and reviewing all the possible solutions, can you begin to select the most appropriate actions. This selection process culminates in the written plan—a series of recommendations detailing what will be done, by whom, and when.

The plan can be in almost any format. However, at a minimum, it should include three things:

- **A description of how the plan was prepared**—This helps readers (and potential funding agencies) understand the background and rationale for the plan and how public input was obtained.
- **Recommendations for action**—The plan should clearly identify what will be done, by whom, by when, and how it will be financed. It can be a list of projects and project assignments—the more specific, the better.

EXAMPLE PLAN ORGANIZATION

1. Introduction
 - a. Why there is a plan
 - b. How it was prepared
 - c. Who was involved
2. Problem description
 - a. Flooding
 - b. Recreation needs
 - c. Fish and wildlife
 - d. etc...
3. Goals and Objectives
4. Alternative measures
5. Recommended measures
 - a. Measure #1
 - Description
 - Objectives supported
 - Who is responsible
 - When it must be done
 - Who can help
 - Budget
 - b. Measure #2
 - Description
 - Objectives supported
 - Who is responsible
 - etc.
6. Implementation and evaluation
 - a. Adoption
 - b. Implementation schedule
 - c. Monitoring
 - d. Evaluation and revision

- **A budget**—The plan should explain how its recommendations will be financed. It should note those recommendations (like policies and public information activities) that can be implemented as part of a community's or organization's normal operations without special funding.

Get Public and Official Acceptance

You may see the need for another park, but the neighbors at the proposed site may object to having children playing so close to their homes. An acquisition project may threaten to dismantle a neighborhood. A plan to convert grassy back yards into effective but ugly concrete ditches may bring protests by the score. Getting public acceptance is vital to reduce conflicts and build support for the plan's recommendations.

The draft plan should be made available for review by the residents and businesses who will be affected, appropriate community departments, interested organizations, state and federal agencies, and neighboring communities.

Public meeting

After people have had several weeks to digest the plan, a public meeting or workshop should be held. A public meeting is a requirement for many funding programs.

In preparing for a public meeting, adequate notice of the date, time, and place must be given, and information about the plan should be distributed well in advance. The best notice is a flyer, brochure, or other announcement with a summary of the plan delivered to all potentially affected parties. The notice should tell people where they can obtain a copy of the draft plan for review before the meeting.

A public *meeting* is not the same as a public *hearing*. State or local laws usually require a public hearing when a community is considering adopting or amending a land use plan or zoning ordinance. There are specific legal requirements for notifying the public and conducting such a hearing. These legal requirements need not be met for M-O-M plans in most communities, although to be certain, you should check with your attorney.

Official acceptance

After the meeting, the planning committee should make appropriate changes to the plan. To have a real impact, the plan should be adopted by the appropriate governing board(s). This may be the city council of the one city affected or it may be several city, town, and county boards.

What counts is which governments are needed to implement the recommendations. For example, a plan with recommendations on watershed management could go to the soil and water conservation district for a vote of adoption or support.

It always helps to get support from other entities. If planning committee members were selected to represent a particular interest or organization, those organizations should pass a resolution or otherwise officially support the plan.

The city council will probably act more favorably towards a plan that has written support from the chamber of commerce and neighborhood organizations.

In big cities and counties, you may need to circulate the plan for approval from various department heads before it goes to the governing board. A plan that needs Federal Emergency Management Agency funding should have a letter of support from the state emergency management agency and/or the State NFIP Coordinator.

Implement and Follow Through

Adoption by the various governments is not the last step in the M-O-M approach. You will probably have to do some monitoring and follow up to ensure that it is implemented.

Implementation

The key to success is that all the people responsible for the various recommendations understand what is expected of them and are willing to work toward their implementation. Thus, it is helpful to have people likely to be involved in implementation—such as representatives of local departments and other agencies—participate in the planning process. It would help greatly if the plan (or the governing board’s resolution of adoption) clearly identified a person responsible for each recommendation.

It also helps to associate the recommendations with the plans and activities of the implementing agency or organization. For example, people responsible for specific recommendations could have the duties included in their job descriptions or annual performance plans.

It is a good idea for the plan to identify some highly visible but inexpensive projects that can be done quickly. This helps reassure the public and the planning committee participants that something is being done. Examples are locally funded projects (because they usually get done the quickest), such as a stream cleanup or distribution of public information materials.

