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Hydrologic Engineering Center

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# **HEC-FIA Flood Impact Analysis**

## **User's Manual**

Version 3.0  
August 2015

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# **HEC-FIA**

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## Flood Impact Analysis Package, HEC-FIA, User's Manual

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# CHAPTER 1

## Introduction

### 1.1 Overview

The HEC-FIA (Flood Impact Analysis) software analyzes the consequences from a flood event. The software calculates structure and content damages, agricultural losses, and estimates potential life loss. These computations are performed by evaluating deterministically input single events, but uses uncertainty to describe the damageable elements and their susceptibility to flooding. The outputs support US Army Corps of Engineers (USACE) planning studies by supporting other social effects (OSE) account estimates associated with event-by-event based loss of life, property, content and agricultural estimates in the user defined study area. It supports dam and levee safety programs by allowing users evaluate the consequences associated and with poor performance (e.g. levee or dam failure) and perform scalable analysis in support of screening decisions. It supports water management functions by allowing for the rapid evaluation of actual events supporting real-time decision making during the operation of a system of flood risk management infrastructure.

This User's Manual details Version 3.0 of HEC-FIA. Version 3.0 is an update to Version 2.2 of HEC-FIA. HEC-FIA is the successor to the Project Benefit Accomplishment (HEC-PBA) software. HEC-FIA includes the damage-analysis capabilities summarized above and discussed in detail below. It features the ability to analyze geo-referenced gridded data, utilizes DSS (HEC's Data Storage System) datasets, produces tabular reports, and interfaces with geographic information systems (GIS). The software also includes a graphical user interface (GUI) that allows the user to enter and edit data necessary for impact analysis.

### 1.2 Purpose

The HEC-FIA software provides the capability to estimate a variety of flood impacts (listed on the following page) associated with flood actual or modeled events. HEC-FIA facilitates the:

- assessment of disaster impacts after a flood,
- analysis of flood impacts in real time to assist with decision-making and response activities,
- development of annual reports of USACE project benefit accomplishments that are required by USACE headquarters (HQUSACE) and Congress (not automated in Version 3.0, but possible through the alternative analysis capabilities); and
- development of consequence estimates to support risk assessments for the Dam Safety program and the Levee Safety program.

HEC-FIA evaluates impacts to a study area, the damageable elements are defined through the addition of user defined agricultural inventories, structural inventories, critical infrastructure, and impact response curves. These damageable elements can be impacted by hydraulic parameters which can be described through two main data formats, either geo-referenced gridded model outputs (which describe depth, arrival time, duration and depth times velocity) or through a set of geo-referenced hydrographs (stage or flow with accompanying rating curves) which represent a single event. For the specified analysis period of that single event, the program can estimate:

- Structure damage
- Content damage
- Car damage
- Population impacted
- Life loss
- Agricultural losses
- Indirect income and job losses
- Impacts based on exceeding high stage thresholds
- Impacts based on falling below low stage thresholds
- Impacts to critical infrastructure

HEC-FIA includes a number of reports that detail these impacts. The impacts can be sorted by impact area or by any user supplied polygon.

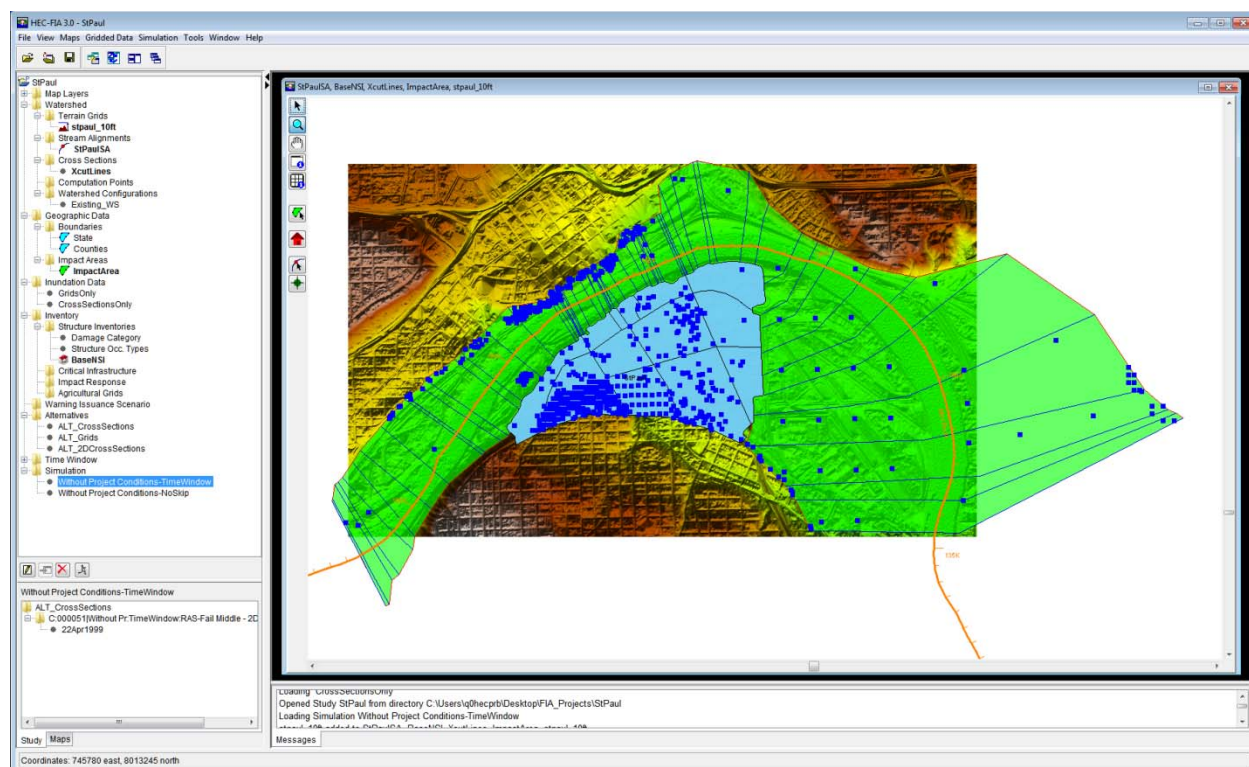
To calculate impacts, HEC-FIA requires the user to identify the study, assemble and enter data, and execute the program. These analysis steps are covered in detail in this manual. For a brief overview of HEC-FIA and how to build a project quickly, refer to the HEC-FIA Quick Start Guide (CPD-81a).

## 1.3 Overview of HEC-FIA

HEC-FIA (Figure 1.1) can be used to assess structural and non structural changes within a floodplain. The software is designed to be scalable; if users do not have high resolution data HEC-FIA can support the user through accessing national datasets for inputs like structures and agriculture. If the user determines that more detail is needed, it is simple for the user to incorporate higher resolution input data to replace the low resolution input data. The output from HEC-FIA can support decision making processes to assure that the projects do not present unacceptable risks to the environment, public, and property.

HEC-FIA supports several USACE missions:

- **Dam and Levee Safety** – HEC-FIA supports this mission by providing estimates for consequences from single events which can represent dam failure, levee failure, or exceedance of existing infrastructure. The software is utilized to provide information that can be used to assist in screening level decisions at lower resolution and accuracy, all the way through detailed assessments to support a decision document.



**Figure 1.1** HEC-FIA Project

- **Water Management** - HEC-FIA can be utilized for evaluating real time consequence estimates to support decisions regarding actions taken during flood operations for a system of existing projects. HEC-FIA is also utilized to create estimates to support after action reporting for a historic event.
- **Planning** - HEC-FIA is available to assist planners in evaluating consequences such as life loss estimation, agricultural damages, and indirect production and job losses. HEC-FIA can be utilized within HEC-WAT (HEC's Watershed Analysis Tool) with the FRA (flood risk analysis) compute option to evaluate the full range of Hydrologic, Hydraulic, Geotechnical, and Economic uncertainties to assist planners in evaluating the aforementioned consequences and to evaluate a standard benefit within uncertainty through the evaluation of alternatives much like HEC-FDA (HEC's Flood Damage Reduction Analysis software).

### 1.3.1 Identifying a Study

The first step of any HEC-FIA study (i.e., reconnaissance, or feasibility) is the definition of the study extent. A study extent is typically represented by a polygon of the area that has the possibility of getting wet when a large event is being assessed. The Project Delivery Team (PDT), under the direction of a Project Manager (PM), should start the process of defining the study extent by meeting to acquaint themselves with the type (i.e., reconnaissance, feasibility, watershed, restoration) and location of the study to be conducted.

The PDT evaluates existing data; identifies data which needs to be gathered, and select or build the hydrology and hydraulics models needed to provide simulation results. This determination

allows the PDT to make a rough estimate of the study extent and various other data elements such as the stream alignments which may be defined within some geospatial mapping product. With a map in hand, the PM should lead the PDT to choose the study boundaries, identifying gage locations, sub-basin delineations, impact areas, and location of measures (i.e., reservoirs, levees).

### 1.3.2 Creating a Project

After the PDT has identified the study area, an HEC-FIA project can be created (see Figure 1.1). A **project** in HEC-FIA is a combination of the input data describing a geographic location and hydraulic events which describe the flood hazard. The first step is to define a **watershed configuration**, which is a representation of the watershed (for example, the Without Project Condition), or a watershed configuration can be an alternative that changes elements in the study area.

A **watershed configuration** consists of a terrain grid, stream alignment, cross sections, related storage areas, and a set of common computation points. Not all elements of the watershed are required for HEC-FIA to compute hydraulic information at a location, but there are minimum requirements dependent upon the desired methodology to evaluate hydraulic information at an independent location. For example, if a user is defining the hydraulic events using gridded data, the grids describing the event (in terms of depth, duration, depth times velocity and arrival time) are sufficient to describe how the watershed responds to a given event, and therefore the only watershed element required is a terrain grid. Each watershed configuration would be representative of different structural alternatives. To compare alternatives, a watershed configuration representing the Without Project Conditions (it can be named whatever the user would like) would be required to evaluate a net benefit for the specific event. For a detailed description of the necessary input, refer to the HEC-FIA Technical Guide (Chapter 3) and the HEC-FIA Applications Guide (Chapter 2, Section 4).

**Geographic data** describes discrete parts of the study area. Boundaries allow the user to report information in the study area by specific areas. Impact areas are used in the life loss computations to define the geographic extent and type of warning system and mobilization relationship to be used within the study area.

Computing consequences in an HEC-FIA project requires **inundation data**. Inundation data provides a pattern for HEC-FIA simulations, through defining the source and type of hydraulic information at a any point in the study area. Inundation data can be in the form of grids, which define an event, representing the maximum depth at each grid cell and the arrival time of the

non-evacuation depth (recorded in decimal hours from the start time of the simulation). Alternatively, inundation data can be provided as a HEC-DSS file that contains stage hydrographs at cross sections and storage areas throughout the study area. In this case, the cross sections and storage areas define the geographic locations of the stage hydrographs. The inundation data configurations define the structure and data available to define hydraulic parameters throughout the watershed. The final step is to create an event for each inundation configuration which represents the specific characteristic of the flood in question at all locations within the watershed.

A **structure inventory** is required to estimate direct economic damages for a flood event. To estimate life loss for an event, the structure inventory must be supplied with a population estimate at each structure. **Damage categories** are the first aggregation level for structures, in the inventory. These damage categories represent a high level grouping for structures. They are used in the Economic Consequence Assessment Model (ECAM) process to determine population and capital impacted for each event. **Structure occupancy types** are the next level of aggregation for structures in HEC-FIA, these are imperative for any consequence calculation. The occupancy types describe depth-damage relationships, life loss parameters, general information about the structures, and contain information about uncertainty computations associated with the structure inventory. Each structure is required to have an occupancy type and damage category.

Other optional input data elements for an HEC-FIA project include critical infrastructure, definitions of impact response tables, agriculture data, and the definition of warning issuance scenarios. These additional input data elements are defined in this User's Manual.

An **alternative** in HEC-FIA is combination of inundation data, impact area (geographic data), and structure inventory. Once an alternative is defined, then a **time window** needs to be created. The time window defines the start and end times for a **simulation**. For HEC-FIA each simulation is defined by the combination of the specified alternative, event, and time window.

## 1.4 Starting HEC-FIA

When starting HEC-FIA, double-click the **HEC-FIA** icon on from desktop of a computer, or from the taskbar click **Start**, point to **All Programs**, point to **HEC**, point to **HEC-FIA**, and then click **HEC-FIA**. The splash dialog box for HEC-FIA opens (Figure 1.2).



The splash dialog box (Figure 1.2) appears for a few seconds, and then the main window of HEC-FIA appears. A user is now ready to start using HEC-FIA.

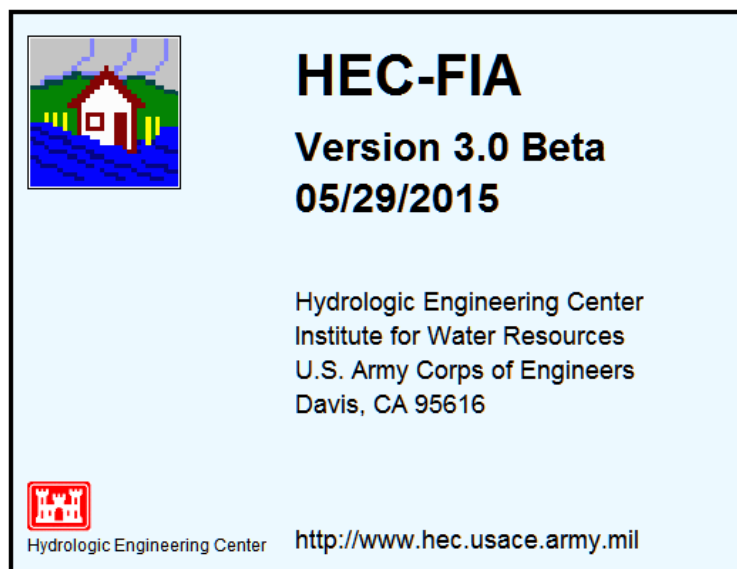


Figure 1.2 HEC-FIA Splash Dialog Box

## 1.5 Organization of Manual

The organization of this manual is shown in Table 1.1. The capabilities of FIA are described in Chapters 3 through 12

**Table 1.1**  
Summary of Contents of User's Manual

Topic	Chapter
The layout of the FIA GUI	Chapter 2
Creating and managing HEC-FIA projects	Chapter 3
How to work with map layers	Chapter 4
How to define watershed elements (stream alignment, computation points, watershed configurations, terrain grids, cross section sets)	Chapter 5
Define geographic data (boundaries, impact areas)	Chapter 6
Creating inundation configurations	Chapter 7
How to add and define structure inventories	Chapter 8
Creating warning issuance scenarios	Chapter 9
How to create alternatives	Chapter 10
How to define a time window	Chapter 11
How to run simulations & review results	Chapter 12
References	Appendix A
How to prepare data for use in HEC-FIA	Appendix B
How to setup coordinate systems	Appendix C
How to edit map layer display properties	Appendix D
How to use the Color Chooser	Appendix E
How to use HEC-DSSVue	Appendix F
Getting data from HEC-RAS	Appendix G

## 1.6 References

This User's Manual, the HEC-FIA Quick Start Guide, Technical Reference Manual, and the HEC-FIA software are available on the HEC web site (<http://www.hec.usace.army.mil/software/hec-fia/>).

## 1.7 Additional HEC-FIA Documentation

**HEC-FIA Quick Start Guide** helps the user through the initial steps of building an HEC-FIA model and using HEC-FIA to perform consequence analysis. The document provides an easy to understand steps incorporated with screenshots. Once the user has gone through this Guide they have a basic understanding of HEC-FIA.



**HEC-FIA Applications Guide** contains examples that demonstrate the various aspects of HEC-FIA. Each example consists of a problem description, data for the analysis, step by step input and explanation of results.

**HEC-FIA Technical Reference Manual** describes the theory and computational methodology behind the HEC-FIA computations. Equations are presented which allow the user to understand how various inputs impact results.



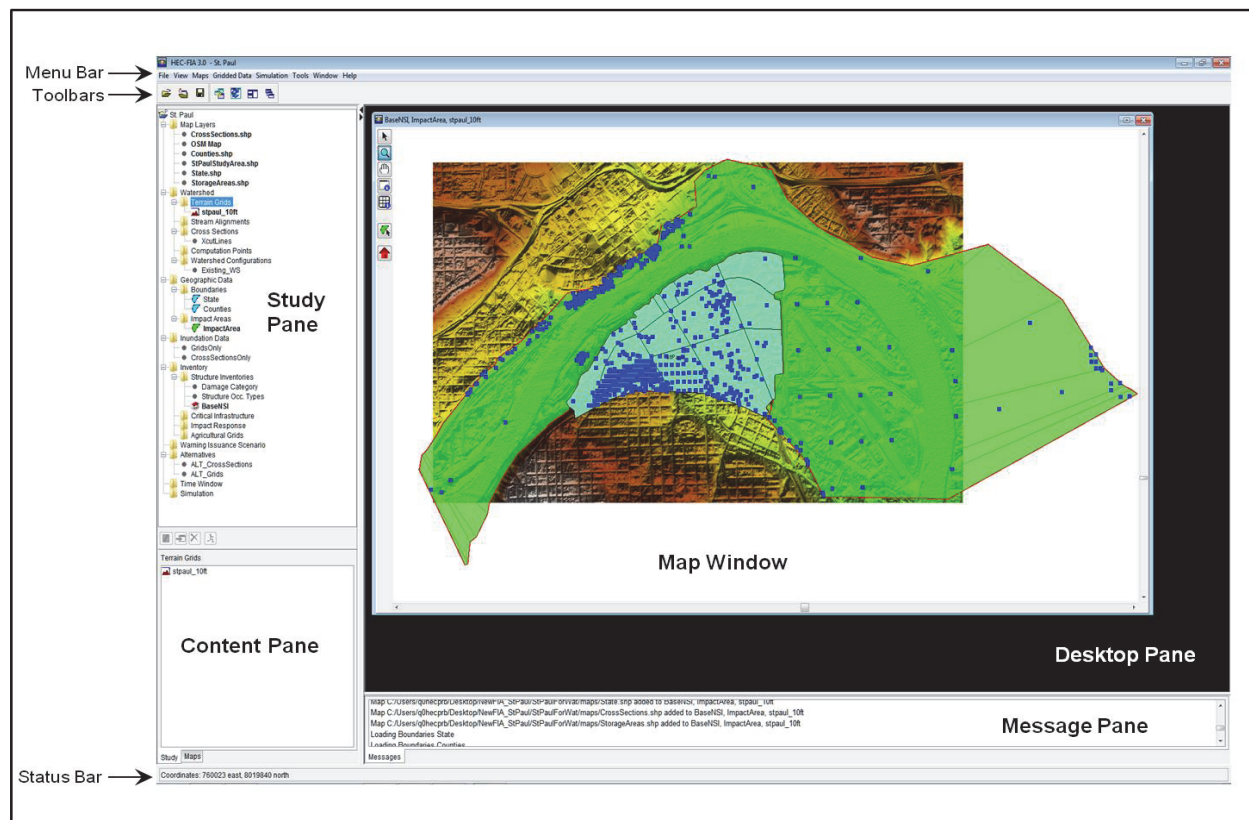
# CHAPTER 2

## HEC-FIA Interface

This chapter begins with an introduction to the layout of the HEC-FIA GUI, including display elements, menu bar, and tools. The chapter then gives an overview of the process of creating, opening, and saving a project in HEC-FIA.

