

## INTRODUCTION TO MITIGATION

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### MITIGATION STRATEGIES

### INTRODUCTION

Once the hazard analysis process has been completed, the risk associated with each hazard can be communicated by explaining:

- What can occur,
- The likelihood that it will occur, and
- The consequences if it does occur, in terms of casualties, destruction, disruption and costs.

Community leaders must then decide what level of risk is acceptable, and what will be done to achieve the desired level of disaster resistance.

Communities *can* take actions that will reduce future hazard losses. The knowledge and the tools do exist. However, mitigation of natural hazards cannot be approached in isolation. Communities must study and then select a mitigation strategy that promotes the concurrent achievement of hazard loss reduction and other community goals.

This unit focuses on *what* communities can do to solve hazard risk problems.

### MITIGATION MEASURES

Because mitigation can be accomplished in a number of ways, mitigation strategies can be either elaborate or simple. Mitigation strategies are comprised of one or more mitigation measures, which are usually classified into categories. French Wetmore, of Wetmore and Associates in Park Forest, Illinois, has developed a useful approach to describing flood mitigation options. It has been adapted here for all-hazard use and is based on six categories:

- Prevention
- Property Protection
- Natural Resource Protection
- Emergency Services

#### Unit 2 Objectives

1. List and describe various mitigation strategies.
2. Apply multi-objective decision criteria for selecting a mitigation strategy.



- Structural Projects
- Public Information

## Prevention

Prevention measures are intended to keep a hazard risk problem from getting worse. They ensure that future development does not increase hazard losses. Communities can achieve significant progress toward hazard resistance through prevention measures. This is particularly true in areas that have not been developed or where capital investment has not been substantial. Some examples of prevention measures are:



- Planning and zoning.
- Open space preservation.
- Land development regulations.
- Storm water management.
- Dune and beach maintenance.

Using prevention measures, future development can be guided away from hazards, while maintaining other community goals such as economic development and quality of life. For example, floodplains, steep slopes, areas subject to liquefaction and areas prone to wildfires can be designated for open space or other low-density uses. Low hazard risk property can be designated for higher density uses that bring revenue to the property owners as well as the jurisdiction.

Goals to reduce hazard risk can be coordinated with the community's comprehensive plan and capital improvements program. A comprehensive plan reflects what the community would like to see happen. The plan itself has limited authority, but it guides other local measures such as capital improvements, zoning and subdivision ordinances. A community's capital improvement program identifies where major public expenditures will be made over the next 5 to 20 years. A zoning ordinance regulates development by dividing the community into zones or districts and setting development criteria for each.

The comprehensive plan can incorporate mitigation strategies to discourage new development in hazard prone areas and encourage practices that are consistent with disaster resistant community goals. These strategies might include

- Tax breaks and other financial incentives.

- Denial of loans to would-be borrowers who cannot show hazard-related standards are being met.
- Locating public facilities in low-hazard areas to encourage development in those areas.
- Preventing construction of public buildings in hazardous areas.

A recent publication of the Natural Hazard Research and Applications Information Center called *Confronting Hazards: Land Use Planning for Sustainable Communities*, lists five principles for future planning and public policy that endorse the use of prevention measures.

- Government must limit the practice of subsidizing the risks involved in using hazardous areas.
- Government must build and share a base of knowledge about the nature of risks and sustainable ways of living with hazards.
- Governments themselves must develop commitment and capacity to change the way they manage the use of hazardous areas.
- Governments must do a better job of coordinating and integrating policies to manage exposure to hazards with policies to accomplish economic, social and environmental objectives.
- Governments must foster innovations in governance and land management to better match institutional systems and tools with the problems posed by natural hazards.

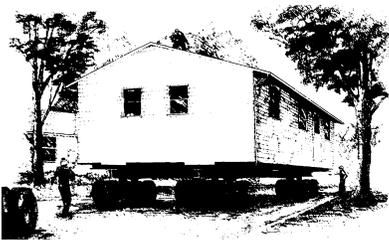
## Property Protection Measures

Property protection measures are used to modify buildings subject to hazard risk, or their surroundings, rather than to prevent the hazard from occurring. A community may find these to be inexpensive measures because often they are implemented or cost-shared with property owners. These measures directly protect people and property at risk. Protecting a building does not have to affect the building's appearance and is therefore a popular measure for historic and cultural sites. Some examples of property protection measures are:

- Acquisition
- Relocation
- Rebuilding
- Floodproofing

Acquisition is the public procurement and management of lands that are vulnerable to damage from hazards. Following acquisition, land uses more appropriate to the degree of risk may be chosen. Public acquisition has been achieved by:

- Purchase at full market value, or
- Purchase at less than full market value through methods such as foreclosure of tax delinquent property; bargain sales, purchase and lease back; donation through reserved real estate; donation by will; donation and lease back; leases, and easements.



