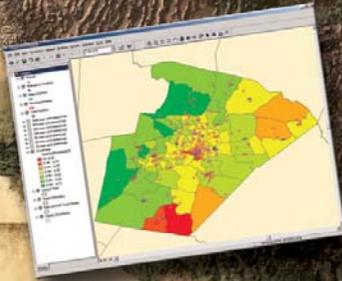


# HAZUS<sup>®</sup> MH

EARTHQUAKE • WIND • FLOOD



# HAZUS<sup>®</sup> Annual Progress and Utilization Report for Fiscal Year 2004

FEMA 493 / January 2005



FEMA

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## Executive Summary

In fiscal year (FY) 2004, the Hazards-US (HAZUS) program made significant progress, including a major increase in utilization. The number of HAZUS users has nearly tripled during the past four years from an estimated 1,300 users in 2000 to an estimated 4,200 users in 2004. To arrive at these utilization figures, the Department of Homeland Security's (DHS) Federal Emergency Management Agency (FEMA) conducted a market study and tracked distribution of the HAZUS application software.

In March 2004, FEMA's Mitigation Division publicly released HAZUS Multi-Hazard (HAZUS-MH) with enhanced capabilities. In the past year, the user base has nearly doubled. In addition, the *HAZUS Strategic Plan*, developed in January 2001, estimated that there would be 4,000 users in FY 2004 and 7,000 users in FY 2005. The estimated 4,200 identified HAZUS users exceeded the strategic plan FY 2004 goal of 4,000 users. The *HAZUS Market Study* estimated a market potential for HAZUS of 19,600 users by 2008. Current usage, based on the first six months HAZUS-MH has been available, already represents 21 percent of this potential market.

### HAZUS Usage

In FY 2004, HAZUS-MH software was utilized, to varying degrees, in all segments of the market, including other nations. Analyzing orders placed for HAZUS software, local government agencies placed 39 percent of the orders, 23 percent went to private industry, 13 percent went to universities, 8 percent each went to Federal and State agencies, 7 percent went to individuals with unidentified affiliations, including some Indian Tribes, and 1 percent each went to interest group organizations and the military. The 2004 data indicate that 68 percent of the States and 66 percent of the pre-disaster mitigation projects submitted to FEMA used HAZUS. Many of those that did not use HAZUS indicated they were well into the planning process when HAZUS-MH was

### FY 2004 HAZUS Highlights

- Tripled number of users since 2000; nearly doubled the number of users since 2003
- Released multi-hazard product enhancements
  - Enhanced Earthquake Model
  - New Flood Model
  - New Hurricane Wind Model
- Used by 68 percent of States and Territories and 15 percent of participating localities in multi-hazard mitigation planning
- International users include Norway and Sweden
- FEMA trained over 15 percent of the estimated 4,200 HAZUS users
- More than quadrupled the number of HAZUS User Groups to a level of 24, thereby saving \$500K to \$1M in technical assistance costs
- Supported Federal and State level emergency management decision making during the 2004 hurricane season
- Part of the North American Aerospace Defense Command (NORAD)/USNORTHCOM and other DoD Homeland Security exercises
- Received ESRI Award

released in March 2004. Of those that did not use HAZUS to date, many indicated they would in subsequent mitigation planning efforts. In addition, several States indicated that they ran HAZUS and provided HAZUS products to their communities, which may have resulted in underreporting of HAZUS usage at the local level.

## **Product Features**

HAZUS-MH was built on the earlier versions of HAZUS, Version 1. HAZUS-MH includes new Flood and Hurricane Wind Models while enhancing the existing Earthquake Model. In addition, updates to HAZUS software have been and will continue to be produced to respond to evolving operating system requirements and ArcView updates. These product updates respond to user needs, assist them in meeting FEMA's multi-hazard planning requirements, and will continue to expand the market potential.

## **Product Uses**

Most users applied HAZUS-MH to multi-hazard mitigation planning efforts required under FEMA regulations, including the Disaster Mitigation Act of 2000 (referred to in the rest of this report as multi-hazard mitigation planning). In addition, HAZUS supported Federal and State level emergency management decision-making during the 2004 hurricane season. FEMA's Mitigation Division supported the Response and Recovery Divisions and affected States by using HAZUS-MH to estimate potential damages based on National Weather Service forecast products. The HAZUS Hurricane Wind Model was used extensively at FEMA Headquarters, in Region IV, and by the State of Florida to first predict potential damages prior to landfall and then to estimate actual damages immediately following landfall. The State of Florida included HAZUS damage estimates in their requests for Presidential Disaster Declarations.

FEMA has also partnered with the Department of Defense (DoD) to help them prepare HAZUS-MH risk assessments for several military facilities. HAZUS data were incorporated into a Unified Defense exercise designed to support their homeland security mission. The US Geological Survey (USGS) Rocky Mountain Mapping Center helped support the US Northern Command (USNORTHCOM) Interagency Coordination Group for monitoring situational awareness in the United States. Support has focused on the development and implementation of a web-enabled reporting system for natural and man-made incidents. This system, known as the Interagency Operating Picture (IOP), incorporates natural hazard events and man-made incidents with baseline geospatial data. The National Map serves as the primary baseline geospatial data infrastructure while HAZUS datasets augmented this infrastructure to highlight critical information including essential facilities, high potential loss facilities, transportation systems, utility systems, and hazardous materials facilities.

## Customer Support

With the release of HAZUS-MH, and to support risk assessment activities, FEMA has provided support to form numerous public-private partnerships called HAZUS User Groups (HUGs). These HUGs leverage the resources of all partners (State, regional, local, private sector, and nonprofit organizations) involved in disaster mitigation planning and reduce the cost FEMA would have to absorb to provide the technical support that is provided by HUGs. To facilitate the formation of additional HUGs, FEMA developed a toolkit that provides examples and template materials to help communities form local HUGs. In FY 2004, FEMA more than quadrupled the number of HAZUS HUGs to 24 groups spread throughout the US.

While there has been no formal study, discussions with HUG leaders indicate that FEMA avoided technical assistance costs of \$500,000 to \$1 million in FY 2004. As the number of HAZUS users grows, the avoided technical support costs resulting from HAZUS HUGs are expected to increase as well. By the end of FY 2004, there were approximately 700 people participating in HUG meetings with approximately 4,500 users on HUG e-mail lists.

## Training Programs

Since the release of HAZUS 97, FEMA has provided both resident courses on how to use HAZUS at the FEMA's Emergency Management Institute (EMI) and other hands-on training throughout the country. To support the release of HAZUS-MH, the suite of available curriculum has grown to include *Intro to ArcGIS for HAZUS Users*, *Basic Multi-hazard HAZUS*, *Advanced HAZUS Earthquake*, *Advanced HAZUS Flood*, and *Advanced HAZUS Hurricane*. In addition, a new *HAZUS for Disaster Operations* course is scheduled for delivery in 2005.

Nationwide, more than 40 HAZUS training courses were delivered in FY 2004 to train at least 665 professionals how to use HAZUS. Fourteen courses were offered at EMI with 264 students in attendance, and at least 27 courses were offered in the field training more than 400 additional students. As a result of these activities, FEMA has directly trained more than 15 percent of the estimated 4,200 HAZUS users. Many of those who were trained in FY 2004 are sharing their knowledge with other users, especially through HAZUS HUGs.

## ESRI Award

Each year, at its annual International User Conference, ESRI (the developers of ArcGIS, the underlying operating software system of HAZUS) presents its Special Achievement in GIS Award to honor an "elite group of organizations that

*have embraced GIS technology to better serve our world. By their extraordinary contributions to our society they have set new precedents throughout the GIS community.*” FEMA was presented with this estimable award at the 2004 conference for efforts to develop HAZUS and promote public safety.

## Introduction

FY 2004 was a significant year for HAZUS. In March 2004, FEMA publicly released HAZUS-MH, a powerful risk assessment software program for analyzing potential losses from floods, hurricane winds, and earthquakes. This report documents a number of other significant accomplishments that occurred throughout FY 2004.

### Purpose of This Report

The purpose of this report is to document both the progress and utilization of HAZUS during FY 2004. As with all other organizational elements of DHS, FEMA is adopting and implementing the principles of performance-based budgeting and program management. While FEMA has made a significant investment in HAZUS to date, it is essential that future investment be carefully weighed against other priorities and needs to ensure that future investments are wisely made. Before making any future investments, it is essential to determine the progress made in delivering the HAZUS initiative and the extent to which our customers are making productive use of the HAZUS products released to date. HAZUS products not only include application software, but also support a wide variety of efforts related to publications, training, user groups, and technical support.

This report is the first annual utilization and program report on HAZUS. As such, this initial report documents the extensive use of HAZUS and serves as a baseline from which future progress can be measured in FY 2005, and beyond.

### Preparation of This Report

This report was developed by FEMA's Mitigation Division, Risk Assessment Branch, with assistance from FEMA's Regions, HAZUS users, support contractors, and others. In compiling this report, information was solicited from a broad range of parties with an interest in HAZUS. Mitigation Division staff that oversee various aspects of the HAZUS initiative provided information on their respective projects. These staff also contacted contractors supporting their efforts to solicit additional information. Each Regional Mitigation Division was contacted, and information concerning HAZUS activities within their respective regions was requested. In many cases, Regional staff contacted their State counterparts soliciting information concerning utilization of HAZUS, at the State and local levels, within their States. Each HUG that was contacted was asked to submit information on HAZUS activities. A simple utilization information request form was circulated, via e-mail, to 4,500 individuals that receive information from HUGs.

## Organization of This Report

This report is organized into several chapters and includes two appendices, as described below.

**Executive Summary:** This section provides a brief overview of the initial development of HAZUS, development of HAZUS-MH and related products, and the successes to date in expanding the user base.

**Introduction:** This section outlines the various products and activities related to HAZUS and the evolution of new products.

**Summary of HAZUS Utilization:** This section looks at usage statistics across the nation in terms of distribution, types of projects using HAZUS, usage in developing mitigation plans, and other project-specific information.

**HAZUS Program Management:** This section begins with an overview of HAZUS Program strategic planning and performance-based program management. HAZUS utilization met FY 2004 performance-based metrics.

**Status of HAZUS Development:** This section provides an overview of HAZUS products and new features available in HAZUS-MH such as enhanced earthquake modeling capabilities, new flood modeling for coastal and riverine flooding, and new developments in hurricane modeling capabilities.

**Future HAZUS-MH Development:** This section provides a preview of future products and how these products are being developed to meet changing user needs and new developments in ArcGIS and operating systems.

**HAZUS Initiatives:** This section highlights ongoing and upcoming activities to enhance customer support such as training and outreach activities, preparation of technical studies, and applications and collaboration with third parties including other Federal Agencies as well as international entities.

**HAZUS Awards and Recognition:** This section highlights the value our users and other agencies place on these products, and how well-received and critical HAZUS is becoming in implementing emergency management activities and multi-hazard mitigation planning requirements.

**HAZUS-Related Publications and Products:** This section illustrates a number of publications developed at the National, State, and local levels to promote the use of HAZUS.

**Appendix A: Summary of HAZUS Projects, By Region and State:** This section was developed in coordination with FEMA's Regional Offices and includes information from surveys, and other information sources.

**Appendix B: List of Acronyms:** This appendix provides a handy reference list for the reader to define acronyms commonly used throughout this report.

## Overview of HAZUS-MH

HAZUS-MH is a nationally applicable, standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by FEMA under contract with the National Institute of Building Sciences (NIBS). NIBS maintains committees of hurricane wind, flood, earthquake, and software experts to provide technical oversight and guidance to HAZUS-MH development. Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods, and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing mitigation plans and policies, emergency preparedness, and response and recovery planning.



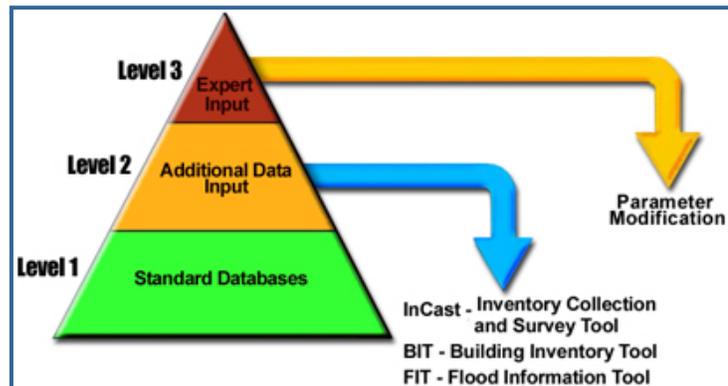
HAZUS-MH uses state-of-the-art Geographic Information System (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods, and earthquakes on populations. HAZUS-MH will be designed to facilitate use in real-time to support response and recovery following a natural disaster.

## HAZUS-MH Analysis Levels

HAZUS-MH provides for three levels of analysis:

- A Level 1 analysis yields a rough estimate based on the nationwide database and is a great way to begin the risk assessment process and prioritize high-risk communities.

- A Level 2 analysis requires the input of additional or refined data and hazard maps that will produce more accurate risk and loss estimates. Assistance from local emergency management personnel, city planners, GIS professionals, and others may be necessary for this level of analysis.



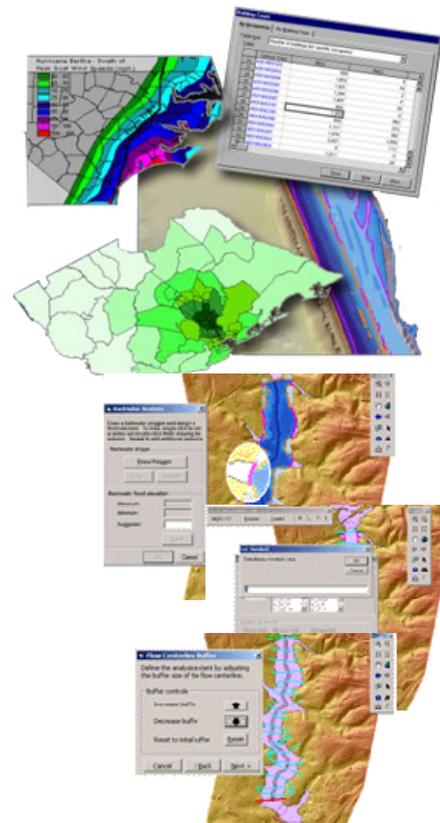
- A Level 3 analysis yields the most accurate estimate of damage and loss. This type of analysis typically requires the involvement of technical experts such as structural and geotechnical engineers who can modify loss parameters based on the specific conditions of a community. This level analysis will allow users to supply their own techniques to study special conditions such as dam breaks and tsunamis. Engineering and other expertise is needed at this level.

Three data input tools were developed to support data collection. The Inventory Collection and Survey Tool (InCAST) helps users collect and manage local building data for more refined analyses than are possible with the National level data sets that come with HAZUS. InCast was released in 2002 with expanded capabilities for multi-hazard data collection. HAZUS-MH includes an enhanced Building Inventory Tool (BIT) that allows users to import building data and is most useful when handling large datasets (over 100,000 records) such as tax assessor records. The Flood Information Tool (FIT) helps users manipulate flood data into the format required by the HAZUS flood model.

## HAZUS-MH Models

The **HAZUS-MH Hurricane Wind Model** gives users in the Atlantic and Gulf Coast regions the ability to estimate potential damage and loss to residential, commercial, and industrial buildings. It also allows users to estimate direct economic loss, post-storm shelter needs, and building debris. In the future, the model will include the capability to estimate hurricane wind effects in island territories, storm surge, indirect economic losses, casualties, and impacts to utility and transportation lifelines and agriculture. Loss models for other severe hurricane wind hazards will be included in the future.