### 2.1 HEC-FIA Main Window

The HEC-FIA main window (Figure 2.1) displays the HEC-FIA user interface. The user interface allows the user to define and view the study area, create and edit structure inventories, alternatives, and other model elements, and then run simulations and view results. From the main window the **Map Window**, **Menu**, **Tool**, and **Status Bar(s)** are viewable in addition to the **Desktop**, **Message**, **Content** and **Study Pane(s)** as is shown in (Figure 2.1) below. Note, if these items are not viewable from the main window it is likely that a study has not be loaded or some default views, managed from the views menu located on the menu bar, have been altered. The **Title Bar** (Figure 2.1) displays the version of HEC-FIA and the name of the project, if a project is opened.



**Figure 2.1** HEC-FIA Main Window

## 2.2 Panes

**Study Pane** Provides an overview of items that have been defined for an HEC-FIA project (Figure 2.2). The **Study Pane** displays information about the map layers; watershed elements (terrain grids, stream alignments, cross sections, computation points, and watershed configurations); geographic data (boundaries, impact areas); inundation data; inventory data (structure inventories, critical infrastructure, impact response, agricultural grids); warning issuance scenarios; alternatives; time windows; and, simulations.

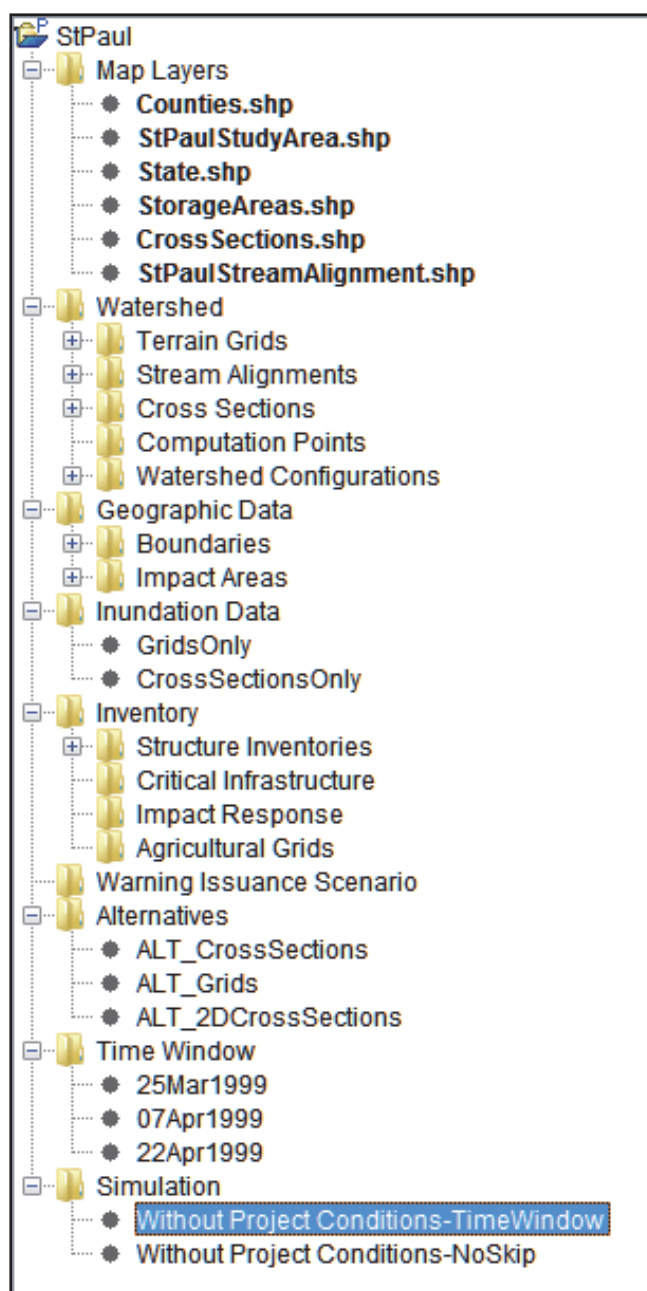


Figure 2.2 Study Pane

**Content Pane** This pane provides details on selected HEC-FIA components (Figure 2.3) from the **Study Pane**. For example, in Figure 2.3, an HEC-FIA simulation has been selected – *Without Project Conditions-TimeWindow*. The **Content Pane** displays the elements of that simulation. Information includes the alternative and the time window.

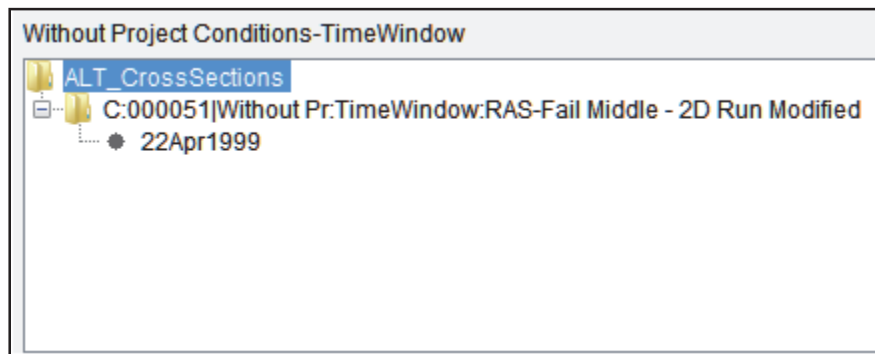


Figure 2.3 Content Pane

**Desktop Pane** The **Desktop Pane** (Figure 2.4) is where the different map windows available from HEC-FIA are displayed. For example, in Figure 2.4, the Desktop Pane contains a map window of a selected simulation and a map window of a selected schematic. These two map windows provide the user with a graphical representation of a simulation and a schematic, respectively.

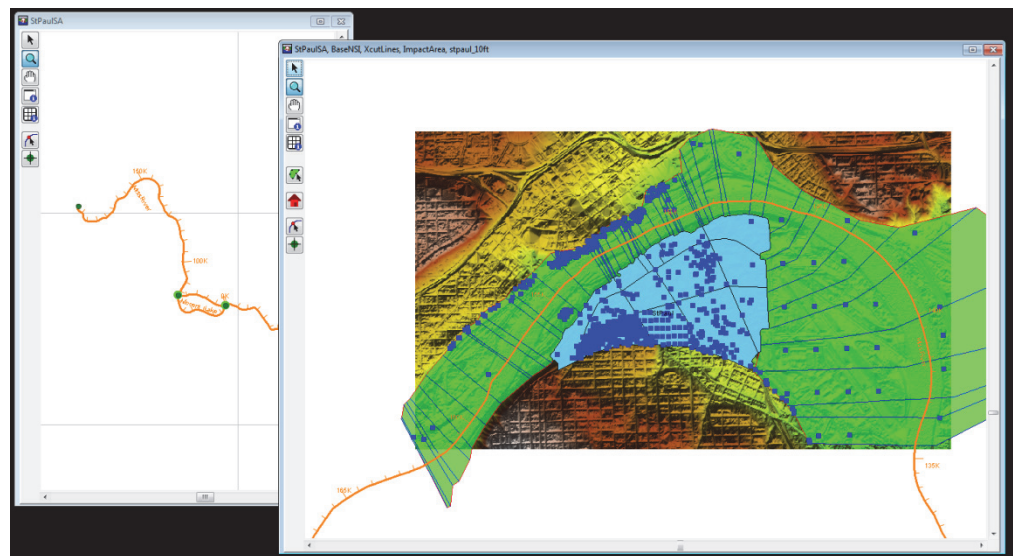


Figure 2.4 Desktop Pane

**Message Pane** The **Message Pane** (Figure 2.5) contains messages that the HEC-FIA software is providing for informational purposes. The information in the **Message Pane** is a record of HEC-FIA software activities, recording the opening of a study, opening map windows, accessing DSS, and many other HEC-FIA activities.

```

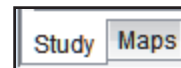
Loading CrossSectionsOnly
Opened Study StPaul from directory C:\Users\q0hecprb\Desktop\FIA_Projects\StPaul
Loading Simulation Without Project Conditions-TimeWindow
stpaul_10ft added to StPaulSA, BaseNSI, XcutLines, ImpactArea, stpaul_10ft
ImpactArea added to StPaulSA, BaseNSI, XcutLines, ImpactArea, stpaul_10ft
XcutLines added to StPaulSA, BaseNSI, XcutLines, ImpactArea, stpaul_10ft

```

Figure 2.5 Message Pane

## 2.3 Tabs

HEC-FIA has two tabs the **Study** and the **Maps** tabs. The study tab which is the default tab provides a view of the project data in a tree. The Maps tab provides a view of the available maps.



**Study** The default tab (Figure 2.2) which provides a view of the project data in a tree (Study Tree) in the **Study Pane**. Also, from the **Study Tree** a user can create, edit, and delete alternatives, analysis periods, and simulations. From the **Content Pane** (Figure 2.3) the user can view detailed information about items listed in the **Study Tree**.

**Maps** This tab (Figure 2.6) provides a view of the available map windows currently active in the **Desktop Pane** (Figure 2.4). The maps windows are displayed by type in the **Study Pane** portion (Figure 2.6). In the **Content Pane** portion (Figure 2.6) information about the layers for a selected map window are displayed. Also, from the **Content Pane** in the **Maps View** the user can turn layers on/off, adjust properties of the layers, and order the layers for viewing in the associated map window.

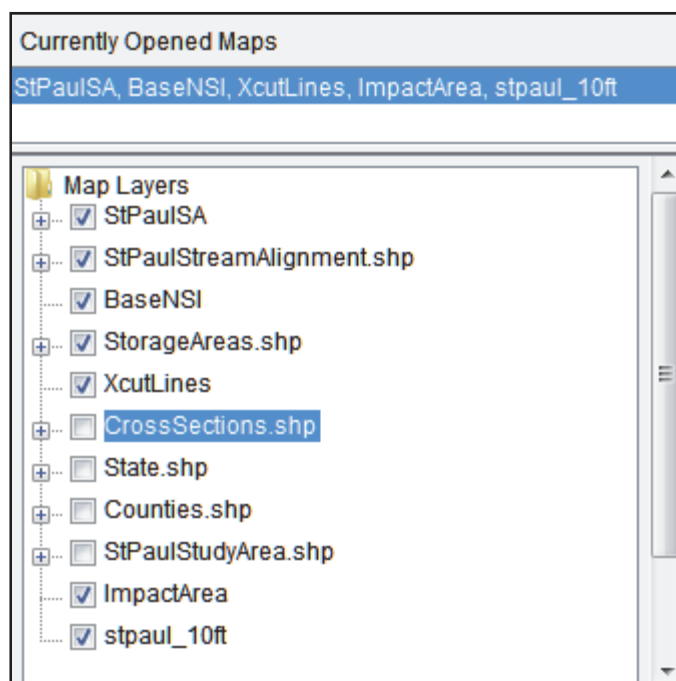


Figure 2.6 Maps Tab

## 2.4 Menu Bar

The menu bar of HEC-FIA provides the user with many commands to perform various functions.

The **File** menu (Table 2.1) allows the user to perform study management functions such as creating, opening, closing, and saving an HEC-FIA project. Also, provides information about the project properties; and, exit the HEC-WAT software.

**Table 2.1** HEC-FIA File Menu Commands

Commands	Description
New Study	create a new HEC-FIA project; opens the <b>Create New Study</b> dialog box
Open Study	open an HEC-FIA project; opens the <b>Open Study Browser</b>
Save Study	save the current HEC-FIA project.
Save Study As	make a copy of the current HEC-project; opens the <b>Save Study As</b> dialog box.
Close Study	close the current HEC-FIA project.
Study Properties	Opens the Study Properties dialog box. Provides general information about the HEC-FIA project; user can turn on/off map window grids; and, change background color.
Recent Studies	List the studies (last five) that have been opened.
Exit	Exit the HEC-FIA software.

The **View** menu (Table 2.2) is where an HEC-FIA user can setup the HEC-FIA main window: The user can select which toolbars and panes to display and not display; create and use layouts of the main window; manage layouts; set display units for plotting and tabulating (English, SI); and, display the active map window in either the watershed coordinate system or web coordinate system.

**Table 2.2** HEC-FIA View Menu Commands

Commands	Description
Toolbars	from this menu item the user can toggle on/off the following toolbars that available in the HEC-FIA framework - <b>Standard</b> or <b>Maps</b>
Study Pane	menu item that toggles on/off the <b>Study Pane</b> in the HEC-FIA main window.
Messages Pane	menu item that toggles on/off the <b>Message Pane</b> in the HEC-FIA main window.
Status Bar	menu item that toggles on/off the <b>Status Bar</b> in the HEC-FIA main window.
Toggle Views	menu item that toggles on/off display of the <b>Desktop Pane</b>
Save Layout	opens the <b>Create Layout</b> dialog box.
Restore Layout	menu item provides a list of layouts that a user can choose from.
Layout Manager	opens the <b>Layout Manager</b> dialog box.
Set Display Units	user can set the display units for the HEC-FIA project - English (default) or SI.
Displayed Coordinate System	user can set the displayed coordinate system for the HEC-FIA project - Web Coordinate System or Watershed Coordinate System (default).

From the **Maps** menu (Table 2.3), an HEC-FIA user can setup map layers and map windows for the HEC-FIA project. Commands include setting spatial properties; open a new map window;

view the settings of the current map window that is being displayed; zoom the active map window out to its full extents; and, save the contents of the active map window as a graphics file.

**Table 2.3** HEC-FIA Maps Menu Commands

Commands	Description
Default Map Properties	opens the <b>Default Map Properties for</b> dialog box.
New Map Window	opens a map window in the <b>Desktop Pane</b> that displays the map layers selected for the HEC-FIA project.
Map Window Settings	opens the <b>Map Window Settings</b> dialog box.
Zoom to Map Extents	zoom the active map window out to its full extents
Save Map Image	opens a Save Browser that allows the user to save the active map window as a graphic (*.wmf, *.jpg, *.png).

The **Gridded Data** (Table 2.4) menu provides the capability to create grids that HEC-FIA can use and display.

**Table 2.4** HEC-FIA Gridded Menu Commands

Commands	Description
Convert Grids	opens a <b>Open</b> browser that allows the user to select either a ArcInfo (*.asc) DEM file or a ESRI FLT (*.flt) file; which is converted to a *.tif file.
Import FLO-2D Grids	opens the <b>Import Arrival and Depth Grids from Flo2D</b> dialog box; allows the user select certain files from a FLO-2D model (FLO-2D Software, Inc., Nutrioso, AZ).

From the **Simulation** menu the HEC-FIA user run several HEC-FIA simulations at a time from the Compute Manager.

The **Tools** menu (Table 2.5) provides access to DSS data (HEC-DSSVue); provides options for HEC-FIA startup, setting system properties, viewing threads, setup simulation and compute color, and plug-in information; view the log for HEC-FIA, and monitor memory usage.

**Table 2.5** HEC-FIA Tools Menu Commands

Commands	Description
HEC-DSSVue	opens the HEC-DSSVue application.
Options	open the <b>Options</b> dialog box.
Console Output	opens the <b>Console Window</b> which contains the HEC-FIA log for the study.
Memory Monitor	opens the <b>Memory Monitor</b> dialog box; displays HEC-FIA memory usage

From the **Window** menu (Table 2.6) is where the HEC-FIA user can control the appearance of the map windows in the **Desktop Pane** (Figure 2.4) of the HEC-FIA main window.

From the **Help** menu (Table 2.7) the user can access the HEC-FIA User's Manual, view the HEC-FIA Terms and Conditions for Use (TCU), and display current version information about HEC-FIA.



**Table 2.6** HEC-FIA Window Menu Commands

Commands	Description
Tile	Menu item that allows the user to organize all of the currently opened map windows in either a vertical or horizontal tile.
Cascade	Menu item that allows the user to, place one map window on top of the next in a cascading fashion.
Next Window	Menu item that brings the next map window in the list of currently opened map windows to the top.
Previous Window	Menu item that brings the previous map window that was on top to the top.
Window Selector	Menu item that provides a list of the currently opened map windows.
Window	Menu item that lists the currently opened map windows.

**Table 2.7** HEC-FIA Help Menu Commands

Commands	Description
User's Manual	opens the HEC-FIA User's Manual.
Terms and Conditions for Use	opens the <b>HEC-FIA Terms and Conditions for Use (TCU)</b> .
About	opens the <b>About Box</b> for HEC-FIA.

## 2.5 Toolbar

The toolbar area of the HEC-FIA main window (Figure 2.1) provides quick access to the most frequently used options from the HEC-FIA menu bar. There are two available toolbars from the main toolbar:

**Standard** There are four tools available from the **Standard Toolbar** (Figure 2.7). The tools allow the user to open a study, close a study, and save a study. These tools have the same function as items under the **File** menu (see Table 2.1).

**Figure 2.7** Standard Toolbar

**Maps** There are four tools available from the **Maps Toolbar** (Figure 2.8). The tools allow the HEC-FIA user to control the appearance of map windows in the **Desktop Pane** (Figure 2.4) - create a new map window; synchronize active map windows; tile; and, cascade. These tools have the same function as items under the **Window** menu (see Table 2.6).

**Figure 2.8** Maps Toolbar

To toggle these toolbars on and off, from the HEC-FIA menu bar, from **View**, point to **Toolbars**, and select the toolbar the user wishes to toggle on and off.

## 2.6 Map Windows

Map windows (Figure 2.9) are a way to graphically display stream alignments, alternatives, and display other HEC-FIA project elements. From an alternative map window the user can open editors and view results.