Relocation involves permanent evacuation of hazard-prone areas through movement of existing hazard prone development and population to safer areas. Two common components of relocation are:

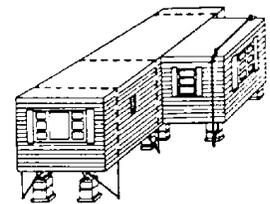
- Physical removal of buildings to a safer area with the future use of the vacated area limited to permanent open space; and
- Substitution of existing uses for others that are less vulnerable to the hazard.

*The Castaic Union School District in southern California is located in an area through which the San Andreas and San Gabriel fault systems pass. The District conducted an assessment of earthquake risks that threatened their elementary and middle schools, and administration building. The study led the school district to conclude that the probability of a large earthquake affecting these facilities was high. In addition to expected seismic damage, the study showed that the school buildings were located within the inundation area of the Castaic Dam, and at high risk of damage from fire and explosion if crude oil pipelines that cross the campus should fail.*

*Based on estimates of potential casualties, building and content damages, and lost educational services, the decision was made to condemn the structures on the high-risk site. The area selected for relocation is completely out of the dam inundation area and far removed from the oil pipelines. The new buildings were constructed to conform fully to 1995 building code provisions that make them more resistant to seismic damage than the ones they replaced.*

Rebuilding or modifying structures to reduce damage by future hazard events is another type of property protection measure.

- Masonry structures can be retrofitted to lessen damage in earthquakes.
- Manufactured homes can be anchored to withstand hurricane wind speeds without significant damage.
- Storm shutters can be installed to protect windows and glass doors from flying debris in areas at risk from high winds.



Ideally, adoption and/or enforcement of building codes accompany rebuilding of damaged or hazard prone structures to minimize future risk of hazard damage.

*The service area for Beebe Medical Center in Lewes, Delaware, is the fastest growing population center in Delaware. Because of nearby resort beaches, the population and the service requirements expand exponentially during vacation periods. From experiences during previous hurricanes, the Lewes area can expect interrupted electrical power supply, interrupted water supply and wastewater treatment, street flooding, high winds and windborne debris. Penetration of building envelopes would allow both wind and rain to damage building interiors and contents. Beebe Medical Center developed mitigation priorities and determined that installation of storm shutters is the number one mitigation priority. Because of the relatively high cost of permanent storm shutters, the Medical Center has signed a contract with a local contractor to install inexpensive plywood storm shutters in the event of a hurricane warning. Meanwhile, annual capital improvement budgets will include some funds to install more permanent storm shutters that will afford greater protection and are usable in more than one event.*

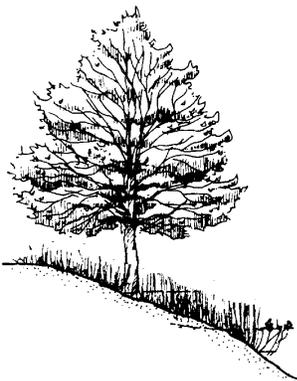
Floodproofing is protecting a flood-prone building using one or more of several different methods. Dry floodproofing means sealing a building against floodwater by making all areas below the flood protection level watertight. Wet floodproofing means allowing the floodwaters to enter the building to minimize pressure on the structure. Furniture, appliances and valuables may be moved out of the floodable area.

## Natural Resource Protection

Natural resource protection measures are intended to reduce the intensity of hazard effects as well as to improve the quality of the environment and wildlife habitats. Parks, recreation, or conservation agencies or organizations usually implement these activities.

Examples of natural resource protection include:

- Erosion and sediment control
- Wetlands protection



On sites such as farmland, construction areas, and burned out forests, stormwater runoff can erode soil and send sediment into downstream waterways. Sedimentation will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters, and reducing the light, oxygen and overall water quality. Practices such as reforestation and planting other vegetation minimizes the erosion and captures sediment before it leaves the site. Terracing, contour strip

farming, no-till farming and impoundments (sediment basin, farm ponds, and wetlands) also slow runoff. Beach nourishment measures such as the use of white sandy clay, have been shown to reduce beach erosion.

