

the natural hazard mitigation planning process

Natural hazard mitigation planning is the process of figuring out how to reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and tornadoes. Four basic phases are described for the natural hazard mitigation planning process as shown in this diagram.

For illustration purposes, this diagram portrays a process that appears to proceed in a single direction. However, the mitigation planning process is rarely a linear process. It is not unusual that ideas developed while assessing risks should need revision and additional information while developing the mitigation plan, or that implementing the plan may result in new goals or additional risk assessment.

organize resources

From the start, communities should focus the resources needed for a successful mitigation planning process. Essential steps include identifying and organizing interested members of the community as well as the technical expertise required during the planning process.



assess risks

Next, communities need to identify the characteristics and potential consequences of natural hazards. It is important to understand how much of the community can be affected by specific hazards and what the impacts would be for important community assets.



develop a mitigation plan

Armed with an understanding of the risks posed by natural hazards, communities need to determine what their priorities should be and then look at possible ways to avoid or minimize the undesired effects. The result is a natural hazard mitigation plan and strategy for implementation.



implement the plan and monitor progress

Communities can bring the plan to life in a variety of ways ranging from implementing specific mitigation projects to changes in the day-to-day operation of the local government. To ensure the success of an on-going program, it is critical that the plan remains effective. Thus, it is important to conduct periodic evaluations and make revisions as needed.



foreword

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The Federal Emergency Management Agency (FEMA) has developed this series of mitigation planning "how-to" guides to assist states, communities, and tribes in enhancing their natural hazard mitigation planning capabilities.

These guides are designed to provide the type of information states and communities need to initiate and maintain a planning process that will result in safer communities. These guides are applicable to states and communities of various sizes and varying ranges of financial and technical resources.

This how-to series is not intended to be the last word on any of the subject matter covered; rather, it is meant to be an easy to understand guide for the field practitioner. In practice, these guides may be supplemented with more extensive technical data and the use of experts if possible.

The how-to guides cover the following topics:

- Getting started with the mitigation planning process including important considerations for how you can organize to develop a plan;
- Identifying hazards and assessing losses to your community and state;
- Setting mitigation priorities and goals for your community;
- Evaluating potential mitigation measures through the use of benefit-cost analysis and other techniques;
- Creating a mitigation plan and implementation strategy;
- Implementing the mitigation plan including project funding and revising the plan periodically as changes in the community occur; and
- Incorporating special circumstances in hazard mitigation planning for historic structures, among other topics.



mit-i-gate\ 1: to cause to become less harsh or hostile; 2: to make less severe or painful

plan-ning\: the act or process of making or carrying out plans; *specif*: the establishment of goals, policies and procedures for a social or economic unit



The Disaster Mitigation Act of 2000

The impetus for states and local governments to undertake natural hazard mitigation planning was given a significant boost on October 30, 2000, when the President signed the Disaster Mitigation Act of 2000 (Public Law 106-390). The law encourages and rewards local and state pre-disaster planning, promotes sustainability as a strategy for disaster resistance, and is intended to integrate state and local planning with the aim of strengthening statewide mitigation planning. This new approach facilitates cooperation between state and local authorities, prompting them to work together. This enhanced planning network enables local, tribal, and state governments to articulate accurate and specific needs for mitigation, resulting in faster allocation of funding and more effective risk reduction projects.



Why should you spend the time to read these guides?

- It simply costs too much to address the effects of natural disasters only after they happen;
- Neither communities nor their residents can be made whole by state and federal aid after disasters;
- You can prevent a surprising amount of damage from these hazards if you take the time to anticipate where and how these natural phenomena occur; and
- The most meaningful steps in avoiding the impacts of natural hazards are taken at the state and local levels by officials and community members who have a personal stake in the outcome and/or the ability to follow through on a sustained program of planning and implementation.

The guides focus on showing how mitigation planning:

- Can help your community become more *sustainable and disaster-resistant* through selecting the most appropriate mitigation measures, based on the knowledge you gain in the hazard identification and loss estimation process.
- Allows you to *focus your efforts on the hazard areas that are most important to you* by incorporating the concept of determining and setting priorities.
- Can *save you money* by providing a forum for engaging in partnerships that could provide technical, financial, and/or staff resources in your effort to reduce the effects, and hence the costs, of natural hazards.

Developing a successful natural hazard mitigation plan

for your community depends on how well you understand the potential problems you face. This how-to guide is focused on the second phase of the natural hazard mitigation planning process and will help you estimate your losses from selected hazard events.



introduction

Risk assessment answers the fundamental question that fuels the natural hazard mitigation planning process: *"What would happen if a natural hazard event occurred in your community or state?"*

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards by assessing the vulnerability of people, buildings, and infrastructure to natural hazards.