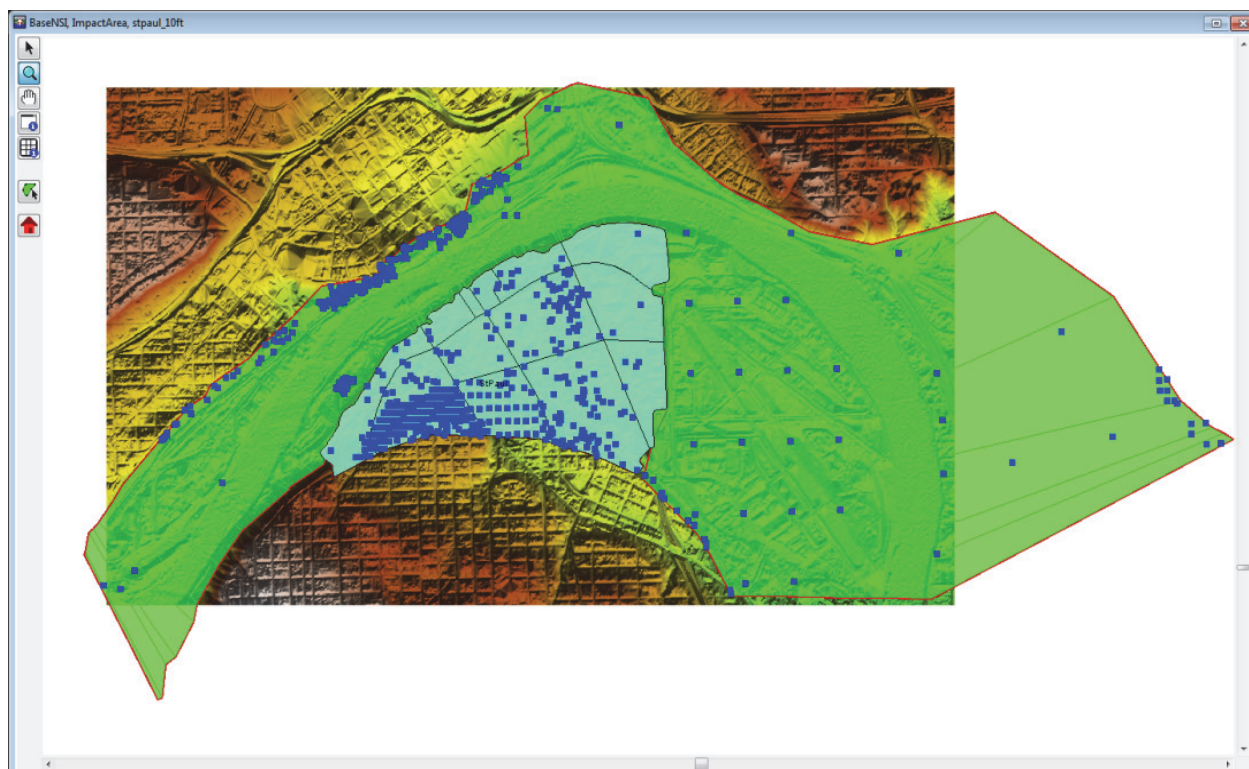


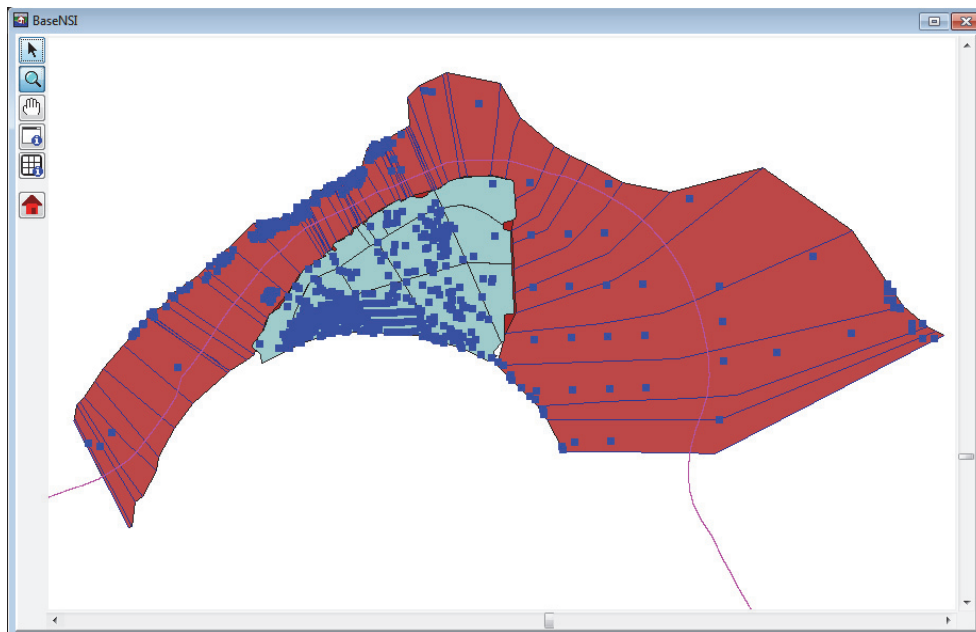
Figure 2.9 Map Window

### 2.6.1 Opening Map Windows

There are two ways to open map windows in the **Desktop Pane** (Figure 2.4), double-click on a stream alignment, alternative, structure inventories or other HEC-FIA project elements; or, from the shortcut menu of a stream alignment, structure inventories or other HEC-FIA project elements.

To open a map window by double-clicking:

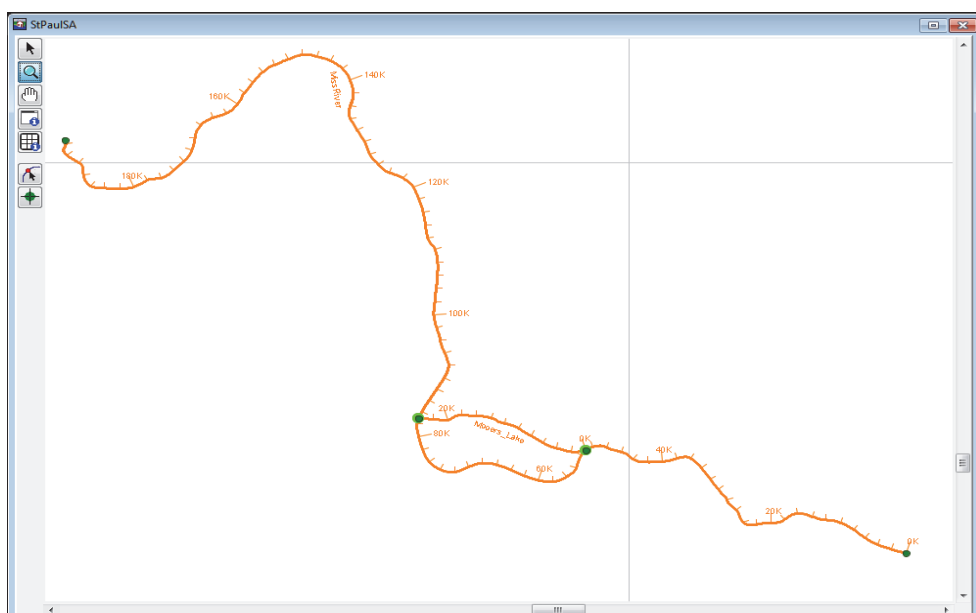
1. From the **Study** tab the user can double-click on stream alignments, alternatives, structure inventories or other HEC-FIA project elements to open map windows in the **Desktop Pane**.
2. For example, in Figure 2.10, from the **Study Tab**, double-click on the *BaseNSI* structure inventory. A map window opens displaying the structures associated with the *BaseNSI* structure inventory.



**Figure 2.10** Structure Inventory Map Window

To open a map window from a shortcut menu:

1. From the **Study** tab, from the shortcut menus available for stream alignments, alternatives, structure inventories, or other HEC-FIA project elements the **Display in Map Window** command, displays map windows in the **Desktop Pane**.
2. For example, in Figure 2.11, from the **Study** tab, right-click on *StPaulSA*. From the shortcut menu, click **Display in Map Window**, a map window (Figure 2.11) opens displaying the elements for the stream alignment.



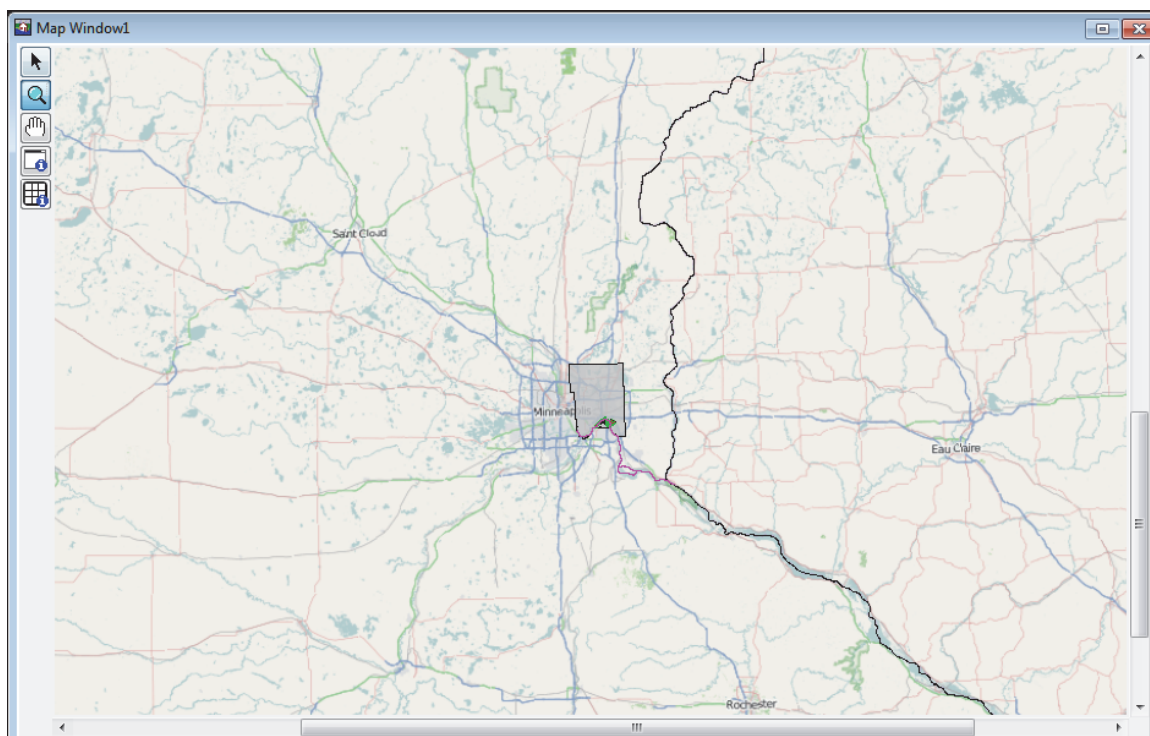
**Figure 2.11** Stream Alignment Map Window

## 2.6.2 New Map Window

HEC-FIA provides a mechanism for the user to build a map window. Instead of double-clicking on an alternative, the user can build a map window.

To create a map window:

1. From the **Maps** menu, click **New Map Window**, in the **Desktop Pane** a **Map Window** opens (Figure 2.12), with the map layers for the study loaded.



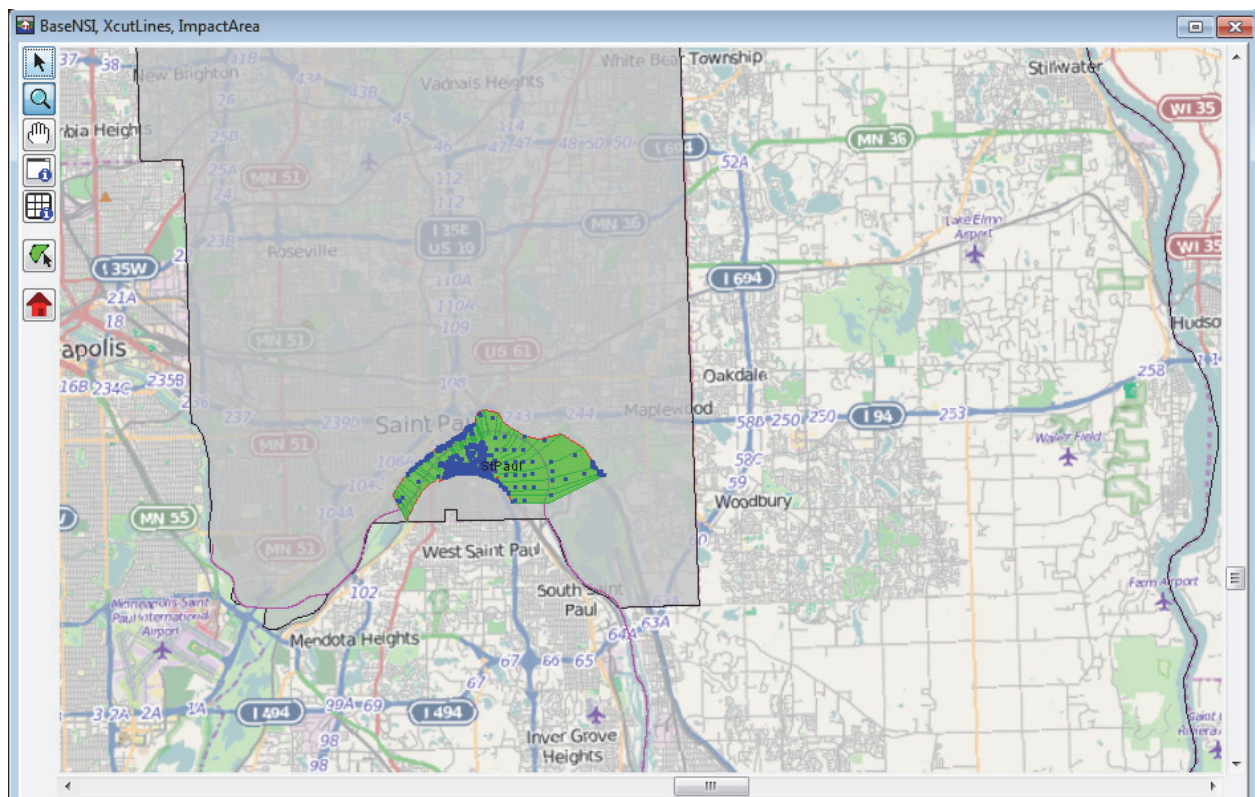
**Figure 2.12** New Map Window

2. To add the elements of an HEC-FIA alternative, from the **Study Tree**, from the **Alternatives** list, double-click on an alternative. The elements that make-up the selected alternative now displays in the new map window (Figure 2.13) and the map window now is an alternative map window.
3. The **Map Window** is saved when the project is saved. So the next time the project is opened the map window displays as it appeared when the project was saved.

## 2.6.3 Map Window Tools

Map window tools allow the user to select structures, zoom in and out the map window, pan in the map window, get information on shapefiles and grids in the map window, and edit impact areas. The following is an overview of available map window tools.





**Figure 2.13** New Map Window with a HEC-FIA Alternative Selected



**Pointer/Selector Tool** – use this tool to edit and delete structures. This tool can also be used to edit information contained in the displayed alternative, such as adding impact response rules to cross sections, viewing hydrographs at cross sections, editing critical infrastructure, or defining warning issuance rules.



**Zoom Tool** - use this tool to zoom in and out of the map window. To zoom in, hold the mouse button down and outline the area that is to be zoomed in on. To zoom out, click the right mouse button (right-click).



**Pan Tool** – use this tool to move the map window while zoomed in.



**Shapefile Query Tool** – use this tool to query shapefile information at specific points on a shapefile. This tool is functional when a shapefile is uploaded.



**Grid Query Tool** – use this tool to query gridded data. For an inundation grid, a click displays depth values. For an arrival time grid, a click displays the computed arrival time of flood waters during an event for the point at which the user clicked. For a duration grid, the values of the duration of water during a flood event for the cell are displayed where the user clicked. For a digital terrain model, the tool queries elevation values. This tool is only functional when terrain or inundation grids have been added to a project.



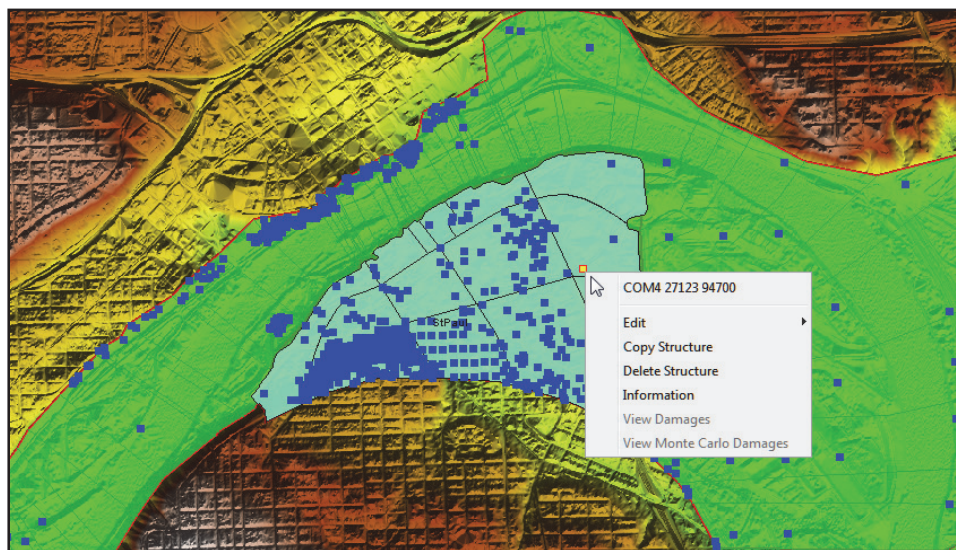
**Impact Area Polygon Tool** - use this tool to edit impact area properties.



**Structure Tool** – use this tool to copy, delete, edit, and get information for an individual structure.

## 2.6.4 Using Shortcut Menus

Using the previously described **Map Window** tools, users can edit the project elements displayed in the window using shortcut menus. For example, when users engage the **Structure Tool**, they can locate an individual structure they wish to edit, right-click, and perform a variety of actions from a shortcut menu, as shown in Figure 2.14.



**Figure 2.14** Structure Shortcut Menu

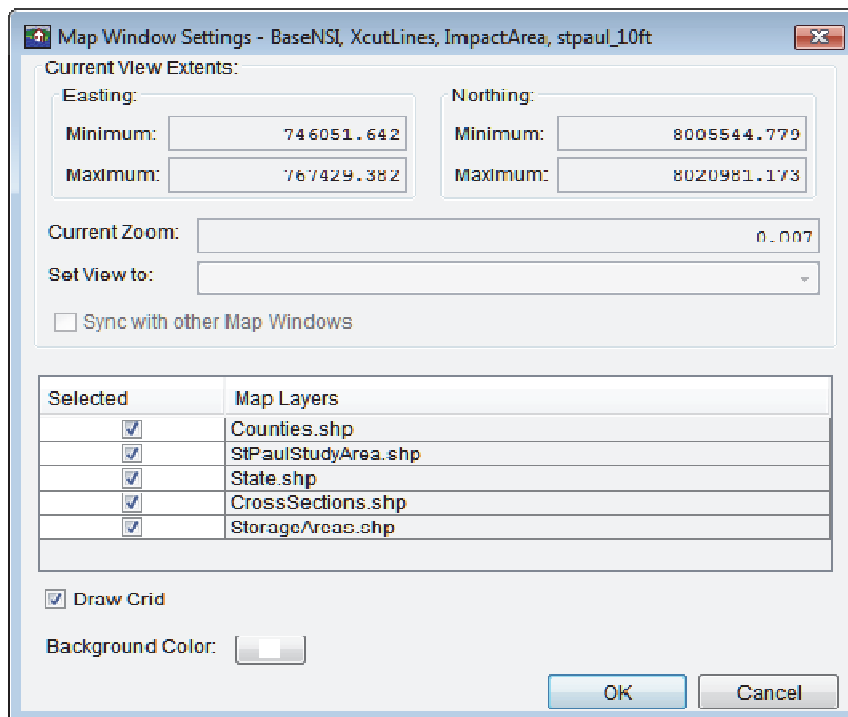
The shortcut menu makes creating and editing projects in HEC-FIA efficient and intuitive. The editing capabilities for different project elements and data is described in their respective chapters of this manual.

## 2.6.5 Properties of a Map Window

The basic properties of a map window are the geographic extents, zoom factor, available map layers, grid, and background color. From the **Maps** menu, click **Map Window Settings**, the **Map Window Settings** dialog box (Figure 2.15) displays. This dialog box provides information about the current **Map Window** that is open. The user can toggle on/off map layers; toggle on/off the grid in the map window; and, the user can change the background color of the **Map Window**.

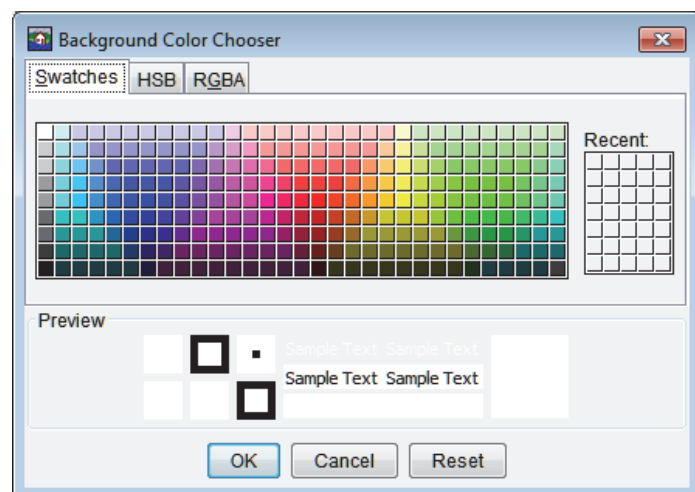
To edit and view map window properties:

1. From the **Maps** menu, click **Map Window Properties**, the **Map Window Settings** dialog box opens (Figure 2.15).
2. From the **Current View Extents** box, the user can view the extents of the map window and the current zoom factor.



