Multi-hazard Loss Estimation Methodology

Hurricane Model

Hazus®–MH 2.1

User Manual

Developed by:

Department of Homeland Security
Federal Emergency Management Agency
Mitigation Division
Washington, D.C.

This manual is available on the FEMA website at http://www.fema.gov/plan/prevent/hazus.

To order the Hazus software visit www.msc.fema.gov and go to the Product Catalog to place your order.

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MESSAGE TO USERS

The Hazus Hurricane Model is designed to produce loss estimates for use by federal, state, regional and local governments in planning for hurricane risk mitigation, emergency preparedness, response and recovery. The methodology deals with important aspects of the built environment, and a wide range of different types of losses. Extensive national databases are embedded within Hazus, containing information such as demographic aspects of the population in a study region, square footage for different occupancies of buildings, and numbers and locations of bridges. Embedded parameters have been included as needed. Using this information, users can carry out general loss estimates for a region. The Hazus methodology and software are flexible enough so that locally developed inventories and other data that more accurately reflect the local environment can be substituted, resulting in increased accuracy.

Uncertainties are inherent in any loss estimation methodology. They arise in part from incomplete scientific knowledge concerning hurricanes and their effects upon buildings and facilities. They also result from the approximations and simplifications that are necessary for comprehensive analyses. Incomplete or inaccurate inventories of the built environment, demographics and economic parameters add to the uncertainty. Where inventories, demographics and economic parameters track closely those assumed and built into the basic methodology, estimates of loss should be within a factor of two. Where one or more of these parameters are incomplete or inaccurate the range of uncertainty may exceed a factor of two or more.

The hurricane loss estimation methodology is based on sound scientific and engineering principals and experimental and experience data. The methodology has been tested against the judgment of experts and, to the extent possible, against records from several past hurricanes. However, limited and incomplete data about actual hurricane damage precludes complete calibration of the methodology. Nevertheless, when used with embedded inventories and parameters, the Hazus Hurricane Model has provided a credible estimate of such aggregated losses as the total cost of damage.

Users should be aware of the following specific limitations:

- While the Hazus Hurricane Model can be used to estimate losses for an individual building, the results must be considered as average for a group of similar buildings. It is frequently noted that nominally similar buildings have experienced vastly different damage and losses during a hurricane.

- The Hurricane model contains definitions and assumptions regarding building strengths that represent a norm for construction in hurricane zones. These norms are defined in the technical manual. Where construction quality is known to be different from the defined norms, larger uncertainties in loss projections may be realized.

Hazus should still be regarded as a work in progress. Additional damage and loss data from actual hurricanes and further experience in using the software will contribute to

improvements in future releases. To assist us in further improving Hazus, users are invited to submit comments on methodological and software issues by letter, fax or e-mail to:

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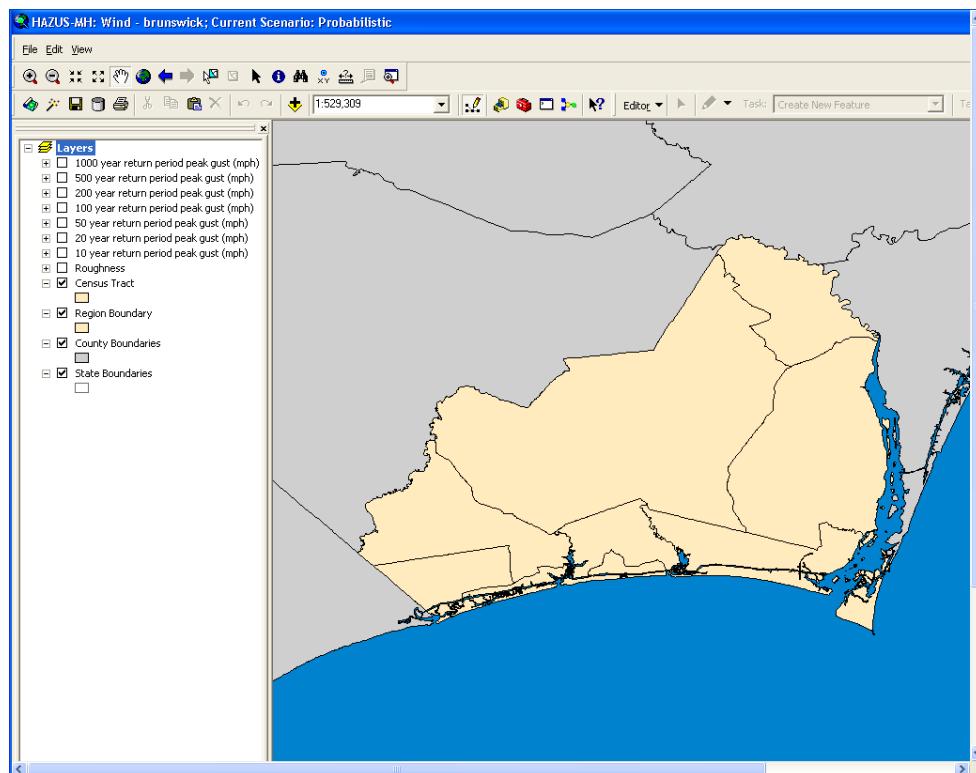
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Chapter 1. Introduction

1.1   Background

In 1997, the National Institute of Building Sciences (NIBS), under a cooperative agreement with the Federal Emergency Management Agency (FEMA), released the first Hazus Earthquake Model, a national, standardized GIS-based tool for estimating potential losses from earthquake. Earthquake loss estimates calculated with Hazus are used by local, state, and regional officials for planning and stimulating mitigation efforts to reduce losses from earthquakes, and preparing for emergency response and recovery following earthquakes. Hazus has also been used to perform a nationwide assessment of earthquake risk.
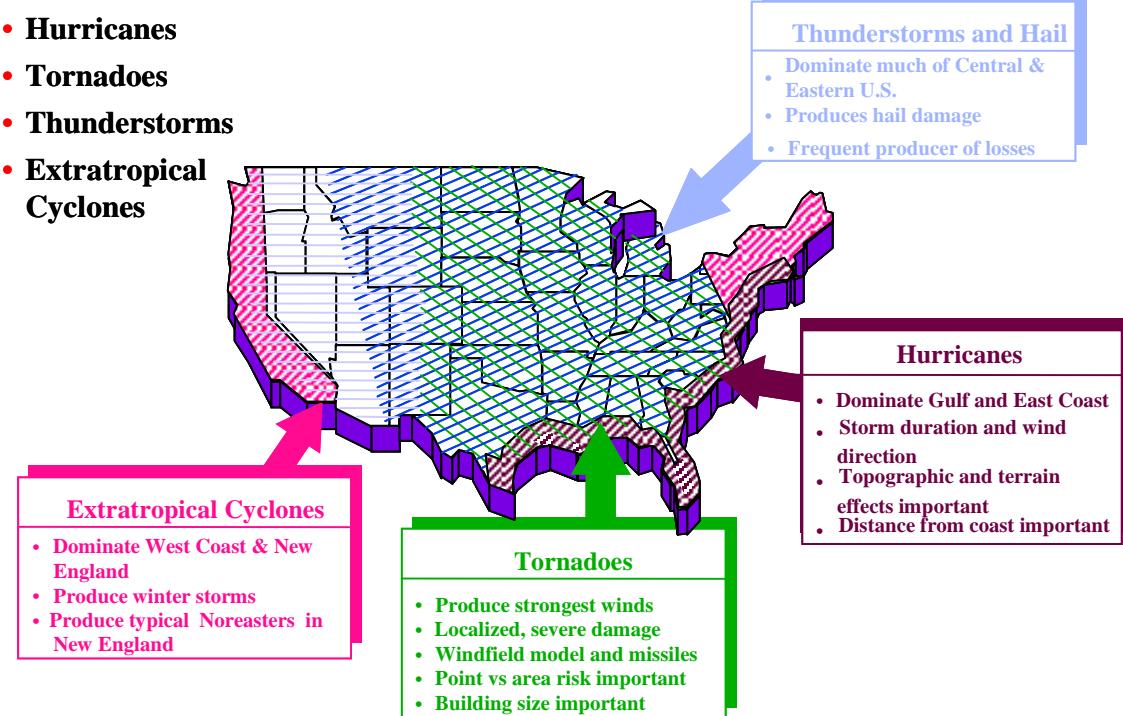
Hazus has been expanded to perform similar loss evaluations for wind and flood. FEMA and NIBS initiated development of the wind and flood models in 1997 with the creation of two committees to oversee technical development of the models. The resulting Hazus software, shown in Figure 1-1, is an integrated, multi-hazard loss estimation program, packaged to run within ArcView®, a full-featured GIS platform.

Figure 1-1. Hurricane Model Map Document Window.

The Hurricane Model allows practitioners to estimate of the economic and social losses from hurricane winds. The information provided by the model will assist state and local officials in evaluating, planning for, and mitigating the effects of hurricane winds. The Hurricane Model provides practitioners and policy makers with a tool to help reduce wind damage, reduce disaster payments, and make wise use of the nation's emergency management resources.

The Hurricane Model is the first component of a planned Hazus Wind Model. When fully implemented, the Wind Model will address the wind hazard and effects associated with hurricanes, tornadoes, thunderstorms, extratropical storms, and hail. The need for Hazus to treat the different meteorological phenomena is indicated in Figure 1-2, where it is seen that different regions of the United States are affected by different types of windstorms. In many regions of the country, damaging winds are produced by more than one meteorological phenomenon.

- **Hurricanes**
- **Tornadoes**
- **Thunderstorms**
- **Extratropical Cyclones**

Thunderstorms and Hail
- Dominate much of Central & Eastern U.S.
- Produces hail damage
- Frequent producer of losses

Hurricanes
- Dominate Gulf and East Coast
- Storm duration and wind direction
- Topographic and terrain effects important
- Distance from coast important

Extratropical Cyclones
- Dominate West Coast & New England
- Produce winter storms
- Produce typical Noreasters in New England

Tornadoes
- Produce strongest winds
- Localized, severe damage
- Windfield model and missiles
- Point vs area risk important
- Building size important

Figure 1-2. Meteorological Events Contributing to the Wind Hazard in Different Regions of the Continental United States.

1.2 Scope

The geographic scope of the present Hurricane Model is limited to the Atlantic and Gulf coasts of the United States and Hawaii. The capabilities of the model are summarized in Table 1.1. The Hurricane Model includes a default terrain roughness based on digitized

Table 1.1. Summary of Hurricane Model Capabilities
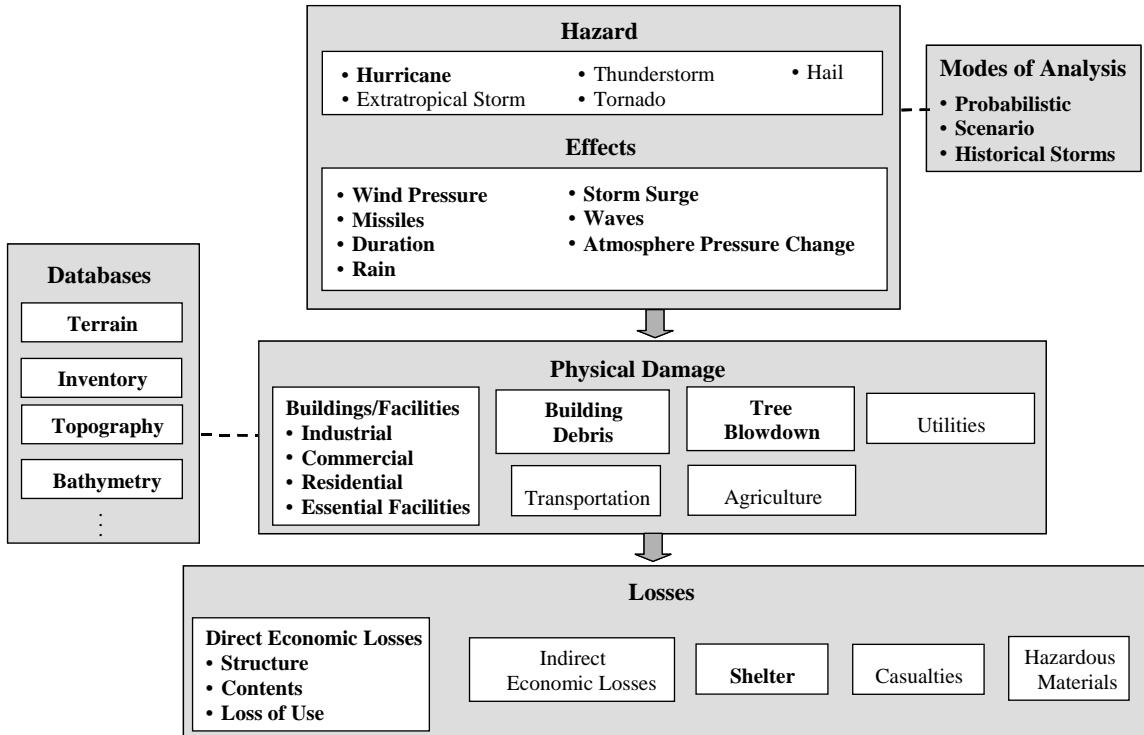
Parameter/ Data	Level 1 (Default Data)	Level 2 (User-Supplied Data)	Level 3 (Advanced Data)
Wind Model	Default Probabilistic or Historic	User-Defined Scenario	
Coastal Surge Model	Default Historic	User-Defined Scenario	
Building Inventory	Default	User-Supplied	
Facilities and Building Classes	Residential Commercial Industrial Essential Facilities		
Utility, Transportation, and High Potential Loss Facilities	Display Locations Only – No Damage or Loss Estimates		
Terrain	Default		Expert-Supplied
Loss Functions	Default		
Damage Functions	Default		
Shelter Requirements	Default	User-Supplied Parameters	
Debris	Default	User-Supplied Tree Coverage Parameters	

Land Use and Land Cover (LULC) data, but topographic speedups are only modeled in Hawaii. Damage, direct economic losses, and building debris are modeled for the General Building Stock (i.e., residential, commercial, industrial, agricultural, educational, and government building occupancies). Short-term public shelter requirements for displaced households and loss of function for essential facilities are also included in the model.

1.3   Overview of the Methodology

The approach and framework of the Hazus Wind Model are outlined in Figure 1-3, with the elements of the present Hurricane Model indicated in bold. The approach is based on a hazard-load-resistance-damage-loss methodology developed from an individual risk framework. The basic model components (hazard model, load model, resistance models, etc.) are developed separately. Each model component is, wherever possible, separately validated using full-scale data, model scale data, or experimental data. A first principles based hazard-load-resistance-loss model is used, providing the capability to model the effects of building code changes and mitigation strategies on reduction in damage and loss. Furthermore, since economic damage (loss) is modeled separately from physical damage to a building, estimates of both building damage and loss are separately modeled and predicted.

The performance of a building class under wind loading events is formulated probabilistically using the concepts of structural reliability. The probability of an individual failure mode, such as a window or door failure, is the probability that the wind load effect (e.g., aerodynamic pressure or impact energy) is greater than the resistance of the element. By performing many simulations on representative buildings within many classes of building construction, the damage probabilities for the key building components are estimated and the relationships between physical damage and wind

Figure 1-3. Hazus Wind Model Framework – Elements Shown in Bold are Implemented in the Current Version of the Hurricane Model.

hazard are developed. Similarly, losses are estimated using repair and restoration models for physical damage states. These concepts have been used to generate the fast-running damage and loss functions required in the Hazus software tool.

Several steps are typically performed in assessing and mitigating the impacts of a natural hazard such as a hurricane. The methodology encompasses inventory collection, hazard identification, and impact assessment. In a simplified form, the steps are:

- Select the area to be studied. This may be a city, a county or a group of municipalities. It is generally desirable to select an area that is under the jurisdiction of an existing regional planning group.

- Specify the hazard. In the Hurricane Model the hazard can be specified as either a single historical or user-defined storm scenario or as a complete probabilistic analysis. When a single event scenario is chosen, the option of developing coastal storm surge and wave estimates is available. These results can be fed into the Hazus Flood Model to produce combined wind and surge loss estimates for the General Building Stock.

- Provide additional information describing the building inventory, essential facilities, tree coverage, and surface roughness, if available.

- Using formulas embedded in Hazus, damage probabilities, expected building losses, expected contents losses, and expected loss-of-use are computed for different classes of buildings.

- The above results are used to compute estimates of direct economic loss and short-term shelter needs.

- Using formulas embedded in Hazus, the expected amounts and types of debris are estimated.

The user plays a major role in selecting the scope and nature of the output of a loss estimation study. A variety of maps can be generated for visualizing the extent of the losses. Numerical results may be examined at the level of the census tract or may be aggregated by county or region.

1.4   Hurricane Hazards Considered in the Methodology

The hurricane-related hazards or effects considered in the model include wind pressure, wind borne debris missiles, tree blow down, and rainfall. The effects of storm duration are also included in the model by accumulating damage over the life of each storm. When a single event scenario is chosen, the option of developing coastal storm surge and wave estimates is available. These results can be fed into the Hazus Flood Model to produce combined wind and surge loss estimates for the General Building Stock. Coastal surge analysis has not been implemented for probabilistic analysis.

Tree coverage and terrain (i.e., surface roughness) can have significant effects on the damage and loss estimates produces by the Hurricane Model. You may select the default tree coverage and terrain data or supply your own data. If you are considering supplying your own terrain data, we strongly recommend that you consult with a wind engineering expert.

Planning for mitigation and disaster response generally is based on large, damaging events, but the probability that such events will occur also should be considered. Probabilistic hurricane analyses inherently account for the full spectrum of probable events, producing both annualized and return period loss estimates. When working with deterministic hurricane scenarios, we recommend that you consult with hurricane experts to develop a *maximum credible hurricane* scenario that is realistic for your area. Consideration should be given to repeating loss calculations for several scenario hurricanes with different magnitudes and locations and different probabilities of occurrence, since these factors are a major source of uncertainty.

1.5   Types of Buildings and Facilities Considered in the Hurricane Model

The buildings and facilities analyzed by the Hurricane Model are as follows:

- *General Building Stoc*k: The majority of commercial, industrial and residential buildings in your region are not considered individually when calculating losses. Instead, they are grouped together into 39 specific building types and 33 occupancy classes. Degrees of damage and loss are computed for each group.

Examples of specific building types include one-story wood frame single-family housing (WSF1), two-story masonry multi-unit housing (MMUH2), and high-rise steel-framed commercial engineered buildings (SECBH). Each model building type is further defined by a distribution of wind building characteristics, such as: roof shape, roof covering, and opening protection. Examples of occupancy classes are single-family dwelling, retail trade, heavy industry, and churches. All structures that are evaluated in this manner are referred to as General Building Stock.

- *Essential Facilities*: Essential facilities, including medical care facilities, emergency response facilities and schools, are those vital to emergency response and recovery following a disaster. School buildings are included in this category because of the key role they often play in housing people displaced from damaged homes. Generally there are very few of each type of essential facility in a census tract, making it easier to obtain site-specific information for each facility. Thus, damage and loss-of-function are evaluated on a building-by-building basis for this class of structures, even though the uncertainty in each such estimate is large.

- *User-Defined Facilities*: User-defined facilities are buildings at specific locations that you add to the inventory. Generally there are very few user-defined facilities in a census tract, making it easier to obtain specific information for each facility. Damage is evaluated on a building-by-building basis for this class of structures, even though the uncertainty in each such estimate is large.

Lifeline systems are modeled in the Earthquake and Flood Models, but are only available for browsing and mapping in the present version of the Hurricane Model. Lifeline systems are classified as follows:

- *Transportation lifeline systems*: Transportation lifelines, including highways, railways, light rail, bus systems, ports, ferry systems and airports, are broken into components such as bridges, stretches of roadway or track, terminals, and port warehouses.

- *Utility lifeline systems*: Utility lifelines, including potable water, electric power, waste water, communications, and liquid fuels (oil and gas), are treated in a manner similar to transportation lifelines. Examples of components are electrical substations, water treatment plants, tank farms and pumping stations.

In any region or community there will be certain types of structures or facilities for which supplemental studies specific to these facilities are required. These omitted structures are referred to as *High Potential Loss Facilities*. Such facilities include dams, nuclear power plants, liquefied natural gas facilities, military installations, and large one-of-a-kind residential or commercial structures. Given the nature of these facilities it would be potentially misleading and politically and legally unwise to estimate damage and losses unless a detailed engineering analysis was performed with the agreement of the owner of the facility. Hence, the approach is to call attention to these facilities by including their locations in the inventory.

1.6   Levels of Analysis

To provide flexibility, the losses are estimated at three levels. For each level, the several hazards and the various types of buildings and facilities can be selectively used as appropriate, to meet the needs and desires of the local or regional user.

1.6.1   Analysis Based on Default Information

The basic level of analysis uses the default general building stock and essential facility databases built into the model. These databases are derived from national-level data sources for building square footage, building value, population characteristics, costs of building repair, and economic data. Default database of surface roughness and tree coverage derived from national land-use data are also used for the study region. Direct economic and social losses associated with the general building stock are computed, as well as estimates of essential facility functionality, short-term shelter requirement, and debris. Because the analysis involves only default data sources, the uncertainties are large.

Other than defining the study region, specifying the hazard (probabilistic or scenario), and making decisions concerning the extent and format of the output, an analysis based on default data requires minimal effort from the user. As indicated, however, since default rather than actual data are used to represent local conditions, the uncertainties in the estimated levels of damage and losses are large. This level of analysis is suitable primarily for preliminary evaluations and crude comparisons among different regions.

1.6.2   Analysis with User-Supplied Inventory

Results from an analysis using only default inventory can be improved greatly with a minimum amount of locally developed input. This is generally the intended level of implementation. Such an effort might involve:

- Use of locally available data or estimates concerning the square footage, count, and replacement values of buildings in different occupancy classes.

- Use of local expertise to modify the databases concerning percentages of model building types associated with different occupancy classes.

- Use of local expertise to modify the databases concerning percentages of wind building characteristics associated with different model building types.

- Preparation of a detailed inventory for all essential facilities.

- Development of maps of tree coverage. These maps would be used for evaluation of the effects of these local conditions upon damage and losses.

- Use of locally available data concerning direct economic analysis parameters.

Depending upon the size of the region and the number of these features selected by the user, months may be required to assemble the required input. The effort put into preparing the inventory of the building stock can range from minimal to extensive, depending upon the desire to reduce uncertainty in computed results.

1.6.3   Analysis with Advanced Data

Local terrain (i.e., surface roughness) has a significant effect on the magnitude of the actual surface level wind speeds applied to buildings. Surface roughness lengths depend on vegetation height and density, building heights and densities, and other obstructions upwind from the point of interest. The default surface roughness lengths provided with the Hurricane Model are derived from state and national land-use databases and have been validated through extensive comparisons with aerial photography. However, land-use conditions change over time and locations with the same land-use category may, in fact, have substantially different surface roughness. If you are considering supplying your own terrain data, we strongly recommend that you consult with a wind engineering expert. It is important to recognize that the surface roughness in Hurricane Model are averaged over each census tract and are assumed to be independent of wind direction.

1.7   Assumed Level of Expertise of Users

Users can be broken into two groups: those who are performing the study, and those who are using the results of the study. For some studies these two groups will consist of the same people, but generally this will not be the case. However, the more interaction that occurs between these two groups, the better the study will be. Those who are performing the study must, at minimum, have a basic understanding of hurricanes and their consequences. In many cases, the results will be presented to audiences (i.e., city councils and other governing bodies) that have little technical knowledge of the hurricane loss problem.

It is assumed that a loss study will be performed by a team consisting of severe storm experts, structural engineers or architects, economists, sociologists, emergency planners and a representative from the group who will be reviewing/using the loss estimates. These individuals are needed to develop hurricane scenarios, develop and classify building inventories, provide and interpret economic data, provide information about the local population, and provide input as to what types of loss estimates are needed to fulfill the goals of the loss study. Because hurricanes frequently also produce coastal and/or inland flooding, the team should also include representatives from the flood modeling and analysis community.

It should be noted that the involvement of the ultimate user of the study on the team is very important. End users of the loss estimation study (i.e., decision makers) need to be involved from the beginning to make results more usable.

If a municipality, local agency or state agency is performing the study, it is possible that some of the expertise can be found in-house. For example, the building department may have engineers who know about local building codes and construction practices. The state climatologist is another useful source of expertise.

Although a loss study can be performed with a minimum of expertise using only the defaults provided by the computer program, the results of such a study should be interpreted with caution, as default values have a great deal of uncertainty associated with

them. If the loss estimation team does not include individuals with expertise in the areas described above, then it is likely that one or more outside consultants may be required.

Unless scenarios have already been developed and documented for the study region, the user may require the expertise of a meteorologist or wind engineer when defining deterministic scenarios. Even if a scenario event has been documented, it may be defined using storm parameters that are different than those used in Hazus. In this case, an expert will be needed to review the scenario and describe it in one of the formats supported by the Hurricane Model. A scenario event that is defined without an in-depth understanding of hurricanes affecting the region may not be appropriate for the loss study.

If the user intends to modify the defaults data or parameters, it is likely that he will need input from someone with expertise in the field. For example, if the user wishes to change default percentages of model building types for the region, he will need the input of a structural engineer who has knowledge of design and construction practices of the region. Modifications to defaults in the economic loss models will require input from an economist.

Technical support is available for the users of Hazus via an on-line help desk. Users should contact FEMA for information on how to obtain technical support.

1.8   Displaying Results

Table 1.2 summarizes the output that can be obtained from an analysis. There is a great deal of flexibility in displaying output. Tables of social and economic losses can be displayed on the screen, printed out or pasted into electronic documents. Most outputs can also be mapped. Colors, legends and titles can be altered easily. Details are provided in Chapter 10.

1.9   Uncertainties in Loss Estimates

Although the software offers users the opportunity to prepare comprehensive loss estimates, it should be recognized that, even with state-of-the-art techniques, uncertainties are inherent in any such estimation methodology. The next major hurricane to affect your area will likely be quite different than any "scenario hurricane" anticipated as part of a hurricane loss estimation study. Hence, the results of a scenario analysis should not be looked upon as a *prediction* but rather as an indication of what the future may hold. Probabilistic analyses can be used to develop estimates of long-term average losses ("annualized losses") as well as the expected distribution of losses ("return period losses"). These estimates reflect the full spectrum of hurricane tracks and intensities that are likely to occur in your region of interest. However, due to the limited history of hurricane observations, limited knowledge of actual building characteristics, modeling simplifications, and other factors, there are also significant uncertainties inherent in the results produced by a probabilistic analysis. To overcome these limitations, ranges of losses should be evaluated by conducting multiple analyses and varying certain input parameters to which the losses are most sensitive.

1.10 Applying Methodology Products

The products of the FEMA methodology for estimating hurricane losses have several pre-event and/or post-event applications in addition to estimating the scale and extent of damage and disruption.

Table 1.2. Hurricane Loss Estimation Methodology Outputs

Maps of wind hazards
- Peak gust (3-second) wind speed for each census tract
- Maximum sustained (1-minute) wind speed for each census tract
- Coastal storm surge still water elevation grid and significant wave height grid for combined wind and surge scenario analysis

General building stock
- Damage probabilities by occupancy
- Damage probabilities by building type
- Cost of building repair or replacement
- Loss of contents
- Business inventory loss
- Loss of rental income
- Relocation costs
- Business income loss
- Employee wage loss

Essential facilities
- Damage probabilities
- Probability of functionality
- Loss of beds in hospitals

Debris
- Building debris generated by weight and type of material
- Tree debris generated by weight or volume

Social losses
- Number of displaced households
- Number of people requiring temporary shelter

High potential loss (HPL) facilities
- Locations of dams
- Locations of nuclear plants
- Locations of military facilities
- Locations of other identified HPLs

Transportation and utility lifelines
- Locations of transportation facilities
- Locations of lifelines

Hazardous material sites
- Location of facilities which contain hazardous materials

Examples of pre-event applications of the outputs are as follows:

- *Development of mitigation strategies* that outline policies and programs for reducing hurricane losses and disruptions indicated in the initial loss estimation study. Strategies can involve upgrading existing buildings (e.g., shutters) and the adoption of new building codes.

- *Anticipation of the nature and scope of response and recovery efforts* including: identifying short-term shelter requirements and debris management requirements.

Post-event applications of the outputs would include:

- *Projection of immediate economic impact assessments for state and federal resource allocation and support* including supporting the declaration of a state and/or federal disaster by calculating direct economic impact on public and private resources, local governments, and the functionality of the area.

- *Activation of immediate emergency recovery efforts* including provision of emergency housing shelters and initiating debris clean-up efforts.

- *Application of long-term reconstruction plans* including the identification of long-term reconstruction goals, the institution of appropriate wide-range economic development plans for the entire area, allocation of permanent housing needs, and the application of land use planning principles and practices.

Once inventory data have been collected and imported, making modifications and running new analyses are simple tasks. The ease with which reports and maps can be generated makes the software a useful tool for a variety of applications.

1.11 Organization of the Manual

The *User's Manual* provides the background and instructions for developing an inventory to complete a hurricane loss estimation study using Hazus. It also provides information on how to install and run the software, and how to interpret and report model output. The *Technical Manual*, a companion publication, documents the methods of calculating losses and the default data. Taken together, the two manuals provide a comprehensive overview of the nationally applicable loss estimation methodology.

The contents and organization of the *User's Manual* are summarized below:

Chapter 1 provides the user with a general understanding of the purpose, uses, and components of a regional hurricane loss estimation study.

Chapter 2 gives instructions for installing and starting Hazus.

Chapter 3 runs through an analysis using only default data.

Chapter 4 provides an overview of the types of data required to run the loss study, as well as a description of the default database.

Chapter 5 contains information about what data are needed to complete a loss study, sources of inventory, how to collect inventory, how to convert data to the correct format for the methodology, and how to enter data into Hazus.

Chapter 6 includes instructions for entering data and editing existing records.

Chapter 7 provides the user with a discussion of how to display, modify, and print databases.

Chapter 8 provides a link to information on the Comprehensive Data Management System (CDMS) which has replaced the now deprecated Building Data Import Tool (BIT).

Chapter 9 provides a detailed step-by-step description of how to run an analysis using Hazus, including analysis with user-supplied data.

Chapter 10 summarizes the results and reports generated by the Hurricane Model.

The appendices contain installation verification tests and detailed information about the structure of the methodology.

Appendix A provides a series of tests to verify that the Hurricane Model has been correctly installed and is executing as intended. If you encounter any problems with the Hurricane Model, we ask that you run through the tests in Appendix A before contacting the Hazus help desk.

Appendix B defines the building characteristics considered in the methodology, and

Appendix C provides descriptions of the model building types used in the methodology.

Appendix D shows how Hazus can be configured to run with SQL Server 2005.

Appendix E is a database dictionary containing details about the format of all of the databases used by the Hazus Hurricane model.

Chapter 2. Installing and Starting Hazus-MH

This section, the release notes, and the summary of software limitations have been moved to a separate document entitled *Getting Started with Hazus-MH 2.1*.

Chapter 3. Running Hazus with Default Data

Hazus contains a variety of default parameters and databases. You can run a loss estimation analysis using only default data, but your results will be subject to a great deal of uncertainty. Default data supplied with Hazus are described in Section 3.5. If you wish to reduce the uncertainty associated with your results, you can augment or replace the default information with improved data collected for your region of study. This chapter will guide you through a very simple analysis using only default data. For more detailed information about collecting and entering additional data or modifying default parameters and data, see Chapters 4 through 8.

Before running a loss estimation analysis you must define a study region. *The Study Region*, in Hazus terminology, is the geographic unit for which data are aggregated, the hazard defined, and the analysis carried out.

3.1   Defining the Study Region

To create a study region, start Hazus and step through the study region creation wizard as illustrated in Figures 3.1 through 3.9:

- Select "Create a new region" and click **OK**.
- Enter a unique name for the study region.
- Select the hurricane hazard.
- Select whether or not to use the Hurricane Scenario Wizard[1].
- Select aggregation at the county level.
- Select North Carolina, or verify state choices if you used the Hurricane Scenario Wizard to define your study region.
- Select Brunswick County, or verify county choices if you used the Hurricane Scenario Wizard to define your study region.
- Finish the wizard.
- Wait for region to be created.
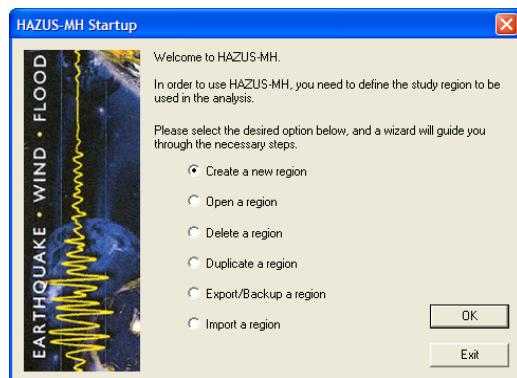
A progress bar will be displayed and the Hazus Shell will create the study region. When the creation process ends, the progress and creation dialogs will close, leaving the region wizard dialog on screen as shown in Figure 3.10. To open a region:

- Select "Open a region".
- Pick the region you created and step through the rest of the wizard (Figure 3.11).

---
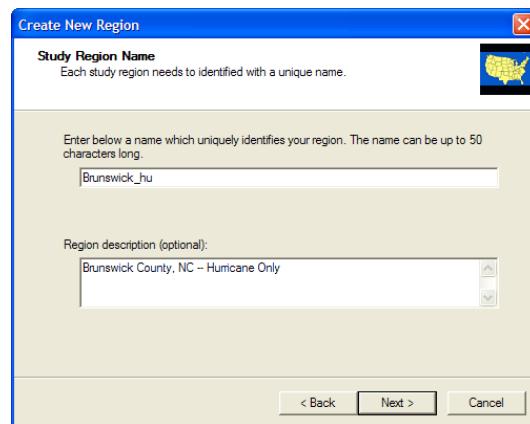
[1] Selecting this option will open the Hurricane Scenario Wizard. Simply follow the steps outlined in Section 9.3 to define your scenario and Hazus will automatically select the states and counties to define an appropriate study region. The State and County Selection Steps will then involve verifying the automated selections instead of making selections.
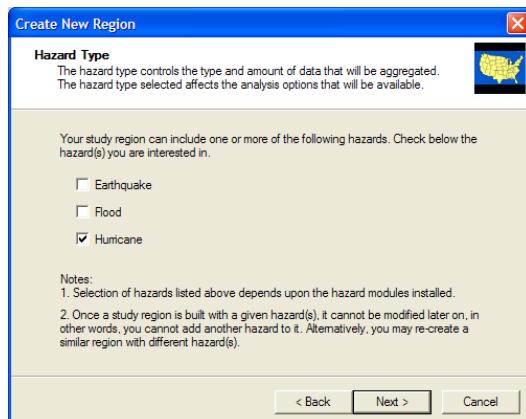
You should see a screen similar to the one shown in Figure 3-12.
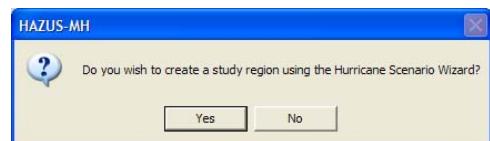
Figure 3-1. Startup Screen.
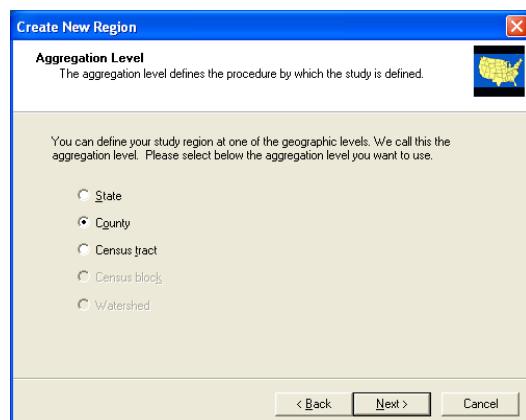
Figure 3-2. Study Region Name.
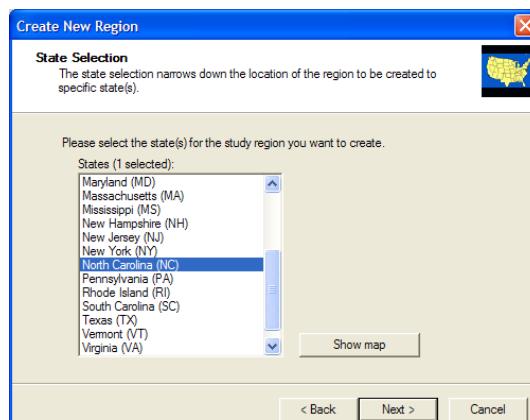
Figure 3-3. Hazard Selection.

Figure 3-4. Hurricane Scenario Wizard.

Figure 3-5. Aggregation Level.

Figure 3-6. State Selection.

Figure 3-7. County Selection.

Figure 3-8. Completion Page in Study Region Creation Wizard.
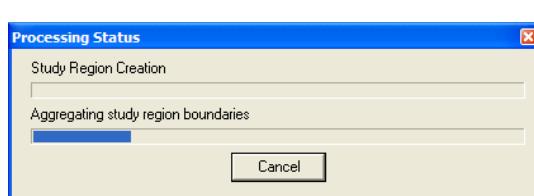
Figure 3-9. Study Region Creation Status.
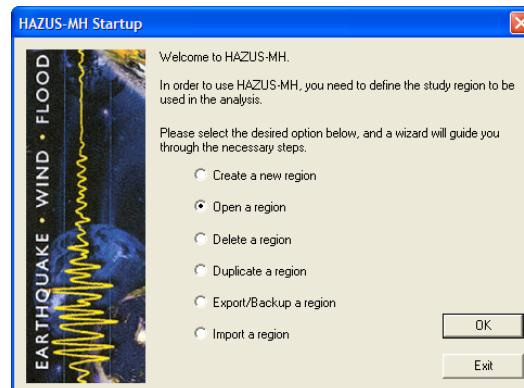
Figure 3-10. Open a Region.
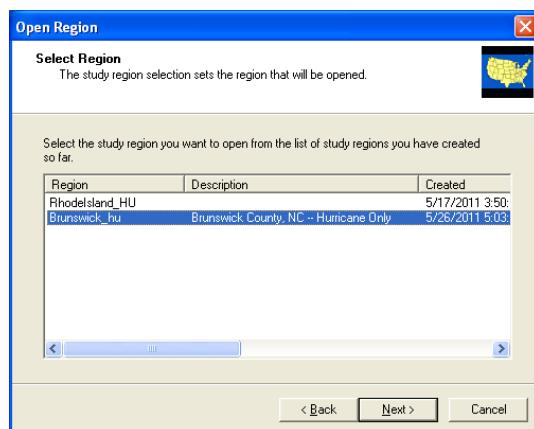
Figure 3-11. Select Region.
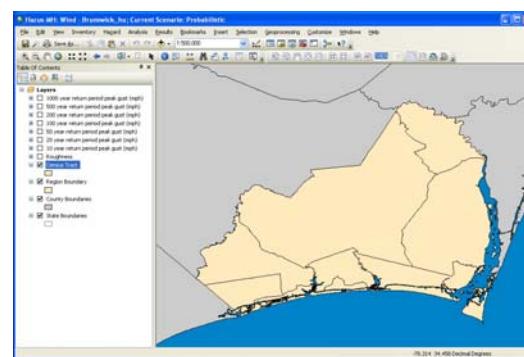
Figure 3-12. Sample Hurricane Study Region for Brunswick County, NC.

3.2   Defining a Hurricane Hazard
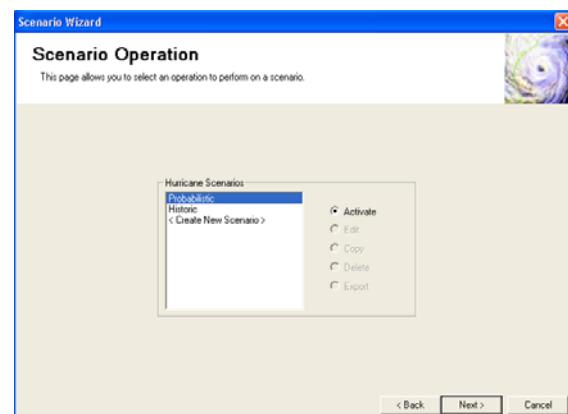
Before an analysis can be run, you must specify the hurricane hazard. While there are multiple hurricane hazard options available (see Section 9.3), the option discussed in this section is a probabilistic hurricane hazard, which is the default hurricane hazard. To activate the probabilistic hurricane hazard, follow these steps:

- Select the **Scenario** command from the **Hazard** menu. This brings up the Welcome Page of the Hurricane Scenario Wizard shown in Figure 3-13.

- Click on the **Next** button.

- Make sure that **Probabilistic** is selected in the Hurricane Scenarios list box as shown in Figure 3-14.

- Click on the **Next** button two times.

- Click on **Finish** to exit the Hurricane Scenario Wizard (Figure 3-15).

To confirm that the active hurricane hazard is set to Probabilistic, select the **Show Current** command from the **Hazard** menu (Figure 3-16).
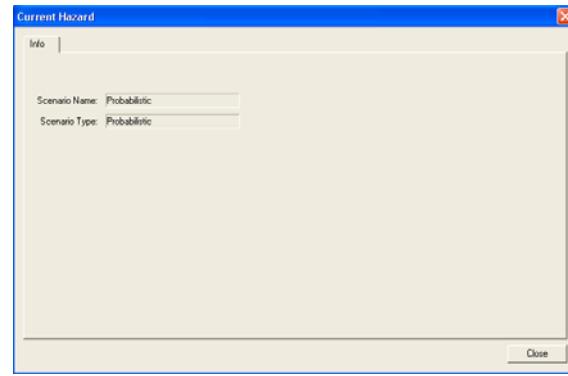
Figure 3-13. Hurricane Scenario Wizard – Welcome Page.

Figure 3-14. Hurricane Scenario Wizard – Scenario Selection Page.
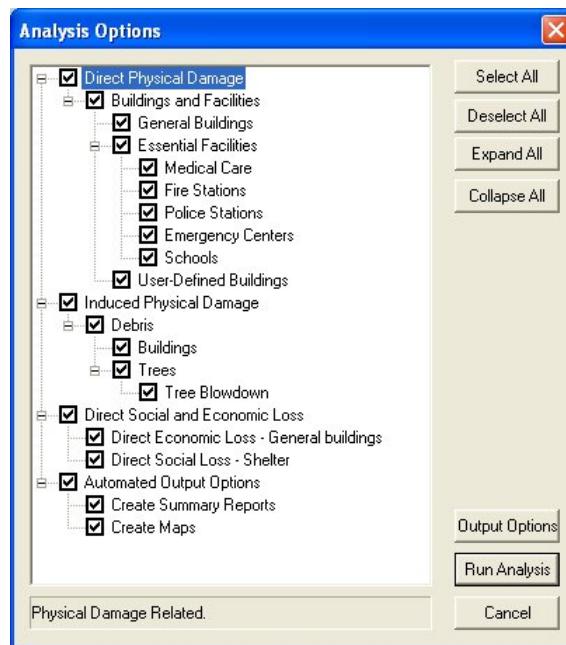
Figure 3-15. Hurricane Scenario Wizard – Completion Page.

Figure 3-16. Current Hazard Dialog.

3.3   Running an Analysis Using Default Data
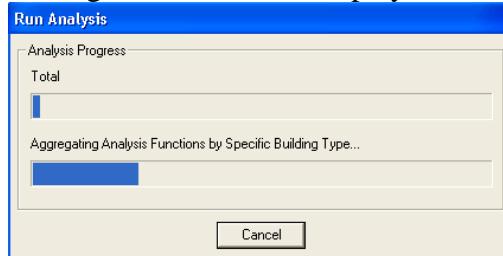
To run an analysis with default data and parameters, select the **Run** command from the **Analysis** menu. This command brings up the Analysis Options Dialog shown in Figure 3-17.

Figure 3-17. Analysis Options Dialog.

Depending on the size or your study region and the performance of your computer, you may find it useful to exclude inventory items or outputs that are of secondary interest. This allows you to review intermediate results and check to determine if the most important results look reasonable or serve your needs without waiting several hours to run a complete analysis. Once you are satisfied with inventories and model parameters,

you may wish to perform additional analyses with all options running simultaneously. For the small study region created for this example, click on the **Select All** button and then click on the **Run Analysis** button to start the analysis. While the analysis is running, the progress dialog shown in Figure 3-18 will be displayed.
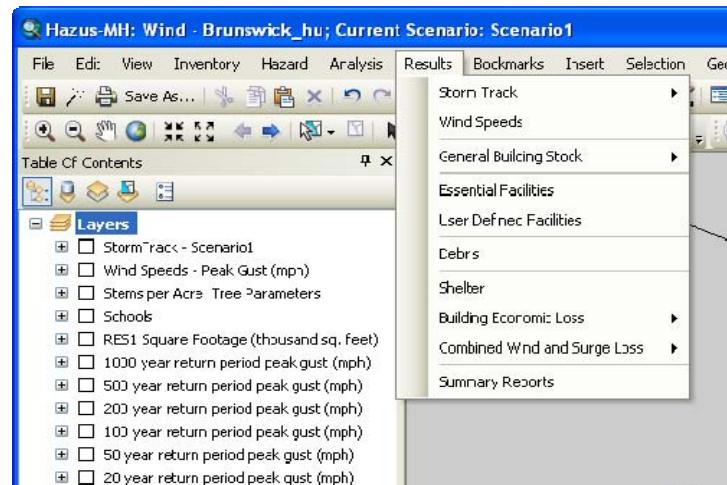
Figure 3-18. Analysis Progress Dialog.

3.4   Viewing Analysis Results

Each of the analysis modules produces a series of outputs. The outputs can be in a tabular or graphical form. Analysis results are accessed from the **<u>Results</u>** menu as shown in Figure 3-19. Three types of output are available:

- Tables of results by census tract (Figure 3-20)
- Map layers (Figure 3-21)
- Summary reports of results by county and for the whole region (Figure 3-22)

Figure 3-19. Results Menu Choices.

Figure 3-20. Sample Results Table: Damage Probabilities for Single-Family Residential Buildings.

Figure 3-21. Sample Map Layer: Probability of at Least Moderate Damage for Residential Buildings.

Figure 3-22. Sample Summary Report: Building Damage by General Occupancy.

Map layers use colors or symbols to display results. For example in Figure 3-21, the census tracts with the darkest shading indicate 56% to 61% of the single-family residential buildings are at least moderately damaged. To create a map layer, select the desired column in a results table and click on the **Map** button at the bottom of a table of results (see Figure 3-20). A variety of summary reports are available through the **Summary Reports** menu at the bottom of the **Results** menu. A sample report is shown in Figure 3-22. Displaying results is discussed in more detail in Chapter 10.

3.5   Default Databases and Default Parameters

While most users will develop a local inventory that best reflects the characteristics of their region, such as building types and demographics, Hazus is capable of producing crude estimates of losses based on a minimum of local input. Of course, the quality and uncertainty of the results will be affected by the detail and accuracy of the inventory and the economic and demographic data provided. The crude estimates would most likely be used only as initial estimates to determine where more detailed analyses would be warranted. This section describes the types of data that are supplied as defaults with Hazus.

3.5.1   Default Databases

Default inventory databases provided with Hazus are of two types. The first type is a national listing of individual facilities, such as dams, bridges, or locations where toxic materials are stored. These databases are modified versions of publicly available databases. The modifications that have been made have been to eliminate data elements that are not needed for the loss estimation methodology. The second type of default database consists of data aggregated on a census tract or census block scale. Examples are building stock square footage for each census tract and census data. These default databases are also derived from publicly available data, eliminating fields of data that are not needed for the methodology.

The databases are stored on the Hazus Data DVD. When you aggregate a region, Hazus extracts only those portions of the databases that are relevant to your region. You can then access these region specific default databases and update them with improved information that you have obtained. Displaying and modifying inventories is discussed in Chapter 7.

The following default inventory data are currently supplied with Hazus:

- Demographic Data
    - Population Distribution
    - Age, Ethnic, and Income Distribution
- General Building Stock
    - Square Footage of Occupancy Classes for Each Census Tract
- Essential Facilities
    - Medical Care Facilities
    - Emergency Response Facilities (fire stations, police stations, EOCs)
    - Schools
- High Potential Loss Facilities
    - Dams
    - Nuclear Power Plants
    - Military Installations
- Facilities Containing Hazardous Materials
- Transportation Lifelines
    - Highway Segments, Bridges and Tunnels
    - Railroad Tracks, Bridges, Tunnels and Facilities
    - Light Rail Tracks, Bridges, Tunnels and Facilities
    - Bus Facilities
    - Port Facilities
    - Ferry Facilities

- Airports Facilities and Runways
- Utility Lifelines
  - Potable Water Facilities, Pipelines and Distribution Lines
  - Waste Water Facilities, Pipelines and Distribution Lines
  - Oil Facilities and Pipelines
  - Natural Gas Facilities, Pipelines and Distribution Lines
  - Electric Power Facilities and Distribution Lines
  - Communication Facilities and Distribution Lines
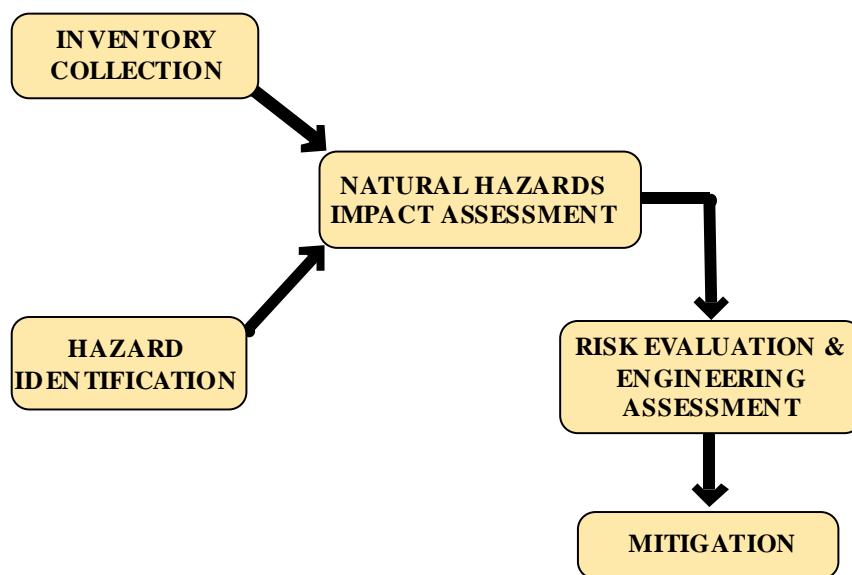
Note that only the Demographics, General Building Stock, and Essential Facilities are used in the loss models developed for the present version of the Hurricane Model. The remaining default inventory databases can only be viewed in tables or as map layers.

3.5.2   Default Parameters

In addition to default databases, the user is supplied with default parameters documented throughout the *Technical Manual*. Examples of default parameters are terrain, tree coverage, and percent of residences that are owner occupied. Default relationships between occupancy classes and building types are provided to infer building inventory characteristics. With the exception of damage, loss, loss-of-use, and debris functions, the user can modify the default parameters if better information is available. Modifying default parameters is discussed in Chapter 4 through Chapter 8.

Chapter 4. Data Needed for a More Complete Loss Estimation Study

Figure 4-1 shows the steps that are typically performed in assessing and mitigating the impacts of a natural hazard such as an earthquake, hurricane or flood. In order to estimate regional losses resulting from a natural disaster, you need to have an understanding of both the size of the potential event (hazard identification) and the characteristics of the population and the environment that will be impacted (inventory collection). For example, a flood that occurs near a densely populated region will cause different types of losses than one that occurs in a mostly agricultural region. Similarly, the economic impacts of an earthquake in a highly industrialized region will be different from those in a region that predominantly supports a service economy. Thus, to reliably model the losses in your region, you will need to collect a wide variety of data so as to be able to characterize the buildings and lifelines, the population, and the structure of the local economy.

Figure 4-1. Steps in Assessing and Mitigating Losses Due to Natural Hazards.
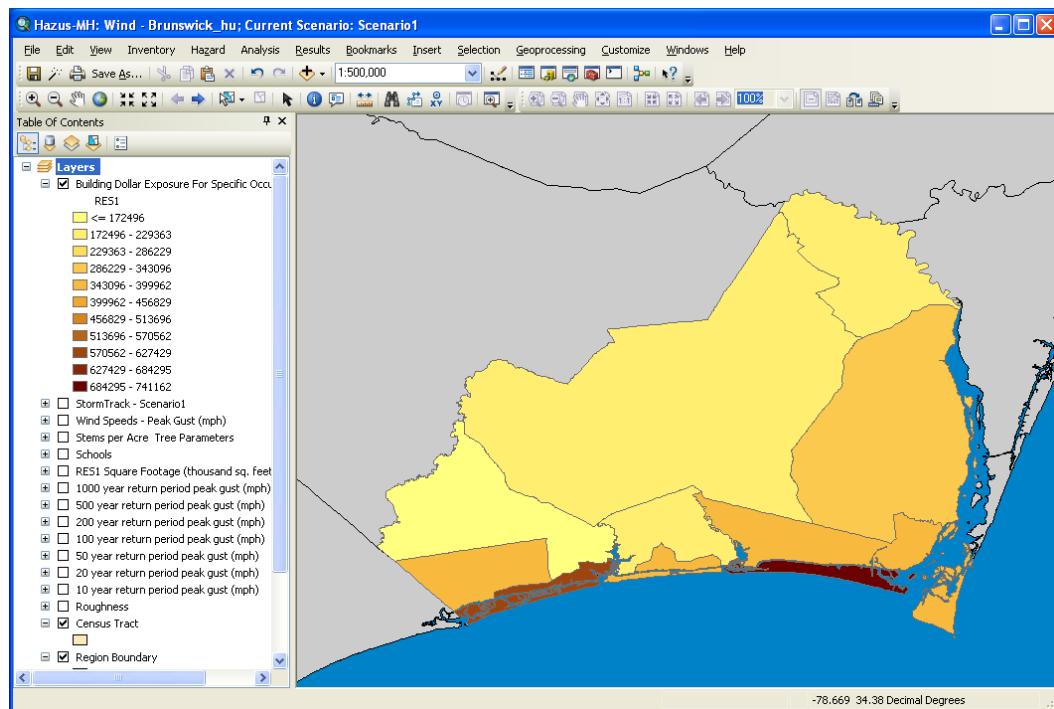
4.1   Developing a Regional Inventory

In developing a regional inventory, it is almost impossible from a cost point of view to individually identify and inventory each man-made structure. Some important structures such as hospitals, schools, emergency operation centers, and fire stations may be identified individually, but the majority of buildings in a region are grouped together collectively and identified by their total value or square footage. To permit modeling of spatial variation in types and occupancies of buildings, a region is built up from sub-regions, and the inventory is collected for each sub-region. The Hurricane Model is

designed to use **census tracts** as the basic sub-region unit, and regions are built up by aggregating census tracts. However, if you select both hurricane and flood hazards when you create a study region, the Hurricane Model will use **census blocks** as the basic sub-region unit for consistency with the implementation of the Flood Model. Selecting or omitting Earthquake hazards in a study region has no effect on the whether the Hurricane Model will work at the census block or census tract level of aggregation.

Although the basic sub-region unit used in the Hurricane Model depends on whether your study region includes or excludes flood hazards, we will generally refer to census tracts as the basic sub-region unit throughout this manual to simplify the presentation.

For each census tract, your inventory might consist of the number of square feet of wood frame buildings, the number of square feet of unreinforced masonry buildings and so on for each building type. Figure 4-2 shows the inventory of single-family residential construction in a region. Note that the value of single-family residential construction is stored and displayed for each census tract in the region.

Figure 4-2. Value of Single-Family Residential Homes (RES1) by Census Tract.

In the methodology, the residential, commercial and industrial buildings that are not identified specifically are called the **general building stock**. General building stock is inventoried by calculating, for each census tract, the total square footage of groups of buildings with specific characteristics (i.e., calculating the total square footage of masonry structures). Collecting even this "simplified" inventory can be problematic. There are rarely reliable and complete databases that provide the necessary information such as building size, building occupancy, building height and structural system that

could be used to obtain total values for each census tract. Therefore, in general, inferences are made about large groups of buildings based on land use patterns, census information, business patterns, assessors' files, insurance files, etc. Inferences can take the form, "if this is a residential area, 50% of the buildings are single family wood structures and 50% are multi-family wood structures".

In contrast to the inventory of general building stock which is maintained in terms of total value per census tract, facilities that have some special significance such as **essential facilities** or components of **lifeline systems** can be maintained in the database by individual location. While some inferences can be used for site-specific facilities when data are unavailable, often you will have better access to databases about these facilities than you will for general building stock. Sometimes there will be few enough of these facilities that you can actually go to the site and collect the required inventory information. Sources of inventory information and how to go about collecting it are discussed in Chapter 5.

4.2   Standardizing and Classifying Data

There are two issues that must be considered in the development of an inventory: classification of data and collection and handling of data. Classification systems are essential to ensuring a uniform interpretation of data and results. As discussed earlier, it is almost impossible, from a cost point of view, to identify and individually inventory each building or component of each lifeline. Thus, losses in a regional study are estimated based on general characteristics of buildings or lifeline components, and classification systems are a tool to group together structures or lifeline components that would be expected to behave similarly in a seismic event. For each of the types of data that must be collected to perform a loss study, a classification system has been defined in this methodology.

The building classification systems used in Hazus have been developed to provide an ability to differentiate between buildings with substantially different damage and loss characteristics. The extent of wind-induced damage to buildings is largely determined by the performance of the building envelope. As a result, the building classification system developed for the Hurricane Model is significantly different than the scheme developed for the Earthquake Model (which focuses on the parameters that control the structural response of buildings subjected to ground motion) or the Flood Model (which focus on the depth of flooding relative to the finished floor elevation). Occupancies, on the other hand, are hazard-independent.

Although the details of the individual building classification schemes must necessarily be different, it is desirable to enforce at least a basic level of commonality among the building classification schemes developed for each hazard. This common basis is needed to facilitate comparisons of the risks posed by the three hazards in a given geographic region. The five simple construction categories listed in Table 4.1 form the common basis for the building classification schemes used by the Earthquake, Flood, and Hurricane models.

Table 4.1. Hazus General Building Types

General Building Type	Description
Wood	Wood frame construction
Masonry	Reinforced or unreinforced masonry construction
Steel	Steel frame construction
Concrete	Cast-in-place or pre-cast reinforced concrete construction
Manufactured Homes	Factory-built residential construction

Using the General Building Types (GBTs) in Table 4.1 as a point of departure, additional hazard-specific attributes have been added to the building classification scheme to provide a richer level of construction detail that is needed to accurately estimate damage and losses. For the Hurricane Model, two additional levels of detail have been added: (a) Specific Building Types (SBTs), which expand upon the five common GBTs, and (b) a set of Wind Building Characteristics (WBCs) within each SBT. The SBTs and WBCs are defined in Appendices A and B. Additional details can be found in the *Technical Manual*.

Even within a particular combination of Specific Building Type and Wind Building Characteristics, there will be variations in building performance. Consider, for example, the metal connectors frequently used in residential construction to tie-down roof trusses to exterior walls. Depending on the product selected, the installation methods, the physical properties of the materials, and other factors, there can be a wide variation in uplift resistance. As a result, the **model building types** defined in the Hurricane Model are designed to represent the <u>average</u> characteristics of buildings in a class. The damage and loss prediction models are developed for model building types and the estimated performance is based upon the "average characteristics" of the total population of buildings within each class.

The general building stock is also classified based on occupancy. The occupancy classification is broken into **general occupancy** and **specific occupancy** classes. These classifications are common to the Hurricane, Flood, and Earthquake Models. The general occupancy classification system consists of seven groups: residential, commercial, industrial, agricultural, religion/non profit, government, and educational. These groups are further divided into 33 specific occupancies. A great deal of inventory information, such as census data, is only available by occupancy.

4.3   Inventory Databases

Once data have been collected, they can be accessed more easily and updated in the future if they are maintained in an orderly manner. Database formats have been developed for all of the data that you will collect to perform the loss study. An example of a database of medical care facilities as you would see it when using Hazus is found in Figure 4-3. The database contains fields that allow you to store a variety of attributes about each facility. For example, in addition to the name, address and city of the medical facilities as shown in Figure 4-3, you have space to enter the zip code, the name and

phone number of a contact at the facility, the class of facility (small, medium, large), the number of beds, the structural type and several other attributes. There is also a "comments" field that allows you to include any information that does not fit into other fields. Some of these fields are not shown in the figure but can be accessed if you scroll to the right. You will notice in this example that some of the facilities are missing information such as address. A missing address does not prevent a facility from being included in the database or in the analysis. In order to be included, only the latitude, longitude and county need be specified while other attributes can be inferred (with corresponding uncertainty).

Figure 4-3. Sample Database of Medical Care Facilities.

Figure 4-4 shows an inventory database for general building stock. For general building stock, data are stored by census tract and for each census tract you will find the total monetary value for each of the seven general occupancy types: residential, commercial, industrial, agricultural, religious/non-profit, governmental and educational. For example, in census tract 37019020100, the value of residential construction is $259.6 million and for commercial construction is $37.5 million. You can also view the inventory in terms of each of the 33 specific occupancy types (RES1, RES2, RES3, etc.) by clicking on **Specific Occupancy** in the **Table Type** box above the table.

You will find that data entry is in a familiar spreadsheet format to allow for easy entry and modification. Moving around in the database involves using the arrow keys at the bottom and to the right of the window. Discussion of how to display, print, modify and map your inventories is found in Chapter 7. The structures of all the databases that are maintained by Hazus are found in Appendix G. A discussion of default databases is found in Chapter 3.5.

Figure 4-4. Value of General Building Stock Inventory.

4.4 Inventory Requirements

Each module in the hurricane loss estimation methodology requires a specific set of input data. The required data can take two forms. The first is inventory data such as the square footage of buildings of a specified type or the population in the study region. These are used to estimate the amount of exposure or potential damage in the region. The second data type includes characteristics of the local economy that are important in estimating losses (e.g., rental rates, construction costs or regional unemployment rates). This section summarizes the inventory information that is needed to perform a loss study.

Table 4.2 lists the inventory required for each type of output that is provided in the methodology. You will find that there are varying degrees of difficulty in developing this inventory. For example, in your region excellent records may be available concerning the police and fire stations and schools. On the other hand you may find that it is difficult to obtain detailed information about some of the lifeline facilities. An issue that you will likely run into is that data you collect will have to be adjusted so that the inventory is classified according to the systems defined in the methodology. In some cases, you may find that you require a consultant to assist with the classification of data. Default values are provided for most of the input information (see Chapter 3.5).

4.5 Relationship between Building Types and Occupancy Classes

Since much of the inventory information that is available is based on the 33 specific occupancy classes, inferences must be made to convert occupancy class inventory to model building types. The relationship between model building type and occupancy class will vary on a regional basis. For example, in North Carolina, the default mapping of the RES1 (single-family dwelling) occupancy is 92% wood frame houses and 8% masonry houses (see Figure 4-5). Because the general building types defined in Hazus are common across all three hazards, the relationship shown in Figure 4-5 applies to the Hurricane, Flood, and Earthquake Models.

Table 4.2. Minimum Inventory for the Hurricane Loss Estimation Methodology

Desired Output	Required Input
GENERAL BUILDING STOCK	
Damage to general building stock by occupancy or building type	Total square footage of each occupancy by census tract, occupancy to building type relationships
ESSENTIAL FACILITIES	
Damage and functionality of essential facilities	Location and building type of each facility
Loss of beds and estimated recovery time for hospitals	Number of beds at each facility
HIGH POTENTIAL LOSS FACILITIES	
Map of high potential loss facilities	Locations and types of facilities
TRANSPORTATION LIFELINES	
Map of transportation components	Locations and classes of components
UTILITY LIFELINES	
Map of utility components	Locations and classes of components
DIRECT SOCIAL LOSSES	
Number of displaced households	Number of households per census tract
Number of people requiring temporary shelter	Population including ethnicity, age, income
ECONOMIC LOSSES	
Cost of building repair or replacement	Cost per square foot to repair damage by structural type and occupancy for each level of damage
Loss of contents	Replacement value by occupancy
Business inventory damage or loss	Annual gross sales in $ per square foot
Relocation costs	Rental costs per month per square foot by occupancy
Business income loss	Income in $ per square foot per month by occupancy
Employee wage Loss	Wages in $ per square foot per month by occupancy
Loss of rental income	Rental costs per month per square foot by occupancy
Cost of damage to transportation components	Costs of repair/replacement of components
Cost of damage to utility components	Costs of repair/replacement of components

The relationship between specific building type and occupancy class also varies on a regional basis. For the example shown in Figure 4-6, the 63% of the wood frame buildings in the RES1 (single-family dwelling) specific occupancy category are mapped to the WSF1 (wood frame, single-family, one-story) specific building type and 37% are mapped to WSF2 (wood frame, single-family, two or more stories). Because the specific building types defined for each hazard are different, the relationship shown in Figure 4-6 applies only to the Hurricane Model.

Finally, the distribution of wind building characteristics within each specific building type also varies on a regional basis. For the example shown in Figure 4-7, the 19% of the WSF1 (wood frame, single-family, one-story) specific building types have hip-shaped roofs and 89% have gable roofs. Since the characteristics shown in Figure 4-7 apply to the specific building types defined for the Hurricane Model, the relationships do not affect the Flood or Earthquake Models.

General Building Type Mapping Scheme Distribution

NC1

	Occupancy	Total	Wood	Masonry	Concrete	Steel	MH
1	RES1	100	92	8	0	0	0
2	RES2	100	0	0	0	0	100
3	RES3A	100	62	31	4	3	0
4	RES3B	100	62	31	4	3	0
5	RES3C	100	62	31	4	3	0
6	RES3D	100	62	31	4	3	0
7	RES3E	100	62	31	4	3	0
8	RES3F	100	62	31	4	3	0
9	RES4	100	48	21	18	13	0
10	RES5	100	7	34	40	19	0
11	RES6	100	22	31	20	27	0
12	COM1	100	14	23	7	56	0
13	COM2	100	10	24	7	59	0
14	COM3	100	25	40	7	28	0
15	COM4	100	26	33	9	32	0
16	COM5	100	13	30	12	45	0
17	COM6	100	2	18	25	55	0
18	COM7	100	24	28	8	40	0
19	COM8	100	19	21	7	53	0
20	COM9	100	5	17	15	63	0
21	COM10	100	0	2	73	25	0
22	IND1	100	5	19	16	60	0
23	IND2	100	10	28	12	50	0
24	IND3	100	7	18	10	65	0
25	IND4	100	7	18	7	68	0
26	IND5	100	5	12	16	67	0
27	IND6	100	10	19	11	60	0
28	AGR1	100	48	17	2	33	0
29	REL1	100	36	47	6	11	0
30	GOV1	100	7	19	12	62	0
31	GOV2	100	8	28	20	44	0
32	EDU1	100	13	32	12	43	0
33	EDU2	100	4	31	20	45	0

Apply   OK   Cancel

Figure 4-5. Default Mapping of Specific Occupancy to General Building Type for North Carolina.

While the relationships shown in Figure 4-5 through Figure 4-7 can be developed from data collected locally, Hazus provides default mappings of specific occupancy classes to model building types. Three general mapping schemes have been defined and assigned depending upon whether a state is in the Western U. S., the Mid-West or the Eastern U.S. Eight specific building type mappings and eight wind building characteristics mappings are provided for the 22 states covered by the present Hurricane Model. Four additional pairs of mappings are provided for Hawaii. It will be up to you to modify these defaults to reflect characteristics that are specific to your local region.
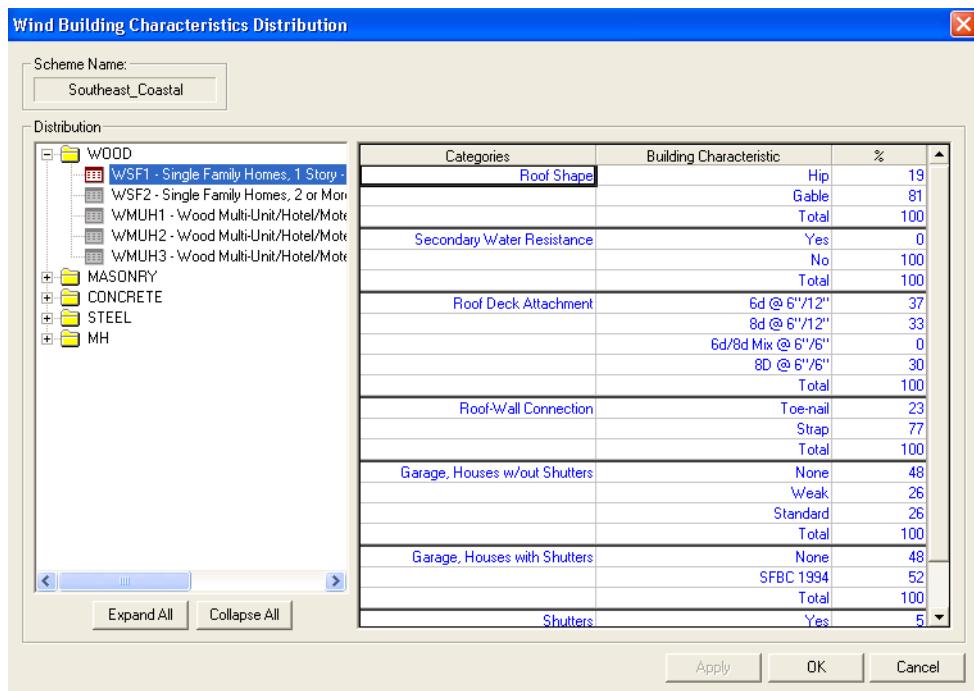
Modifying occupancy to model building type relationships is discussed in Chapter 7. Developing custom mapping schemes using local data and experts is discussed in Chapter 5. Developing mapping schemes using tax assessor or property records is discussed in Chapter 8.

Figure 4-6. Default Mapping of Specific Occupancy to Specific Building Type for Wood Frame Buildings Located in the Coastal Counties of North Carolina.

Figure 4-7. Default Distribution of Wind Building Characteristics for One-Story, Single-Family Wood Frame Houses (WSF1) Located in the Coastal Counties of North Carolina.

Chapter 5. Collecting Inventory Data

A limiting factor in performing a loss estimation study is the cost and quality of the inventory. Collection of inventory is without question the most costly part of performing the study. Crude estimates of damage do not require extensive inventory data and can be performed on a modest budget. As the damage estimates become more precise, the need for inventory information increases, as does the cost to obtain this information. Since many municipalities have limited budgets for performing loss estimation study, Hazus accommodates different users with different levels of resources. It should be understood, however, that the uncertainty of the loss estimates increases with less detailed inventory, and that there are uncertainties associated with modules other than inventory. For example, even an accurate inventory of buildings and terrain in the study area, Hazus or any other loss estimation methodology cannot infallibly predict damage and associated losses.

Inventory information will come from and/or be collected in databases compatible with the GIS technology. Once collected and entered into the database, the data will also be available to users for other applications, such as city planning.

5.1   Sources of Information

As discussed in Chapter 3, the use of default parameters and default inventory in performing a loss study introduces a great deal of uncertainty. Loss studies performed with only default data may be best for preliminary assessments to determine where more information is needed. For example, if the analysis using only default information suggests that hurricanes will cause a great deal of damage in a particular part of your community, you may want to collect more detailed inventory for that area to have a better understanding of the types of structures, the essential facilities and businesses that will be affected.

Regional building inventories can be built up from a variety of sources, including: federal government, state government, local government and private sector databases. These databases may be useful for obtaining facility-specific information. Following are examples of sources of inventory data that can be accessed to enhance the Hazus building data:

- Locations of government facilities such as military installations and government offices
- Tax assessor's files
- School district or university system facilities
- Databases of fire stations or police stations
- Databases of historical buildings
- Databases of churches and other religious facilities

- Postal facilities (ATC-26, 1992)

- Hospitals (The AHA Guide of the American Hospital Association; ATC-23A, 1991)

- Public and private utility facility databases

- Department of transportation bridge inventory

- Dun and Bradstreet database of business establishments

- Insurance Services Office's files of large buildings that is used for fire assessment real estate databases

It should be kept in mind that each of these databases includes only a portion of the building stock, and none is complete. For example, the tax assessor's files do not include untaxed properties such as government buildings, public works and tax-exempt private properties. School district databases probably will not include private schools. A good discussion of available databases is found in ATC-13 (1985) and Vasudevan et al. (1992), although some of the databases discussed in these two references are specific to California.

Another possible source of inventory information is previous loss or hazard studies. Unfortunately many regional loss studies do not contain a listing (either hard copy or electronic) of the inventory that was used.

The following sections contain more detailed information about sources of information for specific modules of the Hurricane Model.

5.1.1   General Building Stock

Developing the inventory for general building stock most likely will require combining information from several sources. As mentioned earlier, there is no complete single source of general building stock information. In addition, you will find that the quality and format of the information varies dramatically from county to county. Furthermore, since general building stock inventory is not normally compiled by counting individual buildings, but instead is developed using various assumptions and inferences, you may find that you need input from local engineers and building officials to ensure that you have captured unique aspects of the region.

5.1.1.1   County Tax Assessor Files

County Tax Assessor files may or may not be a source of general building stock information. Since Tax Assessor files are kept for the purposes of collecting property taxes, they may contain little or no useful structural information. The quality of the data varies widely from county to county. The most useful data will contain occupancy, structural type, square footage, height, and age. Generally, the files contain good information on the use (occupancy) of the building, since tax rates often depend on building use; therefore, either a land use code and/or a specific occupancy of the building is included. Ideally, if good information is available, you can use the Comprehensive

Data Management System (CDMS) to develop region-specific occupancy to model building type relationships. However, several problems generally occur:

- Many Tax Assessor files do not contain building square footage information. In some counties, square footage is not recorded at all. In other cases, it is only sometimes recorded. You should ask the Tax Assessor before you buy the records as to what percentage of the records contain square footage information.