Risk assessment provides the foundation for the rest of the mitigation planning process. The risk assessment process focuses your attention on areas most in need by evaluating which populations and facilities are most vulnerable to natural hazards and to what extent injuries and damages may occur. It tells you:

- The hazards to which your state or community is susceptible;
- What these hazards can do to physical, social, and economic assets;
- Which areas are most vulnerable to damage from these hazards; and
- The resulting cost of damages or costs avoided through future mitigation projects.

In addition to benefiting mitigation planning, risk assessment information also allows emergency management personnel to establish early response priorities by identifying potential hazards and vulnerable assets.

The steps in this how-to guide describe some methods you may use to develop this information. Subsequent guides assist you in determining priorities for mitigation and in deciding which assets in your community or state should be protected.

State and Local Risk Assessment

Risk assessment is a shared responsibility between states and local communities. Both states and communities should assess their risks from natural hazards as part of their respective planning processes. While local governments focus on the hazards, vulnerabilities, and risks on a local or regional scale, states should focus on the re-



haz-ard \ : a source of danger

vul-ner-a-bil-i-ty \ : open to attack or damage

risk \ : possibility of loss or injury

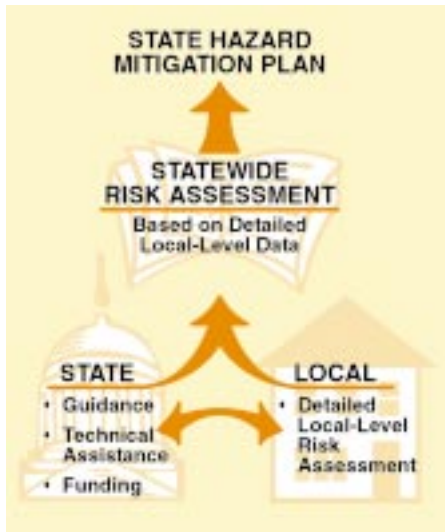
Understanding Your Risks: Identifying Hazards & Estimating Losses

is part of a series of guides that will help you identify, plan, and evaluate measures that can reduce the impacts of natural hazards in your community or state through a comprehensive and orderly process known as **Natural Hazard Mitigation Planning**.

As detailed in the Foreword, the process consists of four basic phases as shown below. The first phase consists of creating a mitigation planning team (referred to as the "Planning Team" in these guides) with representatives from the public and private sectors, citizen groups, colleges or universities, as well as non-profit agencies.



This guide, *Understanding Your Risks*, addresses the second phase of the planning process. Guides dealing with the third and fourth phases, "Develop a Mitigation Plan" and "Implement the Plan and Monitor Progress", discuss establishing goals and priorities, selecting mitigation projects, conducting benefit-cost analyses, and writing, implementing, and revisiting the mitigation plan.



gional and statewide implications of hazards. The risk assessment process introduced in this guide encourages the reciprocity of information and support between states and local governments - states provide leadership and support to local communities, and local communities provide their states with local-level risk analyses. Through this exchange of information, statewide risk assessments based on detailed, local-level analysis are produced.

States can provide leadership early on by establishing guidelines, setting expectations, and providing incentives for local risk assessment and mitigation planning activities. To support and facilitate the risk assessment process, states should be able to provide communities with technical assistance, basic hazard data, and access to a range of state agency technical resources. Key decisions must be made by states to ensure a level of consistency in local risk data to facilitate statewide analysis.

As states gain a greater understanding of where the highest risks are across the state, they will be better prepared to decide where and how mitigation resources can be most effective. This information will become part of the state's mitigation plan, where mitigation priorities and criteria for those priorities are articulated.

How do you use this guide?



Understanding Your Risks provides detailed, step-by-step instructions on the procedures which are part of the Assessing Risks phase of the Natural Hazard Mitigation Planning Process. The recommended steps in this guide, shown here, are organized into four simple steps to estimate losses from a single hazard event. More complex risk assessment processes use complicated statistical analysis of a wide range of past hazard events and geological, climatic and meteorological data to determine probable losses on an annual basis. The intent of this how-to guide is to help you develop a baseline estimate of possible losses throughout your community or state from one event.