**Figure 2.15** Map Window Settings

3. The map layers associated with the active map window are listed in the table on the **Map Window Settings** dialog box (Figure 2.15). The user can remove a map layer from the active map window by clicking on the **Selected** column. For example, in Figure 2.15, if user does not want to display the map layer associated with the storage areas, click the cell in the **Selected** column associated with *StorageAreas.shp*. Click **OK**, the **Map Windows Settings** dialog box closes, and the map layer no longer displays in the active map window.
4. By clicking **Draw Grid** (Figure 2.15) the user can turn on and off the grid that is displayed in the active map window.
5. The default background color for the active map window is white, by clicking **Background Color**; a **Color Chooser** dialog box opens (Figure 2.16). From the **Swatches** Tab click on a color, click **OK**, the **Color Chooser** dialog box (Figure 2.16) closes. See Appendix F for further details on the color chooser. From the **Map Windows Setting** dialog box (Figure 3.20), click **OK**. The **Map Windows Setting** dialog box closes and the background color of the active map window changes.



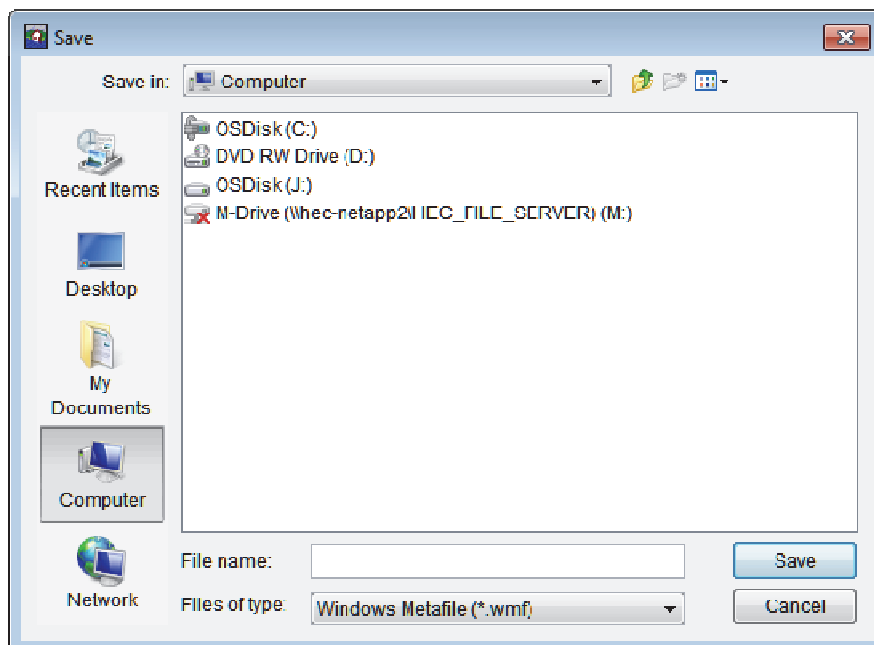
**Figure 2.16** Color Chooser Dialog Box

## 2.6.6 Saving a Map Window to a Graphics File

HEC-FIA allows the user to save the active map window to a graphics file for inclusion in reports and presentations. HEC-FIA has three possible formats: Windows Metafile (\*.wmf; default), JPEG (\*.jpg, \*.jpeg) and Portable Network Graphics (\*.png).

To create a graphics file of the active map window:

1. From the **Maps** menu, click **Save Map Image**, the **Save Browser** opens (Figure 2.17).



**Figure 2.17** Save Browser

2. Browse to the location where the file is to be saved, in the **File name** box type a name. From the **Files of type** list select the graphics file type (i.e., Windows Metafile - \*.wmf; JPEG - \*.jpg, \*.jpeg; Portable Network Graphics - \*.png) that is to be created.
3. Click **Save**, the **Save Browser** closes (Figure 2.17), and a file with the appropriate extension is created in the selected location. The file contains an image of the active map window.



# CHAPTER 3

## Creating and Managing Projects

Data management by HEC-FIA is largely done behind the scenes. Files are automatically created and named by HEC-FIA to store information. Information regarding the project are stored in ASCII text files, XML files, ASCII serialized files, and database files (\*.dbf, \*.mdx, \*.dbt).

### 3.1 Managing Projects

In HEC-FIA, the set of files associated with a particular water resources study is called a **project**. HEC-FIA creates a directory (folder) with the project name specified, and stores all the files associated with the project in that directory.

Commands available in the **File** menu (Figure 3.1) allows the user to create a new project, open an existing project, close the current project, save the current project, save the current project as another project, and review project properties.

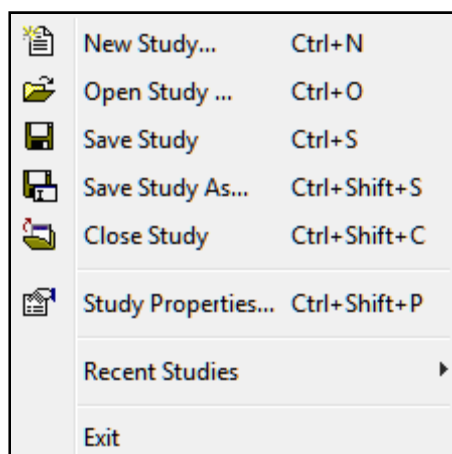
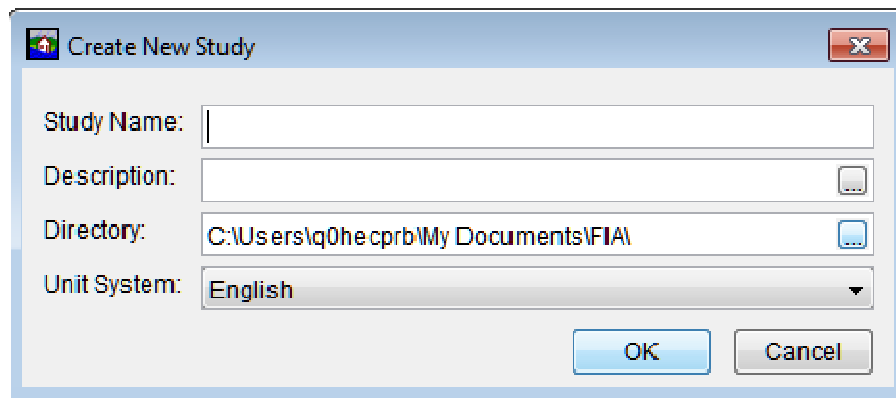


Figure 3.1 File Menu Commands


#### 3.1.1 Creating a New Project

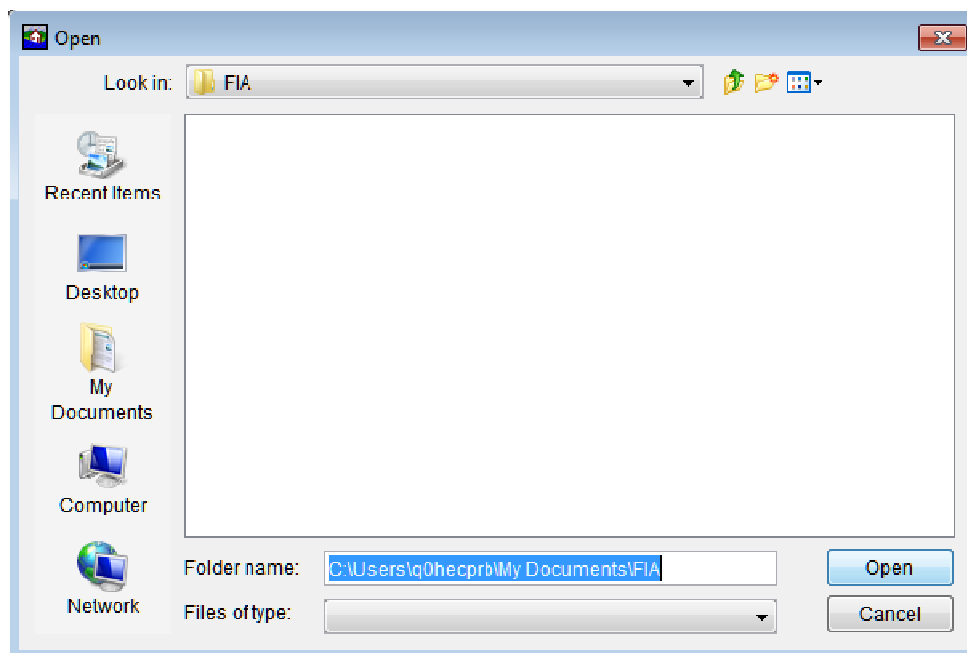
To create a new project:

1. From the **File** menu, click **New Study**, the **Create New Study** dialog box opens (Figure 3.2).
2. From the **Create New Study** dialog box, enter a name (required) in the **Study Name** box, and in the **Description** box, enter a description (optional, but recommended) for the new project.



**Figure 3.2** Create New Study Dialog Box

3. In the **Directory** box, either enter the name of the directory where the HEC-FIA project is to be stored, or click , an **Open Browser** (Figure 3.3) opens. The user can navigate to the directory where the HEC-FIA project is stored on the user's computer or network.
4. The **Unit System** dropdown allows the user to select either **English** (default) or **SI** units for the project.



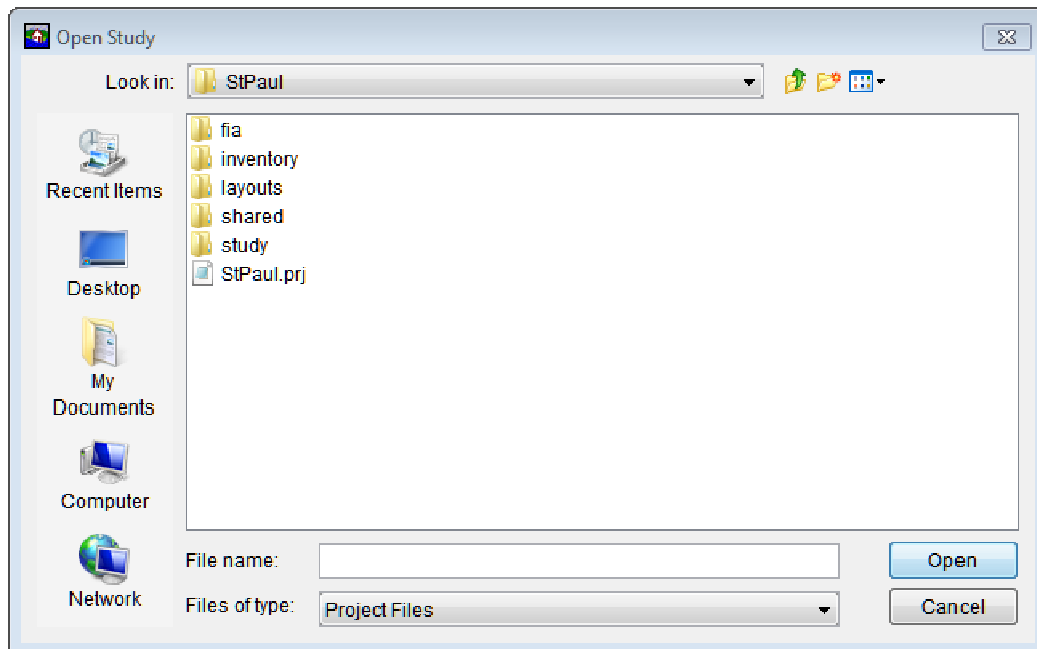
**Figure 3.3** Open Browser

5. Click **OK**, the **Create New Study** dialog box closes (Figure 3.2). The HEC-FIA main window now has the name of the project in the title bar.
6. A map window opens in the **Desktop Pane** and in the **Study Pane** (see Chapter 2, Section 2.3.1, page 2-10) displaying the project.
7. A directory with the project name and associated files is being created for the project. For further details on the project directory and files, see Section 3.2 (page 3-6).

### 3.1.2 Opening an Existing Project

There are two ways to open existing projects in the HEC-FIA. The first is to open the project by selecting it from the list of most-recently-opened projects. To do this, from the **File** menu (Figure 3.1), point to **Recent Studies**, and select the name of the project from the list of the previous five opened projects. HEC-FIA automatically loads the selected project. The second way to open an existing project is described below.

1. From the **File** menu, click **Open Study**, an **Open Study Browser** (Figure 3.4) opens.



**Figure 3.4** Open Study Browser

2. From the **Open Study Browser**, browse to the location of the existing HEC-FIA project. Note, by default, HEC-FIA is looking for a file with the extension *\*.prj*.
3. Select the project name, click **Open**, the **Open Study Browser** closes, and the selected project opens in HEC-FIA.

### 3.1.3 Close a Project

To close an active project, from the **File** menu (Figure 3.1), click **Close Study** and the project automatically closes. All changes that were made are automatically saved when exiting HEC-FIA.

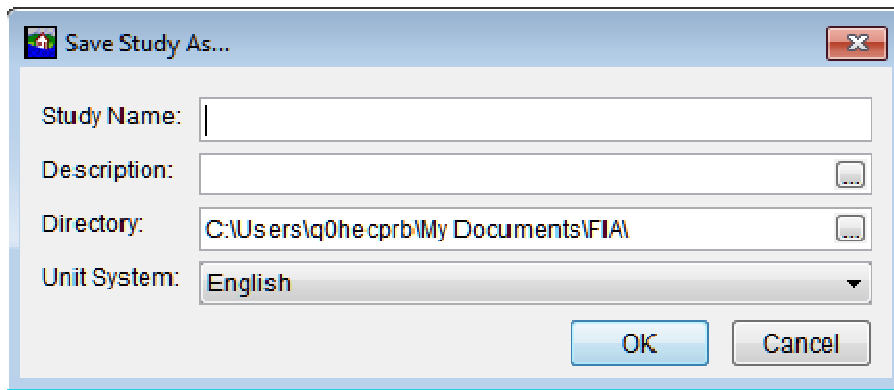
### 3.1.4 Save a Project

To save a project, from the **File** menu (Figure 3.1), click **Save Study**, HEC-FIA automatically saves the project. Saving a project saves all unsaved project elements. Project elements that are not saved are marked by an asterisk(\*).


### 3.1.5 Save a Project As

To save a project as a different project:

1. From the **File** menu, click **Save Study As**, the **Save Study As** dialog box opens (Figure 3.5).

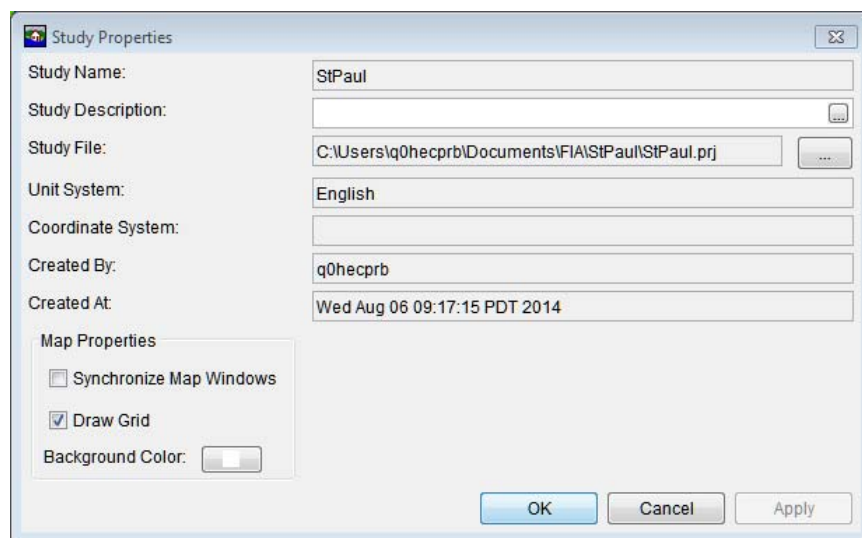


**Figure 3.5** Save Study As Dialog Box

2. From the **Save Study As** dialog box, enter a name (required) in the **Study Name** box, and in the **Description** box, enter a description (optional, but recommended) for the new project.
3. In the **Directory** box, either enter the name of the directory where the HEC-FIA project is to be stored, or click , an **Open Browser** (Figure 3.3) opens. The user can navigate to the directory where the HEC-FIA project is stored on the user's computer or network.
4. The **Unit System** list allows the user to select either **English** (default) or **SI** units for the project.
5. Click **OK**, the **Save Study As** dialog box closes (Figure 3.5). A progress window opens, providing information on the copying of the project. When that closes, the HEC-FIA main window now has the name of the project in the title bar.
7. The new project is named in the **Study Tree** and all data associated with the original project is now available.
8. A directory with the project name and associated files is created for the project. For further details on the project directory and files, see Section 3.2 (page 3-6).

### 3.1.6 Project Properties

The **Study Properties** dialog box (Figure 3.6) displays the name of the project, the project description (which the user can edit), location of the project file (\*.prj), the selected unit system, coordinate system, the Windows User ID name of the team member that created the project, and the date and time the study was created.



**Figure 3.6** Study Properties Dialog Box

Certain map window property options are provided in the **Study Properties** dialog box (Figure 3.6). For instance, the default property of synchronize map windows, the property to draw a grid, and the background color of the grid can all be set via this interface.

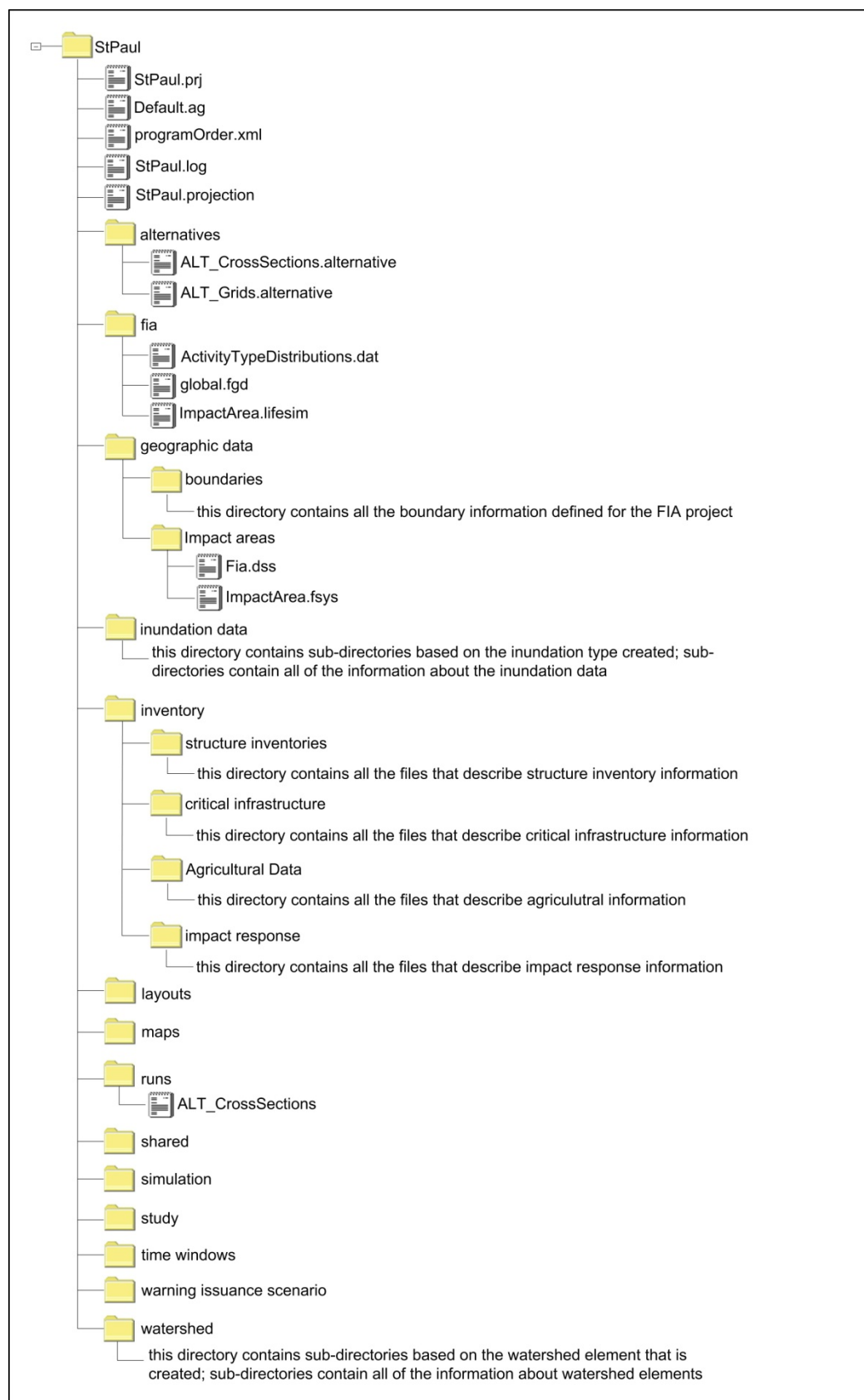
## 3.2 Project Directories and Files

Figure 3.7 shows an example of how HEC-FIA organizes the directories and files that are created in the project directory. In this example, the study directory is */StPaul*. As data is entered, other files and subdirectories are created. Table 3.1 describes each directory and file that is shown in Figure 3.7.





