- Many Tax Assessor files contain square footage information that may be difficult to interpret. For example, a property that is owned by several owners (such as an office building) may appear several times in the files. Perhaps Owner #1 owns two floors of the building and Owner #2 owns eight floors. The Tax Assessor's records may not reflect the fact that Owner #1 owns 20% of the Building and Owner #2 owns 80%. In fact, sometimes both property entries will show the total building square footage instead of Owner #1 with 20% of the square footage and Owner #2 with 80%. Without going through the files record by record, this is difficult to fix.

- Since some occupants that do not pay taxes (e.g., schools, churches, and government buildings) are not usually well represented in the Tax Assessor's files. Often these types of properties include an entry and an Assessor's Parcel Number, but omit assessed value, square footage, structural type, height or age.

- Structural type may not be recorded at all in the files. You need to ask the Tax Assessor what percentage of the records has structural information before you buy the files.

- Similar comments about missing data can be made about age and height.

- Some or all of the properties in the Tax Assessor's files may contain no address information. In some counties, the Assessor's Parcel Number is the only identifier in the database. While this can be mapped to location, it is not an easy task. The file may contain a mailing address of the owner, but this is not a reliable address to locate properties. In other cases, selected properties are missing addresses. Address information is important because you can use addresses to see how the types and occupancies of buildings vary geographically.

- Perhaps one of the most difficult problems is that, in many cases, the Tax Assessors use a system of classifying structures that is difficult to map to the model building types defined in Appendices A and B. For example, there may only be five building types, such as steel frame, wood frame, fire resistant, masonry and other. It is difficult from this very simple classification system to determine whether masonry structures are reinforced or unreinforced. Fire resistant construction could include a variety of structural types consisting of concrete or masonry. In these cases you will need to use local experts to help define the mix of construction.

5.1.1.2 Commercial Sources of Property Data

There are a variety of on-line services that maintain databases of real property that are designed to assist realtors and other commercial enterprises in gathering property sales

data and owner information, and to assist in generating mailing lists and labels. The databases are developed from County Tax Assessor's files and updated as properties are sold or as other information becomes available.

You can subscribe to one of these services and download records over a telephone line, or you can order CDs of selected counties and use software supplied by the service to extract the records on your own computer. It seems that different services tend to focus their efforts in different parts of the United States. Therefore, one service may not maintain a database on the county you wish to study while another service may. Typical costs for a county are $300 to $1000, depending on its size. Addresses and phone numbers of several on-line services are listed below. (Note: While these are California addresses, they carry data from around the country. There may be local offices for these companies.) If one of these services does not have the counties in your study region you may find that there is a service in your own community that maintains these types of records. Local real estate agencies or the local Board of Realtors would probably know about this. Alternatively, you could try calling local Tax Assessors and see if they have sold their data to this type of service.

Some of the Commercial Sources of Property Data are:

> *Experian Property Data (formally known as TRW)*
> 3610 Central Avenue
> Riverside, CA 92506
> (800) 345-7334

> *Transamerica Information Management (offer a program called MetroScan)*
> 1860 Howe Avenue, Suite 455
> Sacramento, CA 98525
> (800) 866-2783

> *DataQuick Information Services*
> 9171 Towne Centre Drive, #404
> San Diego, CA 92122
> (800) 950-9171

The commercially available databases contain the same type of problems found in the County Assessor's data since they were obtained from them. Perhaps one of the main advantages of the commercially available data is that you can get some technical support in trying to put the data into databases. The software they provide enables you to look at individual properties or to sort properties in a variety of ways such as by zip code, or by census tract, or by age, or by occupancy to name a few. On the other hand, assessor's data are often stored on 9-track tape and little instruction is provided about how to extract the data.

One note of caution: The software that commercial services provide is limited in that you cannot extract the entire county at once. You are limited to extracting a certain number of records (for example 9000) at a time. A large county such as Los Angeles contains over two million records. Thus extracting all of the records for the county can be a tedious task, sometimes taking several days.

5.1.2 Occupancy to Model Building Type Relationships

Developing occupancy to model building type mapping schemes that accurately reflect your study region will require combining available data with input from local experts. Collecting supplemental information about local building practices through the use of a questionnaire and/or a workshop is recommended.

5.1.3 Essential Facilities

Essential facilities, to a great degree, are owned or licensed by government agencies. Consequently, lists of these facilities often have been compiled for a region. Therefore, the time associated with collecting inventory on essential facilities may be relatively small; perhaps a day or two, if no building type information is collected and default occupancy to building type mappings are used. However, more detailed building type information may require a site visit for each facility. Some essential facilities are subject to special design and construction considerations that may help these structures perform better than the typical building when subjected to high winds.

5.1.3.1 Medical Care Facilities

Sources of inventory information for medical care facilities include the yellow pages of the telephone book, city and county emergency response offices, the American Hospital Association and previous loss studies. The default medical facilities database included with Hazus was developed from a FEMA database and contains the number of beds for many of the facilities. Determining the number of beds for other facilities may require the user to contact facilities on an individual basis. In some cases, county guides, such as the McCormack Guides in California, provide a listing of all health care facilities, their addresses, phone numbers and the number of beds. The State Department of Public Health in California (and its equivalent in other states) licenses health care facilities and may publish a directory of licensed facilities.

5.1.3.2 Fire Stations, Police Stations and Emergency Operations Centers

Locations of fire stations, police stations and emergency operations centers can be obtained from city and county emergency response offices. In addition, many city maps show locations of police and fire stations.

5.1.3.3 Schools

Locations of public schools and their enrollments can be obtained from district offices. The Board of Education in some states compiles a directory of all schools (public and private) in the state with names, addresses, phone numbers and enrollments. The yellow pages of the phone book can be used as an initial listing. Regional governments may compile directories of local educational institutions (including colleges and universities).

5.1.4   User-Defined Facilities

User-defined facilities are those structures, other than essential facilities or high potential loss facilities, which the user may wish to analyze on a site-specific basis. For example, you may wish to identify all of the pharmacies in the community. You can collect data about these types of structures using the same sources you would use for general building stock or essential facilities, namely: specific databases that may be available to you through some agency, commercial sources of property data, the phone book, interviews with owners and site visits.

5.1.5   Demographics

Population statistics are used in estimating several different losses such as casualties, displaced households and shelter needs. Population location, as well as ethnicity, income level, age and home ownership is needed to make these estimates. The 2000 Census data are included with Hazus. You may be able to obtain updated information from the Census Bureau or from a regional planning agency.

5.1.6   Direct Economic Loss Parameters

Direct economic losses begin with the cost of repair and replacement of damaged or destroyed buildings. However, building damage results in a number of consequential losses that are defined as direct economic losses. Thus, building-related direct economic losses (which are all expressed in dollars) comprise two groups. The first group consists of losses that are directly derived from building damage:

- Cost of repair and replacement of damaged and destroyed buildings
- Cost of damage to building contents
- Losses of building inventory (contents related to business activities)

The second group consists of losses that are related to the length of time the facility is non-operational (or the immediate economic consequences of damage):

- Relocation expense (for businesses and institutions)
- Capital-related income loss (a measure of the loss of services or sales)
- Wage loss (consistent with income loss)
- Rental income loss (to building owners)

5.1.6.1   County Business Patterns

County Business Patterns is an annual series published by the United States Census Bureau that presents state and county-level employment, annual payrolls, total number of establishments, and establishments by employee size. The data are tabulated by industry as defined by the Standard Industrial Classification (SIC) Code. Most economic divisions are covered, which include agricultural services, mining, construction, manufacturing, transportation, public utilities, wholesale trade, retail trade, finance, insurance, real estate and services.

The data generally represents the types of employment covered by the Federal Insurance Contributions Act (FICA). Data for employees of establishments totally exempt from FICA are excluded, such as self-employed persons, domestic service employees, railroad employees, agricultural production employees and most government employees.

County Business Patterns is the only complete source of sub-national data based on the four digit SIC system. The series, therefore, is useful in making basic economic studies of small areas (counties), for analyzing the industrial structure of regions, and as a benchmark for statistical series, surveys and other economic databases. The data can serve a variety of business uses as well as being used by government agencies for administration and planning.

County Business Patterns data are extracted from the Standard Statistical Establishment List, a file of known single- and multi-establishment companies maintained and updated by the Bureau of the Census every year. The Annual Company Organization provides individual establishment data for multi-location firms. Data for single-location firms are obtained from various programs conducted by the Census Bureau as well as from administrative records of the Internal Revenue Service (Census Bureau, 1991).

5.1.6.2 Means Square Foot Costs

The default replacement costs supplied with the methodology were derived from Means Square Foot Costs for Residential, Commercial, Industrial, and Institutional buildings. The Means publication (Means, 2005) is a nationally accepted reference on building construction costs, which is published annually. This publication provides cost information for a number of low-rise residential model buildings, and for 70 other residential, commercial, institutional and industrial buildings. These are presented in a format that shows typical costs for each model building, showing variations by size of building, type of building structure, and building enclosure. One of these variations is chosen as "typical" for this model, and a breakdown is provided that shows the cost and percentages of each building system or component. The methodology also allows the user to adjust costs for location of the structure (e.g., New York and Miami). A description of how to estimate costs from the Means publication is found in the *Flood Model Technical Manual*.

Selected Means models have been chosen from the more than 70 models that represent the 33 occupancy types. The wide range of costs shown, even for a single model, emphasize the importance of understanding that the dollar values shown should only be used to represent costs of large aggregations of building types. If costs for single buildings or small groups (such as a college campus) are desired for more detailed loss analysis, then local building specific cost estimates should be used.

5.1.6.3 Dun and Bradstreet

Dun and Bradstreet is an organization that tracks all businesses that are incorporated. Dun and Bradstreet maintains data on the type of business, the number of employees, the square footage of the business, the annual sales and a variety of other information. The

default square footage for the occupancy classes and for all the census tracts was created from the 2 and 4 digit (Standard Industrial Classification) SIC 2002 Dun and Bradstreet data. Dun and Bradstreet provides aggregated information for a specific region on total number of employees, total annual sales and total square footage by census tract. They can also provide information on specific businesses.

5.1.6.4 Capital-Related Income

The U.S. Department of Commerce's Bureau of Economic Analysis reports regional estimates of capital-related income by economic sector. Capital-related income per square foot of floor space can then be derived by dividing income by the floor space occupied by a specific sector. Income will vary considerably depending on regional economic conditions. Therefore, default values need to be adjusted for local conditions.

5.2 Collecting Inventory Data

It should be understood that many available databases do not contain all of the information that is needed to perform a loss study. For example, they may contain street addresses, the size of the facility, or the value of the facility, but may not contain information about structural type or age. Databases may be out of date and may not contain all of the facilities in the region. Another problem the user can encounter is that databases may be in a paper rather than electronic format, making them difficult or impossible to use. Combining multiple databases can also be problematic. Issues such as double counting facilities and eliminating unnecessary information need to be addressed.

In general, the majority of the building inventory used in the regional loss estimation will not be collected or kept on a facility-by-facility basis. Resource limitations make it difficult to collect such detailed information. Management and storage of such a large amount of information, while possible, is beyond the state-of-practice for many municipalities and government agencies. Maintaining facility-specific databases will be most useful for important or hazardous facilities such as hospitals, fire stations, emergency operation centers, facilities storing hazardous materials, and high occupancy facilities, to name a few. Procedures exist for supplementing facility-specific databases with area-specific inventory information. An example of an area specific inventory is the number of square feet of commercial space in a census tract or zip code. These area-specific inventories are often based on economic or land use information that is augmented using inference techniques. For example, the user may have available the number of commercial establishments in a region. Assuming an average size (in square feet) per establishment, the user can infer the total square footage of that occupancy. Similarly, a land use map may be converted to building square footage by multiplying land use area by percent of area covered by buildings.

Techniques for developing inventories include:

- Sidewalk/windshield surveys
- Analysis of land use data
- Analysis of aerial photography

- Discussions with local engineers and building officials
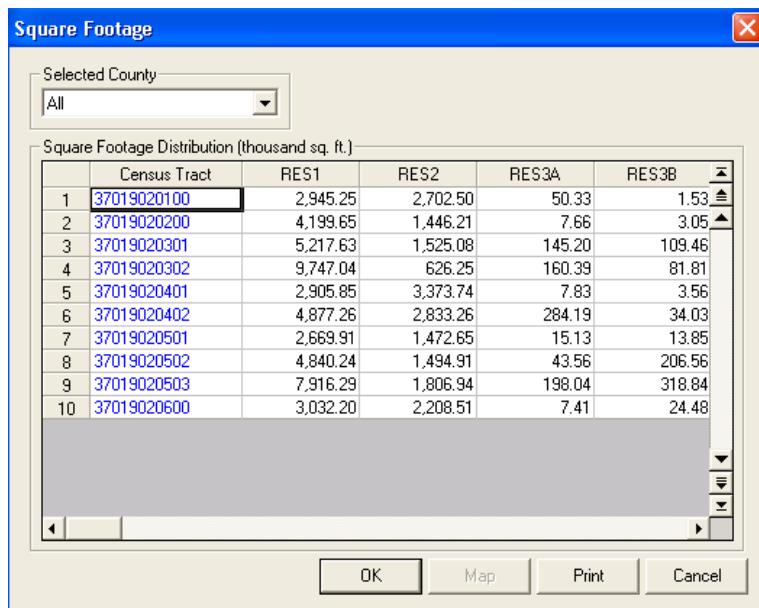
Development of sample survey forms or other examples of the above techniques was beyond the scope of the current version of the Hurricane Model. Please refer to the Earthquake *User Manual* to see comparable examples for earthquake hazards.

5.3   Inventory Menu Items

5.3.1   General Building Stock

5.3.1.1   Square Footage
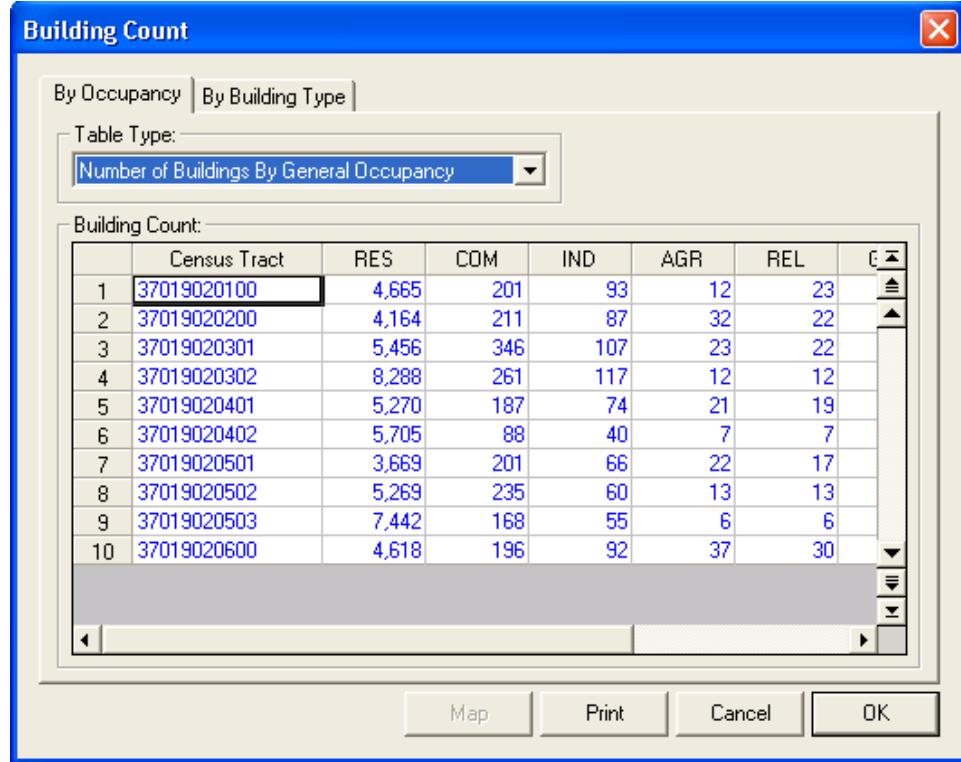
The Square Footage browser allows you to view or modify the general building stock square footage by specific occupancy and census tract. The data in this browser are common to all three hazards.

Figure 5-1. Square Footage Browser.

5.3.1.2   Building Count
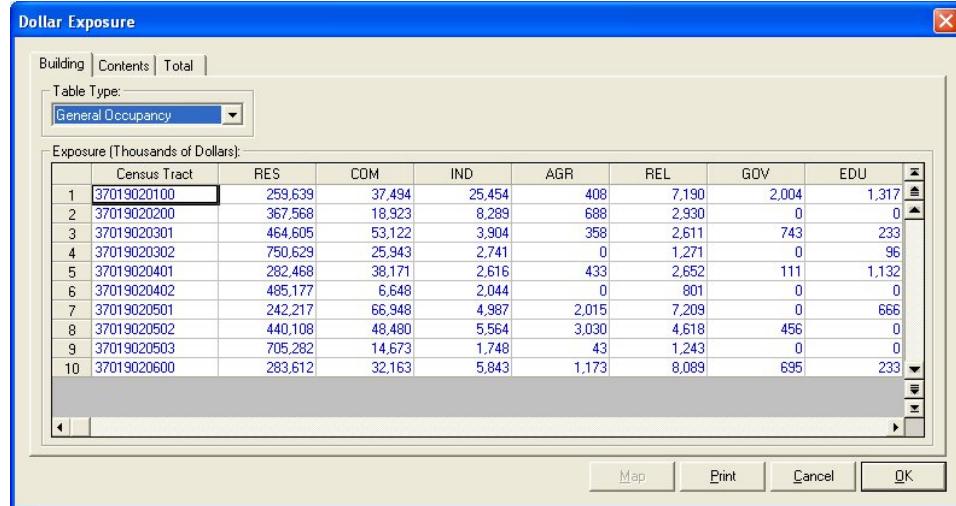
The Building Count browser allows you to view the general building stock count by census tract. When viewing the building counts by specific occupancy, you can modify the data. When viewed by general occupancy, general building type, or specific building type, the data are read-only. The data displayed in this browser are common to all three hazards (except when viewed by specific building type).

Figure 5-2. Building Count Browser.

5.3.1.3   Dollar Exposure
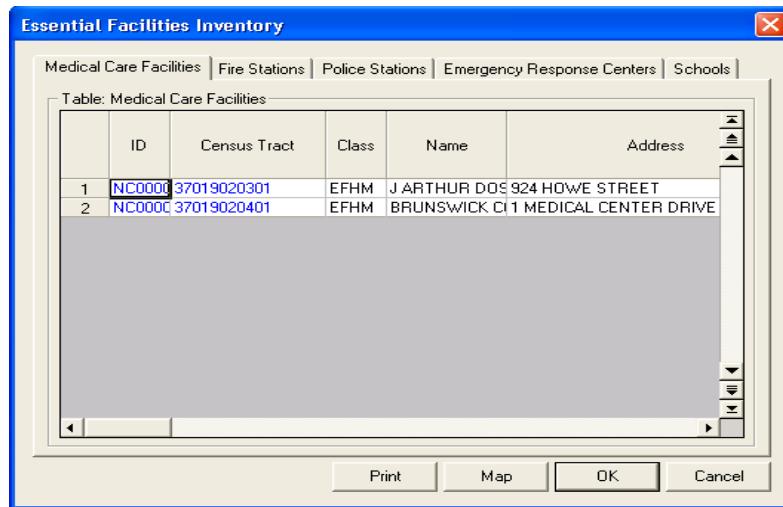
The Dollar Exposure browser allows you to view the general building stock dollar exposure by census tract. When viewing the dollar exposures by specific occupancy, you can modify the data. When viewed by general occupancy, general building type, or specific building type, the data are read-only. The data displayed in this browser are common to all three hazards (except when viewed by specific building type).

Figure 5-3. Dollar Exposure Browser.

5.3.2 Essential Facilities
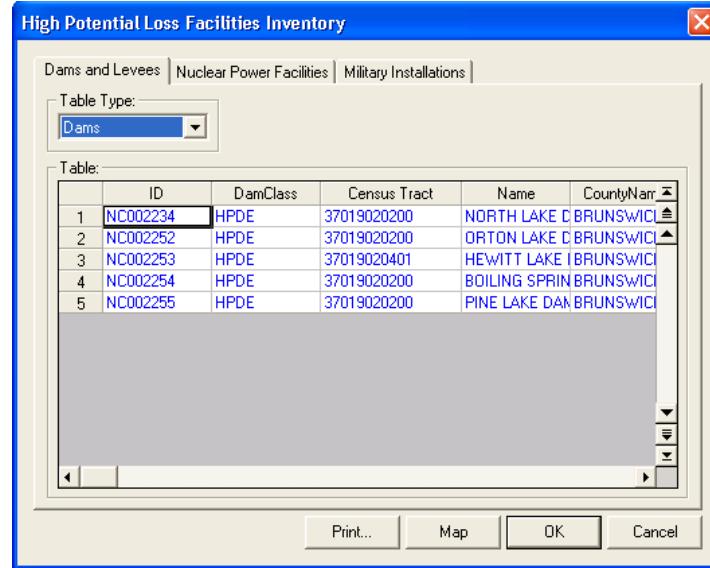
Most of the essential facility inventory data is common to all three hazards. The only hazard-specific data is the specific building type, if that information is available.

Figure 5-4. Essential Facilities Inventory Data Browser.

5.3.3 High Potential Loss Facilities

The High Potential Loss Facilities (HPLF) browser allows you to view and map the default database for your study region. Damage and loss are not computed for HPLF's in the present version of the Hurricane Model.
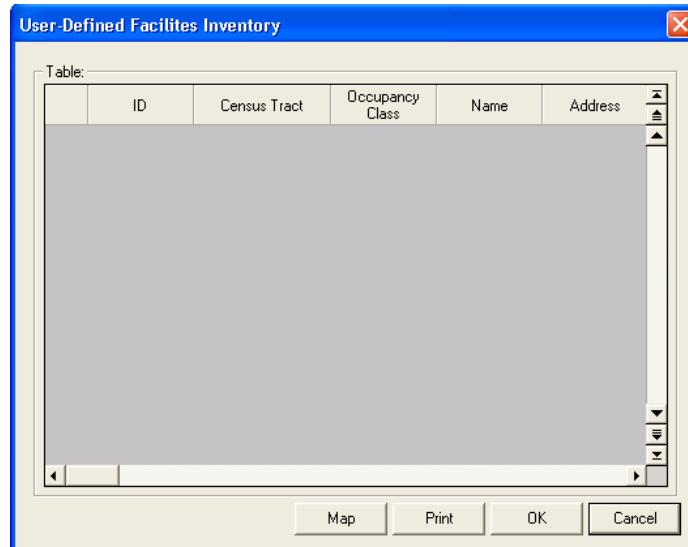
Figure 5-5. High Potential Loss Facilities Inventory Data Browser.

5.3.4   User-Defined Facilities

User-Defined Facilities (UDFs) are any individual buildings that you may wish to add to the study region. The Hurricane Model outputs damage state probabilities for each UDF.

UDFs default to the General Building Stock mapping schemes defined for the census tracts in which they are located. However, you can define a specific building type and a set of wind building characteristics if such information is available for an individual UDF.

Figure 5-6. User-Defined Facilities Inventory Data Browser.

5.3.5 Transportation Systems

The Transportation Systems browser allows you to view and map the default database for your study region. Damage and loss are not computed for Transportation Systems in the present version of the Hurricane Model.
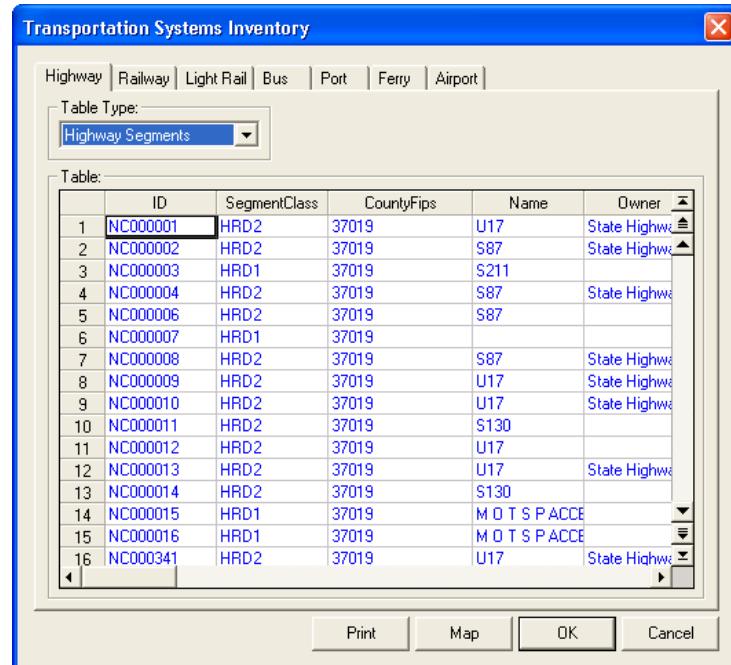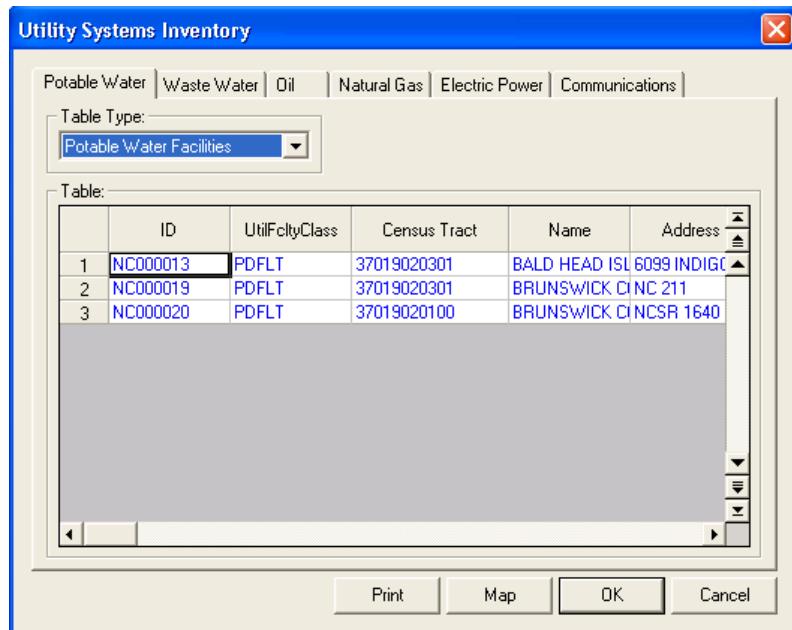
Figure 5-7. Transportation Systems Data Browser.

5.3.6 Utility Systems

The Utilities Systems browser allows you to view and map the default database for your study region. Damage and loss are not computed for Utilities Systems in the present version of the Hurricane Model.

Figure 5-8. Utility Systems Data Browser.

5.3.7 Hazardous Materials

The Hazardous Materials browser allows you to view and map the default database for your study region. Damage and loss are not computed for Hazardous Materials sites in the present version of the Hurricane Model.

Figure 5-9. Hazardous Materials Data Browser.

5.3.8 Demographics

The Demographics browser allows you to view and map the default database for your study region. Demographics data are used in the shelter requirements methodology.

Figure 5-10. Demographics Data Browser.

5.3.9 View Classification

The View Classification browser allows you to view definitions of the classification categories.
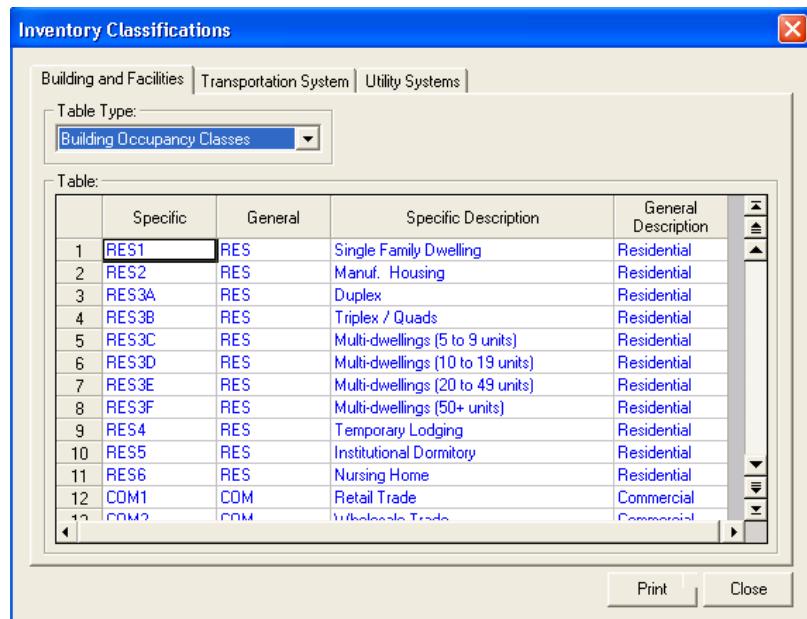
Figure 5-11. View Classification Browser.

Chapter 6. Entering and Managing Data in Hazus

Hazus contains a variety of default parameters and databases. You can run a loss estimation analysis using only default data (Chapter 3), but your results will be subject to a great deal of uncertainty. If you wish to reduce the uncertainty associated with your results, you can augment or replace the default information with improved data collected for your region of study.

Hazus contains two import tools for entering data: the stand-alone CDMS (Comprehensive Data Management System) for improving general building stock and site-specific data (see Chapter 8), and the Inventory import menu option for entering site-specific (e.g., hospitals and schools). Data which has not been imported can still be used as overlays and for general spatial queries, but will not be treated in the loss estimation model.

As has been discussed in earlier sections, it is very likely that data obtained from different sources will not be in the same format. Furthermore, the data may contain a different number of fields than the data defined in Hazus. This will require mapping the data fields to the correct format and inclusion in the centralized geodatabase. The following sections describe importing data, entering data through Hazus windows, and managing the data.
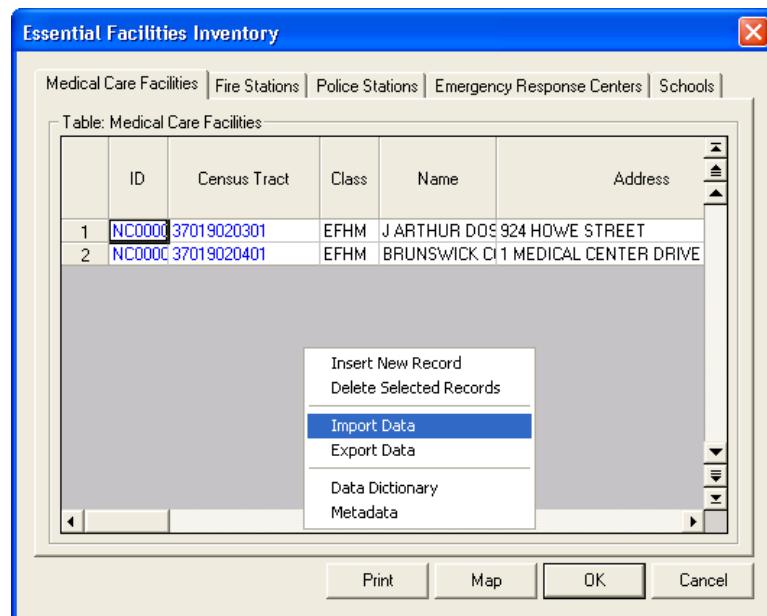
6.1   Importing Features and Files

Only some offices and potential Hazus users will have the most current version of GIS software; others will not currently use ESRI software. Those who have previously applied Hazus for Level II analysis will recognize the similarity of data field headers and inventory requirements. All operators of Hazus will be starting with the newest default datasets; first to be evaluated, and then improved by directly editing the default inventories, or by importing new data files. Data that are not already formatted in GIS will require conversion to the standardized ESRI ArcGIS geodatabase format before importing.

6.1.1   Importing Site-Specific Data Files

Arcview shapefiles, ArcInfo coverage files, CAD files, image files, and tabular database files (e.g., Paradox, dBase) must be converted to a geodatabase (*.mdb) for use with Hazus. Several file types (e.g., shapefile, drawing, tabular) may be converted to one or more geodatabases for import. MapInfo, Atlas, or other CAD file formats will generally require exporting files to a shapefile format in order to bring them into ArcGIS. Images or files designated for reference only can still be added as a simple layer for use in displays, and need not be imported. Data intended for consideration by the loss estimation model must be imported. ArcCatalog or ArcMap can be used for this purpose.

Select the inventory you wish to improve from the Hazus Inventory menu. Right-click and choose "Import Data" (Figure 6-1). Enter the directory and filename for the database you wish to import.
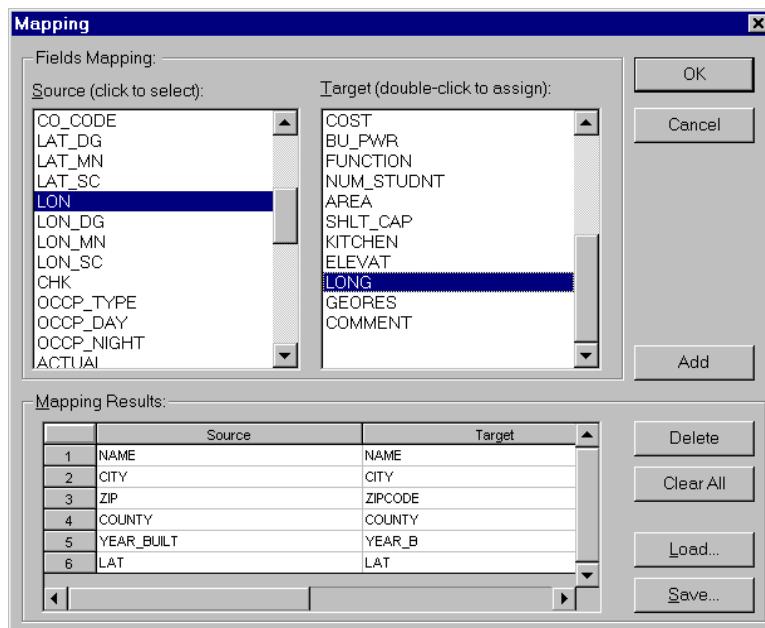
Figure 6-1. Import Features with Attributes.
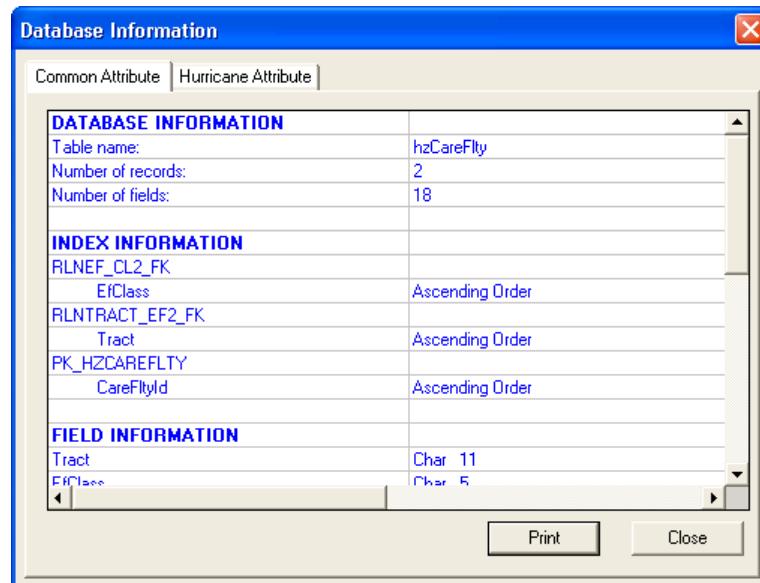
6.1.2   The Import Database Utility

A database import utility has been developed to assist you in converting an electronic database to the appropriate format for Hazus. The mapping window shown in Figure 6-2 is used to map the each field in your database (the source) to the corresponding field used in the Hazus database (the target database). The Database Dictionary contains the names and structures of all of the databases that are used by Hazus. From the Database Dictionary you can determine the names of the target fields. The Database Dictionary, in an abbreviated form, is available interactively in Hazus. To access it, click on the right mouse button; using the same menu shown in Figure 6-1, click on **Dictionary**. An example from the Database Dictionary is shown in Figure 6-3.

The fields from the **Source** menu do not have to be in the same order nor do they have to have the same names as the fields in the **Target** menu. For example, in Figure 6-3, the year the school was built is in a field called "YEAR_BUILT" in the **Source** file, whereas the field that contains this information is in the "YEAR_B" field in the **Target** file. To define the desired mapping scheme, simply click on a field name from the **Source** menu (e.g., LON) and the corresponding field name from the **Target** menu (e.g., LONG); then click on the **Add** button.

Figure 6-2. Mapping the Fields of Your Data File to the Hazus Data Structure.
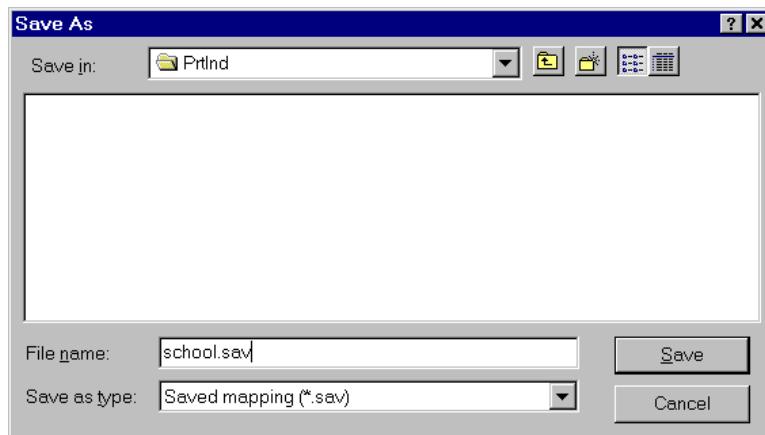
Figure 6-3. Interactive Database Dictionary.

After performing these steps, the mapping you have defined will disappear from the **Source** and **Target** menus and will appear in the **Mapping Results** box at the bottom of the window. If you make a mistake, click the **Delete** button, and the last mapping pair you have defined will be undone. In this example, the user has already defined six relationships and is in the process of defining a seventh. When you have completed defining all of the information, click on the **OK** button, wait a few seconds, and your

imported database will be displayed in Hazus. You do not have to map all of the fields from the **Source** menu. However, any fields you do not map will not be imported into the **Target** database.

It is possible to have several databases with the same format. To save the mapping that you have defined so that it can be reapplied to other files, click the **Save** button in Figure 6-2 and the dialog box shown in Figure 6-4 will appear. Enter a name for the mapping scheme and click the **OK** button. To retrieve the saved mapping, click on the **Load** button in Figure 6-2.

Figure 6-4. Saving a Database Mapping Scheme.

6.2   Adding Records to Site Specific Databases

In addition to importing entire datasets, you can add one or more site-specific (point) feature records at a time to improve inventories of essential facilities, high potential loss facilities, lifeline components and facilities storing hazardous materials. When you identify a new site, you will need to add a new feature record with attributes.
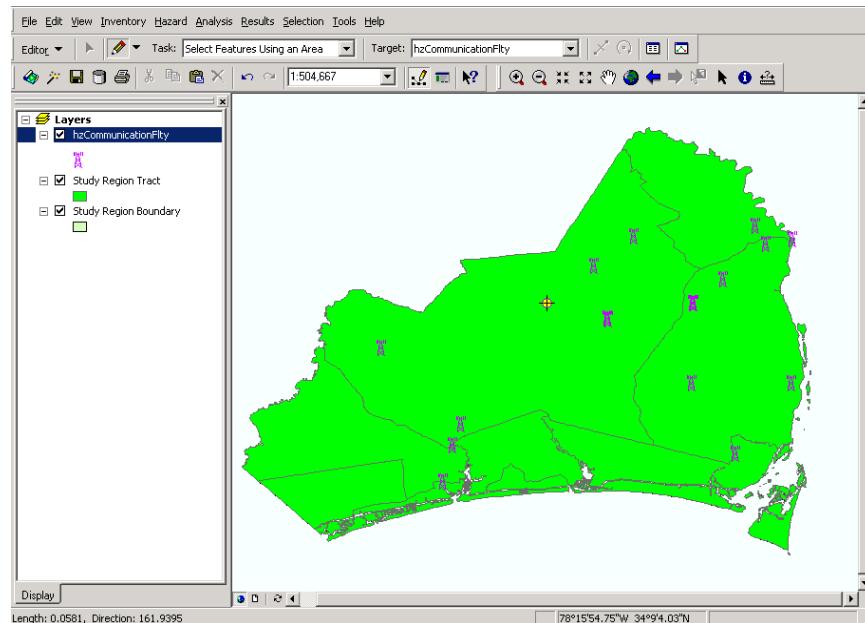
6.2.1   Adding Features Using the Study Region Map

You will notice that feature locations are listed in the ArcMap attribute table without the entire set of feature attributes. Hazus stores attributes other than the each feature identifier and coordinates using SQL Server. This design for feature and attribute storage is for efficiency, and allows for anticipated expansion to interactive web-based delivery of the program. The database design requires you to add features in the following steps:

1. **Start Editing** using the ArcMap Editor toolbar.

2. Select the appropriate and available database (e.g., util.mdb for editing utility facilities).

3. Add features.[2]

4. Save and Stop Editing features.

5. Open the Inventory menu and select the appropriate inventory (e.g., utilities).

6. Add attributes to each new feature record by placing the cursor in the desired field.
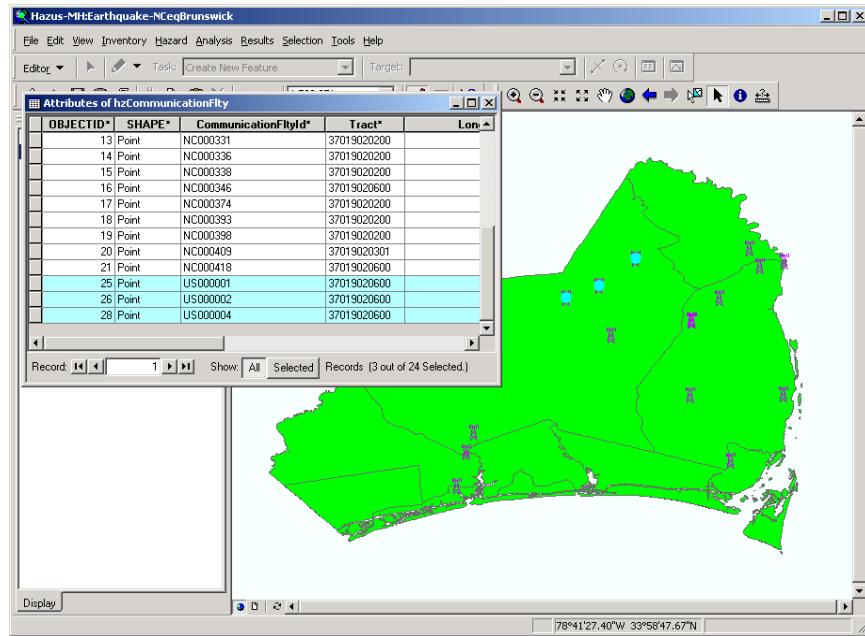
Note that the feature ID field cannot be edited.
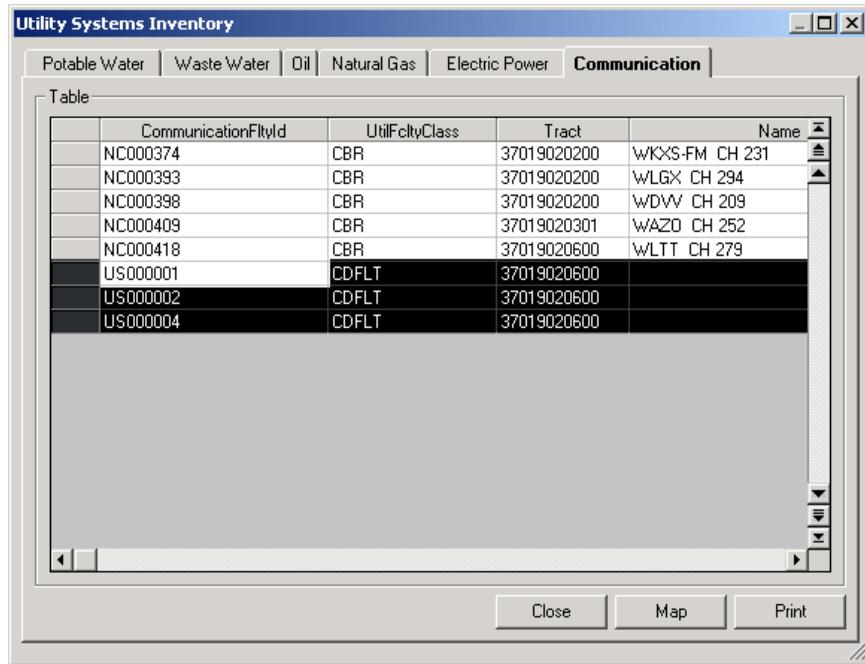
Figure 6-5. Add Site-Specific Feature.

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[2] Editing using the **Editor** toolbar is a standard ArcMap. Refer to ArcMap's documentation and online help for details.

Figure 6-6. Add Feature Using ArcMap Edit Tool.

Figure 6-7. Add Attributes Under Hazus Inventory Menu.

The site-specific, or facility inventories have many more data fields than are required for estimating potential losses. The additional information is beneficial to the overall analysis and cost-efficient to collect along with the minimum data required to run Hazus. At

minimum, the required fields for each database are specified in the Database Dictionary.[3] **Hazus** will create automatically a unique ID to identify uniquely the record.[4]

6.2.2 Adding Records to the Attribute Table

The one essential datum element *required* to define a facility is its location. If its location was not added graphically (see Figure 6-5), the only other way to define a facility location in Hazus is to type the longitude and latitude of the facility, as in Figure 6-8. If you don't know the longitude and latitude of the facility, you will need to use a geocoder[5] to get the longitude and latitude of the location and then add it to the database in Hazus. Once you have defined a location, click on the **OK** button and the new point feature will be saved.
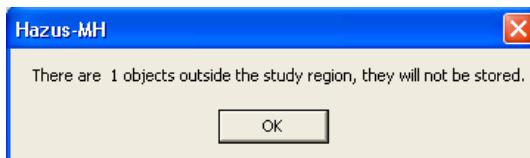
Figure 6-8. Add Record Latitude/Longitude Coordinates.

When the location has been entered, a default set of attributes will be assigned to each new record, in the event no other detail is available.

6.2.3 Errors When Adding Records

Hazus is very strict about enforcing the rule that *all inventory data points must fall within the study region boundary*. If you define facility locations that are outside the study region, Hazus deletes them and displays the dialog show in Figure 6-9.

Figure 6-9. Sites Added Outside the Study Region will not be Accepted.

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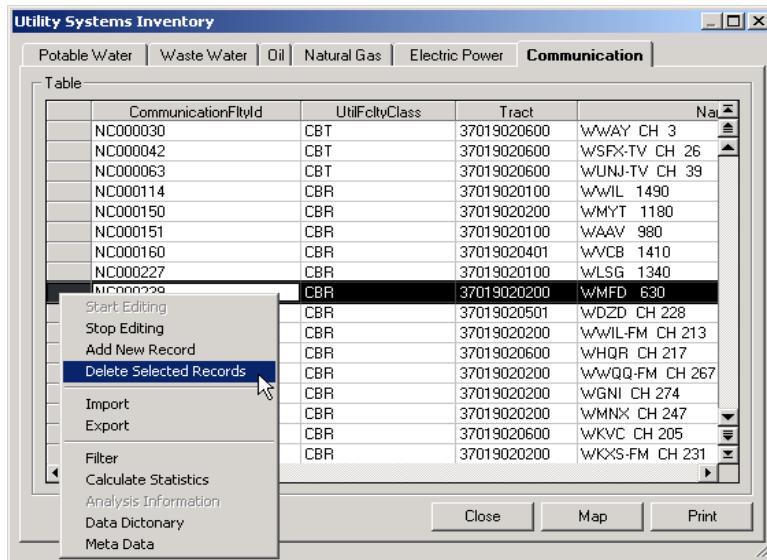
[3] Required fields are labeled as mandatory fields in the data model. While required, in most cases the data model has default values assigned as shown also in the data model in the Database Dictionary.

[4] For user-input data, the ID is in the format USnnnnnnnn, where n is sequential number. For the default data, the first two characters are the state code (CA, DC, GA, etc.).

[5] The geocoding process is performed outside Hazus. Any commercial geocoder application can be used.

6.3   Deleting Records from Site Specific Databases

Select the record to be deleted from a database by clicking on the record marker on the left side of the record ID. When the records have been selected, use the right mouse button to display the database management options shown in Figure 6-10, and choose **Delete Selected Records**.

Figure 6-10. Select and Delete Records from a Facility Database.

6.4   Editing Records

Attributes associated with default, or improved point and line features can be edited directly in Hazus. Open the **Inventory** menu and choose the database to edit. Data within a record can be edited by right-clicking the mouse on the spreadsheet, placing the cursor in the desired cell, and replacing the text to be modified.

Alternatively, a structure's location can be moved by choosing **Start Editing** from the ArcMap **Editor** toolbar. In edit mode, use one of ArcMap's selection buttons to isolate the facility of interest. With your feature selected and mouse button held down, drag and drop the facility symbol from its old location to the desired new location. To delete a location, select the facility on the map and press the <**Delete>** key. The feature and all associated attributes in the inventory database will be deleted.

You can move or delete multiple records at one time. To do so, use the ArcMap selection tools to select by location. You can draw a box around several sites to select a group; or, select a single structure by clicking on each location, one at a time, while holding the <**Shift**> key down. When all the locations have been selected, release the <**Shift**> key and follow the above steps for deleting or moving a record. When finished, click on the **Editor** toolbar and select **Stop Editing**. You will be asked to confirm (or dismiss) your changes to the database.

Chapter 7. Displaying and Modifying Inventories

Chapter 6 discussed how to enter data and import databases. Once your data is entered into Hazus, you have a number of options available for displaying and modifying the data.

7.1 Editing a Database

Data within a database can be edited by clicking on the spreadsheet cell containing the data you want to change. Highlight the text you wish to replace, and your typing will replace the highlighted text.

7.2 Printing a Database

All databases can be printed using the **Print** button at the bottom of the window.

7.3 Mapping a Database

All databases can be mapped by using the **Map** button at the bottom of the window. ArcView tools can be used to modify legends and to bring different layers to the front. Entries in site-specific databases, such as emergency facilities and lifeline components, will appear as symbols on the map. Other types of databases, such as census data and general building stock inventory, are displayed as shaded map layers. Please refer to the ArcView User Manual for instructions on how to format map layers.

7.4 Defining Occupancy to Model Building Type Relationships
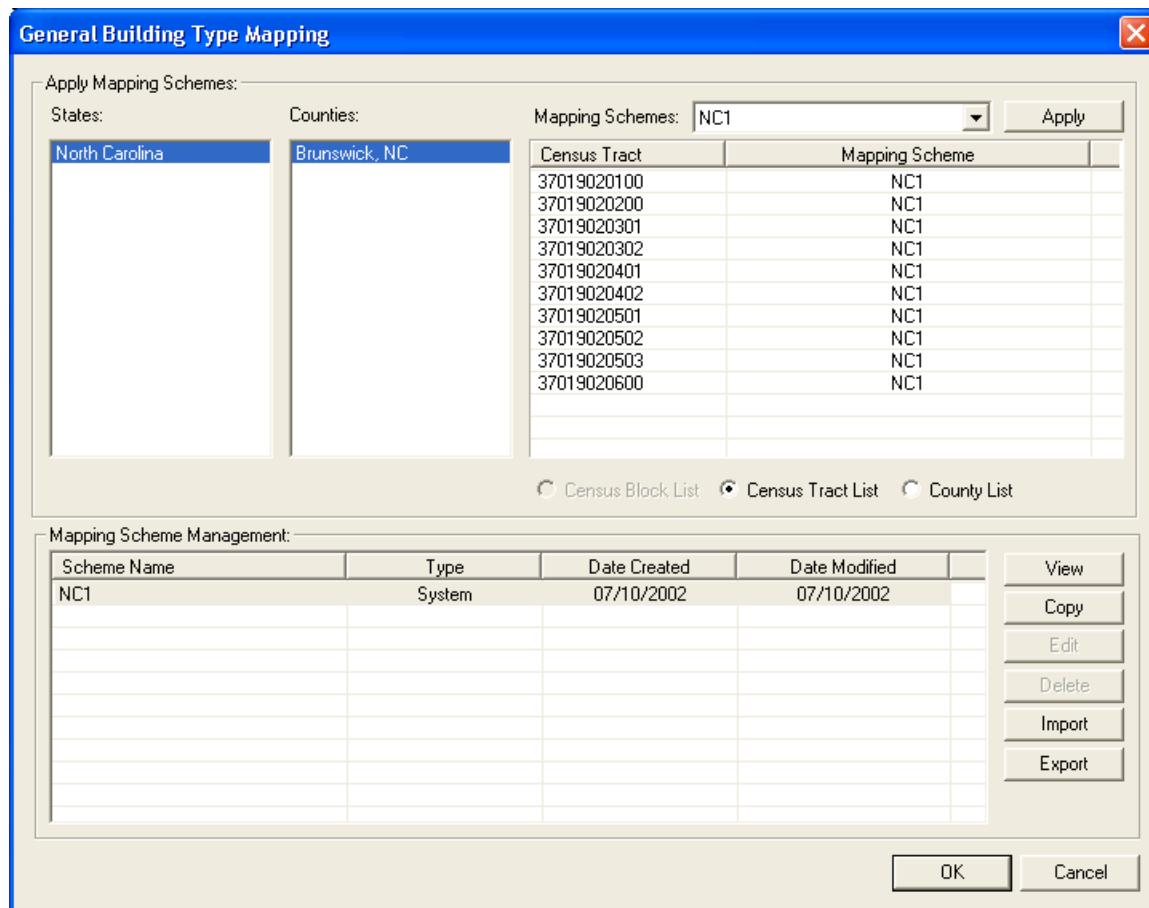
The hierarchy of model building mapping schemes use the Hurricane Model was presented in Section 4.5. In this section we cover the following related topics for the model building mapping schemes used in the Hurricane Model:

- How to assign a mapping scheme to a geographic area.
- How to view the details of a mapping scheme.
- How to edit, create, and delete mapping schemes.
- How to quickly create a wind building characteristics mapping scheme with mitigated buildings.

7.4.1 Defining Specific Occupancy to General Building Type Mapping Schemes

The General Building Occupancy Mapping dialog allows you to assign, view, or edit the distribution of general building types within each specific occupancy and census tract. The data in these dialogs are common to all three hazards; therefore, any changes made in these dialogs also apply to the Earthquake and Flood Models, if either of these hazards is included in your study region.

To access the General Building Occupancy Mapping dialog, shown in Figure 7-1, select the **Inventory | General Building Stock | General Building Type Mapping** menu command. This dialog allows you to assign general building type mapping schemes to your study region in the upper half of the window and manage your mapping schemes in the lower half of the dialog.
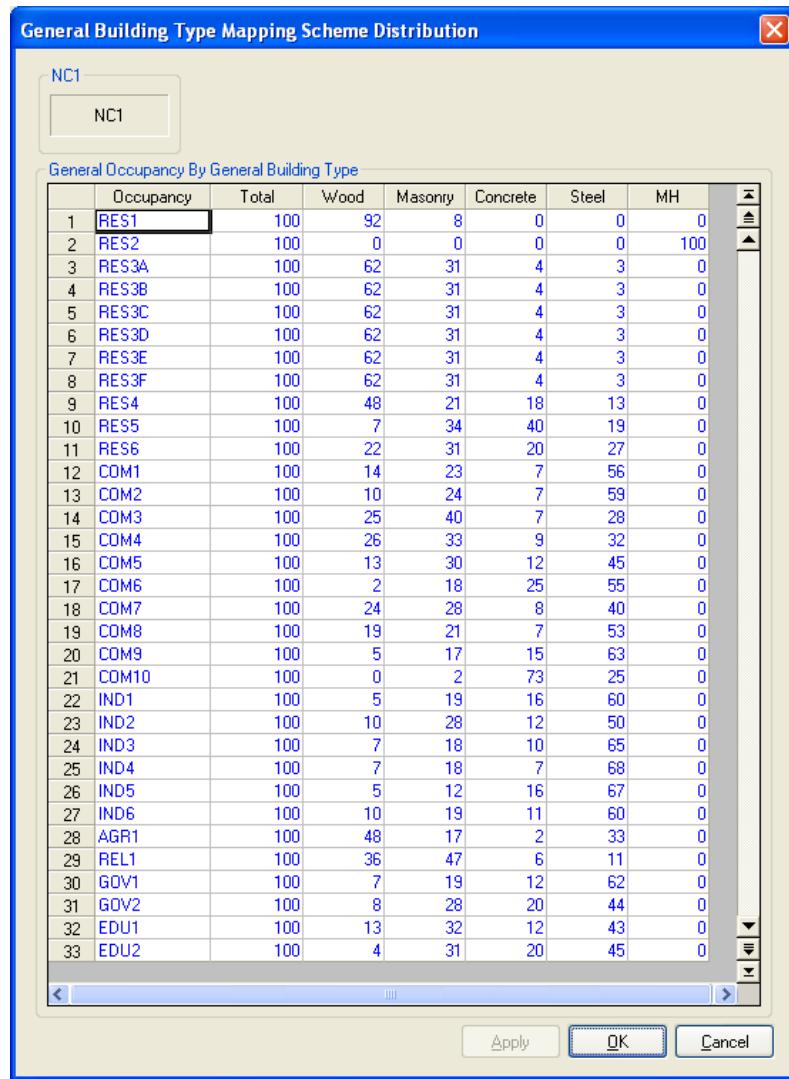
Figure 7-1. General Building Type Mapping Dialog.

General building type mapping schemes can be assigned at the state, county, or census tract level. Select one or more counties and click on *Census Track List* to see a listing of the individual census tracts in the selected states and counties. To change the mapping scheme assigned to one or more census tracts highlight the states, counties, and tracts of interest, select the desired mapping scheme from the drop down list box in the top right corner of the window, and click on the **Apply** button. When selecting multiple census tracts, use the Shift key to select a range of tracts or the Control key to select individual tracts.

The list box in the lower half of the General Building Occupancy Mapping dialog displays all of the mapping schemes that are available for use. The *Type* column indicates whether the mapping scheme is one of the default mapping schemes provided with the

Hurricane Model ("*System*") or a custom mapping scheme ("*User*"). The highlighted mapping scheme can be displayed by clicking the **View** button (Figure 7-2). Other options include:
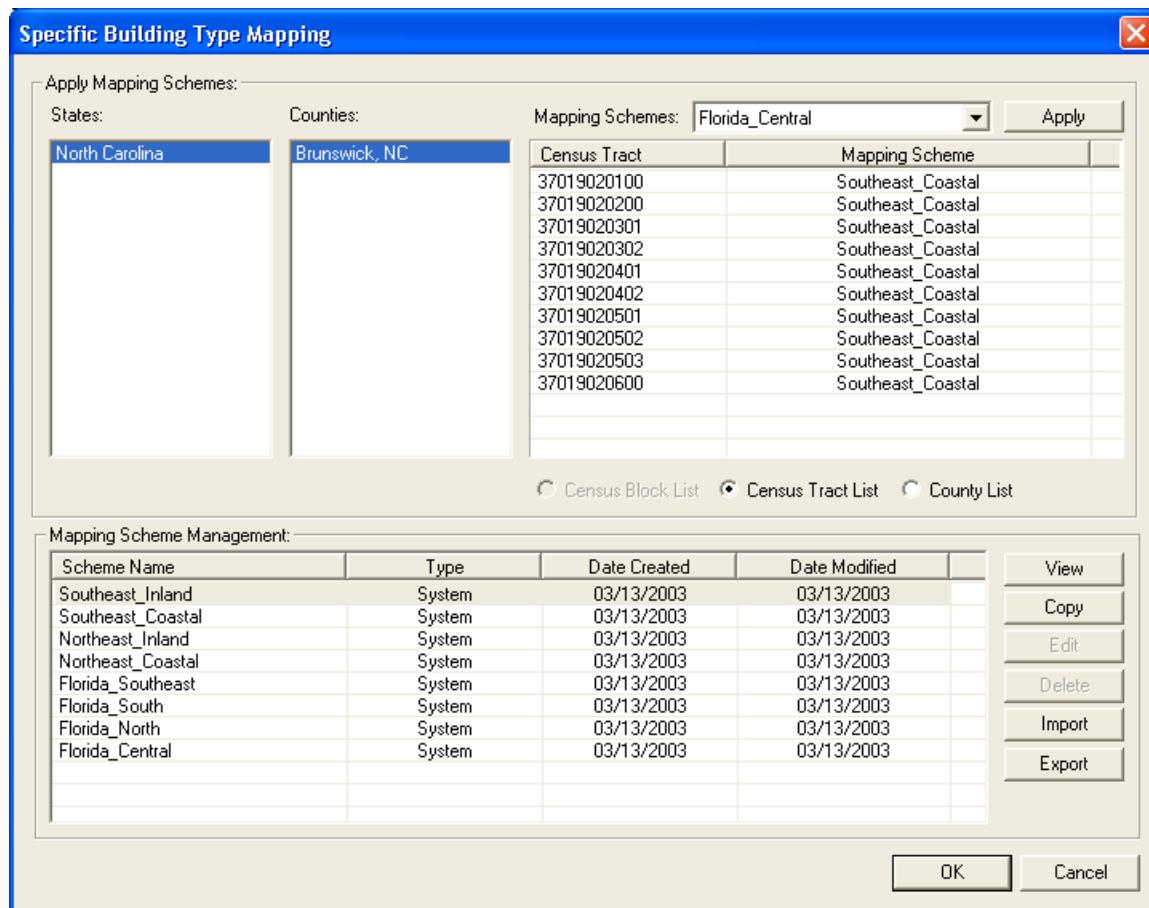
Figure 7-2. General Building Type Mapping Scheme Distribution Viewer.

- **Copy** – Creates a copy of the selected mapping scheme that you can modify.

- **Edit** – Allows you to modify the percentages in a mapping scheme. This option is disabled for *System* mapping schemes.

- **Delete** – Deletes the selected mapping scheme from the list. This option is disabled for *System* mapping schemes.

- **Import** – Allows you to import a mapping scheme exported from another hurricane study region.

- **Export** – Copies a mapping scheme to text file.

7.4.2 Defining Specific Building Type Mapping Schemes

The Specific Building Occupancy Mapping dialog allows you to assign, view, or edit the distribution of specific building types within each specific occupancy and census tract. The data in these dialogs are specific to the Hurricane Model.

To access the Specific Building Occupancy Mapping dialog, shown in Figure 7-3, select the **Inventory | General Building Stock | Specific Building Type Mapping** menu command. This dialog allows you to assign specific building type mapping schemes to your study region in the upper half of the window and manage your mapping schemes in the lower half of the dialog.
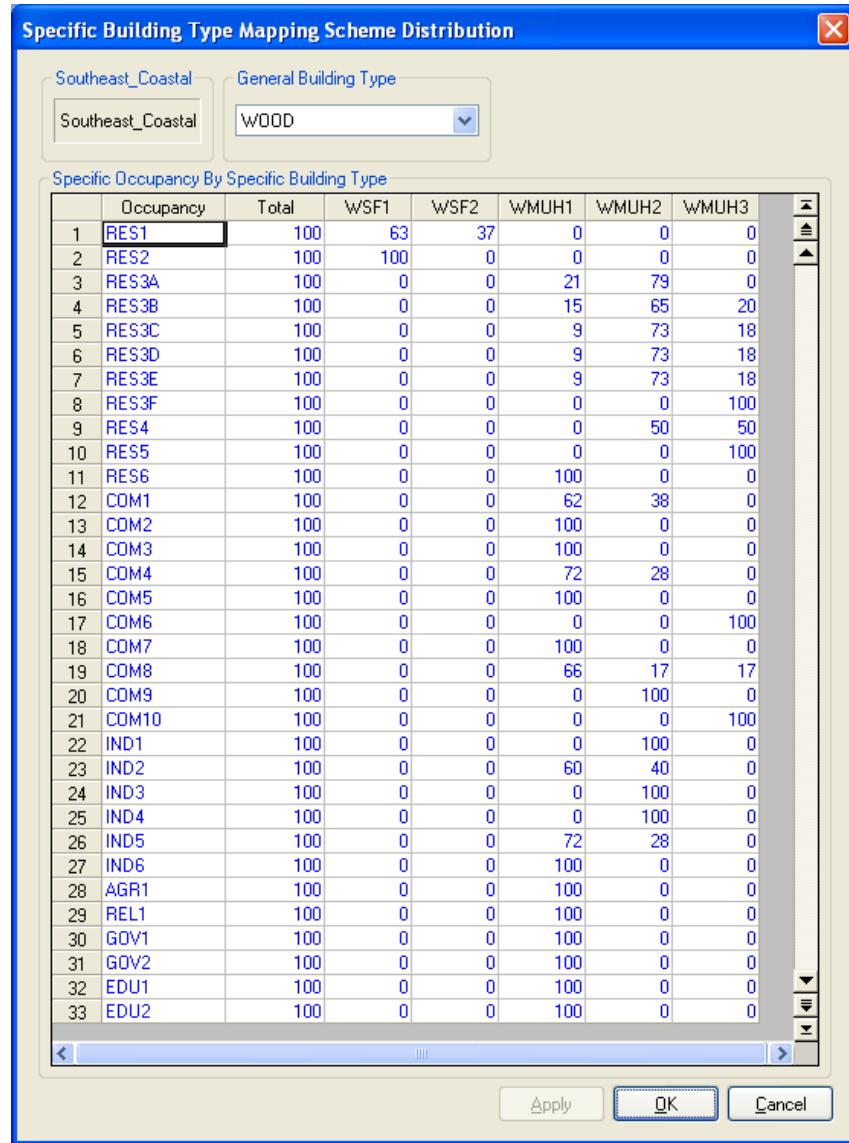
Figure 7-3. Specific Building Type Mapping Dialog.

Specific building type mapping schemes can be assigned at the state, county, or census tract level. Select one or more counties and click on *Census Track List* to see a listing of the individual census tracts in the selected states and counties. To change the mapping scheme assigned to one or more census tracts highlight the states, counties, and tracts of interest, select the desired mapping scheme from the drop down list box in the top right corner of the window, and click on the **Apply** button. When selecting multiple census

tracts, use the Shift key to select a range of tracts or the Control key to select individual tracts.

The list box in the lower half of the Specific Building Occupancy Mapping dialog displays all of the mapping schemes that are available for use. The *Type* column indicates whether the mapping scheme is one of the default mapping schemes provided with the Hurricane Model ("*System*") or a custom mapping scheme ("*User*"). The highlighted mapping scheme can be displayed by clicking the **View** button (Figure 7-4). Other options include:

- **Copy** – Creates a copy of the selected mapping scheme that you can modify.

- **Edit** – Allows you to modify the percentages in a mapping scheme. This option is disabled for *System* mapping schemes.

- **Delete** – Deletes the selected mapping scheme from the list. This option is disabled for *System* mapping schemes.

- **Import** – Allows you to import a mapping scheme exported from another study region.

- **Export** – Copies a mapping scheme to text file.

Specific Building Type Mapping Scheme Distribution

Southeast_Coastal

Southeast_Coastal

General Building Type

WOOD

Specific Occupancy By Specific Building Type

	Occupancy	Total	WSF1	WSF2	WMUH1	WMUH2	WMUH3
1	RES1	100	63	37	0	0	0
2	RES2	100	100	0	0	0	0
3	RES3A	100	0	0	21	79	0
4	RES3B	100	0	0	15	65	20
5	RES3C	100	0	0	9	73	18
6	RES3D	100	0	0	9	73	18
7	RES3E	100	0	0	9	73	18
8	RES3F	100	0	0	0	0	100
9	RES4	100	0	0	0	50	50
10	RES5	100	0	0	0	0	100
11	RES6	100	0	0	100	0	0
12	COM1	100	0	0	62	38	0
13	COM2	100	0	0	100	0	0
14	COM3	100	0	0	100	0	0
15	COM4	100	0	0	72	28	0
16	COM5	100	0	0	100	0	0
17	COM6	100	0	0	0	0	100
18	COM7	100	0	0	100	0	0
19	COM8	100	0	0	66	17	17
20	COM9	100	0	0	0	100	0
21	COM10	100	0	0	0	0	100
22	IND1	100	0	0	0	100	0
23	IND2	100	0	0	60	40	0
24	IND3	100	0	0	0	100	0
25	IND4	100	0	0	0	100	0
26	IND5	100	0	0	72	28	0
27	IND6	100	0	0	100	0	0
28	AGR1	100	0	0	100	0	0
29	REL1	100	0	0	100	0	0
30	GOV1	100	0	0	100	0	0
31	GOV2	100	0	0	100	0	0
32	EDU1	100	0	0	100	0	0
33	EDU2	100	0	0	100	0	0

Apply   OK   Cancel

Figure 7-4. Specific Building Type Mapping Scheme Distribution Viewer.

7.4.3   Defining Wind Building Characteristics Distributions

The Wind Building Characteristics Distribution dialogs allow you to assign, view, or edit the distribution of wind building characteristics within each specific building type and census tract. The data in these dialogs are specific to the Hurricane Model.

To access the Wind Building Characteristics Distribution dialog, shown in Figure 7-5, select the **Inventory | General Building Stock | Wind Building Characteristics Distribution** menu command. This dialog allows you to assign wind building characteristics mapping schemes to your study region in the upper half of the window and manage your mapping schemes in the lower half of the dialog.
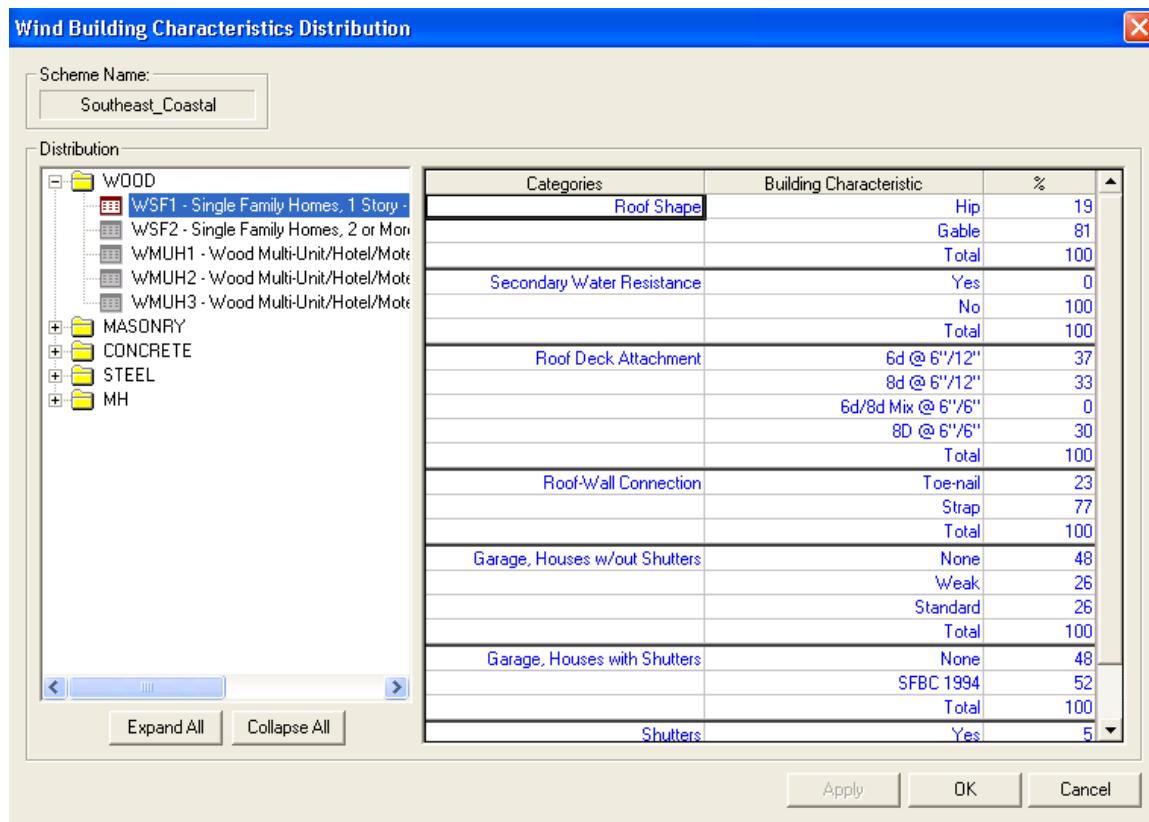
Figure 7-5. Wind Building Characteristics Distribution Dialog.

Wind building characteristics distributions can be assigned at the state, county, or census tract level. Select one or more counties and click on *Census Track List* to see a listing of the individual census tracts in the selected states and counties. To change the distribution assigned to one or more census tracts highlight the states, counties, and tracts of interest, select the desired distribution from the drop down list box in the top right corner of the window, and click on the **Apply** button. When selecting multiple census tracts, use the Shift key to select a range of tracts or the Control key to select individual tracts.

The list box in the lower half of the Wind Building Characteristics Distribution dialog displays all of the distributions that are available for use. The *Type* column indicates whether the distribution is one of the default distributions provided with the Hurricane Model ("*System*") or a custom distribution ("*User*"). The highlighted distribution can be displayed by clicking the **View** button (Figure 7-6). Other options include:

- **Copy** – Creates a copy of the selected distribution that you can modify.

- **Edit** – Allows you to modify the percentages in a distribution. This option is disabled for *System* distributions.

- **Delete** – Deletes the selected mapping scheme from the list. This option is disabled for *System* distributions.

- **Import** – Allows you to import a distribution exported from another study region.

- **Export** – Copies a distribution to a text file.