Wetlands must be protected because they can store large amounts of floodwater, filter water, and provide habitats for many species of fish and wildlife. Development projects in wetlands are regulated by the U.S. Army Corps of Engineers (USACE), which must issue a “404” permit before any fill or dredged material is placed in a wetland. The U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency review these permits.

*After Hurricane Hugo, it was found that South Carolina beaches, at which white sandy clay had been deposited prior to the storm to slow erosion, exhibited much less erosion than adjacent natural beaches.*

*Between 1984 and 1993 Iowa instituted farm conservation projects including no tillage of certain areas, use of terracing, contouring, and strip cropping. Authorities estimated that damage from the 1993 floods would have been 3.5 times greater without these measures.*

## Emergency Services

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

- Warning.
- Response.
- Critical facilities protection.
- Health and safety maintenance.

A warning program must include both recognition of the threat and a warning system. The National Weather Service provides information about potential threats such as tornadoes, hurricanes, heavy rains, blizzards, etc. Examples of local hazard recognition capabilities may include tornado spotters, rain and river gauges. Once the threat recognition system tells the emergency management contact that the hazard event will actually occur, the next step is to notify the public and staff in other agencies and critical facilities. The earlier and more accurate the warning, the greater the number of people that can implement protective measures. Warning may be disseminated via sirens, radio, television, mobile public address systems, telephone,



and door-to-door contact. Multiple or redundant warning increases the number of people that will hear the message.

Communities can mitigate hazard losses by responding to warning with actions that can prevent or reduce damage and/or injury. A few examples of these actions include the following:

- Activating the emergency operations center.
- Restricting access to hazard prone areas.
- Accomplishing expedient mitigation measures such as sandbagging, installing storm shutters, shutting off power to threatened areas.
- Ordering evacuation and opening shelters.

An emergency response plan developed in coordination with all agencies and organizations having emergency responsibilities is the best way to ensure smooth response when needed. Drills and exercises ensure that response personnel know what to do when warned of an impending hazard event.

Protection of critical facilities is mitigation measure. Critical facilities include

- essential facilities such as police stations, fire stations, and hospitals that are vital to the response effort.
- special facilities that house populations requiring special consideration such as nursing homes and prisons.
- facilities that can create secondary hazards such as nuclear power plants and hazardous materials production or storage facilities.

Provisions for safe drinking water, tetanus vaccination, and cleaning up debris and garbage are a few examples of health and safety maintenance.

## Structural Projects

Structural measures directly protect people and property at risk. They are called “structural” because they involve construction of man-made structures to control hazards. Some examples of structural projects are dams, reservoirs, dikes, levees, seawalls, bulkheads, revetments, high flow diversions, spillways, buttresses, debris basins, detaining walls, channel modifications, storm sewers elevated roadways, and debris basins.

Structural projects can be very expensive. Other disadvantages may include the following:

- They disturb the land and may disrupt natural functions such as water flow. This can destroy wildlife habitats.

- They require regular maintenance. If this maintenance is neglected, the consequences can be disastrous.
- If the hazard exceeds the projected capability of the structural measure, the damage will still be extensive.
- They create a false sense of security.

*During the Midwest Floods of 1993, the levee protecting the Des Moines, Iowa, water works facility was over-topped by floodwater.*

*The plant could not be operated and as a result, over 250,000 customers were without water service for 11 days. In addition to the impact on residents, the sanitation and fire hazards forced a large percentage of area businesses to close until water service was restored.*

*To reduce the possibility of a reoccurrence, Des Moines Water Works has undertaken a series of mitigation measures: The protective levee has been raised by 6 feet. A second, smaller treatment facility is being built at another location. A plan has been developed for use of that second facility and aquifer storage if flooding of the main facility occurs again.*

## Public Information

Public information activities inform and remind people about hazardous areas and the measures necessary to avoid potential damage and injury. The public can be informed about mitigation through several avenues. Some examples include:

- Outreach projects.
- Real estate disclosure.
- Hazard information center.
- Technical assistance.
- School age and adult education programs.

FEMA funded a focus group study on attitudes toward mitigation among homeowners, small businesses and community leaders. The report included some interesting conclusions that will be helpful in the design of a public information program about mitigation.

- The first barrier to mitigation is lack of knowledge of what to do. People are simply unaware of mitigation activities and need information.



