

PHASE 2 – HAZARD IDENTIFICATION AND RISK ASSESSMENT

Prioritize Hazards

After you have developed a full list of potential hazards affecting your campus, prioritize them based on their likelihood of occurrence. This step should not downplay the possibly devastating consequences of a single unlikely event; however, with limited resources, and as a place to start, focus on the hazards *most likely* to affect your institution. The advisory committee or a subcommittee can be useful to engage in this prioritization. Local and state emergency management officials can also provide valuable assistance. If communities adjacent to your campus have undertaken this step, you should consider using all or part of the same prioritized list.

PROFILE HAZARD EVENTS

Detailed Hazard Profiles

After the initial list of potential hazards has been compiled and you have decided whether to address all or a subset of these events, the next step is to create detailed hazard profiles. This step addresses in specific terms the scope and extent of damage that a particular hazard event could cause to your institution. This is an important step, because determining the type of impact a hazard event will have on your campus can help identify the institution's vulnerable assets.

Mapping

The creation of a campus base map upon which various hazard events can be profiled is the starting point for creating a detailed hazard profile. The FEMA how-to guide, *Understanding Your Risks: Identifying Hazards and Estimating Losses* (FEMA 386-2) explains this process in greater detail. It is important to point out, however, that your geography department or other academic unit with expertise in mapping may be able to create this map for you as a student project or with limited resources. If a member of the geography department is not on the steering committee, contact the department, explain your interests, and inquire about potential help.

Experience

Conducting a risk assessment requires a wide variety of experts and resources. In preparing for this step you should review the skills, knowledge and abilities of your advisory committee members and canvass other campus resources for possible contributors. Faculty members may already have answered some of your risk questions as part of their own teaching or research activities. Other campus units, such as Facilities, Planning, Environmental Health & Safety, and Risk Management, may possess relevant expertise as well as data that will help in the risk analysis. You should also look to the community and state for help. There, you may find specialists in the city or county government who will help you as part of their jobs, or scientists working for the state department of water or geology. Already established community working groups or committees may have some of the information you need, or they may agree to help you get it. If adequate capacity is not available, seriously consider hiring a consultant to complete the risk assessment.

Experience

A contractor hired by the University of Miami used information available for a potential flood event related to a hurricane to develop a map that displays the campus facilities that might be flooded or disrupted by road closings or power outages. This map subsequently allowed the university to target those structures for mitigation actions that will lessen the impact of a flood event.

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The map should display as many features of your campus as possible. At a minimum, it should show classroom buildings, dormitories, communications and computer facilities, laboratories, offices, libraries, food service, historic and architecturally important structures, parking areas, and any other unique or institution-specific resources. It will also be important to map essential services such as fire, police, emergency communications, emergency operations centers, medical facilities, and shelters, as all of these would be needed during and immediately after a disaster. Locations of items such as hazardous materials and biological agent storage and use areas and animal research facilities should also be noted as this information is critical for local first responders. Finally, the map should illustrate campus lifelines and critical infrastructures such as roads and water, power, communication, and wastewater lines.

The base map should extend beyond the campus boundaries to include campus-related facilities such as residential areas, local fire stations, transportation facilities, and fraternity and sorority buildings. Coordinate this activity closely with surrounding local officials. Placing this map on a geographic information system (GIS) will make it more useful as the project progresses and the data become more complex. GIS can be used to store and access the mapping information, displaying the areas, systems, and functions that are at risk and graphically depicting potentially damaged areas and buildings, costs of repair, and concomitant threats to operations that will assist in setting mitigation priorities. Almost every college and university has GIS specialists within an academic department such as engineering or geography.

Regardless of whether you choose to address each of the hazards you have identified or to narrow your focus from the full range of potential hazards to a subset of the potential threats, the next step is to collect more detailed information. The goal is to identify information, maps, experts, and other resources helpful to beginning the step of

Recent Disasters and Universities

On January 11, 2002, a three-alarm fire broke out in the Sinsheimer Laboratories building on the campus of the University of California Santa Cruz. The fire completely destroyed several labs, including the research lab of Professor Manny Ares, who lost more than a decade of work on the Human Genome Project. Damage from the fire has been estimated at \$4-5 million. The building was constructed in 1987, before fire codes required a sprinkler system.