- **Mitigate** – Allows you to quickly create a new distribution with different mitigation characteristics for single-family housing, manufactured homes, and multi-unit housing (see Section 7.4.4).
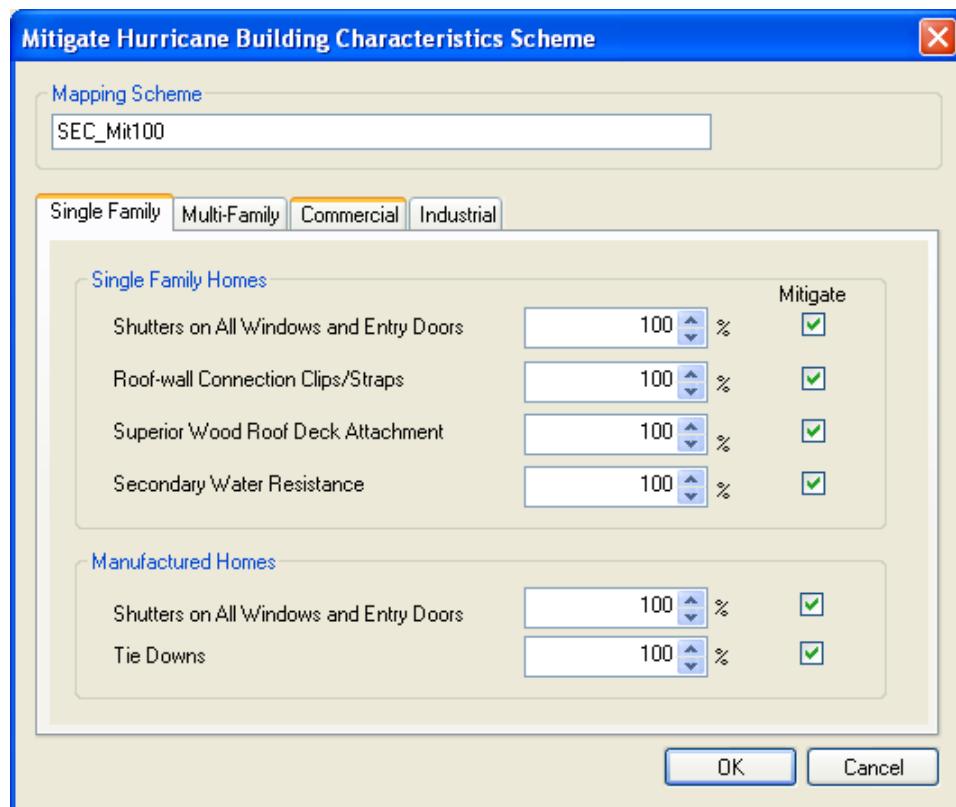
Figure 7-6. Wind Building Characteristics Distribution Viewer.

7.4.4 Applying Mitigation to the General Building Stock

The Hurricane Model includes mitigation options for single-family housing, multi-unit housing, commercial buildings, and industrial buildings. The mitigation analysis capability provided in the Hurricane Model allows you to assess the potential benefits of mitigation programs or building code changes.

As an alternative to specifying the degrees of mitigation separately for each specific building type, the Hurricane Model has an option to quickly generate a new Wind Building Characteristics Distribution with mitigation. To access this capability, select a Wind Building Characteristics Distribution from the list in the lower portion of Figure 7-5 and then click on the **Mitigate** button in the lower right. The dialog shown in Figure 7-7 will appear. Simply name the new mapping scheme, check the types of mitigation you want applied to the general building stock, and fill-in the desired percentages for the

checked items. Be sure to complete each of the four pages before clicking the **OK** button. The Hurricane Model will create a new mapping scheme with your specified levels of mitigation applied to the general building stock. Any items that are not checked will remain unchanged from the base Wind Building Characteristics Distribution. Remember to **Apply** the new distribution to the desired tracks or counties when you return to the Wind Building Characteristics Distribution dialog.
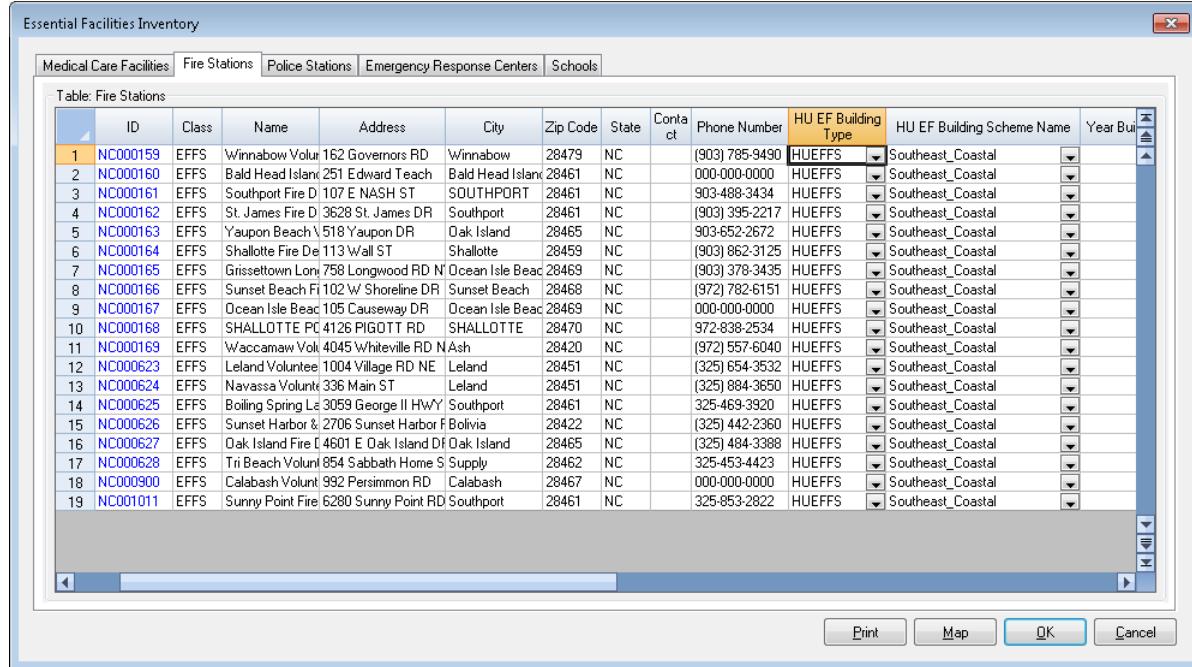
Figure 7-7. Mitigation Hurricane Building Characteristics Scheme.

7.5   Defining Wind-Related Building Characteristics for Essential Facilities
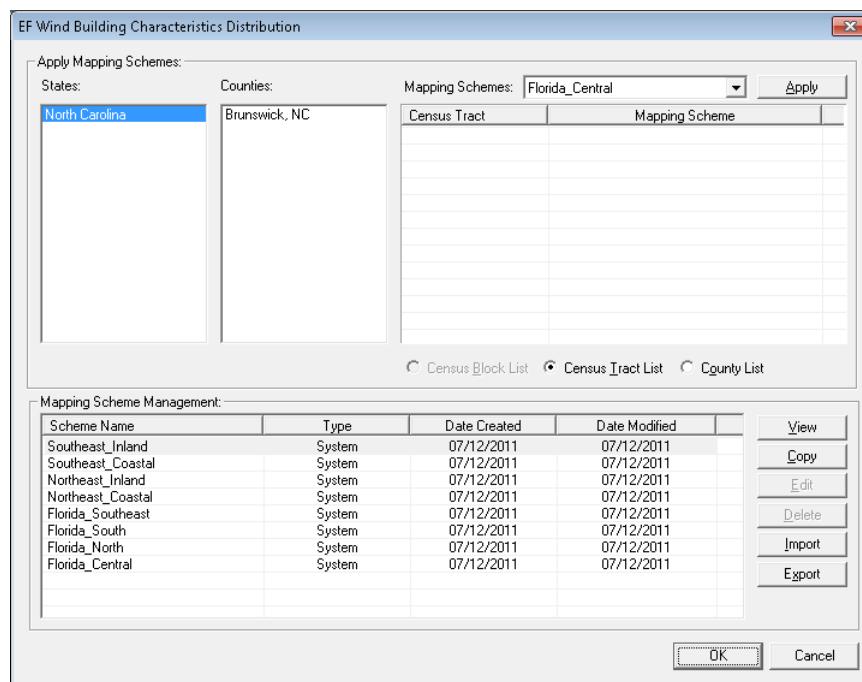
Both the specific building type and wind building characteristics can be specified for essential facilities as described in this section. The data in these dialogs are specific to the Hurricane Model.

To view wind-related building characteristics for essential facilities shown in **Error! Reference source not found.**, select the **Inventory | Essential Facilities | Inventory** menu command. This dialog allows you to assign essential facility building type via a drop down box located in the column "HU EF Building Type" for a given facility. Likewise, building mapping schemes can be modified by clicking on the drop down box in the column labeled "HU EF Building Scheme name".
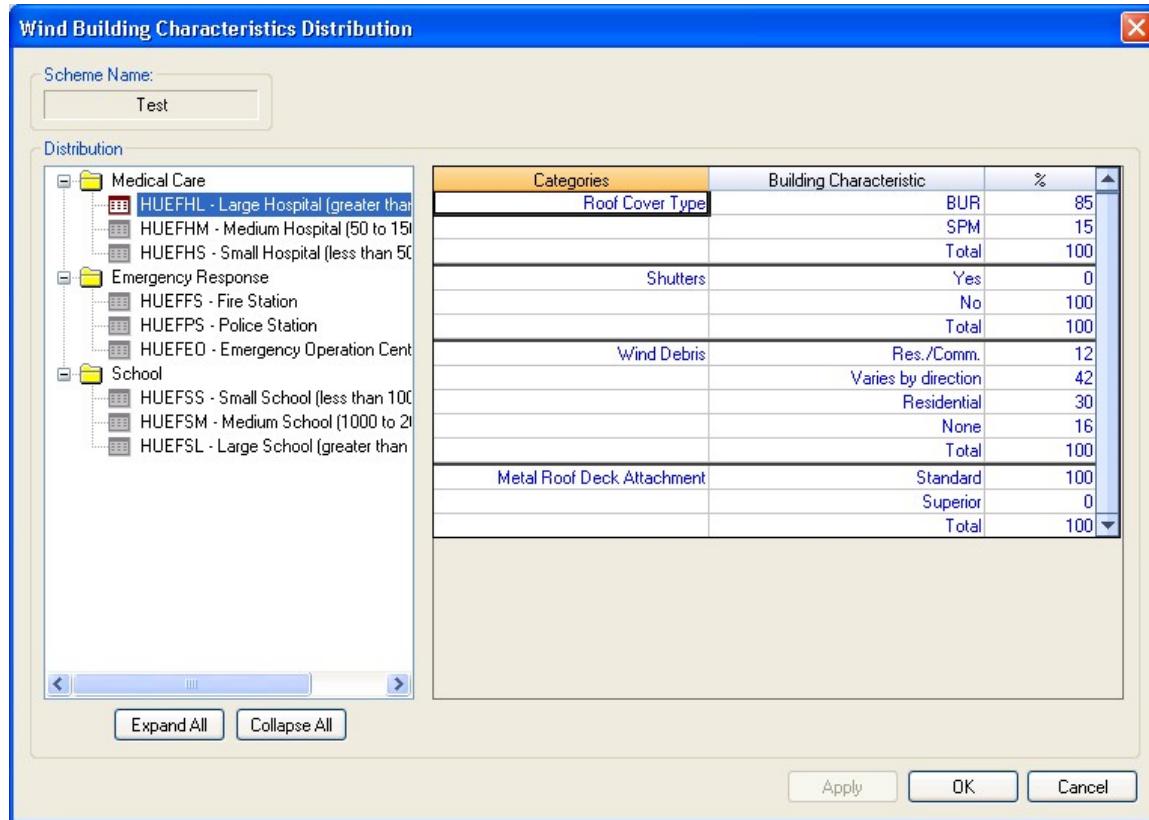
Figure 7-8. Essential Facilities Inventory Dialog.

To review an existing essential facility mapping scheme or to create a new one, select the **Inventory | Essential Facilities | Wind Building Characteristics Distribution** menu command. The menu displayed should be similar to the one shown in **Error! Reference source not found.**.

Figure 7-9. Essential Facilities Wind Building Characteristics Dialog.

To view, create, or modify an essential facilities wind building mapping scheme, simply select a scheme from the list at the bottom of the page and then click View, Copy, or Edit. Note that the default mapping schemes (denoted by Type=System) cannot be edited; however, you can make a copy of one and edit the copy. **Error! Reference source not found.** displays an example of a mapping scheme named "Test" which was created by copying the Southeast_Coastal mapping scheme. For a specific structure with known characteristics, the percentages in the wind building characteristics distribution table will typically be 0% or 100%. Intermediate values are used to represent generic structures with unknown details.

Figure 7-10. Wind Building Characteristics Distribution Dialog.

Chapter 8.   Building-Data Import Tool (BIT)

The Building-Data Import Tool (BIT) is a deprecated utility and is no longer included with Hazus-MH.

Similar functionality (and more) can be found in the Comprehensive Data Management System (CDMS). CDMS is distributed with Hazus-MH. Instructions on how to use CDMS are provided in Chapter 8 of the *Hazus-MH Earthquake User Manual*.

Chapter 9. Running Hazus with User-Supplied Data

This chapter provides a step-by-step discussion of how to perform an analysis if you wish to modify the hazard definition, default analysis parameters, or analysis options. Before attempting an analysis that will incorporate user-supplied data, follow the steps in Chapter 3 for running an analysis using only default data.

9.1   Defining the Study Region

The first step in any analysis is defining a study region. Please refer to Section 3.1 for a complete description of this process.

9.2   Defining the Inventory Data

The second step is to review the inventory data and modify the data, as necessary. Please refer to Chapter 4 through Chapter 8 for information on how to define the inventory data.

9.3   Defining the Hurricane Hazard
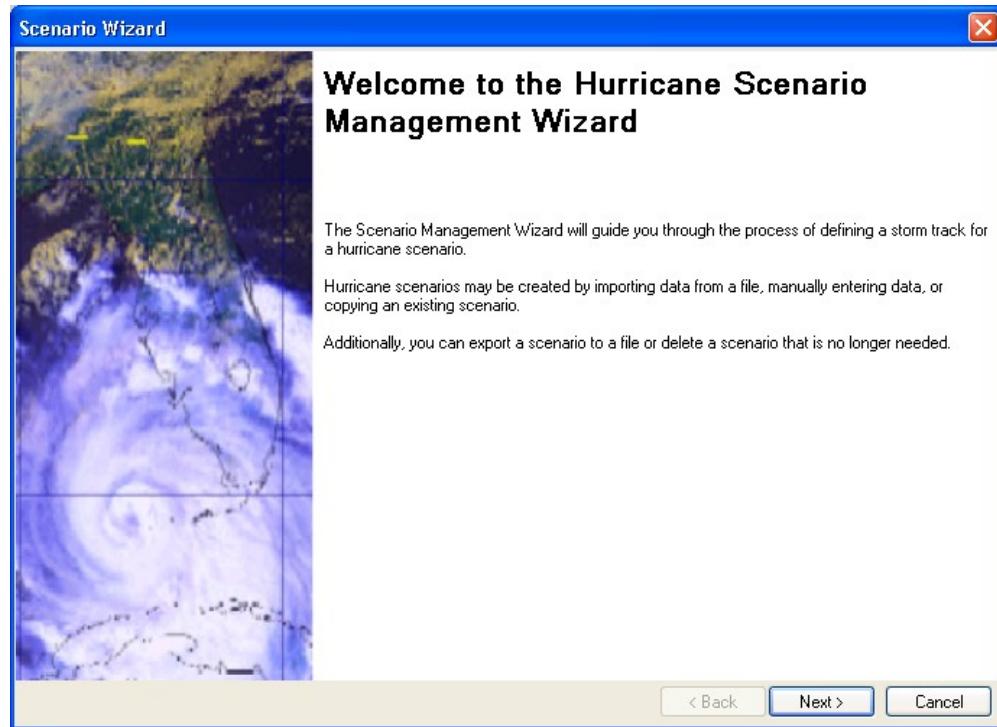
The third step is to define the hurricane hazard. The options are either a probabilistic hurricane hazard, which activates a database of many thousand potential storms that have tracks and intensities reflecting the full spectrum of Atlantic or Central Pacific hurricanes, or a single deterministic hurricane scenario. The inputs required for each of the two options are described in the following sections.

9.3.1   Defining a Probabilistic Hurricane Hazard
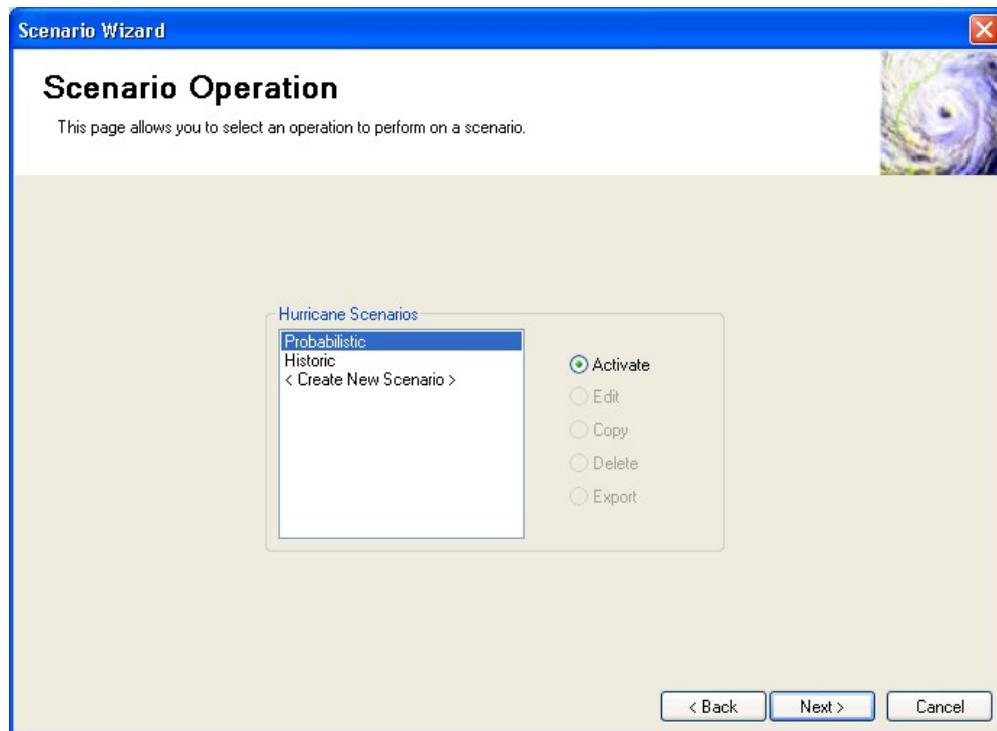
The probabilistic scenario is the default hazard option in the Hurricane Model. There are no options or special settings required. The required steps are:

- Select the **Scenario** command from the **Hazard** menu. This brings up the Welcome Page of the Hurricane Scenario Wizard, shown in Figure 9-1.

- Click on the **Next** button.

- Select the **Probabilistic** item in the Hurricane Scenarios list box and select the **Activate** option, as shown in Figure 9-2.

- Click on the **Next** button two times.

- Click on **Finish** to exit the Hurricane Scenario Wizard (Figure 9-3).

Activating the Probabilistic hurricane hazard will cause the Hurricane Model to execute a 100,000-year simulation of storms when the next analysis is run on the current study region. The probabilistic scenario option will remain as the active scenario until a different type of scenario is made active for the current study region.

Figure 9-1. Hurricane Scenario Wizard – Welcome Page.

Figure 9-2. Hurricane Scenario Wizard – Scenario Operation Page.

Figure 9-3. Hurricane Scenario Wizard – Completion Page.

9.3.2 Defining a Deterministic Hurricane Scenario

There are five ways to define a deterministic hurricane scenario. You can:

- Manually define a storm.
- Import a storm created by another Hazus user.
- Select a historical storm
- Import an H*Wind File
- Import a Hurrevac Storm Advisory[6]

The steps required for each of these options are described in the following sections.

9.3.2.1 Manually Defining a Storm Track

The required steps required to manually define a storm track are:

- Select the **Scenario** command from the **Hazard** menu. This brings up the Welcome Page of the Hurricane Scenario Wizard, shown previously in Figure 9-1.

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[6] When an existing forecast/advisory is selected or a new forecast/advisory is downloaded, the hurricane radii and wind speeds in the forecast/advisory files are reduced by the factors given in the HurrevacVmaxFactor, HurrevacRHurr64Factor, and HurrevacRHurrr64Factor entries in the HKEY_LOCAL_MACHINE\SOFTWARE\ FEMA\HAZUS-MH\HU registry key.

- Click on the **Next** button.

- Select the **<Create New Scenario>** item in the Hurricane Scenarios list box, as shown in Figure 9-4, and then click on the **Next** button.

- Select *Define Storm Track Manually* (Figure 9-5) and click on the **Next** button.

- Enter a name for the new scenario (Figure 9-6) and click on the **Next** button.

- This brings up the Storm Track Definition Method page (Figure 9-7). At this point you must answer three questions:

  - Do you want to specify the elapsed time for each point along the storm track or do you want to specify the forward translation speed of the storm at each point?

  - Do you want to specify the size of the storm in terms of radius to maximum winds or radius to hurricane force winds?

  - Do you want to characterize the wind field of the storm in terms of maximum wind speed or a Holland profile parameter?

  The answers to these questions will depend on the format of the information you have. After answering these questions, click on the **Next** button.
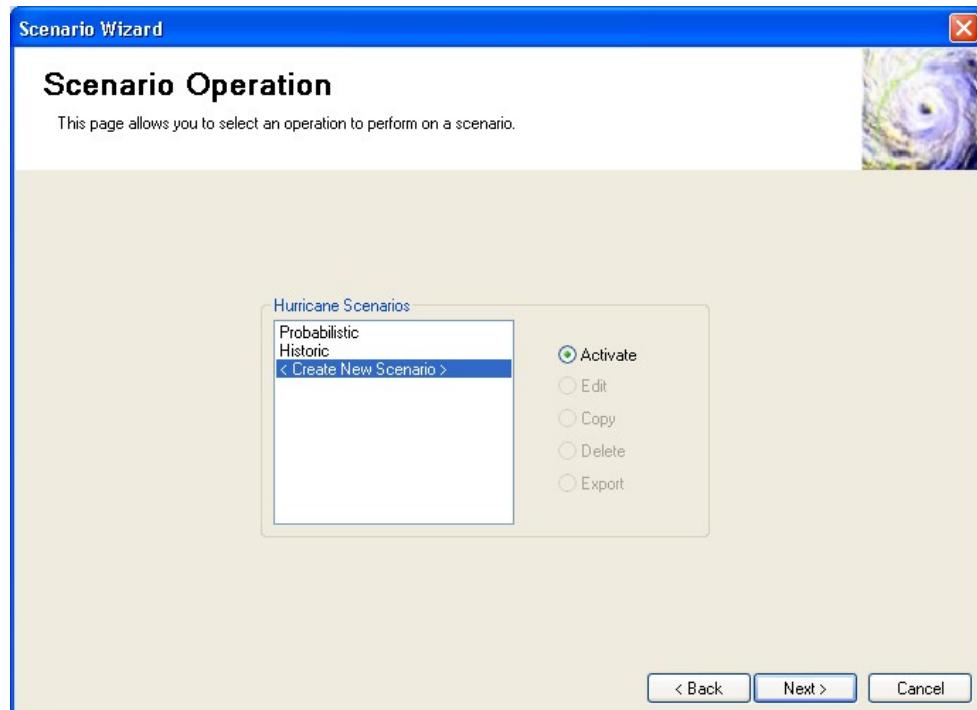
- Specify the storm parameters at each point along the storm track using the table shown in Figure 9-8. To add a new row, left click anywhere in the blank area to the left of the "Latitude" column and then right click and select "Insert Row". Pay careful attention to the units shown in the column headings. Depending on your previous inputs you will be asked to provide eight of the following inputs:

  - Latitude – This column is filled in automatically based on the locations of the points on your storm track. All values are in decimal degrees (North is positive). You can edit the values to move the track points to specific coordinates.

  - Longitude – This column is filled in automatically based on the locations of the points on your storm track. All values are in decimal degrees (East is positive). You can edit the values to move the track points to specific coordinates.

  - Note: if coastal surge analyses are also going to be performed, the storm track should extend beyond the outer boundary of the applicable SLOSH basin grids, and all the way out to 60 degrees west longitude if deep water and near shore waves are to be enabled.

  - Time – Elapsed time in hours at each point along the track. The first point should be zero.

  - Translation Speed – Forward speed of the storm in miles/hour at each point along the track. Typical translation speeds range from 5 to 25 mph.

  - Radius to Maximum Winds – Distance in miles from the center of the storm to the location of highest winds. Typical values range from 6 to 60 miles. Intense storms generally have smaller radii to maximum winds.

- Radius to Hurricane Winds, 50 knot winds, or 34 knot winds – Greatest distance in miles from the center of the storm to hurricane force winds (i.e., 74 mph sustained), 50 knot winds, or 34 knot winds. These values are provided in Hurricane Forecast/Advisories. Typical values range from 10 to 200 miles.

- Maximum Wind Speed – Maximum 1-minute sustained wind speed in miles per hour in the storm at the current location.

  o Category 1: 74-95 mph

  o Category 2: 96-110 mph

  o Category 3: 111-130 mph

  o Category 4: 131-155 mph

  o Category 5: >155 mph

- Profile Parameter – Holland B parameter defines the distribution of atmospheric pressures as a function of distance from the center of the storm. Values range from 0.5 to 2.5 with a typical value being 1.3.

- Central Pressure – Surface level atmospheric pressure in mbar at the center of the storm at the current location.

  o Category 1: >979 mbar

  o Category 2: 965-979 mbar

  o Category 3: 945-964 mbar

  o Category 4: 920-944 mbar

  o Category 5: <920 mbar

- Inland – If the point is inland and your input data are from an NHC Forecast/Advisory, then check this box. Hazus uses this information to estimate the Radius to Maximum Winds from the NHC Radius to Hurricane Winds.

- Forecast – If the point is a forecast position and you wish to estimate a range of expected losses taking into account forecast uncertainties, then check this box. Hazus uses this information to simulate a variety of potential tracks given the last known position and intensity.
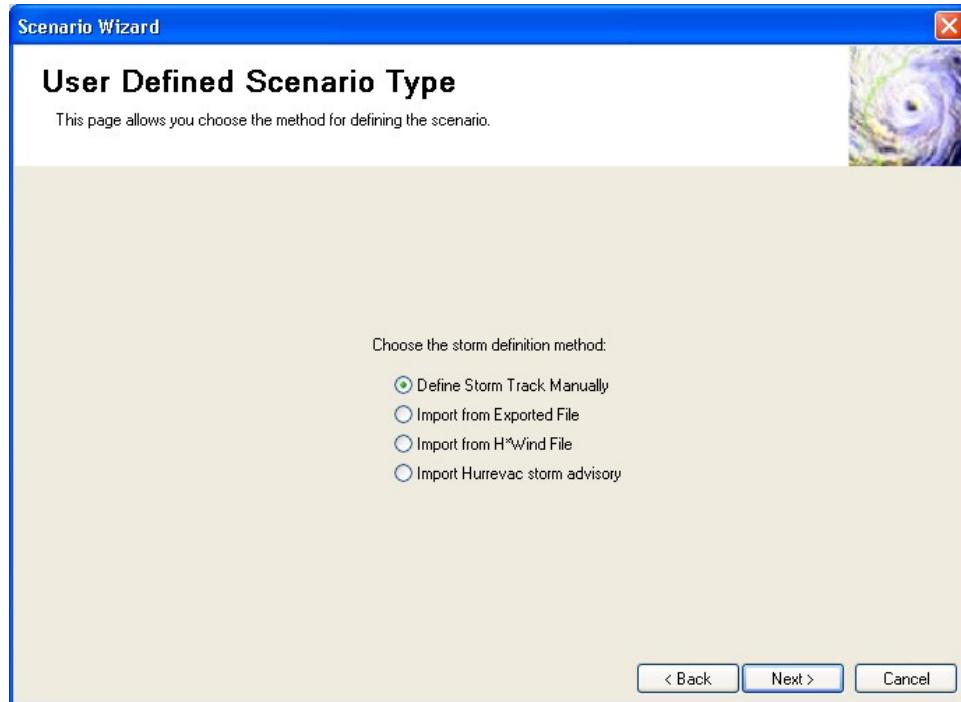
  IMPORTANT NOTE: To run an analysis with the forecast uncertainties, the track must be defined using Time (not Translation Speed) and Maximum Wind Speed (not Profile Parameter). The times of the forecast points must be T+9 hrs, T+21 hrs, T+33 hrs, T+45 hrs, and T+69 hrs, where T is the time of the last known position. These are the time increments used in the official NHC Forecast/Advisories. Note that it is not necessary to include all of the forecast positions from the advisory. The minimum number of permitted forecast points is one (T+9 hrs), and the maximum is five (T+69 hrs).

- Use the Tab key or Arrow keys to move between cells. If you need to insert another point in the middle of the track, use the Insert button. After defining the track, click on the **Next** button to start the wind field calculation.

- A progress bar will be displayed during the calculation, as shown in Figure 9-9. When the analysis is complete, click on the **Next** button

- When the analysis is complete, a summary of the new scenario will be displayed, as shown in Figure 9-10. After reviewing the information, click on the **Next** button to continue.

- If you want to make the new storm the active scenario, click on *Yes* on the Activate Scenario page (Figure 9-11) and then click on the **Next** button.

- Click on **Finish** to exit the Hurricane Scenario Wizard (Figure 9-12).
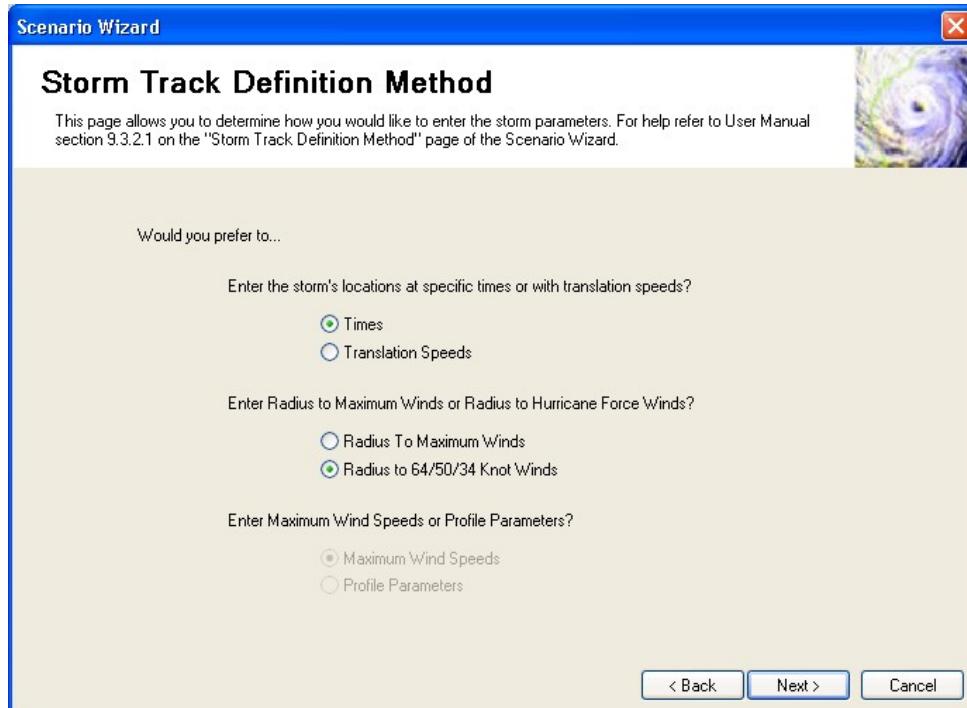
Figure 9-4. Hurricane Scenario Wizard – Scenario Operation Page.

Figure 9-5. Hurricane Scenario Wizard – User Defined Type Page.

Figure 9-6. Hurricane Scenario Wizard – Name Page.
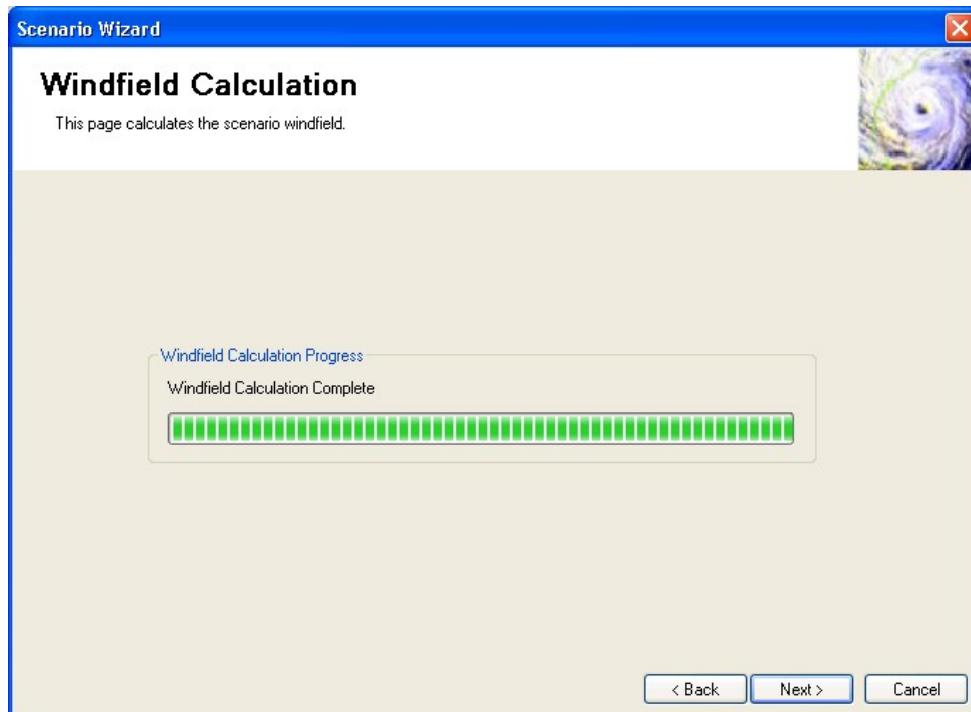
Figure 9-7. Hurricane Scenario Wizard – Track Parameter Preferences Page.
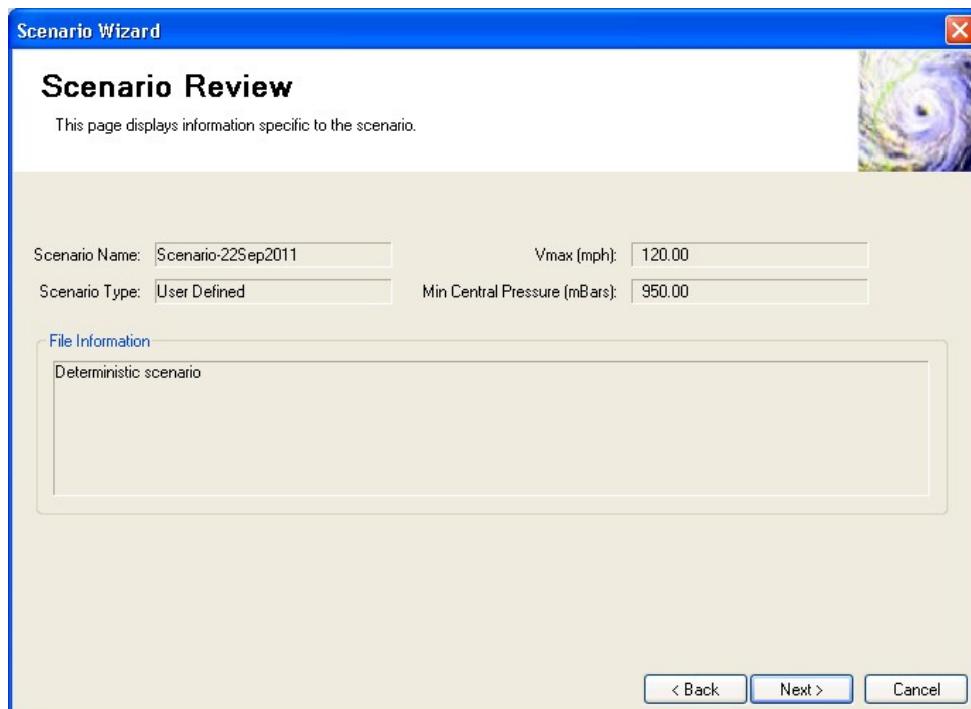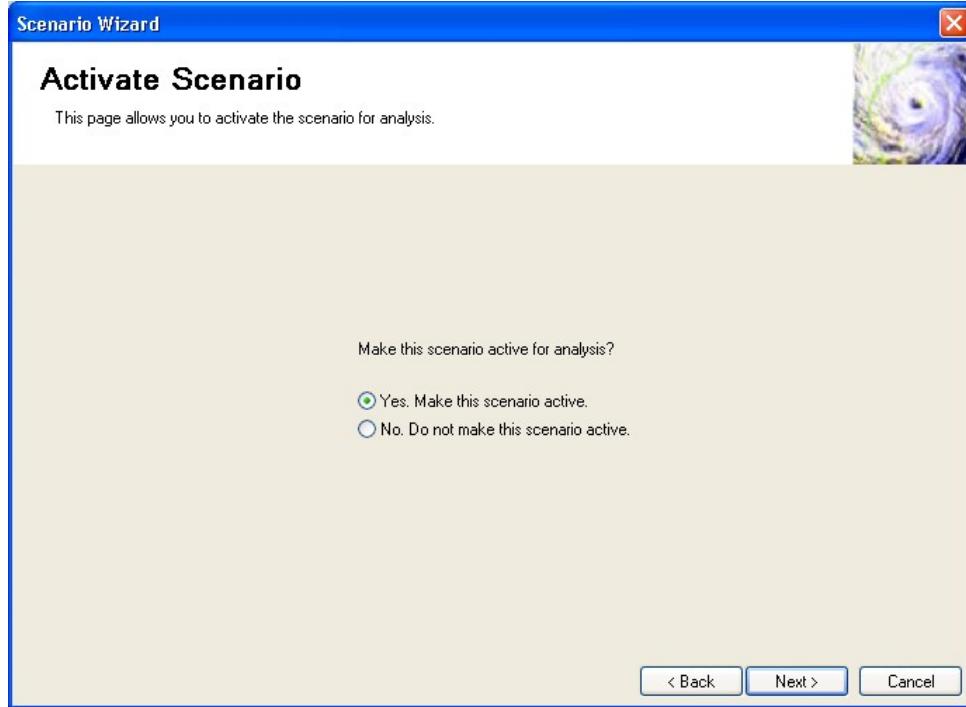
Figure 9-8. Hurricane Scenario Wizard – Edit Track Page.
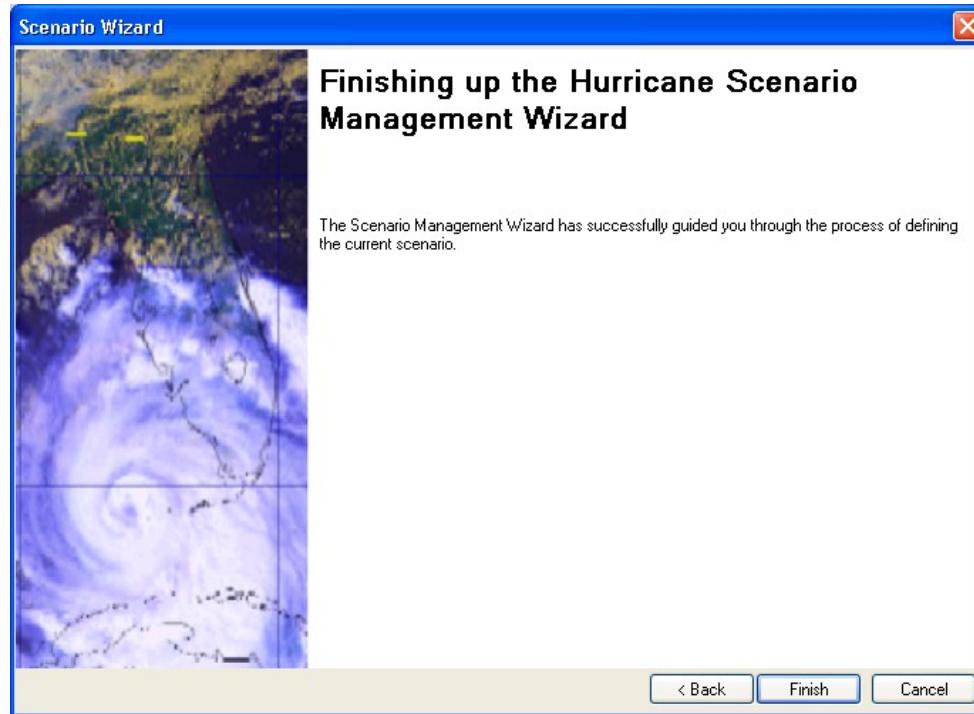
Figure 9-9. Hurricane Scenario Wizard – Wind Field Calculation Progress Page.

Figure 9-10. Hurricane Scenario Wizard – Scenario Review Page.

Figure 9-11. Hurricane Scenario Wizard – Activate Scenario Page.
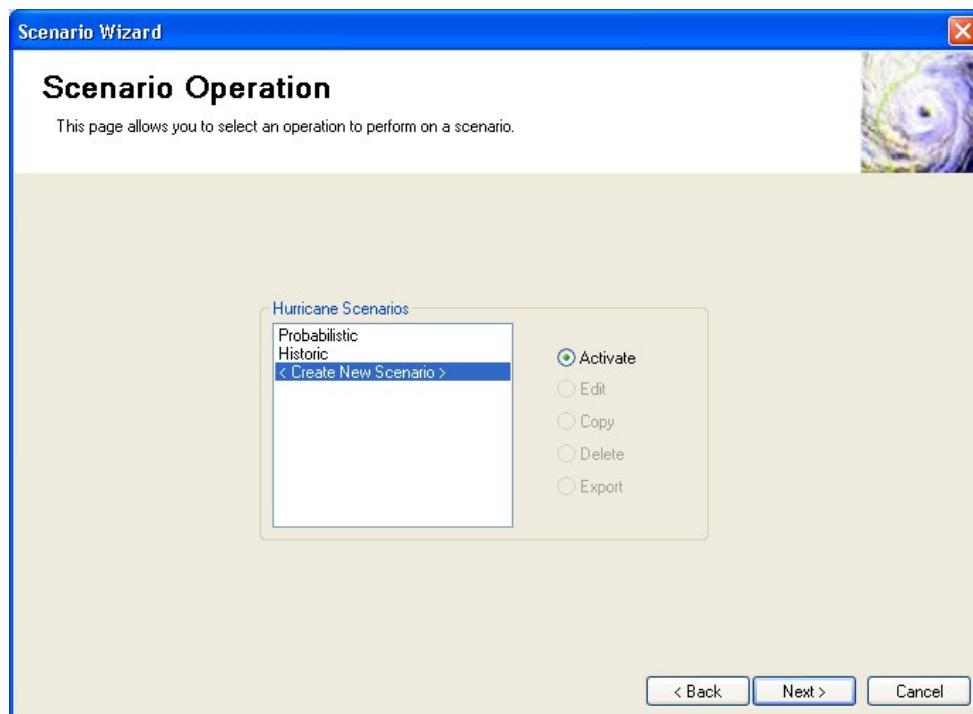
Figure 9-12. Hurricane Scenario Wizard – Completion Page.
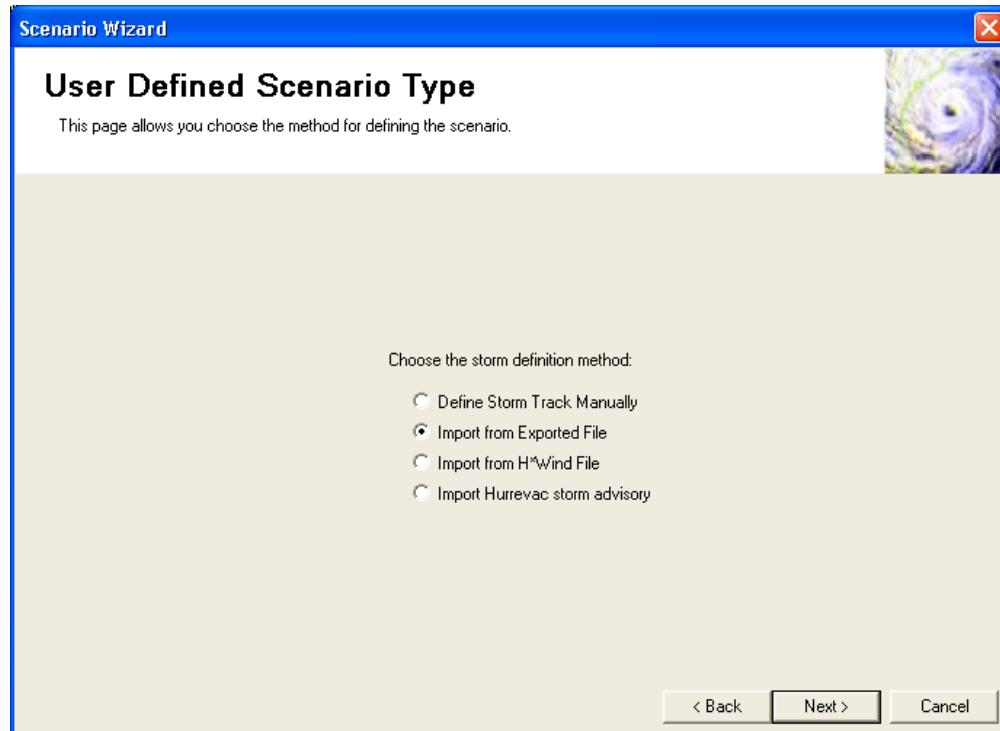
9.3.2.2   Importing a Storm Track from a File

The required steps to import a storm track are:

- Select the **S̲cenario** command from the **Ha̲zard** menu. This brings up the Welcome Page of the Hurricane Scenario Wizard, shown previously in Figure 9-1.

- Click on the **Next** button.

- Select the **<Create New Scenario>** item in the Hurricane Scenarios list box and select the **Activate** option, as shown in Figure 9-13, and then click on the **Next** button.

- Select *Import from Exported File* (Figure 9-14) and click on the **Next** button.

- Enter a name for the new scenario (Figure 9-15) and click on the **Next** button.

- Use the browser shown in Figure 9-16 to select the import file and click on the **Open** button**.** This will bring up the import progress page shown in Figure 9-17.

- When the import is complete, click on the **Next** button to display a summary of the new scenario, as shown in Figure 9-18. After reviewing the information, click on the **Next** button to continue.

- If you want to make the new storm the active scenario, click on *Yes* on the Activate Scenario page (Figure 9-19).

- Click on **Finish** to exit the Hurricane Scenario Wizard (Figure 9-20).
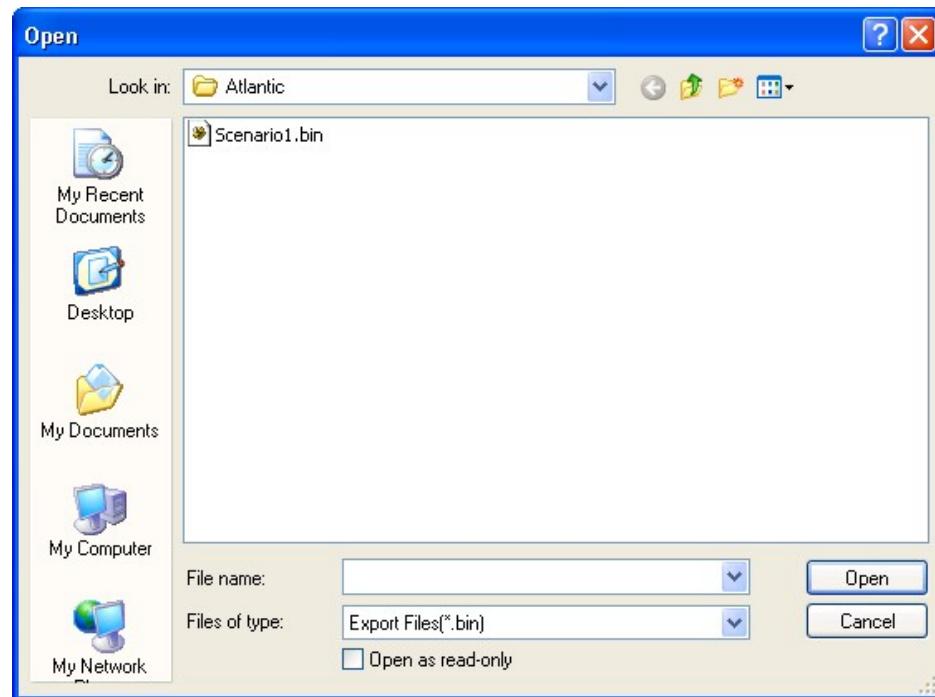
Figure 9-13. Hurricane Scenario Wizard – Scenario Operation Page.
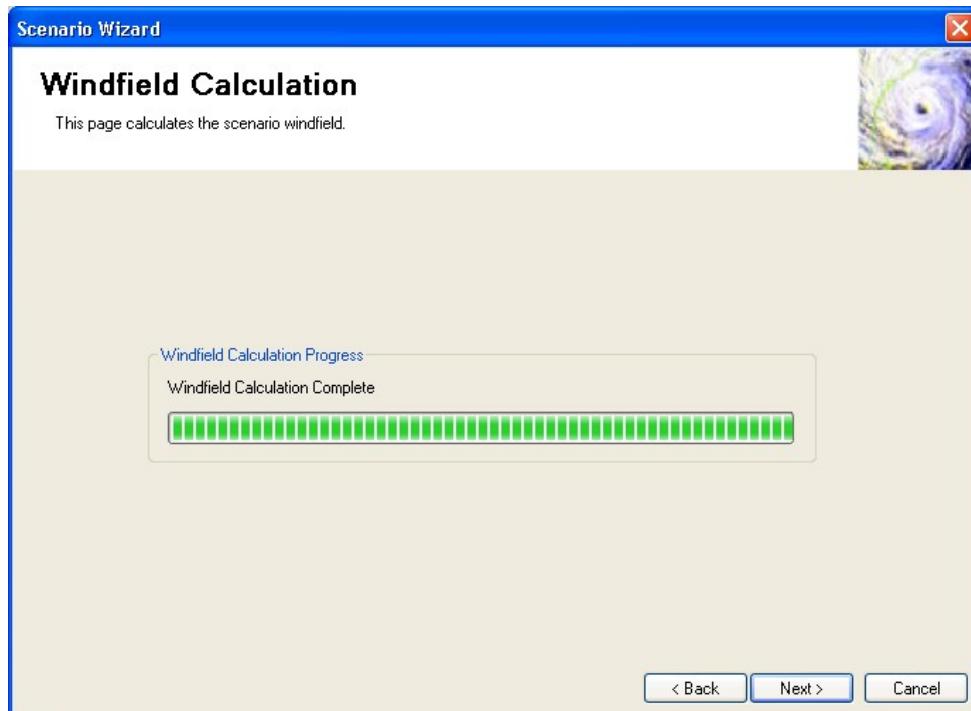
Figure 9-14. Hurricane Scenario Wizard – User Defined Type Page.
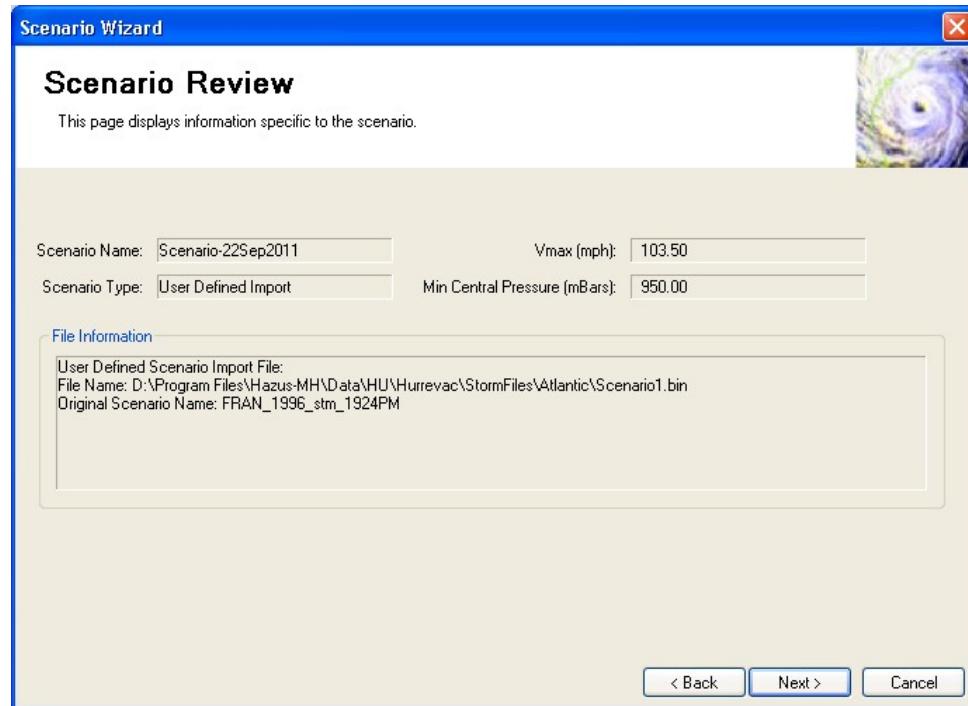
Figure 9-15. Hurricane Scenario Wizard – Name Page.
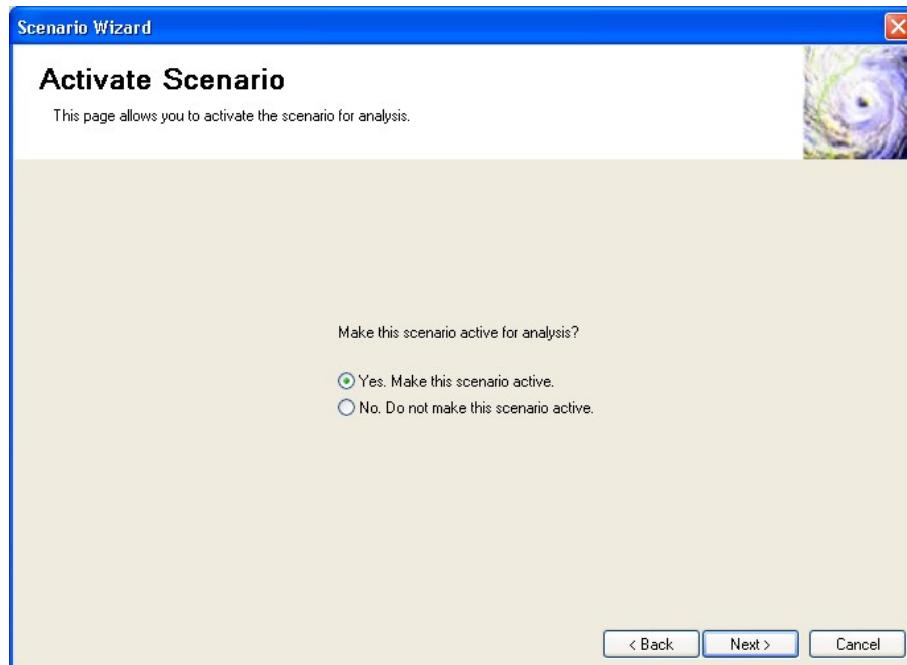
Figure 9-16. File Open Dialog.

Figure 9-17. Hurricane Scenario Wizard – File Import Progress Page.

Figure 9-18. Hurricane Scenario Wizard – Scenario Review Page.

Figure 9-19. Hurricane Scenario Wizard – Activate Scenario Page.

Figure 9-20. Hurricane Scenario Wizard – Completion Page.

9.3.2.3   Selecting a Historic Storm

The required steps select a historic storm are:

- Select the **<u>S</u>cenario** command from the **Ha<u>z</u>ard** menu. This brings up the Welcome Page of the Hurricane Scenario Wizard, shown previously in Figure 9-1.

- Click on the **Next** button.

- Select the **Historic** item in the Hurricane Scenarios list box.

- Click on the **Next** button.

- Select a storm from the list. The list includes all Category 3-5 storms (at the time of landfall) since 1900. Click on the **Region Filter** button to exclude storms that do not affect your study region.

- Click on the **Next** button.

- Click on **Finish** to exit the Hurricane Scenario Wizard (Figure 9-3).

9.3.2.4   Import from H*Wind File

In order to import and H*Wind file into Hazus, you must already have an H*Wind (.dat) file locally on your computer.[7] The required steps to import and H*Wind data file are:

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[7] H*Wind files formatted for HAZUS as *.dat files are not routinely produced by the NOAA AOML Hurricane Research Division (HRD) and are not available through the H*Wind website.

- Select the **S̲cenario** command from the **Ha̲zard** menu. This brings up the Welcome Page of the Hurricane Scenario Wizard, shown previously in Figure 9-1.

- Click on the **Next** button.

- Select the **<Create New Scenario>** item in the Hurricane Scenarios list box as shown in Figure 9-21 and click on the **Next** button.

- Select *Import Hurrevac storm advisory*, as shown in Figure 9-22, and click on the **Next** button.

- Enter a name for the new scenario you would like to create based on the H*Wind file (Figure 9-23) and click on the **Next** button.

- Type the name of the H*Wind file you would like to import (Figure 9-24), or use the **Browse** button to find the appropriate .dat file on your hard drive, and click on the **Next** button.

- Next, a summary of the H*Wind scenario will be displayed. After reviewing the information, click on the **Next** button to continue.

- If you want to make the new scenario the active scenario, click on *Yes* on the Activate Scenario page () and then click on the **Next** button.

- Click on **Finish** to exit the Hurricane Scenario Wizard.

H*Wind files formatted for HAZUS are special research products and have not generally widely been widely circulated in past hurricane seasons.
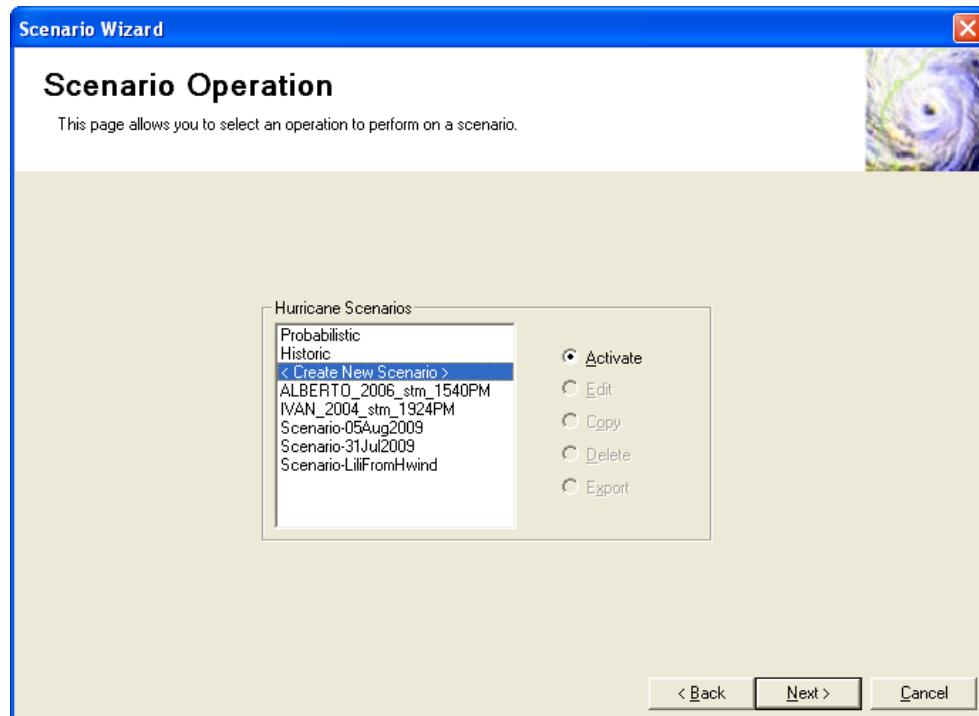
Figure 9-21. Select Create A New Scenario on the Scenario Operation Page.
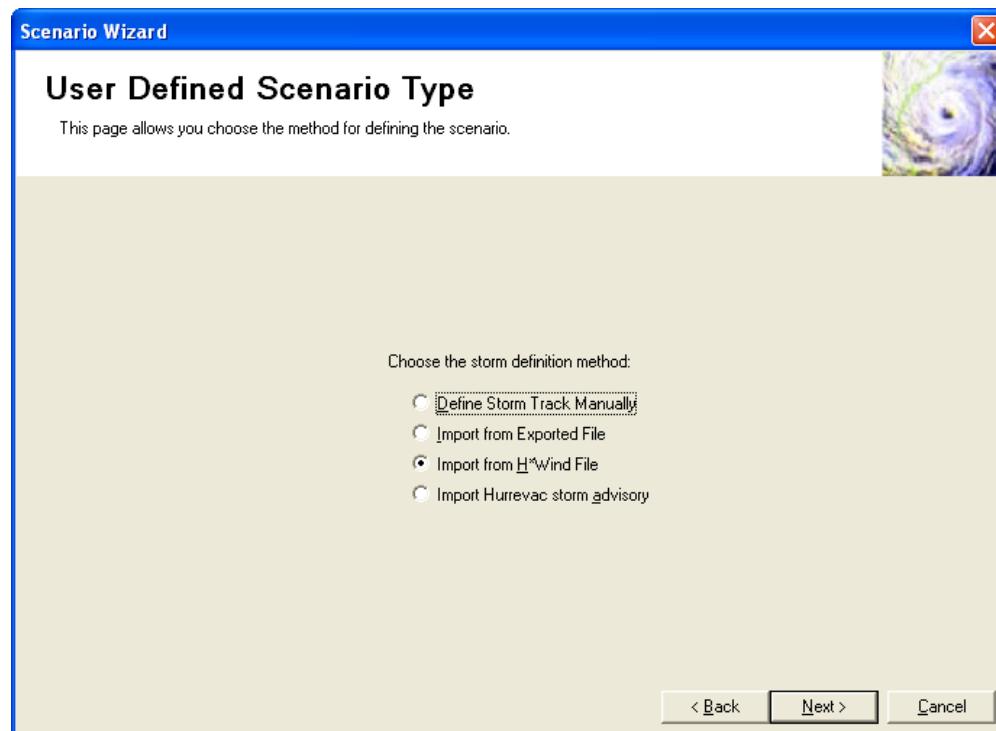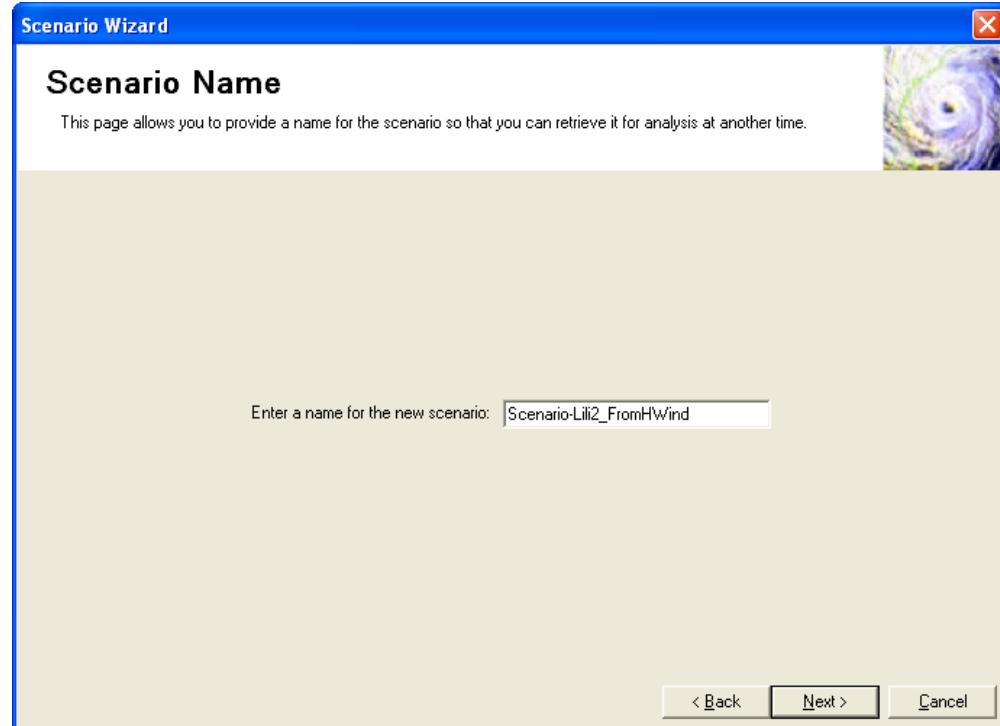
Figure 9-22. Select Import from H*Wind File on Scenario Type Page.

Figure 9-23. Enter Name for New Scenario to Create from an H*Wind file.

Figure 9-24. Enter Location and Name of H*Wind File to Define Scenario.
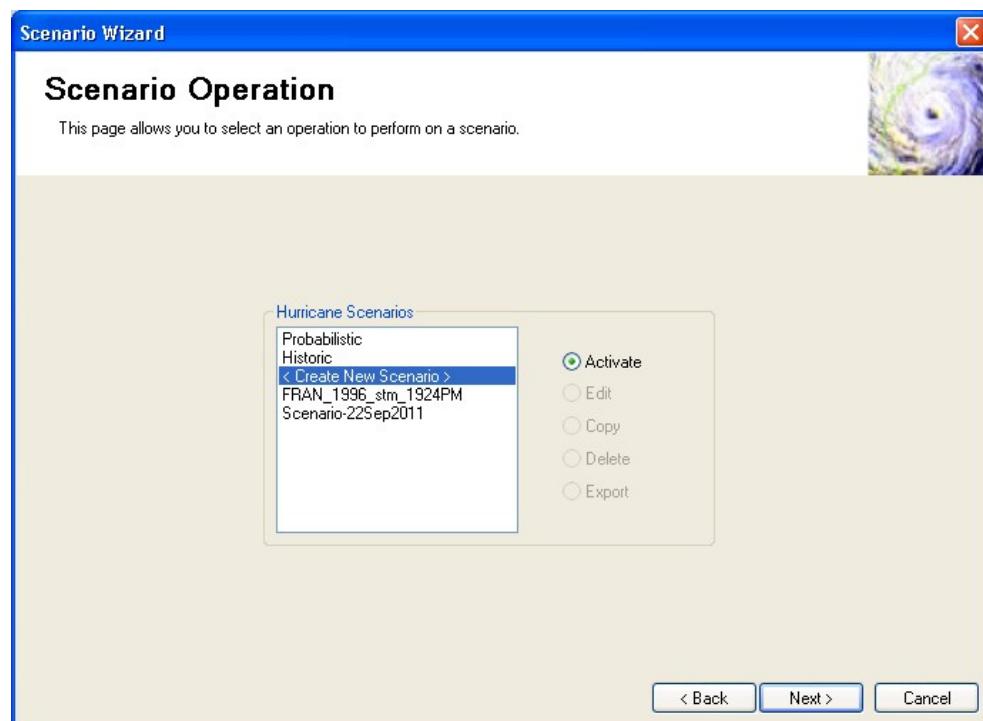
9.3.2.5   Import Hurrevac Storm Advisory

The required steps to import a Hurrevac Storm Advisory are:
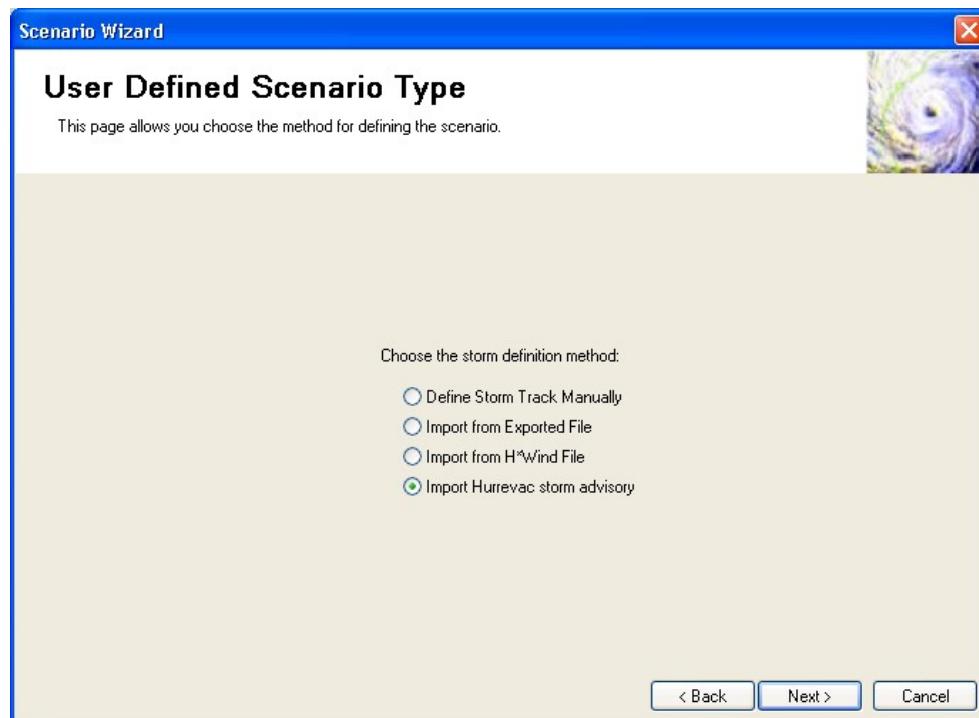
- Select the **<u>S</u>cenario** command from the **Ha<u>z</u>ard** menu. This brings up the Welcome Page of the Hurricane Scenario Wizard, shown previously in Figure 9-1.

- Click on the **Next** button.

- Select the **<Create New Scenario>** item in the Hurricane Scenarios list box, as shown in Figure 9-25, and then click on the **Next** button.

- Select *Import HurrEvac storm advisory* (Figure 9-26) and click on the **Next** button.

- This brings up the Storm Selection page (Figure 9-27). Select *Atlantic* (or *Central Pacific* if your study region is all or part of Hawaii) on the left side of the page.

- This populates the storm list (Figure 9-28) with the names of all of the available Forecast/Advisories available prior to the release of the software.

- If you would like to search the storm list for a particular storm, click on the third tool in the group in the top left area of the Storm Selection page. This brings up the Query Dialog (Figure 9-29).

- Enter the appropriate query parameters (Figure 9-30) and click on **Create Query** (Figure 9-31).

- Click on **OK.** This action will return you to the Storm Selection page to view a filtered list of storms (Figure 9-32).

- Select the proper storm. To quickly view the contents of the Forecast/Advisory data file, click on the first tool in the group in the top left area of the Storm Selection page. If you have a default program for viewing comma separated files (*.csv), such as Microsoft Excel, this will automatically bring up a display of the Forecast/Advisory data file contents (Figure 9-33).

- After closing the Quick View, click on the **Next** button on the Storm Selection page to display the Edit Storm Track page of the Hurricane Scenario Wizard (Figure 9-34).

- Note that coastal surge analysis for forecast/advisories issued more than 24 hours prior to landfall is not permitted, since storm track uncertainty beyond this time frame compromises the analysis.

- If there are positions on the Forecast/Advisory storm track that are a hundreds of miles from your study region, you can delete these rows from the table by selecting the appropriate rows, right clicking, and selecting "Delete Row". This step will speed up the processing of the Forecast/Advisory, but care should be taken to ensure enough points are left to properly compute the correct peak gust wind speeds in your entire study region (Figure 9-35). If coastal surge analyses are also going to be performed, the storm track should extend beyond the outer

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boundary of the applicable SLOSH basin grids, and all the way out to 60 degrees west longitude if the deep water and near shore waves option is to be used.
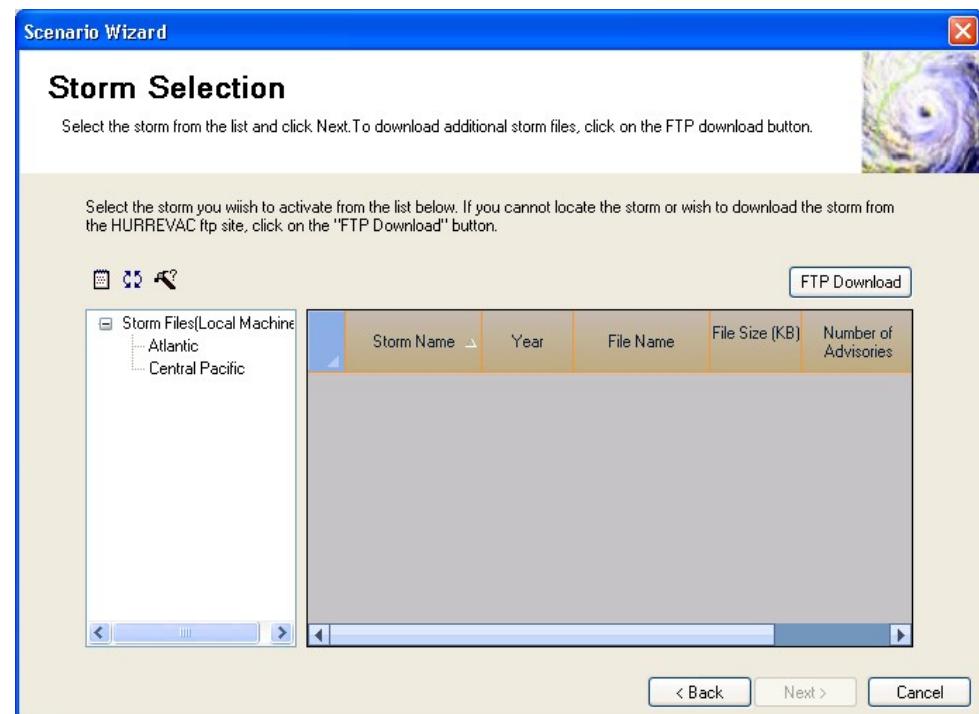
- After making any edits to the storm track, click on the **Next** button to initiate the windfield calculation (Figure 9-36).