## 3.3 Automatic Backup Files












As stream alignments, map layers, and data are added to a project, the files and directories listed in Table 3.1 are created, along with automatic backup files. For example, a *StPaul.prj* file and a *StPaul.prj.bak* file are created when the project is created. For example, when a map layer is added to a map window, the *.bak* file of the project's *.prj* file (where map window properties are stored) would not have any reference to the added map layer, since the backup file reflects the state previous to the current changes. So every time the user **Save's** a project, the *\*.bak* file is updated to the previous state of the file being saved, and edits are saved in the *\*.prj* file.

Automatic backup files are created for all project, alternative, simulation, and results files. DSS files are not automatically backed up. Since the *.bak* file reflects the previous state of that file, the user can go back to the previous state by eliminating the actual file, and deleting the *.bak* extension of the backup file (this should be done while the HEC-FIA project is closed). This would allow the information for that previous state to become the current state. The overall effect would be "undoing" all changes the user made in the last cycle even if the changes have been saved or automatically saved. One should note, as soon as the HEC-FIA project is re-opened, the model files are all "backed up" so the *.bak* file is auto updated. If the user wants to eliminate saved changes, deletion of the *.bak* file must occur before re-opening of the project.

**Figure 3.7** Example HEC-FIA Project Directory Structure

**Table 3.1** Example HEC-FIA Directories and Files

File or Directory Name	Contents
 StPaul	Project directory that is created when a user creates a new project (see Section 3.1.1, page 3-1).
 StPaul.prj  StPaul.prj.bak	ASCII text file created by HEC-FIA when a project is created. Contains the name and description of the project, what user created the project, map coordinate information, and references to HEC-FIA project elements. The *.bak file is an automatic backup file of the *.prj file.
 Default.ag  Default.ag.bak	ASCIISerializer text file created by HEC-FIA when a project is created. Contains information for a default analysis group. The <i>Default.ag.bak</i> file is an automatic backup file of the <i>Default.ag</i> file.
 programOrder.xml  programOrder.xml.bak	An XML file created by HEC-FIA when a project is created. The <i>programOrder.xml.bak</i> file is an automatic backup file of the <i>programOrder.xml</i> file.
 StPaul.projection  StPaul.projection.bak	ASCII text file created by HEC-FIA when the projection for the project is set. Contains the projection information for the HEC-FIA project. The *.bak file is an automatic backup file of the *.projection file.
 alternatives	Sub-directory created by HEC-FIA when an alternative is created.
 ALT_CrossSections.alternative  ALT_Grids.alternative	An XML file that is created by HEC-FIA when an alternative is created. This file contains information on an HEC-FIA alternative.
 fia	Sub-directory created by HEC-FIA when a project is created. Contains files that define data items for life loss calculations, global data, and impact area data for life loss calculations.
 ActivityTypeDistributions.dat  global.fgd  ImpactArea.lifesim	<b>ActivityTypeDistributions.dat</b> is an ASCII text file that contains user entered information for life loss calculations. <b>Global.fgd</b> is an ASCII text file that contains global information (boundary information, agriculture and urban price index factors, monetary units, system units). <b>ImpactArea.lifesim</b> is an ASCII Serializer text file that contains impact area data for life loss calculations.
 geographic data	Sub-directory created by HEC- FIA when geographic data (boundary, impact areas) is defined. Also, created are two sub-directories - boundaries and impact areas.
 inundation data	Sub-directory created by HEC-FIA when inundation data is defined. Also, created are sub-directories depending on which inundation type is selected - CCP only; cross sections only configuration; grids cross sections configuration; and grids only configuration.
 inventory	Sub-directory created by HEC-FIA when a structure inventory is created. Several sub-directories are created: <b>structure inventories</b> - this directory contains all of the information about the structure inventory, damage categories and structure occupancy types. <b>critical infrastructure</b> - this directory contains all of the critical infrastructure information. <b>Agricultural Data</b> - this directory contains all of the agricultural data information. <b>impact response</b> - this directory contains all of the impact response information.
 layouts	Sub-directory created by HEC-FIA when a project is created. This folder contains the saved layouts for the <b>Desktop Pane</b> .

 maps	Sub-directory created by HEC-FIA when a project is created and is used to store map layers and GIS coverages associated with a project. It is strongly <b>encouraged</b> that all maps (of any type) related to the HEC-FIA project be added to this directory. When adding map layers to a HEC-FIA, <i>maps</i> are the location where the maps are copied ( <b>Select Map Layer to Add</b> dialog box with <b>Create Copy</b> option selected).
 runs	Sub-directory created by HEC-FIA when a simulation is created. A sub-directory that has an alternative name that is associated with the simulation. All HEC-FIA results are stored to this directory.
 shared	Sub-directory created by the HEC-FIA when a study is created. This folder is a place to store files that might be used by the study.
 simulation	Sub-directory created by HEC-FIA when a simulation is created.
 WithoutProjectConditions.simulation	ASCII text file created by HEC-FIA when a simulation is created. Contains the name and description of the simulation, the name of the associated HEC-FIA alternative, event name, and the time window name.
 study	Sub-directory created by HEC-FIA when a project is created. This folder contains database files (*.dbf, *.dbt, *.mdx) that contain the data when creating measures, impact areas, and common computation points.
 time windows	Sub-directory created by HEC-FIA when a <b>Time Window</b> is created.
 TimeWindow.timewindow  TimeWindow.timewindow.bak	ASCIISerializer text file created by HEC-FIA when a time window is created. Contains the name and description of the time window, and the start and end dates of the time window. The *.bak file is an automatic backup file of the *.timewindow file.
 warning issuance scenario	Sub-directory created by HEC-FIA when a <b>Warning Issuance Scenario</b> is created.
 watershed	Sub-directory created by HEC-FIA when a project is created. Sub-directories are created for each HEC-FIA watershed element that is defined - terrain grids, cross sections; computation points; watershed configurations



# CHAPTER 4

## Map Layers

### 4.1 Map Layers Concepts

In order to make viewing, editing, and reviewing data simpler in HEC-FIA 3.0, most data elements have geospatial components that are interactive through the map window. To enable the geospatial features of model elements, HEC-FIA Version 3.0 has the ability to import model data from shapefiles. If the user wishes to provide auxiliary maps for visualization purposes, (but not for model data) that is possible also. The geospatial data formats HEC-FIA supports are reviewed in the following sections.

### 4.2 Map Layer Formats

In HEC-FIA, digital maps are referred to as map layers. When a map layer is added to the study, the program displays it in the map window. HEC-FIA can use certain types of map layers as data sources. The map layer formats that HEC-FIA can display are listed in Table 4.1.

**Table 4.1.** Map Layer Formats Compatible with HEC-FIA

Description	Common Filename Extension
USGS digital line graph	.dlg
AutoCAD® DXF	.dxf
ArcGIS® Shapefile	.shp
Raster image	.png, .jpg, .gif, .bmp
ASCII NetTin	.net
USGS DEM	.dem, .flt
ArcGIS® Grid Exports	.asc, .flt
LizardTech® MrSID®	.sid
HEC-FIA SMRMP	.smrmp
Open Street Maps	.osm
Virtual Format	.vrt

Typical data map layers required for a study include:

- Stream centerline shapefile (i.e., *StPaulStreamAlignment.shp*)
- Census block, parcel, or structure point shapefile (i.e., *Census\_Block\_Clip.shp*)
- Impact area shapefile (i.e., *Counties.shp*)

Typical data map layers used but not required for a study include:

- Study Area shapefile (i.e., *StPaulStudyArea.shp*)
- Cross Sections shapefile (i.e., *CrossSections.shp*)
- Storage Area shapefile (i.e., *StorageAreas.shp*)
- Computation Point shapefile (i.e., *StPaulCCPs.shp*)

### 4.2.1 USGS Digital Line Graph (.dlg)

U.S. Geological Survey (USGS) Digital Line Graphs (DLGs) are created from two sources using manual and automated digitizing methods. The two sources are aerial photographs and cartographic sources. DLG files are vector representations of the data. When HEC-FIA interacts with a .dlg file it automatically creates a .dlgbin file for use.

### 4.2.2 AutoCAD® DXF (.dxf)

A Drawing Interchange File (dxf) is created by a Computer-Aided Design (CAD) package, AutoCAD®. This format is a tagged data representation of an AutoCad® drawing file. The dxf format is commonly used for data exported from other CAD and GIS programs.

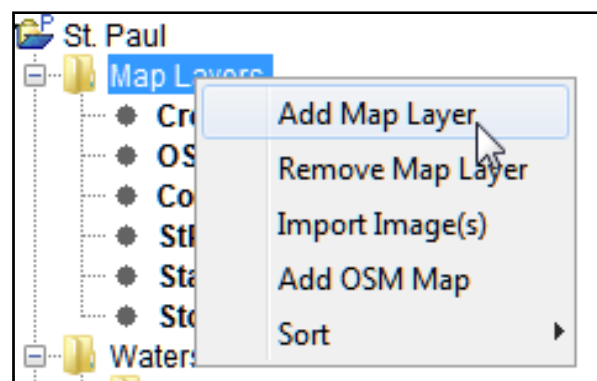
### 4.2.3 ArcGIS® Shapefiles (.shp)

This file type is the native data structure for the ArcGIS® program. Shapefiles store non-topological geometry and attribute information for the spatial features of a data set in a particular format. Usually there are four component files associated with a shapefile: .dbf, .shp, .prj, and .shx. The .shp file contains the shapes (points, polylines, or polygons) that are displayed in the layer. Each shape has a record in the .dbf file containing descriptive data called "attributes". The .prj file contains the projection information for the shapefile. Finally, the .shx file contains an index that links each shape to its record in the .dbf file. For more information on shapefiles, see the *ESRI Shapefile Technical Description* available here: <http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf>.

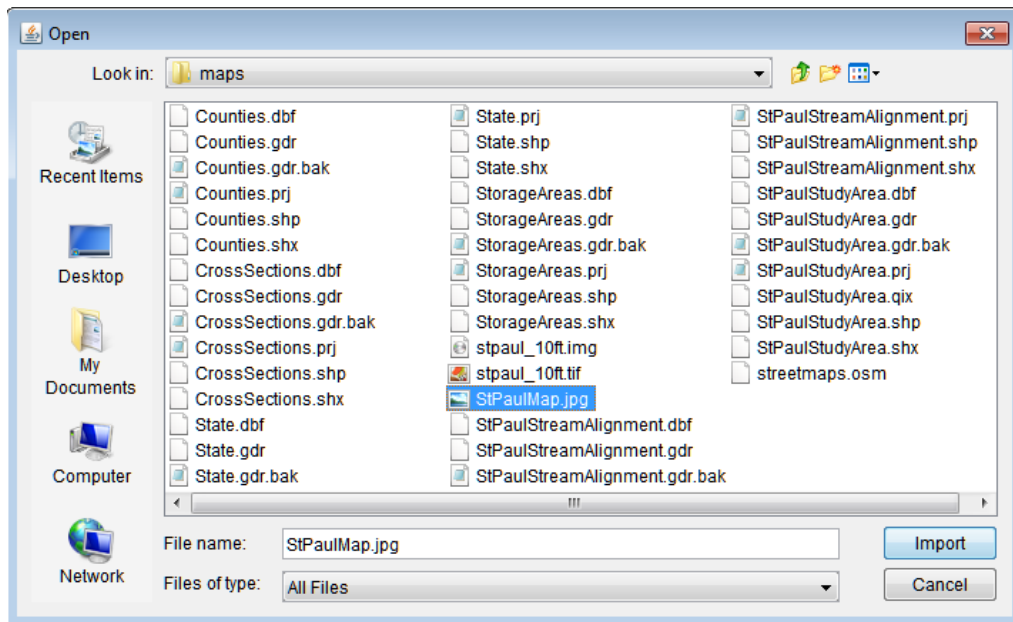
### 4.2.4 Raster Image

The raster image formats supported by HEC-FIA are: JPEG format (.jpg), Graphics Interchange Format (.gif), Portable Network Graphic (.png), and, bitmap (.bmp). To import a raster image:

1. From the **Study Pane**, right-click on the **Map Layers** subfolder. From the shortcut menu (Figure 4.1), click **Import Image(s)**; an **Open Browser** (Figure 4.2) opens.
2. Browse to the location of the image that is to be uploaded. Click on the name of

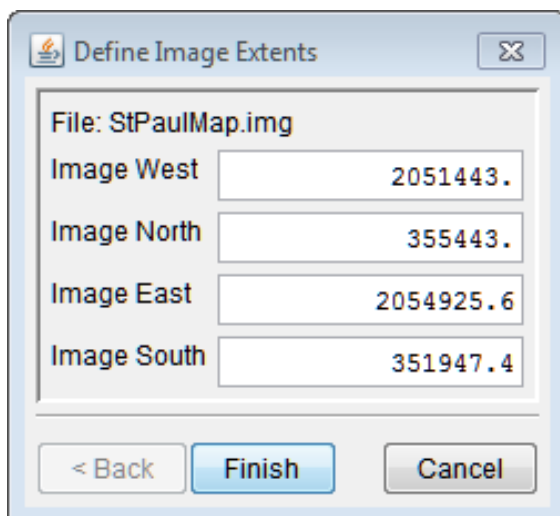


**Figure 4.1** Map Layers Shortcut Menu (Study Tree)



**Figure 4.2** Open Browser

image that could be used for the project. The name appears in the **File name** box. Click **Import**, the **Open Browser** closes and the **Define Image Extents** dialog box opens (Figure 4.3).



**Figure 4.3** Define Image Extents Dialog Box

4. Enter the extents of the image; once defined, click **Finish**. The filename of the selected image displays under the **Map Layers** folder in the **Study Pane** and the image file is stored in the *maps* folder of the study directory.

### 4.2.5 USGS DEM (.dem)

The U.S. Geological Survey (USGS) published the file format USGS DEM (as of 2006 USGS no longer directly distributes elevation data in the DEM format). A raster file format, *.dem* files usually contain terrain elevations, but the file format can be used for representing any surface.

The format, published by the USGS, allows internal documentation of coordinate system, date of publication, etc. These values are referenced horizontally, either to a Universal Transverse Mercator (UTM) projection or to a geographic coordinate system.

### 4.2.6 ArcGIS® Grid Exports (.asc, .flt)

The *.asc* file is an ASCII file format representation of a grid generated by ArcGIS®. The file consists of keywords followed by values defining the number of columns, number of rows, lower left corner, cell size, no data value, and each cell value.

The *.flt* file is a similar format (ESRI binary grid file), but split into two files: an ASCII header (*.hdr*) file and an *.flt* file which contains binary representations of the cell values. The binary file (*.flt*) contains 32-bit floating data that is stored line by line from north to south (topological elevation values). The *.hdr* file contains the geo-referencing information. Both files need to be stored in the same place.

### 4.2.7 HEC-FIA SMRMP (.smrmp)

The Segmented Multi-Resolution Multi-Parameter (SMRMP) file was created to operate gridded data (namely, digital terrain grids, inundation depth grids, and arrival time grids) more efficiently in HEC-FIA. When users add terrain and inundation data (see Chapter 7), the user is prompted to convert to SMRMP format. The conversion is not required, but is recommended for higher efficiency. This file type is not recommended and is only being maintained for existing projects which have the *.smrmp* format a conversion tool to export to any another file format is not available.

### 4.2.8 ASCII NetTin (.net)

An ASCII file format used to represent a triangulated irregular network (TIN). TIN data are stored in a simple format that defines the nodes, edges, and triangles contained in the TIN. This format is common for transferring TIN data between software.

### 4.2.9 LizardTech® MrSID® (.sid)

The MrSID® (multi-resolution seamless image database) is a propriety geo-referenced image file format developed by LizardTech® for use with Geographic Information Systems (GIS). This format compresses large raster image files like aerial photographs or satellite imagery for easier viewing. Some MrSID images contain geo-referencing and positioning information and can be placed in the watershed.

### 4.2.10 Open Street Maps (.osm)

An XML file created by RMA to store user preferences regarding streaming services. This file is generated by HEC-FIA in the project's Maps folder. This file should not be edited by the user.

### 4.2.11 Virtual Format (.vrt)

The *.vrt* format is a format driver for GDAL (Geospatial Data Abstraction Library) and allows for a virtual GDAL dataset to be composed of other GDAL datasets. The primary use of this format is to group together a series of grids that should be associated together. This file format allows multiple depth grids for the same event to create a mosaic single grid. Relative file paths are saved in an XML format, as well as a histogram describing the frequency of cell values across all grids within the *vrt*.

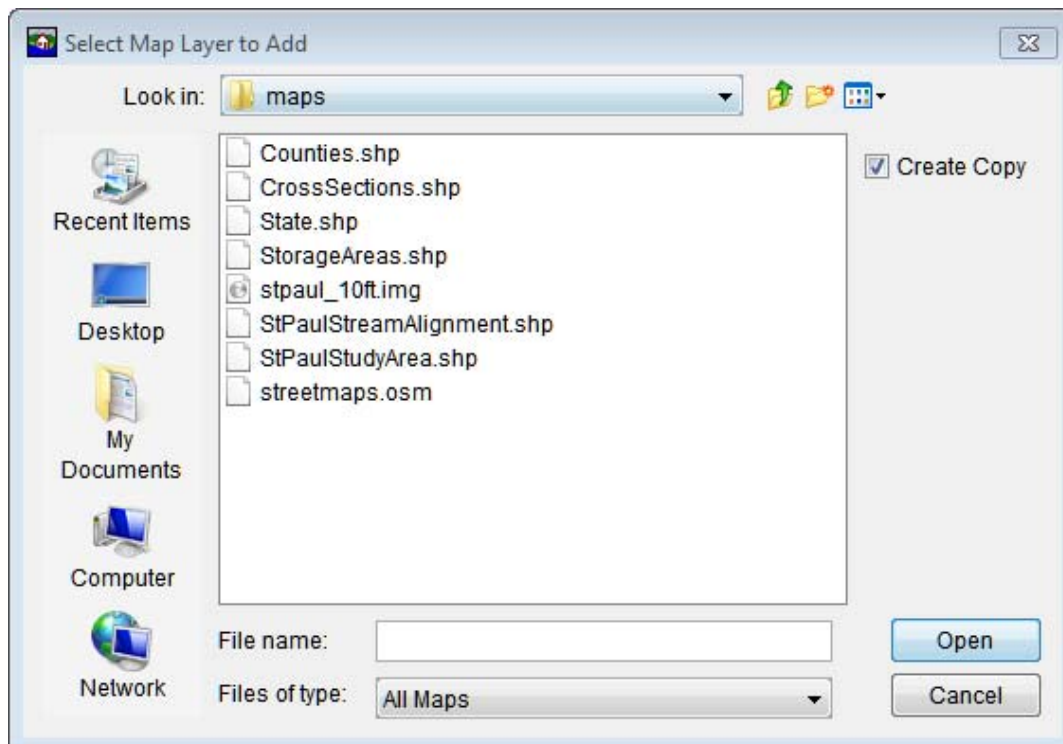
## 4.3 Add Map Layers

The user can add as many types of map layers as needed. However, the user must make sure that all map layers use the same origin and measurement units. In GIS jargon, all map layers must use the same projection.