The **HAZUS-MH Flood Model** is capable of assessing riverine and coastal flooding. It estimates potential damage to all classes of buildings, essential facilities, transportation and utility lifelines, vehicles, and agricultural crops. The model addresses building debris generation and shelter requirements. Direct losses are estimated based on physical damage to structures, contents, and building interiors. The effects of flood warning are taken into account, as



are flow velocity effects. The FIT, released in 2002, allows users to prepare local flood hazard and other pertinent data for use in the HAZUS-MH Flood Model.

The **HAZUS-MH Earthquake Model**, an updated version of HAZUS99 Software Release 2, continues to provide loss estimates of damage and loss to buildings, essential facilities, transportation and utility lifelines, and population based on scenario or probabilistic earthquakes. The model addresses debris generation, fire-following, casualties, and shelter requirements. Direct losses are estimated based on physical damage to structures, contents, inventory, and building interiors. The Earthquake Model also includes the new Advanced Engineering Building Model for single- and group-building mitigation analysis. The updated Earthquake Model released with HAZUS-MH includes:

- The new (September 2002) National Hazard Maps,
- Project '02 attenuation functions,
- Updated historical earthquake catalog (magnitude 5 or greater), and
- New Advanced Engineering Building Module for single and group building mitigation analysis.

Additionally, HAZUS-MH can perform multi-hazard analyses by providing access to the average annualized loss and probabilistic results from the hurricane wind, flood, and earthquake models and combining them to provide integrated multi-hazard reports and graphs. HAZUS-MH also contains a third-party model integration capability that provides access and operational capability to a wide range of natural, man-made, and technological hazard models (nuclear and conventional blast, radiological, chemical, and biological) to supplement the natural hazard loss estimation capability (hurricane wind, flood, and earthquake) in HAZUS-MH.

	Earthquake Ground Motion Ground Failure	Flood Frequency Depth Discharge Velocity	Hurricanes/Winds Pressure Missile Rain
<b>Direct Damage</b>			
General Building Stock	✓	✓	✓
Essential Facilities	✓	✓	✓
High Potential Loss Facilities	✓	✓	✓
Transportation Facilities	✓	✓	✓
Lifelines	✓	✓	✓
<b>Induced Damage</b>			
Fire Following	✓		
Hazardous Materials Release	✓	✓	✓
Debris Generation	✓		✓
<b>Direct Losses</b>			
Cost of Repairs/Replacement	✓	✓	✓
Income Loss	✓	✓	✓
Crop Damage	✓	✓	✓
Casualties	✓		
Shelter and Recovery Needs	✓	✓	✓
<b>Indirect Losses</b>			
Supply Shortages	✓	✓	
Sales Decline	✓	✓	
Opportunity Costs	✓	✓	
Economic Loss	✓	✓	

## Summary of HAZUS Utilization

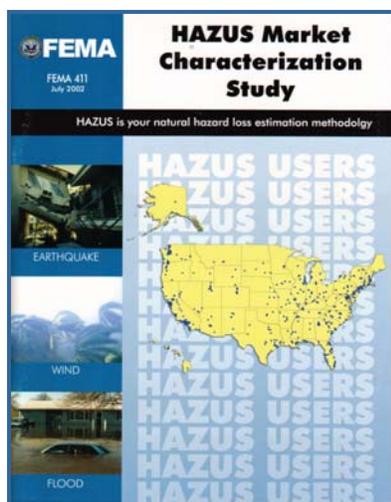
Representatives of Federal, State, and local government agencies as well as the private sector have been ordering HAZUS-MH, free-of-charge, in large numbers. HAZUS 97, and the updated HAZUS 99, originally ran earthquake scenarios using ArcView and MapInfo operating systems as well as updated National inventories. Updates were issued to allow users to take advantage of newer versions of these operating systems. When HAZUS-MH was released it included flood analyses that required ArcView 8.3 to take advantage of a spatial analyst tool that was not included in MapInfo.

There are several ways to assess HAZUS-MH usage. The following sections estimate the number of users based on distribution information. Then, data are presented to characterize user types and the types of projects they conducted.

### HAZUS-MH Distribution

HAZUS users were anxious to get copies of HAZUS-MH when it became available in March 2004 — particularly new users specializing in assessing flood and hurricane wind damage — as well as the original users interested in assessing earthquake damage. Beginning in March 2004, FEMA's Distribution Center processed nearly 4,000 orders for HAZUS-MH, distributing more than 9,000 software disks through the end of FY 2004.

The number of HAZUS-MH software systems shipped (FEMA shipped 3,977 copies) is considered to be a reasonable indicator of the number of users since some of the software that was ordered may not be actually used and other copies may be shared within an organization. Further analysis to determine the number of those that order the HAZUS-MH software that then go on to utilize it in their work will be conducted in FY 2005.



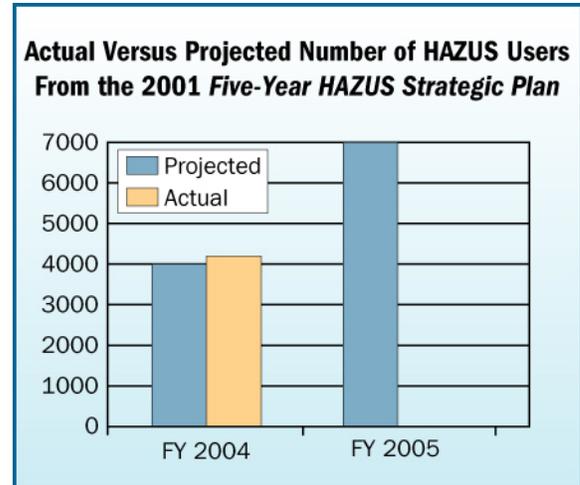
In addition, some States and communities are continuing to use HAZUS-99 while they await the release of HAZUS-MH Maintenance Release 1 (MR-1) that will run on ArcGIS 9.0 software to avoid the need for an interim purchase and installation of ArcGIS 8.3. An informal survey indicated that approximately 200 users continue to use HAZUS-99, and that there was a total of 4,200 HAZUS users at the end of FY 2004. This is an increase of 2,450 HAZUS users from approximately 1,750 HAZUS users in FY 2003, a 170 percent increase during this one-year period.

The *HAZUS Market Characterization Study*, conducted in 2001/2002, predicted that HAZUS, if properly positioned and marketed, would reach 25 percent of the potential market place. This study estimated the current size of the potential market at approximately 70,000 persons, with the potential market growing to 78,500 persons in 2008. The estimated market size was based on an analysis of current HAZUS usage data from FEMA as well as US Census Bureau and Bureau of Labor Statistics (BLS) data. *Standard Industry Classification* and *Standard Occupational Classification* information contained in BLS's *Occupational Employment Statistics* reports was used to correlate and derive data for the market segments and use roles defined by the marketing study. A market penetration of 25 percent would equate to 19,600 potential HAZUS users by 2008. With 4,200 users, HAZUS-MH has reached 21 percent of this estimated 2008 potential market in the first six months of its release.

Number of HAZUS Users		
Year	Number	Basis
2000	1,300	Estimated
2002	1,500	Estimated
2003	1,750	Estimated
2004	4,200	Actual
2008	19,600	Predicted Potential

Additionally, the *HAZUS Strategic Plan*, developed in January 2001, estimated that there would be 4,000 HAZUS users in 2004 and 7,000 users in FY 2005 (see the HAZUS Program Management Section for more information). The projected versus actual number of HAZUS users is shown below.

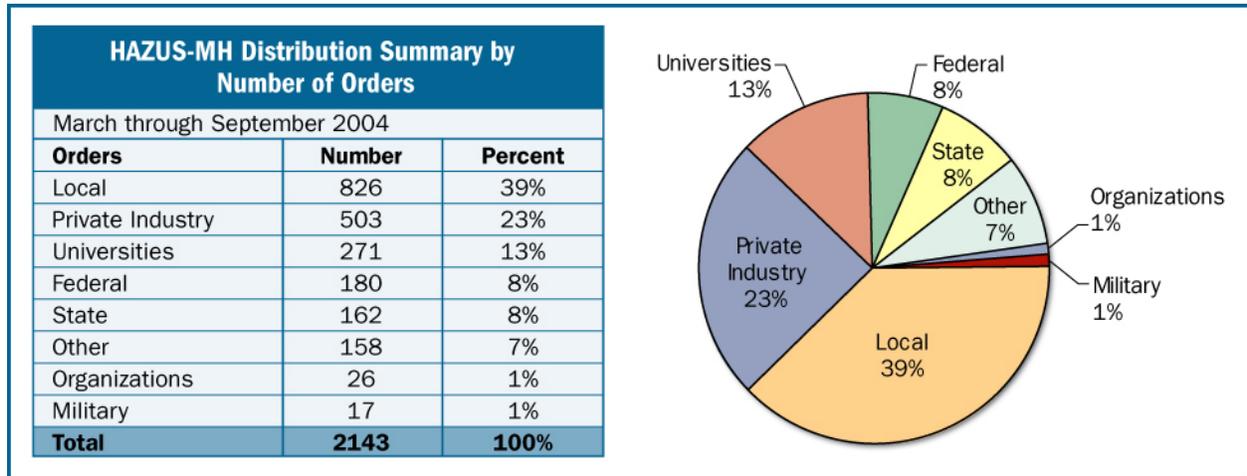
Three important factors contribute to the distribution increase, all of which distinguish the pattern of HAZUS-MH distribution from earlier versions of HAZUS: (1) the addition of flood and hurricane wind models, (2) enhancements to the earthquake model, and (3) new State grant requirements associated with mitigation planning. According to the marketing study, the first two factors strengthen the usefulness of HAZUS in the market, and the third factor, State mitigation planning, helps “push” the use of HAZUS in local and State government agencies. For detailed information concerning HAZUS software distribution, see *Appendix A: Summary of HAZUS Projects*.



### HAZUS-MH Users

From March 2004 through the end of FY 2004, HAZUS-MH was being used broadly. As seen in the table and chart below, HAZUS-MH software is being utilized, to varying degrees, in all segments of the market. Local government agencies placed 39 percent of the orders, 23 percent went to private industry,

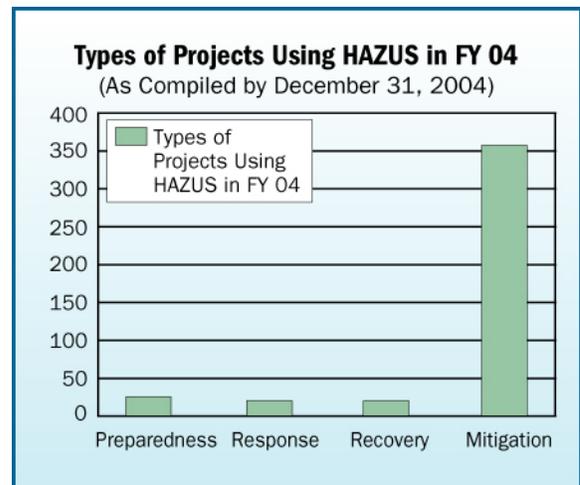
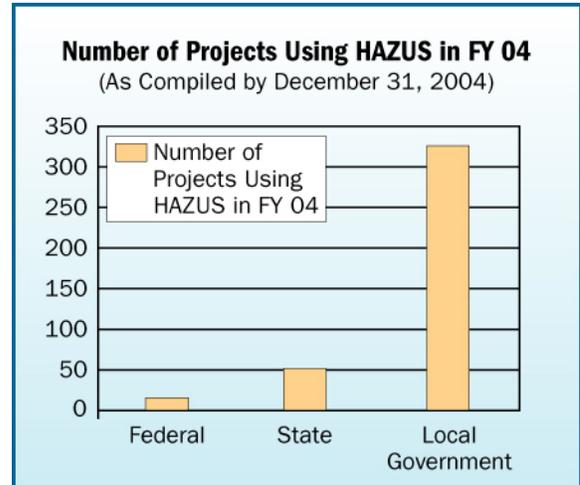
13 percent went to universities, 8 percent each went to Federal and State agencies, 7 percent went to individuals with unidentified affiliations, including some Indian Tribes, and 1 percent each went to interest group organizations and the military.



### HAZUS-MH Projects

In November 2004, FEMA asked HAZUS users how they were using HAZUS. This information was solicited through a number of outlets including HAZUS User Groups, the FEMA Regional Offices, direct contact with known major users, and through associations such as the Association of State Flood Plain Managers (ASFPM). Additional information was gleaned from previous data collection activities, such as the upcoming *National Earthquake Hazards Reduction Program (NEHRP) Biennial Report to Congress*. More detailed information concerning what kinds of projects are utilizing HAZUS can be found later in *Appendix A: Summary of HAZUS Projects*.

FY 2004 data indicates that HAZUS is being used to support all facets of emergency management, including preparedness, response, recovery, and mitigation in both the public and private



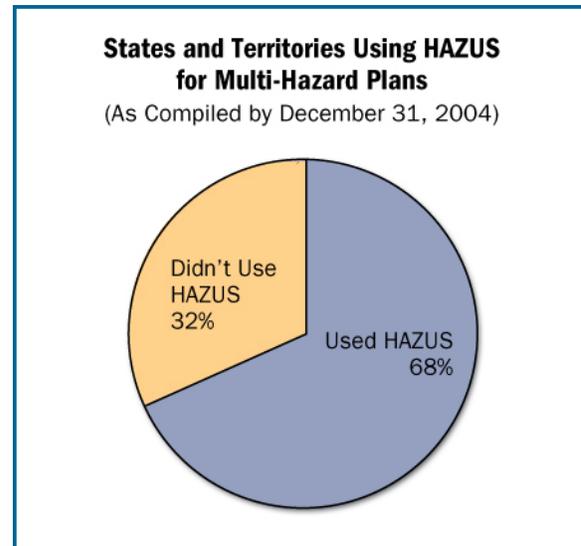
sectors. For example, the Narragansett Indian Tribe created flood maps using HAZUS that were submitted as part of their National Flood Insurance Program (NFIP) application. The figure above indicates the number of projects supported by HAZUS that have been reported to FEMA to date while the types of projects using HAZUS are shown below.

### HAZUS Usage in Preparing Multi-Hazard Mitigation Plans

A November 2004 survey of the FEMA Regional Mitigation Divisions indicated widespread use of HAZUS by States and communities in meeting FEMA's multi-hazard mitigation planning requirements. By the end of FY 2004, 56 States and Territories as well as 2,052 communities submitted multi-hazard plans to FEMA's Regional Offices for review. Of the local plans, 38 States and Territories as well as 317 communities prepared multi-hazard mitigation plans using HAZUS.

Additionally, Region VIII asked communities who had submitted multi-hazard mitigation plans but did not use HAZUS whether they intended to use HAZUS in the future. Of the 113 communities in Region VIII that submitted plans by the end of FY 2004, 36 indicated that they had used HAZUS to varying degrees, 73 indicated that they intended to use HAZUS in future mitigation planning efforts, and only 4 indicated no intent to use HAZUS in the future.

Many of those that did not use HAZUS to meet FEMA's multi-hazard planning requirements indicated they had not used HAZUS because they were well into the planning process when HAZUS-MH was released in March 2004.