- When the windfield calculation is complete, click on the **Next** button.

- A summary of the Forecast/Advisory scenario will be displayed, as shown in Figure 9-37. After reviewing the information, click on the **Next** button to continue.

- If you want to make the new scenario the active scenario, click on *Yes* on the Activate Scenario page (Figure 9-38) and then click on the **Next** button.

- Click on **Finish** to exit the Hurricane Scenario Wizard (Figure 9-39).
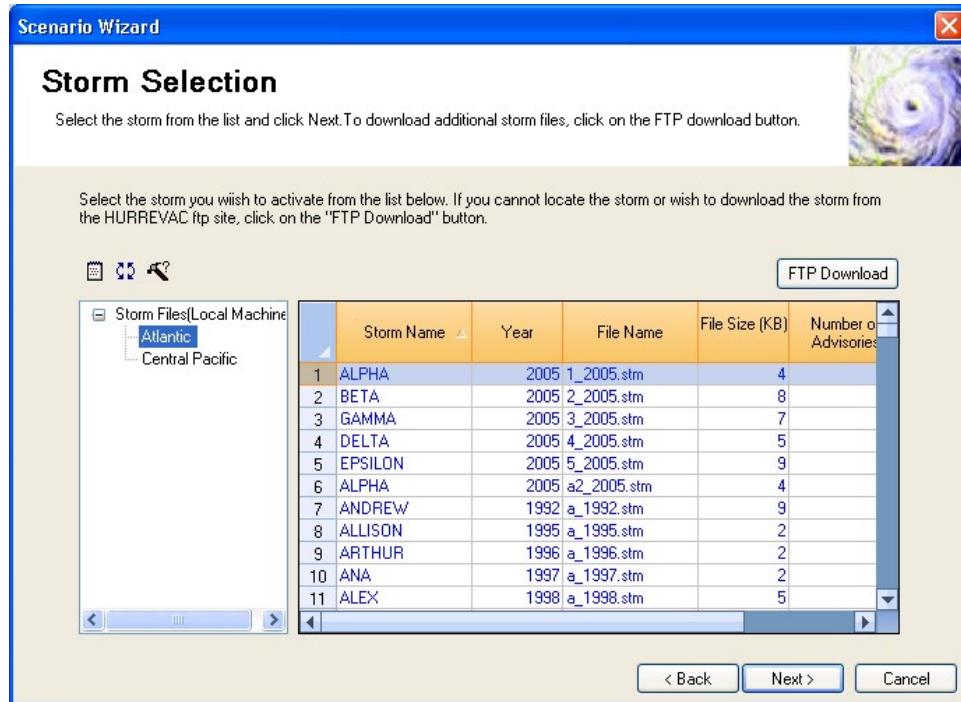
Figure 9-25. Hurricane Scenario Wizard – Scenario Operation Page.
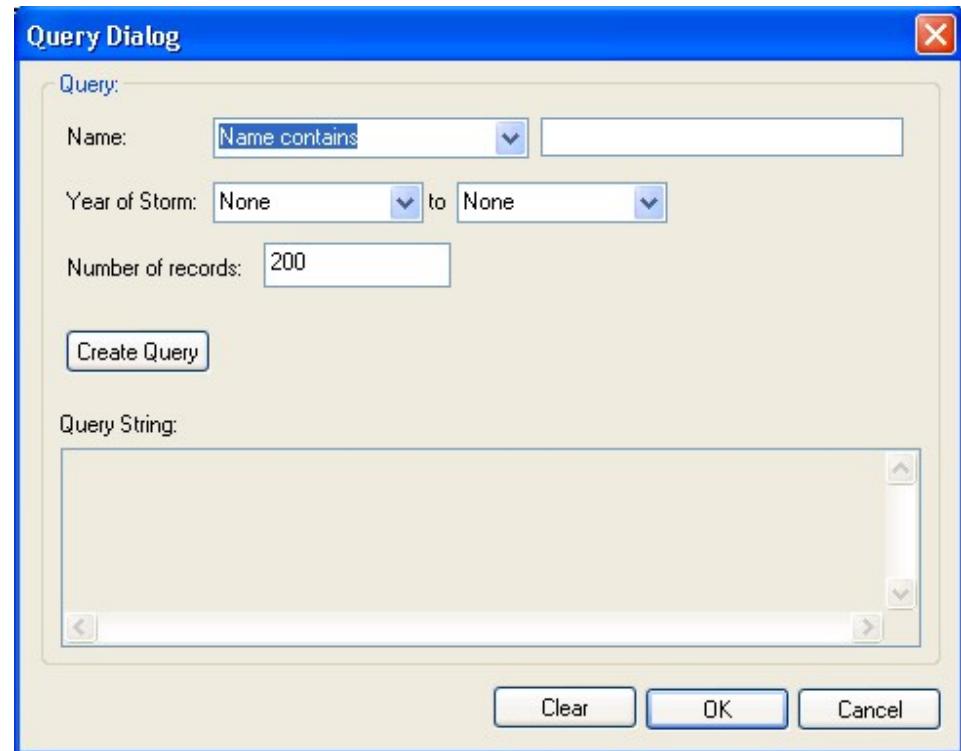
**Figure 9-26. Hurricane Scenario Wizard – User Defined Scenario Type Page.**


Figure 9-27. Hurricane Scenario Wizard – Storm Selection Page.

Figure 9-28. Hurricane Scenario Wizard – Storm Selection Page with Atlantic Storms.

Figure 9-29. Forecast/Advisory Query Dialog (1 of 3).
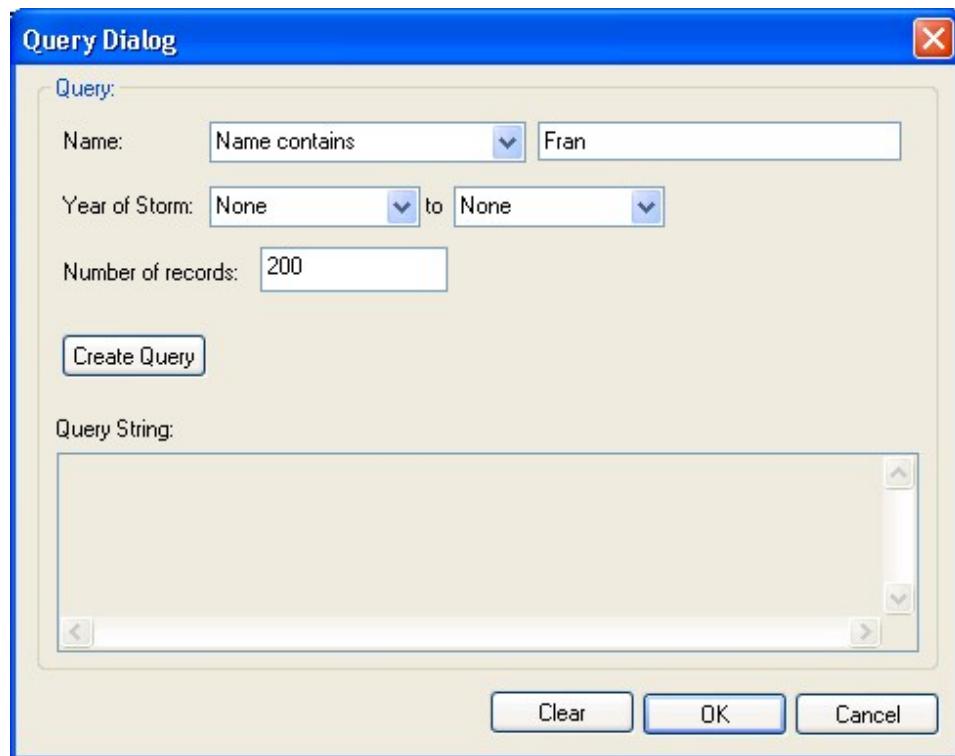
Figure 9-30. Forecast/Advisory Query Dialog (2 of 3).
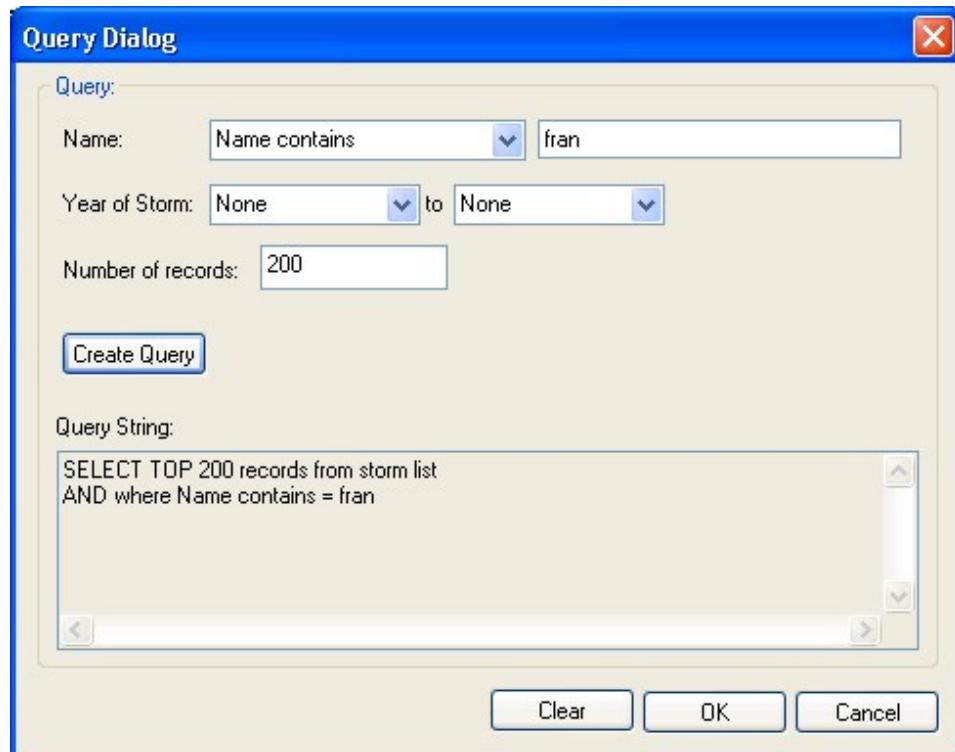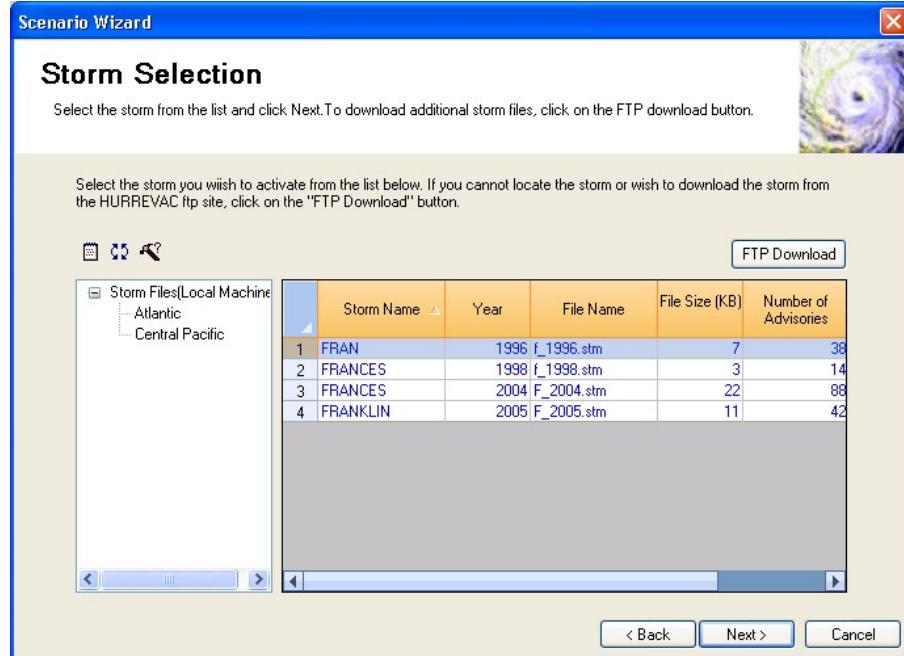
Figure 9-31. Forecast/Advisory Query Dialog (3 of 3).

Figure 9-32. Hurricane Scenario Wizard – Storm Selection Page with Query Results.

Figure 9-33. Quick View of Forecast/Advisory Data File.
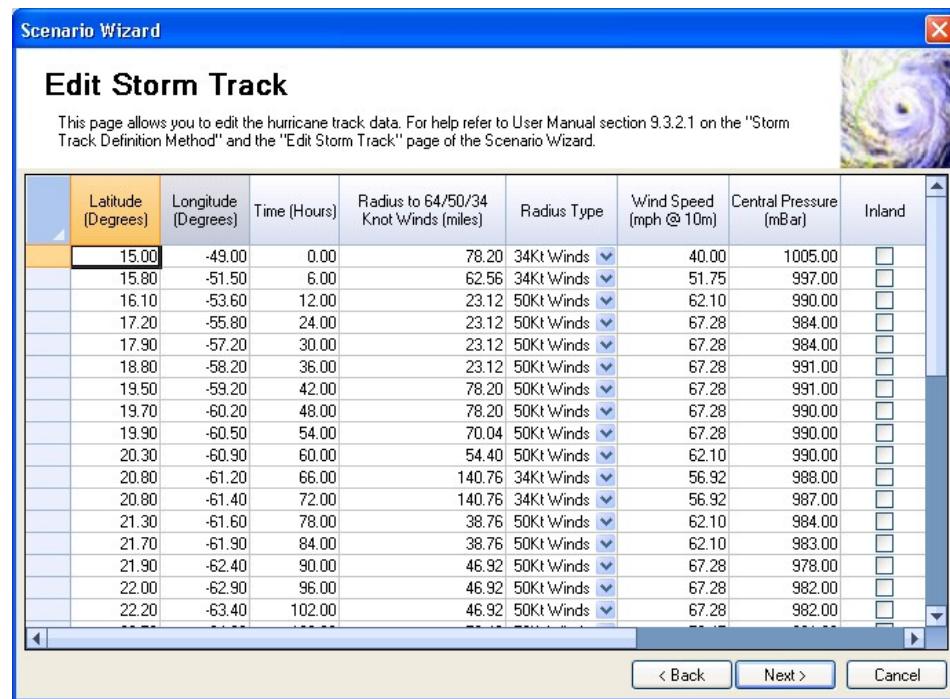
Figure 9-34. Hurricane Scenario Wizard – Edit Storm Track Page.
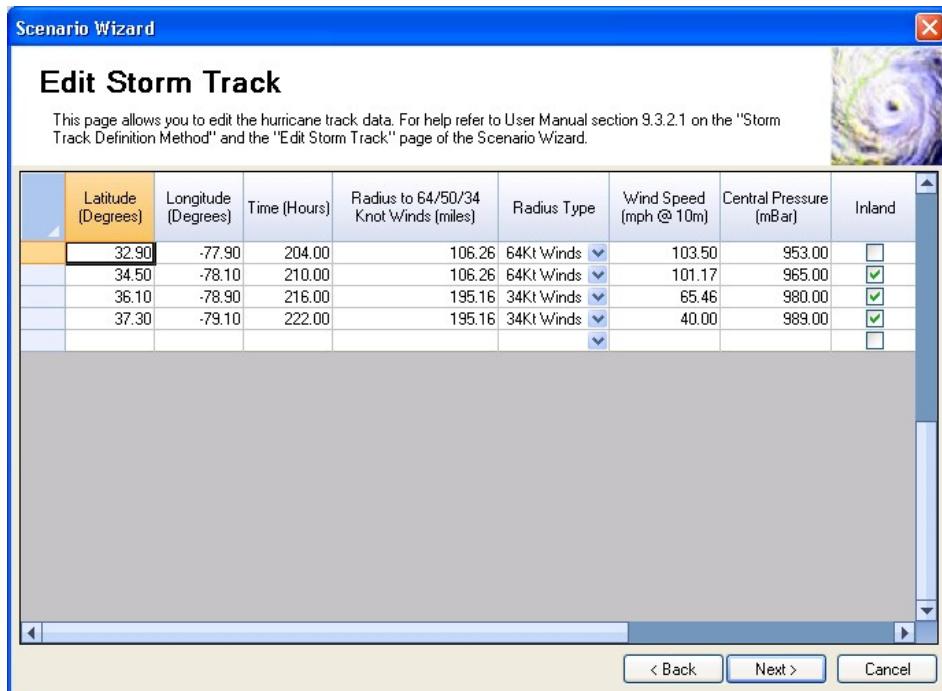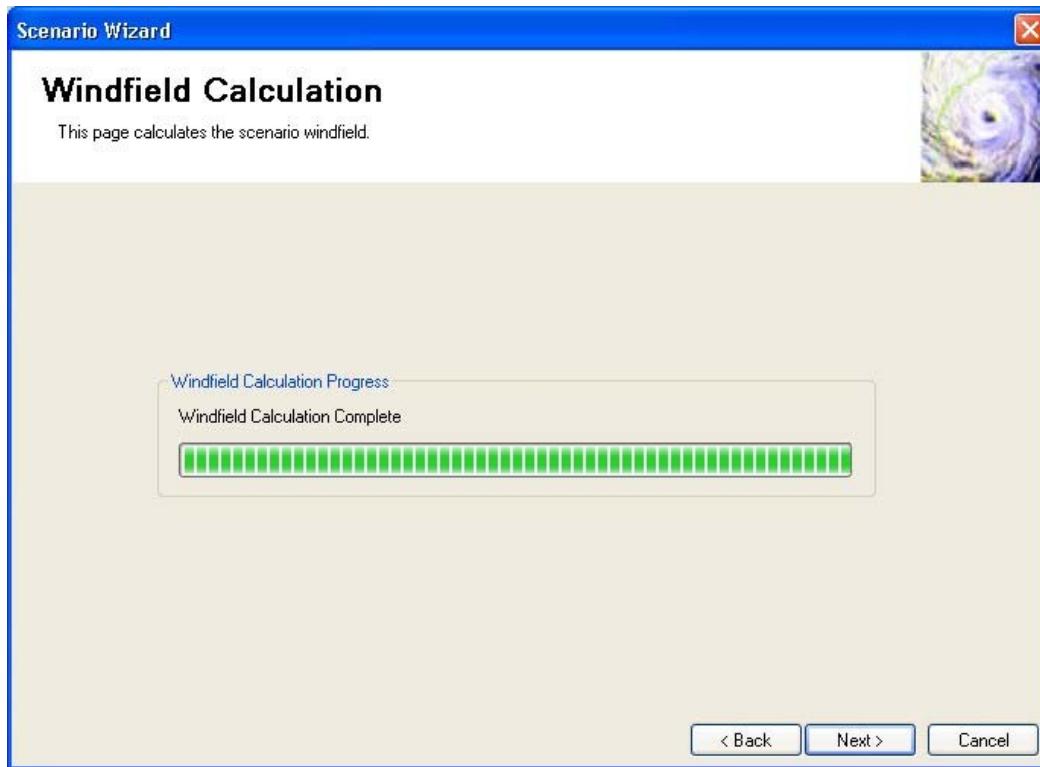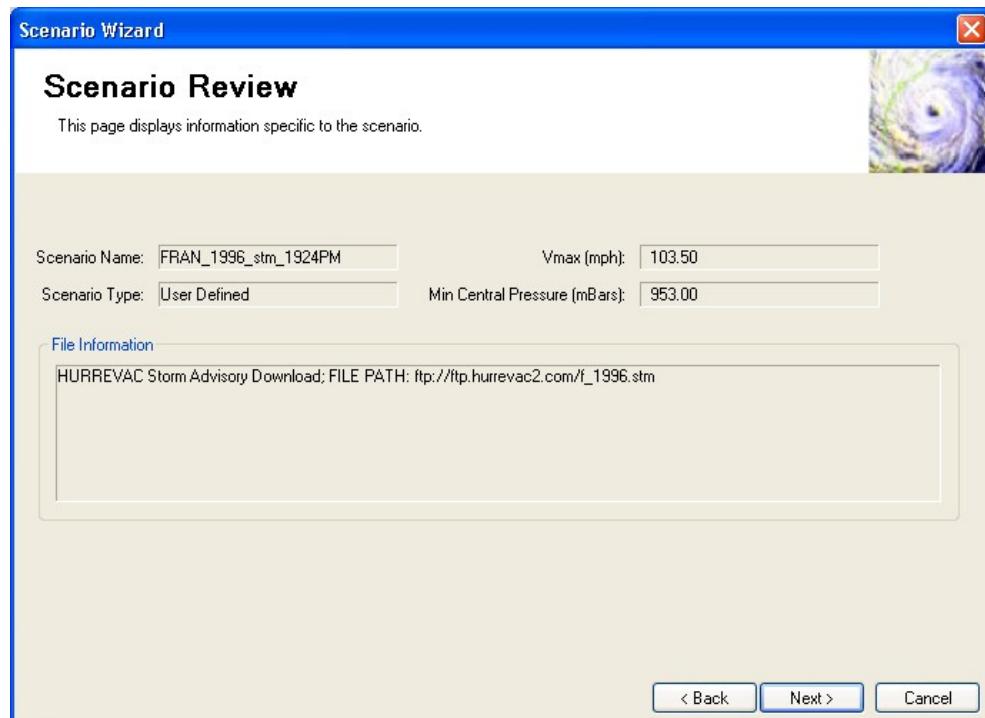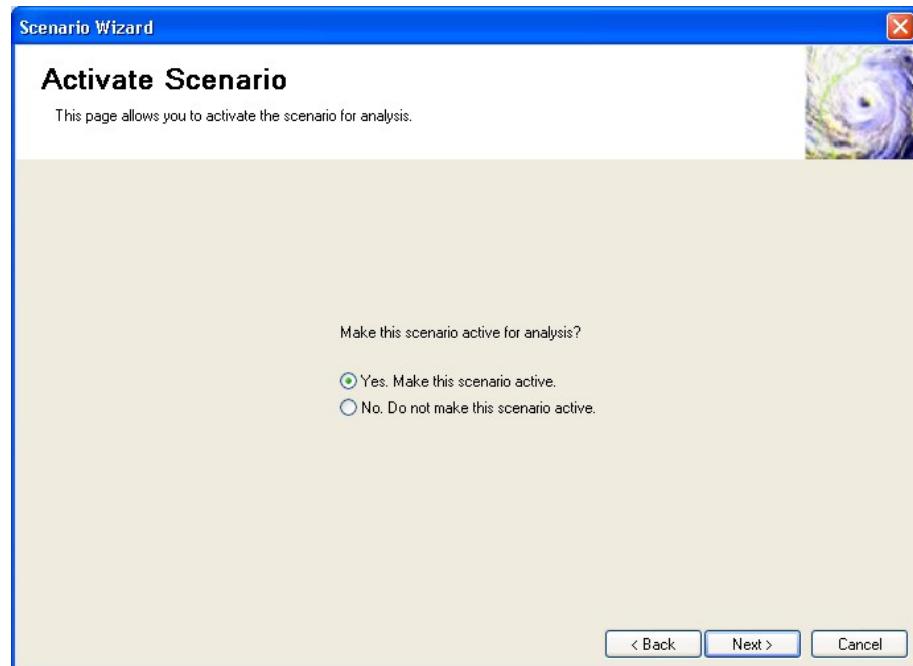
Figure 9-35. Hurricane Scenario Wizard – Edit Storm Track Page After Deleting Excess Rows.

Figure 9-36. Hurricane Scenario Wizard – Windfield Calculation Page.

Figure 9-37. Hurricane Scenario Wizard – Scenario Review Page.
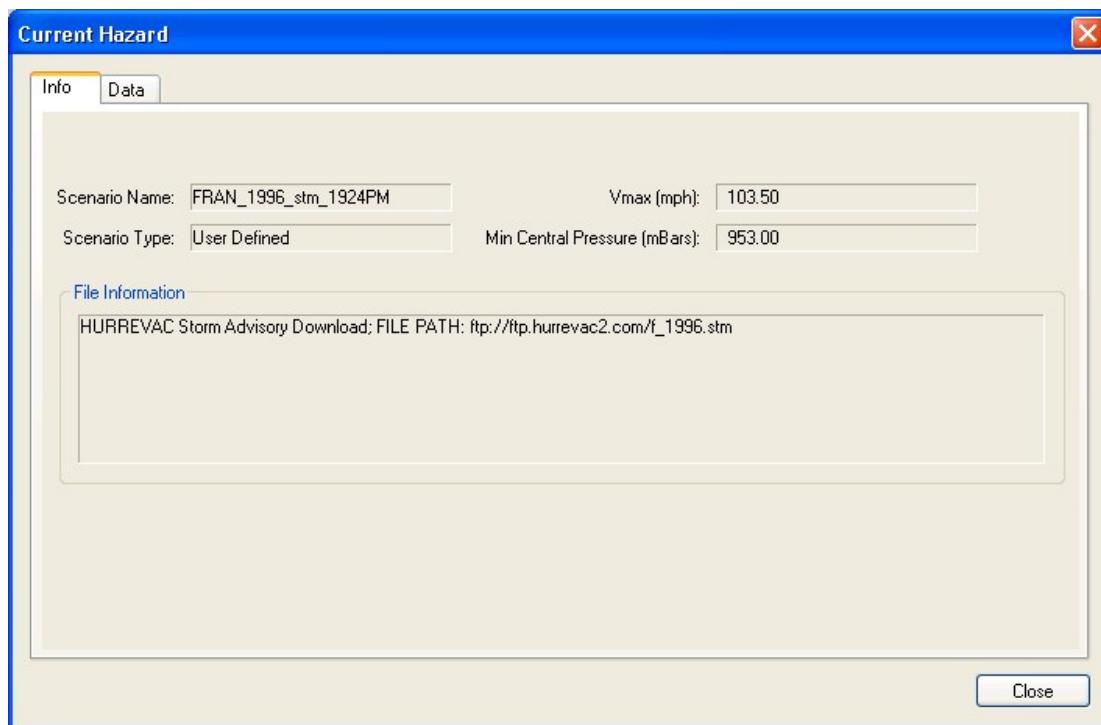
Figure 9-38. Hurricane Scenario Wizard – Activate Scenario Page.

Figure 9-39. Hurricane Scenario Wizard – Completion Page.

9.3.3   Viewing the Currently Defined Hazard

To view a summary of the currently active scenario, execute the **Ha<u>z</u>ard | Show <u>C</u>urrent** command. An example of the summary is shown in Figure 9-40.

Figure 9-40. Current Hazard Dialog.

9.4   Viewing the Damage, Loss, and Debris Functions
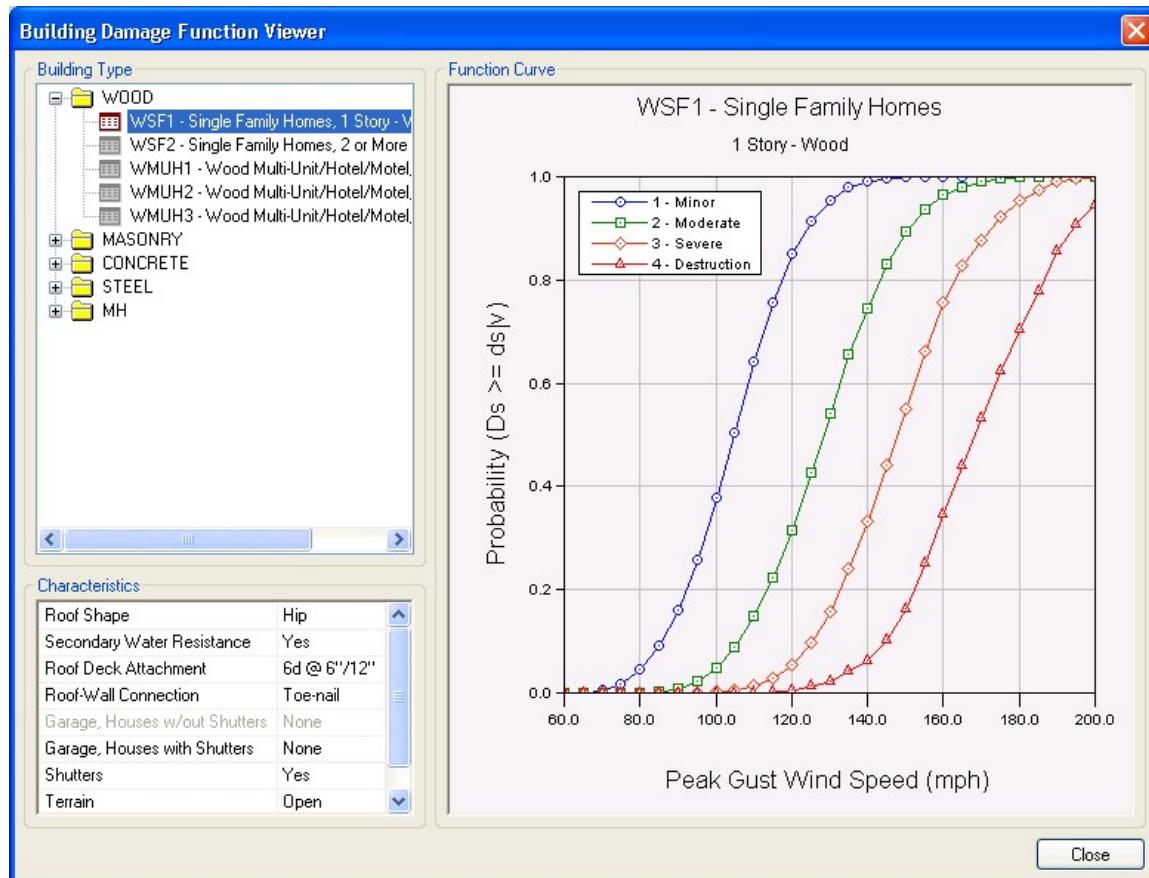
There are four basic classes of analysis functions used in the Hurricane Model:

- Building damage functions.
- Building and contents loss functions.
- Building loss of use functions.
- Building debris functions.

These functions have been developed for all of the model building types in the Hurricane Model using the methodologies described in the *Technical Manual*. The resulting functions cannot be modified, but you can view each graphs of each function in the software. These views are described in the following sections.

9.4.1 Viewing the Building Damage Functions
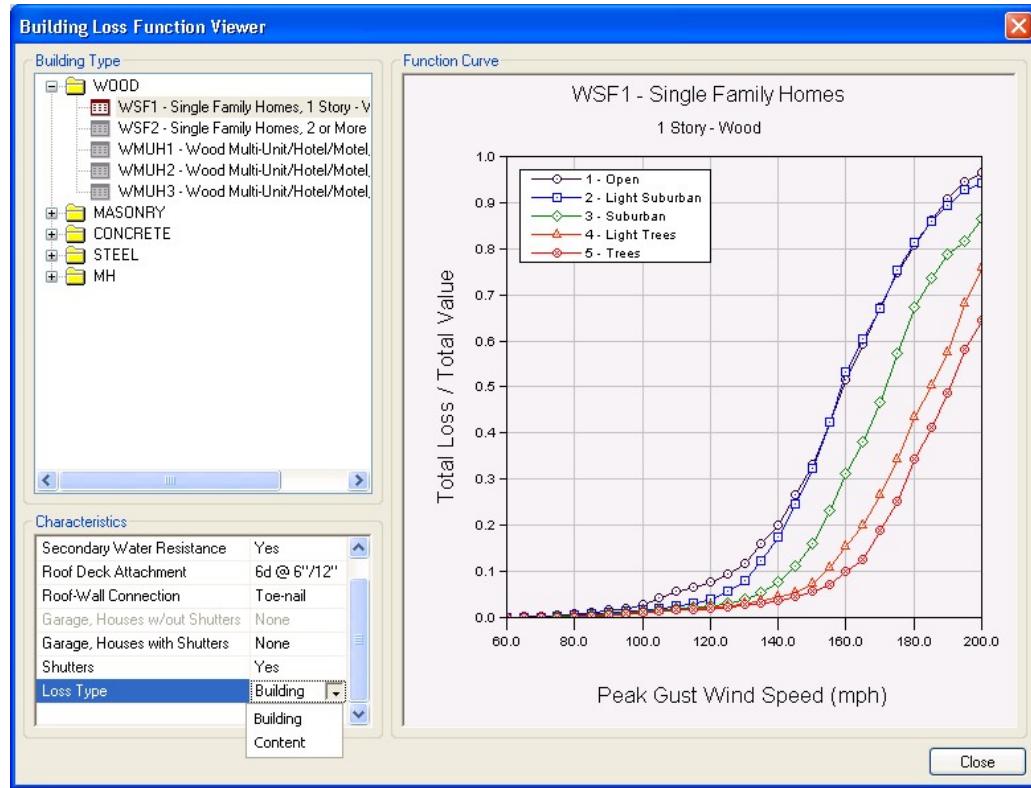
The **Analysis | Damage Function** command displays graphs of the probabilities of four different damage states for each wind building type as a function of peak gust wind speed.

Figure 9-41. Building Damage Function Viewer.

9.4.2 Viewing the Building Loss Functions
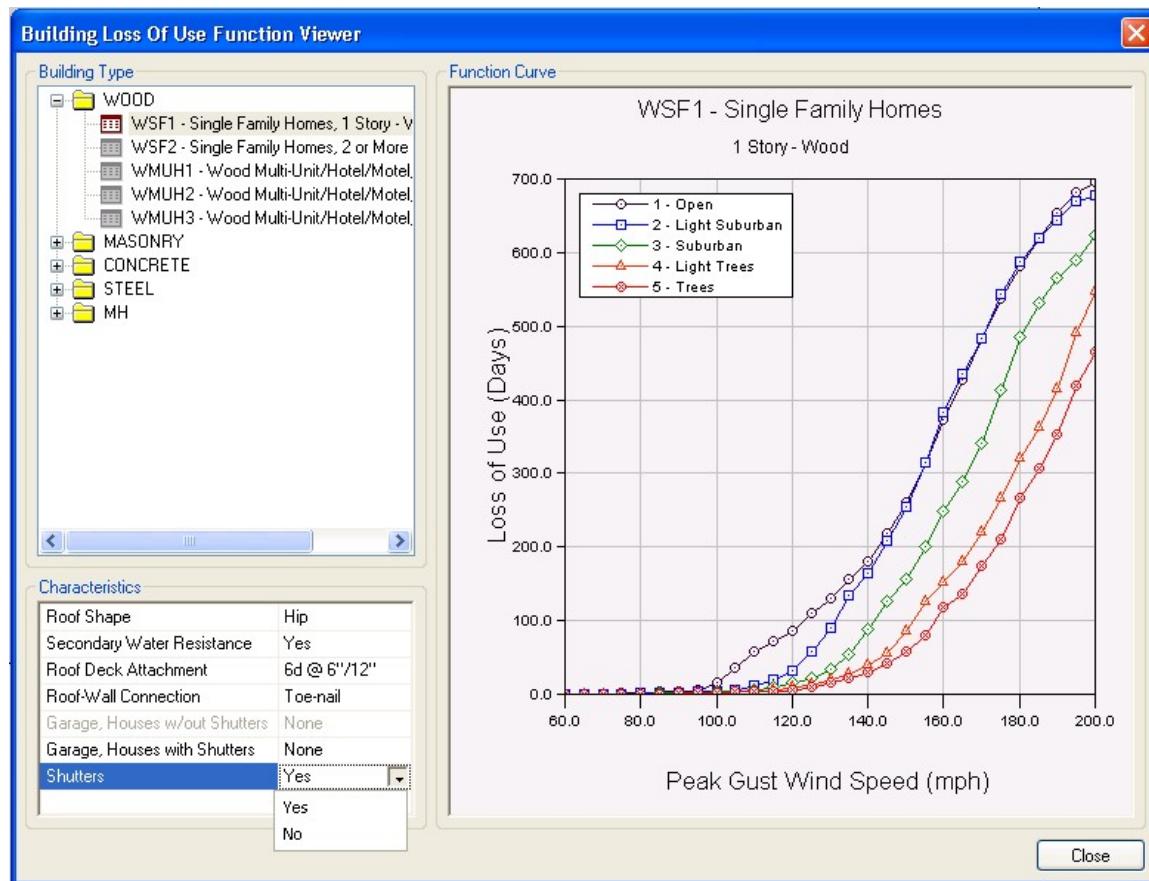
The **Analysis | Loss Functions** command displays graphs of the building, contents, or combined loss ratios for each wind building type as a function of peak gust wind speed.

Figure 9-42. Building Loss Function Viewer.

9.4.3 Viewing the Loss of Use Functions
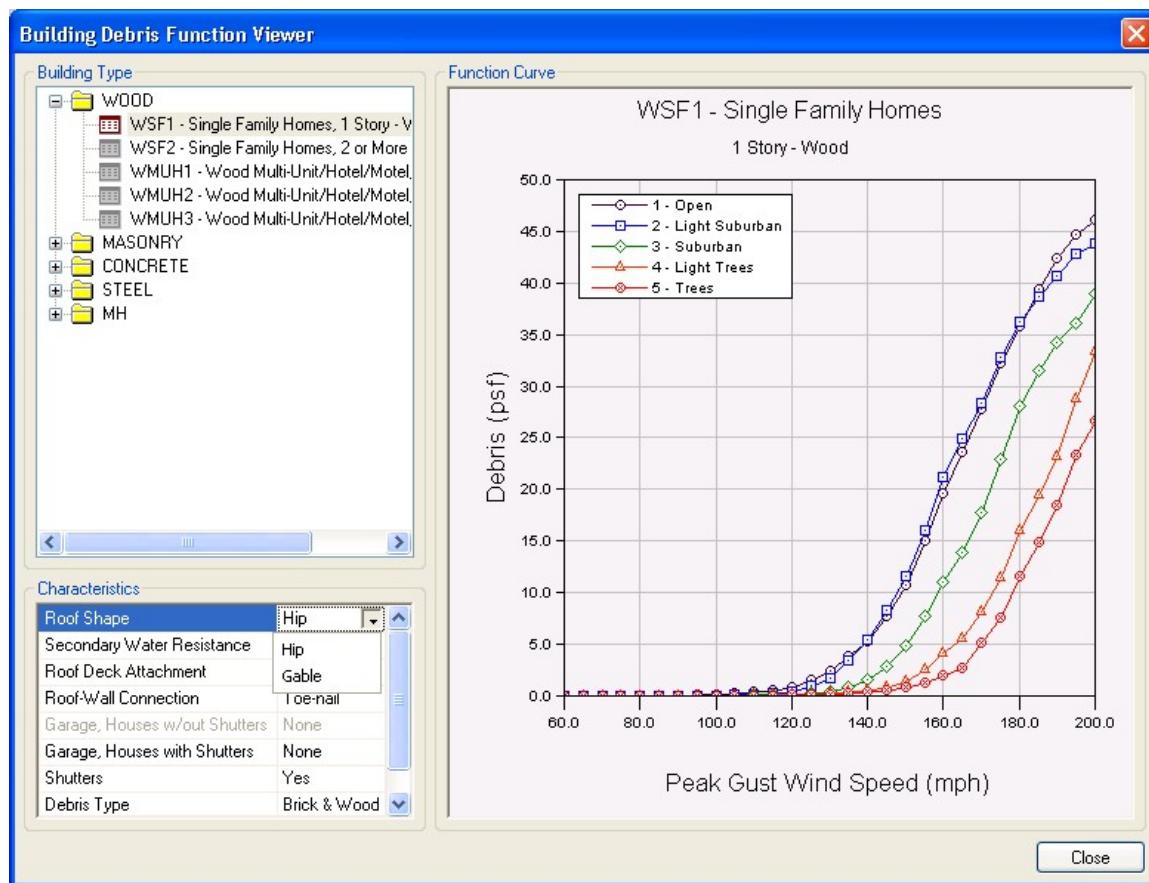
The **Analysis | Loss of Use Functions** command displays graphs of the expected number of days to restore the function of each wind building type as a function of peak gust wind speed.

Figure 9-43. Loss of Use Function Viewer.

9.4.4 Viewing the Building Debris Functions

The **Analysis | Debris Functions** command displays graphs of the expected debris weights (per unit floor area) generated by each wind building type as a function of peak gust wind speed.

Figure 9-44. Debris Functions Viewer.

Building debris is divided into two types:

- Debris Type 1 – Brick, wood and other debris
- Debris Type 2 – Reinforced concrete and steel members

The first type of debris includes everything except wrecked reinforced concrete and steel members. It would include glass, furniture, equipment, and plaster walls, as well as brick and wood. The difference in these two types of debris is that Type 1 can be moved and broken up with a bulldozer or hand held tools. Type 2 would require special treatment to break up the long steel members or the large pieces of concrete before they could be transported. It is likely cranes and other heavy equipment would be needed.
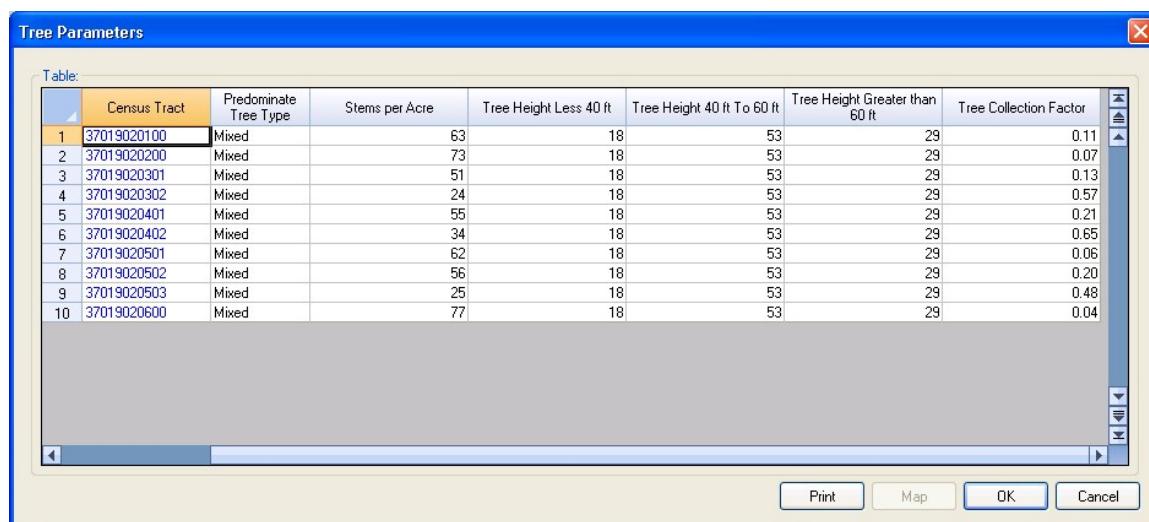
9.5 Setting the Analysis Parameters

9.5.1 Defining Tree Coverage Data

The Tree Coverage browser allows you to view, map, and edit the type, density, and height distribution of trees as well as the tree debris collection factor for each census tract. The tree blow down model is used to estimate tree debris and added losses to single-family housing due to tree impacts. Note that the tree blow down model only considers trees over 30 feet in height. The applicable tree types are:

- Coniferous (>75% evergreens)
- Deciduous (>75% deciduous)
- Mixed

The Tree Collection factor is a number between zero and one representing the fraction of downed trees that would likely be collected and disposed at public expense. In sparsely developed census tracts, the tree collection factor should tend towards zero; whereas in heavily developed census tracts, the tree collection factor should tend towards one. The methodology used to develop the default tree parameters is described in Chapter 12 of the Hazus Hurricane Technical Manual.
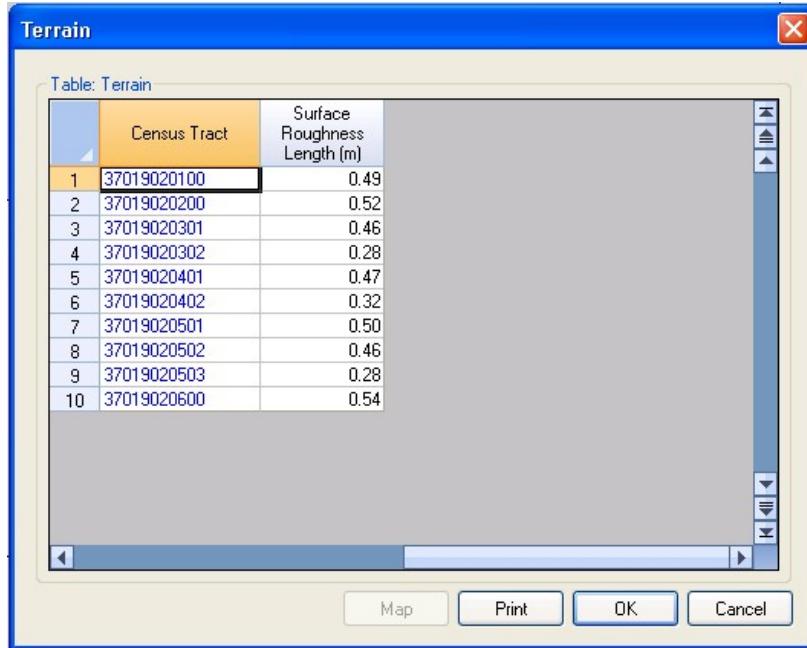
Figure 9-45. Tree Parameters.

9.5.2   Defining Terrain Data

The Terrain browser allows you to view, map, and edit the surface roughness values for each census tract.

Figure 9-46. Terrain Browser.

If you are considering modifying the default terrain, it is strongly recommended that you consult with a wind engineer.

9.5.3   Defining the Shelter Parameters

Hurricanes can cause loss of habitability of buildings that contain housing units resulting in predictable numbers of displaced households. These households will need alternative short-term shelter from family, friends, or public shelters provided by relief organizations such as the Red Cross and Salvation Army. For units where repair takes longer than a few weeks, long-term alternative housing can be achieved through importation of mobile homes, a reduction in vacant units, net emigration from the impacted area, and eventually by the repair or reconstruction of new public and private housing. While the number of people seeking short-term public shelter is of great concern to emergency response organizations, the longer-term impacts on the housing stock are of great concern to local governments. The shelter module provides two estimates:

- The total number of displaced households (due to loss of habitability)
- The number of people requiring short-term shelter

Loss of habitability is calculated directly from damage to the residential occupancy inventory and from loss of water and power. The methodology for calculating short-term

shelter requirements recognizes that only a portion of those displaced from their homes will seek public shelter, and some will seek shelter even though their residence may have little, if any, damage.

All households living in uninhabitable dwellings will seek alternative shelter. Many will stay with friends and relatives or in the family car. Others will stay in hotels. Some will stay in public shelters provided by the Red Cross or others. Hazus estimates the number of displaced persons seeking public shelter. In addition, observations from past disasters show that approximately 80% of the pre-disaster homeless will seek public shelter. Finally, data from Northridge indicate that approximately one-third of those in public shelters came from residences with no or insignificant structural damage. Depending on the degree to which infrastructure damage is incorporated into the number of displaced households, that number could be increased by up to 50% to account for "perceived" structural damage as well as lack of water and power.

9.5.3.1 Development of Input for Displaced Households

The following inputs are required to compute the number of uninhabitable dwelling units and the number of displaced households:

- Fraction of dwelling units likely to be vacated if damaged.
- Percentage of households affected by utility outages likely to seek alternative shelter.
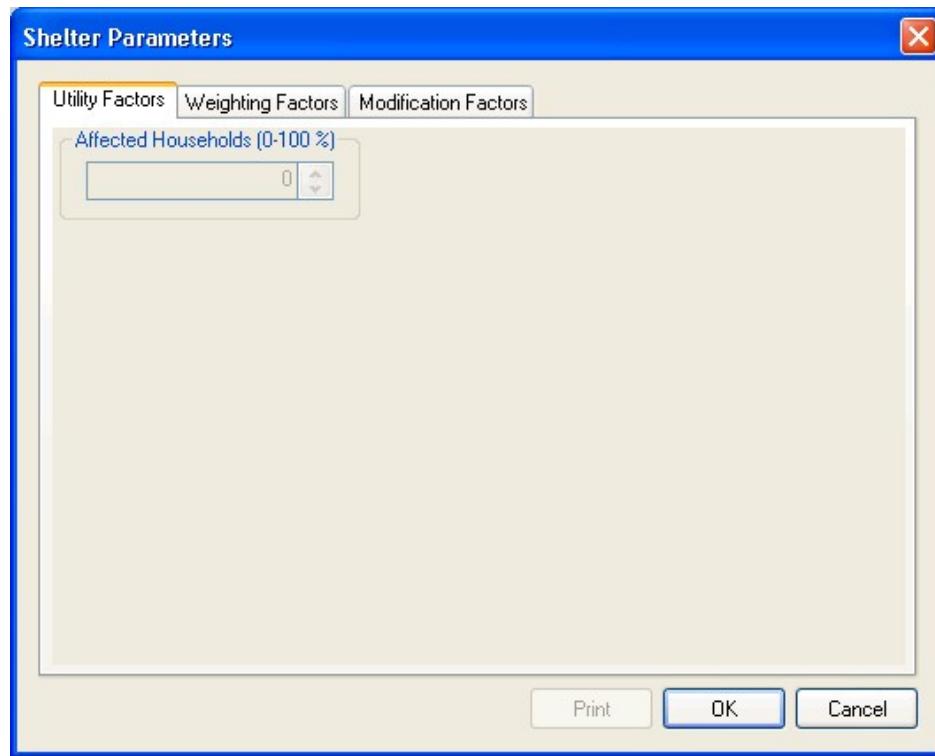
9.5.3.2 Fraction of Dwelling Units Likely to be Vacated if Damaged

The number of uninhabitable dwelling units is not only a function of the amount of damage but it is also a function of the number of damaged units that are perceived to be uninhabitable by their occupants. All dwelling units located in buildings that are in the complete damage state are considered to be uninhabitable. In addition, dwelling units that are in moderately or extensively damaged multi-family structures can also be uninhabitable due to the fact that renters perceive some moderately damaged and most extensively damaged rental property as uninhabitable. On the other hand, those living in single-family homes are much more likely to tolerate damage and continue to live in their homes. A discussion of how the number of uninhabitable dwelling units is estimated in the Hurricane Model is available in the *Technical Manual*.

9.5.3.3 Percentage of Households Affected by Utility Outages Likely to Seek Alternative Shelter

Families living in undamaged households affected by utility outages may seek alternative shelter. Because the current version of the Hurricane Model does not estimate utility outages and no data exist on the impact of utility outages on perceived habitability, this assessment will in the future be left to the user as part of the analysis. The percent of households seeking alternative shelter due to utility outages is currently set to zero and cannot be modified in the Shelter Parameters window shown in Figure 9-47; however, as discussed in the next section, the Weighting Factors for age, ethnicity, income, and

ownership and Modification Factors for income can be modified in the Shelter Parameters window.

Figure 9-47. Utility Factors in the Shelter Parameters Window.

9.5.3.4   Development of Inputs for Shelter Needs

The number of displaced households is combined with the following information to estimate shelter needs:

- Number of people in the census tract
- Number of households in census tract
- Income breakdown of households in census tract
- Ethnicity of households in census tract
- Percentage of homeowners and renters in the census tract
- Age breakdown of households in census tract

All of this information is provided in the default census database. The default census database can be viewed, modified and mapped in the inventory module as shown in Figure 9-48.

Figure 9-48. Demographic Data Supplied in Hazus.

Assumptions of the methodology are that the number of people who require short-term housing is a function of income, ethnicity, ownership and age. Based on experience in past disasters, including both hurricanes and earthquakes, those seeking shelter typically have very low incomes, and therefore have fewer options. In addition, they tend to have young children or are over 65. Finally, even given similar incomes, Hispanic populations from Central America and Mexico tend to be more concerned about reoccupying buildings than other groups. This tendency appears to be because of the fear of collapsed buildings instilled from past disastrous earthquakes.
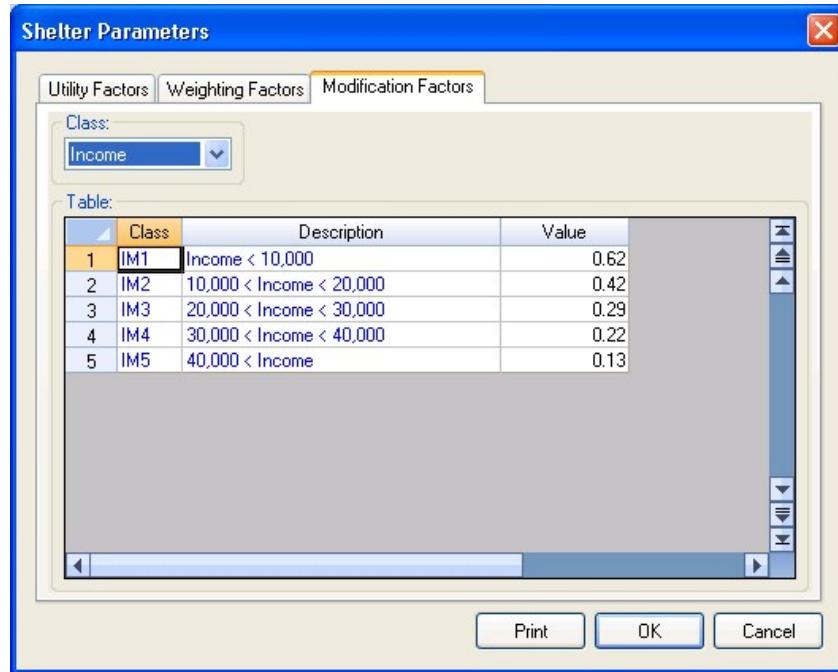
To account for these trends, factors have been developed to represent the fraction of households in each category likely to seek public shelter if their dwellings become uninhabitable. The default values of these factors as shown in Table 9.1 are based upon data from the Northridge earthquake combined with expert opinion (see the *Technical Manual* for more information). From this table you can interpret that 62% of households with incomes less than $10,000 whose dwellings have become uninhabitable will seek public shelter.

The factors in Table 9.1 can be viewed and modified in the **Shelter Parameters** window as shown in Figure 9-49. The **Income**, **Ethnicity**, **Ownership** and **Age** buttons can be used to view the various tables.
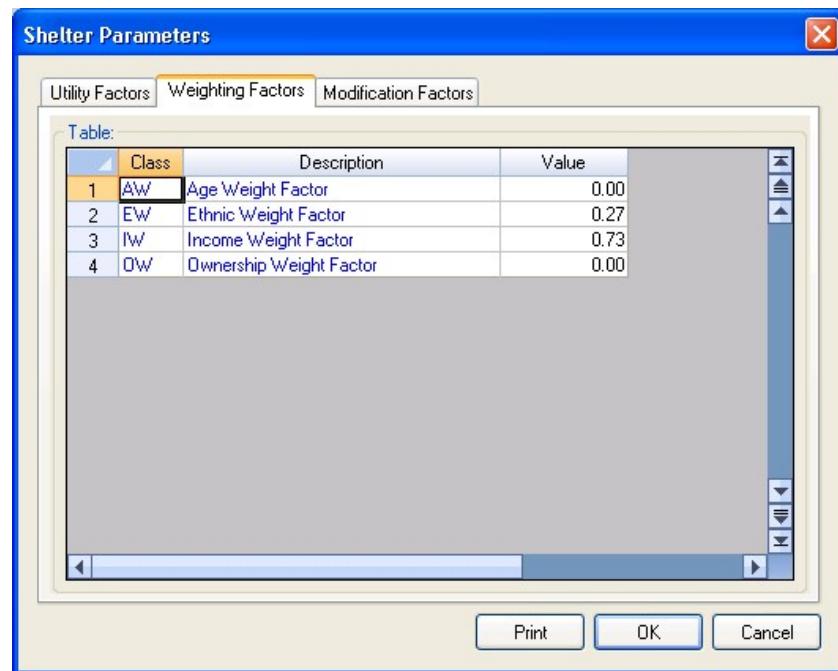
Table 9.1. Fraction of Households Likely to Seek Public Shelter if Dwellings Become Uninhabitable

Household Description	Default
Income	
Household Income < $10,000	0.62
$10,000 < Household Income < $20,000	0.42
$20,000 < Household Income < $30,000	0.29
$30,000 < Household Income < $40,000	0.22
$40,000 < Household Income	0.13
Ethnicity	
White	0.24
Black	0.48
Hispanic	0.47
Asian	0.26
Native American	0.26
Ownership	
Own Dwelling Unit	0.40
Rent Dwelling Unit	0.40
Age	
Population Under 16 Years Old	0.40
Population Between 16 and 65 Years Old	0.40
Population Over 65 Years Old	0.40

You have the option to weight the importance of the four factors that affect the fraction of households seeking public shelter: income, ethnicity, ownership and age. The **importance factors** must sum to one. Defaults of the importance factors are shown in Figure 9-50. The default importance factors indicate that no weight will be put on ownership or age, and income will be weighted almost 3 times as much as ethnicity. If you wish to give all classes equal importance, then the factors should all be 0.25.

Figure 9-49. Fraction of Households Likely to Seek Public Shelter as a Function of Household Income.

Figure 9-50. Importance Factors for Determining Shelter Needs.

9.5.4   Defining the Buildings Economic Parameters

Estimates of damage to the built environment are converted to dollar loss in this module. Beyond economic losses, whose dollar value can be estimated from the extent of building and lifeline damage, there are a number of common socioeconomic impacts from hurricanes that, though their impact is not readily quantifiable, may represent important hurricane effects. These impacts may vary, depending on socioeconomic aspects of the population at risk and the particular physical topography and layout of the affected region. These are impacts such as:

- Psychological and emotional trauma that may affect a variety of populations, such as school children, ethnic groups, recent immigrants, the elderly and the infirm. These effects may influence post-hurricane behavior, for example in the choice of or need for shelter, and require the deployment of large-scale psychological and counseling services. Some of these effects may be of long duration, and may affect children's behavior and adult family and work efficiency.

- Changes in community and family structure caused by large-scale housing losses and consequent relocation and demolition.

This methodology does not attempt to estimate such effects. If the user of the methodology is interested in the possible impact of such effects on the community or region under study, it is recommended that they begin by consulting bibliographic sources to obtain an understanding of the possible importance of these impacts for the area of study. A useful discussion of many of these impacts can be found in "The Loma Prieta, California, Earthquake of October 17, 1989 - Public Response" (Bolton, 1993). This publication has bibliographic references that may be useful for further study.

9.5.4.1   Types of Direct Economic Loss

Direct economic losses begin with the cost of repair and replacement of damaged or destroyed buildings. However, building damage will result in a number of consequential losses that, in Hazus, are defined as direct. Thus, building-related direct economic losses (which are all expressed in dollars) comprise two groups. The first group consists of losses that are directly derived from building damage:

- Cost of repair and replacement of damaged and destroyed buildings

- Costs of damage to building contents

- Losses of building inventory (contents related to business activities)

When a hurricane coastal storm surge analysis is run (see Section 9.5.5), two sets of direct building losses are produced: one set for the wind damage by itself and a second set for the combined wind and surge damage. To obtain the combined wind and surge losses, you must run a Coastal Surge analysis and calculate the combined losses in the Hazus Flood Model. Upon completion, the combined losses can be viewed either in the Flood Model or in the Hurricane Model using either the **Results | Combined Wind and Surge Loss** browser or the **Results | Summary Reports | Direct Losses | Combined Wind and Surge Loss** summary report.

The second group consists of losses that are related to the length of time the facility is non-operational (or the immediate economic consequences of damage):

- Relocation expenses (for businesses and institutions)
- Capital-related income losses (a measure of the loss of productivity, services or sales)
- Wage losses (consistent with income loss)
- Rental income losses (to building owners)

Combined wind and surge loss estimates are not available in this version for income losses. As an interim solution, we recommend summing the wind-only and flood-only income losses to estimate the combined wind and surge income losses.

9.5.4.2   Development of Input for Building Losses

A great deal of default economic data is supplied with Hazus, as follows:

- Building replacement values by census tract for all occupancies
- Contents values by census tract for all occupancies
- Annual gross sales or production in $ per square foot for agricultural, commercial and industrial occupancies
- Business inventory as a percentage of gross annual sales for agricultural, commercial and industrial occupancies
- Business inventory damage as a function of damage state for agricultural, commercial and industrial occupancies
- Building cleanup and repair time in days as a function of wind building type
- Rental costs
- Disruption costs
- Percent of buildings that are owner occupied for each occupancy class
- Capital-related income and wage income in $/day per square foot for each occupancy

These data are described in detail in the *Technical Manual*. With the exception of building and contents value, the default data represent typical values for the United States and thus no regional variations are included. You should review the default data very carefully and modify the data to best represent the characteristics of your region.

The default economic data can be viewed and modified from within Hazus. The window that is used to view and modify the building replacement values and building contents values is shown in Figure 9-51. The values shown in this window are common to all three hazards and are accessed from the **Inventory | General Building Stock | Dollar Exposure** menu. To modify the data, make sure that **Table Type** is set to "Specific Occupancy". The Dollar Exposure data cannot be modified when viewed by general occupancy, general building type, or specific building type.

Figure 9-51. Building Replacement Value and Building Contents Value.

9.5.4.3 Building Replacement Costs
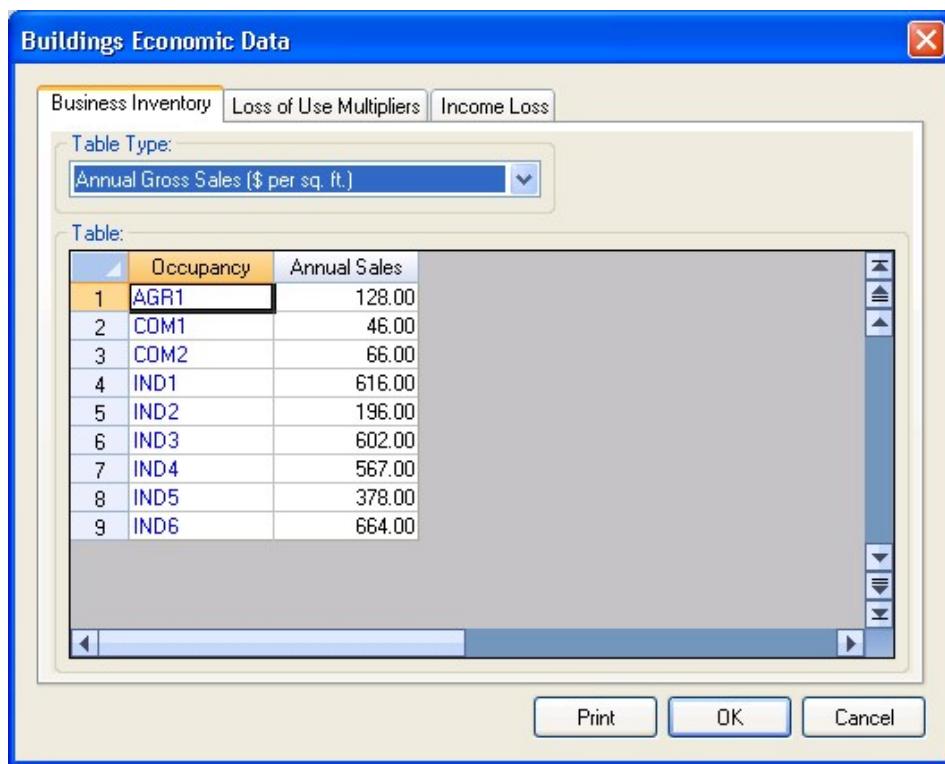
The replacement costs (damage state = complete) were derived from Means Square Foot Costs 2005, for Residential, Commercial, Industrial, and Institutional buildings. The Means publication is a nationally accepted reference on building construction costs, which is published annually. This publication provides cost information for a number of low-rise residential model buildings, and for 70 other residential, commercial, institutional and industrial buildings. These are presented in a format that shows typical costs for each model building, showing variations by size of building, type of building structure, and building enclosure. One of these variations is chosen as "typical" for this typical model, and a breakdown is provided that shows the cost and percentages of each building system or component. A description of how to estimate costs from the Means publication is found in the *Flood Model Technical Manual*.

In Hazus, selected Means models have been chosen from the 70 plus models that represent the 33 occupancy types. The wide range of costs shown, even for a single model, emphasize the importance of understanding that the dollar values shown should only be used to represent costs of large aggregations of building types. If costs for single buildings or small groups (such as a college campus) are desired for more detailed loss analysis, then local building specific cost estimates should be used.

9.5.4.4 Building Contents

Building contents are defined as furniture, equipment that is not integral with the structure, computers, and supplies. Contents do not include inventory or non-structural components such as lighting, ceilings, mechanical and electrical equipment and other fixtures. Default values are provided for contents (by occupancy) as a percentage of the replacement value of the facility. These values are based on Table 4.11 of ATC-13 (ATC, 1985).

The window that is used to view and modify the other economic default data is shown in Figure 9-52. This window is accessed from the **Analysis | Parameters | Buildings Economic** menu.

Figure 9-52. Economic Data for Estimating Business Inventory Losses, Lost Income and Relocation Costs.

9.5.4.5 Business Inventory

Business inventories vary considerably with occupancy. For example, the value of inventory for a high tech manufacturing facility would be very different from that of a retail store. Thus, the default values of business inventory for this model are derived from annual gross sales by assuming that business inventory is some percentage of annual gross sales. These default values are based on judgment.

9.5.4.6 Repair and Clean-up Times

The time to repair a damaged building can be divided into two parts: construction and clean-up time, and time to obtain financing, permits and complete a design. For the lower damage states, the construction time will be close to the real repair time. At the higher damage levels, a number of additional tasks must be undertaken that typically will considerably increase the actual repair time. These tasks, which may vary considerably in scope and time between individual projects, include:

- Decision-making (related to businesses of institutional constraints, plans, financial status, etc.)

- Negotiation with FEMA (for public and non-profit), Small Business Administration, etc.

- Negotiation with insurance company, if insured

- Obtaining financing

- Contract negotiation with design firms(s)

- Detailed inspections and recommendations

- Preparation of contract documents

- Obtaining building and other permits

- Bidding/negotiating construction contract

- Start-up and occupancy activities after construction completion

Building repair and clean-up estimates are provided with Hazus. These values include both the time to do the actual construction or repair and the additional delays described above. All of these factors are built into the Building Loss of Use functions described previously in Section 9.4.3. These functions represent estimates of the <u>median</u> times for actual cleanup and repair

However, repair time does not translate directly into business or service interruption. For some businesses, building repair time is largely irrelevant, because these businesses can rent alternative space or use spare industrial/commercial capacity elsewhere. Thus Building Repair Time Multipliers have been developed to arrive at estimates of business interruption for economic purposes. These values are multiplied by the building cleanup and repair times. Building Repair Time Multipliers can be viewed using the window shown in Figure 9-53.

Applying the building repair time multipliers to the building clean up and repair times results in average values for the business or service interruption. For low levels of damage the time loss is assumed to be short, with cleanup by staff, and work can resume while slight repairs are being done. For most commercial and industrial businesses that suffer moderate or extensive damage, the default business interruption time is short on the assumption that businesses will find alternate ways of continuing their activities. Churches will generally find temporary accommodation quickly, and government offices will also resume operating almost at once. It is assumed that hospitals and medical offices

can continue operating, perhaps with some temporary rearrangement and departmental relocation, after sustaining moderate damage. However, with extensive damage their loss of function time is assumed to be equal to the total time for repair. For other businesses and facilities, the interruption time is assumed to be equal to, or approaching, the total

Figure 9-53. Default Building Repair Time Multipliers.

time for repair. This applies to residential, entertainment, theater, parking, and religious facilities whose revenue or continued service is dependent on the existence and continued operation of the facility.

The median value of repair time applies to a large inventory of facilities. At moderate damage some marginal businesses may close, while others will open after a day's cleanup. Even with extensive damage some businesses will accelerate repair, while a number of others will close or be demolished.

9.5.4.7 Relocation Expenses

Relocation costs may be incurred when the level of building damage is such that the building or portions of the building are unusable while repairs are being made. While relocation costs may include a number of expenses, Hazus only considers disruption costs that may include the cost of shifting and transferring and the rental of temporary space. Relocation expenses are assumed to be incurred only by building owners and measured in $ per square foot per month. A renter who has been displaced from a property due to earthquake damage will cease to pay rent to the owner of the damaged property and will only pay rent to the new landlord. Therefore, the renter has no new rental expenses. It is assumed that the owner of the damaged property will pay the disruption costs for his renter. If the damaged property is owner occupied, then the owner will have to pay for his own disruption costs in addition to the cost of rent while he is repairing his building. Relocation expenses are then a function of the floor area, rental costs per day per square foot, disruption costs, and the expected days of loss of function for each damage state.

9.5.4.8 Capital-related Income

Capital-related income is a measure of the profitability of a commercial enterprise. Income losses occur when building damage disrupts commercial activity. Income losses are the product of floor area, income realized per square foot and the expected days of loss of function for each damage state. The U.S. Department of Commerce's Bureau of Economic Analysis reports regional estimates of capital-related income by economic sector. Capital-related income per square foot of floor space can then be derived by dividing income by the floor space occupied by a specific sector. Income will vary considerably depending on regional economic conditions. Therefore, default values need to be adjusted for local conditions. Default values were derived from information in Table 4.7 of ATC-13.

9.5.5 Selecting Analysis Options and Running an Analysis

When the study region inventory, hazard, and analysis parameters have been specified, you are ready to run an analysis. Select the **Analysis | Run** menu option to display the Analysis Options dialog shown in Figure 9-54.

Because they are interrelated through the tree blowdown analysis, the first three major categories (Direct Physical Damage, Induced Physical Damage, and Direct Social and Economic Loses) are always selected in the Hurricane Model.
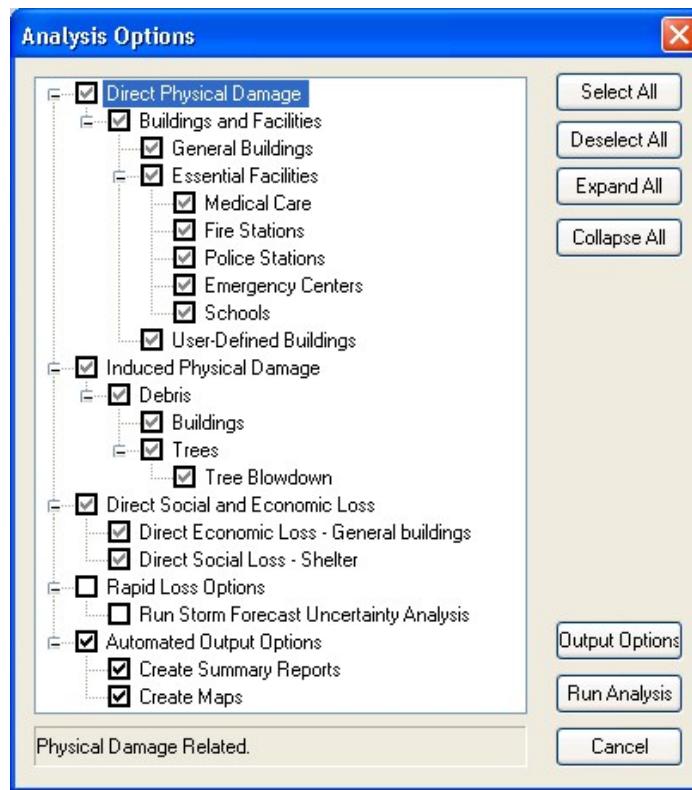
9.5.5.1 Rapid Loss Options

The Rapid Loss Option is available for user-defined or Hurrevac import hurricane scenarios that meet the requirements listed in Section 9.3.2.5. The Rapid Loss Option

causes the Hurricane Model to execute an ensemble of 100 possible realizations given the known and forecast points on the storm track. The result is a range of possible outcomes (5th and 95th percentiles) reflecting the historical accuracy of National Hurricane Center hurricane track and intensity forecasts.

9.5.5.2   Automated Outputs Options

The Automated Output Option allows you to specify a set of Summary Reports and map layers to be automatically produced by the Hurricane Model at the conclusion of the analysis. The selected summary reports are output as PDF documents to a subfolder of the study region folder that has the name of the hurricane scenario. The selected map layers are automatically added to the map.

Figure 9-54. Analysis Options Dialog.

9.5.5.3   Storm Surge Options

The **Storm Surge** Options are available for four of the five of the single event hurricane scenario types (manual, Hazus import, historical, and Hurrevac import), but not for H*Wind or probabilistic scenarios. To run a coastal surge analysis, the study region must have been created for both Hurricane and Flood Hazard analysis and the Hurricane **Analysis | Set Optimized Analysis Mode** must be "Off".
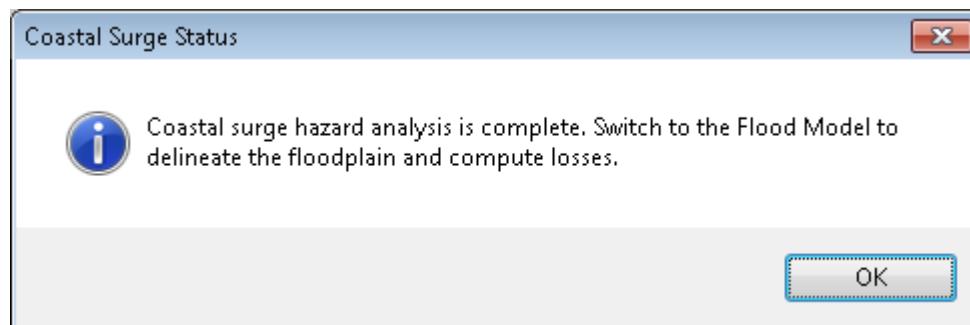
When coastal surge is selected, a storm surge analysis using the NOAA SLOSH model is executed in the Hurricane Model to produce estimates of coastal still water elevations. Note that the storm track used should extend beyond the outer boundary of the applicable SLOSH basin grids. In addition there are options for running coupled surge and wave analysis using the Delft University SWAN model:

- **Deep water and near shore wave models**. A coarse analysis of the entire northwest Atlantic basin is run and the results are then coupled into one or more nearshore wave grids, which are superimposed on the relevant SLOSH basin(s). This option is the most detailed and slowest running. The storm track used should also extend all the way out to 60 degrees west longitude when this option is selected.