Monitoring

No plan is perfect. As implementation proceeds, flaws will be discovered and changes will be needed. Your plan should have a formal process to measure progress, assess how things are proceeding, and recommend needed changes.

Those responsible for implementing the various recommendations probably have many other jobs to do. A monitoring system helps ensure that they don’t forget their assignments or fall behind in working on them. It can be as simple as a checklist kept by the person designated as responsible for the plan, or a more formal reporting system to a higher authority, such as the governing board or an oversight committee.

The Community Rating System

The Community Rating System (CRS) can help monitor local flood loss reduction programs and encourage communities to keep implementing them over the years. It is administered by the Federal Emergency Management Agency under the National Flood Insurance Program. The flood insurance premium rates are reduced for properties in a CRS community based on the floodplain management activities the community implements.

The CRS encourages local governments to start new programs in areas such as public information, technical assistance to property owners, open space preservation, higher regulatory standards, stormwater management, acquisition and relocation, and flood warning. Their work is monitored by the Federal Emergency Management Agency. If the activity is forgotten or modified, the agency advises the local officials that the CRS classification is threatened and their residents' insurance premiums could go up. This usually is sufficient to get the activities going again.

Evaluation

Even with full implementation, the plan should be evaluated in light of progress and changing conditions. Your planning committee could meet periodically to review progress and submit its

recommendations to the agencies and organizations responsible for implementation.

Although a M-O-M plan will usually produce the best and most efficient program, a community should be ready to act fast to take advantage of opportunities provided by disasters, extra end-of-the-year money, changes in one of the non-flood concerns, or heightened public interest due to flooding elsewhere. There may be a chance to effect major changes quickly.

BEING PREPARED

A good example of flexible implementation is Plainfield, Illinois. In 1990, a tornado destroyed 20 buildings in the village's floodway. Federal disaster assistance and state flood protection funds were made available to buy the properties and convert the damaged floodway lands into open space.

National Agencies and Organizations

This appendix lists the national offices of selected agencies and organizations that can help on various aspects of multi-objective management. In most cases, you should contact the local or state office.

An excellent initial source of information is the *M.O.M. Resource Directory* prepared jointly by the Federal Emergency Management Agency and the National Park Service. It is a computer program that lists over 300 government and private programs. It is easy to install and use. The software is designed to run in Windows® and is available free from

Rivers, Trails and Conservation Assistance
National Park Service
P.O. Box 25287 IMFA-RM-S
Denver, CO 80225-0287
(303) 969-2781 fax: 303-987-6676

State Floodplain Management Agencies

The State Coordinating Office for the National Flood Insurance Program is the recommended first point of contact for more information or assistance on floodplain management programs.

Note to readers of the 2005 Adobe Acrobat version of this manual. The list of state floodplain management and federal agencies in the original text was prepared in 1996. It is recommended that more recent website directories be used, such as the ASFPM list of state contacts, which can be found at www.floods.org

Additional advice about useful documents and ideas of whom to contact in floodplain management agencies and programs are available from the Association of State Floodplain Managers at (608) 274-0123.

Assistance on wetlands issues can be obtained by calling the U.S. Environmental Protection Agency Wetlands Information Hotline at 800-832-7828.

Note to readers of the 2005 Adobe Acrobat version of this manual. The list of state floodplain management and federal agencies in the original text was prepared in 1996. It is recommended that more recent website directories be used, such as the ASFPM list of state contacts, which can be found at www.floods.org

Federal Agencies

Army Corps of Engineers (202) 272-0169
Bureau of Reclamation (303) 236-4200 x552
Consolidated Farm Service Agency (formerly ASCS) (202) 720-3760
Environmental Protection Agency (202) 260-7963
Federal Emergency Management Agency (202) 646-2717
Fish and Wildlife Service (703) 358-1700
National Oceanic and Atmospheric Administration (301) 713-3109 x162
National Park Service (202) 343-3780
National Trust for Historic Preservation (202) 673-4000
National Weather Service (301) 713-1658
Natural Resources Conservation Service (formerly SCS) (202) 720-3760
Tennessee Valley Authority (615) 632-6065