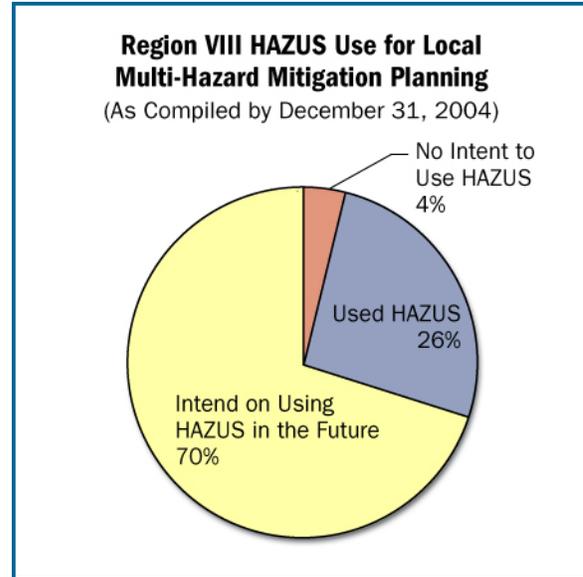


HAZUS Usage in Preparing Multi-hazard Mitigation Plans		
Region	State <sup>1</sup>	Local
I	6	10
II	2	20
III	3	68
IV	6	71
V	3	7
VI	3	60
VII	1	0
VIII	6	36
IX	7	35
X	1	10
<b>Total Multi-Hazard Mitigation Plans Using HAZUS</b>	<b>38</b>	<b>317</b>
<b>Number of Plans Approved or Under Development</b>	<b>56</b>	<b>2052</b>
<b>Percent Usage of HAZUS</b>	<b>68%</b>	<b>15%</b>

<sup>1</sup> Includes Territories

It is worth noting that every State in Region VIII used HAZUS in preparing their multi-hazard mitigation plan. In addition, Region IV reported that all

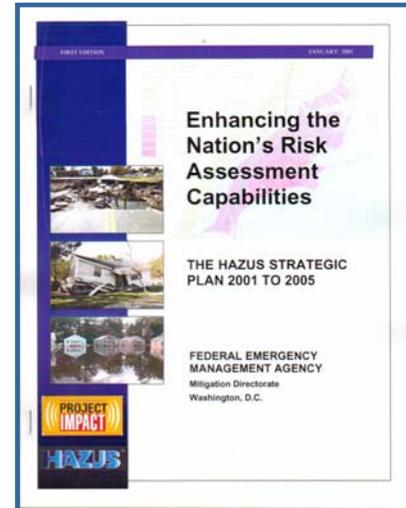
communities in the State of Kentucky will use HAZUS-MH for their plans, and Region III reported the same for Delaware communities. Though this is a limited sample, it appears that more and more communities are using the product. In addition, some of the Regions are reporting that States run HAZUS-MH scenarios on behalf of their communities. While this is significant, it may result in underreporting of the total number of communities where HAZUS was used to develop local multi-hazard mitigation plans.



## HAZUS Program Management

### Strategic Planning

FY 2004 represented the fourth year of a five-year *HAZUS Strategic Plan* prepared in January 2001. That strategic plan provided a vision and framework for what we see today: release of a multi-hazard version of HAZUS, the presence of HAZUS Users Groups spread throughout the US, a private sector initiative underway, a support network for HAZUS users that includes training and technical support, and HAZUS being used by thousands of land-use and emergency management planners, engineers, and GIS specialists in both the government and private sectors. These goals were met or significant progress was made in meeting the FY 2004 goals.



This strategic plan provided a timeline that was further refined when a three-year HAZUS development contract was awarded in FY 2001. The release date for HAZUS-MH was approximately eight months later than originally planned due primarily to the complexity of the software programming required to merge all three risk assessment models (earthquake, flood, and hurricane wind) within the Graphic User Interface (GUI) or shell and delays in ESRI's development and release of ArcGIS 8.3, the operating software for HAZUS-MH.

At the end of FY 2004, a program management support contractor was employed to develop a new five-year *HAZUS Strategic Plan* that meets today's many Office of Management and Budget (OMB) and DHS Information Technology program requirements, including future submissions of the HAZUS Exhibit 300. The development of the revised *HAZUS Strategic Plan* is currently underway, and the project schedule calls for its completion late in FY 2005. Intermediate products, such as needs assessments and requirements documents, are expected starting midway through FY 2005.

### Performance-Based Program Management

As part of FEMA and DHS's migration to performance-based budget and execution, all FEMA programs were required to develop performance metrics in FY 2004. For HAZUS, FEMA developed HAZUS utilization metrics related to the number of States and communities initiating projects using HAZUS and the number of partnerships FEMA creates to support HAZUS. Both quarterly and annual performance metrics were met in FY 2004 (see table below). In FY 2005,

surveillance systems will be formalized to collect HAZUS utilization data in a timely manner that also aligns with metric reporting timelines.

FY 2004 Sub-Program Element Performance Measure(s) for HAZUS	Targets	Actual
Quantitative risk analysis data such as that developed using HAZUS is used in Statewide planning efforts	4 States	38 States
Quantitative risk analysis data such as that developed using HAZUS is used by regional governments or communities in local planning efforts	15 regional or local	317 regional or local
Establish intergovernmental partnerships utilizing HAZUS and/or providing support for the development or application of HAZUS or other risk assessment tools are established	1 partnership	3 partnerships

## Status of HAZUS Development

### Release of HAZUS-MH

HAZUS-MH contains state-of-the-art integrated earthquake, flood, and hurricane wind loss models using ArcGIS 8.3 with new COM-based architecture to provide the mapping capabilities needed for HAZUS. This new GIS architecture is expected to reduce the maintenance required to adapt to ever-changing third-party software that HAZUS relies on.

HAZUS-MH earthquake model provides capability to utilize Shake Maps generated by USGS following an earthquake event, to characterize ground shaking for loss analyses conducted during response and recovery. In addition, HAZUS-MH has added the latest attenuation functions developed by the USGS and the capability to analyze segmented faults and economic loss for user-defined buildings, import ground failure maps, and automatically import data from the BIT.

The Flood Model includes methods for assessing riverine and coastal flooding and contains a library of damage functions for all classes of buildings and essential facilities. The model estimates damage to transportation and utility lifelines, agricultural areas and vehicles, debris generation, and shelter requirements, as well as direct losses based on physical damage to structures, contents, and building interiors. Flood warning is taken into account, as are flow velocity effects.

The preview, or partial, Hurricane Wind Model contains a number of essential capabilities but will continue to be developed over the next three years. Current capabilities include a physical damage module based on an engineering-based load and resistance analysis of building component performance for all classes of residential, commercial, and industrial buildings. Hurricane wind-induced pressure and windborne debris impacts are included. Losses are determined by combining the damage estimates with empirical cost estimation techniques for building repair and replacement of structures, contents, and building interiors. The load-resistance-damage-loss framework allows users to reliably examine the quantitative effects of taking specific mitigation measures by modeling building components with increased resistances. The benefits of specific mitigation actions can be quantified in the model and compared on a regional

### HAZUS-MH Features

- Uses ArcGIS Version 8.3
- Enhanced Earthquake Model
  - Uses USGS Shake Maps
  - Uses latest USGS attenuation function
  - Imports BIT information
- New Flood Model
  - Includes coastal and riverine
  - Can import a Flood Insurance Study (FIS)
  - Can generate estimates without an FIS
- New Hurricane Model
  - Contains historical database
  - Develops damage states and economic losses for individual building components

basis for a number of building classes. Modules also were developed for estimating building debris, tree debris, and post-storm shelter requirements. The Hurricane Wind Model also predicts damages and losses in a real-time mode by integrating the use of a real-time hurricane wind field data.

### HAZUS-MH MR1

In FY 2004, HAZUS-MH was developed further and tested for a planned maintenance release, HAZUS-MH MR1. MR1 was released and FEMA began shipping the update in January 2005.

#### HAZUS-MH Risk Assessment Tool

FEMA has developed a software tool to assist users in transferring and reproducing HAZUS-MH data for multi-hazard mitigation plans called the Risk Assessment Tool (RAT). This tool will help local mitigation planners use information from common data queries in HAZUS-MH to develop local mitigation plans.

#### HAZUS-MH Flood Macro Wizard

FEMA has developed a software tool that automates and expedites the processing of HAZUS-MH flood loss analyses called the Flood Macro Wizard. This tool facilitates the preparation of regional studies and will allow the direct application of the HAZUS-MH flood loss analysis tool to multi-hazard mitigation plans.

#### HAZUS-MH MR1 Capabilities

-  Uses new ArcGIS 9.0 platform
-  Runs with faster software
-  Has optimized coastal flooding model and hurricane model
-  Defines hurricanes by downloading National Weather Service (NWS) forecasts/advisories directly from the Internet
-  Tests hurricane mitigation options for multi-unit buildings and manufactured housing
-  Customizes building types in the earthquake model
-  Contains optimized earthquake model for rapid loss assessment

## **Future HAZUS-MH Development**

Future development of HAZUS-MH is planned, including interim Maintenance Releases 2, 3, and 4 (MR2, MR3, and MR4) in 2005, 2006, and Version 2 with full hurricane capabilities in 2007. The HAZUS software will continue to be updated in response to ArcGIS improvements and operating system changes.

### **HAZUS Maintenance Release 2**

Development of MR2 is now underway. It will have the capability to test hurricane mitigation options for additional building types, optimized earthquake damage functions, the ability to filter the earthquake attenuation functions, and modified default mapping schemes for Wyoming and Montana.

### **HAZUS Maintenance Release 3**

MR3 will contain the capability to report rapid loss for hurricanes, probabilistic scenario magnitude definition for earthquakes, and improved earthquake debris modeling.

### **HAZUS Maintenance Release 4**

MR4 will have the capability to model storm surge in the hurricane model, as well as transportation lifelines, an Indirect Economic Loss Model (IELM), tree blowdown modeling enhancements, and updated resistances for commercial buildings and manufactured houses. The Flood and Hurricane Models will be fully integrated for the first time, and the flood model will contain dam failure/flash flooding analysis capabilities, and IELM validation. The Earthquake Model will contain shelter and casualties models improvements. MR4 will have new multi-hazard analysis for floods and earthquakes as well as modified thematic mapping capabilities.

### **HAZUS Version 2**

HAZUS Version 2 will contain a complete Hurricane Model with utility lifelines, indirect economic losses, duration effects, island Territories modeling, Hurricane Wind Model field updates. The Flood Model will have new rapid loss capabilities and the Earthquake Model will contain new elastic damping factors. In addition, the auxiliary tools – InCAST and BIT – will be updated and new versions will be released.

## HAZUS Initiatives

Customer support activities conducted throughout FY 2004 included HUGs and training development, technical studies and validation efforts, special applications for DoD use and to address the 2004 hurricanes, and collaborative efforts with third parties including other countries.

### Customer Support

#### HAZUS User Groups Initiative

With the release of HAZUS-MH, and to support risk assessment activities, FEMA has provided support to form public-private partnerships called HUGs. The intent of these HUGs is to better leverage the resources of all the partners involved in disaster



mitigation planning and to reduce the cost FEMA would have to absorb to provide the technical support that is provided by the HUGs. While there has been no formal study, discussions with the HUG leaders indicates that in FY 2004 FEMA avoided \$500,000 to \$1 million in technical assistance costs. As the number of HAZUS users grows, the avoided technical support costs are expected to increase as well. FEMA has helped form two-dozen HUGs to date (see list above). By the end of FY 2004, there were approximately 700 people participating in the HUG meetings with approximately 4,500 people signed up for HUG e-mail lists.



## HUG Toolkit

FEMA has developed a HUG toolkit that provides examples and template materials to help communities form local HUGs. The toolkit includes example documents in hard copies and on a compact disk. These materials can be easily tailored to local needs. The toolkit includes FEMA-related information, a strategic plan, and materials to help communities organize meetings and launch an outreach program.

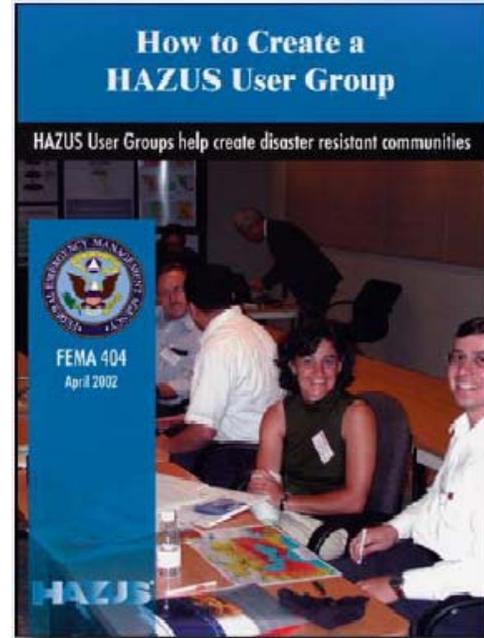
## HAZUS Vendor Privatization Initiative

In response to the anticipated increase in the number of HAZUS users, and the need to provide training and technical support, efforts continued in establishing the HAZUS-MH Vendor Program under the Private Sector Initiative (PSI). The goal of this initiative is to establish a self-sufficient program, administered through the private sector, which provides training and technical assistance to the next generation of HAZUS users. The term “vendor” refers to individuals who will be trained and authorized by FEMA to implement the program. To become an “Authorized” vendor, individuals must successfully complete a series technical HAZUS training courses. For more information on vendor training, see the section entitled *Development of Training for HAZUS Users* elsewhere in this chapter. The first group of HAZUS-MH Vendors (16 total) was authorized in the spring of 2004. The only FEMA Regional employee authorized as a HAZUS-MH vendor in the Flood Model is in Region III, and received training through this initiative. Efforts continued to train and authorize vendors through FY 2004, FY 2005, and beyond.

## Technical Support

### **Direct Assistance**

Under contract to FEMA, NIBS works with technical contractors to function as an information resource for HAZUS-MH users. NIBS’ staff provides first-line support for less technical questions concerning HAZUS-MH. For more technical questions, NIBS maintains a toll-free telephone number that re-routes calls based on the users questions. Fax numbers and e-mail addresses for NIBS and the technical contractors are provided with the HAZUS-MH software and are available on the FEMA Internet site. NIBS also arranges site visits by the technical contractors for more in-depth support for users, when needed and in consultation with FEMA. Additionally, NIBS maintains technical information



and outreach for users and arranges technical and logistical support for meetings, conferences, and workshops, including the annual ASFPM conference and the National Hurricane conference. Participation includes technical presentations, software demonstrations, training, and support at the HAZUS exhibit booth.

**HAZUS-MH How-To Guide to Prepare Risk Assessments**

A step-by-step “How-To” guide has been prepared to assist communities and decision makers in preparing standardized, comparable, mitigation plans using HAZUS-MH. The tool is designed to help GIS specialists, planners, and engineers in collecting and organizing local inventories and natural disaster information for use in risk assessment studies.

Training Development

Since the release of HAZUS 97, FEMA has provided both resident courses at EMI and other hands-on training throughout the country on how to use HAZUS. In FY 2004, to support the release of HAZUS-MH, the suite of available courses has grown to include *Intro to ArcGIS for HAZUS Users*, *Basic Multi-hazard HAZUS*, *Advanced HAZUS Earthquake*, *Advanced HAZUS Flood*, and *Advanced HAZUS Hurricane*. *HAZUS for Disaster Operations* is a new course scheduled for delivery in 2005. Increasingly, Tribal representatives are attending these courses to learn more about these products and FEMA’s multi-hazard planning requirements and related grant opportunities.

**HAZUS-MH Courses for HAZUS Vendors**

A new HAZUS-MH curriculum has been developed by FEMA to teach HAZUS vendors, based largely on the technical courses developed in 2004 as outlined above. These courses incorporate the risk engineering and software upgrades in the HAZUS-MH, and provide users with a working knowledge of the methodology and GIS-based software.