- **Near shore wave model only**. This option runs a coupled surge and wave analysis just within the relevant SLOSH basin(s). This option is faster than the first option, but still significantly slower running than the "no waves" option.

- **No waves**. This option skips the SWAN model entirely. For this case, the Flood Model assumes depth-limited waves at the coastline rather than using significant wave heights produced by SWAN. This is the fastest running option.

When you start the analysis, the Hurricane Model will prompt you for an **initial water level** in feet with respect to the NAVD 1988 datum. This represents the water level along the coast that would have been expected near the center of the study region at the time of hurricane landfall that would have been expected in the absence of any hurricane. The initial water level can be estimated by using NOAA tide forecasts plus the pre-storm tidal anomaly (i.e., the difference between the forecast and observed water level two days before landfall).

When running a coastal surge hazard analysis in the Hurricane Model a second progress dialog will appear after the wind-only damage and loss calculations are completed.

When the coastal surge analysis is complete, click on the **Analysis | Show Coastal Surge Status** to confirm that the analysis was successful. You should see the dialog shown below.

Figure 9-55. Analysis Options Dialog.

At this point you can switch to the Hazus Flood Model to complete the analysis. Please refer to the *Hazus Flood User Manual* for step-by-step instructions on how to complete the coastal surge analysis and view the depth grid results and the combined wind and surge losses in the Flood Model. Additional information on viewing the combined wind and surge losses in the Hurricane Model after returning from the Flood Model is provided in Section

Chapter 10. Viewing and Reporting the Results

This chapter describes the results tables, maps, and reports produced by the Hurricane Model. The items discussed are accessed via the **Results** menu after running a scenario or probabilistic analysis.

10.1 Guidance for Reporting Loss Results

There is no single format that is appropriate for presentation of loss study results. The format will depend on the use of the results and the intended audience. The audience can vary from the general public to technical experts. Decision makers such as city council members and other government officials may require only summaries of losses for a region. Emergency response planners may want to see the geographical distribution of all losses and damage for several different hurricane scenarios. Hazus provides a great deal of flexibility in presenting results. Results can be presented in a tabular or map form. The users of the results should be involved from the beginning in determining the types and formats of the results that best suit their needs.

In previous loss studies, authors of reports have had the difficult task of trying to combine the study results with the theory of how they were calculated. Consequently, reports often seemed overly technical, reducing their readability and usefulness for many audiences. Hazus-MH users can refer to the *Technical Manual*, which describes all of the theories and equations that provide the basis of any loss estimate. Thus, reports do not need to, and probably should not include technical discussions of theory. Instead, reports should focus on describing results in non-technical language that is easily understood by the intended audience.

While no particular format for presenting results can be recommended, several general statements about reporting of results can be made. Reports should serve to clarify the meaning of the loss estimates. For example, the report should indicate whether losses are due only to building and contents damage or if they also include monetary losses resulting from loss of function. It should be clarified that losses are not calculated for individual buildings, but instead are based on the performances of entire classes of buildings. These are just a few examples of the types of clarifications that should appear in reports.

Reports should also clarify for the reader what assumptions were made in developing the scenario and inventory and in calculating losses. For example, were losses based on default inventories or were default inventories augmented? Were default analysis parameters used? If not, what values were used? What assumptions were made in selecting the scenario hurricane? Is it based on an historical event? Is it based on an expected probability of occurrence (e.g., a 100-year return period event)? What types of assumptions were made about the building stock?

A criticism of past studies is that there has been little qualitative or quantitative treatment of uncertainty. Discussions with users of previous studies have indicated that users need information about where errors in prediction are most likely to occur. While this methodology does not explicitly include a technique for carrying the uncertainty of each variable through the entire set of calculations, sensitivity analyses are useful for providing bounds on loss estimates. At a minimum, reports should make some statement about the uncertainty of the input values.

10.2 Differences Between Probabilistic and Scenario Results

There are important differences in the format of the results for a probabilistic analysis compared to a scenario analysis. Scenario results represent the expected damage and loss from a single hurricane event, while probabilistic results represent the range of probable losses estimated from a 100,000-year simulation of expected hurricane activity.

In all of the probabilistic results displays, you will see sample results for seven different return periods ranging from 10 years to 1,000 years. Regardless of the result being displayed, the seven return period sample events are selected based solely on the total direct economic loss for the entire study region. This approach ensures that all of the results for a given return period come from the same simulated event.

- For example, the 100-year shelter estimate is the shelter demand that was computed in the single hurricane event that produced a total direct loss that was exceeded by other events in 1,000 (i.e., 1/100) of the 100,000 years in the simulation. A return period of 100 years corresponds to a 1% chance per year or equaling or exceeding the computed total direct loss shown for the 100-year event.

- *A possible consequence of the methodology used in the hurricane model to select the sample return period events is that **some damage or loss estimates (other than the total direct economic loss for the entire study region) may decrease as the return period increases.** This apparently counterintuitive result is simply a reflection of the randomness of damage and loss concentrations within the study region from event to event, and it is more likely to occur as the geographic size of the study region increases.* [8]

In addition to return period loss estimates, the direct economic loss results for a probabilistic analysis also include annualized loss estimates (see Chapter 10.9). Annualized losses are simply the total losses summed over the entire simulation period divided by 100,000 years. Annualized losses are very useful for comparing loss estimates from different locations or comparing the risks posed be different hazards at a single

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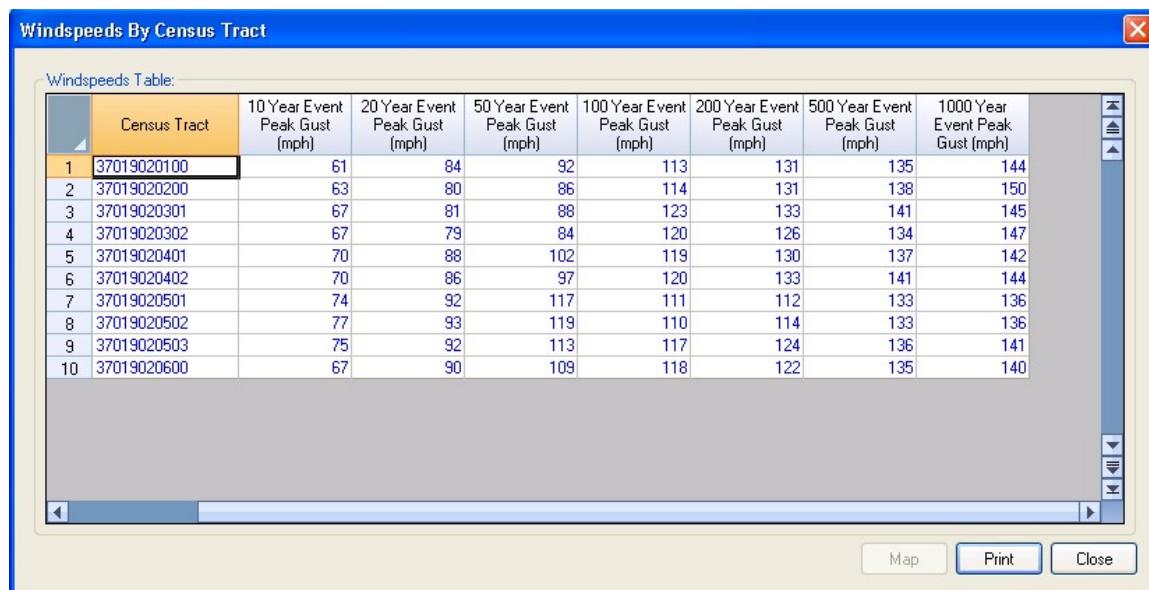
[8] When viewing return period sample event results for large study regions (e.g., entire states), it is likely that one or more counties will have little or no damage. This is to be expected since no single storm can cause damage throughout a large study region. To obtain accurate return period results for a specific county or metropolitan area, your study region must be restricted to the specific area of interest.

location. Annualized losses are also very useful in evaluating the potential benefits of mitigation.[9]

The screen faces shown in the following sections are all taken from a probabilistic analysis.

10.3 Wind Speeds

The **Results | Wind Speeds** command allows you to view and map the peak wind speeds for the current hazard by census tract. The wind speeds shown are the estimated maximum 3-second gusts in open terrain at 10m above ground at the centroid of each census tract. To display the data on the study region map, select the appropriate column and click on the **Map** button.

	Census Tract	10 Year Event Peak Gust (mph)	20 Year Event Peak Gust (mph)	50 Year Event Peak Gust (mph)	100 Year Event Peak Gust (mph)	200 Year Event Peak Gust (mph)	500 Year Event Peak Gust (mph)	1000 Year Event Peak Gust (mph)
1	37019020100	61	84	92	113	131	135	144
2	37019020200	63	80	86	114	131	138	150
3	37019020301	67	81	88	123	133	141	145
4	37019020302	67	79	84	120	126	134	147
5	37019020401	70	88	102	119	130	137	142
6	37019020402	70	86	97	120	133	141	144
7	37019020501	74	92	117	111	112	133	136
8	37019020502	77	93	119	110	114	133	136
9	37019020503	75	92	113	117	124	136	141
10	37019020600	67	90	109	118	122	135	140
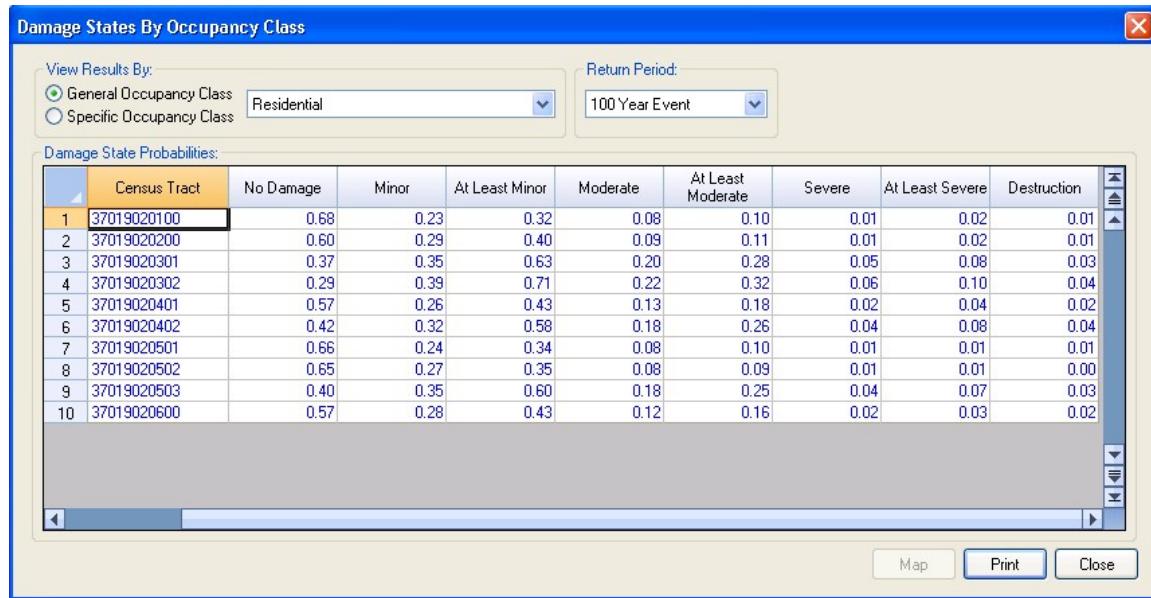
Figure 10-1. Wind Speed Results.

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[9] Unlike return period loss results, annualized losses for specific counties or census tracts do not depend on the size of study region. Therefore, it is not necessary to create separate study regions for each county in a state to compute the annualized losses for each county.

10.4   General Building Stock

The **Results | General Building Stock** command allows you to view and map the general inventory damage results either by occupancy or building type. The values in the table represent the expected fraction of building square footage in each damage state.

For probabilistic scenarios, the drop-down box allows you to select one of seven sample return period events (e.g., 10-year return period event, 20-year return period event, etc.).

Damage States By Occupancy Class

View Results By:
- ◉ General Occupancy Class
- ○ Specific Occupancy Class   [Residential ▾]

Return Period: [100 Year Event ▾]

Damage State Probabilities:

	Census Tract	No Damage	Minor	At Least Minor	Moderate	At Least Moderate	Severe	At Least Severe	Destruction
1	37019020100	0.68	0.23	0.32	0.08	0.10	0.01	0.02	0.01
2	37019020200	0.60	0.29	0.40	0.09	0.11	0.01	0.02	0.01
3	37019020301	0.37	0.35	0.63	0.20	0.28	0.05	0.08	0.03
4	37019020302	0.29	0.39	0.71	0.22	0.32	0.06	0.10	0.04
5	37019020401	0.57	0.26	0.43	0.13	0.18	0.02	0.04	0.02
6	37019020402	0.42	0.32	0.58	0.18	0.26	0.04	0.08	0.04
7	37019020501	0.66	0.24	0.34	0.08	0.10	0.01	0.01	0.01
8	37019020502	0.65	0.27	0.35	0.08	0.09	0.01	0.01	0.00
9	37019020503	0.40	0.35	0.60	0.18	0.25	0.04	0.07	0.03
10	37019020600	0.57	0.28	0.43	0.12	0.16	0.02	0.03	0.02

[Map]   [Print]   [Close]

Figure 10-2. General Building Stock Damage Results.

10.5 Essential Facilities

The **Results | Essential Facilities** command allows you to view and map the damage and loss of use results for hospitals, police stations, fire stations, emergency operations centers, and schools.

For probabilistic scenarios, the drop-down box allows you to select one of seven sample return period events (e.g., 10-year return period event, 20-year return period event, etc.).

Figure 10-3. Essential Facilities Damage Results.

10.6 User-Defined Facilities

The **Results | User-Defined Facilities** command allows you to view and map the damage results for individual, user-specified facilities. Damage probabilities are provided for overall building damage.

For probabilistic scenarios, the drop-down box allows you to select one of seven sample return period events (e.g., 10-year return period event, 20-year return period event, etc.).

Figure 10-4. User-Defined Facilities Damage Results.

10.7 Debris

The **Results | Debris** command allows you to view and map building and tree debris results by census tract.

For probabilistic scenarios, the drop-down box allows you to select one of seven sample return period events (e.g., 10-year return period event, 20-year return period event, etc.).

The Eligible Tree Debris columns provide estimates of the weight and volume of downed trees that would likely be collected and disposed at public expense. As discussed in Chapter 12 of the *Hazus-MH Hurricane Model Technical Manual*, the eligible tree debris estimates produced by the Hurricane Model tend to underestimate reported volumes of debris brought to landfills for a number of events that have occurred over the past several years. This indicates that that there may be other sources of vegetative and non-vegetative debris that are not currently being modeled in Hazus.

For landfill estimation purposes, it is recommended that the Hazus debris volume estimate be treated as an approximate lower bound. Based on actual reported debris volumes, it is recommended that the Hazus results be multiplied by three to obtain an approximate upper bound estimate. It is also important to note that the Hurricane Model assumes a bulking factor of 10 cubic yards per ton of tree debris. If the debris is chipped prior to transport or disposal, a bulking factor of 4 is recommended. Thus, for chipped debris, the eligible tree debris volume should be multiplied by 0.4.

Debris Analysis Results

Return Period:
100 Year Event

Table:

	Census Tract	Brick/ Wood (tons)	Concrete/ Steel (tons)	Eligible Tree Weight (tons)	Eligible Tree Volume (cubic yards)	Trees (tons)	Tree Volume (cubic yards)
1	37019020100	2,861	51	13,372	133,723	121,567	1,215,665
2	37019020200	1,707	27	18,575	185,747	265,353	2,653,527
3	37019020301	2,025	14	11,624	116,235	89,412	894,118
4	37019020302	1,807	29	8,833	88,334	15,497	154,972
5	37019020401	2,655	47	11,295	112,951	53,786	537,864
6	37019020402	2,671	92	8,480	84,798	13,046	130,458
7	37019020501	1,743	28	8,557	85,566	142,610	1,426,103
8	37019020502	1,945	21	11,068	110,681	55,341	553,406
9	37019020503	2,783	126	9,088	90,884	18,934	189,341
10	37019020600	2,290	41	24,147	241,466	603,666	6,036,661

Print   Map   Close

Figure 10-5. Debris Results.

10.8 Shelter

The **Results | Shelter** command allows you to view and map the estimated number of displaced households and the estimated short-term shelter needs by census tract.

For probabilistic scenarios, the drop-down box allows you to select one of seven sample return period events (e.g., 10-year return period event, 20-year return period event, etc.).

Figure 10-6. Shelter Results.

10.9 Buildings Economic Loss

The **Results | General Building Stock | Buildings Economic Loss** command allows you to view and map economic losses for the general building stock by census tract.

For probabilistic scenarios, the drop-down box allows you to select either annualized losses or one of seven sample return period events (e.g., 10-year return period event, 20-year return period event, etc.).
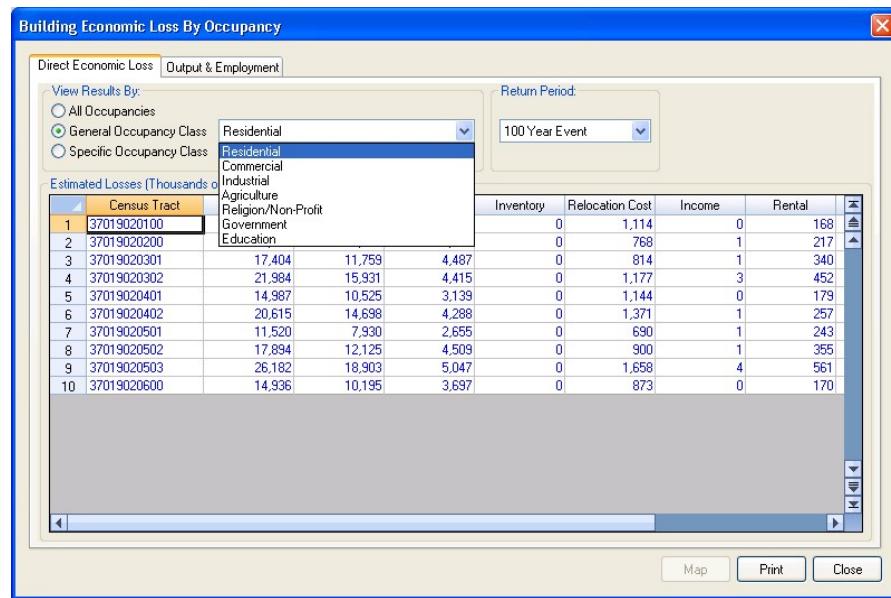
Figure 10-7. Buildings Economic Loss Results – Direct Economic Losses.
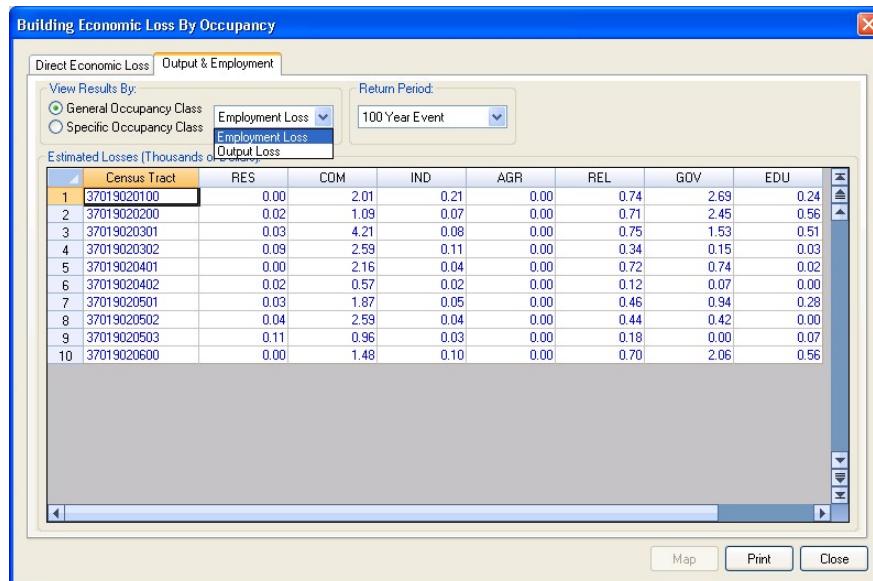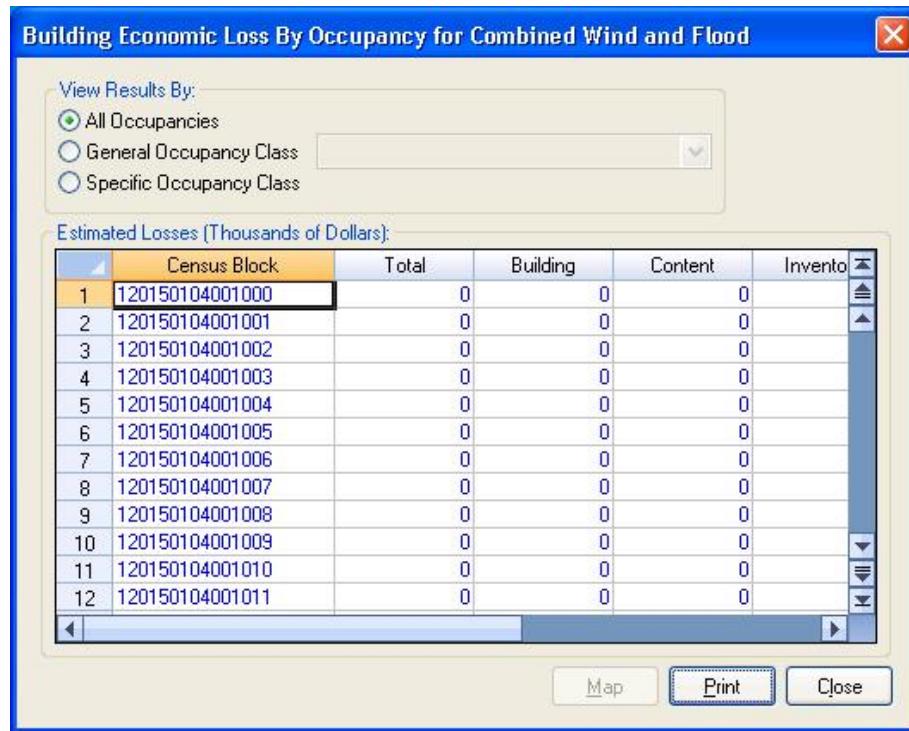
Figure 10-8. Buildings Economic Loss Results – Output and Employment Losses.

10.10 Combined Wind and Surge Loss

The **<u>Results</u> | Combined Wind and Surge Loss** command allows you to view and map combined wind and surge losses computed in the Hazus Flood Model using surge and wave grids from the Hurricane Storm Surge analysis option described in Section 9.5.5.3.

Recall that **Coastal Surge** results can be generated for four of the five of the single event hurricane scenario types (manual, Hazus import, historical, and Hurrevac import), but not for H*Wind or probabilistic scenarios. To run a coastal surge analysis, the study region must have been created for both Hurricane and Flood Hazard analysis and the Hurricane **Analysis | Set Optimized Analysis Mode** must be "Off".

Note that combined wind and surge results are available for building, content and inventory losses, but not for relocation, income, rental, or wage losses. The radio buttons and drop-down boxes allow you to filter the losses by occupancy or building type.
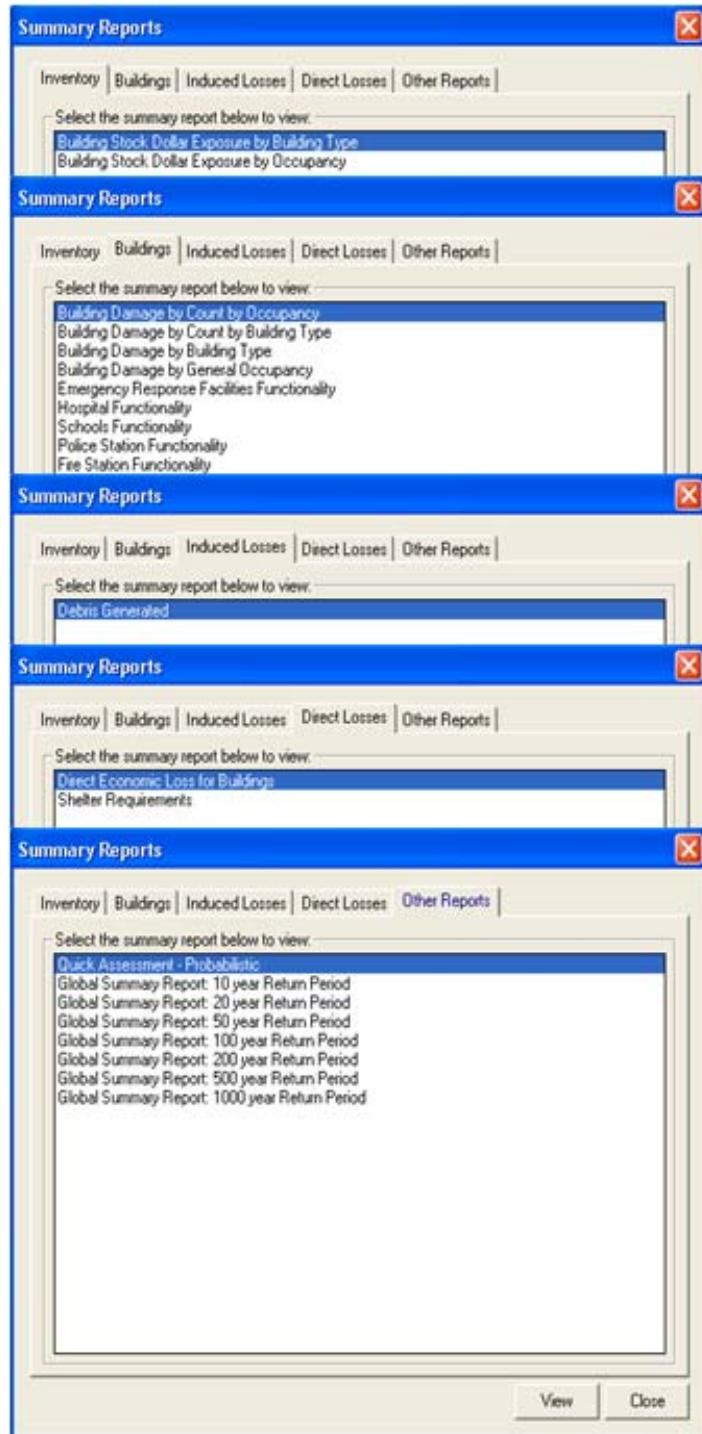
Figure 10-9. Buildings Economic Loss Results – Combined Wind and Flood.

The flood model writes the combined wind and flood results to the hzSurgeFRCombSOccupB table and the hzSurgeFRCombByBldgTypeB table in the study region database. The hzSurgeFRCombSOccupB table results are by specific occupancy and the hzSurgeFRCombByBldgTypeB table results are by general building type.

10.11 Summary Reports

The **Results | Summary Reports** command allows you to select one of several summary reports for viewing and printing. The reports will be generated using the Crystal Reports report engine.

Figure 10-10. Summary Reports Dialog.

Figure 10-11. Sample Summary Report: Building Damage by General Occupancy.
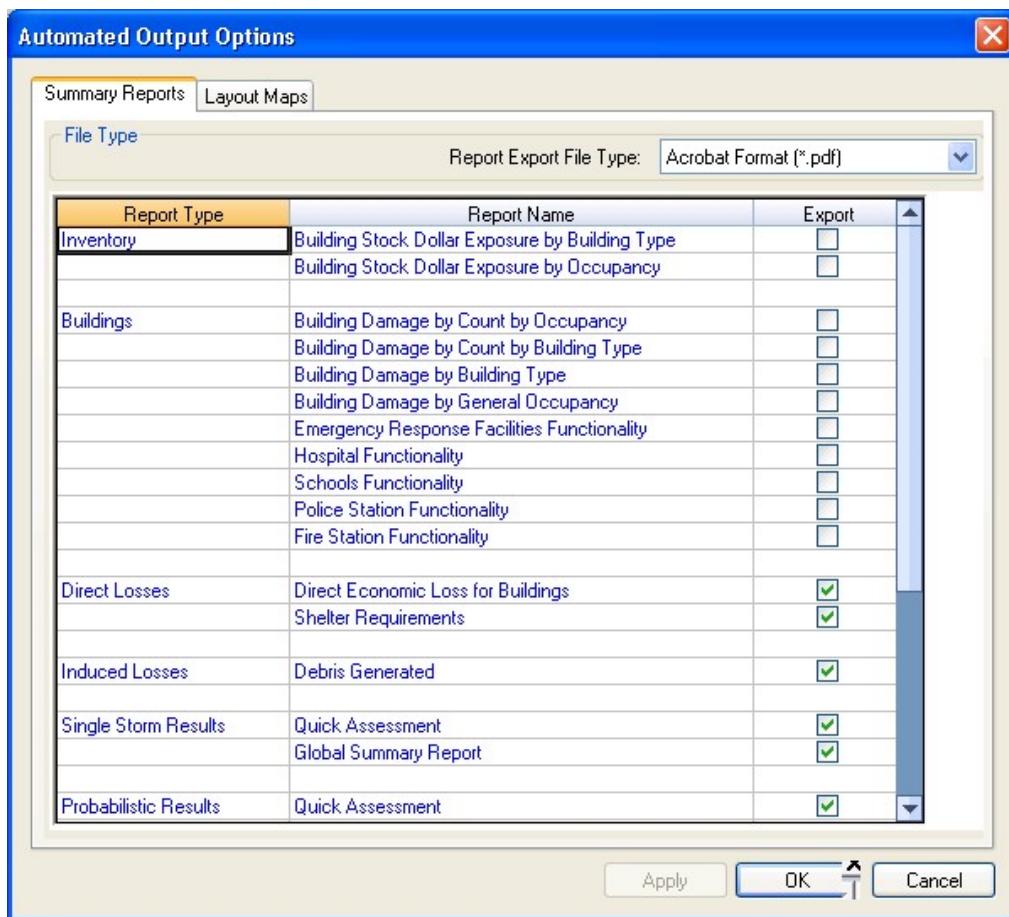
10.12 Automatic Outputs

If you have selected Automatic Outputs Options in the Analysis Options dialog, as shown in Figure 10-12, the Hurricane Model will automatically create and export your preferred summary reports and automatically add your preferred map layers to the table of contents. To review or modify your preferred summary reports and map layers, click on the **Output Options** button on the lower right side of the Analysis Options dialog. This will open the Automated Output Options dialog.
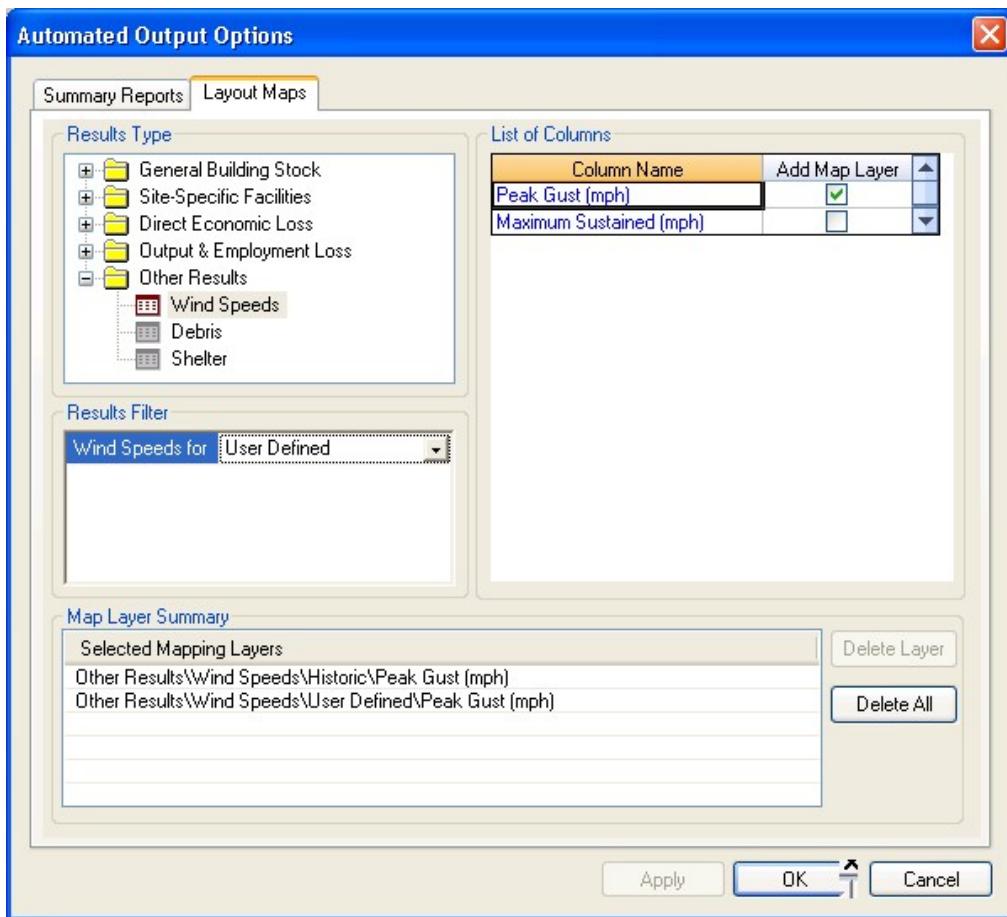
Figure 10-12. Analysis Options Dialog with Automated Output Options Selected.

On the first page of the Automated Output Options dialog (Figure 10-13), you can select your preferred summary reports. When the Automatic Outputs Option is selected the select summary reports will be created and saved in PDF format in your study region folder under a subfolder with the same name as the current scenario. Since you can run more than one analysis with the same scenario, each set of automatically generated reports is prepended with a three digit identifier. For each successive run the identifier is automatically incremented by one.

Figure 10-13. Automated Outputs – Selection of Preferred Summary Reports.
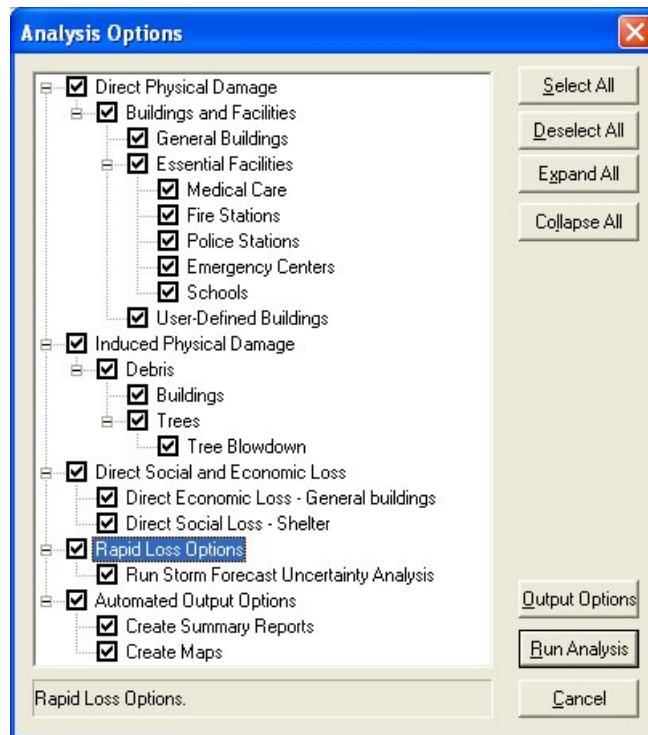
On the second page of the Automated Output Options dialog (Figure 10-14), you can select your preferred map layers. Select the Results Type and Results Filter to view a List of Columns that can be mapped, and then check your preferred the data columns. Click on the right hand side of the Results Filter to change the filter setting. The summary at the bottom of the screen lists all of the currently selected map layers. When the Automatic Outputs Option is selected the select map layers will be automatically created and added to the map table of contents.

Figure 10-14. Automated Outputs – Selection of Preferred Map Layers.

10.13 Rapid Loss Assessment with Forecast Uncertainties

If you have run a scenario analysis of expected losses using the Rapid Loss Option in the Analysis Options dialog as shown in Figure 10-15, the Hazus Hurricane Model will estimate a range of potential losses taking into account forecast uncertainties in the hurricane track and hurricane intensity. To execute this analysis you must specify which points on the user-defined hurricane scenario are known points and which points are forecast points, as discussed in Section 9.3.2.1.

Figure 10-15. Analysis Options Dialog with Rapid Loss Options Selected.

An example of a Rapid Loss Report is shown in Figure 10-16. In this hypothetical scenario, the storm is currently about one day from landfall and there is some possibility that the storm could miss the study region almost entirely, but there is also some possibility that the storm could change direction (and intensify) and cause severe damage to the study region. The forecast uncertainties model uses statistics of forecast errors compiled from the period 1993 to 2004 to simulate a range of possible outcomes and reports the 5th and 95th percentiles of the simulated outcomes. The former case represents an outcome approaching a best case scenario, producing a maximum peak gust of just 57 mph in the study region and essentially no damage. The latter case represents an outcome approaching a worst scenario, producing a peak gust wind speed of 145 mph in the study region and severe damage.

Rapid Loss Assessment Report

April 20, 2006

Study Region : Brunswick_hu
Scenario : Test2
Scenario Description : User Defined
Peak Gust Wind Speed (mph) : 57-145

Regional Statistics

Area (Square Miles)	862
Number of Census Tracts	10
Number of People in the Region	73,143

General Building Stock

Occupancy	Building Count	Dollar Exposure ($ M)
Residential	49,137	4,281
Commercial	185	342
Other	33	116
Total	49,355	4,741

Scenario Results

Number of Buildings Damaged

Damage State	Residential	Commercial	Other	Total
Minor	<10-42,000	0-200	0-30	<10-42,000
Moderate	0-30,000	0-100	0-20	0-30,000
Severe	0-15,000	0-60	0-10	0-15,000
Destruction	0-7,100	<10	0	0-7,100

Shelter Requirements

Displaced Households (# Households)	0-8,800
Short Term Shelter (# People)	0-2,200
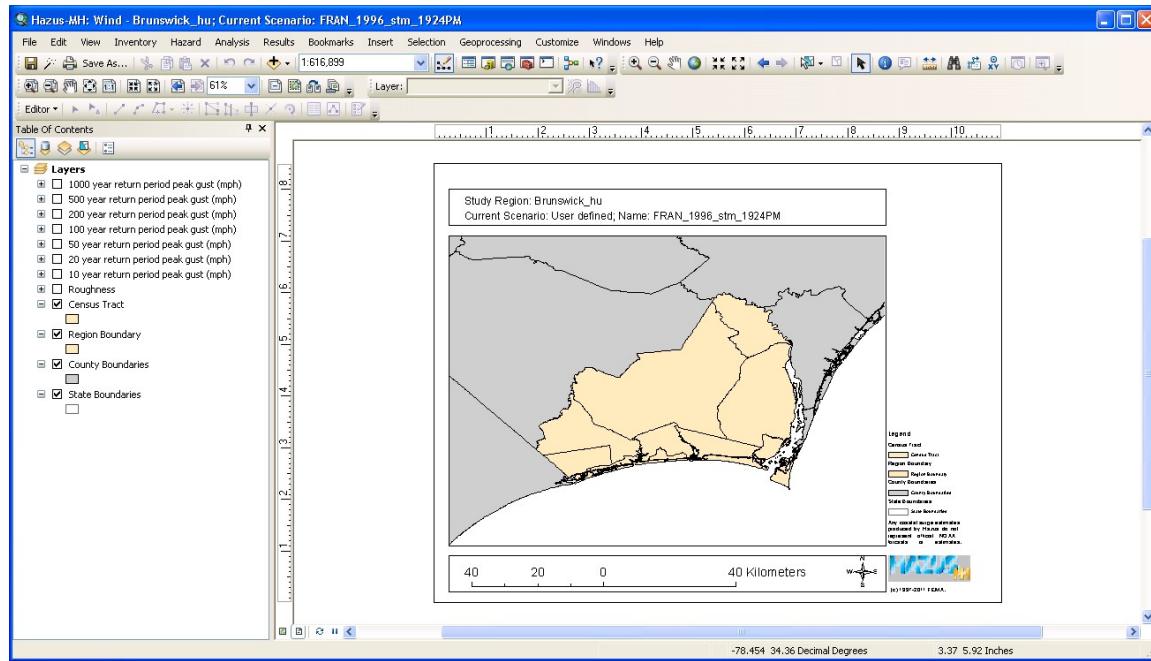
Economic Loss ($ Millions)

Capital Stock		0-2,167
Residential Property	0-2,027	
Commercial Property	0-108	
Other Property	0-32	
Business Interruption (Income)		0-436
Total Direct Economic Loss		0-2,603

Figure 10-16. Rapid Loss Report Given Forecast Uncertainties.

10.14 Hazus Map Layout

If you wish to use the default Hazus Hurricane Model map layout, select the **Apply Hazus Layout** option under the **View** menu. This action will apply the default Hazus layout to the layout view. The items added to the layout are a legend, a title box, a scale, a North arrow, and the Hazus-MH logo.

Figure 10-17. Apply Hazus Layout Menu Option.

Chapter 11. References

Applied Technology Council. 1985. *Earthquake Damage Evaluation Data for California*, ATC - 13, Redwood City, CA.

Applied Technology Council. 1991. *General Acute Care Hospital Earthquake Survivability Inventory for California: Survey Description, Summary of Results, Data Analysis and Interpretation*, ATC - 23A, Redwood City, CA.

Applied Technology Council. 1992. *Evaluation of United States Postal Service Facilities*, ATC - 26, Redwood City, CA.

Bolton, P. A., ed. (1993). *The Loma Prieta, California, Earthquake of October 17, 1989 - Public Response*. US Geological Survey; Professional Paper 1553-B.

Means, 2005. *Means Square Foot Costs,* R. S. Means Company, Inc., Kingston, MA.

Vasudevan, R., A. S. Kiremidjian, and H. C. Howard (1992). *An Integrated Inventory Methodology for Seismic Damage Assessment* - Report #102. John A. Blume Earthquake Engineering Center, Department of Civil Engineering, Stanford University, Stanford, California.

Appendix A. Hurricane Model Installation Verification Instructions

A.1   Introduction

A.1.1 Purpose

The goal of the document is to show that the Hazus-MH product can successfully generate results immediately following product installation.

This document provides a step-by-step procedure that should enable a user to start with a successfully installed Hazus-MH product and end up with a summary report.

A.1.2 Scope

This document discusses only the Hurricane model steps required to generate an initial set of results. It does not address installation or any of the other hazards. The test case is fixed: Brunswick County, North Carolina.

A.1.3 Timing

For reference, in some steps it will say that the step should take, for example, 3-5 minutes. This is to give you an idea of what to expect. The timing is based on a 2.5 GHz PC with 2 GB of RAM. Faster or slower computers will vary accordingly.
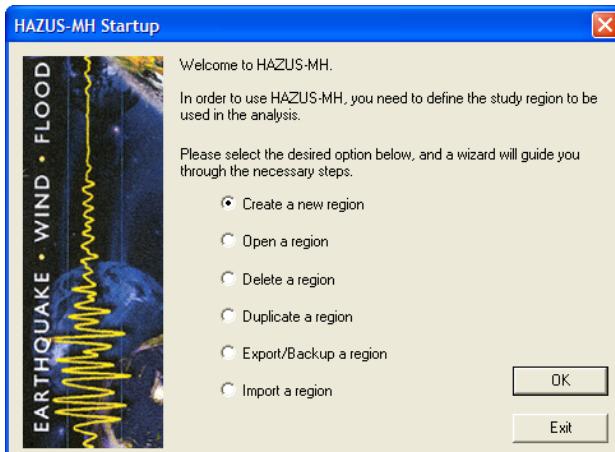
A.2   Study Region Creation Verification Procedure

This section assumes that Hazus-MH has been successfully installed. The data path pointers must point to where the CD data was copied to the hard drive. The region path needs to point to a folder where regions should be created.

The following steps will demonstrate that a hurricane study region can be created.
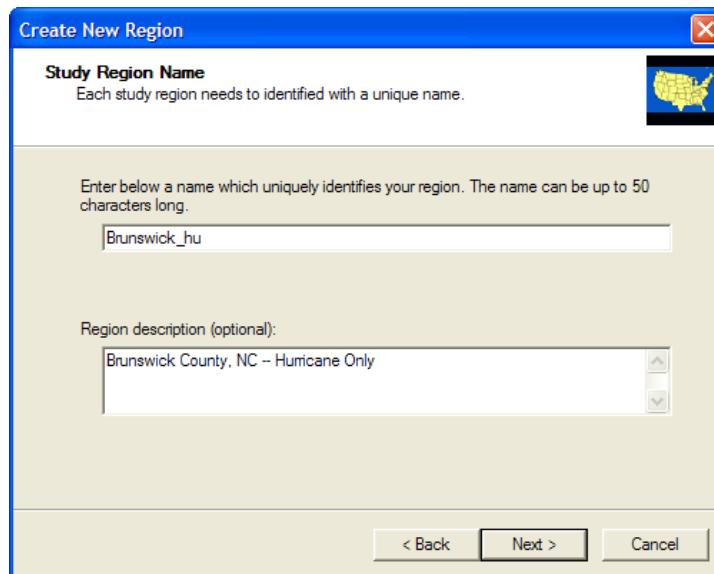
A.2.1 Select "Create a new region"

Start Hazus-MH. Use the region wizard to create a study region.
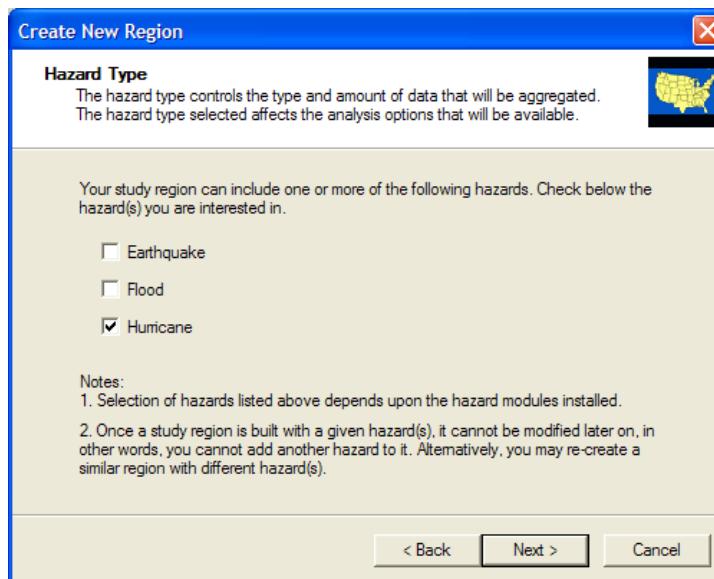
A.2.2 Enter a Name
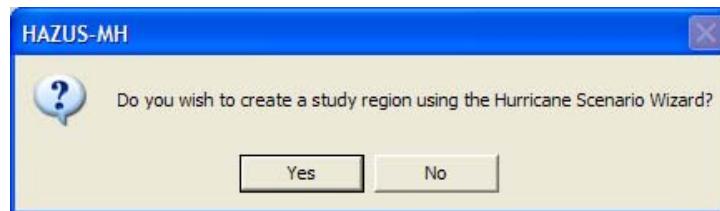
Enter a unique name for the study region, as shown below.
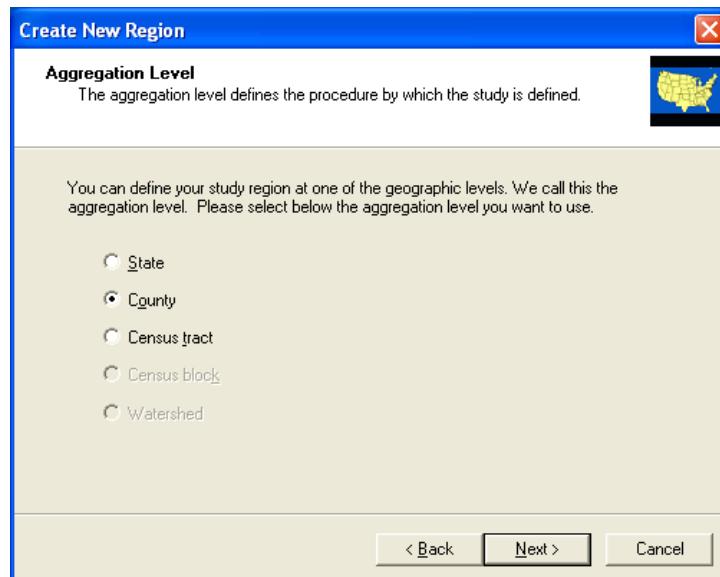
A.2.3 Select Hurricane Hazard
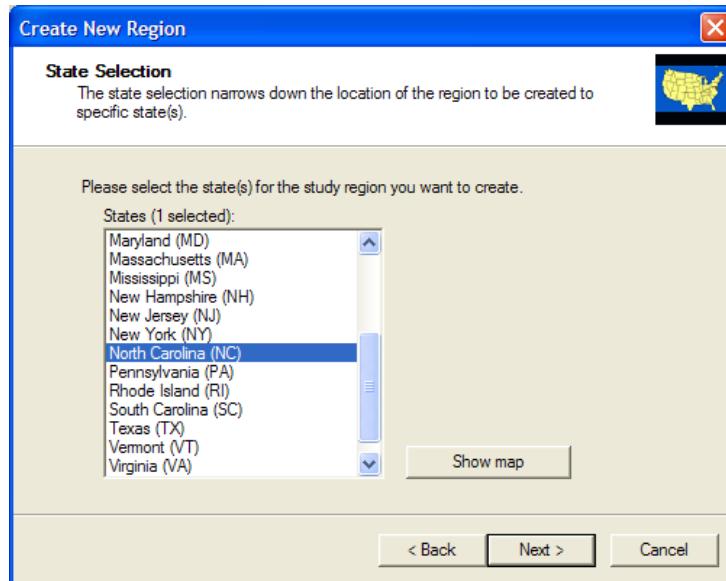
A.2.4 Select Not to Use Hurricane Scenario
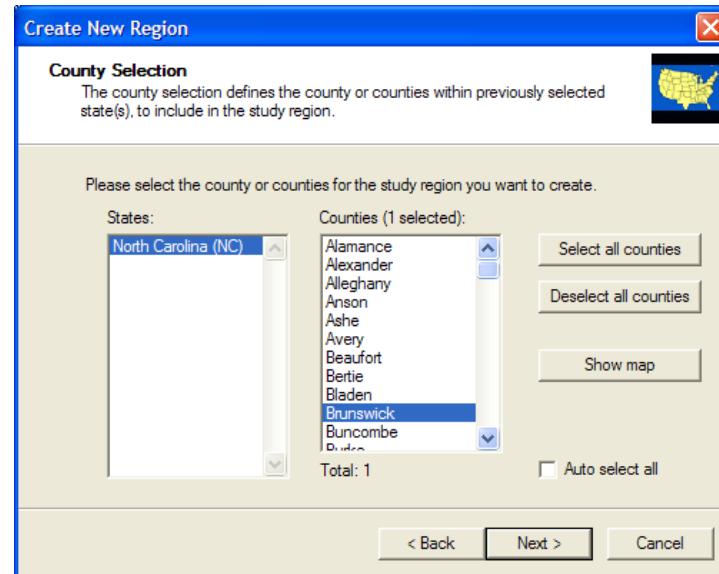
A.2.5 Select Aggregation at County Level
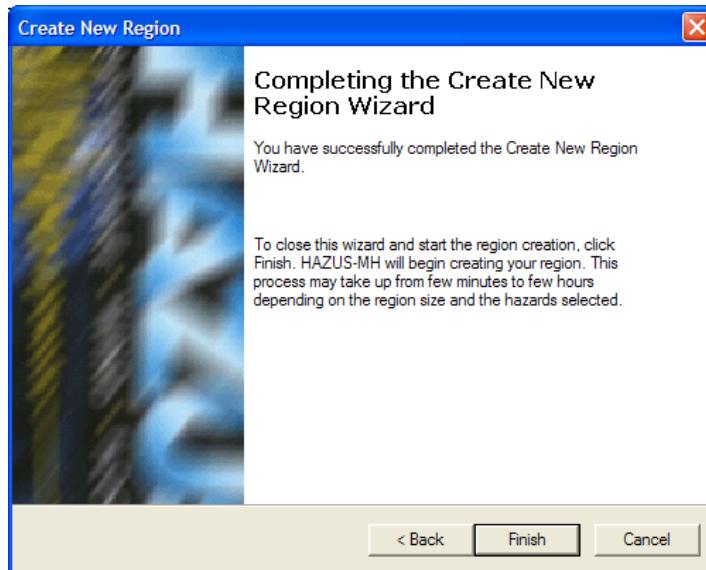
A.2.6 Select North Carolina

A.2.7 Select Brunswick County
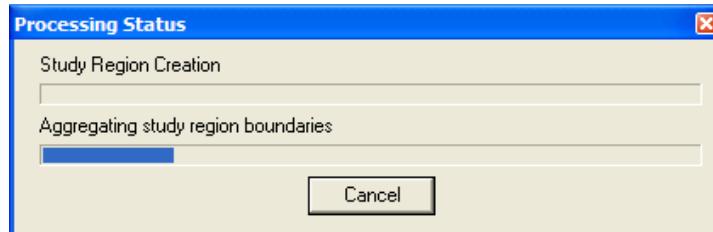
A.2.8   Finish the Wizard
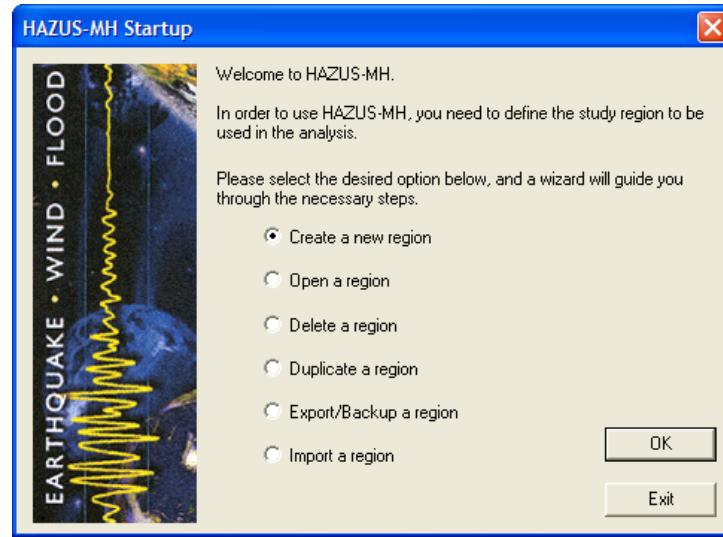
A.2.9   Wait for Region to be Created

A progress bar will display and the Hazus-MH "shell" will create the study region. It will take 2-3 minutes to create the study region.
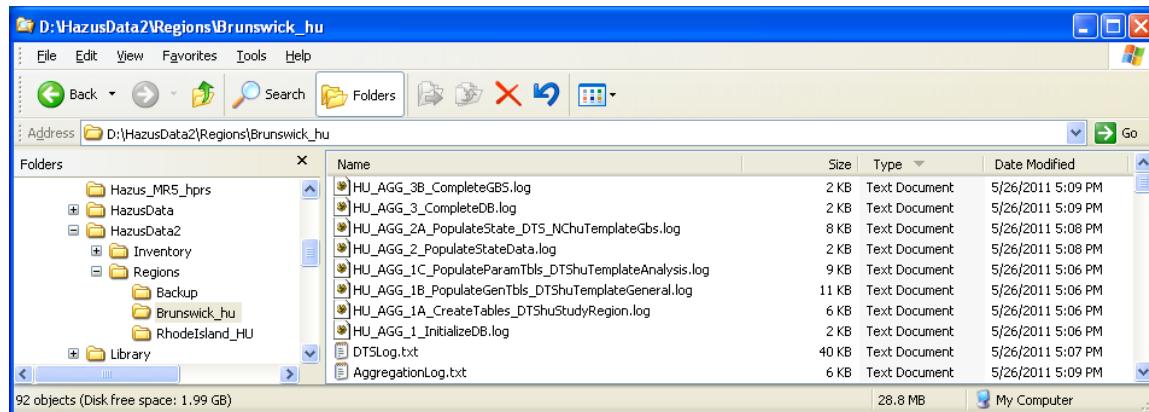
When the study region creation process is complete, you should see the following screen:

A folder with the study region name should be created underneath the folder where regions are kept (the default location is C:\Program Files\Hazus-MH\ but in the default example shown below the study regions are stored in D:\Hazus_StudyRegions). There should be many files in that folder, but the following files are of particular interest:

- Hazushu.mxd: This file should have a size of approximately 49 KB.

- DTSLog.txt and AggregationLog.txt: These files contain the shell's log of the creation process. Should anything not work properly, these will be key files to examine.

- Several additional text files contain logs of the hurricane portion of the study region process. Should the software indicate a failure in the hurricane aggregation process, these will be key files to examine.
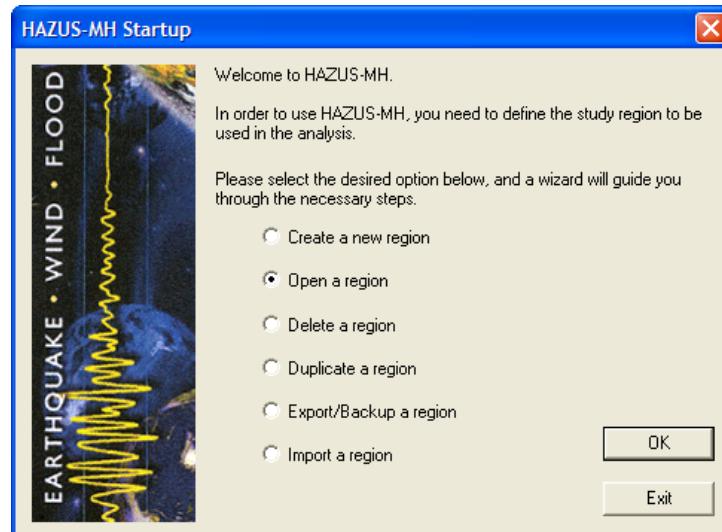
A.3   Study Region Open Verification Procedure

These steps will demonstrate that a hurricane study region can be opened.
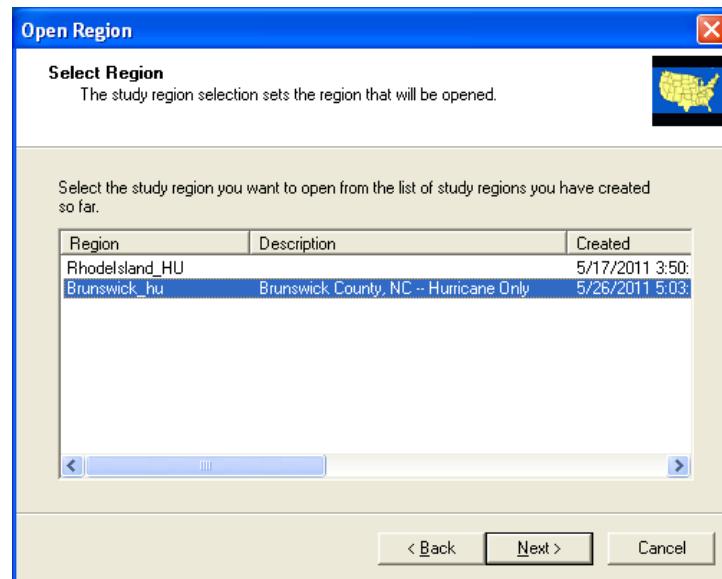
A.3.1 Open the New Region

When the creation process ended, the progress and creation dialogs should have gone away leaving the region wizard dialog on screen. Select "Open a region" and click "Next".
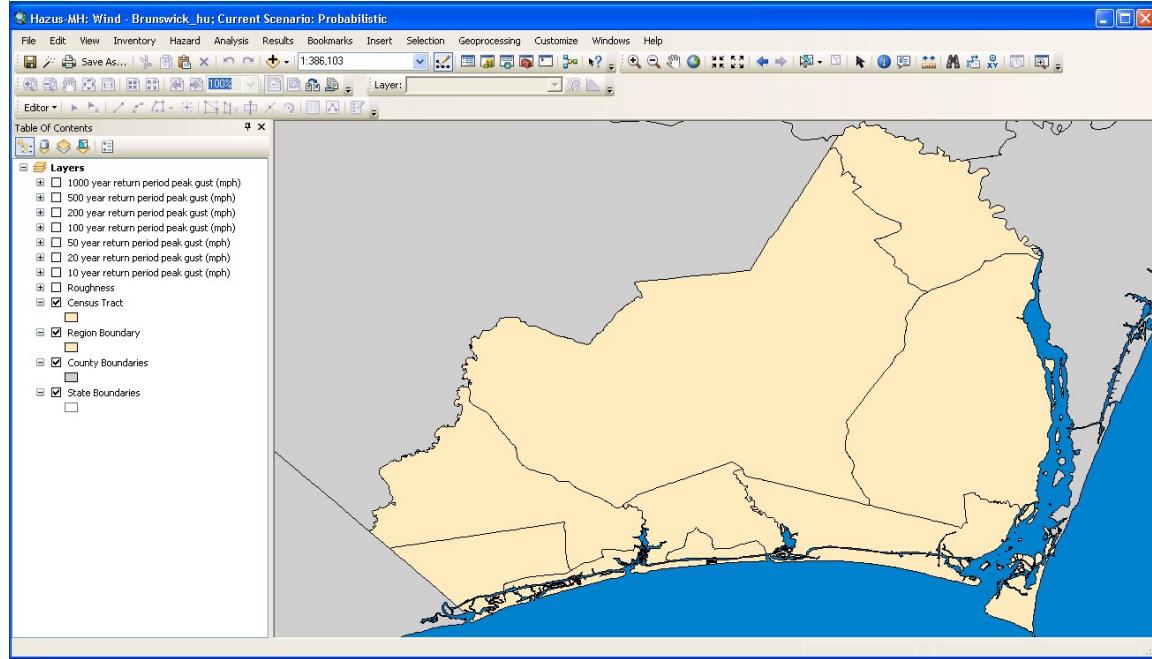
A.3.2 Select the New Region

The region you created will be the only one listed if this is the first region you have created. In the snapshot below, it was not the first. But pick the one you created and step through the rest of the wizard.

A.3.3 Initial Display

Once the region opens it should look like this. The key elements to ensure are that the study region name is in the title bar, the Inventory, Hazard, Analysis, and Results menu items exist, and the ten default layers are in the table of contents.

A.4   Inventory Verification

These steps will demonstrate that the Inventory menu items are functional and that inventory and certain occupancy mapping data were created.

A.4.1   General Build Stock Check

Use menu item Inventory | General Building Stock | Square Footage and ensure this displays. Close the dialog when finished.
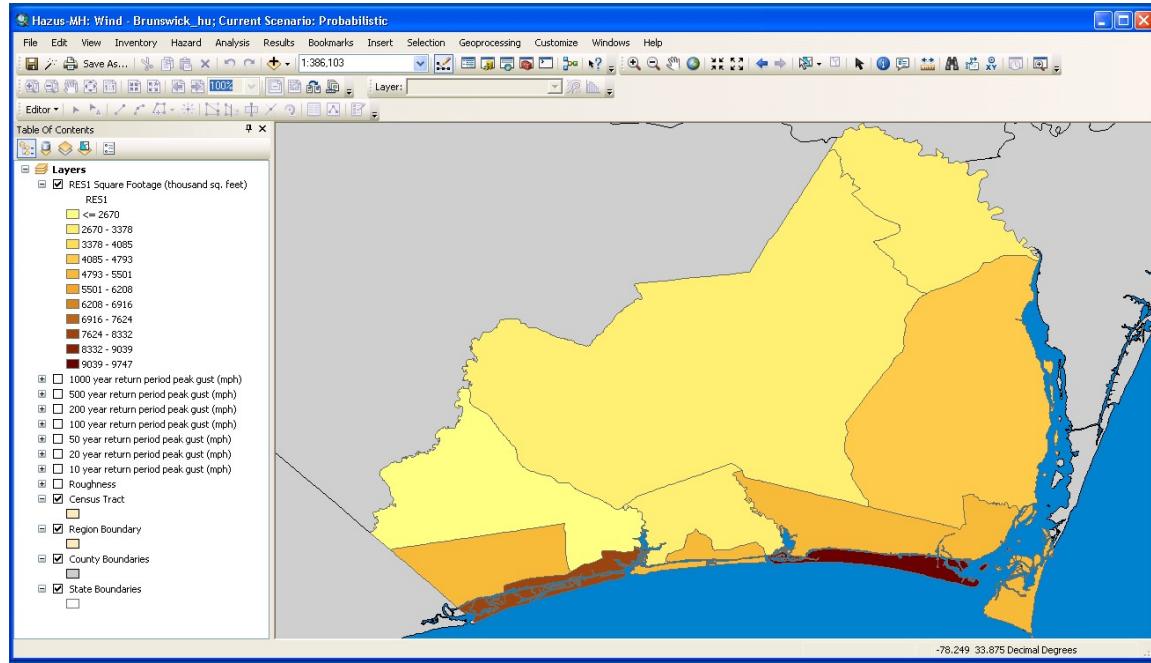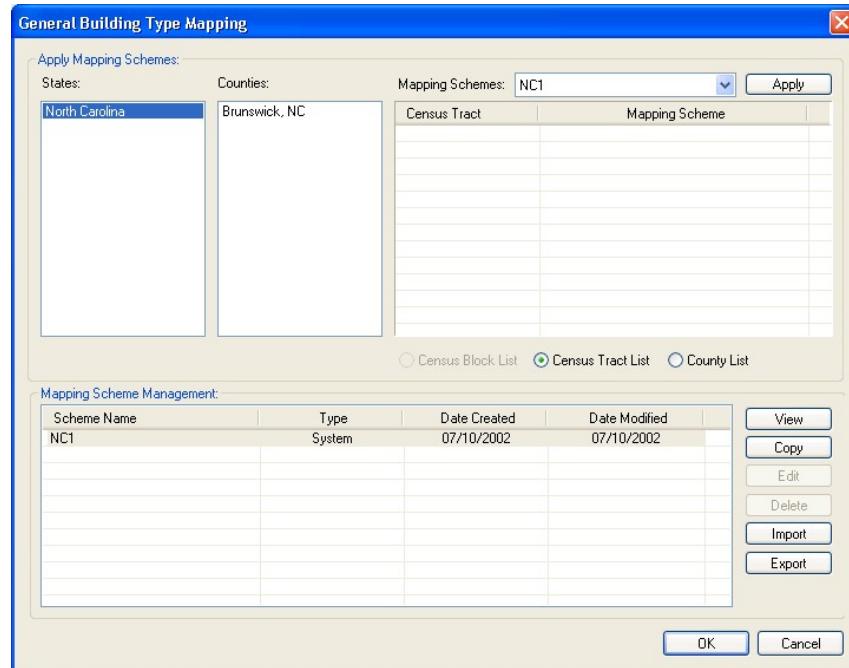
A.4.2 Shade by Res1

Click on the RES1 column header to select column RES1. The Map button should become enabled. Press Map. A new shaded layer should add to the map and show the distribution of RES1 occupancies. Click OK to close the dialog when finished.
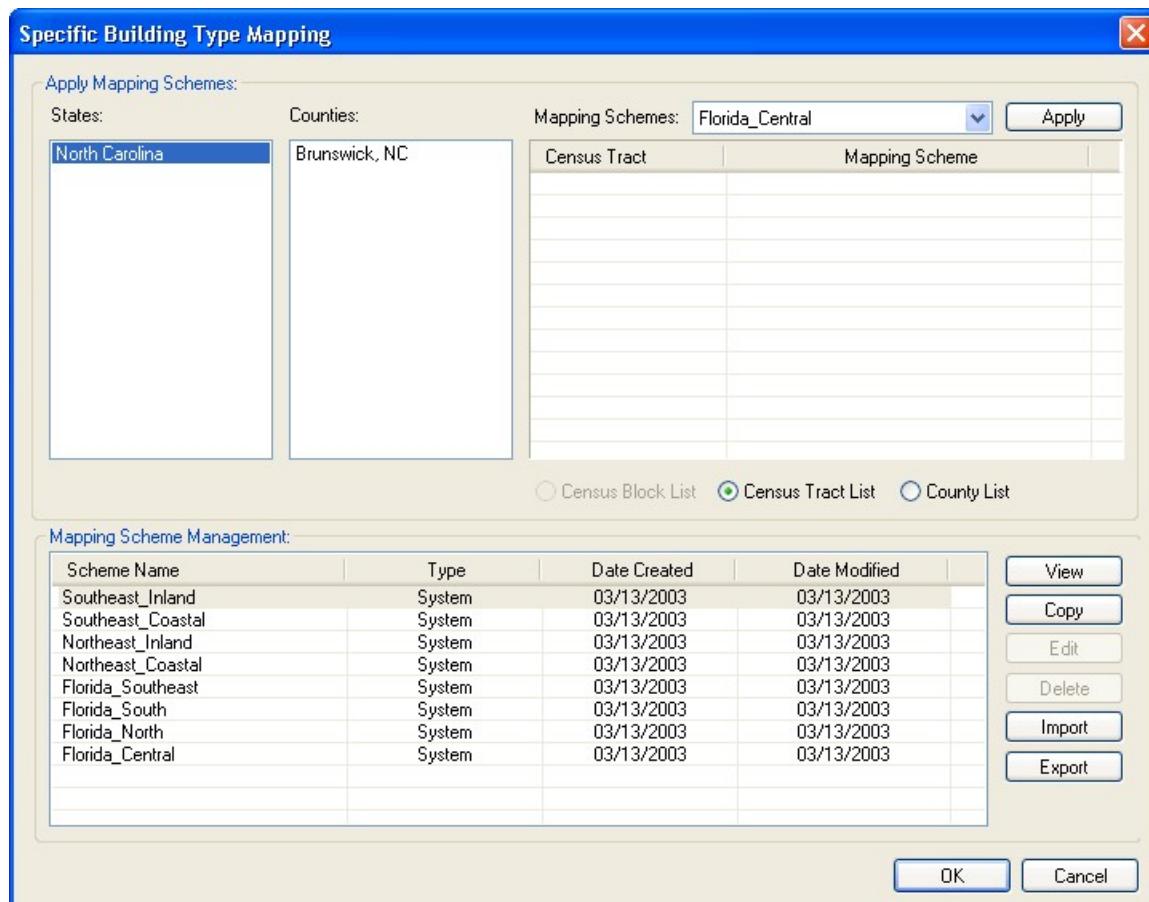
A.4.3 General Building Type Mapping Check

Use menu item Inventory | General Building Stock | General Building Type Mapping and ensure this displays.

If you select "Brunswick, NC" in the Counties list box, a list of the census tracts will appear in the top right list box along with the name of the mapping schemes assigned to each tract. You can change the assignments by selecting one or more tracts and then picking a different mapping scheme name from the drop-down list box in the top right corner of the dialog. When there is only one scheme name shown in the list in the bottom
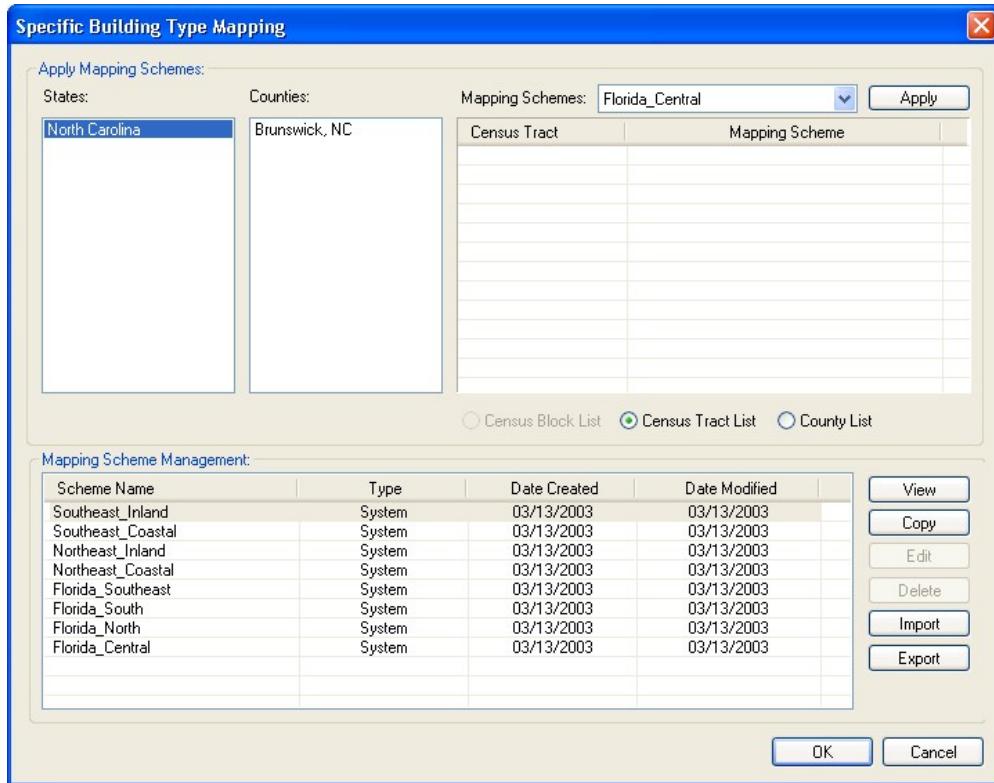
half of the screen (as in the example shown above), there will only be one choice in the drop-down list box in the top right corner.

Close the dialog.