Private Organizations

American Planning Association (312) 431-9100
American Rivers (202) 547-6900
Association of State Floodplain Managers (608) 274-0123
Association of Wetland Managers (518) 872-1804
Coalition to Restore Urban Waters [call the Izaak Walton League at (301) 548-0150 and ask for the CRUW to get the number of the nearest office]
Ducks Unlimited (313) 332-0441
Izaak Walton League, Save Our Streams Program (301) 548-0150 or 800-BUG-IWLA
Know Your Watershed (317) 494-9555
Land Trust Alliance (202) 638-4725
National Association of Conservation Districts (202) 547-6223
National Audubon Society, Wetlands Campaign (202) 861-2242
National Community Development Association (202) 293-7587
National Coordinating Council on Emergency Management (703) 538-1795
National Project WET (Water Education for Teachers) (406) 994-5392
National Recreation and Parks Association (719) 632-7031
National Wildlife Federation (202) 797-6697
Natural Hazards Research Information Center (303) 492-6818
River Network (503) 241-3506
Riverwatch Network (800) 639-8108
The American Greenways Program (703) 525-6300
The Nature Conservancy (703) 841-5300
Trout Unlimited (703) 522-0200
Urban Land Institute (202) 624-7137

Appendix B

References

These general references can help you find out more on particular multi-objective management topics. You should first check those documents published by your state or regional agencies.

Most of these publications are available free by calling the telephone number listed.

⇒ before a title means that it is recommended as an introductory reference for the topic.

Guides for Local Flood Loss Reduction Planning

⇒ *Floods, Floodplains, and Folks: A Casebook in Managing Rivers for Multiple Uses*. National Park Service, 1996. (202) 343-3780.

⇒ *Addressing your Community's Flood Problems: A Guide for Elected Officials*. Association of State Floodplain Managers and the Federal Interagency Floodplain Management Task Force, 1996. (608) 274-0123.

A Multi-Objective Planning Process for Mitigating Natural Hazards, Federal Emergency Management Agency and the National Park Service, 1995. (303) 235-4830 or (303) 969-2850.

A Guide for Developing A Pre-Flood Hazard Mitigation Plan for California Communities. California Department of Water Resources, 1985. (916) 324-3938.

Benefit/Cost Analysis of Hazard Mitigation Projects. Federal Emergency Management Agency, 1995. (computer software with instructions). (800) 480-2520.

⇒ *Community Flood Mitigation Planning Guidebook*. Wisconsin Department of Natural Resources, 1995. (608) 266-0161.

Comprehensive Planning for Flood Hazard Management. Washington Department of Ecology, 1991. (360) 407-6796.

CRS Coordinator's Manual, Example Plans, and other Community Rating System guidance. Federal Emergency Management Agency, 1995. (212) 229-3672.

Flood Proofing: How to Evaluate Your Options. U.S. Army Corps of Engineers, 1994. (202) 761-0169.

Flood Hazard Mitigation. Illinois Department of Natural Resources, Office of Water Resources, 1988. (217) 782-3862.

Flood Hazard Mitigation Handbook. Bruce Menerey and Kirstin Kinzley, Michigan Department of Natural Resources, 1988. (517) 335-3182.

⇒ *Flood Hazard Mitigation in Northeastern Illinois, a Guidebook for Local Officials*. Northeastern Illinois Planning Commission, 1995. (312) 454-0400.

Flood Damage Prevention Handbook. Pennsylvania Department of Community Affairs, 1983. (717) 787-7403.

Helping Small Towns Adopt Programs for Nonstructural Flood Hazard Mitigation. French Wetmore and Larry Johnston, Association of State Floodplain Managers, 1987. (608) 274-0123.

Local Flood Proofing Programs. U.S. Army Corps of Engineers, 1994. (202) 761-0169.

Watershed Planning

⇒ *Clean Water in Your Watershed: A Citizen's Guide to Watershed Protection*. Terrene Institute, 1993. (202) 833-8317.

Delineating Watersheds—A First Step towards Effective Management (brochure). U.S. Environmental Protection Agency, SCS/FWS, Terrene Institute, 1993. (202) 833-8317.

⇒ *Guides for Watershed Partnerships*, a series of short guides put out by the Know Your Watershed Program. (317) 494-9555.

A Watershed Approach to Urban Runoff: Handbook for Decisionmakers. Terrene Institute and U.S. Environmental Protection Agency, 1996. (202) 833-8317.