**HAZUS Vendor Courses Under Development**

- HAZUS-MH Basic
- Advanced HAZUS-Earthquake
- Advanced HAZUS-Flood
- Advanced HAZUS-Wind
- HAZUS-MH Data Management
- Introduction to HAZUS-MH
- Using HAZUS-MH to Support Risk Assessment

**HAZUS-MH Risk Assessment Course**

This course, offered at EMI, enhances the knowledge and capabilities of organizations and individuals so they can prepare risk assessment studies using HAZUS-MH. The risk assessment process followed in this course is based on FEMA’s multi-hazard planning requirements. While mainly designed for State and local government officials, community members, and Federal agencies including the DoD, this course also meets the needs of other

professionals working in building sciences such as consultants and members of academia.

### **HAZUS-MH Risk Assessment Regional Course**

These courses are similar to the HAZUS-MH Risk Assessment Courses offered at EMI, but are designed and will be delivered on a regional basis. This three-day course is designed to train State and local governments in preparing risk assessment studies based on multi-hazard planning guidance and regulations.

#### Training Delivery

In FY 2004, a widespread and successful training effort was accomplished to support the release of HAZUS-MH. At least 41 HAZUS training courses were delivered to train at least 665 persons how to use HAZUS. Fourteen courses were offered at EMI with 264 students in attendance, and at least 27 courses were offered in the field with at least 405 students trained. As a result of this training initiative, FEMA has directly trained over 15 percent of the estimated 4,200 HAZUS users. Many of those trained are part of the HUGs and are sharing their knowledge of HAZUS with other HUG members.

#### HAZUS Users Conferences

### **Third Annual Southeastern HAZUS Users Conference**

In FY 2004, planning began for what will be the largest HAZUS Users conference to date. Users conferences are a tremendous opportunity for HAZUS users to learn from each other and to network, making connections with other users. This conference will be used as a test bed for how to effectively organize the first National users conference, to be held in 2006 (see paragraph below). The conference, sponsored by the Southeastern HAZUS Users Group, will be held in Charleston, South Carolina, in March 2005. FEMA expects 200-300 attendees at this event (see brochure below).

<p>Opportunities for Emergency Managers, GIS Professionals and Universities</p> <p>Light Shows Working Together</p> <p>Charleston, South Carolina is a beautiful city, rich in history and situated right on the coast. The conference will be held at the Embassy Suites Historic Charleston. While at the conference take the opportunity to enjoy the Waterfront Park, Charleston Museum and many wonderful restaurants. The conference will include several receptions complete with hors d'oeuvres and live/entertainment each evening.</p> <p>Exhibitors there is plenty of opportunity for you. If you are interested please contact Clayton Wine at 843-202-8940.</p>	<p>Southeastern HAZUS User Group Conference</p> <p>Hotel Reservations Embassy Suites Historic Charleston 337 Meeting Street, Charleston, SC 29403 843-773-8950 x 2124 <a href="http://www.hazus.org/sehug">http://www.hazus.org/sehug</a> Email: <a href="mailto:clayton@seehug.org">clayton@seehug.org</a> www.hazus.org/SEHUG</p>	<p>Southeastern HAZUS User Group Conference</p> <p>March 7-11, 2005 Charleston, SC</p> <p>Register Today for the Conference and HAZUS-MH Training</p> <p><a href="http://www.hazus.org/SEHUG">www.hazus.org/SEHUG</a></p>	<p>Third Annual Southeastern HAZUS User Group Conference (SEHUG)</p> <p>Join the SEHUG for their third and largest conference. This year promises to be a huge success with opportunities for attendees from emergency managers to GIS professionals and students. The conference will include a number of presentations and three days of HAZUS-MH training. This year's conference theme will be how HAZUS was used during the hurricane season and how it can be used in future response, recovery and planning situations. The SEHUG is a public-private partnership with the program of coordinating risk management activities for all stakeholder groups.</p>	<p>Conference Tracks</p> <p>March 7th, 2005 will include conference presentations held at the Embassy Suites Historic Charleston. The conference will begin with a day of presentations applicable to all attendees. There will include a review of the 2004 Hurricane Season, a Keynote Speaker and presentations on the National Map and Map Modernization Program. The second day will include two conference tracks: a Management Track and a Technical HAZUS-MH Track. The focus of the Management Track will be using HAZUS-MH as a planning tool and creating a GIS system. The Technical Track will include presentations regarding sharing GIS data for use in HAZUS, GIS applications and non-emergency applications of HAZUS-MH.</p> <p>HAZUS-MH Training</p> <p>March 9-11, 2005 will be HAZUS-MH Training at the College of Charleston. Participants have the opportunity to take Basic HAZUS-MH Training or one of three Advanced HAZUS-MH classes, earthquake, wind or flood. Seating is limited for these classes so we are encouraged to register early.</p> <p>For more information visit <a href="http://www.hazus.org">www.hazus.org</a></p>	<p>Conference and HAZUS Training Registration Form</p> <p>Conference registration includes breakfast and luncheon for breakfast and luncheon. Introduction to HAZUS-MH is a prerequisite for all attendees. Based on number of registrants, courses will be modified by February 11, 2005.</p> <p>Name _____ Company _____ Address _____ City _____ State _____ Zip _____ Email _____ Phone _____ Fax _____</p> <p>_____ (Conference, March 7-8, 2005) \$ 100 _____ (Basic HAZUS-MH, March 9-11, 2005) \$ 100 _____ (Advanced HAZUS-MH, March 9-11, 2005) \$ 100 _____ (Advanced Wind, March 9-11, 2005) \$ 100 _____ (Advanced Flood, March 9-11, 2005) \$ 100 _____ (Advanced Earthquake, March 9-11, 2005) \$ 100</p> <p>Please make checks payable to: Charleston County Building Services and mail the form to: Charleston County Building Services, 4044 Bridge View Dr., Room 4211, North Charleston, SC 29405</p> <p>After 3/11/05 Conference and luncheon is \$300 and HAZUS-MH training increases to \$100</p> <p>Southeastern HAZUS User Group Conference</p> <p>Hotel Reservations Embassy Suites Historic Charleston 337 Meeting Street, Charleston, SC 29403 843-773-8950 x 2124 <a href="http://www.hazus.org/sehug">http://www.hazus.org/sehug</a> Email: <a href="mailto:clayton@seehug.org">clayton@seehug.org</a> www.hazus.org/SEHUG</p>
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## First National HAZUS Users Conference

In FY 2004, initial planning discussions were held concerning the first National HAZUS Users Conference to be held in 2006. This conference is anticipated to provide the largest gathering of HAZUS users to date and an unprecedented opportunity for HAZUS users to interact, network, and showcase their efforts to date. A broad cross section of HAZUS users from government, academia, and the private sector are expected to attend.

## Technical Studies

Use of HAZUS in conducting large-scale technical studies is one of the most significant applications of HAZUS since the results of these studies often have a major impact on the formulation of nationally applicable public policy. In some cases, studies that have utilized HAZUS have been congressionally mandated. In other cases, these studies have been conducted to demonstrate the effectiveness of FEMA's mitigation programs and to identify opportunities to improve these programs.

## Economic Studies

## Future Benefits of Hazard Mitigation Activities Study

The mandate for the study proposed in this report comes from Report 106 -161 for the FY 2000 House Appropriations Committee Subcommittee for the Veterans Administration, Department of Housing and Urban Development, and Independent Agencies that states:

Parameters for an Independent Study To Assess the Future Benefits of Hazard Mitigation Activities

*“The Committee recognizes that investing in mitigation will yield reductions in future disaster losses, and that mitigation should be strongly promoted. However, an analytical assessment is needed to support the degree to which mitigation activities will result in future “savings.” Therefore, the Committee directs FEMA to fund an independent study to assess the future savings resulting from the various types of mitigation activities.*

The *Disaster Mitigation Act of 2000* (PL 106–390, October 30, 2000) amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 USC 5121) and provided for a similar study (Section 209, Study Regarding Cost Reduction):

*Not later than 3 years after the date of the enactment of this Act, the Director of the Congressional Budget Office shall complete a study estimating the reduction in Federal disaster assistance that has resulted and is likely to result from the enactment of this Act.*

To respond, FEMA charged the NIBS Multihazard Mitigation Council (MMC) with defining the parameters of the needed independent assessment. Under the oversight of the MMC Board of Direction, a panel of volunteer experts from a variety of disciplines was established to carry out this effort with input from a variety of stakeholders.

Researchers engaged by the MMC are using HAZUS to support the completion of this study. The study relies on benefit-cost methodologies to compare future savings with the costs of carrying out the mitigation activity. For the purposes of this report, “benefits” are expressed in terms of avoided annualized losses. These losses are discounted to their present value in consideration of the time value of money. The researchers are using HAZUS models and relationships to quantify avoided losses by estimating the damage and direct and indirect economic losses before and after mitigation activities are carried out. Unique analytical methods (called “work-arounds”) have been developed for use when HAZUS cannot estimate the losses adequately; however, these “work-arounds” still tend to utilize information contained in HAZUS (e.g., damage-hazard intensity relationships) to the greatest extent possible.

### **Annualized Loss Estimation Study**

In FY 2004, work continued on the first ever Multihazard Annualized Loss Estimation Study. The draft annualized hurricane loss study of November 2003 and the 1999 National earthquake annualized loss study (FEMA publication 366) are being updated using HAZUS-MH and the updated valuation data. Average annualized losses for hurricanes will also be computed using the

hurricane model coupled with the 1990 Census data of HAZUS-99 to produce a picture of the change in hurricane risk that has occurred over the past decade.

### HAZUS Validation Studies

#### **Post-Event Hurricane Wind Damage Model Validation**

In response to the four hurricanes that struck Florida, the Hazard Mitigation Technical Assistance Program (HMTAP) contractor was tasked to conduct a validation study of the hurricane wind and flood models based on HAZUS runs that were completed. The fact that four major hurricanes made landfall in one season provides a tremendous opportunity to systematically evaluate the accuracy of the model. In addition, data collected will be used to improve the accuracy of the portions of the hurricane wind model that are under development at this time.

#### **Building Valuation Model Validation**

A validation study is underway to clearly establish the credibility of the HAZUS-MH building valuations by comparing HAZUS data with other building valuation data sets, such as tax assessor's data. Revisions to the valuation data in HAZUS are already underway, and many were included in the release of HAZUS-MH MR-1.

### Mitigation Program Evaluation

#### **National Flood Insurance Program Effectiveness Study**

HAZUS is playing an important role in evaluating the effectiveness of the NFIP. Under contract to FEMA, the Pacific Institute for Research and Evaluation (PIRE) initiated work in May 2004 on a study to assess the NFIP's effect on total flood losses; Federal, State, and local governments' overall costs of response and recovery; the need for or cost of State and Federal disaster relief; and the impact of the NFIP's policies on low-income populations. PIRE is using the HAZUS Flood Model and complementary software that PIRE is developing to determine the total costs of various types of floods and who bears the costs. To gain further insight into who pays for flooding, PIRE will conduct retrospective community-level case studies about governmental costs and total damages resulting from flood events of varying sizes. PIRE also will analyze the financial impacts of flooding that are not captured in the HAZUS model. Impacts such as bankruptcies and business discontinuations will be studied in a sample of actual communities.

Since finalization of the scope of work for the study, PIRE has developed a work plan, initiated a review of literature, and begun selecting communities to

include in the study. Communities will be selected to overlap communities in nationally representative community samples studied in other parts of the evaluation. PIRE anticipates submitting a draft of its final report in April 2005.

FEMA Region III also conducted a number of studies to coordinate HAZUS with NFIP activities. The Region is currently evaluating the:

- Ability to use known floodplain boundaries with high water marks from a disaster to determine the extent of flooding as well as potential outreach and public awareness applications,
- Efficiencies and inaccuracies of varying levels of flood hazard calculations,
- Use of HEC-RAS profile for flood depth calculation, including incorporation into HAZUS-MH flood hazard vs. FIT flood depth calculation, and
- Use of HAZUS-MH to supplement final meetings to present Digital Flood Insurance Rate Maps (DFIRMs) as part of Map Modernization. Where applicable, this may include flood loss estimations using DFIRM data augmented with hurricane wind loss estimation.

### Application

#### HAZUS-MH Support To Implement Multi-Hazard Planning Requirements

FEMA is promoting efforts to conduct risk assessment studies using HAZUS-MH to facilitate the preparation of multi-hazard mitigation plans. At the end of FY 2004, a survey of FEMA's Regional Mitigation Divisions indicates that 39 State/territorial plans and 317 local plans were prepared using HAZUS (see HAZUS Utilization Section for detailed information).

To promote the use of HAZUS-MH in meeting multi-hazard planning requirements, State and local pilot demonstration projects continued in FY 2004. Pilot communities were selected to ensure a sample of communities willing to participate, representative of varying levels of GIS and emergency management sophistication and include varying levels of hurricane wind, flood (both coastal and riverine) and earthquake risk.

### HAZUS MH Pilot Planning Projects

#### Pilot Project Benefits

- Evaluating and analyzing different hazards
- Helping communities prepare mitigation plans
- Providing more defensible cost and loss estimates using the automated engineering and scientific risk calculations

#### Pilot Project Communities

- Austin, Texas
- Louisville, Kentucky
- State of Wyoming
- Marion County, Indiana
- Scottsdale, Arizona
- New York City, New York
- Annapolis, Maryland
- Kansas City, Kansas

Through these pilot projects FEMA provided local communities with technical support such as (1) collecting data to update the HAZUS inventory, (2) identifying and prioritizing potential local hazards, (3) providing HAZUS-MH Executive Overview training, (4) updating and running HAZUS-MH using local community data, (5) analyzing and interpreting data, and (6) documenting the results in a HAZUS-MH supported risk assessment report.

### HAZUS Use in Emergency Response

In August and September of 2004, four hurricanes made landfall in Florida and Alabama as shown in the table below. FEMA’s Mitigation Division provided the Response Division with near real-time loss estimation support using HAZUS-MH. Hurricane wind field modeling and hurricane wind loss estimates were performed before, during, and after each of the four hurricanes.

The 2004 hurricane season provided a rare opportunity to test the HAZUS Hurricane Wind Model’s capabilities to support emergency response decision-making. The HAZUS Hurricane Wind Model was used extensively at FEMA Headquarters, in Region IV, and by the State of Florida to first predict potential damages prior to landfall and then to estimate actual damages immediately following landfall. The State of Florida included HAZUS damage estimates in their requests for a Presidential Disaster Declaration.

HAZUS-MH was used to construct probable hurricane and coastal flood scenarios, including National Hurricane Center (NHC) Forecast/Advisories, NHC H\*Wind predictions, and forecast models used by the NHC. The different scenarios constructed and analyzed with HAZUS-MH included variations in storm track (based on landfall probabilities and various forecast models), variations in storm intensity, and variations in coastal surge forecasts.

2004 Hurricane Landfall Conditions				
Hurricane	Location	Date	NHC Saffir-Simpson Category	NHC 1-minute Sustained Wind Speed (mph)
Charley	Charlotte County, FL	8/13/04	4	145
Frances	Martin County, FL	9/5/04	2	105
Ivan	Baldwin County, AL	9/16/04	3	130
Jeanne	Martin County, FL	9/26/04	3	115

Outputs for each scenario included coastal flood or hurricane wind-induced loss estimates for affected counties, including estimates of number of damaged buildings, direct economic losses (building, contents, inventory, and income-related losses), building and tree debris, short-term public shelter requirements, and potential damage to critical facilities, including hospitals,

firehouses, police stations, and schools. The Mitigation Division provided regular briefings to the Response Division and was able to provide timely estimates of key damages and losses to assist in planning response efforts.