A.4.4 Specific Building Type Mapping Check
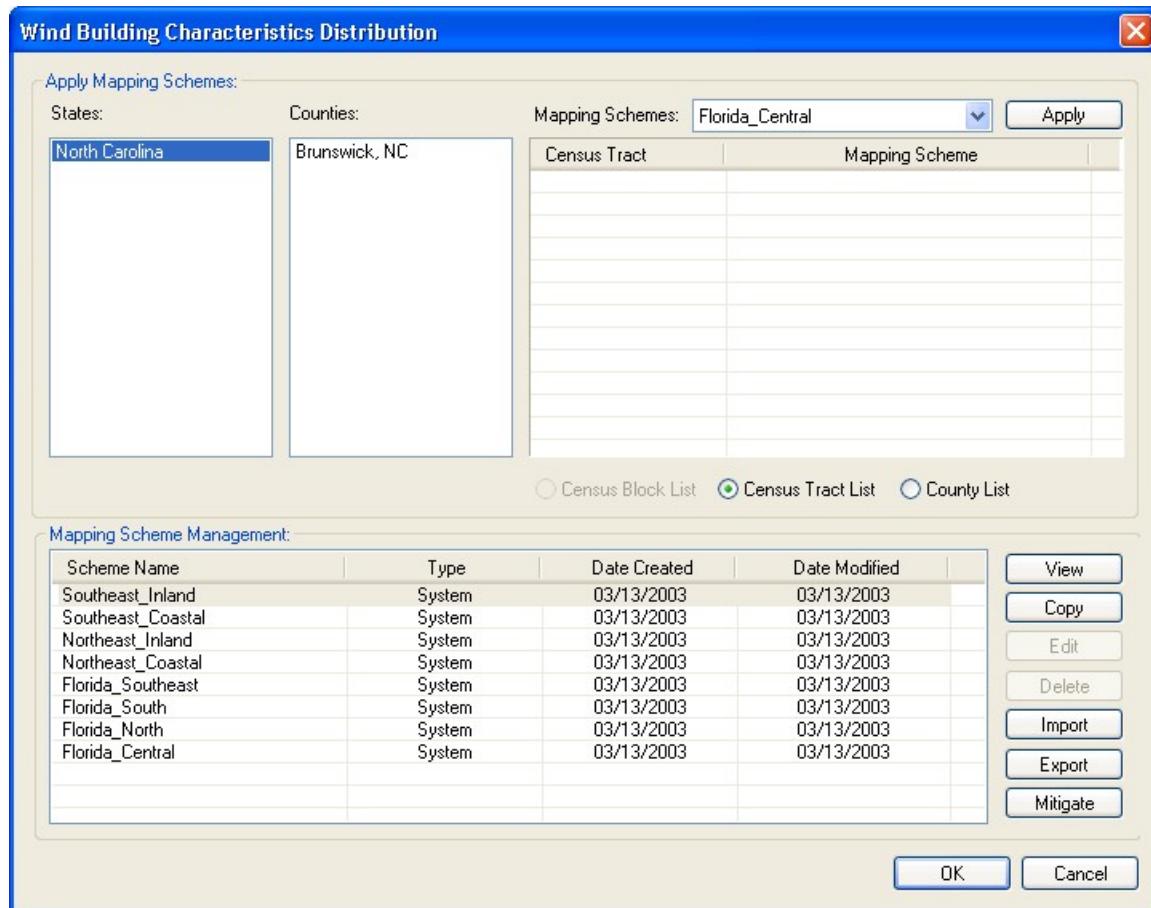
Use menu item Inventory | General Building Stock | Specific Building Type Mapping and ensure this displays.
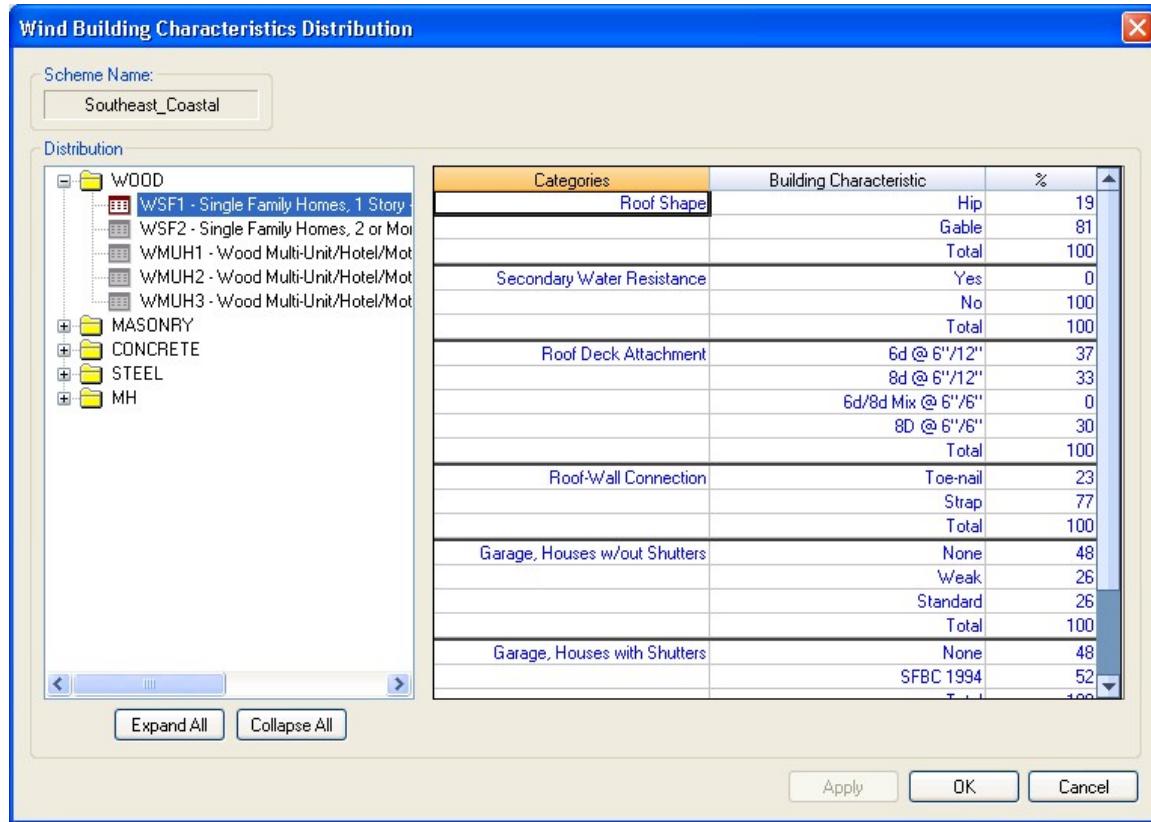
Close the dialog.

A.4.5 Wind Building Characteristics Distribution Check

Use menu item Inventory | General Building Stock | Wind Building Characteristics Distribution and ensure this displays.
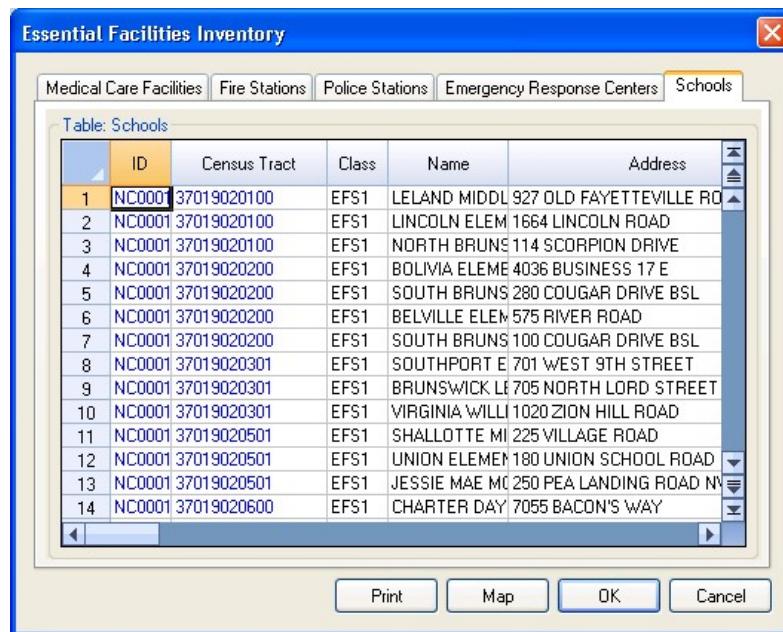
Select the second row in the lower grid. Press the View button, expand the tree on the left, select Wood | WSF1, and ensure this displays. Close the dialog when you are finished.

Also close the Wind Building Mapping dialog.
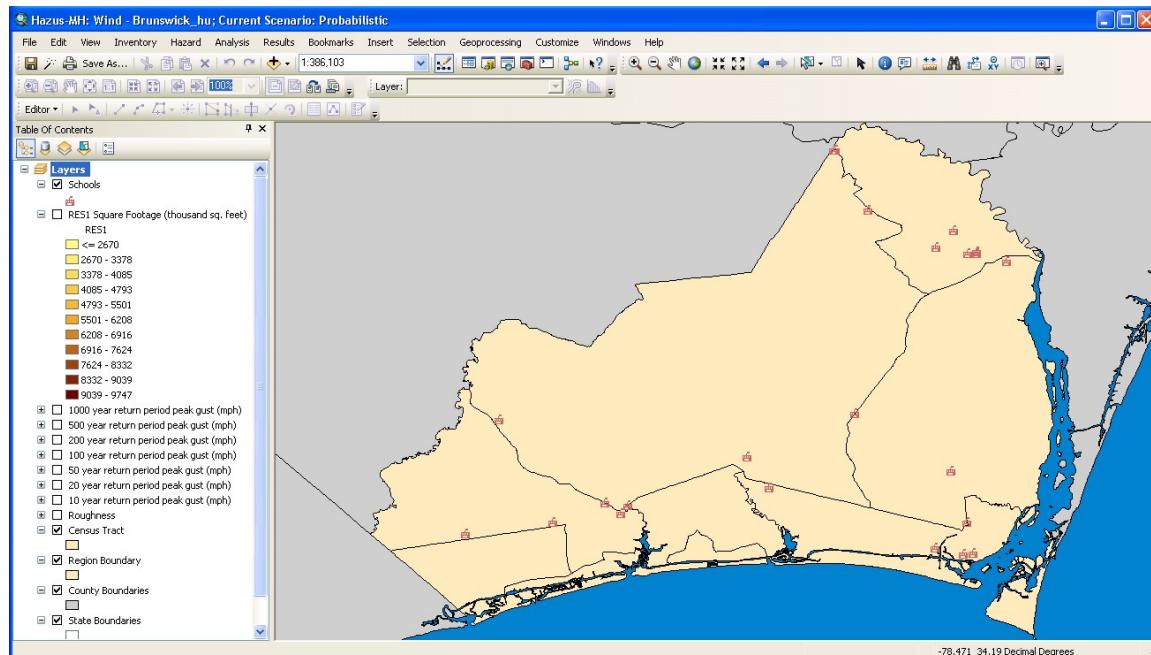
A.4.6 Essential Facilities Check

For the next step it will be useful to de-select the RES1 map layer. Next, select the menu item Inventory | Essential Facilities, then click on the Schools tab and verify that the following screen is displayed.

A.4.7 Plot the Schools

The Map button should be enabled. Press Map. A new point layer should add to the map and show the placement of schools. Close the dialog when finished.

A.4.8 Classification Check

Use menu item Inventory | View Classifications to ensure the following dialog appears. Close the dialog when finished. This completes the Inventory.
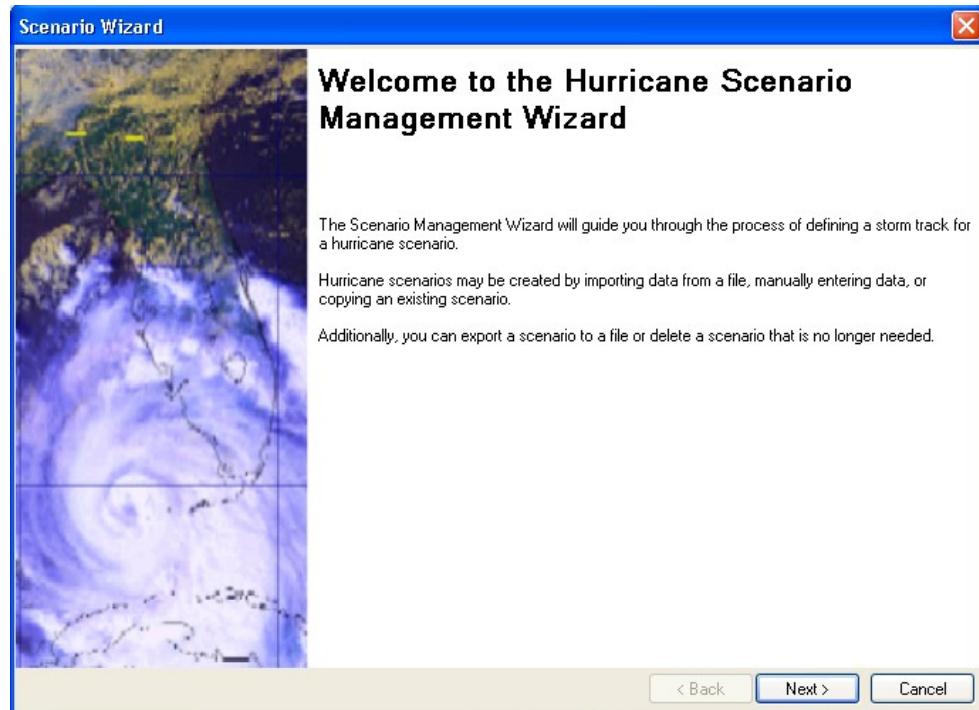
A.5 Hazard Verification

These steps will demonstrate that the Hurricane wind field model is functioning properly.

A.5.1 Set the Active Scenario to "Probabilistic"
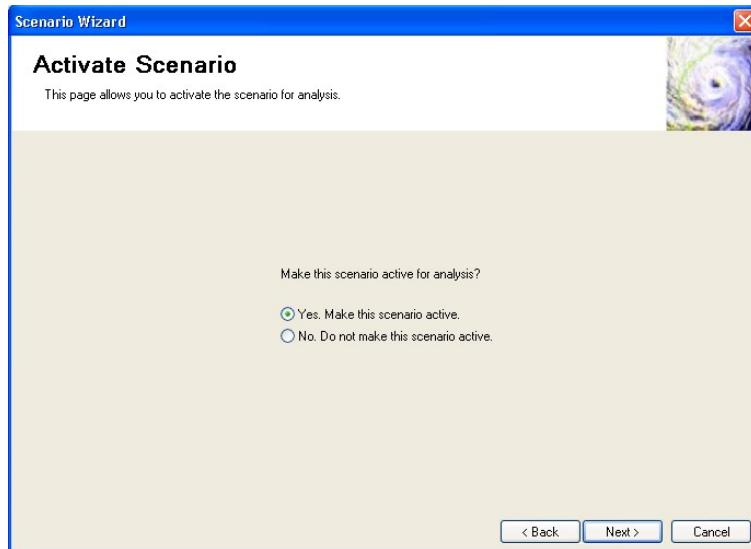
Use the Hazard | Scenario menu to start the scenario wizard:

Click the Next button

The default scenario is "Probabilistic." Click the Next button.
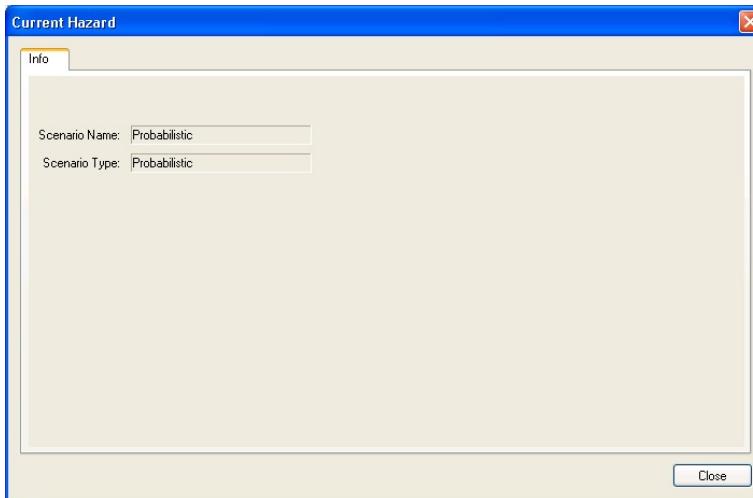
The default option is to set the new scenario as the active scenario. Click the Next button.

Click the "Finish" button to exit the wizard.

A.5.2   Show the Current Scenario

Use the Hazard | Show Current menu to review the current scenario.
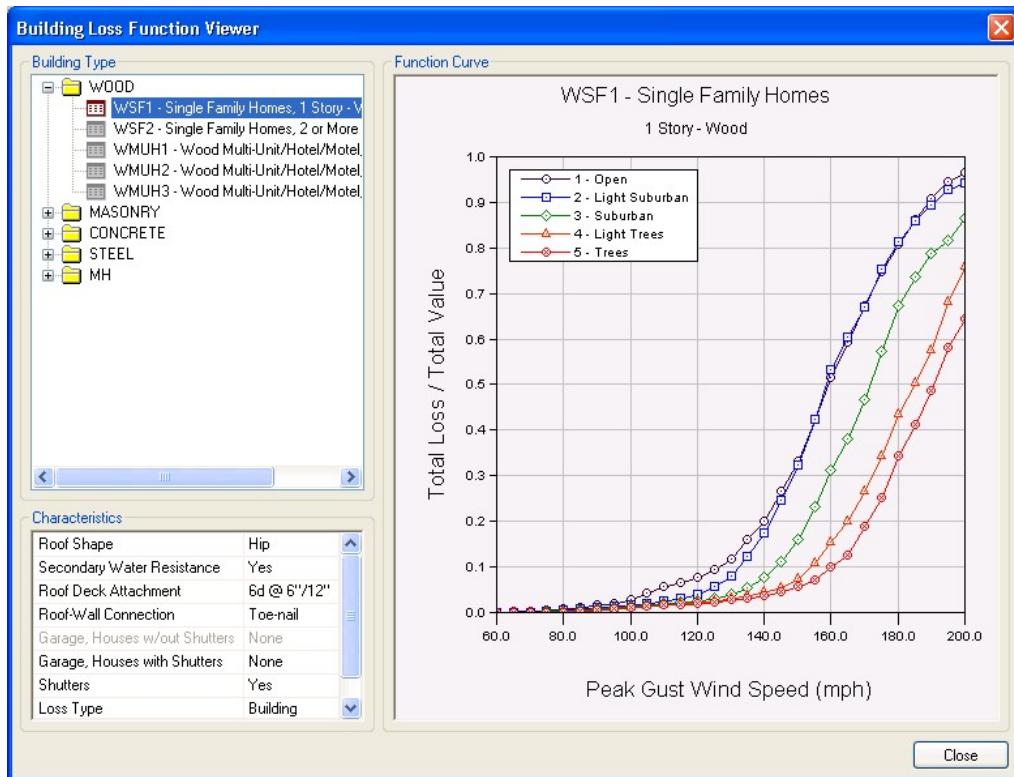
Click the Close button. This completes the Scenario menu.

A.6   Analysis Parameters Verification

These steps will demonstrate that the Analysis Parameters are functioning properly.

A.6.1   View Damage and Loss Functions

Click on the Analysis | Loss Functions menu to open the building loss function viewer. Open the "Wood" folder in the top left and select WSF1. The following graph should appear:

Close the window.

A.6.2 View Tree Parameters
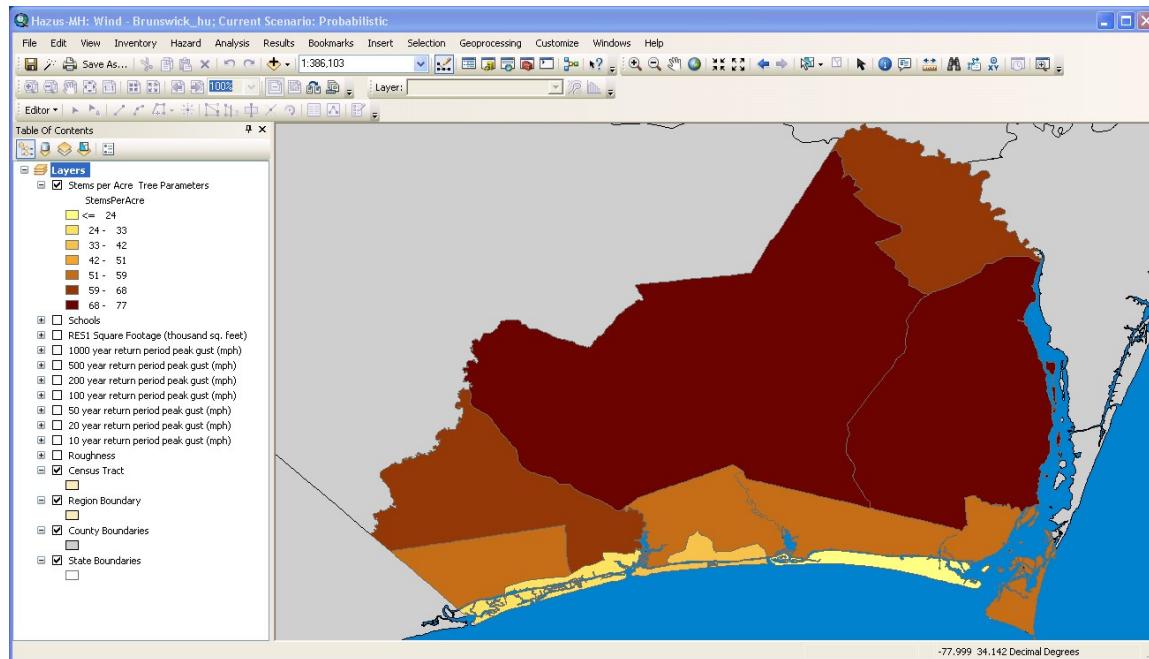
Click on the Analysis | Parameters | Trees menu to open the tree parameters browser. Select the column "Stems Per Acre" and click on the Map button. The following map should appear:
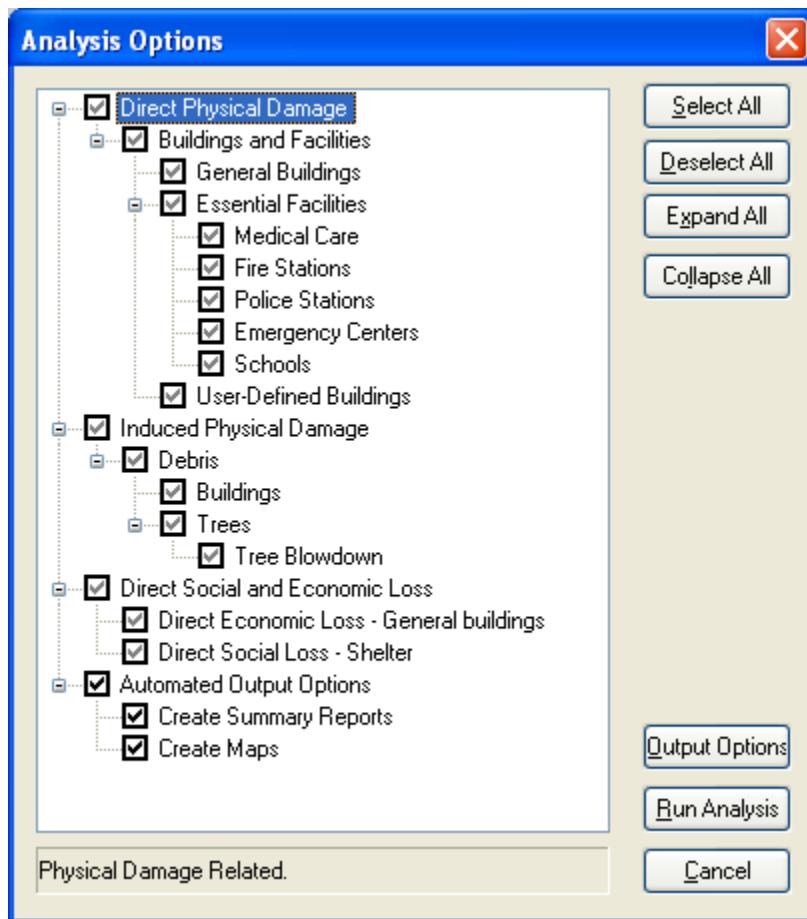
Close the browser.

A.7 Run a Probabilistic Analysis

These steps will demonstrate that the Analysis Run Dialog is functioning properly.
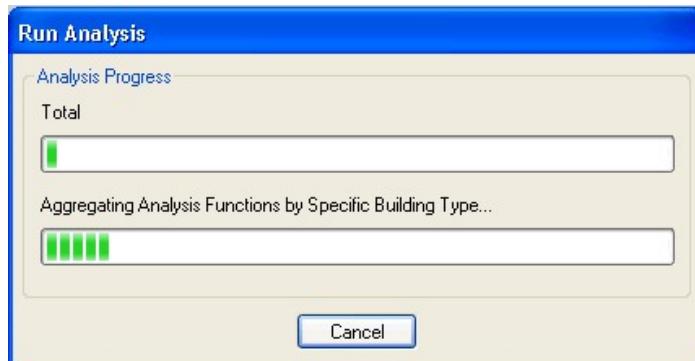
A.7.1 Open the Dialog

Click on the Analysis | Run menu option. This will bring up the analysis options dialog:
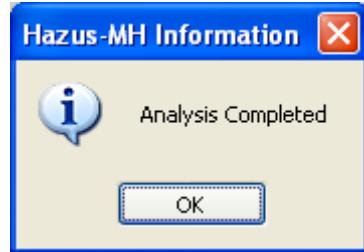
A.7.2 Start the Analysis

Click "Run Analysis" to start the analysis. A progress bar will appear:
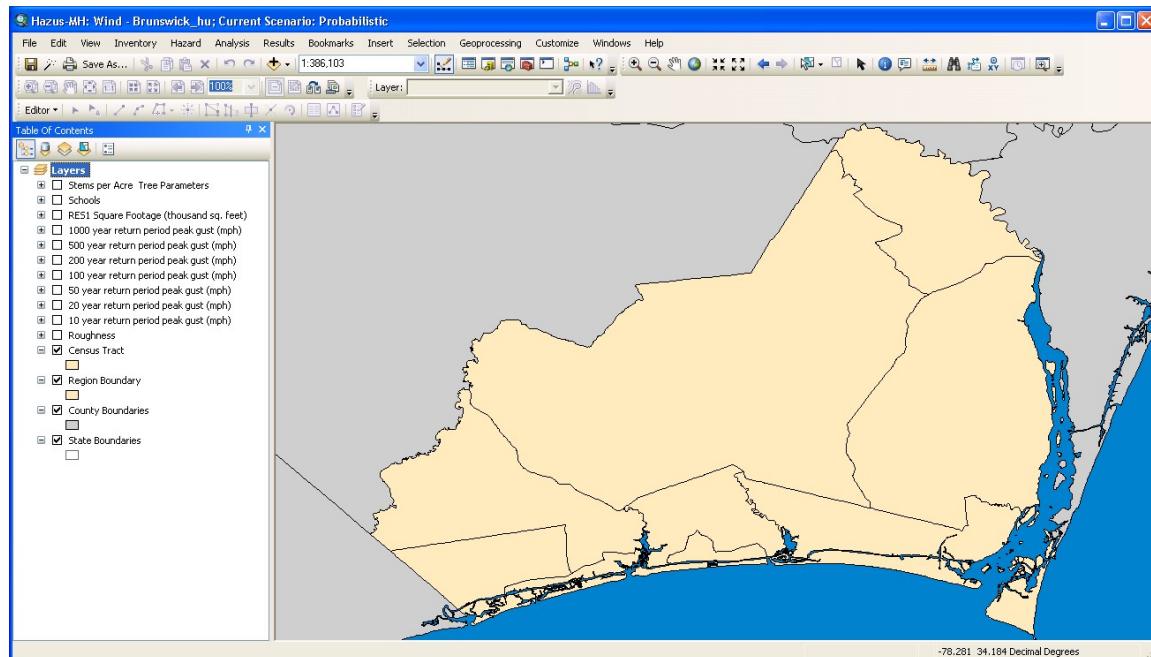
It will take several minutes to complete the analysis. When the analysis is complete, the following dialog will appear:

Click on the OK button in the Information dialog when the analysis is complete. This completes the Analysis menu.

A.8   View Probabilistic Results and Print Reports

These steps will demonstrate that the Analysis Results Browsers and Summary Reports are functioning correctly. Before starting, uncheck all of the map layers except for the default layers.

A.8.1 Wind Speeds

Click on the Results | Wind Speeds menu option. This action will open the following dialog:

These are the wind speeds for the 7 individual events in the 100,000-year storm set that produced the 10, 20, 50, 100, 200, 500, and 1000-year total economic losses for the study region. For example, 1% of the years in the 100,000-year storm set had an event that produced total economic losses equal to or greater than the specific storm represented by the wind speeds in the "100 Year Peak Wind Gust (mph)" column.

The wind speeds in this table are NOT the return period wind speeds for each individual census tract. That information is provided in the seven default layers shown in the map table of contents.
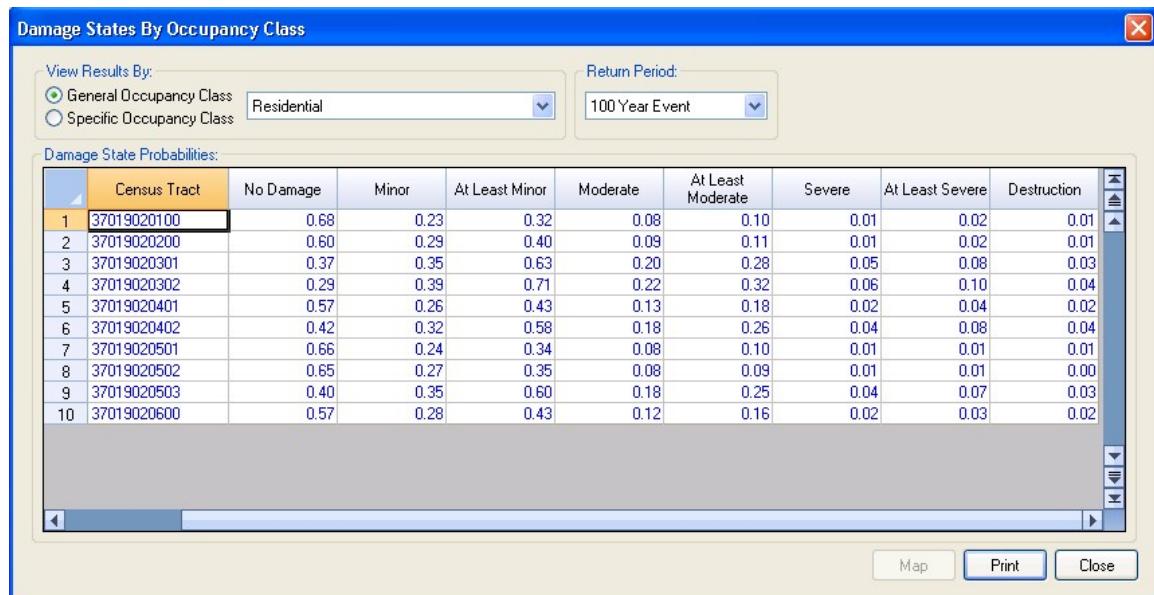
Select the 100-year column and click on the map button. The following map should appear along with the storm track for the 100 year return period event.
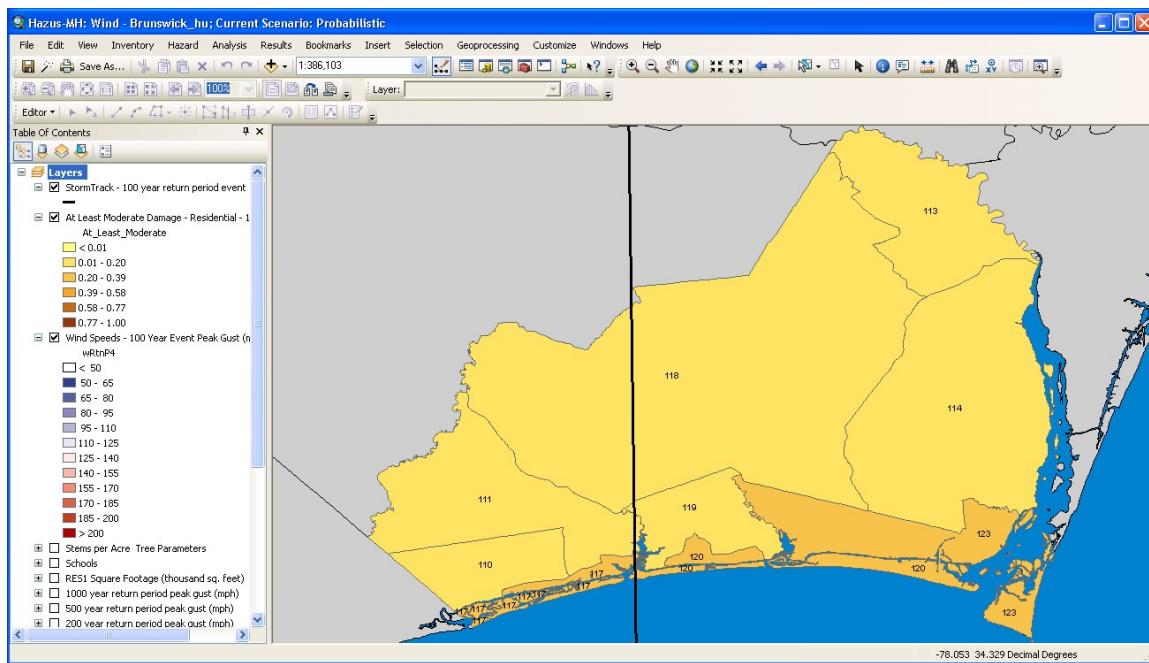
Close the dialog.

A.8.2   Building Damage

Click on the Results | General Building Stock | By Occupancy menu option. This action will open the following dialog:
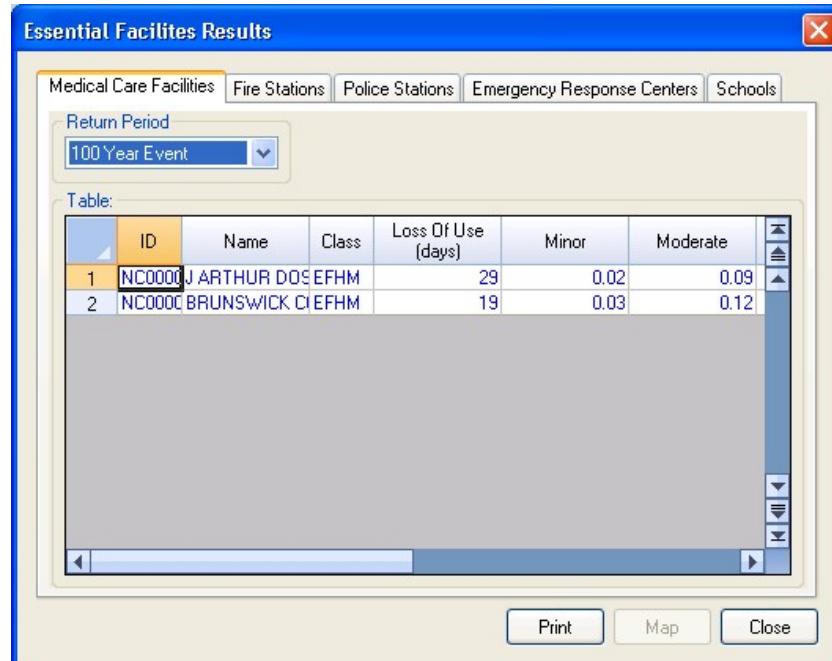
Select the "At Least Moderate" column and click on the map button. The following map should appear.

You can examine sample results for any occupancy category for seven different events by selecting different return periods. These are the same seven events summarized in the wind speed results table in Section A.8.1.

A.8.3 Essential Facility Damage

Click on the Results | Essential Facilities menu option. This action will open the following dialog:

As with the previous results, you can view the results for different return periods or select one of the columns to map the data.

A.8.4 Debris

Click on the Results | Debris menu option. This action will open the following dialog:

As with the previous results, you can view the results for different return periods or select one of the columns to map the data.

A.8.5 Shelter Requirements

Click on the Results | Shelter menu option. This action will open the following dialog:

As with the previous results, you can view the results for different return periods and then select one of the results columns and map the data.

A.8.6 Direct Economic Losses

Click on the Results | General Building Stock | Building Economic Loss | By Occupancy menu option. This action will open the following dialog:

As with the previous results, you can view the results for different return periods and then select one of the results columns and map the data. To view the annualized economic losses, select the last entry in the Return Period drop-down box.

A.8.7   Summary Reports

Click on the Results | Summary Reports menu option. This action will open the following dialog:

Click on the "Other Reports" tab.

Click on the View button to see the Quick Assessment report:

Close the quick assessment report and the summary reports dialog. This concludes the test cases for the Results menu.

A.9   Hazard Verification – Scenario Storm

These steps will demonstrate that the Hurricane wind field model is functioning properly.

A.9.1   Create a New Scenario

Use the Hazard | Scenario menu to start the scenario wizard:

Click the Next button

Select "<Create New Scenario>".

Click the Next button.

Select "Define Storm Track Manually" and click the Next button.
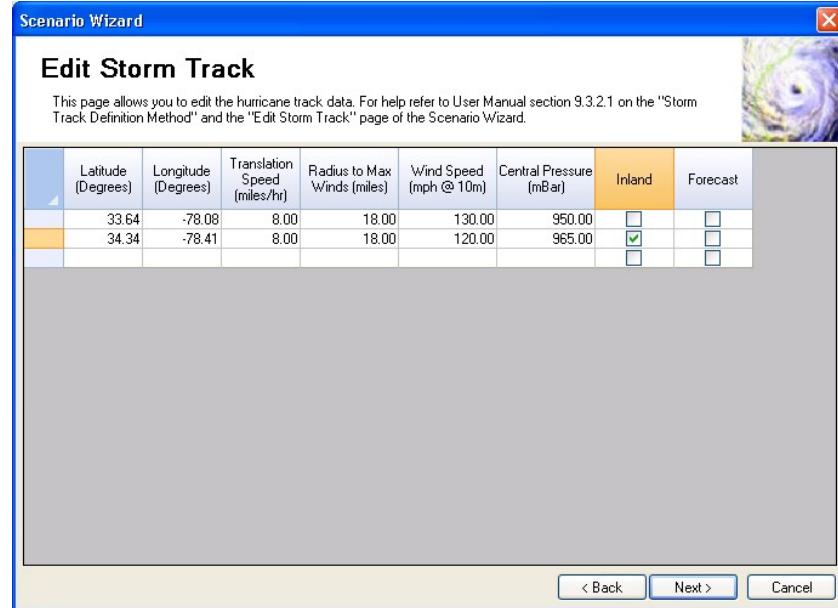
Name the new scenario "Scenario1" and click the Next button.
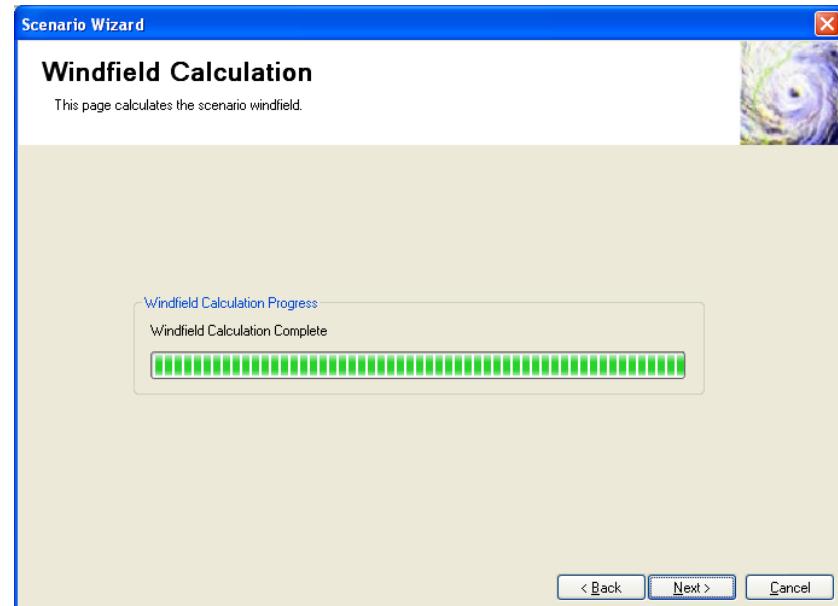
Accept the defaults shown above and click the Next button.

Left click in the blank area to the left of the "Latitude" column heading and then right click and select "Insert Row". Enter the information shown below.

Click on the Next button to start the wind field calculation.

When the wind field analysis is complete, click on the Next button.

Review the storm track inputs and click on the Next button.
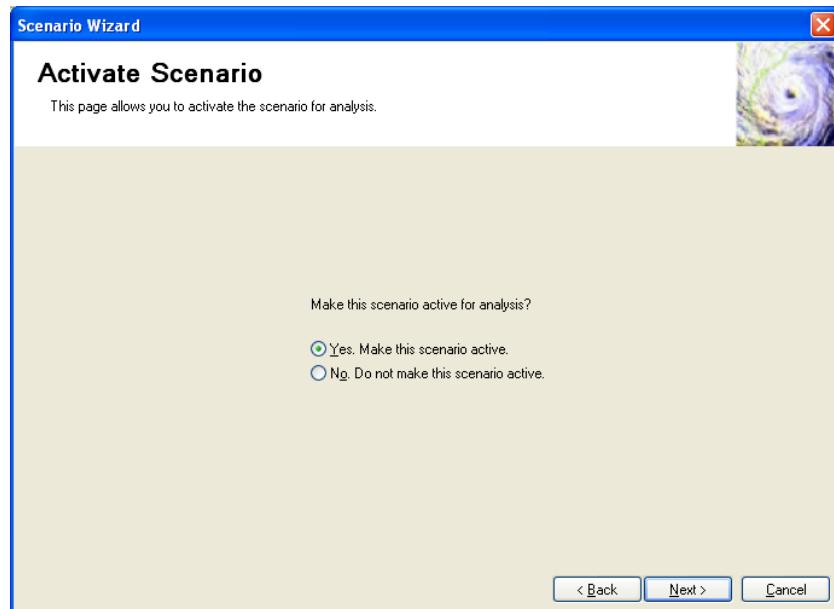
Review the scenario summary and click on the Next button.
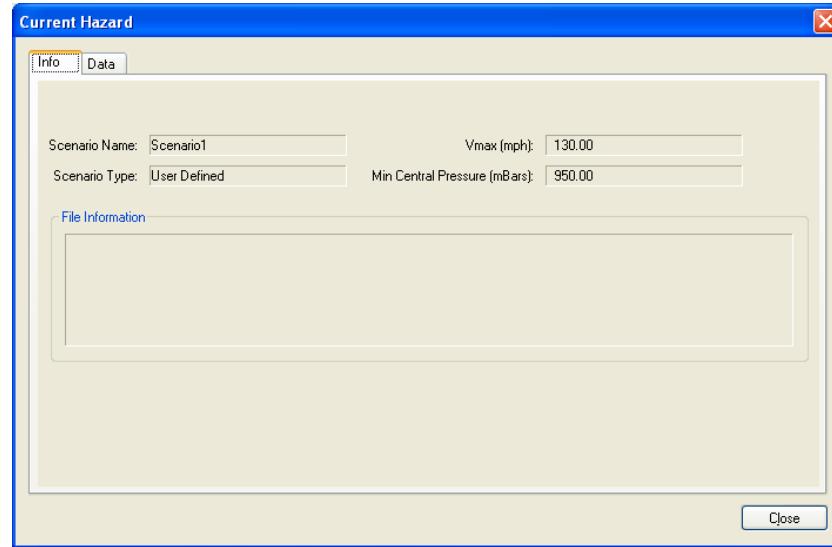
Activate the new scenario by accepting the default option on the screen shown above.
Click on the Next button.

Click the "Finish" button to exit the wizard.

A.9.2 Show the Current Scenario

Use the Hazard | Show Current menu to review the current scenario.

Click the Close button.
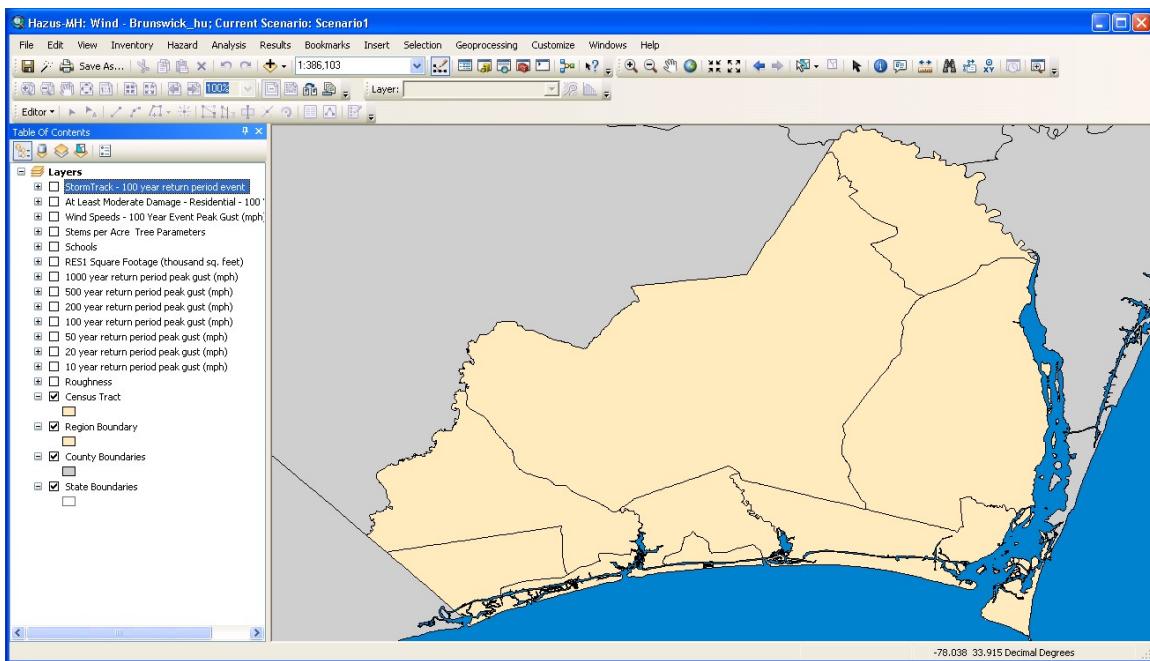
This completes the definition of the scenario.
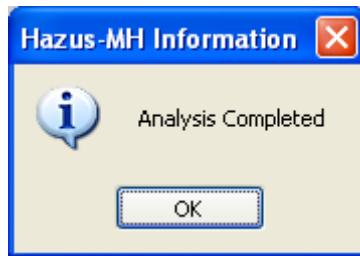
A.10 View Scenario Results and Print Reports

These steps will demonstrate that the Analysis Results Browsers and Summary Reports are functioning correctly. Before starting, uncheck all of the map layers except for the default layers.
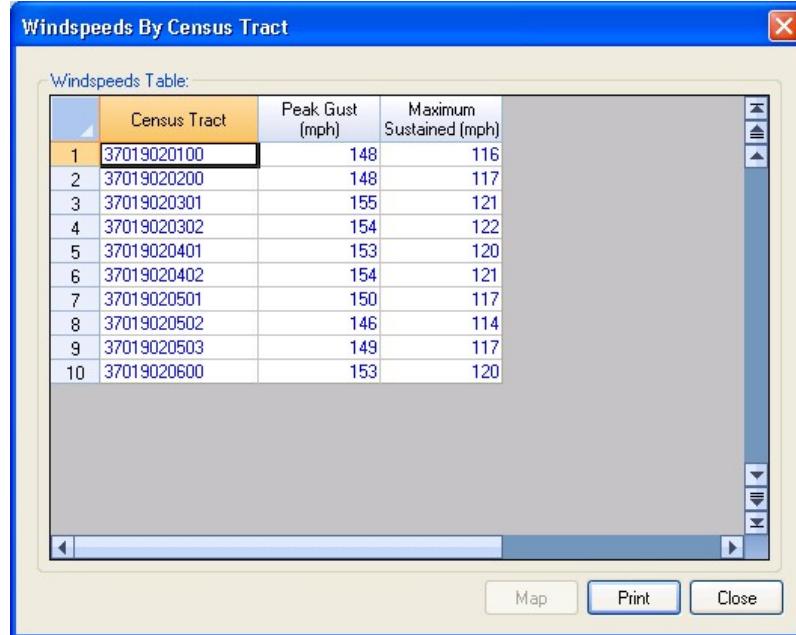
A.10.1 Run the Analysis

Click on the Analysis | Run menu option and follow the instruction in Section A.7 to run the analysis. When the analysis is completed, click on the OK button in the Information dialog and the Close button in the Run Analysis dialog.
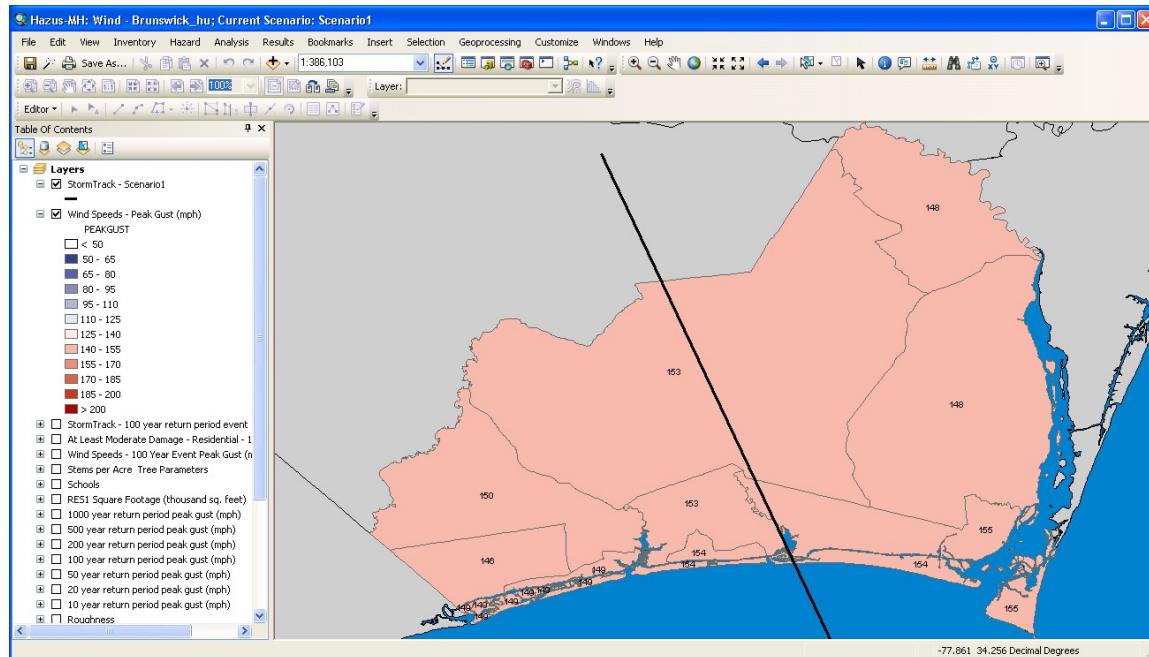
A.10.2 Wind Speeds

Click on the Results | Wind Speeds menu option. This action will open the following dialog:
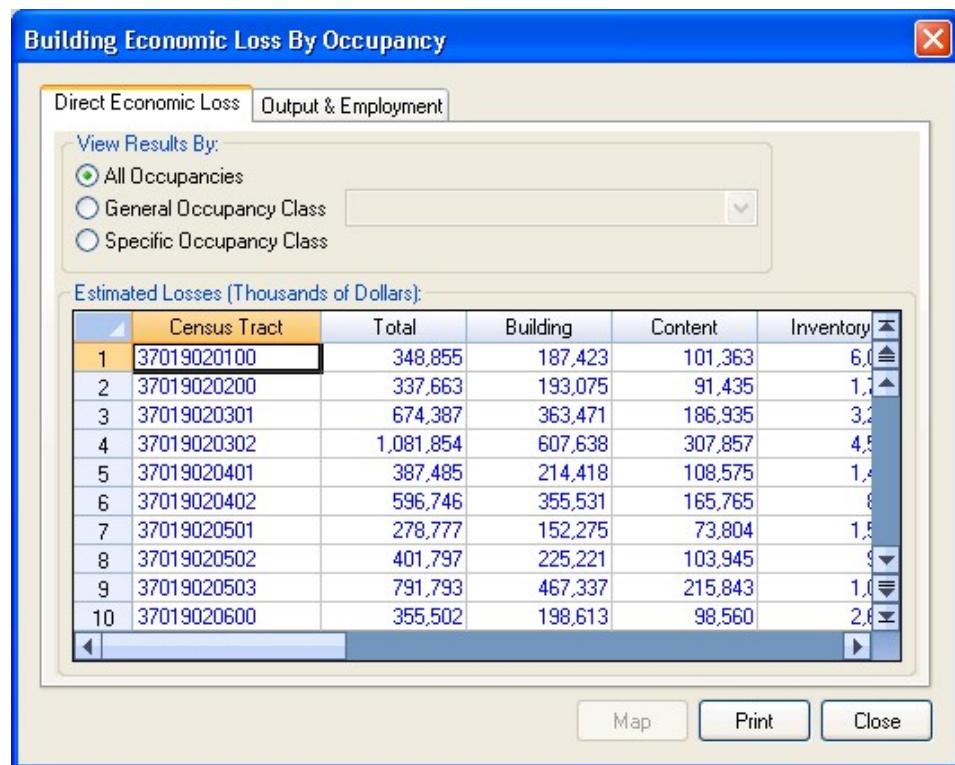
The peak gust (3 second average, open terrain) and maximum sustained (1-minute average, open terrain) wind speed estimates for the scenario are displayed.

Select the Peak Gust column, click on the map button, and close the browser. The following map should appear.

A.10.3 Direct Economic Losses
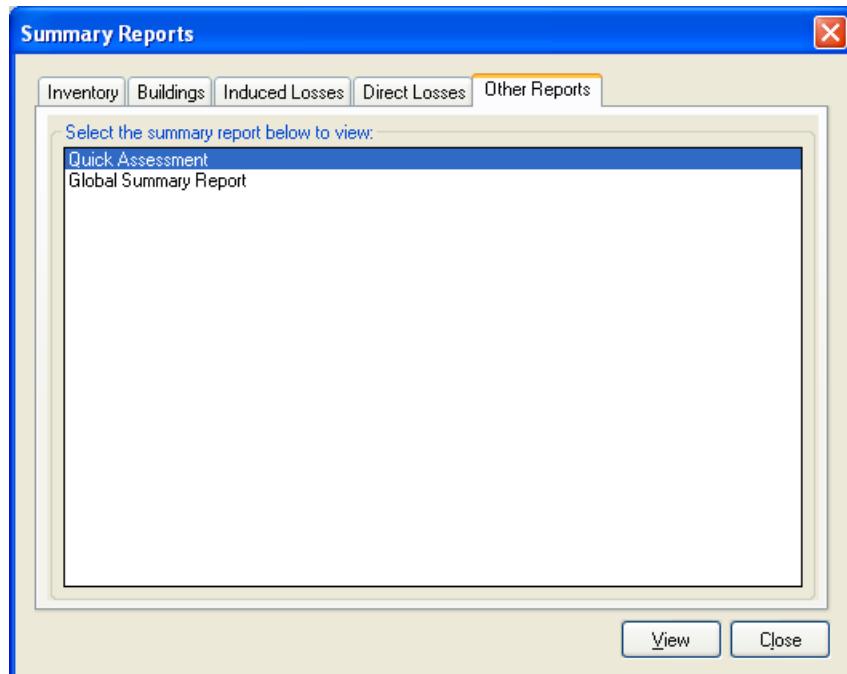
Click on the Results | General Building Stock | Building Economic Loss | By Occupancy menu option. This action will open the following dialog:

Close the browser.

A.10.4 Summary Reports

Click on the Results | Summary Reports menu option. This action will open the following dialog:

Click on the View button to see the Quick Assessment report.

Close the quick assessment report and the summary reports dialog. This concludes the test cases for the Results menu.

A.11   Run a Mitigation Example

The following steps will demonstrate that the mitigation feature is functioning correctly.

A.11.1 Mitigate the Building Stock

Select the Inventory | General Building Stock | Wind Building Characteristics Distribution menu option. This will open the dialog shown below:

In the bottom half of the screen, select the "Southeast_Coastal" scheme and click on the Mitigate button.
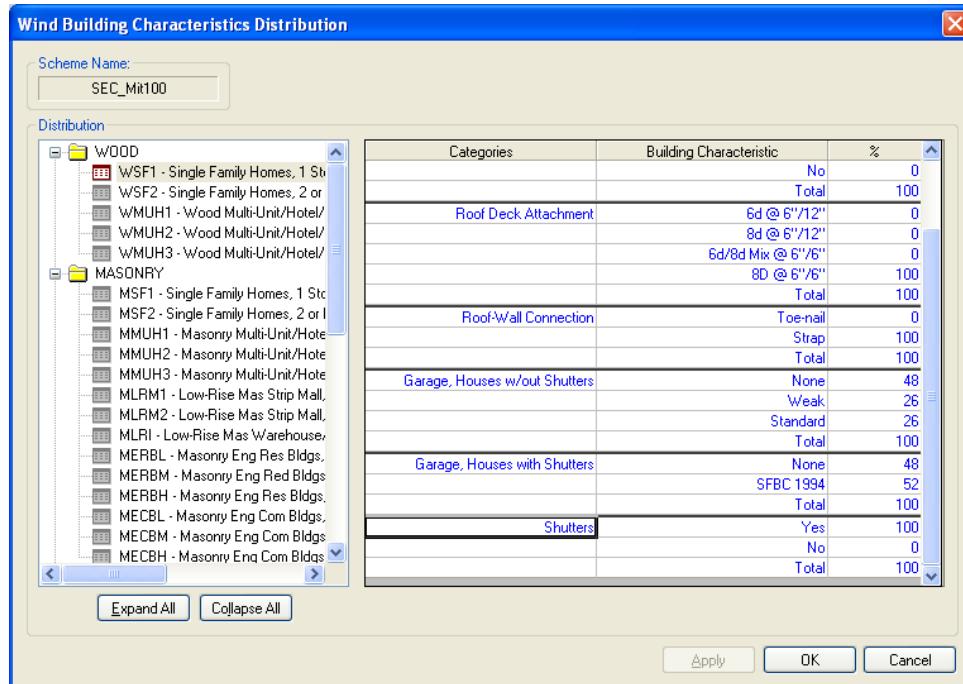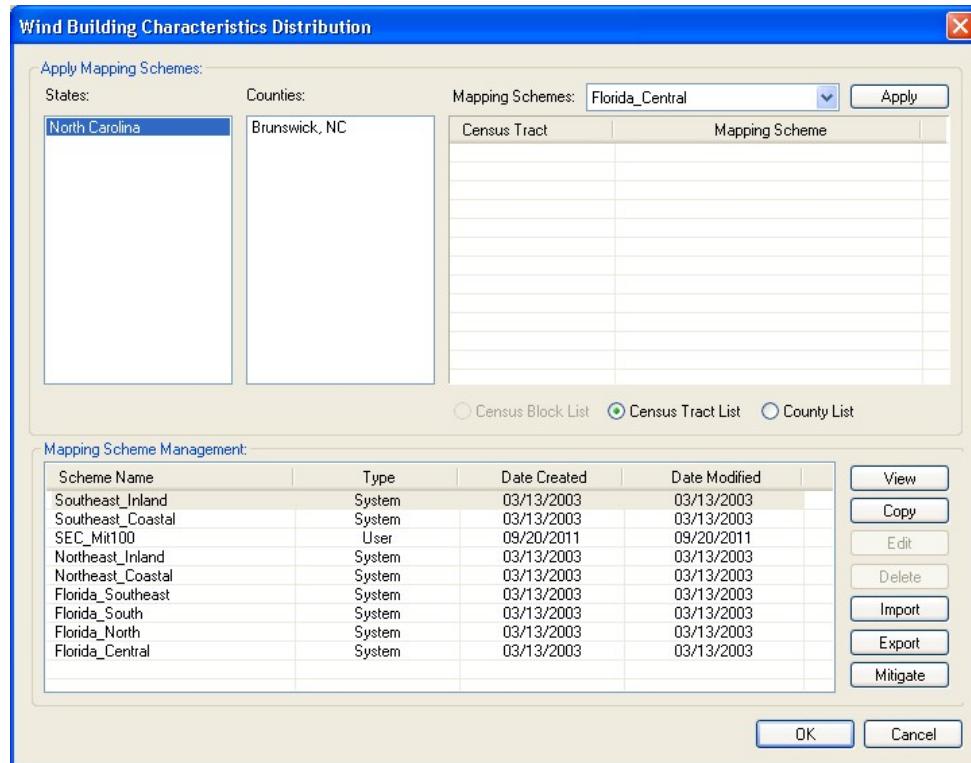
Name the new scheme "SEC_Mit100" and enter the values above by clicking OK. This step will create a new wind building mapping scheme in which 100% of the buildings are mitigated to the full extent permitted for each occupancy.
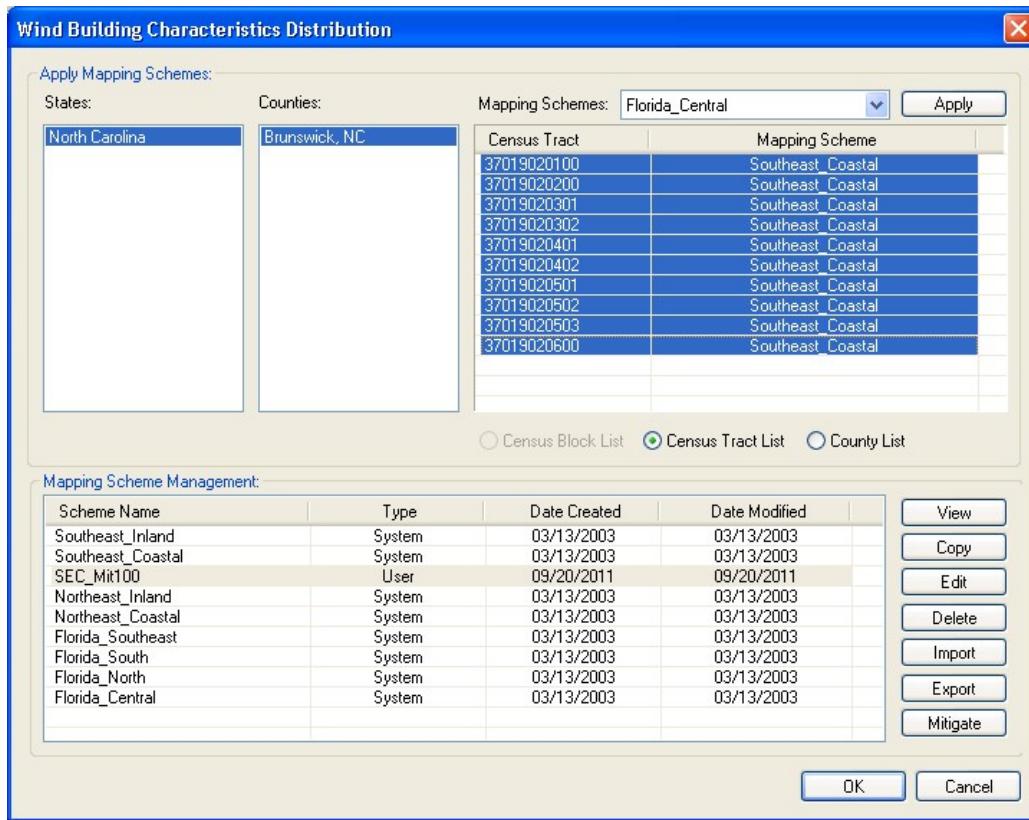
Upon returning to the wind building mapping dialog, click on the View button to view the newly created mapping scheme.
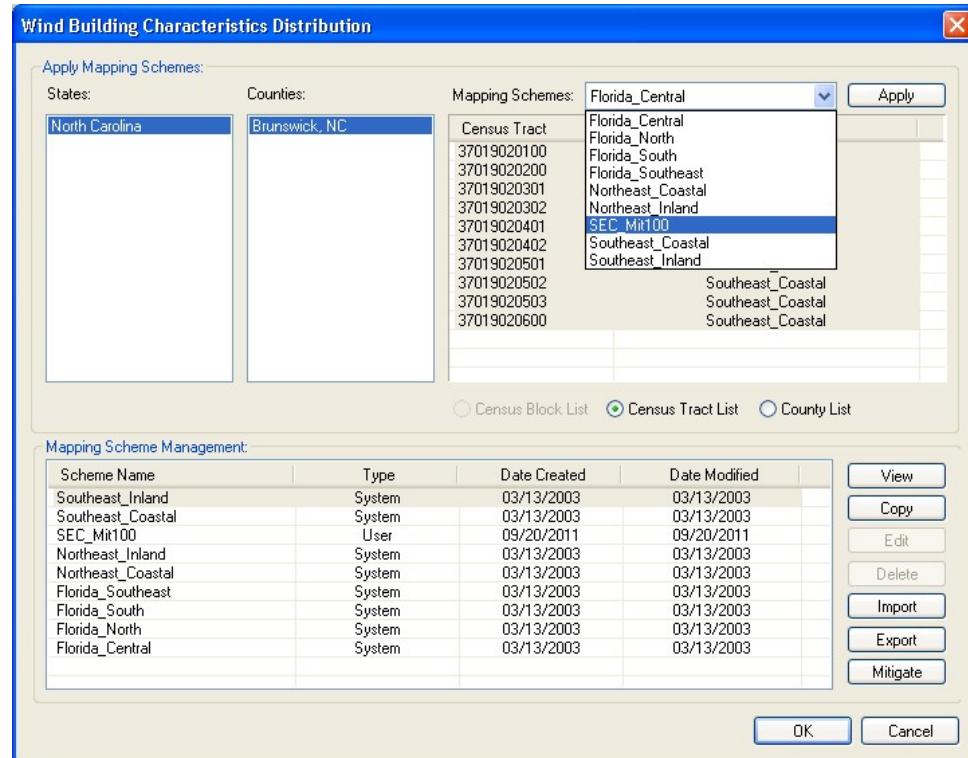
Open the WOOD folder and select WSF1. Scroll down on the right side of the screen. Note that 100% of the one-story wood frame houses in the new mapping scheme have shutters. Click OK to close the dialog.

Appendix A. Hurricane Model Installation Verification Instructions
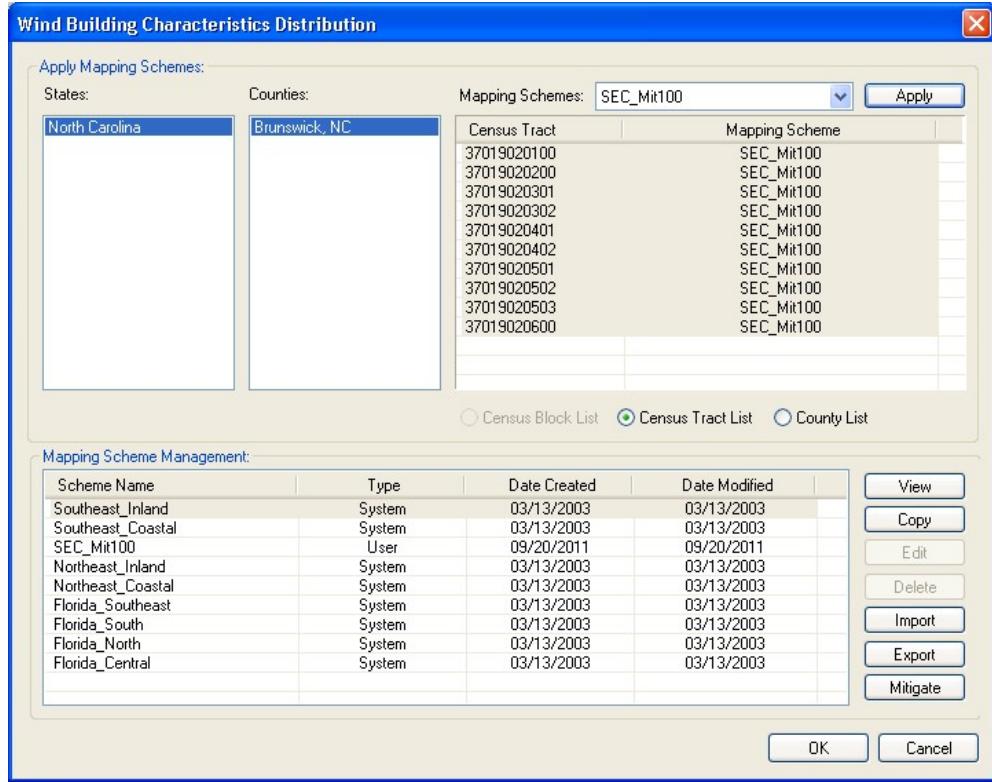
Next, assign the new mapping scheme to the study region. Click on "Brunswick, NC" to display the list of census tracts as shown above. Note that each census tract has a default mapping scheme ("Southeast_Coastal") assigned to it.

Select all of the census tracts in the top-right list box by clicking on the first tract, holding down the Shift key, and then clicking on the last tract.
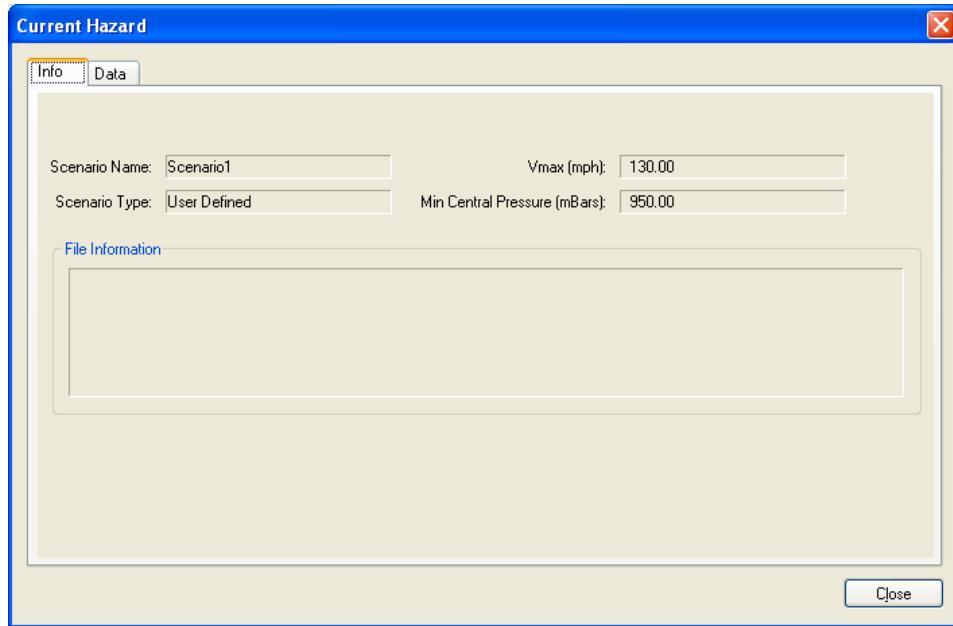
Open the drop-down list box and select the new mapping scheme: "SEC_Mit100". Finally, click on the **Apply** button to update the list as shown below:

Click OK to accept the changes and close the dialog.
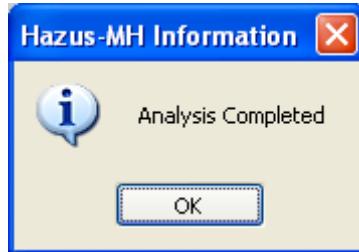
A.11.2 Run the Analysis

Select the Hazard | Show Current menu option and verify that Scenario1 is still active.
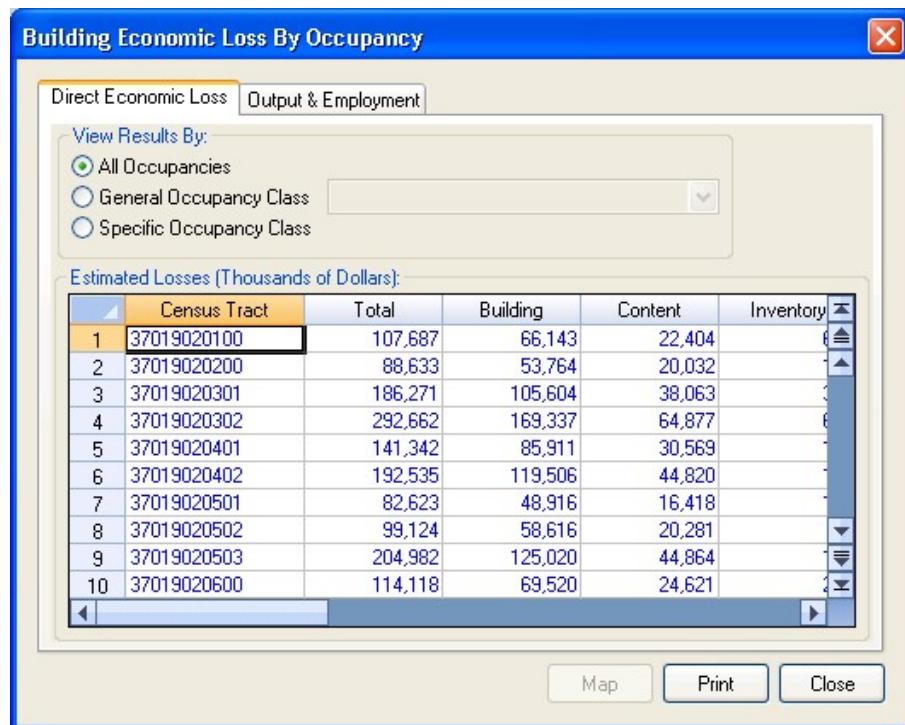
If a different scenario is active, then click on the Hazard | Scenario menu option. Follow the steps in the wizard to activate the proper scenario.

Next, click on the Analysis | Run menu option and follow the instruction in Section A.7 to run the analysis. When the analysis is completed, click on the OK button in the Information dialog and the Close button in the Run Analysis dialog.