Wetlands, Water Quality, and Habitat Protection

Conserving Your Valuable Floodplain Resources (brochure). Tennessee Valley Authority, 1990. (615) 632-4792.

⇒ *Environmental Planning for Small Communities, A Guide for Local Decision-Makers*. U.S. Environmental Protection Agency EPA/625/R-94/009, 1994. (202) 260-7166.

Environmental Considerations in Comprehensive Planning. Northeastern Illinois Planning Commission, 1994. (312) 454-0400.

Environmental Management: A Guide for Town Officials. Maine Department of Environmental Protection, 1992. (207) 289-7688.

Managing Natural Resources: A Planning Guide. Tennessee Conservation League, 1994.

Our National Wetland Heritage: A Protection Guidebook. Jon Kusler, Environmental Law Institute, 1983. (512) 872-1804.

Protecting Floodplain Resources, A Guidebook for Communities. FEMA 268. Federal Interagency Floodplain Management Task Force, 1995. (800) 480-2520.

Protecting Coastal and Wetlands Resources, A Guide for Local Governments. U.S. Environmental Protection Agency EPA 842-R-92-002, 1992. (202) 260-7166.

Recognizing Wetlands (brochure). U.S. Army Corps of Engineers, 1987. Contact your local Corps of Engineers District Office.

Wetlands and Water Quality: A Citizen's Handbook for Protecting Wetlands. Gerald Paulson, Lake Michigan Federation, 1990.

Greenways and River Corridors

⇒ *A Casebook in Managing Rivers for Multiple Uses.* Association of State Floodplain Managers, Association of State Wetland Managers, and National Park Service, 1991. (202) 343-3775.

Economic Impacts of Protecting Rivers, Trails & Greenway Corridors. National Park Service, 1991. (202) 343-3780.

Greenways: A Guide to Planning, Design, and Development. Loring LaB. Schwarz, Editor, The Conservation Fund, 1993. (703) 525-6300.

How Greenways Work: A Handbook on Ecology. Jonathan Labaree, National Park Service, 1992. (202) 343-3780.

How to Save a River: A Handbook for Citizen Action. David Bolling, River Network, 1994. (503) 241-3506.

Riverwork Book, National Park Service, 1988. (202) 343-3780.

Agricultural Protection

Common Groundwork: A Practical Guide to Protecting Rural and Urban Land. Western Reserve Resources Council and Institute for Environmental Education, 1993. (800) 484-7949.

Planning and Zoning for Farmland Protection: A Community Based Approach. American Farmland Trust, 1987. (202) 659-5170.

Economic Development and Protection of Business and Industry
Cooperative Flood Loss Reduction: A Technical Manual for Communities and Industry. Flood Loss Reduction Associates, 1981. (717) 787-7403.

Disaster Mitigation Guide for Business & Industry. Federal Emergency Management Agency, 1990. (800) 480-2520.

Reducing Commercial and Industrial Flood Losses. William Kvaternik, Pennsylvania Department of Community Affairs, 1984. (717) 787-7403.

Historic Preservation

Protecting the Past from Natural Disasters. Carl L. Nelson, National Trust for Historic Preservation, 1991. (202) 673-4000.

⇒ *Safeguarding Your Historic Site: Basic Preparedness and Recovery Measures for Natural Disasters*. Sarah James, Federal Emergency Management Agency Region I, 1993. (800) 480-2520.

Saving Place, A Guide and Report Card for Protecting Community Character. Philip B. Herr, National Trust for Historic Preservation, 1991. (202) 673-4000.

Coastal Flooding

Coastal Management Solutions to Natural Hazards. National Oceanic and Atmospheric Administration, Technical Assistance Bulletin #103, 1990. (202) 673-5158.

Coastal Storm Hazard Mitigation. New Jersey Department of Environmental Protection and Federal Emergency Management Agency, 1985. (609) 292-8262.

Reducing Hurricane & Coastal Storm Hazards through Growth Management: A Guidebook for North Carolina Coastal Localities. Brower, Beatley & Blatt, University of North Carolina and Federal Emergency Management Agency, 1987. (919) 733-3867.

Striking a Balance: A Guide to Coastal Processes & Beach Management in Delaware. Delaware Dept of Natural Resources and Environmental Control, 1985. (302) 736-4764.

Special Flood Hazards

Alluvial Fans: Hazards & Management. Federal Emergency Management Agency, 1989. (800) 480-2520.