At FEMA Headquarters, pre-landfall HAZUS hurricane wind damage estimates were provided to the Emergency Support Team and to the Emergency Support Function (ESF) #5 Information and Planning. The information was then, in turn, provided to the other ESFs for their use. A number of Federal agencies made specific use of HAZUS data in the emergency operations. Additionally, field data necessary to calibrate and validate the HAZUS-MH Hurricane Wind Model was collected and archived. In the future, the data will be used to improve the accuracy of HAZUS.

In response to the four hurricanes that struck Florida, FEMA's HMTAP contractor was tasked to provide HAZUS support to emergency response operations in both Region IV's Regional Operations Center and the Disaster Field Office in Orlando, Florida. This is a pilot initiative intended to identify useful and timely HAZUS products to support emergency operations before, during, and following landfall of a major hurricane. The results of this effort will support the development of the *HAZUS in Emergency Response Standard Operating Procedure* to be initiated in FY 2005.

### HAZUS Use in Homeland Security

#### **US Geological Survey Support for Northern Command**

The USGS Rocky Mountain Mapping Center helps support the USNORTHCOM Interagency Coordination Group for monitoring situational awareness in the United States. Support focused on development and implementation of a web-enabled reporting system for natural and man-made incidents. This system, known as the IOP, incorporates natural hazard events and man-made incidents with baseline



geospatial data covering the North American continent. The National Map serves as the primary baseline geospatial data infrastructure. This infrastructure has been augmented with the incorporation of HAZUS datasets

to highlight critical infrastructure information. HAZUS data has been integrated into seamless National layers including essential facilities, high potential loss facilities, transportation systems, utility systems, and hazardous materials facilities.

The IOP is used to maintain situational awareness and to obtain situational understanding both in the real world and during training exercises. For example, in February 2004, USNORTHCOM utilized the IOP web-based application to support the NORAD/USNORTHCOM Unified Defense exercise. Local data was rapidly synthesized with the HAZUS national data to support the event-driven geospatial data needs in central/southern Texas, and a data integration methodology was developed and implemented to enhance the HAZUS facilities data. Procedures were established to improve the HAZUS spatial accuracy through vertical integration using ortho imagery and update the content using local datasets. These data were integrated into a common data model, and were horizontally and vertically integrated using HAZUS data as the baseline for facilities that populated the IOP. This allowed the user to begin to address the “Who, What, Where, Why, How, and What if” questions that arise during an event in a visual context. These methodologies were then implemented for the Global Mirror exercise, in Colorado Springs, Colorado, as well as in the greater Denver area and the San Luis Valley in Colorado.

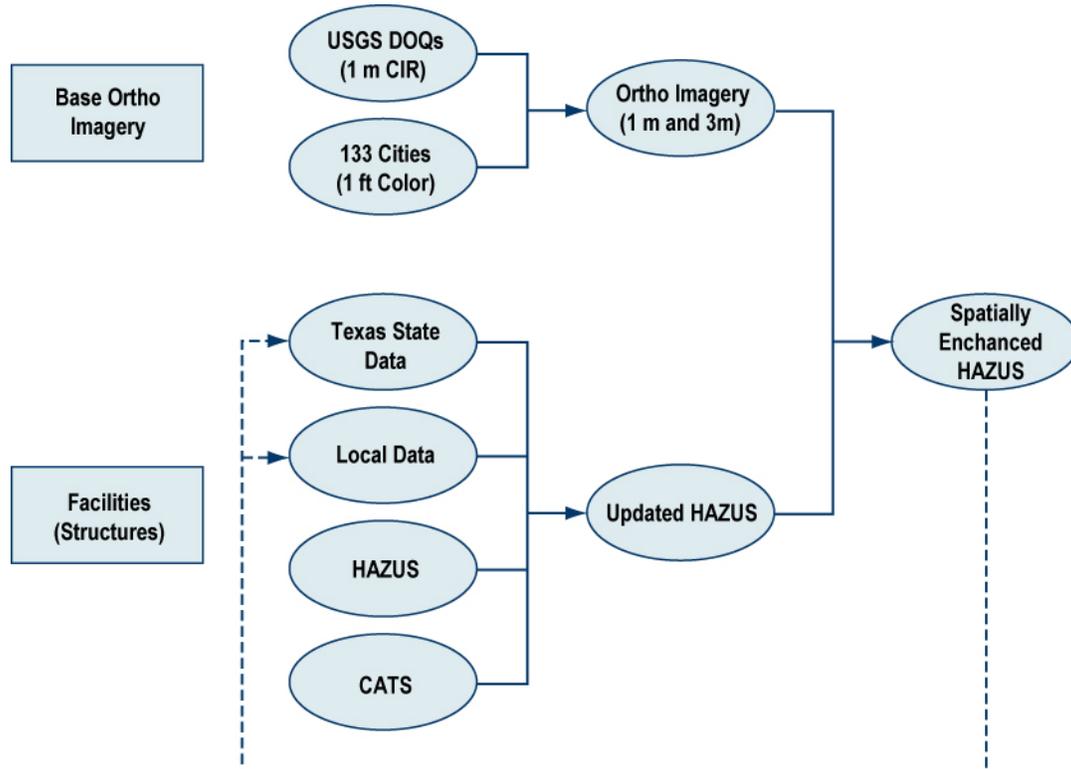


The ultimate USGS goal is to route the integrated data back to local entities for quality control and maintenance. Once this cycle is complete, local data and HAZUS facilities data can share a common baseline. In all of the aforementioned scenarios, the enhanced HAZUS datasets have been returned to the local GIS authorities for verification, maintenance, and local use.

USGS is currently investigating methodologies to update and maintain the synthesized datasets using semi-automated techniques and with reduced manual input and costs. Once developed and implemented, HAZUS data can be made more current and spatially accurate for supporting homeland security issues.

The figure below – Data Integration Methodology – shows how geospatial datasets were integrated into a common data model, and were horizontally and vertically integrated.

### Data Integration Methodology



### Kansas National Guard

The *Kansas National Guard Civilian Support Team* has installed HAZUS and is prepared to use it to support Incident Commanders at emergency scenes throughout the nation.

### State Agency Special Applications

The State of Florida has found HAZUS to be useful in a number of areas related to hurricane wind hazard mitigation and property insurance loss reduction. HAZUS-derived products are being used to drive a number of public policies related to reducing losses from future hurricanes. Under contract to the Florida Department of Insurance, Applied Research Associates (ARA), one of the prime developers of HAZUS-MH, completed the following risk assessment activities:

- Developed insurance loss reductions produced by wood panels protecting windows in masonry construction for application to insurance credits. Loss reductions were computed using HAZUS technology embedded in ARA's proprietary "HURLOSS" model.
- Developed a Florida Mitigation Incentives Database of insurance credits developed using HAZUS technology. These credits have been filed and

approved by the Florida Department of Insurance. A majority of insurers in Florida now offer hurricane wind mitigation credits developed using HAZUS technology embedded in ARA's proprietary HURLOSS model, an insured loss estimation tool. These insurance credits have created an economic incentive for Florida property owners to mitigation potential hurricane wind damages to their property.

- Provided real-time estimates of hurricane losses in Florida for the Florida Hurricane Catastrophe Fund using HAZUS technology embedded in ARA's HURLOSS model. These estimates allowed State regulators to have a real-time understanding of the potential losses the Fund might experience.

### Model Building Code Organizations

Under contract to the International Code Council (ICC), ARA provided 5,000- and 10,000-year return period risk maps that were developed using the HAZUS Hurricane Wind Model for use by the ICC Storm Shelter Committee. This committee is developing the first-ever national consensus standard for storm shelter design and construction. These risk maps are an essential component in determining the design parameters for building a shelter anywhere in the United States. This initiative is a follow on to FEMA's *Saferoom* initiative launched in the late 1990s.

### Universities

Under contract to the University of Western Ontario (UWO), hurricane risk assessments were developed using the HAZUS Hurricane Wind Model for use in their wind tunnel in preparing design loads for major structures along the nation's coastline. UWO is one of only a few wind engineering research centers in North America, and the data developed from HAZUS will allow UWO to more accurately simulate real world conditions in their wind tunnel tests of major buildings and other critical infrastructure.

The University of New Orleans and Louisiana State University (LSU) have partnered with FEMA Region VI, the State of Louisiana, the Louisiana Department of Transportation and Development, the US Army Corps of Engineers, and officials from Jefferson Parish. The members of this partnership have indicated that they intend to develop a study that identifies and characterizes areas of repetitive loss. HAZUS-MH will be used in support of mitigation measures for these repetitive loss areas.

The Department of Environmental Studies at LSU provided a comprehensive hazard analysis for hurricane wind and flood hazards for East Baton Rouge Parish as a part of their hazard mitigation planning efforts. The report included

graphical displays of hazard areas and summary damage estimates utilizing HAZUS-MH.

The accuracy of building counts in the HAZUS-MH building inventory was the basis for a student Ph.D. thesis at the LSU Department of Environmental Studies under the direction of Dr. John C. Pine. Although minor differences were found, the HAZUS building inventory had no significant deviations and did not impact the loss estimations of the software. These findings were presented at the 2004 National Flood Insurance Managers Association Conference in Mississippi.

LSU faculty is currently using HAZUS-MH in a Hazard Mapping and Modeling course under development for EMI's Higher Education Project. The course uses the flood and hurricane wind modules to provide examples of environmental hazards and resources for emergency managers in hazard mitigation, planning, response, and recovery.

### Media

In early FY 2004, the HAZUS-MH database was used in a volcanic ash fall exposure study for a British Broadcasting Company (BBC) documentary dramatizing a possible future cataclysmic Yellowstone Calderas (super volcano) eruption. HAZUS data on building stock and population was provided for six ash zones covering the entire US and six metropolitan areas, nationwide. Additionally, a proxy was developed to estimate potential roof collapse for wet and dry ash of varying depths, depending on ash zones. The BBC used this information to estimate the potential damages and economic losses that might result from such an event. The completed BBC documentary was first aired on the Discovery Channel on January 30, 2005.

## **Collaboration With Third Parties**

### Department of Defense

FEMA has partnered with DoD in support of their preparation of HAZUS-MH risk assessments for Picatinny Arsenal, in Dover, New Jersey, and the Naval Facilities Engineering Command (NAVFAC), Puget Sound Naval Shipyard (PSNS) and Naval Station Bremerton (NS), in Bremerton, Washington.

**Picatinny Arsenal:** For the last seven years, Picatinny Arsenal has been developing the SERIS technology for use in battlefield maneuvers. SERIS is component-based architecture software used for time and asset management for command and control activities during mitigation and response activities. SERIS can be applied to homeland security to deploy and control assets, plan contingencies, update and assess situational information, and develop training

exercises for potential events. For this project, FEMA and Picatinny will determine the data and model needs for SERIS and HAZUS MH; input necessary data into HAZUS and SERIS; and conduct an internal pilot study with various threat scenarios such as Dam Breach at Picatinny to evaluate the combined HAZUS-SERIS model. FEMA has documented the results of each analysis and has developed a report that summarizes and evaluates the tool's use for homeland security decision-making. This report will soon be available (see *HAZUS Related Publications and Products* section).

**NAVFAC:** The NAVFAC project used the HAZUS building model to evaluate specific critical building performance in case of an earthquake. HAZUS analyses included (1) earthquake analysis for the entire base using "limited data," (2) earthquake analysis for critical facilities using "limited data," (3) earthquake analysis for critical facilities using "detailed data" for existing buildings, (4) earthquake analysis for critical facilities using "detailed data" for rehabilitated buildings, and (5) regional analysis with a modified inventory that includes soil data and data for the bases. FEMA has documented the results of each analysis and has developed a report that summarizes and evaluates the project's impact on homeland security decision-making. This report will soon be available (see *HAZUS Related Publications and Products* section).

#### National Aeronautics and Space Administration

A two-year collaboration with researchers at the National Aeronautics and Space Administration (NASA) Stennis Space Center has been underway since October 2003. This project integrates a NASA model and satellite data, along with other relevant models, into the hurricane model of HAZUS-MH for predicting the combined effects of hurricane wind, storm surge, astronomical tide, and waves. The resulting comprehensive model will be the first ever multirisk-consistent hazard model for the prediction of risk, damage, and loss associated with the combined action of hurricane wind, surge, tides, and waves along the entire hurricane-prone coastline of the United States. The results of this initiative will be incorporated into future releases of HAZUS-MH for assessing the physical and economic effects of various building mitigation options.

NASA satellite and other remote sensing data are also being used in the study for estimating surface roughness and land friction for improved land inundation modeling. The utility of the NASA data for improved digital elevation and bathymetry modeling is also being investigated, as is a new concept to enable estimation of aerodynamic surface roughness. If proven effective, the results of this initiative will be incorporated into future releases of HAZUS-MH the result of which will be an enhanced model.

National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) and FEMA worked collaboratively to enhance the capability of the HAZUS hurricane wind model. This enhancement will give emergency managers a powerful tool for quickly and efficiently communicating and sharing via the internet or other electronic media, in near-real time, event-specific hazard and risk information, including the physical damage, economic, and social impacts of an actual hurricane event. This initiative includes developing the capability to utilize NOAA hurricane wind data as near real-time hazard input into the HAZUS hurricane loss estimation module. This will combine the use of the NOAA Hurricane Research Division's real-time hurricane wind data and hurricane wind field analysis technology (H\*Wind) with the HAZUS model's damage/loss analysis and its GIS mapping capabilities. The damage estimates obtained through HAZUS analyses using the H\*Wind inputs that reflect the actual event hurricane wind speeds give a more accurate representation of the impacts from the event. This "enhancement" is analogous to the use of "Shake Map" technology for earthquake hazard and loss analysis that permits the near real-time estimate of damages following a damaging earthquake.

## International Efforts

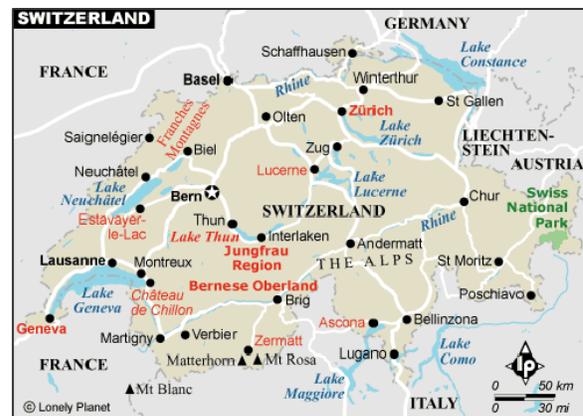
### Oslo, Norway, Earthquake Exercise

In FY 2004, the City of Oslo conducted an earthquake scenario exercise by applying and extending the HAZUS methodology. On the right is the first page of a manuscript that has been submitted for publication in a juried journal. The current plan is to continue developing seismic characterizations for the region, pending further funding.



### Switzerland HAZUS Adaptation Pilot Study

The Swiss government, specifically the Coordination Center for Earthquake Risk Mitigation within the Federal Office of Water and Geology, conducted a pilot study in a small study region to compare the HAZUS methodology with existing seismic studies done for Switzerland. While the results were favorable, further adaptation of HAZUS parameters is needed before the study area can be expanded.