A.11.3 Direct Economic Losses
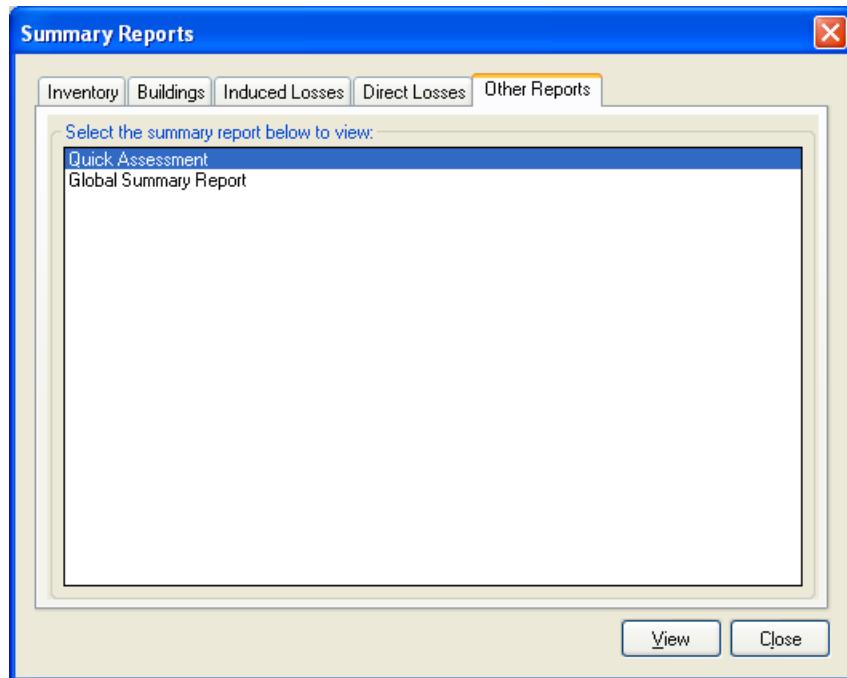
Click on the Results | General Building Stock | Building Economic Loss | By Occupancy menu option. This action will open the following dialog:

The total building losses for the mitigated study region are $1.51 billion compared to $5.25 billion for the default study region results shown in Section A.10.3. Thus, fully mitigating the building stock reduces the estimated total building losses for this scenario by 71%.

A.11.4 Summary Reports

Click on the Results | Summary Reports menu option. This action will open the following dialog:

Click on the View button to see the Quick Assessment report.

Quick Assessment Report

September 20, 2011

Study Region :	Brunswick_hu
Scenario :	Scenario1
Scenario Description :	User Defined
Peak Gust Wind Speed (mph) :	155

Regional Statistics

Area (Square Miles)	862
Number of Census Tracts	10
Number of People in the Region	73,143

General Building Stock

Occupancy	Building Count	Dollar Exposure ($ M)
Residential	54,546	4,656
Commercial	2,094	757
Other	1,260	426
Total	57,900	5,839

Scenario Results

Number of Buildings Damaged

Damage State	Residential	Commercial	Other	Total
Minor	20,000	500	400	21,000
Moderate	19,000	800	400	20,000
Severe	4,200	300	200	4,700
Destruction	3,100	<10	<10	3,100
Total	46,000	1,600	1,000	49,000

Shelter Requirements

Displaced Households (# Households)	1,700
Short Term Shelter (# People)	400

Economic Loss ($ Millions)

Capital Stock		1,232
Residential Property	1,057	
Commercial Property	111	
Other Property	64	
Business Interruption (Income)		278
Total Direct Economic Loss		1,510

Totals only reflect data for those census tracts/block included in the user's study region.

Disclaimer:
The estimates of social and economic impacts contained in this report were produced using HAZUS loss estimation methodology software which is based on current scientific engineering knowledge. There are uncertainties inherent in any loss estimation technique Therefore, there may be significant differences between the modeled results contained this report and the actual social and economic losses following a specific Hurricane. These results can be improved by using enhanced inventory data.

Note that the estimated number of destroyed buildings in the mitigated study region is 3,100 compared to 18,000 in the default study region (Section A.10.4), a reduction of 83%.

This concludes the mitigation test.

A.12   Conclusion

If you have successfully completed all of the steps in the preceding sections, the Hurricane Model has been installed correctly and is functioning as intended. You may now proceed with further use of the software.

Please be aware of the following known problems:

A.12.1 Multi-Hazard Study Regions

If you create a study region that includes both the Hurricane and Flood hazards (it does not matter if Earthquake is or is not included), the Hurricane model will work at the block level to be compatible with the Flood model. This significantly increases the time and memory requirements for the Hurricane model.

DO NOT attempt to run a multi-hazard study region until you have successfully completed the installation tests in this document. We also recommend that you try only two or three census tracts on your first Hurricane & Flood study region.

A.12.2 Large Study Regions

If you create a study region with more than 3000 Census Tracts (Census Blocks for Hurricane + Flood study regions) on a machine with 2 GB RAM, you may encounter errors that are caused by insufficient memory.

Appendix B.   Building Classification System

The 39 Specific Building Types (SBTs) used in the Hurricane Model are listed and briefly described in Table B.1. Each identifier begins with W, M, C, S, or MH, representing the General Building Type (GBT) to which the SBT belongs. Fuller descriptions of each SBT are provided in Appendix C.

The Hurricane Model allows the user to distribute the building stock in each census tract to one or more of the 39 SBTs through the use of an SBT Mapping Scheme. The SBT Mapping Scheme determines, for example, the percentage of Wood Single Family Dwellings that are assigned to the WSF1 or WSF2 category based on the relative frequency of single vs. multi-story construction in a given geographic area. Default mapping schemes are provided for the states covered by the Hurricane Model, but these can be modified on a state, county, or census tract basis if the user has access to more accurate information in his or her geographic area of interest.

The key construction characteristics that control the performance of building under high wind loads are listed in Table B.2. These key construction characteristics are referred to as the Wind Building Characteristics (WBCs). Different subsets of the WBCs control the damage and loss estimates for each SBT. The significant WBCs for each SBT are shown as non-zero entries in Table B.3. As an example, consider the Wood-Frame, One-Story, Multi-Unit Housing (WMUH1) category. The fourth column of Table B.3 shows that there are five active WBCs for the WMUH1 category: roof shape, roof cover type, roof cover quality, roof deck attachment, and roof-wall connection.

Figure B.1 illustrates a subset of the 128 possible combinations of the WBCs for WMUH1 buildings.[1] Three predominant roof shapes are modeled: Hip, Gable, or Flat. For flat roofs, two roof coverings (Built-Up Roof or Single Ply Membrane) and three roof-covering conditions (New, Good, or Poor) are considered. For all roof shapes, two roof-sheathing fastener conditions (6-penny nails or 8-penny nails[2]) and two roof-wall connection conditions (Strapped or Toe-Nailed) are modeled. Similar analyses of the remaining 38 SBTs in Table B.3 produces a total of 4,818 distinct building classes in the Hurricane Model.

In an effort to reduce the amount of data collection and data entry required to characterize the building inventory, it is helpful to assume that the relative frequencies of the various

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[1] Due to space limitations, Figure B.1 does not include shutters, secondary water resistance, and two of the four roof deck attachment types. Each of these excluded items is effectively given 0% weight for the example shown in Figure B.1.

2 In order to qualify for the 8-penny (8d) roof deck attachment category, the maximum nail spacing must not exceed 6 inches along the edges of each sheathing panel or 12 inches in the field of each sheathing panel.

WBCs can be adequately modeled as independent. This assumption allows us to determine the relative frequencies of the 24 WMUH1 cases illustrated in Figure B.1 with only 11 input values. In the hypothetical example shown, 60% of the WMUH1 buildings in the geographic area of interest have flat roofs, 50% of the flat roofs are covered with single-ply membranes, 60% of the flat roof covers are in good condition, 50% of the roof decks are fastened with 8-penny nails, and 30% of the roof-wall connections are made with straps or clips. Multiplying these numbers together produces the percentages shown at the bottom of Figure B.1. For this illustration, the values have been rounded to the nearest 1%.

Mitigation Options

A significant feature of the Hurricane Model is its ability to model the benefits of mitigation for all building types. The mitigation options available in the Hurricane Model are: (1) strengthened roof-wall connections (i.e., straps or clips instead of simple toe-nailed connections), (2) upgraded roof sheathing attachments (i.e., fasteners that meet or exceed the nailing requirements of the 1994 South Florida Building Code), (3) pressure and impact resistant protection for all openings (e.g., shutters and doors meeting the Dade County or ASTM large missile and pressure cycling standards), and (4) secondary water resistance to prevent water penetration through the roof decking after the loss of the roof covering. The specific mitigation options available for each SBT are summarized in Table B.4.

By including these options in the Hurricane Model, the benefits of promoting mitigation can be easily quantified by varying the percentages of buildings that have these features in a given geographic area and comparing the resulting loss estimates. In many hurricane-prone areas, it can be shown with the Hurricane Model that loss reductions of 70% or more can be achieved through mitigation.

Table B.1. Specific Building Types in the Hurricane Model

Specific Building Type	Description
WSF1	Wood, Single Family, One Story
WSF2	Wood, Single Family, Two or More Stories
WMUH1	Wood, Multi-Unit Housing, One Story
WMUH2	Wood, Multi-Unit Housing, Two Stories
WMUH3	Wood, Multi-Unit Housing, Three or More Stories
MSF1	Masonry, Single Family, One Story
MSF2	Masonry, Single Family, Two or More Stories
MMUH1	Masonry, Multi-Unit Housing, One Story
MMUH2	Masonry, Multi-Unit Housing, Two Stories
MMUH3	Masonry, Multi-Unit Housing, Three or More Stories
MLRM1	Masonry, Low-Rise Strip Mall, Up to 15 Feet
MLRM2	Masonry, Low-Rise Strip Mall, More than 15 Feet
MLRI	Masonry, Low-Rise Industrial/Warehouse/Factory Buildings
MERBL	Masonry, Engineered Residential Building, Low-Rise (1-2 Stories)
MERBM	Masonry, Engineered Residential Building, Mid-Rise (3-5 Stories)
MERBH	Masonry, Engineered Residential Building, High-Rise (6+ Stories)
MECBL	Masonry, Engineered Commercial Building, Low-Rise (1-2 Stories)
MECBM	Masonry, Engineered Commercial Building, Mid-Rise (3-5 Stories)
MECBH	Masonry, Engineered Commercial Building, High-Rise (6+ Stories)
CERBL	Concrete, Engineered Residential Building, Low-Rise (1-2 Stories)
CERBM	Concrete, Engineered Residential Building, Mid-Rise (3-5 Stories)
CERBH	Concrete, Engineered Residential Building, High-Rise (6+ Stories)
CECBL	Concrete, Engineered Commercial Building, Low-Rise (1-2 Stories)
CECBM	Concrete, Engineered Commercial Building, Mid-Rise (3-5 Stories)
CECBH	Concrete, Engineered Commercial Building, High-Rise (6+ Stories)
SPMBS	Steel, Pre-Engineered Metal Building, Small
SPMBM	Steel, Pre-Engineered Metal Building, Medium
SPMBL	Steel, Pre-Engineered Metal Building, Large
SERBL	Steel, Engineered Residential Building, Low-Rise (1-2 Stories)
SERBM	Steel, Engineered Residential Building, Mid-Rise (3-5 Stories)
SERBH	Steel, Engineered Residential Building, High-Rise (6+ Stories)
SECBL	Steel, Engineered Commercial Building, Low-Rise (1-2 Stories)
SECBM	Steel, Engineered Commercial Building, Mid-Rise (3-5 Stories)
SECBH	Steel, Engineered Commercial Building, High-Rise (6+ Stories)
MHPHUD	Manufactured Home, Pre-HUD
MH76HUD	Manufactured Home, 1976 HUD
MH94HUD-I	Manufactured Home, 1994 HUD - Wind Zone I
MH94HUD-II	Manufactured Home, 1994 HUD - Wind Zone II
MH94HUD-III	Manufactured Home, 1994 HUD - Wind Zone III

Table B.2. Wind Building Characteristics

Characteristic	Value1	Value2	Value3	Value4
Roof Shape				
- Roof Shape I	Hip	Gable		
- Roof Shape II	Hip	Gable	Flat	
Roof Cover				
- Roof Cover Type	Built-Up	Single Ply		
- Roof Cover Quality	Good	Poor		
- Secondary Water Resistance	Yes	No		
Roof Deck				
- Roof Deck Attach. I	6d Nails @ 6/12	8d Nails @ 6/12		
- Roof Deck Attach. II	6d Nails @ 6/12	8d Nails @ 6/12	6d/8d Mix @ 6/6	8d @ 6/6
- Roof Deck Age	New or Average	Old		
Roof Frame				
- Roof Frame System	Wood Truss	Steel Joist		
- Joist Spacing	4 ft.	6 ft.		
- Roof-Wall Conn.	Toe-Nail	Strap		
Fenestrations				
- Window Area	Low	Medium	High	
- Shutters	Yes	No		
- Garage I (Unshuttered Houses)	None	Weak Door	Standard Door	
- Garage II (Shuttered Houses)	None	SFBC 94		
Other Characteristics				
- Wind Debris	Residential	Res./Comm. Mix	Varies by Direction	No Missiles
- Units Per Floor	Single-Unit	Multi-Unit		
- Masonry Reinforcing	Yes (RM)	No (URM)		
- Tie Downs	Yes	No		

Table B.3. Active Wind Building Characteristics for each Specific Building Type

* branching characteristic

^ conditional characteristic (active if Shutters Not Installed OR if Roof Shape is Flat OR if roof deck is superior and roof cover is shingle)

^ conditional characteristic (active if Shutters Installed or if Roof Frame System is Steel Joist OR if Roof Frame System is Wood Truss)

conditional characteristic (active if Roof Frame System is Steel Joist and Number of Units is Multi-Unit OR if single wall and no uplift restraint)

~ conditional characteristic (active if Roof Frame System is Steel Joist and Number of Units is Multi-Unit OR if single wall and no uplift restraint)

` conditional characteristic (active if Roof Shape is Gable or Hip OR if Roof Deck is Metal and Roof Deck Age is New or Average)

Figure B.1. Sample Distribution of WMUH1 Wind Building Characteristics.

Table B.4. Mitigation Options

Hurricane	Specific Building Types			Shutters on All Windows and Entry Doors	Roof-wall Connection Clips/Straps	Superior Roof Deck Attachment	SWR	MH Tie Downs
Single Family	Wood	WSF1		√	√	√	√	
		WSF2		√	√	√	√	
	Masonry	MSF1		√	√	√	√	
		MSF2		√	√	√	√	
Multi-Unit Housing	Wood	WMUH1	Hip/Gable	√	√	√	√	
			Flat Roof	√	√	√		
		WMUH2	Hip/Gable	√	√	√	√	
			Flat Roof	√	√	√		
		WMUH3	Hip/Gable	√	√	√	√	
			Flat Roof	√	√	√		
	Masonry	MMUH1	Hip/Gable	√	√	√	√	
			Flat Roof	√	√	√		
		MMUH2	Hip/Gable	√	√	√	√	
			Flat Roof	√	√	√		
		MMUH3	Hip/Gable	√	√	√	√	
			Flat Roof	√	√	√		
Industrial Building Masonry		MLRI		√		√		
Low-Rise Strip Mall Masonry		MLRM1	Wood Truss	√	√	√		
			OWSJ	√		√		
		MLRM2	Wood Truss	√	√	√		
			OWSJ	√		√		
Engineered Buildings	Masonry	MERBL		√		√		
		MERBM		√		√		
		MERBH		√		√		
		MECBL		√		√		
		MECBM		√		√		
		MECBH		√		√		
	Concrete	CERBL		√		√		
		CERBM		√		√		
		CERBH		√		√		
		CECBL		√		√		
		CECBM		√		√		
		CECBH		√		√		
	Steel	SERBL		√		√		
		SERBM		√		√		
		SERBH		√		√		
		SECBH		√		√		
		SECBL		√		√		
		SECBM		√		√		
Pre-Engineered Metal Buildings Steel		SPMBS		√		√		
		SPMBM		√		√		
		SPMBL		√		√		
Manufactured Homes		MHPHUD		√				√
		MH76HUD		√				√
		MH94HUDI		√				√
		MH94HUDII		√				√
		MH94HUDIII		√				√

Appendix C.   Descriptions of Model Building Types

C.1   Wood, Single Family, One Story (WSF1)

The WSF1 model building is a wood-framed, single-story, single-family house. See Section 6.4 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.2   Wood, Single Family, Two or More Stories (WSF2)

The WSF2 model building is a wood-framed, two-story, single-family house. See Section 6.4 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.3   Wood, Multi-Unit Housing, One Story (WMUH1)

The WMUH1 model building is a wood-framed, single-story, marginally engineered or non-engineered, multi-family dwelling or hotel/motel. See Section 6.9 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.4   Wood, Multi-Unit Housing, Two Stories (WMUH2)

The WMUH2 model building is a wood-framed, two-story, marginally engineered or non-engineered, multi-family dwelling or hotel/motel. See Section 6.9 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.5   Wood, Multi-Unit Housing, Three or More Stories (WMUH3)

The WMUH3 model building is a wood-framed, three-story, marginally engineered or non-engineered, multi-family dwelling or hotel/motel. See Section 6.9 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.6   Masonry, Single Family, One Story (MSF1)

The MSF1 model building is a masonry wall, single-story, single-family house. The masonry walls can be either reinforced or unreinforced. See Section 6.4 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.7   Masonry, Single Family, Two or More Stories (MSF2)

The MSF2 model building is a masonry wall, two-story, single-family house. The masonry walls can be either reinforced or unreinforced. See Section 6.4 of the *Technical*

Manual for a detailed description of the building geometry and the component resistance values.

C.8   Masonry, Multi-Unit Housing, One Story (MMUH1)

The MMUH1 model building is a masonry wall, single-story, marginally engineered or non-engineered, multi-family dwelling or hotel/motel. The masonry walls can be either reinforced or unreinforced. See Section 6.9 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.9   Masonry, Multi-Unit Housing, Two Stories (MMUH2)

The MMUH2 model building is a masonry wall, single-story, marginally engineered or non-engineered, multi-family dwelling or hotel/motel. The masonry walls can be either reinforced or unreinforced. See Section 6.9 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.10   Masonry, Multi-Unit Housing, Three or More Stories (MMUH3)

The MMUH3 model building is a masonry wall, single-story, marginally engineered or non-engineered, multi-family dwelling or hotel/motel. The masonry walls can be either reinforced or unreinforced. See Section 6.9 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.11   Masonry, Low-Rise Strip Mall, Up to 15 Feet (MLRM1)

The MLRM1 model building is a masonry wall, low-rise strip mall building, up to 15 feet in height. The masonry walls can be either reinforced or unreinforced. See Section 6.10 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.12   Masonry, Low-Rise Strip Mall, More than 15 Feet (MLRM2)

The MLRM2 model building is a masonry wall, low-rise strip mall building, more than 15 feet in height. The masonry walls can be either reinforced or unreinforced. See Section 6.10 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.13   Masonry, Low-Rise Industrial/Warehouse/Factory Buildings (MLRI)

The MLRI model building is a 240,000 square foot, masonry wall, industrial building or warehouse. The masonry walls can be either reinforced or unreinforced. See Section 6.13 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.14 Masonry, Engineered Residential Building, Low-Rise (MERBL)

The MERBL model building is a two-story, engineered, reinforced masonry wall, residential building with a compartmented floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.15 Masonry, Engineered Residential Building, Mid-Rise (MERBM)

The MERBM model building is a five-story, engineered, reinforced masonry wall, residential building with a compartmented floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.16 Masonry, Engineered Residential Building, High-Rise (MERBH)

The MERBH model building is an eight-story, engineered, reinforced masonry wall, residential building with a compartmented floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.17 Masonry, Engineered Commercial Building, Low-Rise (MECBL)

The MERBL model building is a two-story, engineered, reinforced masonry wall, commercial building with an open floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.18 Masonry, Engineered Commercial Building, Mid-Rise (MECBM)

The MERBL model building is a five-story, engineered, reinforced masonry wall, commercial building with an open floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.19 Masonry, Engineered Commercial Building, High-Rise (MECBH)

The MERBL model building is an eight-story, engineered, reinforced masonry wall, commercial building with an open floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.20 Concrete, Engineered Residential Building, Low-Rise (CERBL)

The CERBL model building is a two-story, engineered, reinforced concrete, residential building with a compartmented floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.21   Concrete, Engineered Residential Building, Mid-Rise (CERBM)

The CERBM model building is a five-story, engineered, reinforced concrete, residential building with a compartmented floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.22   Concrete, Engineered Residential Building, High-Rise (CERBH)

The CERBH model building is an eight-story, engineered, reinforced concrete, residential building with a compartmented floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.23   Concrete, Engineered Commercial Building, Low-Rise (CECBL)

The CERBL model building is a two-story, engineered, reinforced concrete, commercial building with an open floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.24   Concrete, Engineered Commercial Building, Mid-Rise (CECBM)

The CERBL model building is a five-story, engineered, reinforced concrete, commercial building with an open floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.25   Concrete, Engineered Commercial Building, High-Rise (CECBH)

The CERBL model building is an eight-story, engineered, reinforced concrete, commercial building with an open floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.26   Steel, Pre-Engineered Metal Building, Small (SPMBS)

The SPMBS model building is a 4,000 square foot, pre-engineered, steel frame, metal clad building. See Section 6.11 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.27   Steel, Pre-Engineered Metal Building, Medium (SPMBM)

The SPMBS model building is a 50,000 square foot, pre-engineered, steel frame, metal clad building. See Section 6.11 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.28   Steel, Pre-Engineered Metal Building, Large (SPMBL)

The SPMBS model building is a 500,000 square foot, pre-engineered, steel frame, metal clad building. See Section 6.11 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.29   Steel, Engineered Residential Building, Low-Rise (SERBL)

The SERBL model building is a two-story, engineered, steel frame, residential building with a compartmented floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.30   Steel, Engineered Residential Building, Mid-Rise (SERBM)

The SERBM model building is a five-story, engineered, steel frame, residential building with a compartmented floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.31   Steel, Engineered Residential Building, High-Rise (SERBH)

The SERBH model building is an eight-story, engineered, steel frame, residential building with a compartmented floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.32   Steel, Engineered Commercial Building, Low-Rise (SECBL)

The SERBL model building is a two-story, engineered, steel frame, commercial building with an open floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.33   Steel, Engineered Commercial Building, Mid-Rise (SECBM)

The SERBM model building is a five-story, engineered, steel frame, commercial building with an open floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.34   Steel, Engineered Commercial Building, High-Rise (SECBH)

The SERBH model building is an eight-story, engineered, steel frame, commercial building with an open floor plan. See Section 6.12 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.35   Manufactured Home, Pre-HUD (MHPHUD)

The MHPHUD model building is a manufactured home built prior to the 1976 HUD standard. The home can be either tied-down or unrestrained. See Section 6.5 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.36   Manufactured Home, 1976 HUD (MH76HUD)

The MHPHUD model building is a manufactured home built to the 1976 HUD standard. The home can be either tied-down or unrestrained. See Section 6.5 of the *Technical*

Manual for a detailed description of the building geometry and the component resistance values.

C.37 Manufactured Home, 1994 HUD Region I (MH94HUD-I)

The MHPHUD model building is a manufactured home built to the 1994 HUD standard for Wind Zone I. The home can be either tied-down or unrestrained. See Section 6.5 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.38 Manufactured Home, 1994 HUD Region II (MH94HUD-II)

The MHPHUD model building is a manufactured home built to the 1994 HUD standard for Wind Zone II. The home can be either tied-down or unrestrained. See Section 6.5 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

C.39 Manufactured Home, 1994 HUD Region III (MH94HUD-III)

The MHPHUD model building is a manufactured home built to the 1994 HUD standard for Wind Zone III. The home can be either tied-down or unrestrained. See Section 6.5 of the *Technical Manual* for a detailed description of the building geometry and the component resistance values.

Appendix D.   Running Hazus-MH with SQL Server 2008 R2

D.1   Introduction

Hazus-MH uses SLQ Server 2008 R2 Express edition as the database engine. The express edition is a free and lightweight version of SQL Server 2008 R2, and therefore has several limitations including an 8-GB database-size limit.

The purpose of this document is to show how Hazus-MH can be configured to run with a full version of SQL Server 2008 R2 and also how to configure Hazus-MH back to run with the SQL Server Express-based default installation.

There are several[1] *full* editions of SQL Server 2008 R2 that lift the 8-GB database limit. A special Developer edition is also available (refer to Microsoft's web site for the differences between the different editions).

Hazus-MH has been tested to run with the ***Express Edition and SQL Server 2008 R2 Developer Edition*** only. Hazus-MH has not been explicitly tested to run with the other editions of SQL Server 2008 R2 (Enterprise, Workgroup, Standard and others).

Hazus-MH neither does it install nor does it include any of the full versions of SQL Server 2008 R2. Before Hazus-MH can be configured to run with any of the full editions of SQL Server, the user needs to purchase and install SQL Server 2008 R2 separately.

D.2   Purpose

This document describes all the steps[2] that the user needs to perform to configure Hazus-MH to run with SQL Server 2008 R2. This document doesn't explain how to install and run Hazus-MH. For that, refer to the Chapter 2 of the User's Manual.

D.3   Steps to Configure Hazus-MH to Run with SQL-Server 2008 R2
1. Install Hazus-MH then launch it at least one time and close it.
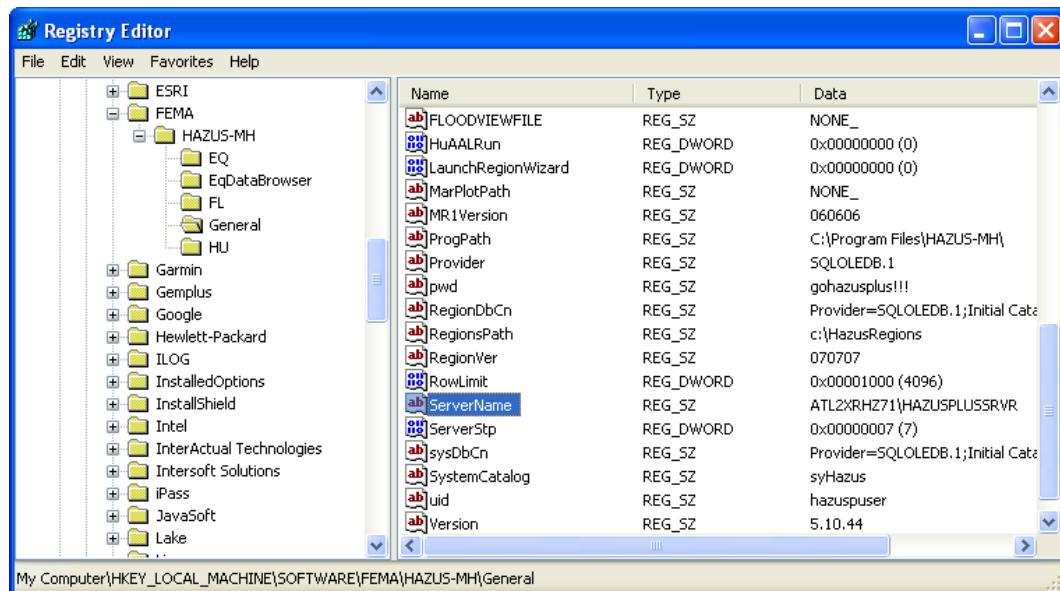
2. Open the windows registry. To do this, click the "Start" button and type "regedit" in the Run window edit box (Figure L-1) and click the "OK" button to open the Registry Editor.

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[1] As of September 2011, Microsoft had no less than 9 other different editions of SQL Server 2008 R2 in addition to the Express edition.

[2] Steps detailed in this document apply to Windows 7. Instructions should be very similar under Windows XP.
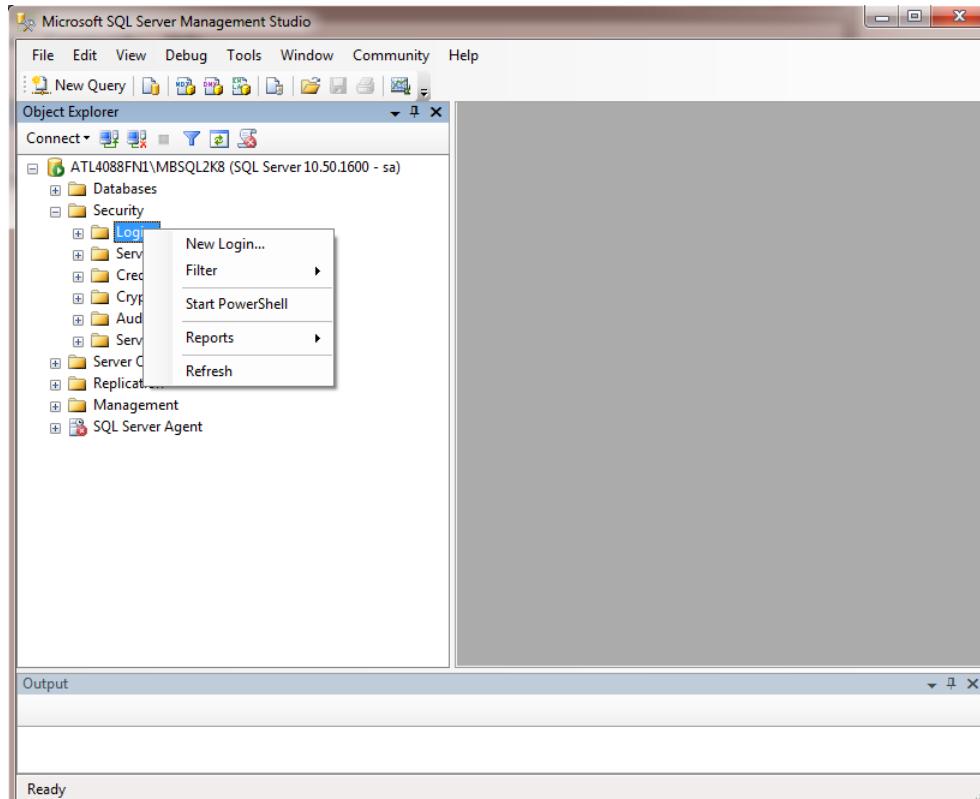
Figure D-1

3. Navigate through the folders listed in the Registry Editor to the location: [HKEY_LOCAL_MACHINE\SOFTWARE\FEMA\HAZUS-MH\General] in Registry Editor Window (Figure D-2 below).

Figure D-2

4. Double click on "ServerName" (shown highlighted above in Figure L-2) and enter the name of the new SQL Server 2008 R2 instance. The name is in the format <computername>/<instancename>. For example, if the machine name is ATLHW32P91 and the instance name is SQL2008[3], then the registry enter should show ATLHW32P91 \SQL2008. Open the SQL Server Management Studio from Start|All Programs|Programs|Microsoft SQL Server 2008 R2|SQL Server Management Studio on windows menu.

5. Under SQL Server double click Security folder and select Logins and right click the mouse. From the Popup menu select New Login as shown in Figure L-3.

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[3] The instance name is specified during the SQL Server 2008 R2 installation.

Figure D-3

6. In "SQL Server Properties -New Login" dialog enter "hazuspuser" in the name field without parentheses as shown in Figure D-4.

7. Click SQL Server Authentication option. Enter the password " "gohazusplus_01" without parentheses.

8. Uncheck the "User must change password at next login" option if it is checked.

You can get the names in 7 and 8 above by copying them from registry [HKEY_LOCAL_MACHINE\SOFTWARE\FEMA\HAZUS-MH\General] (see Figure D-2)

a. For Name field copy it from **uid** in the registry and past it in the appropriate field.

b. For Password copy it from **pwd** in the registry and past it in the appropriate field.

c. It's better to copy these values from registry to avoid typos.
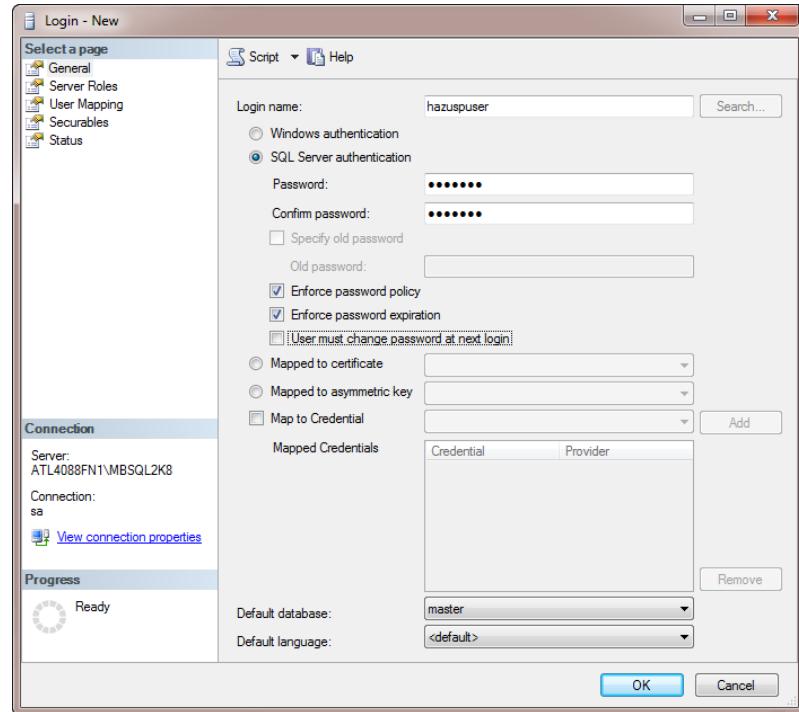
Figure D-4

9. After that Click Server Roles Tab and check sysadmin. Click OK (Figure D-5).
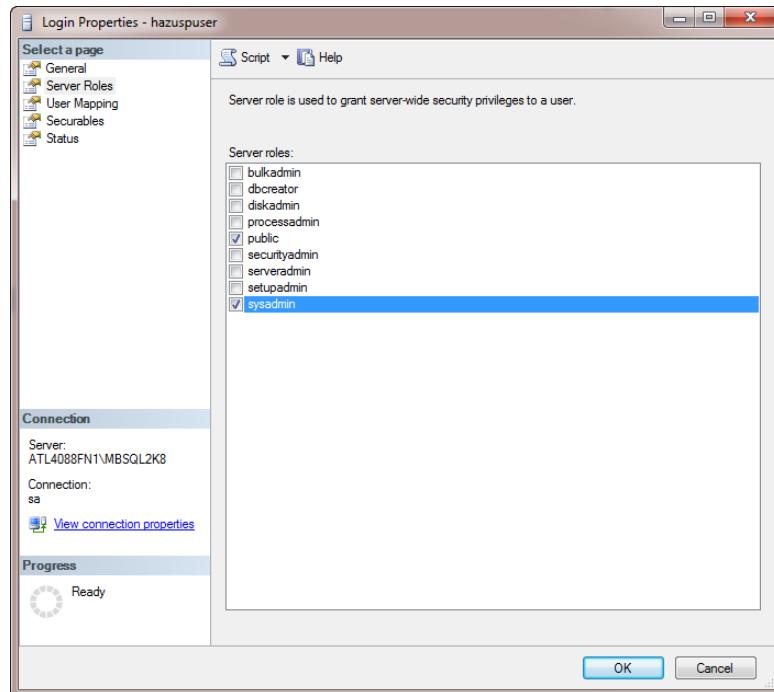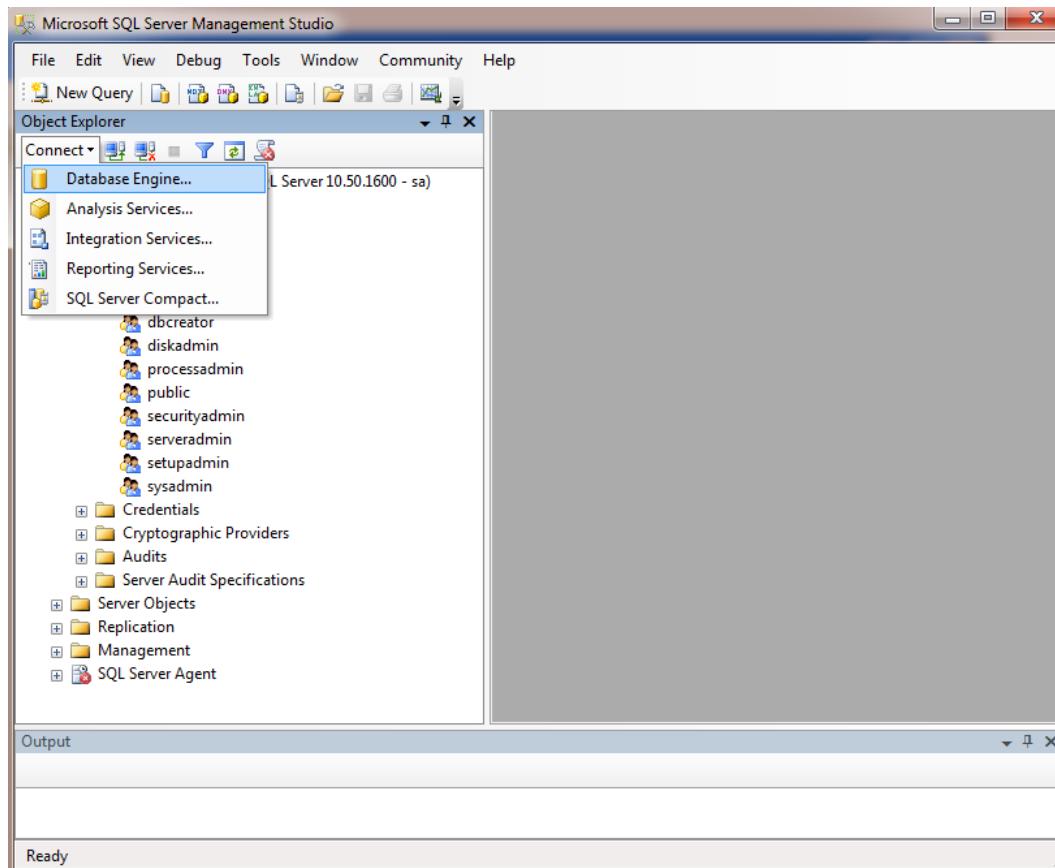
Figure D-5

10. Confirm password "gohazusplus_01" and Click OK.

11. Now connect to the HAZUSPLUSSRVR installed by Hazus-MH via the Management studio. To do that Click the "Connect" button at the top left corner of the SQL Server Management Studio and select Database Engine… option (Figure D-6)
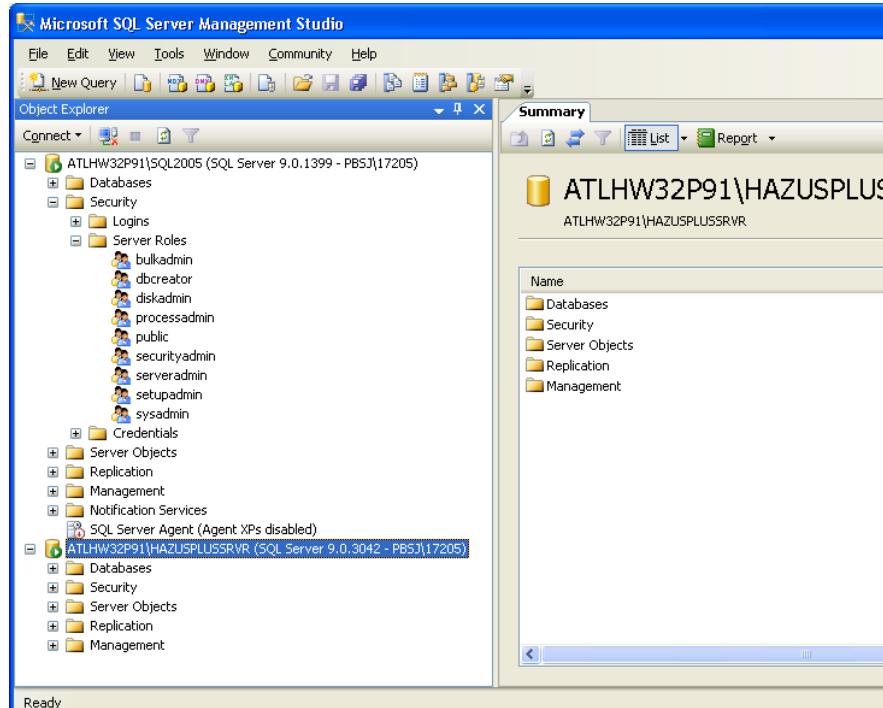
Figure D-6
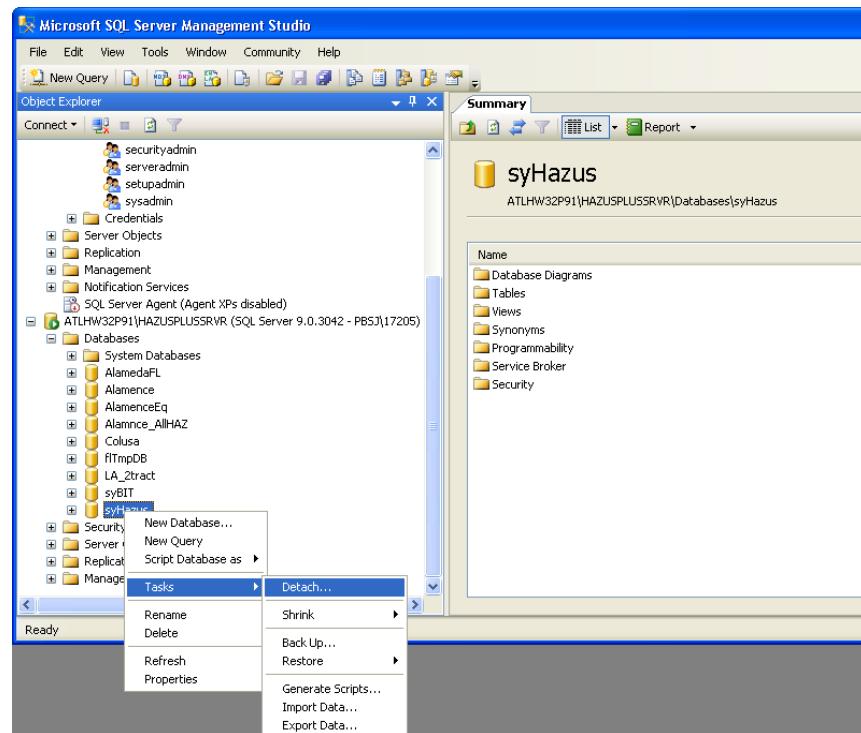
12. For **Server name** select or type in YourComputerName\HAZUSPLUSSRVR.

13. Select Windows Authentication for the **Authentication**

14. Click on the **Connect** button.

Figure D-7

15. Now, the new database server will be visible on the Management Studio as shown in Figure D-8.
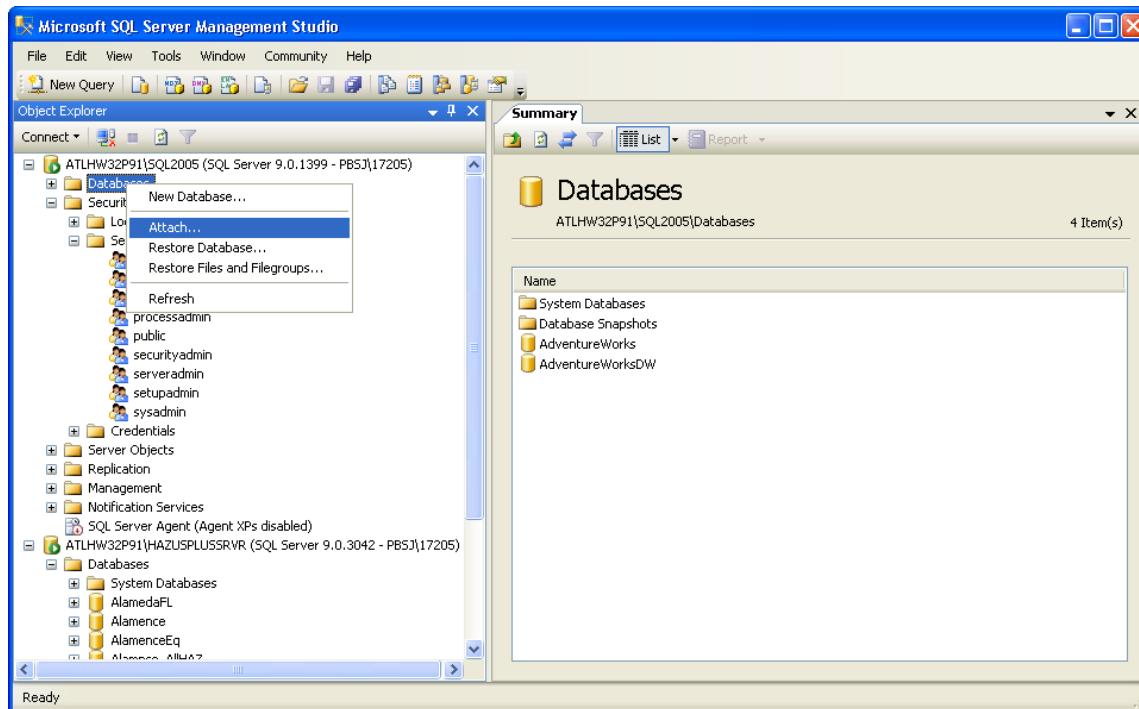
Figure D-8

16. Next navigate to Databases folder under HAZUSPLUSSRVR Server and expand it. Select syHazus database, Right click on it and Task | Detach and click OK (Figure D-9).
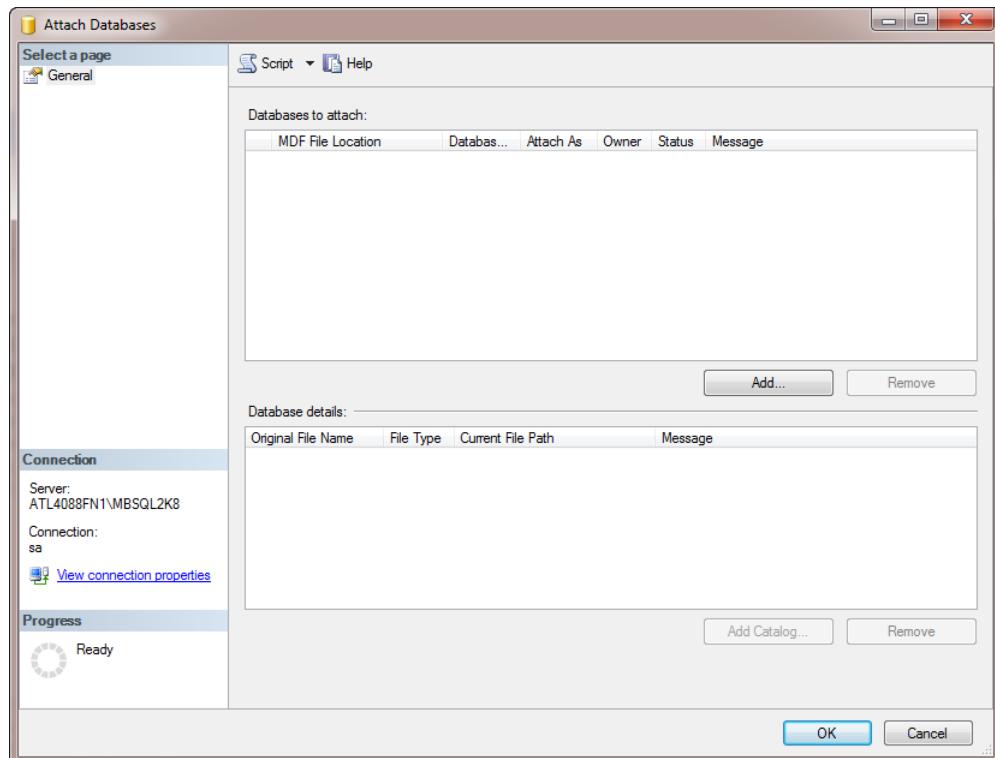
Figure D-9

17. Navigate to the folder that represents the new server (ATLHW32P91 in Figure D-10). Select Database folder and Right click the mouse, Select Attach… database... option as shown in Figure D-10.
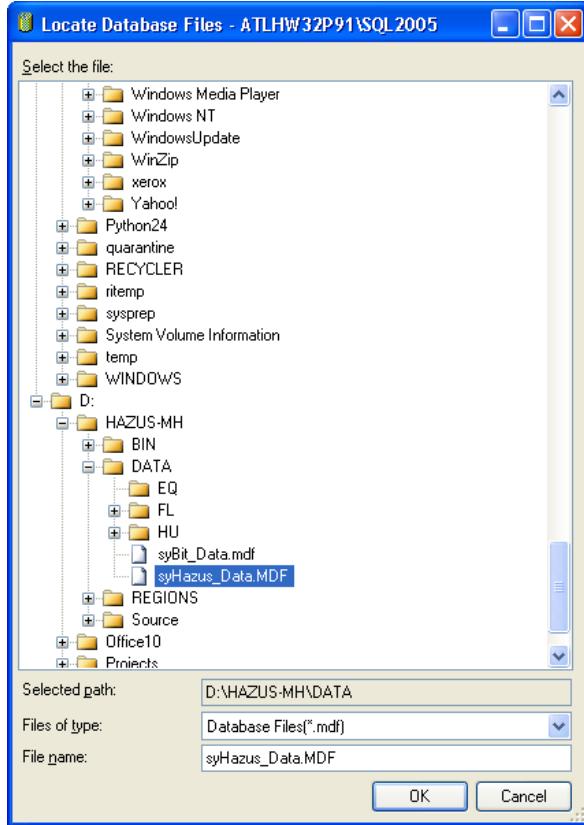
Figure D-10

This will launch the Attach Database dialog as shown in Figure D-11.
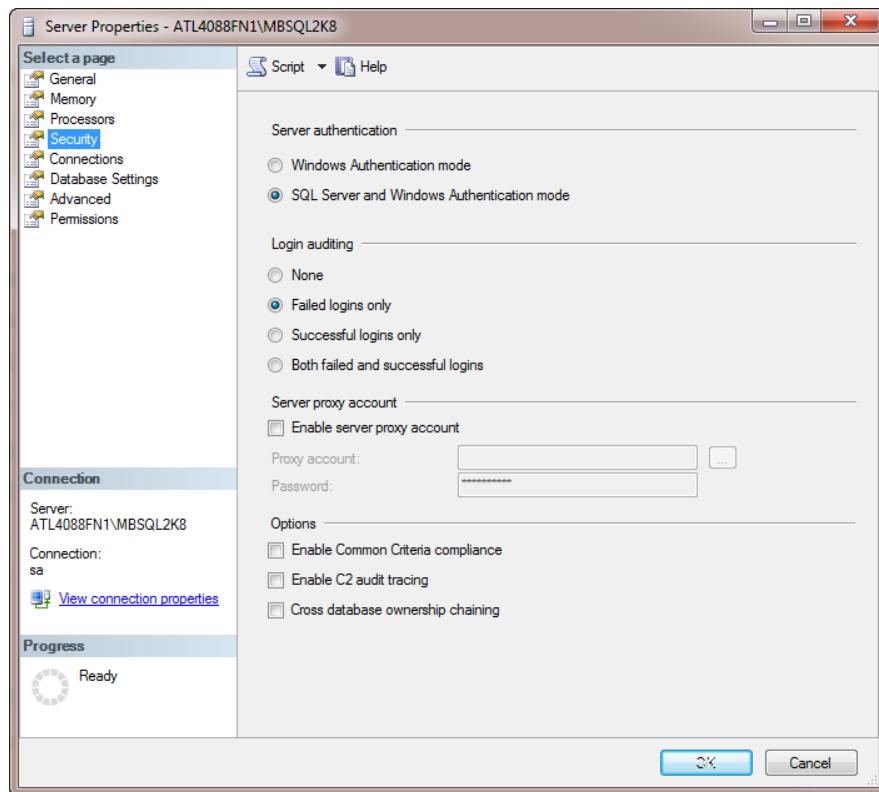
Figure D-11

18. Click Add button and browse to the folder where Hazus-MH is installed. Within Hazus-MH folder open Data folder (Figure D-12).

19. Select SyHazus_Data.MDF and click OK twice

20. You should get a message that the syHazus is attached successfully.

Figure D-12

21. Right click the mouse on New Server (**ATLHW32P91** in Figure D-13) in the Management Studio. Select **Properties** from the short cut menu. This will launch the **Server Properties** dialog. Click on **Security** option, and make sure that the Server Authentication is set ti **SQL Server and Windows Authentication Mode** as shown in Figure D-13.

Figure D-13

Hazus-MH is ready to be run from the New SQL Server. Proceed with creating the desired new study regions.

IMPORTANT NOTE:

Steps above are valid if the re-connection from the SQL Server Express edition to the full version of SQL Server is done right after the Hazus-MH setup. If any number of study regions has been created already, then ALL those study regions must be also moved to the full SQL Server 2008 R2 (follow same process above as for syHAZUS database).

D.4   Steps to Re-configure Hazus-MH to Use Original SQL Server Express

Once Hazus-MH has been configured to run with SQL Server 2008 R2 it cannot be uninstalled. Before uninstalling Hazus-MH it's necessary to reconfigure Hazus-MH to run with HAZUSPLUSSRVR, the way it was configured by the installation. Follow the steps outlined below to achieve this (basically, reversing the syHazus database move).
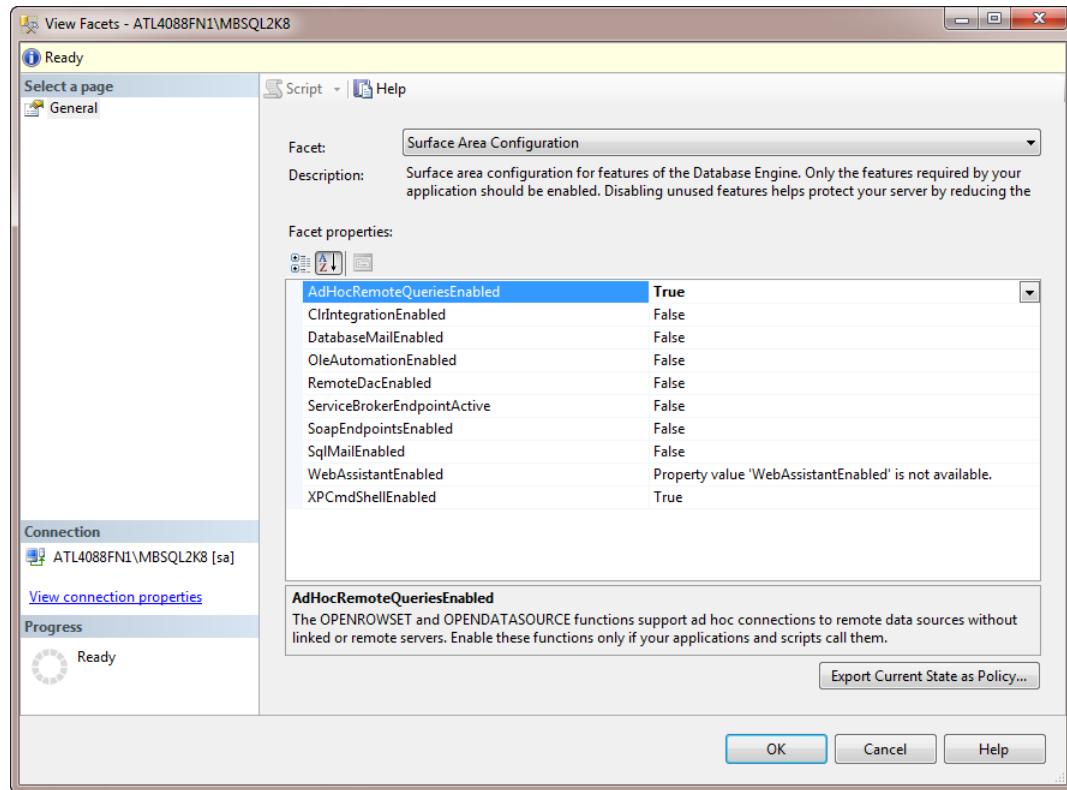
1. Launch SQL Sever Management Studio Manager.

2. Detach syHazus database from SQL Server

3. Attach syHazus to the HAZUSPLUSSRVR.

4. Launch the SQL Server Configuration Manager from **Start|Programs|Microsoft SQL Server 2008 R2|Configuration**

Tools|SQL Server Configuration Manager. Select "SQL Server 2008 R2 Services" from the list.on the left, then select the HAZUSPLUSSRVR instance, right-click, and select Restart.

5. Restart also the full SQL server instance by following the same steps

After you are done with all the steps above, you need to do the following:
-   Select the HAZUSPLUSSRVR instance in the SQL Server Management Studio
-   Right-click and select Facets
-   Make sure the the AdHocRemoteQuriesEnabled option is set to true under the Surface Area Configuration option as shown in dialog below

Appendix E.   Data Model Dictionary

E.1   System Database Table List

Table Name	Primary Key	Description
clBldgTypeHu	idtSbtName	List of Specific Building Type with a description of each (hu hazard)
huDamLossFun	AK_DL	Damage, Loss, Loss of Use, and Debris Functions
huDamLossFunDescription	idtDamLossDescID	Damage, Loss, Loss of Use, and Debris Classification
huDetermWindSpeedResults		Deterministic Wind Speed Results (hu spec.)
huDetermWindSpeedResultsByTimeStep	ak_senario_tract_time	Deterministic Wind Speed Results (hu spec.)
huErrorDef	idtErrID	List of Error codes and strings used in the HU Database and the HU user interface.
huGridProperties		Grid control grid properties
huGridPropertiesControl	PK_HU_GRIDCOL_TYPE	Grid Control control types
huGridPropertiesDataTypes	PK_HU_GRIDCOL_TYPE	Grid Control cell data type
huGridPropertiesEditMode	PK_HU_GRIDCOL_TYPE	Grid Control column edit modes
huGridPropertiesTextColor	PK_HU_GRIDCOL_TYPE	Grid Control cell text color
huGridPropertiesWidth	PK_HU_GRIDCOL_TYPE	Grid Contorl column width
huHistoricStormList	PK_Name	Historic storm list
huHistoricWindSpeedResults	AK_scnnametract	Historic storm wind speeds by historic storm
huListOfWindBldgTypes	itdwbID	combination of Specific Building type and there characteristics(hu hazard)
huOuputOptions	PK_huOuputOptions	Analysis option output scheme
huOutputOptionsByMap	PK_huOutputOptionsByMap	Analysis option map list
huOutputOptionsByMapFilterStr	PK_huOutputOptionsByMapFilterStr	Analysis option tree control name filter
huOutputOptionsByReport	PK_huOutputOptionsByReport	Analysis option report list
huOutputOptionsMapCol	PK_huOutputOptionsMapCol	Analysis option map enabled column names
huOutputOptionsMapFilters	PK_huOutputOptionsMapFilters	Analysis option tree control filter
huOutputOptionsMapRltsByFilter	PK_huOutputOptionsMapRltsByFilter	Analysis option map results filter
huOutputOptionsMapRltsType	PK_huOutputOptionsMapRltsType	Analysis option map results type
huOutputOptionsMapSchemes		Analysis option map schemes
huReports	PK_huReports	Analysis option report list
huScenario	idthuScenario	User-defined scenario list
huStormTrack		User defined and historic storm scenario containing storm track information. (hu hazard)
huTableParams		Metadata documents
huTerrain	idtTerrain	Surface Roughness Table
huTractInlandDistance		Inland distance of Tracts in 36 directions

huTreeBlowdownDensity	idtTreeDensity	Tree Blowdown tree density
huTreeBlowdownFunctions	AK_TreeBDown	Tree Blowdown functions
huTreeBlowdownHeight	idtTreeHeight	Tree Blowdown tree heights
huTreeBlowdownLossFunctions	AK_TreeBDownLoss	Tree Blowdown loss functions
huTreeBlowdownTreeType	PK_TreeType	Tree Blowdown tree types

E.2 System Database Table Columns List

Table Name	Column Name	Data Type	Description
clBldgTypeHu	SbtID	smallint	Specific buiding type ID
clBldgTypeHu	gbtDescription	char(100)	Specific buiding type description
clBldgTypeHu	gbtName	varchar(10)	General buiding type
clBldgTypeHu	sbtDescription	char(100)	General buiding type description
clBldgTypeHu	sbtName	varchar(10)	Hurricane Specific Building Type ID
huDamLossFun	DamLossDescID	smallint	Damage or Loss Description
huDamLossFun	TerrainID	smallint	Surface Roughness ID
huDamLossFun	WS100	real	Damage or Loss Function at 100 mph Wind Speed
huDamLossFun	WS105	real	Damage or Loss Function at 105 mph Wind Speed
huDamLossFun	WS110	real	Damage or Loss Function at 110 mph Wind Speed
huDamLossFun	WS115	real	Damage or Loss Function at 115 mph Wind Speed
huDamLossFun	WS120	real	Damage or Loss Function at 120 mph Wind Speed
huDamLossFun	WS125	real	Damage or Loss Function at 125 mph Wind Speed
huDamLossFun	WS130	real	Damage or Loss Function at 130 mph Wind Speed
huDamLossFun	WS135	real	Damage or Loss Function at 135 mph Wind Speed
huDamLossFun	WS140	real	Damage or Loss Function at 140 mph Wind Speed
huDamLossFun	WS145	real	Damage or Loss Function at 145 mph Wind Speed
huDamLossFun	WS150	real	Damage or Loss Function at 150 mph Wind Speed
huDamLossFun	WS155	real	Damage or Loss Function at 155 mph Wind Speed
huDamLossFun	WS160	real	Damage or Loss Function at 160 mph Wind Speed
huDamLossFun	WS165	real	Damage or Loss Function at 165 mph Wind Speed
huDamLossFun	WS170	real	Damage or Loss Function at 170 mph Wind Speed
huDamLossFun	WS175	real	Damage or Loss Function at 175 mph Wind Speed
huDamLossFun	WS180	real	Damage or Loss Function at 180 mph Wind Speed
huDamLossFun	WS185	real	Damage or Loss Function at 185 mph Wind Speed
huDamLossFun	WS190	real	Damage or Loss Function at 190 mph Wind Speed
huDamLossFun	WS195	real	Damage or Loss Function at 195 mph

Table Name	Column Name	Data Type	Description
			Wind Speed
huDamLossFun	WS200	real	Damage or Loss Function at 200 mph Wind Speed
huDamLossFun	WS205	real	Damage or Loss Function at 205 mph Wind Speed
huDamLossFun	WS210	real	Damage or Loss Function at 210 mph Wind Speed
huDamLossFun	WS215	real	Damage or Loss Function at 215 mph Wind
huDamLossFun	WS220	real	Damage or Loss Function at 220 mph Wind Speed
huDamLossFun	WS225	real	Damage or Loss Function at 225 mph Wind Speed
huDamLossFun	WS230	real	Damage or Loss Function at 230 mph Wind Speed
huDamLossFun	WS235	real	Damage or Loss Function at 235 mph Wind Speed
huDamLossFun	WS240	real	Damage or Loss Function at 240 mph Wind Speed
huDamLossFun	WS245	real	Damage or Loss Function at 245 mph Wind Speed
huDamLossFun	WS250	real	Damage or Loss Function at 250 mph Wind Speed
huDamLossFun	WS50	real	Damage or Loss Function at 50 mph Wind Speed
huDamLossFun	WS55	real	Damage or Loss Function at 55 mph Wind Speed
huDamLossFun	WS60	real	Damage or Loss Function at 60 mph Wind Speed
huDamLossFun	WS65	real	Damage or Loss Function at 65 mph Wind Speed
huDamLossFun	WS70	real	Damage or Loss Function at 70 mph Wind Speed
huDamLossFun	WS75	real	Damage or Loss Function at 75 mph Wind Speed
huDamLossFun	WS80	real	Damage or Loss Function at 80 mph Wind Speed
huDamLossFun	WS85	real	Damage or Loss Function at 85 mph Wind Speed
huDamLossFun	WS90	real	Damage or Loss Function at 90 mph Wind Speed
huDamLossFun	WS95	real	Damage or Loss Function at 95 mph Wind Speed
huDamLossFun	wbID	smallint	Wind Building Type ID
huDamLossFunDescription	DamLossClass	char(20)	Damage or Loss Function Classification
huDamLossFunDescription	DamLossDescID	smallint	Damage or Loss Description ID
huDamLossFunDescription	DamLossDescription	char(40)	Damage or Loss Description
huDetermWindSpeedResults	CenLat	decimal(11,6)	Tract centroid latitiude
huDetermWindSpeedResults	CenLongit	decimal(11,6)	Tract centroid longitude

Table Name	Column Name	Data Type	Description
huDetermWindSpeedResults	DistToCoast	real	Tract centroid distance to coastline
huDetermWindSpeedResults	MaxSustained	smallint	Deterministic Storm 1-min Sustained Wind Speed Results for each Census Tract (mph)
huDetermWindSpeedResults	PeakGust	smallint	Deterministic Storm Peak Gust Wind Speed for each Census Tract (mph)
huDetermWindSpeedResults	Tract	char(11)	Tract number (11-char)
huDetermWindSpeedResults	WindSpeedDir	smallint	Wind speed direction
huDetermWindSpeedResults	huScenarioName	varchar(40)	User defined scenario name
huDetermWindSpeedResultsByTimeStep	MinSustained	smallint	Deterministic Storm 1-min Sustained Wind Speed Results for each Census Tract (mph)
huDetermWindSpeedResultsByTimeStep	PeakGust	smallint	Deterministic Storm Peak Gust Wind Speed for each Census Tract (mph)
huDetermWindSpeedResultsByTimeStep	StepID	int	ID
huDetermWindSpeedResultsByTimeStep	TimeStep	real	Time step
huDetermWindSpeedResultsByTimeStep	Tract	char(11)	Tract number (11-char)
huDetermWindSpeedResultsByTimeStep	WindSpeedDir	smallint	Wind speed direction
huDetermWindSpeedResultsByTimeStep	WindSpeedDirDeg	real	Wind speed direction in degrees
huDetermWindSpeedResultsByTimeStep	huScenarioName	varchar(40)	User defined scenario name
huErrorDef	ErrID	smallint	Error Definition ID
huErrorDef	ErrMsg	varchar(256)	Error Definition Message
huGridProperties	GridName	varchar(50)	Grid Name
huGridProperties	HU_GRIDCOL_CONTROL	varchar(50)	Control Type
huGridProperties	HU_GRIDCOL_EDITMODE	varchar(50)	Edit Mode
huGridProperties	HU_GRIDCOL_EXTNAME	varchar(50)	Column display name
huGridProperties	HU_GRIDCOL_INDEX	int	Grid index
huGridProperties	HU_GRIDCOL_INTNAME	varchar(50)	Table column name
huGridProperties	HU_GRIDCOL_TOOLTIP	varchar(1024)	Coumn tool tip
huGridProperties	HU_GRIDCOL_TXTCOLOR	varchar(50)	Column color
huGridProperties	HU_GRIDCOL_TYPE	varchar(50)	Column data type
huGridProperties	HU_GRIDCOL_WIDTH	varchar(50)	Column width
huGridPropertiesControl	HU_GRIDCOL_CONTROL	varchar(50)	Control Type
huGridPropertiesControl	value	int	Control type value
huGridPropertiesDataTypes	HU_GRIDCOL_TYPE	varchar(50)	Column data type
huGridPropertiesDataTypes	value	int	Column data type value
huGridPropertiesEditMode	HU_GRIDCOL_EDITMODE	varchar(50)	Column edit mode
huGridPropertiesEditMode	value	int	Column edit mode value
huGridPropertiesTextColor	HU_GRIDCOL_TEXTCOLOR	varchar(50)	Column text color
huGridPropertiesTextColor	value	int	Column text color value

Table Name	Column Name	Data Type	Description
huGridPropertiesWidth	HU_GRIDCOL_WIDTH	varchar(50)	Column width
huGridPropertiesWidth	value	real	Column width value
huHistoricStormList	CurrentScenario	bit	Currnet historic storm flag
huHistoricStormList	Event	smallint	Event
huHistoricStormList	LandFallStates	varchar(50)	Land fall states
huHistoricStormList	NumStatesAffected	smallint	Number of states affected
huHistoricStormList	PeakGust	smallint	Peak gust wind speed
huHistoricStormList	StatesAffected	varchar(50)	States affected list
huHistoricStormList	StormNumber	smallint	Storm number
huHistoricStormList	Year	smallint	Storm year
huHistoricStormList	bSSCurrent	smallint	Current storm flag
huHistoricStormList	huScenarioName	varchar(40)	Historic storm name
huHistoricWindSpeedResults	MinSustained	smallint	Minimum sustained wind speed
huHistoricWindSpeedResults	PeakGust	smallint	Peak gust wind speed
huHistoricWindSpeedResults	Tract	char(11)	Census tract
huHistoricWindSpeedResults	huScenarioName	varchar(40)	Historic storm name
huListOfWindBldgTypes	CaseID	int	Wind building case id
huListOfWindBldgTypes	charDescription	varchar(100)	Wind building description
huListOfWindBldgTypes	nWindChar	smallint	Wind building number of character sets (5 char per set)
huListOfWindBldgTypes	sbtName	varchar(10)	Hurricane Specific Building Type ID
huListOfWindBldgTypes	wbID	smallint	Wind Building Type ID
huOuputOptions	OptionSchemeID	smallint	Option scheme ID
huOuputOptions	OptionSchemeName	varchar(100)	Option scheme name
huOuputOptions	RptExportType	smallint	Report export type
huOutputOptionsByMap	ColID	smallint	Map enabled column id
huOutputOptionsByMap	OptionSchemeID	smallint	Option scheme ID
huOutputOptionsByMap	RltsID	smallint	Results id
huOutputOptionsByMap	StrID	smallint	String id
huOutputOptionsByMap	bAvailable	bit	Map available flag
huOutputOptionsByMap	bMapSelected	bit	Map selected flag
huOutputOptionsByMapFilterStr	Return_Period	varchar(25)	Return period
huOutputOptionsByMapFilterStr	StrID	smallint	String id
huOutputOptionsByMapFilterStr	strFilters	varchar(50)	Filter string
huOutputOptionsByReport	OptionSchemeID	smallint	Option scheme ID
huOutputOptionsByReport	ReportID	smallint	Report id
huOutputOptionsByReport	bReportSelected	bit	Report selected flag
huOutputOptionsMapCol	ALT_Return_Period	varchar(25)	Return period display name
huOutputOptionsMapCol	ColID	smallint	Column id
huOutputOptionsMapCol	GridName	varchar(50)	Grid name

Table Name	Column Name	Data Type	Description
huOutputOptionsMapCol	HU_GRIDCOL_INTNAME	varchar(50)	Internal column name
huOutputOptionsMapCol	LegendColName	varchar(50)	Map legend display name
huOutputOptionsMapCol	LegendUnits	varchar(10)	Map legend units
huOutputOptionsMapFilters	AltTable	varchar(50)	Alternate table name
huOutputOptionsMapFilters	ColName	varchar(50)	Map column name
huOutputOptionsMapFilters	ColValue	varchar(50)	Map column value
huOutputOptionsMapFilters	DisplayOrder	smallint	User interface display order
huOutputOptionsMapFilters	FilterID	smallint	Map Filter id
huOutputOptionsMapFilters	FilterStr	char(5)	Map Filter string
huOutputOptionsMapFilters	FilterType	varchar(50)	Map fitler type
huOutputOptionsMapFilters	FilterValue	varchar(50)	Map filter value
huOutputOptionsMapFilters	ehuInventoryClass	varchar(25)	Inventory class
huOutputOptionsMapRltsByFilter	FilterID	smallint	Filter id
huOutputOptionsMapRltsByFilter	RltsID	smallint	Results id
huOutputOptionsMapRltsType	ColName	varchar(50)	Results column name
huOutputOptionsMapRltsType	ColValue	varchar(50)	Results column value
huOutputOptionsMapRltsType	DisplayOrder	smallint	Display order
huOutputOptionsMapRltsType	GenRlts	varchar(100)	General results
huOutputOptionsMapRltsType	GeoRes	tinyint	Tract or block resolution
huOutputOptionsMapRltsType	Legend	varchar(50)	Legend name
huOutputOptionsMapRltsType	MapOrder	smallint	Map order
huOutputOptionsMapRltsType	RltsID	smallint	Results id
huOutputOptionsMapRltsType	SecondaryTableName	varchar(100)	Secondary table name
huOutputOptionsMapRltsType	SpecRlts	varchar(100)	Specific results
huOutputOptionsMapRltsType	TableName	varchar(100)	Table name
huOutputOptionsMapRltsType	ehu_MAPDISPLAY_SCHEME	varchar(50)	Map display scheme
huOutputOptionsMapSchemes	eVal	int	Value
huOutputOptionsMapSchemes	ehu_MAPDISPLAY_SCHEME	varchar(50)	Map display scheme
huReports	DialogReportName	varchar(50)	Dialog report name
huReports	DialogTabName	varchar(50)	Dialog tab name
huReports	DisplayOrder	smallint	Display order
huReports	ExportFileName	varchar(50)	Export file name
huReports	FileName	varchar(50)	File name
huReports	ReportID	smallint	ID
huReports	ReportName	varchar(50)	Report Name
huReports	ReportType	varchar(50)	Report type
huReports	ScenarioType	varchar(25)	Scenario type
huReports	TemplateLoc	varchar(10)	RPT Template location
huScenario	Info	nvarchar(1000)	Description