Losses, as used here, are represented as the monetary damage to structures and contents, interruption of services, and displacement of residents and businesses. The use of money as a measure of loss serves several purposes:

- It conveys the financial cost of a disaster to a community. It is important to note that there are other intangible losses that occur in a community such as losses of historic or cultural integrity or damage to the environment that are difficult to quantify. Other costs, includ-

ing response and recovery costs, are often unrecoverable (these costs are not addressed in this guide).

- It provides an explicit representation of what a community or state stands to lose in a disaster. This is useful for elected officials and other decision makers who will need to balance the costs of mitigation against the costs of damage.
- It provides comparable measurements of losses across different hazards or different parts of the community. It assists a community in determining which hazards or what parts of the community to focus on.
- It provides a dollar amount to use as part of a benefit-cost analysis to be applied later (in subsequent how-to guides) in determining the cost-effectiveness of mitigation initiatives.

After you have estimated losses using one hazard event, you may find it necessary to conduct a comprehensive risk assessment by assessing the full range of hazard events. The work you produce here will serve as a good foundation for this additional effort if the need arises but will be of immediate benefit in helping set priorities and identifying mitigation projects in the next phase of the planning process – “Develop a Mitigation Plan”.

Multi-Hazard Guidance

Where appropriate, this guide includes specific information to estimate losses for seven natural hazards, with a unique icon to identify each:



Floods



Coastal Storms



Earthquakes



Landslides



Tsunamis



Wildfires



Tornadoes

Obviously, there are other hazards that can affect states and communities. While this guide does not provide specific direction for all hazards, the basic procedures explained here could be adapted for any natural hazard with variations that respond to the peculiar



Comprehensive Risk Assessment

Later in the planning process (the third and fourth phases), you will have enough information to decide what mitigation actions you will pursue, and how they may be funded. Potential mitigation projects that will use federal funding require an analysis of benefits and costs across a broad range of hazard events. If you plan to use federal funding, it may be necessary to conduct a comprehensive hazard profile by considering all possible hazard events. For example, a devastating flood may occur every thousand years, however there's also a chance of a minor level of flooding every year, although the depth will obviously be much less. The small annual floods may result in far more damage than one big flood that may only occur once a century. In a rigorous risk assessment or benefit-cost analysis, mathematical calculations are used to determine the expected damages from the whole range of possible flood events, or other hazards that could impact an area. This provides a more accurate and complete picture of risk (and the benefits of avoiding it) than the “single-point” method. The procedures for doing an analysis with FEMA benefit-cost analysis software are simple and are discussed as part of the “how-to” guide for the third phase of the planning process, “Develop a Mitigation Plan”.

nature of each hazard. For a more complete description of the range of natural hazards that can affect the United States, please see *Multihazard Identification and Risk Assessment* published by FEMA.

State and Local Guidance

This guide is focused on providing guidance to communities, tribes, and states. While much of the hazard identification and loss estimation process operates in a similar fashion for each level of government, there are critical points where estimating losses for communities and tribes and states are different due to the differences in size. Therefore, throughout this document, guidance focused solely on the role of the “**States**” is identified as a sidebar with this icon. Furthermore, guidance focussing on communities includes tribes as well.



Types of Information



In addition to helpful hints and useful information identified by the “**Tips**” icon, this guide also provides a number of options that can be used in situations where detailed information is not readily available.

You should follow the main procedures outlined in this guide to produce your loss estimation. However, when you are unable to get desired information, such as the Flood Insurance Rate Map, or when a procedural shortcut may exist, the alternative method will be identified by the “**Basic**” icon.



In addition to the alternative method, advanced information has also been provided and will be identified by the “**Advanced**” icon. This method can be used to refine your loss estimation to improve your results or when specialists may be needed.



The “**HAZUS**” icon identifies suggestions for using the risk assessment tool, HAZUS (Hazards U.S.). In addition to estimating earthquake losses, HAZUS contains a database of economic, census, building stock, transportation facilities, local geology, and other information that can be used for a number of steps in the risk assessment process.



Finally, the “**Caution**” icon will alert you to important information about the risk assessment process.



Glossary

The “**Glossary**” icon identifies terms and concepts that need further explanation. These and other common risk assessment-related terms and phrases are defined in the Glossary included in Appendix A.

Library

In addition, a risk assessment “**Library**” has been included in Appendix B. The library has a wealth of information, including Web addresses, reference books, street addresses, and phone numbers to help you conduct your loss estimation. Each of the Websites and references listed in this how-to guide are included in the library.