## HAZUS Awards and Recognition

### ESRI Special Achievement in GIS Award

Each year, at its annual International User Conference, ESRI (the developers of ArcGIS) presents its Special Achievement in GIS (SAG) award to honor an “elite group of organizations that have embraced GIS technology to better serve our world. By their extraordinary contributions to our society they have set new precedents throughout the GIS community.” At the 2004 conference, FEMA was presented with a SAG award for efforts to develop HAZUS to promote public safety. Nominations for this award are submitted by ESRI staff from thousands of organizations worldwide then reviewed personally by Jack Dangermond, the President of ESRI.

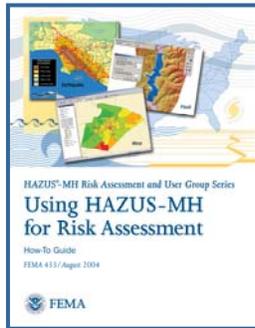


### Emergency Preparedness and Response Under Secretary's Award

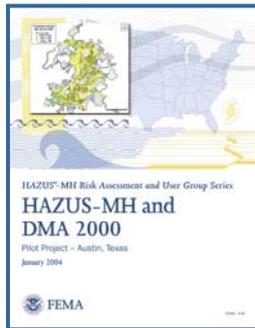
At the 2004 Emergency Preparedness and Response Under Secretary Award Ceremony in Washington, DC., Dr. Kenneth Taylor, the North Carolina Director of Emergency Management, was recognized for his efforts to use and promote the use of HAZUS in Emergency Management by Under Secretary Brown.

## HAZUS-Related Publications and Products

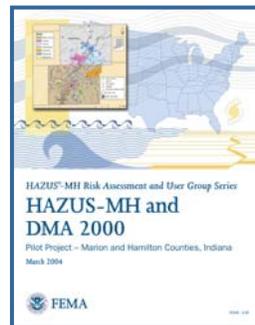
HAZUS is a tool that assists in rationalizing the complex risk assessment phase of a broad range of emergency management projects, especially comprehensive local and State level mitigation planning efforts. To promote the use of HAZUS, a number of new publications and other products were initiated or completed during FY 2004. Below are a list and brief descriptions of these products.



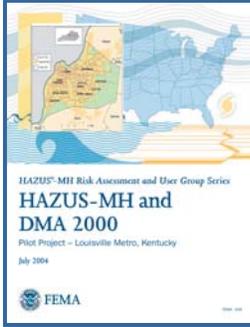
**Using HAZUS-MH for Risk Assessment How-To Guide** is a 200-page implementation manual with specific field application examples for using HAZUS-MH to conduct risk assessments. This How-To Guide was developed based on pilot projects conducted in the field. The resulting risk assessment reports assisted in meeting FEMA's multi-hazard mitigation planning requirements.



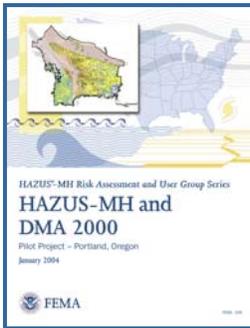
**Austin, Texas, HAZUS-MH Pilot Project Risk Assessment Report** was the first pilot project report. The City of Austin identified 16 natural and man-made hazards. From this list of 16 hazards, 9 were selected: flood, hurricane, dam failure, fuel pipeline breach, urban fire, hazardous materials release (fixed site), tornado, hailstorm, and severe winter storm. The State of Texas used this HAZUS-MH risk assessment information as a guide for collecting all other needed information for multi-hazard reporting for the State.



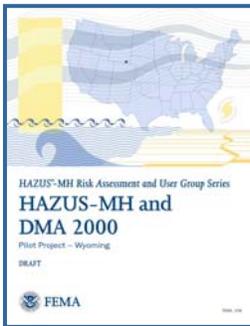
**Marion and Hamilton Counties, Indiana, HAZUS-MH Pilot Project Risk Assessment Report** identified 14 hazards of interest, and the risk assessment team selected three hazards for further study: earthquake, flood, and tornado. Marion County, Indiana, (including the City of Indianapolis) and Hamilton County, Indiana, were defined as the study area. The entire study area has approximately 1,040,000 people as well as \$105 billion in assets.



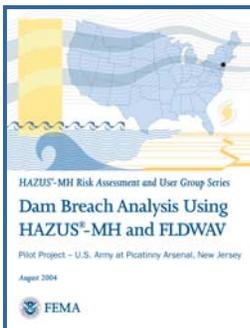
**Louisville, Kentucky, HAZUS-MH Pilot Project Risk Assessment Report** evaluated two priority hazards, flood, which was ranked as severe, and earthquake, which was ranked as moderate. The Louisville Metro area, as defined by the geographic boundaries of Jefferson County, was the study area. The area's newly formed Natural Hazards Mitigation team will continue to study and refine data for these and other priority hazards.



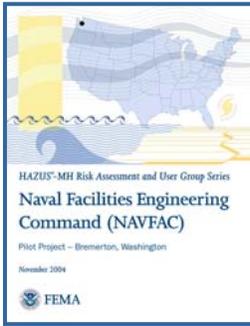
**Portland, Oregon, HAZUS-MH Pilot Project Risk Assessment Report** identified 12 natural and man-made hazards within the study area. From the list of 12 hazards, four were selected as hazards of interest: earthquake, flood, landslide, and wildfire. The City of Portland, as defined by the city's geographic boundary, was defined as the study area.



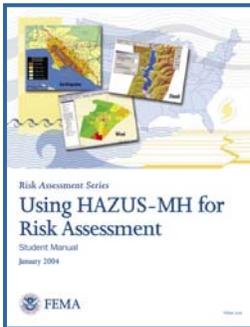
**State of Wyoming HAZUS-MH Pilot Project Risk Assessment Report** describes how to modify the geographic boundary structure of the HAZUS-MH aggregate datasets by substituting the original boundary features (Census tracts) with either (1) a grid arrangement or (2) a Census block arrangement. This approach is used in areas with low population and building concentrations, where the Census tract size is larger than the size desired for analysis or where there is a desire to compare block level flood results to block level results for the other hazards (particularly earthquakes).



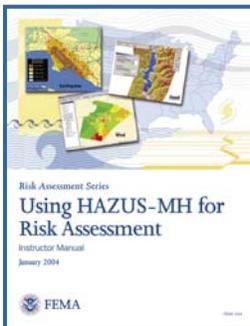
**Picatinny Arsenal Executive Overview Report** used HAZUS-MH to explore the use of a third-party model, FLDWAV, to conduct a dam breach analysis for Picatinny Arsenal. The National Weather Service developed FLDWAV which is compatible with HAZUS and supports the development of water surface profiles and water velocity estimates related to flooding.



**NAVFAC/Naval Station Bremerton Executive Overview Report** used HAZUS-MH to model the inventory of the PSNS to perform seismic risk assessment studies on this portfolio. In addition, detailed HAZUS-MH earthquake analyses were conducted on 30 predefined facilities. Both regional analyses and detailed studies were conducted. The regional analyses consist of HAZUS runs for the whole portfolio of buildings at PSNS. The in-depth analyses focused on the 30 facilities using the ‘detailed data’ for rehabilitated buildings.



**Using HAZUS-MH for Risk Assessment Course Student Manual** is a comprehensive student guide for use in Regional or field training or at FEMA’s EMI.



**Using HAZUS-MH for Risk Assessment Course Instructor Manual** is a guide for how to teach the course consistently in the field or at FEMA’s EMI.



**Flood Wizard** is a companion software tool that works with HAZUS-MH software to aggregate the voluminous flood data by pulling data from selected data fields that would be required for a risk assessment.



**Risk Assessment Tool** is a companion software tool that formats the HAZUS-MH outputs so that they are more easily used as part of a risk assessment report.

## Appendix A: Summary of HAZUS Projects

The information in this appendix was obtained from a number of sources including FEMA Headquarters, FEMA Regions, States and communities, the NEHRP Biennial Report to Congress, HAZUS Users Groups, and HAZUS contractors and vendors. The information presented below summarizes HAZUS projects conducted by States and communities in each Region followed by projects conducted by NEHRP partners. This includes projects initiated, begun, continued, and/or completed during FY 2004. Types of projects range from using HAZUS to develop multi-hazard mitigation plans to technical studies and outreach initiatives.

### Region I

#### Connecticut

The State of Connecticut utilized HAZUS in preparing their State Multi-Hazard Mitigation Plan. In addition, 10 communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans.

The Connecticut River Estuary Regional Planning Agency recently acquired HAZUS-MH and will use it in the near future.

The State of Connecticut used HAZUS to create Critical Facility maps by town. Eventually, these maps will be accessible at the local level. The program was used to simulate two different natural disasters and gather risk assessment data for the State.

The South Western Regional Planning Agency worked with eight communities, Darien, Greenwich, New Canaan, Newark, Stamford, Weston, Westport, and Wilton, to use HAZUS in developing their local multi-hazard mitigation plans.

The Northeast States Emergency Consortium (NESEC) worked with the Connecticut Department of Environmental Management to develop their Multi-Hazard State Mitigation Plan. NESEC utilized HAZUS to help the State of Connecticut quantify the earthquake and hurricane risk and potential financial losses to government owned facilities. In addition, NESEC utilized HAZUS to provide the State of Connecticut with potential statewide losses to critical facilities for several historical earthquake and hurricane scenarios.

**Maine**

The State of Maine utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

The NESEC is working with York County Emergency Management to update and upgrade their default database of critical facilities contained in HAZUS. NESEC has indicated that when complete, HAZUS will be used to estimate earthquake, hurricane, flood risk, and potential losses. In addition, NESEC is working with York County to bring GIS and HAZUS into their operations room as a tool to be utilized for emergency operations, training, and exercises. The critical facilities map will also be utilized for terrorism-related planning, as well as bringing in other hazards layers such as snow, ice, wildfire, etc. This is an "all hazards" approach to utilizing HAZUS.

NESEC worked with the Maine Emergency Management Agency to develop their Multi-Hazard State Mitigation Plan. NESEC used HAZUS to help the State of Maine quantify the flood risk and potential financial losses to State-owned facilities. In addition, NESEC utilized HAZUS to provide the State of Maine with potential statewide losses to critical facilities for several historical earthquake and hurricane scenarios.

**Massachusetts**

The State of Massachusetts utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

**New Hampshire**

The State of New Hampshire utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

**Rhode Island**

The State of Rhode Island utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

**Vermont**

The Vermont Geological Survey (VGS), a Division of the Vermont Agency of Natural Resources, has used HAZUS since 1997 to promote mitigation. They continue to be a leader in New England in using HAZUS and have worked with Regional Planning Commissions to get earthquake risk information in regional and town multi-hazard mitigation plans. Their State Hazard Mitigation plan uses HAZUS-MH output produced by the survey and it is worked into what is believed to be the only proposed enhanced hazard mitigation plan in New England.

HAZUS analyses suggested that the 500-year, 6.8 magnitude, Montreal event would influence the Chittenden County area the most. Peak ground accelerations with default “soft soils” in the study area ranged from 0.09 – 0.11g. With substitution of surficial geologic data from 1:24,000 mapping, accelerations ranged from 0.10 to 0.16g, sufficient to cause significant building damage in the study area, particularly to older unreinforced buildings.

The State of Vermont recently submitted to FEMA the Draft State Multi-Hazard Mitigation Plan for review, also proposed as an enhanced plan. The VGS supplied HAZUS-MH information for the plan based on postulated events in and around Vermont. HAZUS was used for the critical portion of the plan to indicate risk, vulnerability, and estimating losses.

VGS awareness activities utilizing HAZUS in 2004 included:

- Updating the web site to include earthquake and HAZUS information on landslides and erosion hazard mapping that combines data on slope instability and riverine erosion.
- Continuing to develop an information base for decision making soon after landslide events. VGS monitors landslide sites in Hardwick, in Jeffersonville, in the Mad River Valley, along the Great Brook in Plainfield, in Morrisville along the St J and LC Railroad bed, and at Deer Run Heights in Georgia, and has described past slides in Bethel that still threaten property.
- Working with the Agency of Transportation on rockfall hazards.
- Producing HAZUS output for a hurricane wind event that simulated the 1938 hurricane damage for the State Multi-Hazard Mitigation Plan.

## Region II

### New Jersey

The State of New Jersey utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

The New Jersey earthquake hazard reduction program emphasis during FY 2004 has been a continuing effort to populate the HAZUS loss estimation model in concert with New York State and New York City through a cooperative, multi-agency organization known as NYCEM (New York Area Consortium for Earthquake Loss Mitigation). Under this multi-year program, data for counties radiating outward from the New York

metropolitan area has been developed and integrated into the HAZUS model.

New Jersey data for HAZUS is provided by two organizations under contract from the New Jersey Office of Emergency Management. The New Jersey Geological Survey (NJGS) provides geological and earthquake history data. During 2003-2004 the NJGS completed geologic databases for Middlesex County and Passaic County. Tantala Associates, an engineering consulting firm, provides structural and census information. During 2003-2004, Tantala Associates completed studies for Morris, Middlesex, and Passaic Counties.

### **New York**

The State of New York utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

In FY 2004, New York State Emergency Management Office (NYSEMO) has worked closely with HAZUS software developers in testing and evaluating HAZUS-MH, including several pre-release builds of HAZUS-MH Service Release (SR)-1. NYSEMO has been able to identify previously unknown problems and provide valuable feedback to software developers. The NYSEMO has been an active user of HAZUS since it was first introduced by FEMA in 1994. Major efforts have included NYSEMO's collaboration with the NYCEM study of the New York metro area; spearheading efforts with the NYS Geological Survey in shear wave velocity testing of the State's surficial geology, leading to the development of county level HAZUS ready soil site classification maps; a HAZUS validation study based on a comparison of observed vs. modeled losses from the Ausable Forks, New York earthquake; incorporation of HAZUS based risk assessments into the State Hazard Mitigation Plan; and assisting NYCEM in adopting and using HAZUS.

In addition in FY 2004, NYSEMO utilized HAZUS to evaluate the possible effects of Hurricane Ivan and to prepare an earthquake scenario developed for a critical infrastructure table top exercise.

Several years ago, NYCEM was formed to provide a framework for businesses and agencies to take mitigation actions to reduce potential damage and losses that might be experienced after an earthquake. To accomplish this aim, the consortium is developing a forecast of the type of losses that the New York City area could suffer after an earthquake. This study was funded by FEMA Region II and coordinated by the Multidisciplinary Center for Earthquake Engineering Research. Many government and private sector entities donated considerable human resources to the effort. The initial stages of this study involved fact-

finding and assessment, with the development of preliminary soil maps and building inventories.

During FY 2004, work refining this research to develop a more accurate loss estimate was undertaken. This included:

- Providing better data for building age, type, quality, height, square footage, and seismic design level and for performing sensitivity analyses to determine their relative importance.
- Upgrading soil and building inventory information for the entire New York City area.
- Developing and upgrading more accurate fragility curves for the type of buildings unique to the New York City area.

The NYCEM is currently loading Level 2 data into HAZUS. This will enable the agency to run hurricane, earthquake, and flood scenarios to develop their mitigation plan.

## Region III

### Delaware

The State of Delaware utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. In addition, four communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans.

The Delaware Geological Society updated the NEHRP soil classification map in HAZUS using soil boring data in the South Wilmington area for use in the HAZUS earthquake module. Currently, the Delaware Geological Survey is updating the HAZUS-MH default database for an as of yet undetermined area in New Castle County, Delaware, and they are evaluating the effectiveness of various HAZUS flood hazard analyses for accuracy, efficiency, and ease of use with discussions on what methodologies would be best to use in certain situations.