When a map layer is added to an HEC-FIA project, the software reads the coordinates of points, lines, and polygons on the map layer and resets the geographic extents of the watershed to the smallest rectangle that contains all objects in the map layer. If a shapefile is used to import a stream alignment, the units of the stream alignment are based on the units of the projection.

To add a map layer:

1. From the **Study Pane**, right-click on the **Map Layers** folder. From the shortcut menu (Figure 4.1), click **Add Map Layer**, the **Select Map Layer to Add** Browser opens (Figure 4.4).



**Figure 4.4** Select Map Layer to Add Browser

2. Browse to the location where the map layers are located. Select an individual map layer by clicking on the filename, or add multiple map layers by holding down the CTRL-key and selecting the map layers that could be part of the HEC-FIA project.
3. **Create Copy** is selected by default; which creates a copy of the selected files in the *maps* folder within the current study directory. Storing all the data in the project directory is recommended as this makes the project easier to store and share. If **Create Copy** is unchecked, the path to the file is stored relative to the project file. If either the map file itself, or the study project file is moved, HEC-FIA can no longer display the map file.
4. Once the necessary files are selected, click **Open**. The **Select Map Layer to Add Browser** closes (Figure 4.4). A **Set Study Coordinate System** window (Figure 4.5) opens. The window is asking the user if the coordinate system for the HEC-FIA project should be set to the coordinate system of the first selected map layer (i.e., Counties.shp). Click **Yes**, if the coordinate system of the first selected map layer is correct. The **Set Study Coordinate System** window closes, and the map layers display in the **Map Window**.

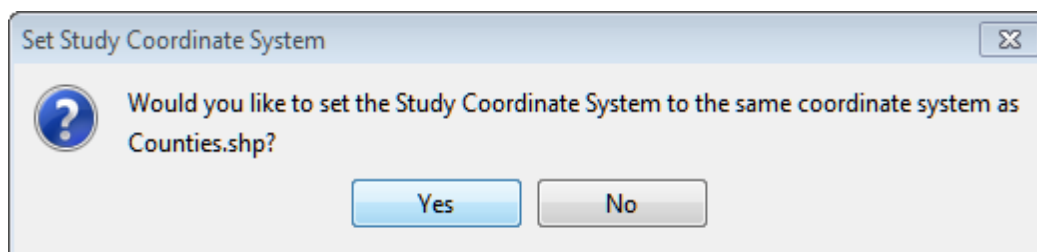



Figure 4.5 Set Study Coordinate System Window

5. The filenames of the selected map layers display under the **Map Layers** folder in the **Study Pane**. To save the HEC-FIA project, from the toolbar click .

## 4.4 Remove Map Layers/Images

From the **Study Pane** of the HEC-FIA software there are two methods to remove map layers/images. The first is to remove individual map layers/images from an HEC-FIA project:

1. From the **Study Pane**, from the **Map Layers** folder, right-click on the name of the map layer/image to be removed. From the **Map Layer** shortcut menu (Figure 4.6), click **Remove Map Layer**.
2. A **Confirm Removal** window opens asking user if it is okay to remove the selected map layer/image from the HEC-FIA project. Click **Yes**, the **Confirm Removal** window closes, and the selected map layer is removed from the HEC-FIA project.

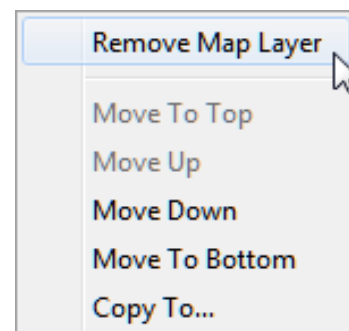
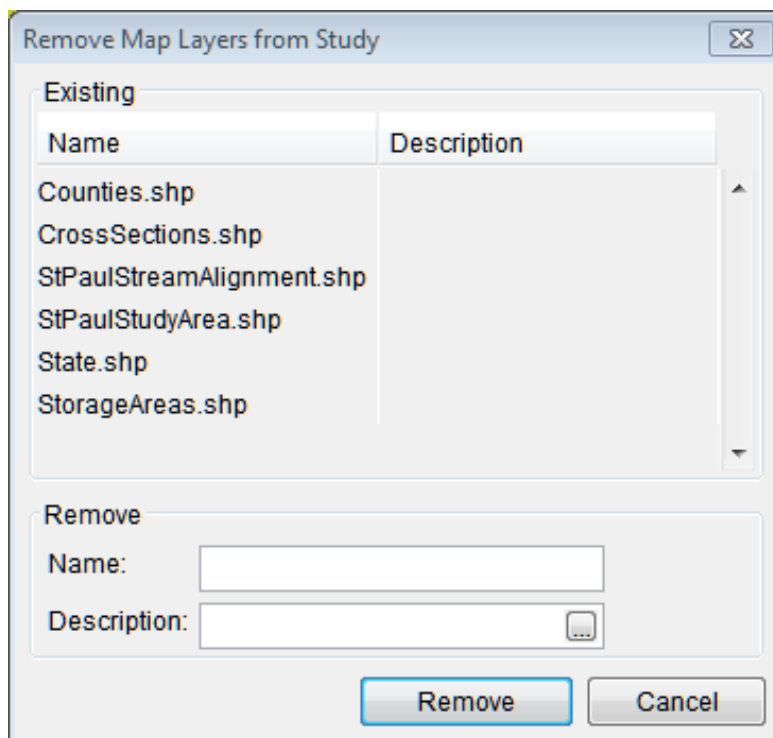


Figure 4.6 Map Layer Shortcut Menu


3. The physical file(s) associated with the map layer/image remains in the HEC-FIA project directory (*maps* folder) on the hard drive. The names of the map layers/images are no longer displayed from the **Study Pane** under the **Map Layers** folder.

The other available methods, allows the user to remove multiple map layers/images from an HEC-FIA project:

1. From the **Study Pane**, right-click on the **Map Layers** folder, from the Maps Layers shortcut menu (Figure 4.2), click **Remove Map Layer**. The **Remove Map Layers from Study** (Figure 4.7) dialog box opens.



**Figure 4.7** Remove Map Layers from Study Dialog Box

2. Select an individual map layer/image by clicking on the filename, or select multiple map layers/images by holding down the CTRL-key and selecting the images that are to be removed from the HEC-FIA project.
3. Click **Remove**, a **Warning** window displays. This window is asking the user if the selected map layers/images are to be removed from the HEC-FIA project. Click **Yes**, the **Warning** window closes.
4. The **Remove Map Layers from Study** dialog box (Figure 4.7) closes. The physical file(s) associated with the map layers/images remains in the HEC-FIA project directory (*maps* folder) on the hard drive. The names of the map layers/images are no longer displayed from the **Study Pane** under the **Map Layers** folder. To save the HEC-FIA project, from the toolbar click .



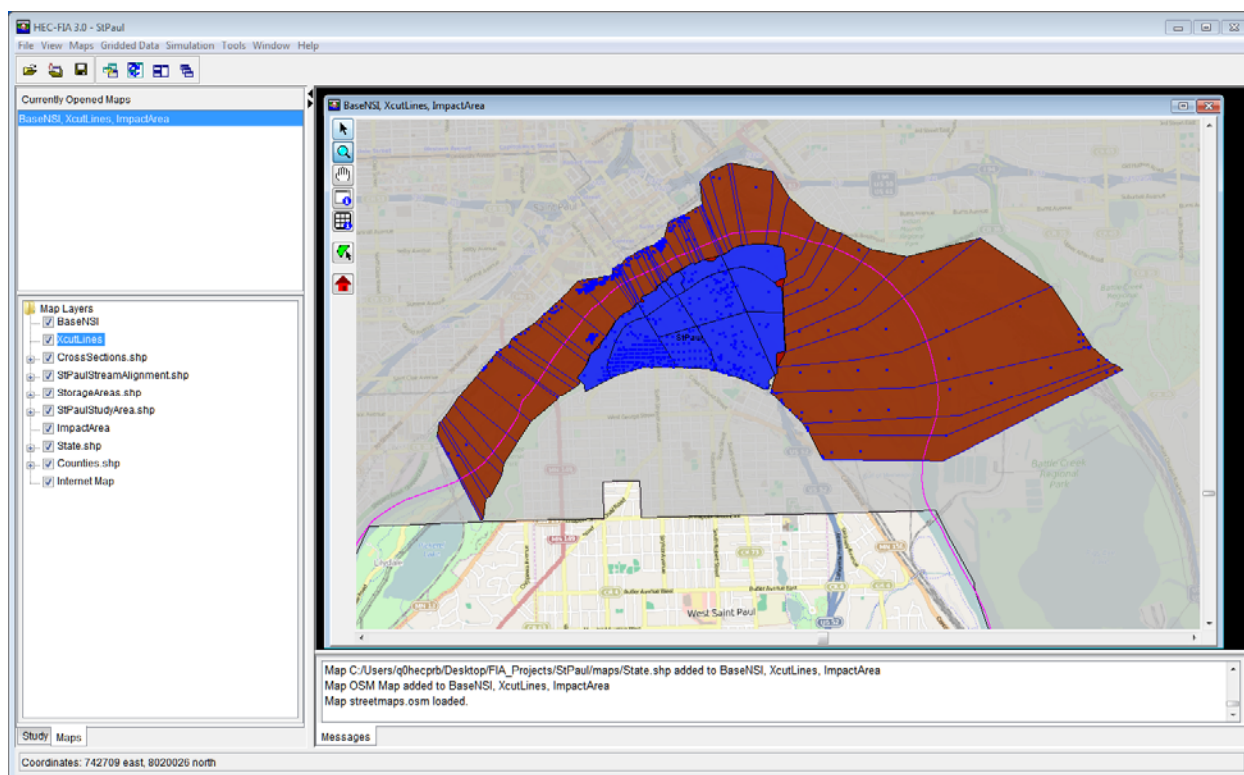
## 4.5 Add OSM Map

Knowing where the HEC-FIA project is located in reference to known locations can be quite helpful when communicating with stakeholders. From the **Maps Layers** shortcut menu (Figure 4.1), click **Add OSM Map (Open Street Map)**. Automatically an OSM map is loaded and displayed the active **Map Window**.

## 4.6 Adjust Map Layers

Once a map layer is part of an HEC-FIA project the user can organize layers, display or hide layers, display the legend of the selected map layer, edit display properties of the map layer, set scale factors; copy to another location, and view the attributes table of certain map layer types.

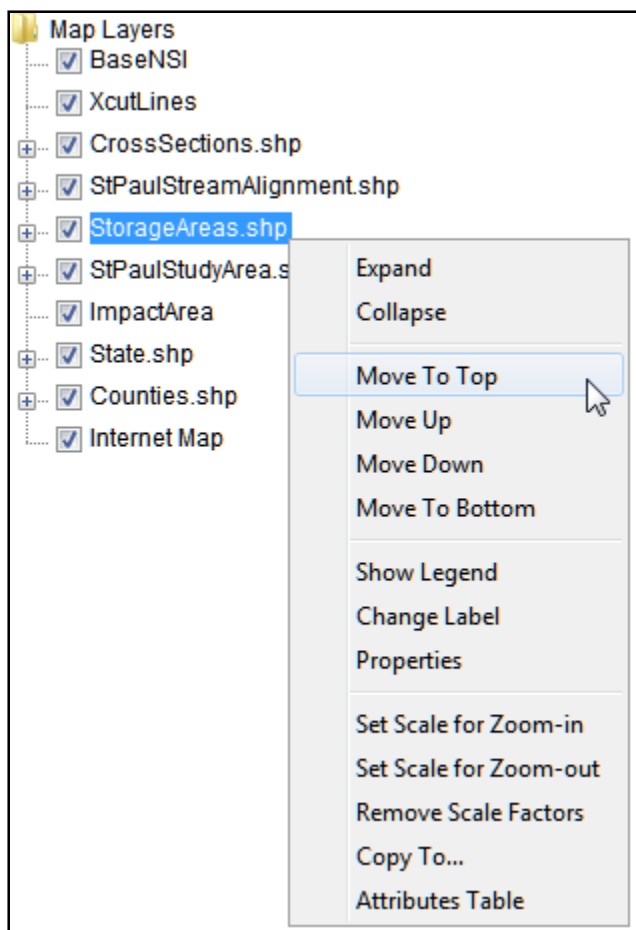
From the HEC-FIA main window, click the **Maps** tab (Figure 4.8). Now the user can see which **Map Window** is currently active and what layers make up that **Map Window**. To change the color and the fill aspects of the *RussianSubbasins.shp* do the following:



**Figure 4.8** HEC-FIA Main Window - Maps Tab

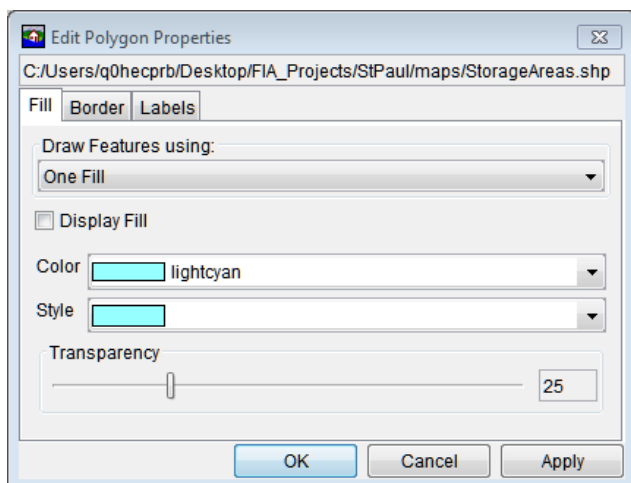
1. From the **Map Layers** tree, right click on *StorageAreas.shp*, the shapefile shortcut menu displays (Figure 4.9). This shortcut menu allows the user to expand/collapse the *StorageAreas.shp* leaf; move the shapefile to different positions in the tree (**Move To Top/Move To Bottom, Move up/Move Down**); show the legend of the shapefile; change the label of the shapefile; edit the properties of the shapefile; set/remove scale factors; copy the map layer to another location; and open the attribute table of the shapefile.






**Figure 4.9** Map Layers Tree Shortcut Menu

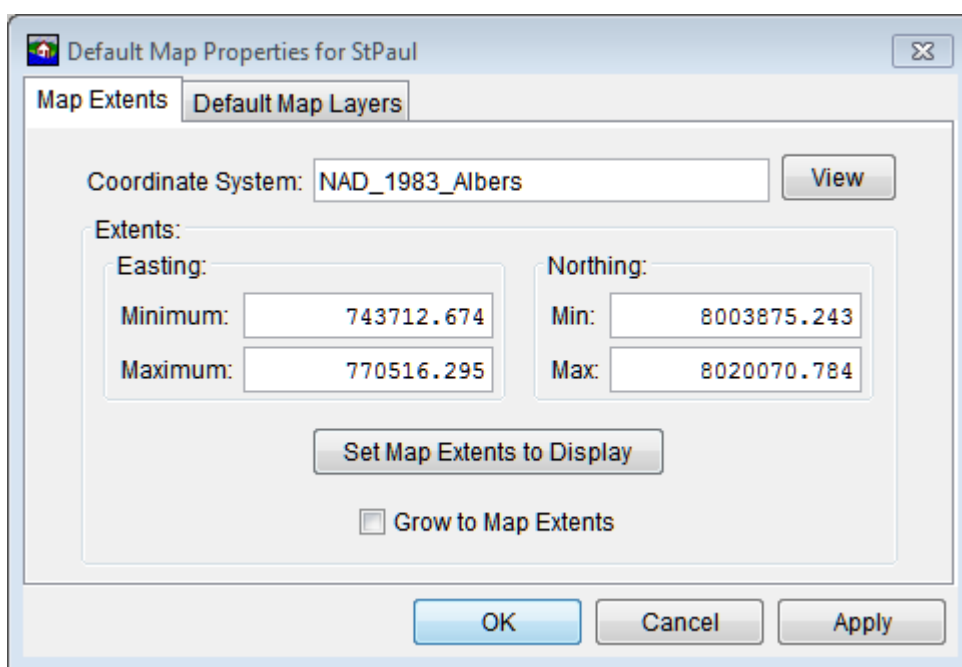
- From the shapefile shortcut menu (Figure 6.9), click **Properties**, the **Edit Polygon Properties** dialog box opens (Figure 4.10). The *StorageAreas.shp* file is a polygon shapefile. To edit the fill of the active map layer, from the **Fill** tab, change the color or not have a fill. To turn off fill, click **Display Fill**, the check mark clears, meaning that fill is turned off.



**Figure 4.10** Edit Polygon Properties Dialog Box

To change the outline color of the subbasin layer, from the **Edit Polygon Properties** dialog box (Figure 4.10), click the **Border** tab. From the **Color** list, select a color ("darkred"). Click **OK**, the **Edit Polygon Properties** dialog box closes and the changes appear in dark red on the **Map Window**.

3. To turn off a map layer - click in the checkbox by *State.shp*, the state no longer appears on the map window.
4. To display the map window zoomed in, select the **Zoom Tool** . Draw a box around the map layers that are displayed in the **Map Window**. From the **Maps** menu, click **Default Map Properties**, the **Default Map Properties for** dialog box opens (Figure 4.11). Click **Set Map Extents to Display**, click **OK**. The **Default Map Properties for** dialog box closes.



**Figure 4.11** Default Map Properties for Dialog Box

This sets the extents for the **Map Window** so that when the HEC-FIA project is opened the next time the **Map Window** is zoomed in to the tighter area.

# CHAPTER 5

## Watershed

In HEC-FIA, a watershed configuration describes a modeled physical state of the watershed. The modeled physical state can represent a without project condition, or a modeled alternative state. The elements used to describe the physical state of the watershed are listed below:

- terrain grids
- stream alignment
- cross section set and associated storage areas
- common computation point set

These model elements are used to represent a state of the watershed being modeled. Not all of the elements are required for HEC-FIA to compute hydraulic information at a location, but there are minimum requirements dependent upon the desired methodology selected to evaluate hydraulic information at a location.

- When providing all gridded data for evaluating hydraulic information at point locations; all that is required for the watershed configuration is a terrain grid.
- When gridded depths are provided but cross sections are being used for arrival times, the watershed configuration needs to include terrain data, and a cross section and storage area set.
- When data is provided as hydrographs at cross sections, the watershed configuration needs terrain and a set of cross sections and storage areas.
- When hydrographs are provided at common computation points, the watershed configuration requires a stream alignment and a set of common computations points.