- The public is much more aware of strategies for preparedness than mitigation. It may be effective to link the two concepts. For example, “prepare and mitigate”.
- Target to high-risk areas. People who feel that disasters don’t happen in their area often are unlikely to “buy into” the concepts of risk or mitigation.
- Timing is important. Target the time when disaster is on the minds of the population – for example at the beginning of hurricane season or after a disaster.
- Mitigation is a “pocketbook” issue. People need to know the perceived return on investment before acting. Cost savings and cost effectiveness must be emphasized in your public information campaign.
- Barriers may drop when a related purchase is under consideration. People are more willing to spend money on mitigation if they perceive that it will save more in the long run.
- While small business owners do not see mitigation as relevant to them personally, in high-risk areas they may be useful supporters. When convinced that what happens to the community happens to them, their self-interest can propel them into activism.

## MULTI-OBJECTIVE DECISION CRITERIA FOR SELECTING A MITIGATION STRATEGY

Selection of a mitigation strategy for the community is part of a mitigation planning process that will be discussed fully in Unit Four. At the beginning of that process a mitigation planning team is formed. The team will include community officials, mitigation experts, business people, residents and other concerned individuals. During that planning process the team will develop a list of possible mitigation measures. That list of possibilities could be a long one.

How will the planning team select the best measures for your community’s mitigation strategy? Obviously the proposed mitigation measures are those that technical experts have selected because they will solve or alleviate the problem. Once it has been established that several proposed measures will accomplish the mitigation objective, how do community leaders choose between them?

Clancy Philipsborn and Daniel Barbee, pioneers in helping communities make mitigation decisions, said the biggest obstacle to solving hazard management problems is the tendency to isolate the problem. If a hazard-prone community avidly pursues mitigation strategies that will consume a disproportionate amount of available

STAPLE

funds, the broader, longer-term community goals may be sacrificed. The solution to long-term, cost-effective mitigation often is imbedded in what the community is already doing. Tools and processes used on a daily basis may be able to be used to solve hazard management problems. While a community may have to rethink their approach to planning to incorporate mitigation, it simply requires coordinating growth, economic development and environmental planning with the results of the hazard analysis.

The viability of the mitigation measures described in this unit has been demonstrated. Multi-objective planning to achieve goals of disaster resistance in coordination with other community goals has also been successfully demonstrated. What is needed is for communities to use a standard set of decision criteria to promote this concurrent achievement of mitigation and other community goals.

### STAPLE Criteria

STAPLE is an acronym for the Social, Technical, Administrative, Political, Legal and Economic/Environmental criteria used in making planning decisions. There is no implied priority or weight to the criteria. STAPLE is just an easy acronym to remember. The following criteria can help communities evaluate and select the most appropriate mitigation measures from the many options that may be available.

#### ***Social***

To be successful, the mitigation strategy must be socially acceptable. Will this proposed action be socially acceptable to the community? Will it cause any one segment of the population to be treated unfairly? Will the action disrupt established neighborhoods, break up voting districts or cause the relocation of low and reduced income people? Is the action compatible with present and future community values?

#### ***Technical***

It is important to determine if the proposed action is technically feasible. What consequences are created by this approach? Most importantly, will it solve the problem? In light of other community goals, is it the most useful?

#### ***Administrative***

Does the community have the capability to implement the action? Can the community provide any maintenance necessary? Are there enough staff, technical experts and funding? Can it be accomplished in a timely manner?

**Political**

Proposed mitigation strategies have failed because of lack of political acceptability. Who are the stakeholders in this proposed action? Have all of the stakeholders been offered an opportunity to participate in the planning process? How can the mitigation goals be accomplished at the lowest cost to the stakeholders? Is there public support both to implement and maintain this measure? Is the political leadership willing to propose and support the favored measure?

**Legal**

Does the community have the authority to implement the proposed measure? Is there a clear legal basis for the mitigation action? Is enabling legislation necessary? What are the legal side effects? Will the community be liable for the actions or support of actions, or lack of action? Is it likely to be challenged?

**Economic**

Economic considerations must include the present economic base, projected growth, and opportunity costs. What are the costs and benefits of this measure? How will the implementation of this measure affect the fiscal capability of the community? What burden will be placed on the tax base or local economy? Does the action contribute to other community economic goals such as capital improvements or economic development?

**Environmental**

Impact on the environment is an important consideration because of the many statutory considerations and because of public desire for sustainable and environmentally healthy communities. How will this action affect the environment? Will this measure comply with local, State and Federal environmental regulations? Is the action consistent with community environmental goals?

Once these questions have been addressed, the community will have a good indication of the feasibility of the measures that have been proposed as the mitigation strategy. The results of this evaluation are used to finalize the development of an effective mitigation strategy. Unit Three, *Responsibilities and Resources for Mitigation*, will provide information on the availability of financial and technical resources that should be considered in the final decisions.