Table Name	Column Name	Data Type	Description
huScenario	Type	tinyint	User defined scenario type
huScenario	bCentralPressure	bit	Central pressure flag
huScenario	bMaxWindSpeed	bit	Max wind speed flag
huScenario	bProfileParameter	bit	Profile parameter flag
huScenario	bRadiusType	bit	Radius to max winds flag
huScenario	bSSCurrent	bit	Current Hurricane Scenario Flag
huScenario	bTimeStep	bit	Time step flag
huScenario	bTranslationSpeed	bit	Translation speed flag
huScenario	huScenarioName	varchar(40)	HU Scenario Name
huStormTrack	CentralPressure	real	Deterministic Storm Track Central Pressure (mbar)
huStormTrack	Latitude	real	Deterministic Storm Track Latitude
huStormTrack	Longitude	real	Deterministic Storm Track Longitude
huStormTrack	MaxWindSpeed	real	Deterministic Storm Track Maximum Wind Speed (mph @ 10m)
huStormTrack	NewCentralPressure	real	Calculated central pressure
huStormTrack	NewTranslationSpeed	real	Calculated translation speed
huStormTrack	PointIndex	int	Deterministic Storm Track Point Index
huStormTrack	ProfileParameter	real	Deterministic Storm Track Profile Parameter
huStormTrack	RadiusToHurrWinds	real	Hurricane wind speed
huStormTrack	RadiusToMaxWinds	real	Deterministic Storm Track Radius to Max Winds (km)
huStormTrack	TimeStep	real	Deterministic Storm Track Time Step Between Storm Tracks (hours)
huStormTrack	TranslationSpeed	real	Deterministic Storm Track Translation Speed Between Storm Tracks (m/s)
huStormTrack	WindSpeedFactor	real	Wind speed factor
huStormTrack	huScenarioName	varchar(40)	Scenario Name
huStormTrack	huStormTrackPtID	smallint	Deterministic Hurricane Storm Scenario ID
huTableParams	HzMetaDataDoc	varchar(50)	HZ document name
huTableParams	huMetaDataDoc	varchar(50)	HU document Name
huTableParams	huTableName	varchar(100)	HU Table Name
huTableParams	hzTableName	varchar(100)	HZ Table Name
huTerrain	SRDescription	varchar(25)	Surface Roughness Description
huTerrain	SurfaceRoughness	real	Surface Roughness Value (meters)
huTerrain	TerrainID	smallint	Surface Roughness ID
huTractInlandDistance	Cnt	smallint	Direction count
huTractInlandDistance	Lat	decimal(11,6)	Centroid Latitude
huTractInlandDistance	Long	decimal(11,6)	Centroid longitude
huTractInlandDistance	MinDistance	smallint	Centroid minimum distance
huTractInlandDistance	Tract	char(11)	Census tract

Table Name	Column Name	Data Type	Description
huTractInlandDistance	d1	real	Direction 1 of 36
huTractInlandDistance	d10	real	Direction 11 of 36
huTractInlandDistance	d11	real	Direction 12 of 36
huTractInlandDistance	d12	real	Direction 1 of 36
huTractInlandDistance	d13	real	Direction 13 of 36
huTractInlandDistance	d14	real	Direction 14 of 36
huTractInlandDistance	d15	real	Direction 15 of 36
huTractInlandDistance	d16	real	Direction 16 of 36
huTractInlandDistance	d17	real	Direction 17 of 36
huTractInlandDistance	d18	real	Direction 18 of 36
huTractInlandDistance	d19	real	Direction 19 of 36
huTractInlandDistance	d2	real	Direction 2 of 36
huTractInlandDistance	d20	real	Direction 20 of 36
huTractInlandDistance	d21	real	Direction 21 of 36
huTractInlandDistance	d22	real	Direction 22 of 36
huTractInlandDistance	d23	real	Direction 23 of 36
huTractInlandDistance	d24	real	Direction 24 of 36
huTractInlandDistance	d25	real	Direction 25 of 36
huTractInlandDistance	d26	real	Direction 26 of 36
huTractInlandDistance	d27	real	Direction 27 of 36
huTractInlandDistance	d28	real	Direction 28 of 36
huTractInlandDistance	d29	real	Direction 29 of 36
huTractInlandDistance	d3	real	Direction 3 of 36
huTractInlandDistance	d30	real	Direction 30 of 36
huTractInlandDistance	d31	real	Direction 31 of 36
huTractInlandDistance	d32	real	Direction 32 of 36
huTractInlandDistance	d33	real	Direction 33 of 36
huTractInlandDistance	d34	real	Direction 34 of 36
huTractInlandDistance	d35	real	Direction 35 of 36
huTractInlandDistance	d36	real	Direction 36 of 36
huTractInlandDistance	d4	real	Direction 4 of 36
huTractInlandDistance	d5	real	Direction 5 of 36
huTractInlandDistance	d6	real	Direction 6 of 36
huTractInlandDistance	d7	real	Direction 7 of 36
huTractInlandDistance	d8	real	Direction 8 of 36
huTractInlandDistance	d9	real	Direction 9 of 36
huTreeBlowdownDensity	Description	varchar(100)	Tree density description
huTreeBlowdownDensity	TreeDensity	varchar(10)	Tree density
huTreeBlowdownFunctions	TreeDensity	varchar(10)	Tree function type
huTreeBlowdownFunctions	TreeHeight	varchar(10)	Tree height

Table Name	Column Name	Data Type	Description
huTreeBlowdownFunctions	TreeType	varchar(20)	Tree type
huTreeBlowdownFunctions	WS100	real	Damage or Loss Function at 100 mph Wind Speed
huTreeBlowdownFunctions	WS105	real	Damage or Loss Function at 105 mph Wind Speed
huTreeBlowdownFunctions	WS110	real	Damage or Loss Function at 110 mph Wind Speed
huTreeBlowdownFunctions	WS115	real	Damage or Loss Function at 115 mph Wind Speed
huTreeBlowdownFunctions	WS120	real	Damage or Loss Function at 120 mph Wind Speed
huTreeBlowdownFunctions	WS125	real	Damage or Loss Function at 125 mph Wind Speed
huTreeBlowdownFunctions	WS130	real	Damage or Loss Function at 130 mph Wind Speed
huTreeBlowdownFunctions	WS135	real	Damage or Loss Function at 135 mph Wind Speed
huTreeBlowdownFunctions	WS140	real	Damage or Loss Function at 140 mph Wind Speed
huTreeBlowdownFunctions	WS145	real	Damage or Loss Function at 145 mph Wind Speed
huTreeBlowdownFunctions	WS150	real	Damage or Loss Function at 150 mph Wind Speed
huTreeBlowdownFunctions	WS155	real	Damage or Loss Function at 155 mph Wind Speed
huTreeBlowdownFunctions	WS160	real	Damage or Loss Function at 160 mph Wind Speed
huTreeBlowdownFunctions	WS165	real	Damage or Loss Function at 165 mph Wind Speed
huTreeBlowdownFunctions	WS170	real	Damage or Loss Function at 170 mph Wind Speed
huTreeBlowdownFunctions	WS175	real	Damage or Loss Function at 175 mph Wind Speed
huTreeBlowdownFunctions	WS180	real	Damage or Loss Function at 180 mph Wind Speed
huTreeBlowdownFunctions	WS185	real	Damage or Loss Function at 185 mph Wind Speed
huTreeBlowdownFunctions	WS190	real	Damage or Loss Function at 190 mph Wind Speed
huTreeBlowdownFunctions	WS195	real	Damage or Loss Function at 195 mph Wind Speed
huTreeBlowdownFunctions	WS200	real	Damage or Loss Function at 200 mph Wind Speed
huTreeBlowdownFunctions	WS205	real	Damage or Loss Function at 205 mph Wind Speed
huTreeBlowdownFunctions	WS210	real	Damage or Loss Function at 210 mph Wind Speed
huTreeBlowdownFunctions	WS215	real	Damage or Loss Function at 215 mph Wind Speed
huTreeBlowdownFunctions	WS220	real	Damage or Loss Function at 220 mph

Table Name	Column Name	Data Type	Description
			Wind Speed
huTreeBlowdownFunctions	WS225	real	Damage or Loss Function at 225 mph Wind Speed
huTreeBlowdownFunctions	WS230	real	Damage or Loss Function at 230 mph Wind Speed
huTreeBlowdownFunctions	WS235	real	Damage or Loss Function at 235 mph Wind Speed
huTreeBlowdownFunctions	WS240	real	Damage or Loss Function at 240 mph Wind Speed
huTreeBlowdownFunctions	WS245	real	Damage or Loss Function at 245 mph Wind Speed
huTreeBlowdownFunctions	WS250	real	Damage or Loss Function at 250 mph Wind Speed
huTreeBlowdownFunctions	WS50	real	Damage or Loss Function at 50 mph Wind Speed
huTreeBlowdownFunctions	WS55	real	Damage or Loss Function at 55 mph Wind Speed
huTreeBlowdownFunctions	WS60	real	Damage or Loss Function at 60 mph Wind Speed
huTreeBlowdownFunctions	WS65	real	Damage or Loss Function at 65 mph Wind Speed
huTreeBlowdownFunctions	WS70	real	Damage or Loss Function at 70 mph Wind Speed
huTreeBlowdownFunctions	WS75	real	Damage or Loss Function at 75 mph Wind Speed
huTreeBlowdownFunctions	WS80	real	Damage or Loss Function at 80 mph Wind Speed
huTreeBlowdownFunctions	WS85	real	Damage or Loss Function at 85 mph Wind Speed
huTreeBlowdownFunctions	WS90	real	Damage or Loss Function at 90 mph Wind Speed
huTreeBlowdownFunctions	WS95	real	Damage or Loss Function at 95 mph Wind Speed
huTreeBlowdownHeight	Description	varchar(100)	Damage or Loss Function Classification
huTreeBlowdownHeight	TreeHeight	varchar(10)	Damage or Loss Description
huTreeBlowdownLossFunctions	LossType	varchar(20)	Loss type
huTreeBlowdownLossFunctions	TreeDensity	varchar(10)	Damage or Loss Description
huTreeBlowdownLossFunctions	TreeHeight	varchar(10)	Wind Building Type ID
huTreeBlowdownLossFunctions	TreeType	varchar(20)	Surface Roughness ID
huTreeBlowdownLossFunctions	WS100	real	Damage or Loss Function at 100 mph Wind Speed
huTreeBlowdownLossFunctions	WS105	real	Damage or Loss Function at 105 mph Wind Speed
huTreeBlowdownLossFunctions	WS110	real	Damage or Loss Function at 110 mph Wind Speed
huTreeBlowdownLossFunctions	WS115	real	Damage or Loss Function at 115 mph Wind Speed
huTreeBlowdownLossFunctions	WS120	real	Damage or Loss Function at 120 mph Wind Speed

Table Name	Column Name	Data Type	Description
huTreeBlowdownLossFunctions	WS125	real	Damage or Loss Function at 125 mph Wind Speed
huTreeBlowdownLossFunctions	WS130	real	Damage or Loss Function at 130 mph Wind Speed
huTreeBlowdownLossFunctions	WS135	real	Damage or Loss Function at 135 mph Wind Speed
huTreeBlowdownLossFunctions	WS140	real	Damage or Loss Function at 140 mph Wind Speed
huTreeBlowdownLossFunctions	WS145	real	Damage or Loss Function at 145 mph Wind Speed
huTreeBlowdownLossFunctions	WS150	real	Damage or Loss Function at 150 mph Wind Speed
huTreeBlowdownLossFunctions	WS155	real	Damage or Loss Function at 155 mph Wind Speed
huTreeBlowdownLossFunctions	WS160	real	Damage or Loss Function at 160 mph Wind Speed
huTreeBlowdownLossFunctions	WS165	real	Damage or Loss Function at 165 mph Wind Speed
huTreeBlowdownLossFunctions	WS170	real	Damage or Loss Function at 170 mph Wind Speed
huTreeBlowdownLossFunctions	WS175	real	Damage or Loss Function at 175 mph Wind Speed
huTreeBlowdownLossFunctions	WS180	real	Damage or Loss Function at 180 mph Wind Speed
huTreeBlowdownLossFunctions	WS185	real	Damage or Loss Function at 185 mph Wind Speed
huTreeBlowdownLossFunctions	WS190	real	Damage or Loss Function at 190 mph Wind Speed
huTreeBlowdownLossFunctions	WS195	real	Damage or Loss Function at 195 mph Wind Speed
huTreeBlowdownLossFunctions	WS200	real	Damage or Loss Function at 200 mph Wind Speed
huTreeBlowdownLossFunctions	WS205	real	Damage or Loss Function at 205 mph Wind Speed
huTreeBlowdownLossFunctions	WS210	real	Damage or Loss Function at 210 mph Wind Speed
huTreeBlowdownLossFunctions	WS215	real	Damage or Loss Function at 215 mph Wind Speed
huTreeBlowdownLossFunctions	WS220	real	Damage or Loss Function at 220 mph Wind Speed
huTreeBlowdownLossFunctions	WS225	real	Damage or Loss Function at 225 mph Wind Speed
huTreeBlowdownLossFunctions	WS230	real	Damage or Loss Function at 230 mph Wind Speed
huTreeBlowdownLossFunctions	WS235	real	Damage or Loss Function at 235 mph Wind Speed
huTreeBlowdownLossFunctions	WS240	real	Damage or Loss Function at 240 mph Wind Speed
huTreeBlowdownLossFunctions	WS245	real	Damage or Loss Function at 245 mph Wind Speed

Table Name	Column Name	Data Type	Description
huTreeBlowdownLossFunctions	WS250	real	Damage or Loss Function at 250 mph Wind Speed
huTreeBlowdownLossFunctions	WS50	real	Damage or Loss Function at 50 mph Wind Speed
huTreeBlowdownLossFunctions	WS55	real	Damage or Loss Function at 55 mph Wind Speed
huTreeBlowdownLossFunctions	WS60	real	Damage or Loss Function at 60 mph Wind Speed
huTreeBlowdownLossFunctions	WS65	real	Damage or Loss Function at 65 mph Wind Speed
huTreeBlowdownLossFunctions	WS70	real	Damage or Loss Function at 70 mph Wind Speed
huTreeBlowdownLossFunctions	WS75	real	Damage or Loss Function at 75 mph Wind Speed
huTreeBlowdownLossFunctions	WS80	real	Damage or Loss Function at 80 mph Wind Speed
huTreeBlowdownLossFunctions	WS85	real	Damage or Loss Function at 85 mph Wind Speed
huTreeBlowdownLossFunctions	WS90	real	Damage or Loss Function at 90 mph Wind Speed
huTreeBlowdownLossFunctions	WS95	real	Damage or Loss Function at 95 mph Wind Speed
huTreeBlowdownLossFunctions	bGarage	bit	Garage exist flag
huTreeBlowdownLossFunctions	sbtName	varchar(10)	Hurricane specific building type
huTreeBlowdownTreeType	Description	varchar(100)	Damage or Loss Function Classification
huTreeBlowdownTreeType	TreeType	varchar(20)	Damage or Loss Description

E.3   Template Database Table List

Name	Primary Key	Description
clBldgTypeHu	idtsbtName	Hurricane List of Specific Building Stock and Description
clOccupancy	idtOccupancy	General and specific occupancy classifications
huAnalysisOpt	idtOptID	Sets the hurricane analysis options for the user.
huAnalysisRunParameters	<None>	Analysis run level by Census Tract or Census Block
huBldgCharCase	PK_CaseID	Contential US/ Hawaii wind building filter
huBldgCharTree	<None>	Wind buiding characteristics tree control filter
huBldgCharValidity	idtbcvID	Matches valid building characteristics to the hurricane specific building types
huBldgCharWt	AK_hubmaplist_wbid	Contains the total weighted average for each unique building type (4325 types for each bldg char scheme).
huBldgCountBldgTypeB	idtKey	Building count by building type by census block.
huBldgCountBldgTypeT	idtKey	Building count table by census tract by specific bldg type. Unique to each hazard since specific bldg type classification varies by hazard.
huBldgEconBIAnnGrossSales	PK_Occupancy	Annual Gross Sales ($ per sqf)
huBldgEconBIBusinessInv	PK_Occupancy	Business Inventory (% of gross annual sales)
huBldgEconILOwnerOcc	PKOccupancy	Building Economic owner occupancy
huBldgEconILRecaptureFactors	PKOccupancy	Building Economic recapture factors
huBldgEconILRentalCost	PKOccupancy	Building Economic rental costs
huBldgEconILWageCapIncome	PKOccupancy	Building Economic wage income caps
huBldgEconLossTypes	pkEconLossType	Building Economic loss types
huBldgEconRTBusInterruption	PKOccupancy	Building Economic business interruption
huBldgMapping	Key_2	Hurricane Specific Wind Building Characteristic Distribution
huBldgMappingList	idthuBldgSchemeName	Hurricane Building Character Scheme List used for naming the characteristic distributions for each building type.
huBldgMappingListExt	PK_HUBLDGMAPPINGLISTExt	Mapping scheme name list extention. Allows the mapping scheme name to be greater than 25 characters
huBldgMapping_Updates	<None>	MR1 wind building mapping scheme updates
huBldgMapping_UpdatesMR2	<None>	MR2 wind building mapping scheme updates
huBldgTypeResultsB	Key_2	Damage and loss results by building type by Block
huBldgTypeResultsT	Key_2	Damage and loss results by building type by Tract
huCareFlty	idtKey	Hurricane Care Facility
huCensusBlock	idtKey	Hurricane Census Block data
huDebrisAndShelterDamTypesByRP	idtDLType	Hurricane Damage and Loss Classification by Return Period for debris and shelter
huDebrisResultsB	Key_2	Hurricane Debris Results by Block
huDebrisResultsT	Key_2	Hurricane Debris Results by Tract
huEfOccMapping	PKEFClass	Essential facilities occupancy to specific occupancy mapping
huEmergencyCtr	idtKey	Hurricane Emergency Center Facility

Name	Primary Key	Description
huExposureBldgTypeB	idtKey	Hurricane Dollar Exposure by Building Type by Census Block
huExposureBldgTypeT	idtKey	Hurricane Dollar Exposure by Building Type by Census Tract
huExposureContentBldgTypeB	idtKey	Hurricane Dollar Content Exposure by Building Type by Census Block
huExposureContentBldgTypeT	idtKey	Hurricane Dollar Content Exposure by Building Type by Census Tract
huFireStation	idtKey	Hurricane Fire Station
huGbsOccMapping	idtKey	Hurricane General Building Stock Occupancy Mapping
huGbsOccMappingList	idthuOccMapSchemeName	Hurricane List of occupancy mapping schemes for the general building stock
huGbsOccMappingListExt	PK_HUGBSOCCMAPPINGLISTExt	Geneal occupancy mapping scheme list. Extends name from 25 to 255 characters
huGenAnalysisOpt	idtGenOptID	Sets the hurricane Gen analysis options for the user.
huHazardMapWindSpeed	idtHazardMapWSKey	Wind Speeds by Return Period for each Census Tract. Use to display default wind speed map layers
huHazardMapWindSpeedB	idtHazardMapWSKey	Wind Speeds by Return Period for each Census Block. Use to display default wind speed map layers
huInCast	<None>	InCast hurricane data
huListOfBldgChar	idtBldgCharID	Hurricane Building Characteristics
huListOfWindBldgTypes	idtwbID	Hurricane List of Hurricane Wind Building Types
huOccResultsB	Key_2	Hurricane damage and loss results by occupancy by Block
huOccResultsT	Key_2	Hurricane damage and loss results by occupancy by Tract
huPoliceStation	idtKey	Hurricane Police Station Facility
huRPWindSpeeds	idtKey	Wind Speeds by Return Period for each Census Tract
huRPWindSpeedsB	idtKey	Wind Speeds by Return Period for each Census Block
huRapidLossResults	<None>	Rapid loss results
huReports	<None>	Hurricane summary report list
huResultsBldgEconOutputAndEmpOccB	idtKey	Building economic loss results by occupancy by Block
huResultsBldgEconOutputAndEmpOccT	idtKey	Building economic loss results by occupancy by Tract
huResultsCareFlty	idtKey	Medical care facilities results
huResultsEmergCtr	idtKey	Emergency center facilities results
huResultsFireStation	idtKey	Fire station results
huResultsPoliceStation	idtKey	Police station results
huResultsSchool	idtKey	School results
huResultsUserDefined	idtKey	User defined facilities results
huReturn Periods	idtReturnPeriod	List of return periods
huSchool	idtKey	Hurricane School Facility
huShelterCategoryWeights	PKClass	Shelter Category Weights
huShelterDSProb	PKWeightFactor	Default values for Damage State Probabilities
huShelterRelModFactors	PKClass	Hurricane specific Shelter Relative Modification Factors

Name	Primary Key	Description
huShelterResultsB	Key_2	Hurricane Shelter Results by Block
huShelterResultsT	Key_2	Hurricane Shelter Results by Tract
huShelterUtilityFactors	pk_Class	Hurricane Shelter utility factors
huSqFootageBldgTypeB	idtKey	Square Footage by Specific Bldg Type (hu specific)
huSqFootageBldgTypeT	idtKey	Square Footage by Specific Bldg Type (hu specific)
huSummaryDamage	Key_2	Summary damage results by Tract
huSummaryDamageB	AK_huSumDamB	Summary damage results by Block
huSummaryLoss	Key_2	Summary Loss Results by Tract
huSummaryLossB	Key_2	Summary Loss Results by Block
huTemplateScenario	Key_1	Current scenario
huTerrain	idtKey	Hurricane Surface Roughness for each Census Tract in the Study Region
huTerrainB	idtKey	Hurricane Surface Roughness for each Census Block in the Study Region
huTract	idtKey	Hurricane census tract datal. The study region hurricane census tract data is written to the huTerrain table in the template.
huTreeParameters	PK_tract	Tree parameters by Tract
huTreeParametersB	PK_block	Tree parameters by Block
huUserDefinedFlty	idtKey	Hurricane User Defined Facilities
hzSurgeFRCombByBldgTypeB	Key	Surge combined wind/flood results by General Building Type
hzSurgeFRCombSOccupB	Key	Surge combined wind/flood results by Specific Occupancy
huEfBldgCharWt	Key	Contains the total weighted average for each unique building type
huEfBldgEconRTBusInterruption	Key	Building Economic business interruption
huEfBldgMapping	Key	Hurricane Specific Wind Building Characteristic Distribution
huEfBldgMappingList	Key	Hurricane Building Character Scheme List used for naming the characteristic distributions for each building type.
huEfBldgMappingListExt	Key	Mapping scheme name list extention. Allows the mapping scheme name to be greater than 25 characters

E.4 Template Database Table Columns List

Table	Name	Data Type	Description
clBldgTypeHu	sbtName	varchar(10)	Hurricane Specific Building Type Name
clBldgTypeHu	SbtID	smallint	Hurricane Specific Building Type ID
clBldgTypeHu	gbtName	varchar(10)	General building type
clBldgTypeHu	sbtDescription	char(100)	Hurricane Specific Building Type Description
clBldgTypeHu	gbtDescription	char(100)	General building type description
clOccupancy	SoccDescription	char(100)	Specific occupancy description
clOccupancy	GoccDescription	char(100)	General occupancy description
clOccupancy	GoccName	varchar(20)	General occupancy
clOccupancy	Occupancy	char(5)	Specific occupancy class
clOccupancy	SoccID	smallint	Specific occupancy id
huAnalysisOpt	OptValue	smallint	Hurricane Analysis Option value
huAnalysisOpt	huAnalysisOpt	varchar(10)	Hurricane Analysis Option
huAnalysisRunParameters	OptimizationType	int	Type
huAnalysisRunParameters	OptimizationDesc	char(50)	Description
huAnalysisRunParameters	bValue	bit	Analysis flag
huAnalysisRunParameters	ValidValues	char(50)	Flag description
huBldgCharCase	CaseName	varchar(25)	Location Name
huBldgCharCase	CaseDescription	varchar(255)	Location description
huBldgCharCase	CaseID	int	Location Filter
huBldgCharTree	CharType	varchar(40)	Character category
huBldgCharTree	sbtName	varchar(10)	Specific building type
huBldgCharTree	CaseID	int	Location Filter
huBldgCharTree	ExcludedBldgCharTypeList	varchar(100)	Excluded building characteristics from tree control
huBldgCharTree	BldgChar	char(5)	Building characteristic
huBldgCharValidity	CaseID	int	Location Filter
huBldgCharValidity	sbtName	varchar(10)	Hurricane Specific Building Type Name
huBldgCharValidity	BldgCharID	int	Hurricane List of Wind Building Characteristic ID
huBldgCharValidity	bcvID	smallint	Hurricane Building Characteristic Validity ID
huBldgCharWt	WtPercent	real	Hurricane Wind Building Type Characteristic Total Distribution Value
huBldgCharWt	wbID	smallint	wbID should be one to one relationship with the huWindBldgChar Table in the system database.
huBldgCharWt	huBldgSchemeName	varchar(20)	Wind building mapping scheme
huBldgCountBldgTypeB	MERBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MERBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MERBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MLRM1i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MLRIi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MLRM2i	int	Hurricane Specific Building Type Count or Exposure

Table	Name	Data Type	Description
huBldgCountBldgTypeB	MMUH3i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	CECBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	CECBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	CECBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	SPMBSi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MECBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MECBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MECBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	CERBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	CERBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	CERBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	SPMBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	SECBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	SECBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	SECBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	SERBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	SERBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MH94HUDIIi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MH94HUDIIIi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MHPHUDi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MH94HUDIi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MH76HUDi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MMUH2i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MSF1i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	WMUH3i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	WMUH2i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MSF2i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	MMUH1i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	SERBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	CensusBlock	char(15)	Full census block number
huBldgCountBldgTypeB	SPMBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	WMUH1i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	WSF1i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeB	WSF2i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	WSF2i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	WMUH1i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	WSF1i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MSF2i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MSF1i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	WMUH2i	int	Hurricane Specific Building Type Count or Exposure

Table	Name	Data Type	Description
huBldgCountBldgTypeT	WMUH3i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	Tract	char(11)	Census Tract
huBldgCountBldgTypeT	MECBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MECBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MECBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MERBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	CERBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	CERBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	CERBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	CECBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MMUH3i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MLRM1i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MMUH2i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MERBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MERBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MLRM2i	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MLRIi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MH94HUDIIIi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	SECBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MHPHUDi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	SECBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	SECBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MH94HUDIIi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MH76HUDi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MH94HUDIi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	CECBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	SPMBSi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	SPMBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	CECBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	SERBHi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	SERBMi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	SPMBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	SERBLi	int	Hurricane Specific Building Type Count or Exposure
huBldgCountBldgTypeT	MMUH1i	int	Hurricane Specific Building Type Count or Exposure
huBldgEconBIAnnGrossSales	Value	real	Gross annual sales factor
huBldgEconBIAnnGrossSales	Occupancy	char(5)	Specific occupancy class
huBldgEconBIBusinessInv	Occupancy	char(5)	Specific occupancy class
huBldgEconBIBusinessInv	Value	real	Business inventory factor
huBldgEconILOwnerOcc	OwnerOcc	real	Owner occupancy factor
huBldgEconILOwnerOcc	Occupancy	char(5)	Specific Occupancy

Table	Name	Data Type	Description
huBldgEconILRecaptureFactors	Income	real	Income factor
huBldgEconILRecaptureFactors	Employment	real	Employment factor
huBldgEconILRecaptureFactors	Occupancy	char(5)	Specific Occupancy
huBldgEconILRecaptureFactors	Wage	real	Wage factor
huBldgEconILRecaptureFactors	OutputRecapture	real	Output recapture factor
huBldgEconILRentalCost	RentalCostMonth	real	Rental cost per month factor
huBldgEconILRentalCost	Occupancy	char(5)	Specific occupancy
huBldgEconILRentalCost	DisruptionCost	real	Disruption factor
huBldgEconILRentalCost	RentalCostDay	real	Rental cost per day factor
huBldgEconILWageCapIncome	OutputDay	real	Output in days
huBldgEconILWageCapIncome	Occupancy	char(5)	Specific occupancy class
huBldgEconILWageCapIncome	IncomeYear	real	Income per Year Factor
huBldgEconILWageCapIncome	IncomeDay	real	Income per Day Factor
huBldgEconILWageCapIncome	Employment	real	Employment Factor
huBldgEconILWageCapIncome	WageDay	real	Wage per Day Factor
huBldgEconLossTypes	Description	varchar(25)	Economic Loss Type Description
huBldgEconLossTypes	EconLossType	varchar(12)	Economic Loss Type
huBldgEconRTBusInterruption	None	real	Building Economic No Damage State
huBldgEconRTBusInterruption	MinorDS	real	Building Economic Minor Damage State
huBldgEconRTBusInterruption	Occupancy	char(5)	Specific Occupancy Class
huBldgEconRTBusInterruption	ModerateDS	real	Building Economic Moderate Damage State
huBldgEconRTBusInterruption	CompleteDS	real	Building Economic Complete Damage State
huBldgEconRTBusInterruption	SevereDS	real	Building Economic Severe Damage State
huBldgMapping	sbtName	varchar(10)	Hurricane Specific Building Type Name
huBldgMapping	huBldgSchemeName	varchar(20)	Wind building mapping scheme
huBldgMapping	PercentDist	real	Hurricane Building Characteristic Distribution
huBldgMapping	BldgCharID	int	Hurricane List of Wind Building Characteristic ID
huBldgMappingList	SchemeDescription	varchar(40)	Hurricane Mapping Scheme List Description
huBldgMappingList	huBldgSchemeName	varchar(20)	Wind building mapping scheme
huBldgMappingList	SchemeUpdated	datetime	Hurricane Mapping Scheme List Updated Date
huBldgMappingList	Updateable	bit	Editable flag
huBldgMappingList	SchemeCreated	datetime	Hurricane Scheme Creation Date
huBldgMappingList	CaseID	int	Location Filter
huBldgMappingListExt	huBldgSchemeName	varchar(20)	Wind building mapping scheme
huBldgMappingListExt	huBldgSchemeNameExt	varchar(255)	Wind building mapping scheme displayed
huBldgMapping_Updates	BLDGCHARID	int	Wind building characteristic id
huBldgMapping_Updates	PercentDist	real	Wind building percent distribution
huBldgMapping_Updates	sbtName	varchar(10)	Specific building type
huBldgMapping_Updates	huBldgSchemeName	varchar(20)	Wind building mapping scheme name
huBldgMapping_UpdatesMR2	huBldgSchemeName	varchar(20)	Wind building mapping scheme name

Table	Name	Data Type	Description
huBldgMapping_UpdatesMR2	sbtName	varchar(10)	Specific building type
huBldgMapping_UpdatesMR2	BLDGCHARID	int	Building characteristic id
huBldgMapping_UpdatesMR2	PercentDist	real	Percent distribution
huBldgTypeResultsB	Severe	real	Hurricane Probability of Severe Damage
huBldgTypeResultsB	At Least Severe	real	Hurricane Probability of Least Severe Damage
huBldgTypeResultsB	At Least Moderate	real	Hurricane Probability of Least Moderate Damage
huBldgTypeResultsB	Moderate	real	Hurricane Probability of Moderate Damage
huBldgTypeResultsB	At Least Minor	real	Hurricane Probability of Least Minor
huBldgTypeResultsB	CensusBlock	char(15)	Full census block number
huBldgTypeResultsB	Complete	real	Hurricane Probability of Complete Damage
huBldgTypeResultsB	huScenarioName	varchar(40)	Hurricane scenario name
huBldgTypeResultsB	bCurrent	bit	Hurricane Results Current Flag
huBldgTypeResultsB	sbtName	varchar(10)	Hurricane Specific Building Type Name
huBldgTypeResultsB	Building	real	Building Loss
huBldgTypeResultsB	Content	real	Content loss
huBldgTypeResultsB	Inventory	real	Inventory loss
huBldgTypeResultsB	Total	real	Total loss
huBldgTypeResultsB	Return_Period	varchar(25)	Return period
huBldgTypeResultsB	Minor	real	Hurricane Probability of Minor Damage
huBldgTypeResultsB	Wage	real	Wage loss
huBldgTypeResultsB	Rental	real	Rental loss
huBldgTypeResultsB	No Damage	real	Hurricane Probability of No Damage
huBldgTypeResultsB	Relocation Cost	real	Relocation cost
huBldgTypeResultsB	Income	real	Income loss
huBldgTypeResultsT	Return_Period	varchar(25)	Return Period
huBldgTypeResultsT	Total	real	Total loss
huBldgTypeResultsT	Building	real	Building loss
huBldgTypeResultsT	sbtName	varchar(10)	Hurricane Specific Building Type Name
huBldgTypeResultsT	Tract	char(11)	Census Tract
huBldgTypeResultsT	Complete	real	Hurricane Probability of Complete Damage
huBldgTypeResultsT	Content	real	Content loss
huBldgTypeResultsT	Inventory	real	Inventory loss
huBldgTypeResultsT	Relocation Cost	real	Relocation loss
huBldgTypeResultsT	At Least Moderate	real	Hurricane Probability of At Least Moderate Damage
huBldgTypeResultsT	Severe	real	Hurricane Probability of Severe Damage
huBldgTypeResultsT	At Least Severe	real	Hurricane Probability of At Least Severe Damage
huBldgTypeResultsT	No Damage	real	Hurricane Probability of No Damage
huBldgTypeResultsT	Minor	real	Hurricane Probability of Minor Damage
huBldgTypeResultsT	Income	real	Income loss
huBldgTypeResultsT	Rental	real	Rental loss

Table	Name	Data Type	Description
huBldgTypeResultsT	Wage	real	Wage loss
huBldgTypeResultsT	Moderate	real	Hurricane Probability of Moderate Damage
huBldgTypeResultsT	At Least Minor	real	Hurricane Probability of At Least Minor Damage
huBldgTypeResultsT	bCurrent	bit	Hurricane Results Current Flag
huBldgTypeResultsT	huScenarioName	varchar(40)	Hurricane scenario name
huCareFlty	huBldgSchemeName	varchar(20)	Wind building mapping scheme name
huCareFlty	sbtName	varchar(10)	Hurricane Specific Building Type Name
huCareFlty	CareFltyId	char(8)	Emergency Care Facility
huCensusBlock	huBldgSchemeName	varchar(20)	Wind building mapping scheme name
huCensusBlock	SurfaceRoughness	real	Surface roughness by block
huCensusBlock	WindGridIndex	smallint	Wind grid index by block
huCensusBlock	huOccMapSchemeName	varchar(20)	Hurricane General Building Stock Occupancy Mapping List ID
huCensusBlock	CensusBlock	char(15)	Full census block number
huDebrisAndShelterDamTypesByRP	DLType	char(12)	Damage Type
huDebrisAndShelterDamTypesByRP	Type	char(5)	Damage type
huDebrisResultsB	huScenarioName	varchar(40)	Hurricane scenario name
huDebrisResultsB	bCurrent	bit	Hurricane Results Current Flag
huDebrisResultsB	CensusBlock	char(15)	Full census block number
huDebrisResultsB	Return_Period	varchar(25)	Return Period
huDebrisResultsB	BrickAndWood	int	Hurricane Debris Results for Brick and Wood
huDebrisResultsB	TreeVolume	real	Tree Debris by volumn
huDebrisResultsB	Tree	int	Tree Debris
huDebrisResultsB	ConcreteAndSteel	int	Hurricane Debris Results for Concrete and Steel
huDebrisResultsT	bCurrent	bit	Hurricane Results Current Flag
huDebrisResultsT	TreeVolume	real	Tree Debris Volumn
huDebrisResultsT	huScenarioName	varchar(40)	Hurricane scenario name
huDebrisResultsT	Return_Period	varchar(25)	Return Period
huDebrisResultsT	Tract	char(11)	Census Tract
huDebrisResultsT	BrickAndWood	int	Hurricane Debris Results for Brick and Wood
huDebrisResultsT	ConcreteAndSteel	int	Hurricane Debris Results for Concrete and Steel
huDebrisResultsT	Tree	int	Tree Debris
huEfOccMapping	Occupancy	char(10)	Occupancy type
huEfOccMapping	EFClass	char(5)	Essential facility occupancy
huEmergencyCtr	huBldgSchemeName	varchar(20)	Wind building mapping scheme name
huEmergencyCtr	sbtName	varchar(10)	Hurricane Specific Building Type Name
huEmergencyCtr	EocId	char(8)	Facility ID
huExposureBldgTypeB	SPMBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	SPMBMi	int	Hurricane Specific Building Type Count or Exposure

Table	Name	Data Type	Description
huExposureBldgTypeB	CECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	SPMBSi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	CECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MH94HUDIIi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MH94HUDIIIi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MH94HUDIi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MH76HUDi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	SERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	SERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	SERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	SECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	SECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	SECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MHPHUDi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MSF2i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MSF1i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	WMUH3i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MMUH1i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MMUH2i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MMUH3i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	WSF1i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	CensusBlock	char(15)	Full census block number
huExposureBldgTypeB	WMUH2i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	WSF2i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	WMUH1i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	CECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	CERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	CERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	CERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MLRM1i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MLRIi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MLRM2i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeB	MERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MMUH3i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	CECBMi	int	Hurricane Specific Building Type Count or Exposure

Table	Name	Data Type	Description
huExposureBldgTypeT	CECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	SPMBSi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	CERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	CECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	CERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	CERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	SECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	SERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	SECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	SPMBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	SPMBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	SERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	SERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	SECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	WSF1i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	WSF2i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	Tract	char(11)	Census Tract
huExposureBldgTypeT	MLRM1i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	WMUH3i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	WMUH1i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	WMUH2i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MLRM2i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MLRIi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MSF1i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MHPHUDi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MH94HUDIIIi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MH76HUDi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MH94HUDIi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MH94HUDIIi	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MSF2i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MMUH1i	int	Hurricane Specific Building Type Count or Exposure
huExposureBldgTypeT	MMUH2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MH94HUDIIIi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MH94HUDIIi	int	Hurricane Specific Building Type Count or Exposure

Table	Name	Data Type	Description
huExposureContentBldgTypeB	MH94HUDIi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	CERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	CECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	CECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	CERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	SPMBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	SPMBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	SERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	SPMBSi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	CECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MH76HUDi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	SECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MHPHUDi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	SERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	SERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	SECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	SECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	CERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MSF1i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	WMUH3i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MSF2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MMUH1i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MMUH2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	WSF1i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	WMUH2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	WSF2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	WMUH1i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	CensusBlock	char(15)	Census Block
huExposureContentBldgTypeB	MECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MMUH3i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MLRM2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MLRM1i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MLRIi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeB	MERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	SECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MHPHUDi	int	Hurricane Specific Building Type Count or Exposure

Table	Name	Data Type	Description
huExposureContentBldgTypeT	SECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	Tract	char(11)	Census Tact
huExposureContentBldgTypeT	WSF1i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MH94HUDIIIi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MH76HUDi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MH94HUDIIi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MH94HUDIi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	SECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	CERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	CECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	CECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	CERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	CERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MECBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	SERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	SERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	SERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	CECBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	SPMBSi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	SPMBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	SPMBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	WSF2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MSF2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MSF1i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MMUH1i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MMUH2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	WMUH1i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	WMUH3i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	WMUH2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MECBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MERBMi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MERBLi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MERBHi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MMUH3i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MLRM2i	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MLRIi	int	Hurricane Specific Building Type Count or Exposure
huExposureContentBldgTypeT	MLRM1i	int	Hurricane Specific Building Type Count or Exposure
huFireStation	sbtName	varchar(10)	Hurricane Specific Building Type Name
huFireStation	FireStationId	char(8)	Fire station ID

Table	Name	Data Type	Description
huFireStation	huBldgSchemeName	varchar(20)	Wind building mapping scheme
huGbsOccMapping	CECBLp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	CERBMp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	CERBHp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MECBLp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MECBMp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	CERBLp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MECBHp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	CECBMp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MMUH3p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MLRM1p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MMUH2p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MMUH1p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MERBMp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MLRM2p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MERBLp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MLRIp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	huOccMapSchemeName	varchar(20)	Hurricane General Building Stock Occupancy Mapping List ID
huGbsOccMapping	WSF1p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	WSF2p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	Occupancy	char(5)	Specific occupancy class
huGbsOccMapping	MSF2p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MSF1p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	WMUH1p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	WMUH3p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	WMUH2p	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class

Table	Name	Data Type	Description
huGbsOccMapping	MERBHp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MHPHUDp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MH76HUDp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	SECBHp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	SECBMp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MH94HUDIIIp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MH94HUDIp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	MH94HUDIIp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	CECBHp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	SPMBMp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	SPMBLp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	SPMBSp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	SECBLp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	SERBHp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	SERBLp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMapping	SERBMp	tinyint	Hurricane Specific Building Types Percentage of Occupancy Class
huGbsOccMappingList	SchemeUpdated	datetime	Hurricane Mapping Scheme List Updated Date
huGbsOccMappingList	Updateable	bit	Mapping scheme editable
huGbsOccMappingList	CaseID	int	Location Filter
huGbsOccMappingList	SchemeCreated	datetime	Hurricane Scheme Creation Date
huGbsOccMappingList	SchemeDescription	varchar(40)	Hurricane Mapping Scheme List Description
huGbsOccMappingList	huOccMapSchemeName	varchar(20)	Hurricane General Building Stock Occupancy Mapping List ID
huGbsOccMappingListExt	huOccMapSchemeName	varchar(20)	General occupancy mapping scheme name
huGbsOccMappingListExt	huOccMapSchemeNameExt	varchar(255)	General occupancy mapping scheme name long
huGenAnalysisOpt	Reserved	smallint	Hurricane Analysis Option
huGenAnalysisOpt	huGenAnalysisOpt	int	General Analysis Option
huHazardMapWindSpeed	Tract	char(11)	Cenus Tract
huHazardMapWindSpeed	f20yr	real	Probabilistic Storm Wind Speed for Return Period 2 (mph)
huHazardMapWindSpeed	f10yr	real	Probabilistic Storm Wind Speed for Return Period 1 (mph)

Table	Name	Data Type	Description
huHazardMapWindSpeed	f50yr	real	Probabilistic Storm Wind Speed for Return Period 3 (mph)
huHazardMapWindSpeed	f200yr	real	Probabilistic Storm Wind Speed for Return Period 5 (mph)
huHazardMapWindSpeed	f500yr	real	Probabilistic Storm Wind Speed for Return Period 6 (mph)
huHazardMapWindSpeed	f1000yr	real	Probabilistic Storm Wind Speed for Return Period 7 (mph)
huHazardMapWindSpeed	f100yr	real	Probabilistic Storm Wind Speed for Return Period 4 (mph)
huHazardMapWindSpeedB	CensusBlock	char(15)	Census Block
huHazardMapWindSpeedB	f10yr	real	Probabilistic Storm Wind Speed for Return Period 1 (mph)
huHazardMapWindSpeedB	f1000yr	real	Probabilistic Storm Wind Speed for Return Period 7 (mph)
huHazardMapWindSpeedB	f500yr	real	Probabilistic Storm Wind Speed for Return Period 6 (mph)
huHazardMapWindSpeedB	f200yr	real	Probabilistic Storm Wind Speed for Return Period 5 (mph)
huHazardMapWindSpeedB	f20yr	real	Probabilistic Storm Wind Speed for Return Period 2 (mph)
huHazardMapWindSpeedB	f100yr	real	Probabilistic Storm Wind Speed for Return Period 4 (mph)
huHazardMapWindSpeedB	f50yr	real	Probabilistic Storm Wind Speed for Return Period 3 (mph)
huInCast	ShieldingHeight	varchar(45)	Sheilding Height
huInCast	WindShielding	varchar(15)	Wind Shielding Height
huInCast	Topography	varchar(15)	Topography
huInCast	WindDebrisSource	varchar(30)	Wind Debris Source
huInCast	WindSpeedType	varchar(15)	Wind speed type
huInCast	RoofSlope	varchar(25)	Roof Slope
huInCast	WallExposure	int	Wall Exposure
huInCast	MHTieDowns	varchar(11)	Manufactured Home Tie Down
huInCast	WindExposure	varchar(25)	Wind Exposures
huInCast	WindDesignYear	smallint	Wind Speed Design Year
huInCast	hzIncastID	int	Incast ID
huInCast	WindSpeed	smallint	Wind Speed
huInCast	ShutterCde	varchar(30)	Shelter Code
huInCast	GarageDoors	varchar(15)	Garage Doors
huInCast	RollUpDoors	varchar(15)	Roll Up Doors
huInCast	RoofSheathing	varchar(30)	Roof Sheathing
huInCast	ShutterType	varchar(15)	Shutter Type
huInCast	WindDesignCode	varchar(15)	Wind Design Code
huInCast	DeckAttach	varchar(12)	Deck Attachement Type
huInCast	DoorProtection	varchar(15)	Door Protection

Table	Name	Data Type	Description
huInCast	OtherDoorArea	varchar(15)	Other Door Area
huInCast	MHWindZone	varchar(15)	MH Wind Zone
huInCast	MHCode	varchar(30)	MH Code
huInCast	Protection	varchar(25)	Protection Type
huInCast	RoofPerimeter	varchar(30)	Roof Perimeter
huInCast	RoofCovering	varchar(45)	Roof Cover
huInCast	NailSize	varchar(15)	Deck Nail Size
huInCast	NailSpacing	varchar(15)	Deck Nail Spacing
huInCast	GlassConstr	varchar(15)	Glass Construction Type
huInCast	Glass	varchar(30)	Glass Type
huInCast	Openings	varchar(15)	Opening type
huInCast	WallAnchorage	varchar(15)	Wall Anchors
huInCast	Cladding	varchar(45)	Wall Cladding
huInCast	RoofShape	varchar(15)	Roof Shape
huInCast	GableBracing	varchar(15)	Gable End Bracing
huInCast	FrameSpacing	varchar(15)	Wall Framing Spacing
huListOfBldgChar	bcDescription	varchar(100)	Hurricane List of Wind Building Characteristic Description
huListOfBldgChar	CharType	varchar(40)	Wind building characteristic type
huListOfBldgChar	BldgCharID	int	Hurricane List of Wind Building Characteristic ID
huListOfBldgChar	bcName	varchar(25)	Building characteristic name
huListOfBldgChar	BldgChar	char(5)	Hurricane List of Wind Building Characteristic Names
huListOfWindBldgTypes	wbID	smallint	Hurricane Wind Building Type ID (equalent to wbID in System Database)
huListOfWindBldgTypes	sbtName	varchar(10)	Hurricane Specific Building Type Name
huListOfWindBldgTypes	CaseID	int	Location Filter
huListOfWindBldgTypes	nWindChar	smallint	Hurricane Number of Wind Building Characteristics per Wind Building Type
huListOfWindBldgTypes	charDescription	char(100)	Hurricane List of Wind Building Types Description
huOccResultsB	At Least Minor	real	Hurricane Probability of At Least Minor Damage
huOccResultsB	Moderate	real	Hurricane Probability of Moderate Damage
huOccResultsB	Minor	real	Hurricane Probability of Minor Damage
huOccResultsB	No Damage	real	Hurricane Probability of No Damage
huOccResultsB	Wage	real	Wage Loss
huOccResultsB	huScenarioName	varchar(40)	Hurricane scenario name
huOccResultsB	bCurrent	bit	Hurricane Results Current Flag
huOccResultsB	At Least Moderate	real	Hurricane Probability of At Least Moderate Damage
huOccResultsB	At Least Severe	real	Hurricane Probability of At Least Severe Damage
huOccResultsB	Severe	real	Hurricane Probability of Severe Damage
huOccResultsB	Complete	real	Hurricane Probability of Complete Damage
huOccResultsB	Return_Period	varchar(25)	Return Period

Table	Name	Data Type	Description
huOccResultsB	Total	real	Total Loss
huOccResultsB	Occupancy	char(5)	Specific occupancy class
huOccResultsB	CensusBlock	char(15)	Full census block number
huOccResultsB	Rental	real	Rental loss
huOccResultsB	Relocation Cost	real	Relocation Cost
huOccResultsB	Income	real	Income Loss
huOccResultsB	Building	real	Building Loss
huOccResultsB	Inventory	real	Inventory Loss
huOccResultsB	Content	real	Content Loss
huOccResultsT	huScenarioName	varchar(40)	Hurricane scenario name
huOccResultsT	bCurrent	bit	Hurricane Results Current Flag
huOccResultsT	At Least Minor	real	Hurricane Probability of At Least Minor
huOccResultsT	Moderate	real	Hurricane Probability of Moderate Damage
huOccResultsT	Minor	real	Hurricane Probability of Minor Damage
huOccResultsT	No Damage	real	Hurricane Probability of No Damage
huOccResultsT	Wage	real	Wage Loss
huOccResultsT	Complete	real	Hurricane Probability of Complete Damage
huOccResultsT	At Least Moderate	real	Hurricane Probability of At Least Moderate Damage
huOccResultsT	At Least Severe	real	Hurricane Probability of At Least Severe Damage
huOccResultsT	Severe	real	Hurricane Probability of Severe Damage
huOccResultsT	Tract	char(11)	Census Tract
huOccResultsT	Total	real	Total Loss
huOccResultsT	Building	real	Building Loss
huOccResultsT	Return_Period	varchar(25)	Return Period
huOccResultsT	Occupancy	char(5)	Specific occupancy class
huOccResultsT	Rental	real	Rental Loss
huOccResultsT	Income	real	Income Loss
huOccResultsT	Content	real	Content Loss
huOccResultsT	Relocation Cost	real	Relocation Cost
huOccResultsT	Inventory	real	Inventory Loss
huPoliceStation	PoliceStationId	char(8)	Facility ID
huPoliceStation	sbtName	varchar(10)	Hurricane Specific Building Type Name
huPoliceStation	huBldgSchemeName	varchar(20)	Wind building mapping scheme name
huRPWindSpeeds	wRtnP2	smallint	Probabilistic Storm Wind Speed for Return Period 2 (mph)
huRPWindSpeeds	wRtnP3	smallint	Probabilistic Storm Wind Speed for Return Period 3 (mph)
huRPWindSpeeds	Tract	char(11)	Census Tract
huRPWindSpeeds	wRtnP1	smallint	Probabilistic Storm Wind Speed for Return Period 1 (mph)
huRPWindSpeeds	wRtnP7	smallint	Probabilistic Storm Wind Speed for Return Period 7

Table	Name	Data Type	Description
			(mph)
huRPWindSpeeds	wRtnP4	smallint	Probabilistic Storm Wind Speed for Return Period 4 (mph)
huRPWindSpeeds	wRtnP6	smallint	Probabilistic Storm Wind Speed for Return Period 6 (mph)
huRPWindSpeeds	wRtnP5	smallint	Probabilistic Storm Wind Speed for Return Period 5 (mph)
huRPWindSpeedsB	wRtnP7	smallint	Probabilistic Storm Wind Speed for Return Period 7 (mph)
huRPWindSpeedsB	wRtnP4	smallint	Probabilistic Storm Wind Speed for Return Period 4 (mph)
huRPWindSpeedsB	wRtnP3	smallint	Probabilistic Storm Wind Speed for Return Period 3 (mph)
huRPWindSpeedsB	wRtnP2	smallint	Probabilistic Storm Wind Speed for Return Period 2 (mph)
huRPWindSpeedsB	wRtnP5	smallint	Probabilistic Storm Wind Speed for Return Period 5 (mph)
huRPWindSpeedsB	wRtnP6	smallint	Probabilistic Storm Wind Speed for Return Period 6 (mph)
huRPWindSpeedsB	CensusBlock	char(15)	Census Block
huRPWindSpeedsB	wRtnP1	smallint	Probabilistic Storm Wind Speed for Return Period 1 (mph)
huRapidLossResults	LossType	varchar(50)	Loss Type (Building, content, etc)
huRapidLossResults	Percentile	smallint	Percentile
huRapidLossResults	ResultsType	varchar(50)	Results Type
huRapidLossResults	ResultsValue	real	Results Value
huRapidLossResults	huScenarioName	varchar(40)	Hurricane scenario name
huReports	FileName	varchar(50)	Long Report Name
huReports	bAvailable	smallint	Available Flag
huReports	ReportName	varchar(50)	Short Report Name
huReports	TabName	varchar(50)	Report Tab Name
huResultsBldgEconOutputAndEmpOccB	EconLossType	varchar(12)	Loss Type (Building, content, etc)
huResultsBldgEconOutputAndEmpOccB	RES2I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	RES1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	IND6I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	IND2I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	IND5I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	IND3I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	IND4I	real	Building Economic Output results by occupancy

Table	Name	Data Type	Description
huResultsBldgEconOutputAndEmpOccB	IND1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	EDU1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	EDU2I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	GOV2I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	AGR1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	REL1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	Return_Period	varchar(25)	Return Period
huResultsBldgEconOutputAndEmpOccB	huScenarioName	varchar(40)	Hurricane scenario name
huResultsBldgEconOutputAndEmpOccB	CensusBlock	char(15)	Census Block
huResultsBldgEconOutputAndEmpOccB	GOV1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	RES3FI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	RES3EI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	RES4I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	RES5I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	RES6I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	RES3CI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	RES3DI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	RES3BI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	RES3AI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	COM10I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	COM7I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	COM6I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	COM8I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	COM9I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	COM1I	real	Building Economic Output results by occupancy

Table	Name	Data Type	Description
huResultsBldgEconOutputAndEmpOccB	COM2I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	COM5I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	COM3I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccB	COM4I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	EconLossType	varchar(12)	Loss Type (Building, content, etc)
huResultsBldgEconOutputAndEmpOccT	Return_Period	varchar(25)	Return Period
huResultsBldgEconOutputAndEmpOccT	COM1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	COM2I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES6I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES5I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	COM5I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	COM3I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	COM4I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	COM6I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES3BI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES3CI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES3AI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES4I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES3FI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES3DI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES3EI	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	huScenarioName	varchar(40)	Hurricane scenario name
huResultsBldgEconOutputAndEmpOccT	REL1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	GOV1I	real	Building Economic Output results by occupancy

Table	Name	Data Type	Description
huResultsBldgEconOutputAndEmpOccT	AGR1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	IND6I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	EDU2I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	GOV2I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	EDU1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	COM7I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	COM9I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	COM10I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	COM8I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	IND5I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	IND4I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	IND1I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	IND3I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	IND2I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	RES2I	real	Building Economic Output results by occupancy
huResultsBldgEconOutputAndEmpOccT	Tract	char(11)	Census Tract
huResultsCareFlty	Minor	real	Hurricane Probability of Minor Damage
huResultsCareFlty	Moderate	real	Hurricane Probability of Moderate Damage
huResultsCareFlty	LossOfUse	real	Loss of User in days
huResultsCareFlty	bCurrent	bit	Hurricane Results Current Flag
huResultsCareFlty	huScenarioName	varchar(40)	Hurricane scenario name
huResultsCareFlty	Severe	real	Hurricane Probability of Severe Damage
huResultsCareFlty	Complete	real	Hurricane Probability of Complete Damage
huResultsCareFlty	Return_Period	varchar(25)	Return Period
huResultsCareFlty	CareFltyId	char(8)	Facility ID
huResultsEmergCtr	Severe	real	Hurricane Probability of Severe Damage
huResultsEmergCtr	Complete	real	Hurricane Probability of Complete Damage
huResultsEmergCtr	huScenarioName	varchar(40)	Hurricane scenario name
huResultsEmergCtr	LossOfUse	real	Loss of User in days
huResultsEmergCtr	Moderate	real	Hurricane Probability of Moderate Damage

Table	Name	Data Type	Description
huResultsEmergCtr	Minor	real	Hurricane Probability of Minor Damage
huResultsEmergCtr	bCurrent	bit	Hurricane Results Current Flag
huResultsEmergCtr	Return_Period	varchar(25)	Return Period
huResultsEmergCtr	EocId	char(8)	Facility ID
huResultsFireStation	Complete	real	Hurricane Probability of Complete Damage
huResultsFireStation	Severe	real	Hurricane Probability of Severe Damage
huResultsFireStation	huScenarioName	varchar(40)	Hurricane scenario name
huResultsFireStation	Minor	real	Hurricane Probability of Minor Damage
huResultsFireStation	bCurrent	bit	Hurricane Results Current Flag
huResultsFireStation	LossOfUse	real	Loss of User in days
huResultsFireStation	Moderate	real	Hurricane Probability of Moderate Damage
huResultsFireStation	Return_Period	varchar(25)	Return Period
huResultsFireStation	FireStationId	char(8)	Facility ID
huResultsPoliceStation	LossOfUse	real	Loss of User in days
huResultsPoliceStation	Minor	real	Hurricane Probability of Minor Damage
huResultsPoliceStation	bCurrent	bit	Hurricane Results Current Flag
huResultsPoliceStation	huScenarioName	varchar(40)	Hurricane scenario name
huResultsPoliceStation	Return_Period	varchar(25)	Return Period
huResultsPoliceStation	PoliceStationId	char(8)	Facility ID
huResultsPoliceStation	Moderate	real	Hurricane Probability of Moderate Damage
huResultsPoliceStation	Complete	real	Hurricane Probability of Complete Damage
huResultsPoliceStation	Severe	real	Hurricane Probability of Severe Damage
huResultsSchool	Minor	real	Hurricane Probability of Minor Damage
huResultsSchool	Moderate	real	Hurricane Probability of Moderate Damage
huResultsSchool	LossOfUse	real	Loss of User in days
huResultsSchool	SchoolId	char(8)	Facility ID
huResultsSchool	Return_Period	varchar(25)	Return Period
huResultsSchool	Severe	real	Hurricane Probability of Severe Damage
huResultsSchool	huScenarioName	varchar(40)	Hurricane scenario name
huResultsSchool	Complete	real	Hurricane Probability of Complete Damage
huResultsSchool	bCurrent	bit	Hurricane Results Current Flag
huResultsUserDefined	Moderate	real	Hurricane Probability of Moderate Damage
huResultsUserDefined	Minor	real	Hurricane Probability of Minor Damage
huResultsUserDefined	bCurrent	bit	Hurricane Results Current Flag
huResultsUserDefined	Severe	real	Hurricane Probability of Severe Damage
huResultsUserDefined	Complete	real	Hurricane Probability of Complete Damage
huResultsUserDefined	huScenarioName	varchar(40)	Hurricane scenario name
huResultsUserDefined	Return_Period	varchar(25)	Return Period
huResultsUserDefined	UserDefinedFltyId	char(8)	Facility ID
huReturn Periods	RPString	varchar(25)	Return Period description

Table	Name	Data Type	Description
huReturn Periods	Return_Period	varchar(25)	Return Period
huSchool	sbtName	varchar(10)	Hurricane Specific Building Type Name
huSchool	SchoolId	char(8)	Facility ID
huSchool	huBldgSchemeName	varchar(20)	Wind Building Mapping Scheme
huShelterCategoryWeights	Value	real	Shelter Category Weight Value
huShelterCategoryWeights	Class	char(5)	Shelter Category Weight class
huShelterCategoryWeights	Description	varchar(100)	Shelter Category Weight Description
huShelterDSProb	Value	real	Shelter Damage State Probility Value
huShelterDSProb	WeightFactor	char(5)	Shelter Damage State Probility weight factor
huShelterDSProb	Description	varchar(100)	Shelter Damage State Probility Description
huShelterRelModFactors	Value	real	Shelter relocation modification factor value
huShelterRelModFactors	Class	char(5)	Shelter relocation modification factor classs
huShelterRelModFactors	Description	varchar(100)	Shelter relocation modification factor description
huShelterResultsB	huScenarioName	varchar(40)	Hurricane scenario name
huShelterResultsB	Return_Period	varchar(25)	Return Period
huShelterResultsB	DisplacedHouseHolds	int	Hurricane Shelter Displaced Housholds Results
huShelterResultsB	CensusBlock	char(15)	Full census block number
huShelterResultsB	bCurrent	bit	Hurricane Results Current Flag
huShelterResultsB	ShortTermShelterNeeds	int	Hurricane Shelter Short Term Needs Results
huShelterResultsT	Return_Period	varchar(25)	Return Period
huShelterResultsT	DisplacedHouseHolds	int	Hurricane Shelter Displaced Housholds Results
huShelterResultsT	Tract	char(11)	Census Tract
huShelterResultsT	huScenarioName	varchar(40)	Hurricane scenario name
huShelterResultsT	ShortTermShelterNeeds	int	Hurricane Shelter Short Term Needs Results
huShelterResultsT	bCurrent	bit	Hurricane Results Current Flag
huShelterUtilityFactors	Description	varchar(100)	Shelter utility description
huShelterUtilityFactors	Class	char(5)	Shelter utility class
huShelterUtilityFactors	Value	real	Shelter utility factor
huSqFootageBldgTypeB	CECBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	CERBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	CERBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	CECBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	CECBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	SPMBSi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MERBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MERBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	CERBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MECBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MECBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MECBMi	real	Hurricane Specific Building Type Count or Exposure

Table	Name	Data Type	Description
huSqFootageBldgTypeB	MERBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MH76HUDi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MHPHUDi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	SECBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MH94HUDIIIi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MH94HUDIi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MH94HUDIIi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	SPMBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	SERBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	SPMBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	SECBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	SECBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	SERBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	SERBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	CensusBlock	char(15)	Full census block number
huSqFootageBldgTypeB	MSF1i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	WMUH3i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MSF2i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MMUH1i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	WSF1i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	WMUH2i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	WSF2i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	WMUH1i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MLRIi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MLRM2i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MMUH2i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MLRM1i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeB	MMUH3i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	CECBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MERBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	CERBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MERBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MLRIi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MERBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MECBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MECBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	CERBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MECBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	CERBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MLRM2i	real	Hurricane Specific Building Type Count or Exposure

Table	Name	Data Type	Description
huSqFootageBldgTypeT	SECBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	SECBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	SERBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MH76HUDi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	SECBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MHPHUDi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	CECBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	SPMBSi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	CECBHi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	SERBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	SERBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	SPMBMi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	SPMBLi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MH94HUDIi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	WSF1i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	WSF2i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	WMUH1i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MH94HUDIIIi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	Tract	char(11)	Census Tract
huSqFootageBldgTypeT	MH94HUDIIi	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MLRM1i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MMUH2i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MMUH1i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MMUH3i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	WMUH2i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	WMUH3i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MSF2i	real	Hurricane Specific Building Type Count or Exposure
huSqFootageBldgTypeT	MSF1i	real	Hurricane Specific Building Type Count or Exposure
huSummaryDamage	ShelterDisp	real	Shelter displacement
huSummaryDamage	ComDamage	real	Complete damage
huSummaryDamage	SevDamage	real	Severe damage
huSummaryDamage	ShelterShortTerm	real	Short term shelter requirements
huSummaryDamage	huScenarioName	varchar(40)	Hurricane scenario name
huSummaryDamage	Tract	char(11)	Census Tract
huSummaryDamage	ReturnPeriod	varchar(25)	Return Period
huSummaryDamage	GenBldgOrGenOcc	varchar(20)	General Buiding or General Occupancy
huSummaryDamage	ModDamage	real	Moderate damage
huSummaryDamage	NonDamage	real	No damage
huSummaryDamage	MinDamage	real	Minor damage
huSummaryDamageB	ShelterShortTerm	real	Short term shelter requirements

Table	Name	Data Type	Description
huSummaryDamageB	ModDamage	real	Moderate Damage
huSummaryDamageB	MinDamage	real	Minimal Damage
huSummaryDamageB	NonDamage	real	No Damage
huSummaryDamageB	SevDamage	real	Severe Damage
huSummaryDamageB	ComDamage	real	Complete Damage
huSummaryDamageB	ShelterDisp	real	Shelter Displacement
huSummaryDamageB	huScenarioName	varchar(40)	Hurricane scenario name
huSummaryDamageB	ReturnPeriod	varchar(25)	Return Period
huSummaryDamageB	CensusBlock	char(15)	Census Block
huSummaryDamageB	GenBldgOrGenOcc	varchar(20)	General Buiding or General Occupancy
huSummaryLoss	RelLoss	real	Relocation Loss
huSummaryLoss	InvLoss	real	Inventory Loss
huSummaryLoss	ConLoss	real	Content Loss
huSummaryLoss	WagLoss	real	Wage Loss
huSummaryLoss	IncLoss	real	Income Loss
huSummaryLoss	RenLoss	real	Rental Loss
huSummaryLoss	huScenarioName	varchar(40)	Hurricane scenario name
huSummaryLoss	GenBldgOrGenOcc	varchar(20)	General Buiding or General Occupancy
huSummaryLoss	Tract	char(11)	Census Tract
huSummaryLoss	BuiLoss	real	Bulding Loss
huSummaryLoss	ReturnPeriod	varchar(25)	Return Period
huSummaryLoss	TotLoss	real	Total Loss
huSummaryLossB	TotLoss	real	Total Loss
huSummaryLossB	ReturnPeriod	varchar(25)	Return Period
huSummaryLossB	GenBldgOrGenOcc	varchar(20)	General Buiding or General Occupancy
huSummaryLossB	BuiLoss	real	Building Loss
huSummaryLossB	ConLoss	real	Content Loss
huSummaryLossB	InvLoss	real	Inventory Loss
huSummaryLossB	WagLoss	real	Wage Loss
huSummaryLossB	huScenarioName	varchar(40)	Hurricane scenario name
huSummaryLossB	RelLoss	real	Relocation Loss
huSummaryLossB	IncLoss	real	Income Loss
huSummaryLossB	CensusBlock	char(15)	Full census block number
huSummaryLossB	RenLoss	real	Rental Loss
huTemplateScenario	CurrentScenario	varchar(40)	Current hurricane scenario name
huTemplateScenario	ScenarioType	Varchar(20)	Scenario Type
huTemplateScenario	lRunCnt	Int	Run count
huTemplateScenario	InitialWaterLevelHeight	Float	Initial waterlevel height
huTerrain	SRindex	float	Hurricane Surface Roughness Index (Calculated)
huTerrain	Tract	char(11)	Census Tract

Table	Name	Data Type	Description
huTerrain	SurfaceRoughness	real	Hurricane Surface Roughness Value (meters)
huTerrainB	SRindex	float	Hurricane Surface Roughness Index (Calculated)
huTerrainB	CensusBlock	char(15)	Census Block
huTerrainB	SurfaceRoughness	real	Hurricane Surface Roughness Value (meters)
huTract	WindGridIndex	smallint	Wind grid index
huTract	huOccMapSchemeName	varchar(20)	Hurricane General Building Stock Occupancy Mapping List ID
huTract	huBldgSchemeName	varchar(20)	Wind building mapping scheme name
huTract	Tract	char(11)	Census Block
huTract	DistToCoast	real	Distance between the Census Tract Centroid and the Coast Line
huTract	SurfaceRoughness	real	Hurricane Surface Roughness Value (meters)
huTreeParameters	StemsPerAcre	int	Count of stems per acre
huTreeParameters	PreDomTreeType	varchar(20)	Predominate tree type
huTreeParameters	Tract	char(11)	Census Tract
huTreeParameters	TreeHeightGreater60	real	Count greater than 60 ft
huTreeParameters	TreeHeightLess40	real	Count less than 40 ft
huTreeParameters	TreeHeight40To60	real	Count 40 to 60 ft
huTreeParametersB	TreeHeightGreater60	real	Count greater than 60 ft
huTreeParametersB	TreeHeightLess40	real	Count less than 40 ft
huTreeParametersB	TreeHeight40To60	real	Count 40 to 60 ft
huTreeParametersB	CensusBlock	char(15)	Census Block
huTreeParametersB	StemsPerAcre	int	Count of Stems per Acre
huTreeParametersB	PreDomTreeType	varchar(20)	Perdominate Tree Type
huUserDefinedFlty	UserDefinedFltyId	char(8)	Facility ID
huUserDefinedFlty	huBldgSchemeName	varchar(20)	Wind Building Mapping Scheme
huUserDefinedFlty	sbtName	varchar(10)	Hurricane Specific Building Type Name
hzSurgeFRCombByBldgTypeB	StudyCaseID	int	Study case id
hzSurgeFRCombByBldgTypeB	ReturnPeriodId	char(6)	Return period id
hzSurgeFRCombByBldgTypeB	AnalysisOptId	int	Analysis option id
hzSurgeFRCombByBldgTypeB	CensusBlock	char(15)	Census block
hzSurgeFRCombByBldgTypeB	BldgTypeID	int	Building type id
hzSurgeFRCombByBldgTypeB	Firm	int	Firm
hzSurgeFRCombByBldgTypeB	PrePostPct	real	Pre-Post percent
hzSurgeFRCombByBldgTypeB	H_BuildingLoss	real	Hurricane building loss
hzSurgeFRCombByBldgTypeB	H_ContentsLoss	real	Hurricane content loss
hzSurgeFRCombByBldgTypeB	H_InventoryLoss	real	Hurricane inventory loss
hzSurgeFRCombByBldgTypeB	F_BuildingLoss	real	Flood building loss
hzSurgeFRCombByBldgTypeB	F_ContentsLoss	real	Flood content loss
hzSurgeFRCombByBldgTypeB	F_InventoryLoss	real	Flood inventory loss
hzSurgeFRCombByBldgTypeB	ExpBldg	int	Building Exposure

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Table	Name	Data Type	Description
hzSurgeFRCombByBldgTypeB	ExpCont	int	Building Content
hzSurgeFRCombByBldgTypeB	ExpInventory	int	Inventory Exposure
hzSurgeFRCombByBldgTypeB	H_BldgPct	real	Hurricane Building Percent
hzSurgeFRCombByBldgTypeB	H_ContPct	real	Hurricane Content Percent
hzSurgeFRCombByBldgTypeB	H_InvPct	real	Hurricane Inventory Percent
hzSurgeFRCombByBldgTypeB	F_BldgPct	real	Flood Building Percent
hzSurgeFRCombByBldgTypeB	F_ContPct	real	Flood Content Percent
hzSurgeFRCombByBldgTypeB	F_InvPct	real	Flood Inventory Percent
hzSurgeFRCombByBldgTypeB	FH_BldgPct	real	Flood-Hurricane building percent
hzSurgeFRCombByBldgTypeB	FH_ContPct	real	Flood-Hurricane content percent
hzSurgeFRCombByBldgTypeB	FH_InvPct	real	Flood-Hurricane inventory percent
hzSurgeFRCombByBldgTypeB	BldgFloodLoss	real	Building flood loss
hzSurgeFRCombByBldgTypeB	BldgWindLoss	real	Building wind loss
hzSurgeFRCombByBldgTypeB	BldgCombLoss	real	Building combined loss
hzSurgeFRCombByBldgTypeB	ContFloodLoss	real	Content flood loss
hzSurgeFRCombByBldgTypeB	ContWindLoss	real	Content wind loss
hzSurgeFRCombByBldgTypeB	ContCombLoss	real	Content combined loss
hzSurgeFRCombByBldgTypeB	InvFloodLoss	real	Inventory flood loss
hzSurgeFRCombByBldgTypeB	InvWindLoss	real	Inventory wind loss
hzSurgeFRCombByBldgTypeB	InvCombLoss	real	Inventory combined loss
hzSurgeFRCombSOccupB	StudyCaseID	int	Study case id
hzSurgeFRCombSOccupB	ReturnPeriodId	char(6)	Return period id
hzSurgeFRCombSOccupB	AnalysisOptId	int	Analysis option id
hzSurgeFRCombSOccupB	CensusBlock	char(15)	Census block
hzSurgeFRCombSOccupB	SOccup	varchar(5)	Specific Occupancy
hzSurgeFRCombSOccupB	Pre_PostFirm	bit	Pre-Post Firm
hzSurgeFRCombSOccupB	PrePostPCT	float	Pre-Post Firm Percent
hzSurgeFRCombSOccupB	PrePostExp	float	Pre-Post Exposure
hzSurgeFRCombSOccupB	Exposure	int	Exposure
hzSurgeFRCombSOccupB	BldgFloodLoss	float	Building Flood Loss
hzSurgeFRCombSOccupB	BldgWindLoss	float	Building Wind Loss
hzSurgeFRCombSOccupB	BldgCombLoss	float	Building Combined Loss
hzSurgeFRCombSOccupB	ContFloodLoss	float	Content Flood Loss
hzSurgeFRCombSOccupB	ContWindLoss	float	Content Wind Loss
hzSurgeFRCombSOccupB	ContCombLoss	float	Content Combined Loss
hzSurgeFRCombSOccupB	InvFloodLoss	float	Inventory Flood Loss
hzSurgeFRCombSOccupB	InvWindLoss	float	Inventory Wind Loss
hzSurgeFRCombSOccupB	InvCombLoss	float	Inventory Combined Loss
huEfBldgCharWt	WtPercent	real	Hurricane Wind Building Type Characteristic Total Distribution Value

Table	Name	Data Type	Description
huEfBldgCharWt	wbID	smallint	wbID should be one to one relationship with the huWindBldgChar Table in the system database.
huEfBldgEconRTBusInterruptio n	HuEfSbt	varchar(10)	Essential Facility Building Type
huEfBldgEconRTBusInterruptio n	None	Real	Building Economic No Damage State
huEfBldgEconRTBusInterruptio n	MinorDS	real	Building Economic Minor Damage State
huEfBldgEconRTBusInterruptio n	ModerateDS	real	Building Economic Moderate Damage State
huEfBldgEconRTBusInterruptio n	CompleteDS	real	Building Economic Complete Damage State
huEfBldgEconRTBusInterruptio n	SevereDS	real	Building Economic Severe Damage State
huEfBldgMapping	HuEfSbt	varchar(10)	Hurricane Specific Building Type Name
huEfBldgMapping	huEfBldgSchemeName	varchar(20)	Wind building mapping scheme
huEfBldgMapping	PercentDist	real	Hurricane Building Characteristic Distribution
huEfBldgMapping	BldgCharID	int	Hurricane List of Wind Building Characteristic ID
huEfBldgMappingList	SchemeDescription	varchar(40)	Hurricane Mapping Scheme List Description
huEfBldgMappingList	huEfBldgSchemeName	varchar(20)	Wind building mapping scheme
huEfBldgMappingList	SchemeUpdated	datetime	Hurricane Mapping Scheme List Updated Date
huEfBldgMappingList	Updateable	bit	Editable flag
huEfBldgMappingList	SchemeCreated	datetime	Hurricane Scheme Creation Date
huEfBldgMappingList	CaseID	int	Location Filter
huEfBldgMappingListExt	huEfBldgSchemeName	varchar(20)	Wind building mapping scheme
huEfBldgMappingListExt	huEfBldgSchemeNameExt	varchar(255)	Wind building mapping scheme displayed