### Maryland

Salisbury University is performing a HAZUS-MH risk assessment for use in the Maryland State Multi-Hazard Mitigation Plan.

### Pennsylvania

The Commonwealth of Pennsylvania utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. In addition, ten communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans.

The Pennsylvania Emergency Management Agency is developing a decision-tree based work-flow for using HAZUS-MH in mitigation planning for Northumberland County, Pennsylvania.

### Virginia

The Commonwealth of Virginia utilized HAZUS-MH in preparing their Multi-Hazard State Mitigation Plan. In addition, 53 communities utilized HAZUS in preparing their local multi-hazard mitigation plans.

The Rappahannock-Rapidan Regional Commission hosted HAZUS-MH on-site training to State and local partners.

### West Virginia

One community, Logan County, made use of HAZUS-MH in preparing their local multi-hazard mitigation plan.

### Region IV

#### Alabama

The State of Alabama utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

#### Florida

As described earlier in this report, the State of Florida used HAZUS for emergency management operations during the 2004 hurricane season.

#### Kentucky

The State of Kentucky utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. The combined communities of the City of Louisville and Jefferson County made use of HAZUS in developing their local multi-hazard mitigation plans. State officials indicate that all local plans within the State will make use of HAZUS.

#### Mississippi

The State of Mississippi utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

Providing adequate technological infrastructure to support training in HAZUS is a challenge to many rural communities. FEMA and the State of Mississippi have a valuable ally in overcoming this hurdle in GEM, the Global Education Mobile



managed by the Mississippi Institutions of Higher Learning's Office of Academic Affairs. The Mobile Electronic Classroom, pictured above, provides Mississippians with access to modern computer Technologies for HAZUS Training.

Making sophisticated technology available to rural communities, GEM offers a network server, 13 computer work stations, 20 laptop computers connected with a wireless local area network, and a satellite internet system capable of providing internet access in highly remote locations.

The success of GEM is a result of partnerships and innovative thinking. Funded through a grant from the Mississippi Space Commerce Initiative, a joint partnership between the State of Mississippi, the University of Mississippi, NASA, and private industry, GEM was originally designed to serve as a resource for K-12 schools to get technology incorporated into the classroom in areas where access to technology is



limited. In fact, while GEM remains available free of charge to all eligible educational institutions, its ability to serve rural communities has grown considerably. On display at a ESRI conference, FEMA recognized GEM's capabilities and a partnership was forged allowing FEMA's Mitigation Division to bring HAZUS training sessions to rural communities that would not otherwise be able to support such training activities.

As result of FEMA and GEM teaming up, HAZUS more readily available, communities can better understand and plan for the risks that may affect the physical, social, and economic components of an individual community. GEM's ability to bring HAZUS to communities that wouldn't otherwise have access to this sophisticated tool allows for better planning to minimize damage and loss of life and to prevent natural hazard events from becoming natural disasters.

### North Carolina

The State of North Carolina utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. In addition, 54 communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans. The State also used HAZUS during emergency management operations.

GIS data layers of sinkholes and other hazards were plotted on the HAZUS inventory as part of the State land use portion of the State Hazard Mitigation Plan.

Earthquake and Hurricane Wind Models were used in the risk assessment portion of the State Hazard Mitigation (322 Plan). HAZUS inventory and demographics were used as part of the statewide vulnerability assessment while mapping of potential buyout areas was conducted using HAZUS inventory and population data.

Two regional exercises were conducted – Hurricane Wilma (eastern region) and Hurricane Gert (central region). HAZUS results were used to generate the extent of play and to calculate resource needs.

### **South Carolina**

The State of South Carolina utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. In addition, one community, Charleston County, made use of HAZUS in developing their local multi-hazard mitigation plan.

The State of South Carolina utilized HAZUS in the preparation of their Earthquake Plan.

### **Tennessee**

Fifteen communities utilized HAZUS in preparing their local multi-hazard mitigation plans.

### **Region V**

#### **Illinois**

Three communities utilized HAZUS in preparing their local multi-hazard mitigation plans.

#### **Indiana**

The State of Indiana utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. In addition, four communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans.

In 2004, Federal, State, and local collaboration brought HAZUS training to the State of Indiana. As a result, communities now have a better understanding of their vulnerability to natural hazards and can better make decisions in light of those hazards and the associated risks. HAZUS assisted in the planning process by providing answers to complex questions about the consequences of potential hazard events. Providing

adequate technological infrastructure to support HAZUS training, however, had become a challenge to many communities in Indiana.

FEMA, the Indiana State Emergency Management Agency (SEMA), and the Polis Center at Indiana University Purdue University collaborated to ensure HAZUS users in Indiana were able to obtain sufficient training to leverage the HAZUS hazard mitigation technology. This collaboration has and will continue to ensure that HAZUS tools are made available to the widest possible range of local users, recognizing that each planning jurisdiction has potentially unique challenges that require effective mitigation strategies.

In order to provide users with the necessary knowledge for effectively using HAZUS, adequate training had to be provided. While training opportunities were available at EMI, financial and time constraints prohibited many potential users from attending. In order to address these needs and provide local training, FEMA and SEMA united with the Polis Center to provide HAZUS training in locations throughout Indiana on an ongoing basis.

This collaboration effort represents a model others may wish to replicate. Many higher education institutions offer a wealth of expertise in GIS, education, and planning. By effectively harnessing these resources, communities can ensure that the widest possible range of users use HAZUS.

### **Minnesota**

The State of Minnesota utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

### **Ohio**

The State of Ohio utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

## **Region VI**

### **Arkansas**

The State of Arkansas utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. In addition, 20 communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans.

The State has trained several local coordinators and economic development districts on planning for disasters, developing risk assessments, and identifying their hazards. Currently, the State and

several counties are using HAZUS to run risk assessments and uses HAZUS to help develop local hazard mitigation plans.

### **Louisiana**

The State of Louisiana utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. In addition, 32 communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans.

In the summer of 2004, FEMA and the State of Louisiana Emergency Management coordinated Hurricane Pam, a catastrophic exercise with a hurricane and flood scenario impacting the New Orleans metropolitan area. HAZUS-MH was utilized as a part of this scenario.

In response to Hurricane Ivan, FEMA Headquarters used HAZUS-MH to provide Region VI Regional Operations Center officials with potential damage predictions along the Gulf coast, including Louisiana.

### **New Mexico**

The State of New Mexico used HAZUS, to a minimal extent, in preparing their Multi-Hazard State Mitigation Plan. The State identified the need for better State and local data in the State Mitigation Plan.

### **Oklahoma**

The State of Oklahoma utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. In addition, three communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans.

### **Texas**

The State of Texas utilized the HAZUS InCAST instrument when compiling our database of State facilities in preparing their Multi-Hazard State Mitigation Plan. The State GIS staff and the Texas Water Development Board received training on HAZUS software. In addition, six communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans.

The City of Austin served as a pilot for using HAZUS-MH in support of multi-hazard mitigation planning.

The Texas HAZUS User Group held a kick-off meeting in Austin, Texas, in December 2004. Over the next year, the steering committee indicated that they will focus on expanding the user base, providing training, and developing applicability.

## Region VII

### Missouri

The State of Missouri utilized HAZUS in preparing their Enhanced Multi-Hazard Mitigation Plan.

The State promoted the use of HAZUS by participating in the newly established Heartland HAZUS Users Group and inviting the Regional Planning Commissions to participate in HAZUS–MH Class held during August 2004.

## Region VIII

### Colorado

The State of Colorado extensively utilized HAZUS, including incorporation of improved datasets and hazard maps, in preparing their Multi-Hazard State Mitigation Plan. In addition, 113 communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans.

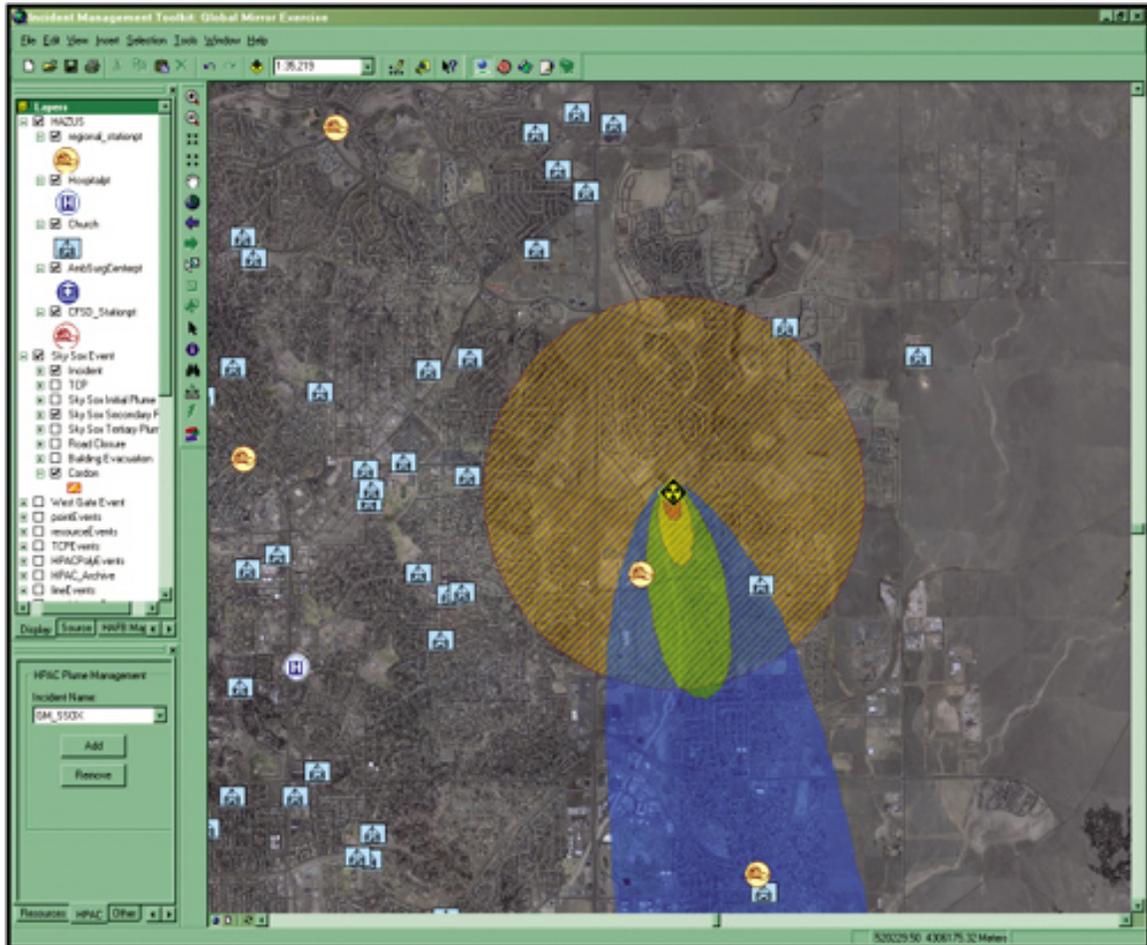
The Denver Regional Council of Governments used HAZUS extensively, including incorporation of improved datasets and hazard maps.

Homeland Security Exercise: On May 10-12, 2004, DHS and FEMA supported an emergency preparedness exercise conducted in Colorado called Global Mirror. The exercise presented a weapons of mass destruction terrorist incident scenario that crossed the jurisdictional and geographic boundaries of multiple participants, including Peterson Air Force Base, the City of Colorado Springs, and El Paso County in Colorado.

While a number of different agencies and organizations participated in Global Mirror, a key objective of the exercise for the US Air Force Space Command (USAFSC), the City of Colorado Springs, and USGS was to demonstrate the integrity of an integrated suite of software applications and their ability to:

- Enhance situational awareness by providing a common operational picture to emergency managers and responders for incident management,
- Support applicable compliance with the Air Force Full Spectrum Treat Response policies and instructions for collaborative emergency response,

- Support the DHS National Incident Management System and Incident Command System for managing local-to-Federal interagency collaboration and communication during emergencies, and
- Provide a secure interagency real-time platform for planned and *ad hoc* emergency management workflow.



Contractors supported the USAFSC in the multi-agency exercise with an integrated suite of technology applications. By leveraging the existing map and imagery data investments of Peterson AFB, the City of Colorado Springs, El Paso County, Colorado Springs Traffic Operations, USGS, NGA, and FEMA, a common and collaborative operating picture for situational awareness was provided in a secure environment.

To anticipate where radiological fallout might spread, operators integrated National Weather Service Feeds with HAZUS-MH data to conduct plume analysis (as shown above). Incident managers were then able to overlay local parcel maps and determine neighborhoods and homes most likely to be affected. This knowledge helped them to

determine where to focus evacuation efforts, which hospitals to route victims to, and which police or fire departments to dispatch.

Combined with data feeds from the National Weather Service, the HAZUS-MH database – which includes information about such key emergency resources as police and fire stations, hospitals, schools, and churches – helped incident managers to anticipate where a nuclear plume might travel and manage evacuation efforts accordingly.

### **Montana**

The State of Montana utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. The State plan also identified future opportunities to utilize HAZUS. In addition, nine communities in the State made use of HAZUS in developing their local Multi-Hazard Mitigation Plans.

Helena, Montana, used HAZUS extensively, including incorporation of improved datasets and hazard maps. Eight communities made some use of HAZUS including Level 1 analyses or used HAZUS data or methodologies and identified future HAZUS use as part of their mitigation strategies. One community did not use HAZUS for their submission, but identified use of HAZUS as a future action item in plan revision and development of mitigation strategies.

### **North Dakota**

The State of North Dakota utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. The State plan also identified future opportunities to utilize HAZUS.

Approximately 30 communities that did not use HAZUS in their submissions identified the use of HAZUS as a future action item in plan revision and development of mitigation strategies.

### **South Dakota**

The State of South Dakota utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. The State plan also identified future opportunities to utilize HAZUS. In addition, three communities in the State made use of HAZUS in developing their local multi-hazard mitigation plans.

Approximately 42 communities that did not use HAZUS in their submissions identified the use of HAZUS as a future action item in plan revision and development of mitigation strategies.

**Utah**

The State of Utah extensively utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan, including incorporation of improved datasets and hazard maps. All six Utah Association of Governments used HAZUS extensively, including incorporation of improved datasets and hazard maps.

The State of Utah used HAZUS for the design of an emergency management exercise and automating HAZUS to work with Shake Map and Shakecast to complete HAZUS runs based on ground motion maps should Utah have an earthquake.

In addition, the State of Utah is currently working on a Level 2/3 HAZUS run for the Salt Lake Valley. A large scale earthquake exercise will also be planned for November 2005 based on the output of this HAZUS run.

**Wyoming**

The Wyoming Geological Survey utilized HAZUS in preparing the State's Multi-Hazard Mitigation Plan. In addition, the survey incorporated improved datasets and hazard maps, including soils, landslide, and liquefaction hazards.

The Wyoming Geologic Survey also utilized HAZUS extensively in helping local governments meet their multi-hazard planning requirements in Wyoming. At least one FTE worked full time on implementing HAZUS in Wyoming for one year.