CRS Commentary Supplement for Special Hazards Credit. Federal Emergency Management Agency, 1995. (212) 229-3672.

Reducing Losses in High Risk Flood Hazard Areas: A Guidebook For Local Officials. Association of State Floodplain Managers and Federal Emergency Management Agency, 1987. (608) 274-0123.

Utah Natural Hazards Handbook. Utah Division of Comprehensive Emergency Management, 1991. (801) 538-3400.

Other References

Sharing the Challenge: Floodplain Management into the 21st Century. Interagency Floodplain Management Review Committee, 1994. (800) 480-2520.

Floodplain Management in the United States: An Assessment Report. L.R. Johnston Associates for the Federal Interagency Floodplain Management Task Force, 1992. (800) 480-2520.

A Unified National Program for Floodplain Management. Federal Interagency Floodplain Management Task Force, 1994. (800) 480-2520.

Appendix C

Terms and Acronyms

100-year flood: See “base flood.”

Section 404: (1) Section of the Clean Water Act that establishes a program to regulate the discharge of dredged and fill material into waters of the United States, including wetlands.

Section 404: (2) The Federal Emergency Management Agency’s Hazard Mitigation Grant Program, authorized by Section 404 of the Stafford Act.

ASCS: Agricultural Stabilization and Conservation Service, the old name for the U.S. Department of Agriculture’s Consolidated Farm Service Agency.

ASFPM: Association of State Floodplain Managers.

Base flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the “100-year” or “1% chance” flood. The base flood is a statistical concept used to ensure that all properties are protected to the same degree against flooding.

Basin: See “watershed.”

Best management practices: Pollution controls for nonpoint source pollution. The controls can include structural, vegetative, or management systems to prevent water pollution originating from human activity.

BFE: Base flood elevation. The elevation of the crest of the base or 100-year flood.

BMP: Best management practice.

Carrying capacity: The level of use or extent of modification an environmental or human-made system may bear without experiencing unacceptable deterioration or degradation.

CDBG: Community Development Block Grant administered by the Department of Housing and Urban Development and state, county, or municipal housing or community development agencies.

Coastal high hazard flooding: A condition of flooding subject to high velocity waters, including, but not limited to, hurricane wave wash or tsunamis. Coastal high hazard flooding is mapped as a velocity zone on a Flood Insurance Rate Map. Coastal flooding without the high velocity hazard is mapped as a Zone A.

Coastal barrier: Offshore formations of sand lying generally parallel to mainland coastlines. They may be connected to the mainland or they may be spits or islands.

COBRA: The Coastal Barrier Resources Act administered by NOAA. COBRA places development restrictions on identified coastal barriers.

Community: A term used by the Federal Emergency Management Agency to designate local governments eligible to participate in the National Flood Insurance Program. A local government can be a “community” if the state enabling legislation gives it the authority to regulate land use and development. It usually includes cities, villages, townships, boroughs, Indian tribes, and counties (usually for their unincorporated areas only).

Contour: A line of equal elevation on a topographic (contour) map.

Critical facilities: Buildings or locations vital to the flood response effort, such as a police station or hospital, and buildings or locations that if flooded would create secondary disasters, such as hazardous materials facilities.

CRS: Community Rating System of the National Flood Insurance Program.

Datum: A reference surface used to ensure that all elevation records are properly related. Many communities have their own datum, which was developed before there was a national standard. The current national datum is the National Geodetic Vertical Datum (NGVD), which is in relation to mean sea level. It is being replaced by the North American Vertical Datum (NAVD).

Discharge: The amount of water that passes a point in a given period of time. Rate of discharge is usually measured in cubic feet per second (cfs).

Divide: The boundary of a watershed. The divide is the high ground and the river or lake is the lowest ground. Rain and snowmelt flow from the divide to the receiving stream or lake.

Drainage area: The total land area of a watershed, measured in acres or square miles.

Drainage basin: See “watershed.”

Dredging: Removing the sediment or sand from a stream channel, lake, or ocean to provide sufficient depth for navigation or to obtain material for construction or beach nourishment.

EDA: U.S. Department of Commerce, Economic Development Administration.

EPA: The U.S. Environmental Protection Agency.

Encroachment: An activity or development project within a floodway that results in an obstruction to flood flows and/or an increase in flood levels.