Experience

Universities and colleges are especially concerned with protecting and retrieving documents. Your hazard profile will probably point to the importance of your library, archives, and research data. Over the past couple of decades, numerous library collections and much research have been lost to hazard events. At the same time, a great deal has been learned about how to protect and restore these important resources. Your inventory of hazards and relevant information could contain separate sections for these special or unique institutional assets.

Experience

Information sources at your institution helpful in creating your base map include:

- An accurate listing of all structures on the campus, as well as those that the institution may own on outlying properties, with as much detailed information about the buildings as possible. Typically, a facilities management department holds these data. Determine the amount of space in classrooms, laboratories, offices, libraries, and other facilities, such as convocation spaces. Most institutions have an office that manages the assignment of space to various departments or units. Note that residential and parking structures should be accounted for as well.
- Maps of the campus infrastructure—power, water, sewer lines, and voice and data communications systems. Typically, the managers of the physical plant or facilities management hold these maps.
- Previous assessments of facilities that may have been done for hazardous materials management, deferred maintenance, or for insurance purposes.

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evaluating the potential threat of this hazard to your institutional mission. A good deal of attention should be focused on local, state, and Federal emergency management personnel who can assist in providing basic information on the consequences of all of the hazards that have been identified. Particular attention should be paid to resources that may show the impact of hazards on the unique assets of your institution or those of higher education institutions generally.

Use the hazard information and prioritization you generated earlier to create hazard event profiles, or maps. In the beginning, this will involve simple tasks such as delineating a fault zone, floodplain, or storm surge run up zone, but the complexity of your map will ultimately depend on the size of your institution and the hazards it faces. Your maps may later include more complex elements, such as a detailed earthquake shaking map or an analysis of peak flood elevations. When added to the base map, these hazard overlays will create a visual display of how the various hazards could affect your campus and facilities.

This effort will be successful only if the campus base map is complete and accurate. Be certain to record and archive all of the information you use to create the hazard event profiles; in addition to safeguarding your work in the event of a disaster, archives may be useful in developing the mitigation plan, and they will be essential to future updates of the risk assessment.

Worksheet #4 (Appendix A) can help you determine how to obtain and record hazard information.

INVENTORY YOUR ASSETS

The third stage of the hazard identification and risk assessment is to conduct an inventory of campus assets in the hazard areas to show how the hazard events you have identified could affect the physical components and operations of the institution. The campus base map and hazard event profiles helped determine *where* hazards can affect your institution; the asset inventory will help determine *what* can be affected.

The inventory should include information about all of the entities located in hazard areas. Your map already shows where these entities are located; now, they need to be described in sufficient detail so the hazard mitigation plan can be developed. The types of assets and hazards determine, in part, the type of information to be collected. Several

Resources

Community Vulnerability Assessment Tool (CVAT) CD-ROM. The CVAT provides guidance on conducting community-wide vulnerability assessments. It also provides a case study demonstrating the process for analyzing physical, social, economic, and environmental vulnerability to hazards at the community level. Some of its aspects could be modified for use by higher education institutions. For more information, visit the NOAA Web site at www.csc.noaa.gov/products.

Experience

Completing the asset inventory may be a substantial task and requires considerable time. The information you need may not be readily accessible, or even available. You may have to consult with numerous campus offices, personnel, experts, etc. and may even need to employ outside consultants on structural, geophysical and other issues. Nevertheless, the inventory is essential to calculating the potential losses and to prioritizing your mitigation actions in the hazard mitigation plan.

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general categories of assets are listed below, along with the types of information about them that will be important for estimating potential losses. You may find additional assets at your institution, and the following guidelines should be modified accordingly.