## SUMMARY

- ✓ Communities can take actions that will reduce future hazard losses.
- ✓ Prevention measures are intended to keep a hazard vulnerability problem from getting worse and to guide development away from hazards. Examples include planning and zoning, open space preservation and land development regulations.
- ✓ Property protection measures are used to modify buildings subject to hazard risk, or their surroundings. Examples include acquisition, relocation, rebuilding and floodproofing.
- ✓ Natural resource protection measures are intended to reduce the intensity of hazard effects while improving quality of the natural environment. Examples include erosion and sediment control, and wetland protection.
- ✓ Emergency services measures protect people before and after a hazard event. Examples include warning, response, critical facilities protection and health and safety maintenance.
- ✓ Structural measures involve construction to control hazards. Examples include elevated roadways, dams, reservoirs, dikes and levees.
- ✓ Public information measures inform and remind people about hazardous areas and the measures necessary to avoid potential damage and injury. Examples are outreach projects, real estate disclosure, hazard information centers, technical assistance and education programs.
- ✓ Develop Social, Technical, Administrative, Political, Legal and Economic/Environmental criteria that can help the community evaluate and select the most appropriate mitigation measures from the many options that may be available.

## MITIGATING YOUR HAZARDS

In the Mitigating Your Hazards section of Unit One, you developed hazard profiles on five hazards that may occur in your community.

For this activity, select one high-priority hazard, as determined by the criteria in the hazard profile. Then review the mitigation measures described in this unit. Complete the following worksheet to identify any mitigation measures that could possibly become a part of the community's strategy to mitigate that hazard. (Remember that this should be done for all of the community hazards after you finish this course!)

HAZARD: \_\_\_\_\_

<b>CATEGORY OF MITIGATION MEASURE</b>	<b>PROPOSED ACTIONS</b>
Prevention Measures	
Property Protection Measures	
Natural Resource Protection Measures	
Emergency Services Measures	
Structural Measures	
Public Information Measures	

After completing the table above, use the STAPLE criteria to evaluate up to five proposed measures. Then develop a prioritized list of mitigation measures to include in your mitigation strategy.

MITIGATION MEASURE:

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<b>CRITERIA</b>	<b>CONSIDERATIONS</b>
Social	
Technical	
Administrative	
Political	
Legal	
Economic	
Environmental	

MITIGATION MEASURE:

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<b>CRITERIA</b>	<b>CONSIDERATIONS</b>
Social	
Technical	
Administrative	
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MITIGATION MEASURE:

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<b>CRITERIA</b>	<b>CONSIDERATIONS</b>
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MITIGATION MEASURE:

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<b>CRITERIA</b>	<b>CONSIDERATIONS</b>
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MITIGATION MEASURE:

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<b>CRITERIA</b>	<b>CONSIDERATIONS</b>
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MITIGATION MEASURE:

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<b>CRITERIA</b>	<b>CONSIDERATIONS</b>
Social	
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Political	
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Economic	
Environmental	

MITIGATION STRATEGY

<b>PRIORITIZED MITIGATION MEASURE</b>	<b>DESCRIPTION</b>

## ✓ CHECKING YOUR MEMORY

Circle the correct response. Answers may be found on page A-1

1. Lands that are at high risk of damage from hazards should be:
  - A) developed for industrial use.
  - B) developed for residential use.
  - C) zoned to restrict human habitation and development.
  
2. Rebuilding of hazard-damaged structures is ideally accompanied by
  - A) adoption or enhancement of building codes that minimize hazard risks.
  - B) reduction in land use control.
  - C) increased insurance premiums.
  
3. An example of a structural solution to a flood hazard is
  - A) wet floodproofing.
  - B) land use planning.
  - C) a levee.
  
4. Terracing, contour strip farming and farm ponds are examples of
  - A) structural measures.
  - B) natural resource measures.
  - C) public information measures.
  
5. A public information program about mitigation will be most well-accepted
  - A) at the beginning of storm season.
  - B) when the economy is poor.
  - C) when highly technical language is used.
  
6. An example of a property protection measure is
  - A) acquisition.
  - B) relocation.
  - C) Both A and B.
  
7. The first and most important STAPLE criteria is:
  - A) social and political acceptability.
  - B) economic feasibility.
  - C) administrative capability.
  - D) there is no implied priority or weight to the STAPLE criteria.