Environmental assessment: An examination of the positive and adverse impacts on the environment of a proposed project.

Environmental impact statement: A detailed environmental analysis and documentation of a proposed project when the project is expected to have a significant effect on the quality of the human environment or the area's ecology.

Erosion: The process of the gradual wearing away of land masses.

FEMA: Federal Emergency Management Agency.

Fetch: The horizontal distance (in the direction of the wind) over which the wind generates waves or creates a wind setup.

FIRM: Flood Insurance Rate Map.

Flood Insurance Rate Map: An official map of a community, on which the Federal Insurance Administration has delineated both the Special Flood Hazard Areas and the risk premium zones applicable to the community. Most FIRMs include base flood elevations for some or all of a community's floodplains.

Flood Insurance Study: A report published by the Federal Insurance Administration for a community in conjunction with the community's Flood Insurance Rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with base flood elevations will have a corresponding flood insurance study.

Flood fringe: The portion of the floodplain lying on either side of the floodway.

Flood Hazard Boundary Map: The first floodplain map prepared for a community for the National Flood Insurance Program. In most communities, this map has been replaced by the Flood Insurance Rate Map.

Floodproofing: Protective measures added to or incorporated in a building that is not elevated above the base flood elevation to prevent or minimize flood damage. "Dry floodproofing" measures are designed to keep water from entering a building. "Wet floodproofing" measures minimize damage to a structure and its contents from water that is allowed into a building.

Floodway: The channel of a river and the portion of the overbank floodplain that carries most of the base flood. The floodway must be kept open so that floods can proceed downstream and not be obstructed or diverted onto other properties.

Freeboard: A margin of safety added to the base flood elevation to account for waves, debris, miscalculations, or lack of data.

Greenway: A linear open space established along a corridor, such as a riverfront, canal, or railroad right of way.

Groin: A structure built out from a beach, river bank, or shoreline to direct water flow and/or reduce shoreline erosion.

Habitat Evaluation Procedure: A method developed by the U.S. Fish and Wildlife Service that evaluates the suitability of wetlands and other habitat types for fish and wildlife species.

HEP: Habitat Evaluation Procedure.

HUD: U.S. Department of Housing and Urban Development.

Human intervention: A person must be present at the flood-prone site to close an opening or install or operate a protection device so that the measure will prevent flood damage.

Hydraulics: The science dealing with the mechanical properties of liquids; it describes the pattern and rate of water movement.

Hydrology: The science dealing with the waters of the earth. A flood discharge is developed by a hydrologic study.

Jetty: A structure built perpendicular to the shoreline at inlets to prevent littoral drift from filling the inlet and to provide protection for navigation.

Littoral: Of or pertaining to the shore, especially of the sea.

Littoral drift: The movement of sand by littoral (longshore) currents in a direction generally parallel to the beach along the shore.

Mean high water: The average height of the maximum elevation reached by each rising tide over a specific 19-year period.

Mean low water: The average height of the minimum elevation reached by each falling tide over a specific 19-year period. All depth measurements in coastal waters and all depths shown on navigation charts are referenced to MLW.

Mean sea level: The arithmetic mean of hourly heights observed over a specific 19-year period.

Mitigation: (1) Any action taken to permanently eliminate or reduce the long-term risk to human life and property and the negative impacts on natural and cultural resources that can be caused by natural and technological hazards. (2) An action that compensates for the impact of development on a wetland.

NAVD: North American Vertical Datum (see “datum”).

NFIP: National Flood Insurance Program administered by the Federal Emergency Management Agency’s Federal Insurance Administration.

NGVD: National Geodetic Vertical Datum of 1929, the national datum used by the National Flood Insurance Program. NGVD is based on mean sea level. It was known formerly as the “Mean Sea Level Datum of 1929 (MSL).”

No net loss: A term used in wetlands protection and restoration programs to signify the intent to reduce the cumulative impact of wetland losses. No net loss determinations may be based on acreage and/or the functional value of wetlands.

NOAA: U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Nonpoint source pollution: Water pollution that originates from diffuse sources, such as rainfall runoff or snowmelt.

Nonstructural measures: Techniques, such as regulations, acquisition, and floodproofing, that modify susceptibility to flooding, as opposed to structural methods that modify flooding, like dams and levees.

Noreaster or Northeaster: On the U.S. East Coast, a storm whose counterclockwise winds approach the shore from the northeast.