In conducting this inventory, you may wish to place priority on identifying which facilities are essential or critical to campus operations on a daily basis, and after an emergency. Examples include medical care facilities, emergency services (police, fire, ambulance), information storage, communications, and utilities. Other priority inventory components include historic and cultural resources housed on campus.

Buildings

Describe each campus building in the hazard areas, detailing its size in square feet, type of construction, materials, age, occupancy, maintenance schedule, and replacement and content values. Try to calculate the type and value of activities, operations, and special contents (e.g., sponsored research, instruction, recreation, animals, special collections, and irreplaceable specimens) for each building, as well as any associated capital investments such as equipment. Pay particular attention to any laboratories that may be located in the buildings, describing the laboratory by its research focus, material and equipment contents, and replacement cost and noting the potential for loss or interruption of research and any lab income that could subsequently be lost. There will be certain aspects of the buildings' construction that will be relevant for certain hazards. For example, if flooding is a possibility, pay particular attention to research investments and activities in the basements and ground floors of buildings. The following table outlines these considerations.

Building Data Requirements by Hazard

Building Characteristics	Flood	Earthquake	Tsunami	Tornado	Coastal Storm	Landslide	Wildfire
Building Type / Type of Foundation	✓	✓	✓		✓		
Building Code Design Level / Date of Construction	✓	✓	✓	✓	✓		✓
Roof Material				✓	✓		✓
Roof Construction				✓	✓		✓
Vegetation							✓
Topography	✓				✓	✓	✓
Distance from the Hazard Zone	✓		✓		✓	✓	✓

Describe buildings according to use. Categories may include classrooms, administration, support, research laboratories, libraries and collections, housing and dining, special uses such as gyms and concert halls, parking, and police, fire, and emergency services. Also characterize the occupancy of each building in one of two ways: 1) estimated continuous occupancy (ECO), an annualized average; or 2) typical peak hour occupancy (i.e., an hour between 8 am and 5 pm).

Resources

Content Loss Model for Campus Library: Determine the replacement value of the collections vulnerable to a hazard event and multiply this figure by the expected damage from the event. For example, a library collection valued at \$225,000 that is projected to suffer 10% damage from a 100-year flood would have an estimated loss value of \$22,500.

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Infrastructure

In addition to buildings, describe the conditions and vulnerabilities of utilities and communications systems. Electric, water, and gas systems are essential for campus activities and may be critical to maintaining many types of experiments, and the ability to move about the campus and to communicate via landline, radio, and Internet must be maintained if the campus is to remain fully operational. Additionally, assess the condition and vulnerabilities of all backup systems.

Finally, administrative systems (payroll, accounts payable, student records) are critical to continued operations. Find out where they are located and how vulnerable they are.

Determine the vulnerability of your important data and associated functions and what type of backup plan is appropriate.

At this point you should have sufficient information on the hazard events that could impact your institution and on the assets and operations that could be affected. This will help you determine how to begin mitigating potential damage and will provide you with a complete understanding of the overall risk your institution faces from hazards. It is important to emphasize that for the steps just described, FEMA provides considerable information developed for communities that can be modified to fit your needs (see FEMA 386-2).

Worksheets #5 and #6 in Appendix A can help you determine the extent to which particular hazards would affect the various elements of your institution. Categories shown are simply examples of how you may wish to break out the different types of buildings on campus. Consider tailoring the worksheets to meet your situation.

ESTIMATE LOSSES

The fourth step of the risk assessment is the estimation of the potential losses your institution could face from a specific hazard event. The purpose of this step is to describe how your institution's assets will be affected by a hazard event. During this step, you create scenarios that estimate the impact of an event on people, buildings, and infrastructure. Some of these entities will be more vulnerable than others, and your estimates of losses will vary depending on factors such as the age of the building, type of construction, and time of the event. In many cases, it has been useful to develop a number of different scenarios that vary by hazard event and expected impact.