### 5.1 Terrain Grids

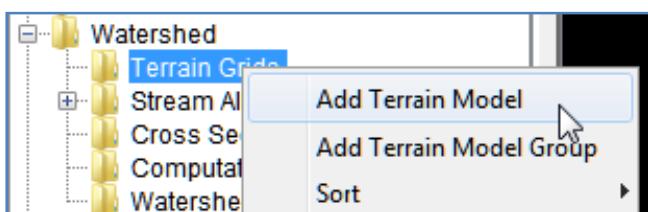
Terrain data is required in HEC-FIA to assign elevations to structures. HEC-FIA accepts terrain data in the following formats:

- GeoTiff (.tif)
- Ascii Format (.asc)
- ESRI floating point binary (.flt)
- Segmented Multi-Resolution Multi-Parameter (SMRMP) grid format (.smrmp)
- Virtual format (.vrt)

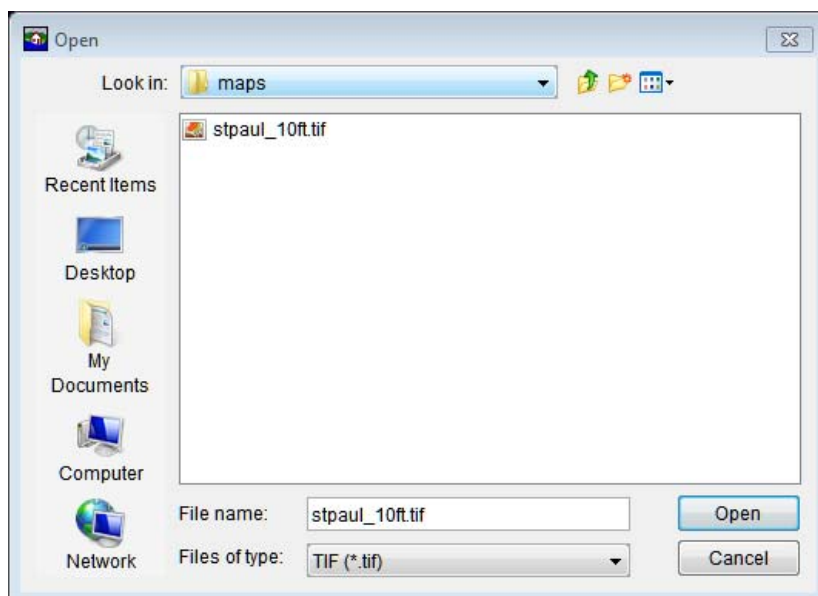
The GeoTiff format is the recommended format and a user should convert the other gridded data types to the GeoTiff format. Note that no conversion process has been developed for .smrmp to any other file format. Also note, since terrain files are typically large HEC-FIA does not copy terrain files to the *maps* directory. Therefore, if the user wishes to include terrain files with the final HEC-FIA project to others, the terrain files need to be copied to the *maps* directory manually.

To add a GeoTiff terrain grid:

1. From the **Study Pane**, from the **Watershed** folder, right-click on the **Terrain Grids** folder. A shortcut menu (Figure 5.1), click **Add Terrain Model**; the **Open Browser** opens (Figure 5.2).




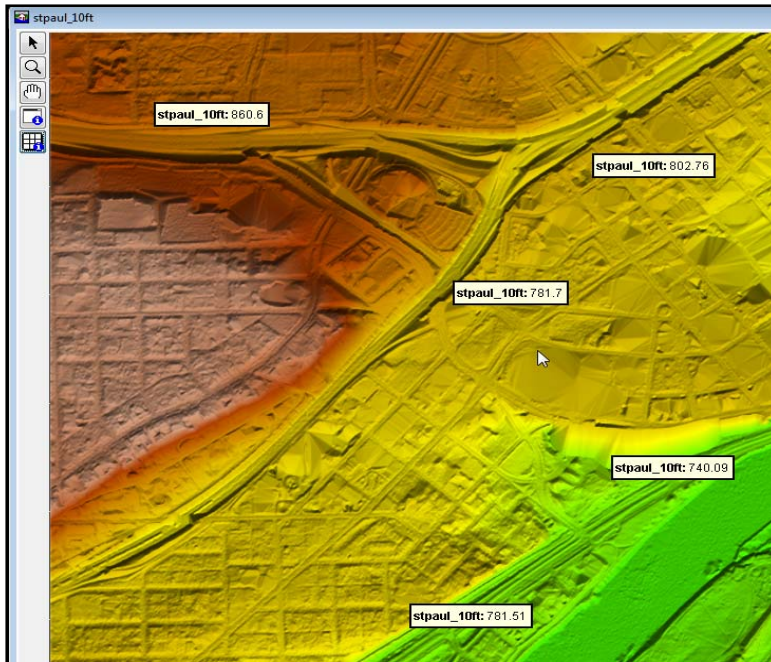
**Figure 5.1** Terrain Grids - Shortcut Menu (Watershed Folder)



**Figure 5.2** Open Browser

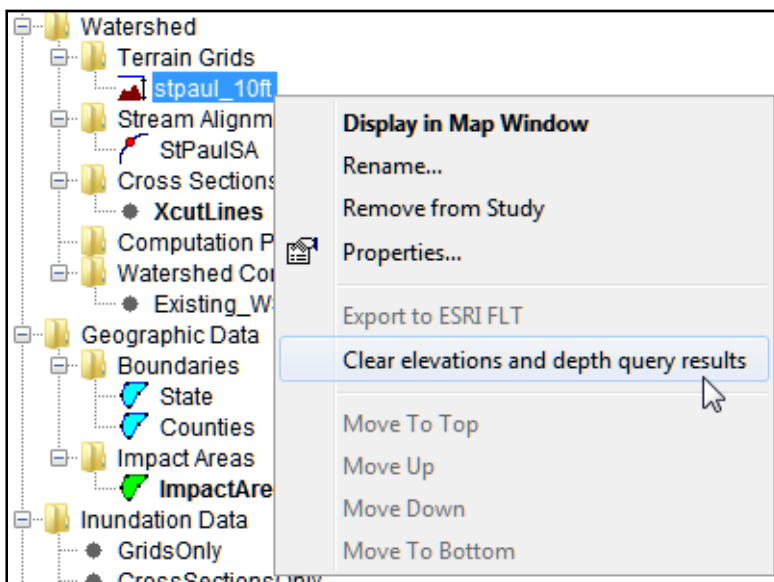
2. Browse to the location of the desired terrain grid. Note the default file type is \*.tif.
3. Select the appropriate type from the **Files of type** list (Figure 5.2). When the user chooses the appropriate file, the name of the file appears in the **File name** box (i.e., *stpaul\_10ft.tif*). To select the file, click **Open**.
4. The **Open Browser** closes (Figure 5.2), a **Map Window** opens in the **Desktop Pane**, displaying the terrain grid, and the name of the terrain grid displays in the **Study Pane** under the **Watershed** folder, under the **Terrain Grids** folder.

- To display elevation values from the terrain grid, use the **Grid Query Tool**  (Figure 5.3) available from the **Map Window** toolbar. To display the elevation for a given point, select the **Grid Query Tool**, click on a location on the terrain grid, a tooltip displays the elevation for that location (Figure 5.3).



**Figure 5.3** Grid Query Tool

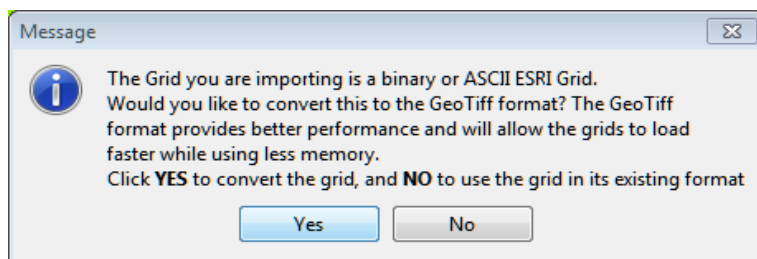
- To clear the elevation labels, zoom or pan in the **Map Window**. Alternatively, from the **Study Pane**, from the **Watershed** folder, from the **Terrain Grids** folder, right click on the filename of the terrain grid. The terrain grid shortcut menu displays (Figure 5.4). From the terrain grid shortcut menu, click **Clear elevations and depth query results**, the elevations are cleared from **Map Window**.



**Figure 5.4** Terrain Grid Shortcut Menu

To add a non-GeoTiff terrain grid:

1. When a non-GeoTiff (i.e., .flt, .asc) terrain grid is selected, a **Message** window opens (Figure 5.5). The **Message** window is letting the user know that the selected file is not a GeoTiff file, and does the user want to convert the selected file. This conversion is not required, but is recommended. HEC-FIA runs more efficiently with grids that are converted to the GeoTiff format, especially large grids.



**Figure 5.5** Message Window - Conversion of Non-GeoTiff Terrain Grid

2. Click **Yes**, the **Message** window closes and a progress dialog box opens displaying the progress of the GeoTiff conversion process. This process could take several minutes depending on the size of the grid.
3. When the conversion is finished, the progress dialog box closes. The terrain data is now displayed in the **Map Window** and the name of the terrain file appears under the **Terrain Grids** folder on the **Study Pane**. The terrain file is created at the same location as the original non-GeoTiff grid.

## 5.2 Stream Alignment

**Stream alignments** represent the stream system in the study. The alignment indicates where confluences and bifurcations occur and provides a sense of distance and scale. Stream alignments are composed of a series of streams, stream nodes, and stream. A **stream** typically begins or ends at a confluence, bifurcation, or at the boundary of the river system. A stream is composed of vertex points, with the beginning and ending vertex points being stream nodes.

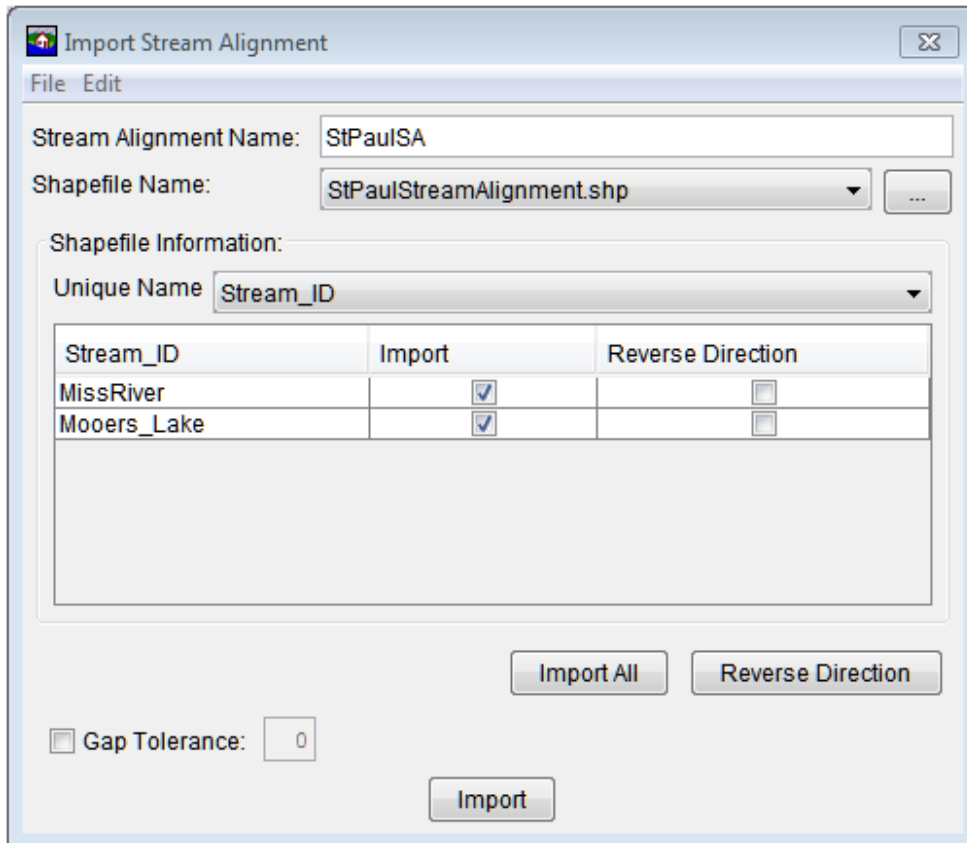
A stream alignment is a one-dimensional river coordinate system, which defines the natural downstream flow network. Also, from the stream centerline, stationing is provided relative to its global location and specific to the study.

In HEC-FIA a stream alignment is optional and is typically used when evaluating consequences by common computation points in CWMS (Corps Water Management System) or the HEC-WAT (Watershed Analysis Tool) software. Stream alignments used by HEC-FIA could possibly be developed in an HEC-ResSim (Reservoir System Simulation) model, or an HEC-RAS (River Analysis System) model.

### 5.2.1 Import a Stream Alignment

To import a stream alignment:

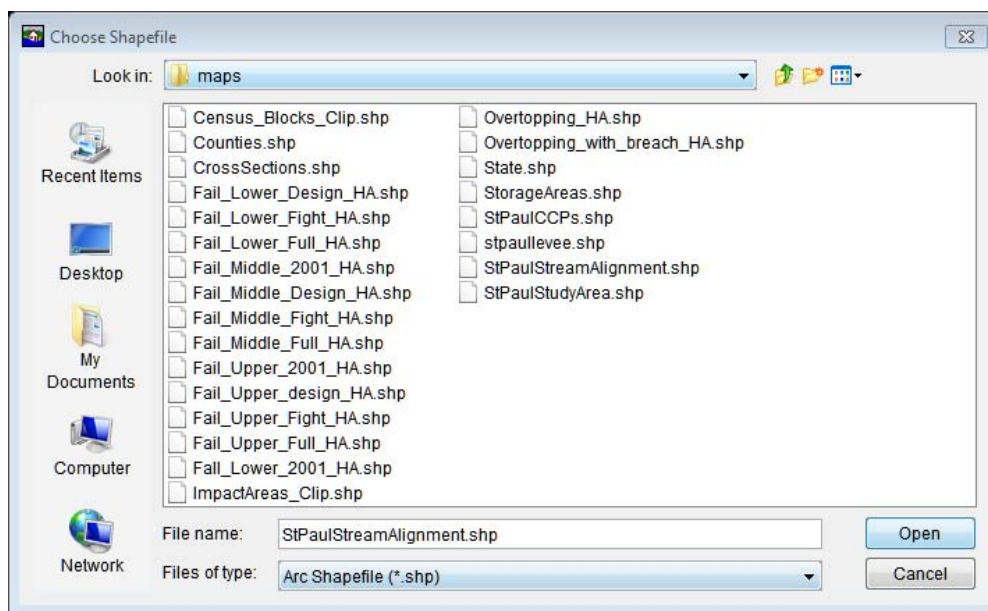
1. From the **Study Pane**, from the **Watershed** folder, right-click on the **Stream Alignments** folder. From the shortcut menu, click **Import**; the **Import Stream Alignment** dialog box opens (Figure 5.6).



**Figure 5.6** Import Stream Alignment Dialog Box

2. The **Shapefile Name** box lists the available shapefiles that have been added as map layers. If a map layer that represents a stream alignment has not been added to the HEC-FIA project, from the **File** menu, click **Choose Shapefile**. The **Choose Shapefile Browser** opens (Figure 5.7). Browse to the location of the shapefile that represents the stream alignment, click on the filename (i.e., *StPaulStreamAlignment.shp*), and click **Open**. The **Choose Shapefile Browser** closes, and the **Import Stream Alignment** dialog box (Figure 5.5) is populated with information from the selected shapefile.
3. From the **Unique Name** list (Figure 5.6), select the appropriate field name that contains the stream names. For example, in Figure 5.6, *Stream\_ID* (default) is the correct unique name for the stream names in the selected shapefile.
4. When the correct unique name has been selected, the table lists the unique stream names. If each stream is a contiguous line with one upstream point and one downstream point, then the checkbox in the **Import** column of the table (Figure 5.6) is set. If something is wrong with the line that represents a stream, the checkbox is not set, and HEC-FIA does not import that stream element. This could be due to lines that are not continuous within one segment.






**Figure 5.7** Choose Shapefile Browser

5. Enter a name for the stream alignment in the **Stream Alignment Name** text box (Figure 5.6).
6. Click **Import**, the **Import Stream Alignment** dialog box closes (Figure 5.6). A message box appears when the stream alignment has been imported and the stream alignment displays in the active **Map Window**. The name of the stream alignment appears in the **Study Pane** under the **Stream Alignments** folder.
7. The stream alignment displays in the Map Window with assigned stationing. Stream stationing is assigned to a stream segment when the stream alignment is created. Stationing should begin at the downstream end and ascend while proceeding upstream. HEC-FIA uses the units set by the coordinate system of the base shapefile. So, if horizontal units are in feet for the original shapefile, the stationing represents feet. By default, HEC-FIA assumes the base of the river (river station equal to zero) is at the end of each line segment that is most north east on the map.

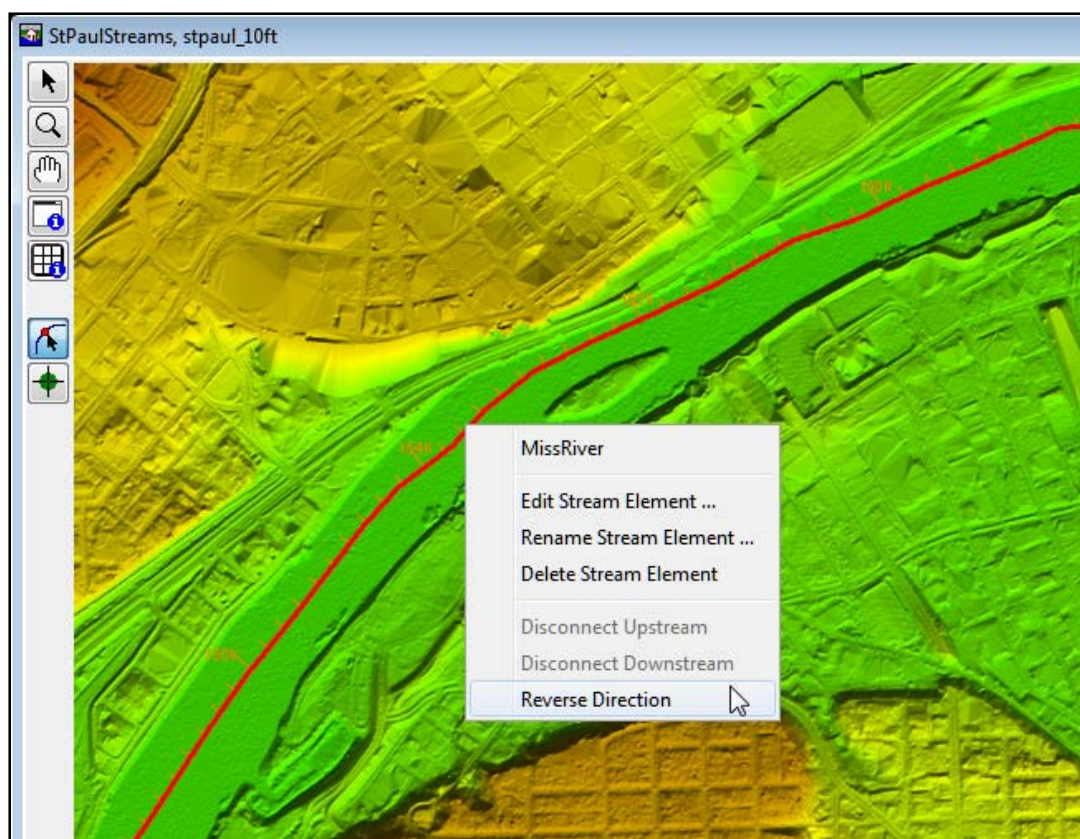
## 5.2.2 Changing the Stream Alignment

To make changes to the stream alignment, from the **Map Window**, select the **Stream Alignment Tool** . Using the **Stream Alignment Tool** a user can add stream segments to a stream alignment, and by right-clicking on a stream segment access the **Stream Alignment Shortcut Menu** (Figure 5.8). From the shortcut menu, a user can delete, rename, reverse the direction, disconnect the upstream or downstream ends, and edit stream segments.