NPDES: The National Pollutant Discharge Elimination System, a program managed by the U.S. Environmental Protection Agency to improve water quality. Larger businesses must work to improve the quality of stormwater runoff in order to get NPDES permits.

NPS: U.S. Department of the Interior, National Park Service

NRCS: U.S. Department of Agriculture, Natural Resources Conservation Service.

NWS: National Weather Service.

One percent chance flood: See “base flood.”

Point source pollution: Water pollution that is discharged from a discrete location, such as a pipe, tank, pit, or ditch.

Ponding: A flooding condition in flat areas caused when rain runoff drains to a location that has no ready outlet. Ponding water usually stands until it evaporates, seeps into the ground, or is pumped out.

Post-FIRM: Constructed after the date of the community’s Flood Insurance Rate Map.

Pre-FIRM: Constructed before the date of the community’s Flood Insurance Rate Map.

Repetitive loss structure: A building that has incurred two or more losses of more than \$1,000 over a specified period of time, usually over the last 10 years.

Retrofitting: Techniques, such as floodproofing, elevation, construction of small levees, and other modifications, made to an existing building or its yard to protect it from flood damage.

Rip rap: Large rocks placed along a bank or shoreline to protect it from erosion.

Riparian ecosystem: A distinct association of flora, fauna, and soil occurring along a river, stream, or other body of water and dependent upon high water tables and occasional flooding to maintain its viability. These areas often exhibit high biological productivity and species diversity.

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

Sand dunes: Naturally occurring accumulations of sand that form ridges or mounds landward of a beach.

SBA: U.S. Small Business Administration.

SCS: Soil Conservation Service, the old name for the U.S. Department of Agriculture's Natural Resources Conservation Service.

Sensitive area: An area defined by state or local regulations as deserving special protection because of its unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive area is subject to more restrictive development regulations than other floodplains or wetlands.

SFHA: Special Flood Hazard Area.

Sheet flow: A condition of flooding where there is moving water but no identifiable channel. Flooding depths are usually shallow (less than 3 feet). Sheet flow may have a high velocity, as on alluvial fans.

SHMO: State hazard mitigation officer, usually in the state emergency management agency.

SHPO: State historic preservation officer in the state historic preservation agency.

Special Flood Hazard Area (SFHA): The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A (see definition). In coastal situations, Zone V (see definition) is also a part of the SFHA. The SFHA may or may not encompass all of a community's flood problems.

Standard project flood: A very large, low-frequency flood used as the standard for designing major flood control structures.

Structural measures: Flood control techniques that modify flood flows. Examples are dams, reservoirs, levees, channel alterations, and diversions.

Surcharge: An increase in flood elevation due to an obstruction of the floodplain that has reduced its conveyance capacity. Floodway boundaries are usually set based on a specified surcharge that is allowed to be caused by new development in the floodplain.

TDR: Transfer of development rights.

Tsunami: Sea waves of seismic origin.

Typhoon: Pacific Ocean hurricane.

USACE: U.S. Army Corps of Engineers.

USGS: U.S. Geological Survey.

Watershed: All of the area that drains to a particular stream or lake. It is also called a basin or catchment area.

Wetlands: The collective term for marshes, swamps, bogs, and similar areas found in flat vegetated areas, in depressions in the landscape, and between dry land and water along the edges of streams, rivers, lakes, and coastlines.

Zone A: The Special Flood Hazard Area (except coastal V Zones) shown on a community's Flood Insurance Rate Map.

Zone B: Area of moderate flood hazard depicted on a community's Flood Insurance Rate Map, usually between the limits of the base and 500-year floods. B Zones are also used to designate base floodplains of little hazard, such as those with average flood depths of less than 1 foot.

Zone C: Area of minimal flood hazard, usually depicted on a community's Flood Insurance Rate Map as above the 500-year flood level. C Zones may have flooding that does not meet the criteria to be mapped as a Special Flood Hazard Area, especially ponding and local drainage problems.

Zone D: Area of undetermined but possible flood hazard depicted on a community's Flood Insurance Rate Map.

Zone V: The Special Flood Hazard Area subject to coastal high hazard flooding depicted on a community's Flood Insurance Rate Map.

Zone X: Newer Flood Insurance Rate Maps show Zones B and C (see above) as Zone X.