Communities typically express their expected losses in dollars, and representing risk in economic terms can make a compelling case to administrators and others responsible for hazard mitigation policy at your institution. However, while dollar estimates are often required for community, state, or Federal assistance, the nature of higher education institutions suggests that other descriptions of losses may be appropriate. Lost instructional time, research equipment, data, and subjects, along with unique historical artifacts and library collections, should not only be

Experience

The University of California, Berkeley has developed a loss estimation methodology for the potential disruption of an earthquake to their University and the associated impact of that interruption on the surrounding region. A report entitled: *The Economic Benefits of a Disaster-resistant University: Earthquake Loss Estimation for UC Berkeley* can be found at www-iurd.ced.berkeley.edu/pub/WP-2000-02.pdf

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quantified but also described in such a way as to communicate the potential human and social costs of failing to reduce risk before disaster strikes.

In a traditional loss estimation process, three types of potential losses are considered: life, property (structure and contents), and function. However, due to the unique characteristics of many institutions' assets, you may also decide to develop separate loss function models for special equipment or research facilities that are particularly vulnerable. The basic formula for calculating loss to an asset is the replacement or interruption costs multiplied by the percent of the asset expected to be damaged from an event. The overall projected loss from a hazard event is expressed as the sum of the appropriate loss equations. Additional information on conducting loss estimates is available in the FEMA how-to guide *Understanding Your Risks: Identifying Hazards and Estimating Losses* (FEMA 386-2). You should be able to estimate structural, content, and functional use equations for each asset. Combined, these estimates provide a complete picture of the economic and financial vulnerability of your institution to various hazard events.

The asset inventory and hazard event profiles will provide the necessary information to develop detailed loss estimates for each structure and function at your institution. Ideally, all of this information should be collected in a common format and mapped using GIS. A composite loss map that combines the individual hazard event maps to determine the most vulnerable campus areas can then be created. While quantifying losses of information and operations may appear challenging, local, state, and Federal emergency management officials have been dealing with the complex issue of establishing loss estimates for years and they have a lot to offer as you work on loss estimates for your campus. You will probably discover that your institution has much in common with communities and that the general guidance FEMA provides to communities often is applicable to the needs of your own institution. Loss estimation tables for floods, earthquakes, and coastal storms, as well as guidance for estimating losses from other hazards, are available in the FEMA how-to guide referenced above.

You may also consider developing estimates of the impact that an interruption in your institution's operations would have on your community and the surrounding region. The local economy is affected by your institution's presence and spending, so capital costs (repair and replacement), student expenditures, faculty and staff salaries and benefits, and other measures of institutional economic activity should be highlighted in this calculation. Documenting this impact will demonstrate the degree to which the community is dependent on your institution, and it will help you in your efforts to mobilize the local community and to build support for your disaster mitigation effort.

Worksheet #7 (Appendix A) can help guide you in calculating the dollar value of losses to individual structures on campus. You can use a separate worksheet for each hazard you wish to evaluate.

CONCLUSION

Assessing your institution's vulnerability to natural and man-made hazards can be a challenging exercise. Imprudent decisions that your institution may have made in the past most likely will be revealed. It will take real effort to keep

Recent Disasters and Universities

In September 1999, Hurricane Floyd pounded North Carolina, causing serious flooding at East Carolina University in Greenville. The campus was surrounded by water for weeks. The university was only partially operational, and some students were forced to lodge with residents in the town.

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everyone focused on the long-term goal, but this is essential if you plan to take hazard mitigation seriously. A thorough analysis of the hazards that affect your institution, a profile of potential events, an inventory of the institution's assets, and an estimate of potential losses are necessary before a mitigation plan can be written and your needs can be prioritized. Even if mitigation actions are not immediately forthcoming, a risk assessment and vulnerability study will benefit your institution in many ways. By recognizing the hazards your institution faces and estimating potential losses from these events, your long-range planning efforts will improve and your institution will be more likely to make strategic choices that incorporate the principles of disaster mitigation.

Once the hazard identification and risk assessment are complete, you are ready to write your mitigation plan. The risk assessment will provide you with the information necessary to identify and prioritize mitigation actions based on the vulnerability of your institution; after determining and prioritizing appropriate mitigation actions, you can begin securing support and implementing the plan.