**Region IX****American Samoa**

American Samoa utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

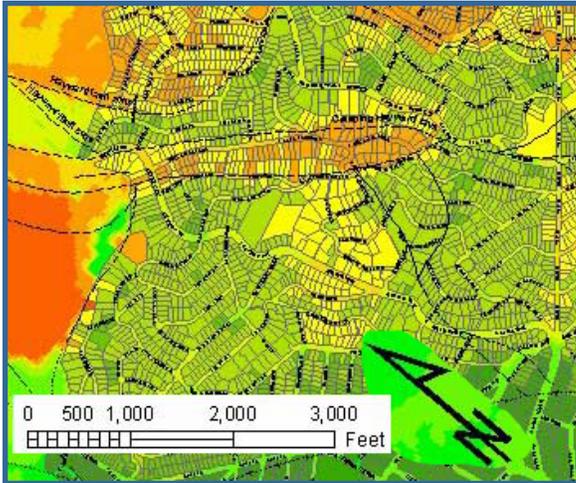
**Arizona**

The State of Arizona utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. All 27 counties are currently producing plans utilizing HAZUS.

**California**

The State of California utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. In addition, two communities, the City of Berkeley and Yuba County, made use of HAZUS in developing their local multi-hazard mitigation plans.

The State of California and Yolo County partnered to perform an Earthquake analysis of the County using HAZUS-MH. The analysis supported the County's Hazard Mitigation Plan to fulfill FEMA's multi-hazard planning requirements.



The City of Berkeley used FEMA Q3 flood hazard data layers from HAZUS-MH for to identify, within the city's GIS system, which property parcels were possibly prone to flooding and the city's floodplain management ordinance. Also, the city used HAZUS database layers in preparing scenario maps for an emergency management exercise. The city's model was refined with parcel-level interpretations of several USGS publications,

including MF-2378, MF-2379, MF-2385, and OFR-02-296, and with city-scale geo-hazard context derived from OFR-95-597 and OFR-00-444. Together with groundwater depth estimates from the regional water quality control board and OFR-02-296, it became possible to estimate ground water depth, seismic soils amplification factor, liquefaction hazard, and seismic landslide hazard on a regular 10-meter interval across Berkeley. Berkeley's 26,000 parcel polygons were converted to a 1-meter grid representation providing a unique raster mask for each parcel. Geo-hazard summaries (max, min, mode, median) were tabulated over each hazard type for each parcel, in preparation for HAZUS runs that will use the Advanced Engineering Building Model. The figure above illustrates the slope failure hazard by parcel as adapted from MF-2385 to Berkeley parcels.

Berkely's local government relates to local property owners, businesses, and residents by dealing with detailed issues and mapping. Due to their modeling efforts using HAZUS, gridded summaries of individual and mosaicked scientific publications can be compiled horizontally across a region and vertically across various investigations by local government. Public availability of parcel-specific indices of geologic hazards can be used to standardize inputs to loss estimation, and offer public-facing queries by address, parcel number, or owner name.

The California State Office of Emergency Services continues to use Shake Map data produced by the California Integrated Seismic Network in running their HAZUS Modeling, using both the automatic system the

State set up in HAZUS 99, and using manual inputs to HAZUS-MH. The State utilized these runs to assist in formulating their response to the San Simeon earthquake, and also to analyze the effects of the recent 6.0MM Parkfield event. The State of California also continues its work with other partners in creating scenario events for use by the general public, as well as undertaking activities in support of the 100-year anniversary of the 1906 earthquake.

### **Commonwealth of the Northern Mariana Islands**

The Northern Mariana Islands utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

### **Guam**

Guam utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

### **Hawaii**

The State of Hawaii utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. All four counties utilized HAZUS in developing their local multi-hazard mitigation plans.

The State of Hawaii has successfully implemented HAZUS Earthquake Loss Estimation Methodology using a newly constructed Building Inventory Database for Hawaii and Maui Counties that yield more accurate damage results. Moreover, during a destructive Hawaii earthquake event, the Pacific Disaster Center (PDC) indicated that they will generate a HAZUS report and construct a PowerPoint graphics briefing within 60 minutes after earthquake origin time for critical decision-making by the Hawaii Emergency Management community.

The PDC created a web interface that extracted select information from the global reports provided by HAZUS, thereby converting the information into a PowerPoint format for use by Hawaii's emergency responders. HSEAC and the PDC developed the Hawaii HAZUS Atlas, which is a collection of 17 earthquake scenarios provided by the Hawaii Earthquake Advisory Committee, which can be used by emergency managers for mitigation and planning purposes. This provides the emergency managers with a 24/7 capability. The PDC successfully used HAZUS to support the Hawaii State Civil Defense in conducting earthquake/tsunami exercises.

### **Nevada**

The State of Nevada utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan. In addition, Reno, and Douglas and Clarke

Counties utilized HAZUS in developing their local multi-hazard mitigation plans.

After receiving one of the on-site HAZUS-MH basic training sessions presented by Region IX and Headquarters, the Nevada HAZUS User's Group has been formed, with plans to split the organization into two chapters to meet the special needs for northern and rural Nevada, as well as the greater Las Vegas metropolitan area. The Lake Tahoe Basin group, a multi-state, multi-jurisdictional working group, has initiated a project to study that area's unique threats. This group indicated that they expect to have a first edition study by mid-year 2005.

## Region X

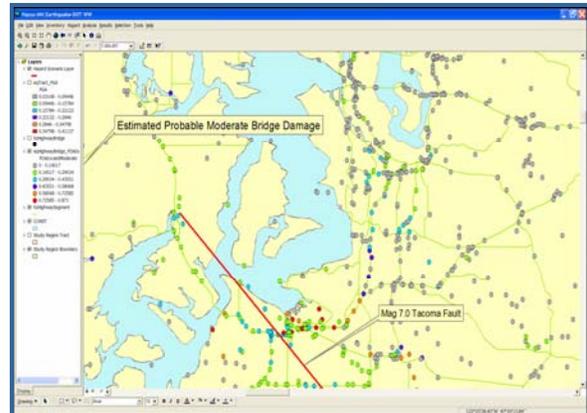
### Oregon

The State of Oregon utilized HAZUS in preparing their Multi-Hazard State Mitigation Plan.

The State of Oregon coordinated the Oregon HAZUS user group (ORHUG) and conducted local training for HAZUS-MH.

### Washington

The State Emergency Management Division partnered with State Department of Transportation (WSDOT) to facilitate a statewide earthquake response exercise on April 22, 2004, called Drop, Cover, and Hold Day. The exercise involved two associated earthquake events: one in the Tacoma area and the second near Wenatchee. HAZUS-MH was used to generate a realistic overall scenario including estimates of damage to bridges and buildings in specific areas. These estimates were used to generate realistic, coherent exercise inputs that were sent to WSDOT regions for appropriate action. Using HAZUS, WSDOT EOC staff in Olympia, were able to gain Statewide situational awareness to prioritize and direct response and recovery actions. Drop, Cover, and Hold Day was the first Northwest use of HAZUS-MH to support an exercise by a major State agency.



With respect to training, Washington State continued the collaborated effort with FEMA and FEMA Region X to teach HAZUS locally to the public and private sector. The HAZUS course has been updated to teach

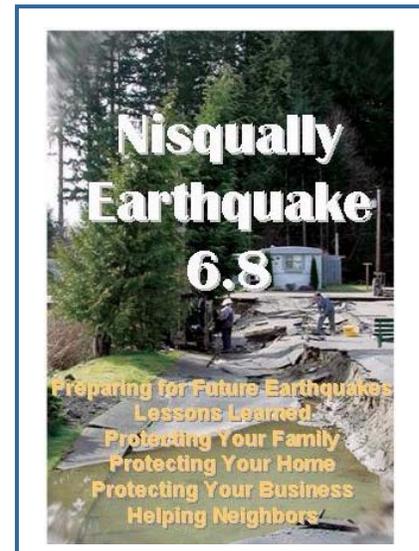
HAZUS-MH and is followed up with one-on-one training within the local jurisdiction to ensure that HAZUS is correctly loaded and used. A Washington HUG meets monthly and works with various jurisdictions/private entities to work HAZUS issues and better data sharing among all State HAZUS users.

The course allows students to deal with local issues and focuses on a multi-disciplinary approach to using HAZUS for Hazard Mitigation. HAZUS training is more accessible to the local communities and provides the opportunity for the emergency manager and others to take HAZUS directly to local officials and community groups.

The City of Seattle completed a HAZUS Pilot Project on designated schools. The project used HAZUS-MH to support emergency response plans for schools in the Seattle Public School District. It emphasized the seismic vulnerabilities of school facilities, nearby bridges, and other resources upon which the schools would depend on in an emergency. Using HAZUS-MH, each "Hazard Impact Area" was analyzed based on several earthquake scenarios to produce damage estimates that will later be used to support mitigation and preparation planning. The project also produced two maps for each participating school showing resources in their area. Their goal is to develop a template that the Washington school districts can use to assess their school structures and develop appropriate mitigation and preparedness plans.

In the aftermath of the Nisqually earthquake of 2001, use of HAZUS peaked in the State of Washington, and its potential applications as a mitigation planning tool were highlighted. FEMA Region X and the Washington State Emergency Management Division (WSEMD) recognized that in order to provide users with the necessary knowledge for effectively using HAZUS, adequate training must be provided. While training opportunities are available at EMI in Maryland, financial and time constraints prohibit many potential users from attending.

In responding to this challenge, FEMA Region X and WSEMD partnered in developing and marketing a condensed and highly focused two-day HAZUS training to provide 1½ days of training on the earthquake module and ½ day for the flood module. WSEMD and FEMA engaged in significant marketing stressing the benefits of HAZUS and relating the application and benefits



to the local community while avoiding an overly academic approach. Additionally, an introductory one-hour HAZUS marketing presentation was developed allowing counties to see the benefits, and to attend the full training sessions. The course is taken on the road to reduce costs and minimize the need for participants to travel.

Providing adequate technological infrastructure to support HAZUS training is a constraint. In addressing this challenge, the vast majority of the training sessions were conducted using PowerPoint, with HAZUS loaded on the instructor's laptop, allowing the ability to demonstrate the concepts and functionality. Noting that municipalities may go for months without using HAZUS, a means had to be found to keep users' knowledge current. A HUG was established, as well as a detailed student manual that was distributed at all courses and provided as a reference tool. As a potential next step, the State indicated that HAZUS may be loaded on student laptops in the future allowing them to interactively explore HAZUS' full capabilities.

### **NEHRP Partner Activities**

Regional consortia and work groups continue to be actively involved in both using and promoting the use of HAZUS. Below is a summary of earthquake related HAZUS initiatives undertaken by our NEHRP partners.

#### Cascadia Regional Earthquake Workgroup

The Cascadia Regional Earthquake Workgroup (CREW) made use of HAZUS-MH with the CREW Executive Directors attendance at a HAZUS training program held at the EMI in Emmitsburg, Maryland. CREW also supported the Washington State HUG.

#### Central United States Earthquake Consortium

The Central United States Earthquake Consortium (CUSEC) web page added a considerable amount of new information during FY 2004. The NEHRP Strategic Plan was posted as well as information specific to the working groups, new publications, seismic mapping resources, an updated run of the original Six Cities Study using FEMA's state-of-the-art HAZUS software, and new links to informational earthquake sites. The web page also provided background on the programs of the CUSEC member States so that visitors could gain a better understanding of how each State addressed the seismic risk and how that relates to the overall regional approach to reducing the risk.

HAZUS is one of the most promising tools for identifying and ultimately improving the region's seismic risk. Introductory workshops on the use of

HAZUS were conducted during this period. Participants in the workshop represented local and State government, as well as university students.

#### Northeast States Emergency Consortium

NESEC established a HAZUS-MH and GIS Assistance and Coordination Center within its existing office in Wakefield, Massachusetts. NESEC's priority is to provide direct support to those Northeast State Emergency Management Agencies that presently do not have the resources and staff to develop an in-house GIS and HAZUS-MH capability. HAZUS-MH information provides the spatial and temporal backdrop upon which effective and efficient earthquake and "all-hazards" identification and risk and loss assessment can be accomplished. HAZUS-MH information provides a means to detect and analyze patterns regarding earthquakes and other natural disasters. This hazard information, coupled with infrastructure data, can help to mitigate or even prevent the impact of earthquakes and other disasters. Geospatial information is a very important component in analyzing critical infrastructure vulnerabilities. Furthermore, decision support technologies such as visualization and simulation are bolstered through its use and can better anticipate and mitigate the effects of disasters. HAZUS-MH information can be used in response to earthquakes and other disasters and can be invaluable for implementing long-term recovery operations.

NESEC is working with York County Emergency Management to update and upgrade their default database of critical facilities contained in HAZUS. In addition, NESEC is working with York County to bring GIS and HAZUS into their operations room as a tool to be utilized for emergency operations, training, and exercises.

NESEC worked with the Maine Emergency Management Agency and the Connecticut Department of Environmental Management to develop their Multi-Hazard State Mitigation Plan. NESEC utilized HAZUS to help both States to quantify the flood risk and potential financial losses to State owned facilities. In addition, NESEC utilized HAZUS to provide Maine and Connecticut with potential Statewide losses to critical facilities for several historical earthquake and hurricane scenarios.

## Appendix B: List of Acronyms

These acronyms, provided in alphabetical order below, were used in this report.

Acronym	Definition
ARA	Applied Research Associates
ASFPM	Association of State Floodplain Managers
BBC	British Broadcasting Corporation
BIT	Building Inventory Tool
BLS	Bureau of Labor Statistics
CREW	Cascadia Regional Earthquake Workgroup
CUSEC	Central United States Earthquake Consortium
DFIRM	Digital Flood Insurance Rate Map
DHS	Department of Homeland Security
DoD	Department of Defense
EMI	Emergency Management Institute
EOC	Emergency Operations Center
ESF	Emergency Support Function
FEMA	Federal Emergency Management Agency
FIT	Flood Information Tool
FY	Fiscal Year
GEM	Global Education Mobile
GIS	Geographic Information System
GUI	Graphic User Interface
HAZUS	Hazards US
HAZUS-MH	HAZUS Multi-Hazard
HMTAP	Hazard Mitigation Technical Assistance Program
HUG	HAZUS User Group
HURLOSS	Hurricane Loss (model developed by ARA)
ICC	International Code Council
IELM	Indirect Economic Loss Model
InCAST	Inventory Collection and Survey Tool
IOP	Interagency Operating Picture
LSU	Louisiana State University
MMC	Multihazard Mitigation Council
MR1,2, 3, 4	Maintenance Release 1, 2, 3, 4
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Engineering Command
NEHRP	National Earthquake Hazards Reduction Program
NESEC	Northeast States Emergency Consortium
NFIP	National Flood Insurance Program
NHC	National Hurricane Center

Acronym	Definition
NIBS	National Institute of Building Sciences
NJGS	New Jersey Geological Survey
NOAA	National Oceanic and Atmospheric Administration
NS	Naval Station
NWS	National Weather Service
NYCEM	New York Area Consortium for Earthquake Loss Mitigation
NYSEMO	New York State Emergency Management Office
OMB	Office of Management and Budget
ORHUG	Oregon HAZUS User Group
PDC	Pacific Disaster Center
PIRE	Pacific Institute for Research and Evaluation
PSI	Private Sector Initiative
PSNS	Puget Sound Naval Shipyard
RAT	Risk Assessment Tool
SAG	Special Achievement in GIS
SEMA	(Indiana) State Emergency Management Agency
USAFSC	United States Air Force Space Command
USGS	United States Geological Survey
USNORTHCOM	United States Northern Command
UWO	University of Western Ontario
VGS	Vermont Geological Survey
WSDOT	Washington State Department of Transportation
WSEMD	Washington State Emergency Management Division