Hazardville

Applications of the various steps in the risk assessment process will be illustrated through a fictional community, the Town of Hazardville. Hazardville, located in the State of Emergency, is on a quest to develop a natural hazard mitigation plan, which includes an estimate of potential losses. Hazardville is a small community with limited resources and multiple hazards. When we left Hazardville after the first phase of the planning process, “Organize Resources,” the town had just established its mitigation planning team, the Town of Hazardville Organization for Risk Reduction (THORR). Fictional newspaper accounts featuring the THORR will illustrate the various steps in the risk assessment process (see page xi).

Worksheets

Finally, to help you obtain the information you need at each step of the process, worksheets have been developed to correspond with the structure of this guide. In each step, examples of the type of information to be included in these worksheets are shown. All of the worksheets have also been included in Appendix C at the end of this guide. You should photocopy these forms and record your progress as you undertake this risk assessment process. Alternatively, you may use the worksheets as templates with which to set up your own computer spreadsheets, databases, or other applications.



During the development of a mitigation plan, you will need to gather information and data from a number of sources.

As with any effort of this type, it is important to be aware of how different authors use terms. The easiest way is to make sure you look for specific definitions within the source documents to be sure you understand the intended meaning.



Please keep in mind that the World Wide Web is an ever-changing source of information and that web addresses and the information they contain will change over time.



Getting Started

This guide will help you answer the following questions:

What kinds of natural hazards can affect your state or community?

Many Midwestern communities

are located near the New Madrid fault, an area with a high seismic risk; however, most residents are not aware of this risk because the last significant earthquake occurred in the early 19th Century. In addition, many arid regions of the country face significant risk due to flooding, even though most of their watercourses are dry. When heavy rains occur in these areas, the storms can be very intense and cause flash floods on hillsides (alluvial fans) and in "dry" streambeds.



What may have happened in the past that you should know about? Quite naturally, many people are only aware of the most obvious risks, usually as a result of a disaster that affected their community or state in the recent past such as a tornado, hurricane, or flood. In many cases, however, there are hazards most people are not aware of because they haven't affected the community or state during the lifetimes of current residents.

Step 1 of this guide – Identify Hazards – helps explain how to determine which natural hazards can affect you.

How bad can it get?

How "big" is each hazard's potential impact? Will it affect every area the same or will certain areas get hit harder than others? How often will each type of hazard impact your community or state?

Even within the same hazard event,

there can be different types of impacts. Hurricanes can cause flooding due to torrential rains across broad coastal and inland areas. However, along the shoreline, hurricanes and other coastal storms can cause an increase in the mean sea level, called a "storm surge".



It's important to know the location and amount of land area that may be affected by certain kinds of hazards. For example, there may be areas that can be affected repetitively by a hazard in one part of the community (such as floodplains adjacent to streams and rivers) or there may be potential community-wide impacts from events such as hurricanes or earthquakes. You should also note that a specific type of hazard can have varying effects on a community, depending on the severity of individual hazard events. For example, differences in the depth of floodwaters from discrete flood events will yield corresponding differences in the amount of damages.

Step 2 of this guide – Profile Hazard Events – will help you determine how bad a hazard can get.

As communities and states work together

to generate state-wide mitigation plans, many communities may want to update or revise their risk assessment to assess risks from several hazard events encompassing a range of intensities and/or frequencies or to determine future risks.



What will be affected by these hazards?

Are there buildings, roads, and/or other facilities in the community that will be damaged or destroyed by these hazards? Are there concentrations of certain populations in hazard areas that are especially vulnerable, such as elderly or non-English speaking people?

An inventory will help you identify the assets that can be damaged or affected by the hazard event. For detailed assessments, the inventory will also include information on special populations and building characteristics like size, replacement value, content value,



and occupancy. In many cases, community assets may be vulnerable to more than one type of hazard, and you may need to look at different characteristics of the same asset to understand its vulnerability to each type of hazard. For example, if a building is subject to both floods and earthquakes, you will be interested in the location and elevation of the building so you can tell how much of its structure and contents will be damaged by flooding. You will also be interested in the construction of the building and its ability to resist physical damage caused by the anticipated ground movements during an earthquake.

Step 3 of this guide – Inventory Assets – will help you determine where and/or to what extent these hazards will affect the assets of your community or state.

How will these hazards affect you?

What are the varying effects of different hazards on community assets? To what extent will assets be damaged by each hazard? If buildings and other structures are destroyed or damaged, how much will it cost to replace and/or repair them? If the contents of businesses and homes are also affected, how much cost would be added? If there are indirect effects, what is the accumulated cost of the losses?

Hazards create direct damages, indirect effects, and secondary hazards to the community. Direct damages are caused immediately by the event itself, such as a bridge washing out during a flood. Indirect effects usually involve interruptions in asset operations and community functions, also called functional use. For example, when a bridge is closed due to a flood, traffic is delayed or rerouted, which then impacts individuals, businesses, and public services, like fire and police departments that depend on the bridge for transportation. Secondary hazards are caused by the initial hazard event, such as when an earthquake causes a tsunami, landslide, or dam break. While these are disasters in their own right, their consequent damages should be included in the damage calculations of the initial hazard event. Your loss estimations will include a determination of the extent of direct damages to property, indirect effects on functional use, and the damages from secondary hazards for each of the hazards that threaten your community or state.

Step 4 of this guide – Estimate Losses – will help you determine how hazards will affect your community or state.

It is important to continually provide citizens with the information gained throughout the risk assessment process. This not only educates the community on their hazards and risks in an ongoing fashion, but facilitates wider involvement in the process. Holding public meetings to present the most recent findings after each major step in the risk assessment process allows the new information to be reviewed and validated. Making sure that media coverage of the process is regularly engaged is another technique for ensuring that no interested parties are left out of the process.



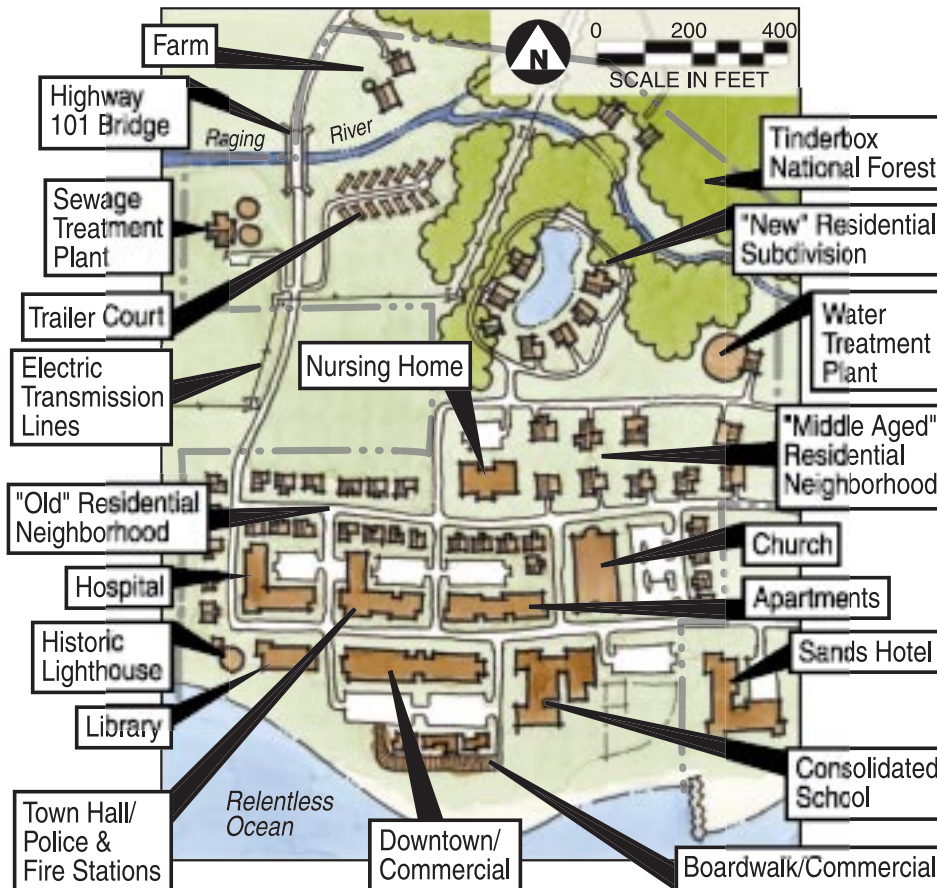
Go to Step 1

After you have read this *Introduction* and reconvened your Planning Team, go to Step 1. In Step 1, you will identify all of your potential hazards and determine which hazards are most prevalent in your community.

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Risky Business

[Hazardville, EM] The Hazardville Town Council unanimously approved the creation of the Town of Hazardville Organization for Risk Reduction (THORR) at a meeting last night. In anticipation of the move, Mayor McDonald nominated THORR members last month. The THORR members will work with town staff to identify natural hazards that could threaten Hazardville and estimate their losses from those hazards. This process is known as risk assessment. As reported previously in the Post, THORR will include a number of prominent community and business leaders. Starting next month, the Post will launch a series of articles covering THORR's work on the risk assessment process.