## 5.3 Import a Cross Section Set

A **cross section set** is used to define the locations of **cross sections** and **storage areas** within the HEC-FIA project area, as well as to map DSS (HEC's Data Storage System) data by using pathnames (A, B, and C parts). A **cross section** is used to pass information about the depth and





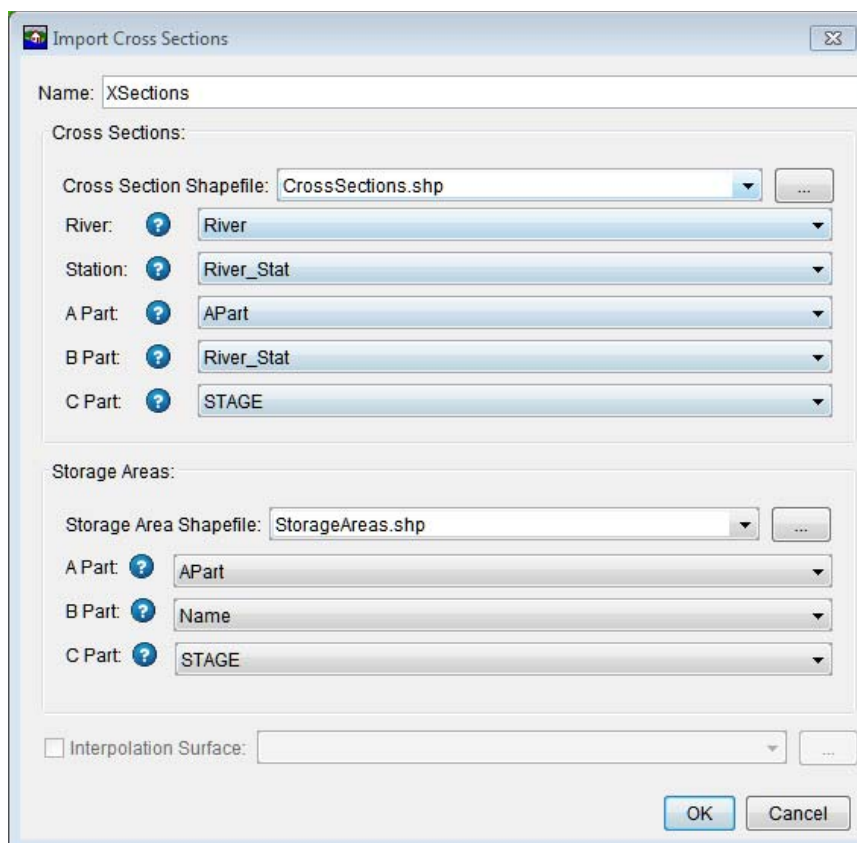
**Figure 5.8** Stream Alignment Shortcut Menu

extents of water in a river reach and within the floodplain. Cross sections usually have a river, reach, and river station that are used to make each one unique. A **storage area** typically represents where water goes if a lateral structure like a levee is overtopped, storage areas are usually given a unique name and are not necessarily tied to a river or river station. Cross section and storage area can be represented by shapefiles and are intended to be used together.


HEC-RAS project alternatives may include cross sections that cover the overbank areas in the without project condition, and cross sections that connect to a lateral structure with a storage area in the with project condition. This would require that two cross section sets be imported into HEC-FIA, each for a different watershed configuration. This would be one way to compare a without levee scenario to a with levee scenario. From the latest version of HEC-RAS, the HEC-RAS Mapper tool can be used to export cross sections and storage areas to shapefiles, see Appendix G for further information on exporting data from HEC-RAS. Once the shapefiles have been generated, it would be a good idea to copy the shapefiles to the *maps* directory of the HEC-FIA project.

To import cross sections:

1. From the **Study Pane**, in the **Watershed** folder, right-click on the **Cross Sections** folder. From the shortcut menu, click **Import**; the **Import Cross Sections** dialog box opens (Figure 5.9).
2. In the **Name** text box, enter a name for the cross section set.




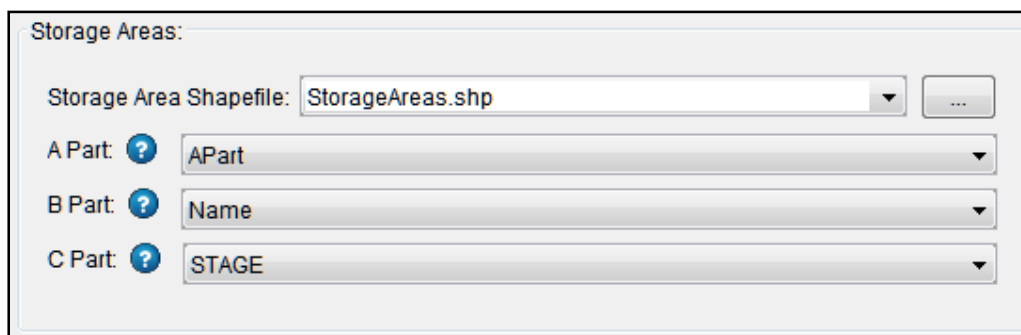
**Figure 5.9** Import Cross Sections Dialog Box

3. To populate the **Cross Section Shapefile** list (Figure 5.9), click the **Browse** button , an **Open Browser** opens (Figure 5.2.). Browse to the location of the cross section shapefile, select the shapefile, click **Open**. The **Open Browser** closes and the name of the selected shapefile appears in the **Cross Section Shapefile** list.
4. Next define information that creates a computational polygon that is used during a cross section compute. The **River** list (Figure 5.9) allows HEC-FIA to group the cross sections that are on the same river. The **Station** (river stationing) list (Figure 5.9) allows HEC-FIA to sort the stationing values on the cross section in ascending order. These two steps allow HEC-FIA to create a polygon for the area in between any two cross sections so that structures can identify which cross sections to retrieve hydraulic data from. Note that it is important to be sure that the data in the shapefile database matches the DSS data record for each cross section exactly, so that HEC-FIA can find the correct data during a computation.

The **A Part**, **B Part** and **C Part** lists (Figure 5.9) allow the user to define a partially qualified DSS path where HEC-RAS outputs stage hydrographs. The **A Part** is generally a river identifier, although for HEC-RAS it is the river name and the reach name concatenated with a space in between. For example in Figure 5.9, the selected **A Part** is *APart*. The **B Part** is generally a point location parameter, HEC-RAS uses the river stationing for this part. For example in Figure 5.9, the selected **B Part** is *River\_Stat*. The **C Part** is typically *STAGE* when using data from cross sections. HEC-FIA interprets the DSS record as stage when calculating damages at structures.

Now if user wishes to include storage areas as part of the cross section set, perform the following steps:

5. To populate the **Storage Area Shapefile** list (Figure 5.10), click the **Browse** button , an **Open Browser** opens (Figure 5.2). Browse to the location of the storage area shapefile, select the shapefile, click **Open**. The **Open Browser** closes and the name of the selected shapefile appears in the **Storage Area Shapefile** list.



**Figure 5.10** Import Cross Sections Dialog Box - Storage Areas

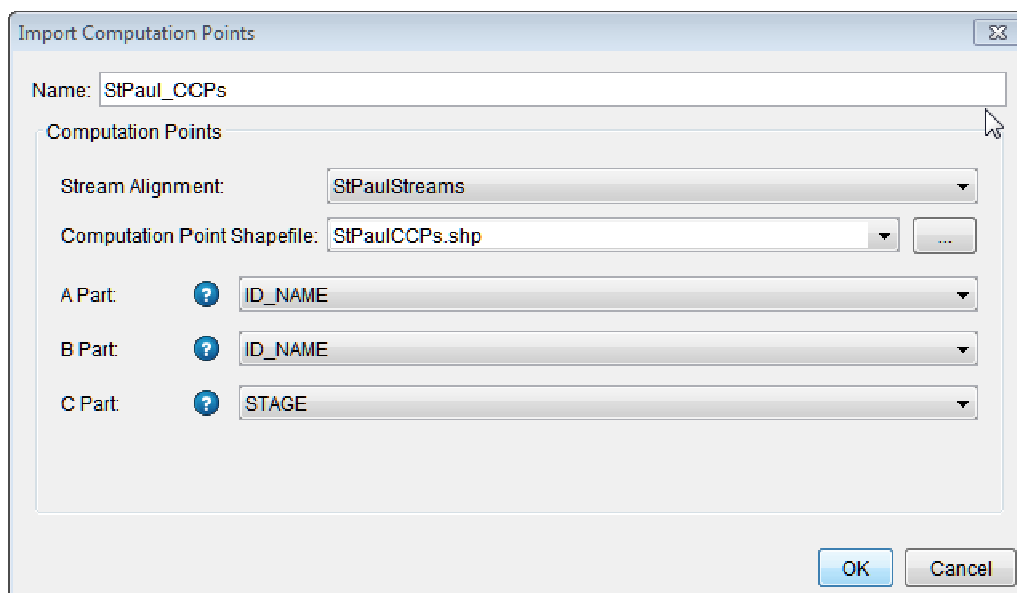
6. Next information about the storage area shapefile needs to be defined. Storage areas are simpler than cross sections, and only needs the **A Part**, **B Part** and **C Parts** (Figure 5.10) defined. The **A Part** is typically "STORAGE AREA" in HEC-RAS, for example, in Figure 5.10 the **A Part** selection is *APart*. The **B Part** is typically the storage area name (*Name*), and the **C Part** is *STAGE*.
7. Once the **A Part**, **B Part**, and **C Parts** have been defined, click **OK**. The **Import Cross Sections** dialog box (Figure 5.9) closes. The selected cross sections and storages areas display in the active **Map Window**. Under the **Cross Sections** folder in the **Study Pane**, the name of the cross section set (*XSections*) appears. Only the fields selected are imported. The naming conventions discussed above provide HEC-FIA with the information needed during computation. Although the HEC-RAS naming conventions are described above, data from a different source can also be used provided the sorting algorithm can understand the river and river stationing for each cross section, and that the **A Part**, **B Part**, and **C Parts** map to valid DSS files.

## 5.4 Import Common Computation Points

Common computation points (CCPs) are not typically used when evaluating consequences. CCPs can be helpful if a quick real-time analysis needs to be completed and HEC-RAS is not part of the CWMS model sequence. If very few damages are expected to occur in an area of the watershed, sometimes hydrologic routing used with a stage-flow rating curve is adequate (a HEC-RAS model can still be used to generate the stage-flow relationship). Since HEC-FIA can only have one provider of hydraulic data per alternative, separate alternatives (or HEC-FIA projects) have to be created for these areas.

To import common computation points:

1. From the **Study Pane**, from the **Watershed** folder, right-click on the **Computation Points** folder. From the shortcut menu, click **Import**; the **Import Computation Points** dialog box opens (Figure 5.11).



**Figure 5.11** Import Computation Points Dialog Box

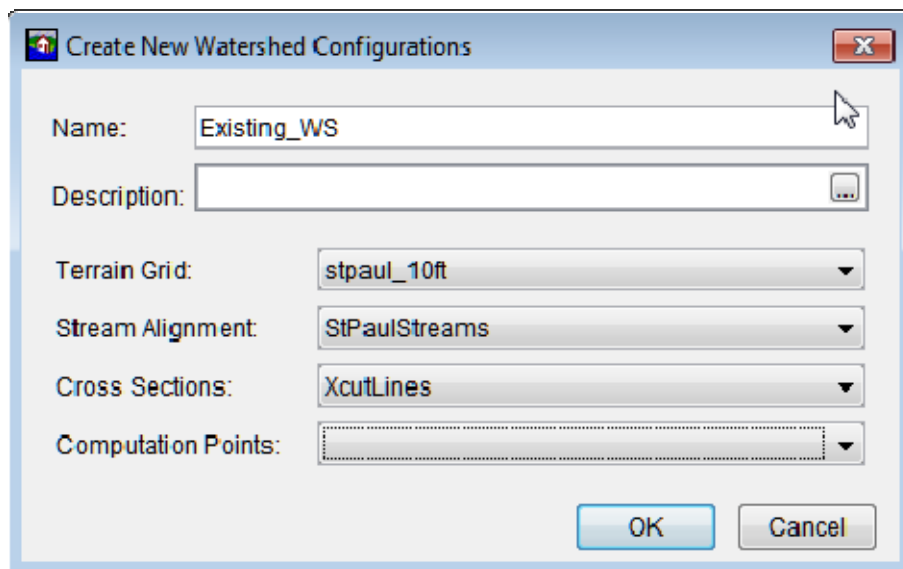
2. Provide a name for the CCP layer in the **Name** box on the **Import Computation Points** dialog box (Figure 5.11).
3. Select the appropriate stream alignment from the **Stream Alignment** list.
4. Select the appropriate CCP shapefile from the **Computation Point Shapefile** list.
5. Next, the user needs to define information about the CCP shapefile. CCPs only need the **A Part**, **B Part** and **C Part** lists (Figure 5.10) defined. When importing CCPs from HEC-HMS or HEC-ResSim the **A Part** is not selected (blank).
6. Now that everything is defined, click **OK**. The **Import Computation Points** dialog box (Figure 5.10) closes. The selected CCPs will display in the active **Map Window**. Under the **Computation Points** folder in the **Study Pane**, the name of the CCP set (*StPaul\_CCPs*) appears.

## 5.5 Create a Watershed Configuration

A watershed configuration is a required element in HEC-FIA 3.0; it replaces the project configuration used by previous versions of the program. The watershed configuration is the HEC-FIA representation of a modeled watershed, which may be representative of the actual watershed, or of some structural representation of an alternative that changes elements in the watershed. Many watershed configurations can be created, and the user can define many versions of any element in the watershed configuration to represent different structural alternatives.

The base elements of an HEC-FIA watershed configuration consists of a terrain grid, a stream alignment, a set of cross sections and storage areas and a set of common computation points. Not all of these base elements are required for HEC-FIA to compute a hydraulic event at a location in the study area. Once the elements of the watershed have been defined, using the processes described above, a watershed configuration can be created, as follows:

1. From the **Study Pane**, from the **Watershed** folder, right-click on the **Watershed Configurations** folder. From the shortcut menu, click **New**; the **Create New Watershed Configurations** dialog box opens (Figure 5.11).



**Figure 5.11** Create New Watershed Configurations Dialog Box

2. Provide a name for the Watershed Configuration in the **Name** box on the **Create New Watershed Configurations** dialog box.
3. Select the appropriate terrain grid from the **Terrain Grid** list.
4. Select the appropriate stream alignment from the **Stream Alignment** list.
5. Select the appropriate cross section set from the **Cross Sections** list.
6. Select the appropriate CCP layer from the **Computation Points** list.
7. Now that everything is defined, click **OK**. The **Create New Watershed Configurations** dialog box (Figure 5.11) closes. Under the **Watershed Configurations** folder in the **Study Pane**, the name of the watershed configuration (*Existing\_WS*) appears.





# CHAPTER 6

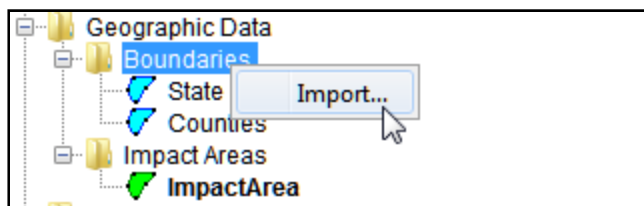
## Geographic Data

With geographic data, users can define important watershed boundaries, using geospatial definitions. A user could either create boundaries or impact areas. Boundaries are used to define areas for aggregation and reporting. Impact areas are used in the life loss computation to describe the geographic extent of specific warning systems and mobilization relationships. These typically correspond with Emergency Management Authorities, or whatever geographic region would contain the same warning system, or mobilization relationship.

### 6.1 Boundaries

Boundaries are geographic areas (e.g., USACE Districts, states, Congressional District, counties, etc.) used by HEC-FIA for reporting. With large scale watersheds, users may need to report for many different overlapping authorities, these boundaries help simplify the reporting function. Boundary delineations can be imported through shapefiles into HEC-FIA. To import boundaries:

1. From the **Study Pane**, from the **Geographic Data** folder, right-click on the **Boundaries** folder. From the shortcut menu (Figure 6.1), click **Import**; the **Import Boundary Shape** dialog box opens (Figure 6.2).



**Figure 6.1** Boundaries - Shortcut Menu

2. From the **Import Boundary Shape** dialog box, in the **Boundary Name** text box, a name must be entered (i.e., State, Counties).
3. From the **Shapefile Name** list (Figure 6.2) select the shapefile that defines the boundary a user is interested in.
4. From the **Unique Name** list, select from the shapefile the data field that contains the name of the boundary. Once selected the table on the **Import Boundary Shape** dialog box (Figure 6.2) lists the available boundary information.
5. Click **Import**, the **Import Boundary Shape** dialog box (Figure 6.2) closes. Information from the selected shapefile is now part of a boundary layer.

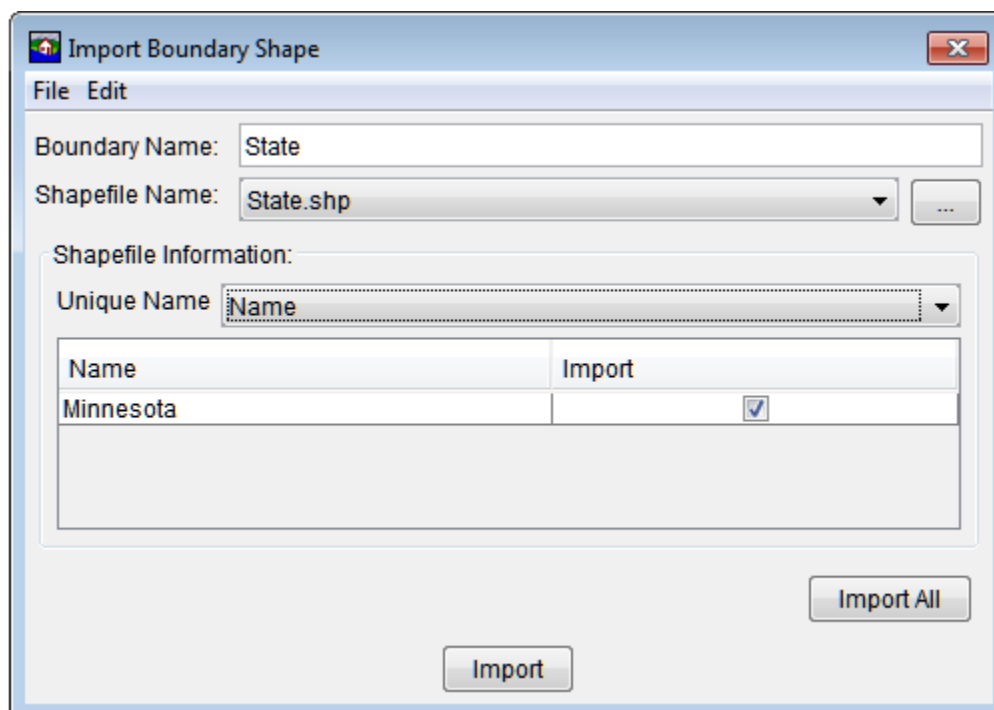


Figure 6.2 Import Boundary Shape Dialog Box

## 6.2 Impact Areas

Impact areas are used by HEC-FIA for defining common life loss input parameters for groups of structures and aggregating consequence results. Impact areas are usually defined by the geographic domain of the authority responsible for issuing warnings for natural disasters. If a shapefile has been added to the study that represents the impact areas (polygon feature class), the user can import the impact areas from that shapefile. To import impact areas:

1. From the **Study Pane**, from the **Geographic Data** folder, right-click on the **Impact Areas** folder. From the shortcut menu (Figure 6.3), click **Import**; the **Import Impact Areas** dialog box opens (Figure 6.4).

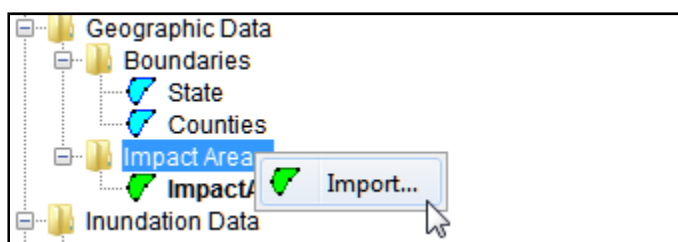
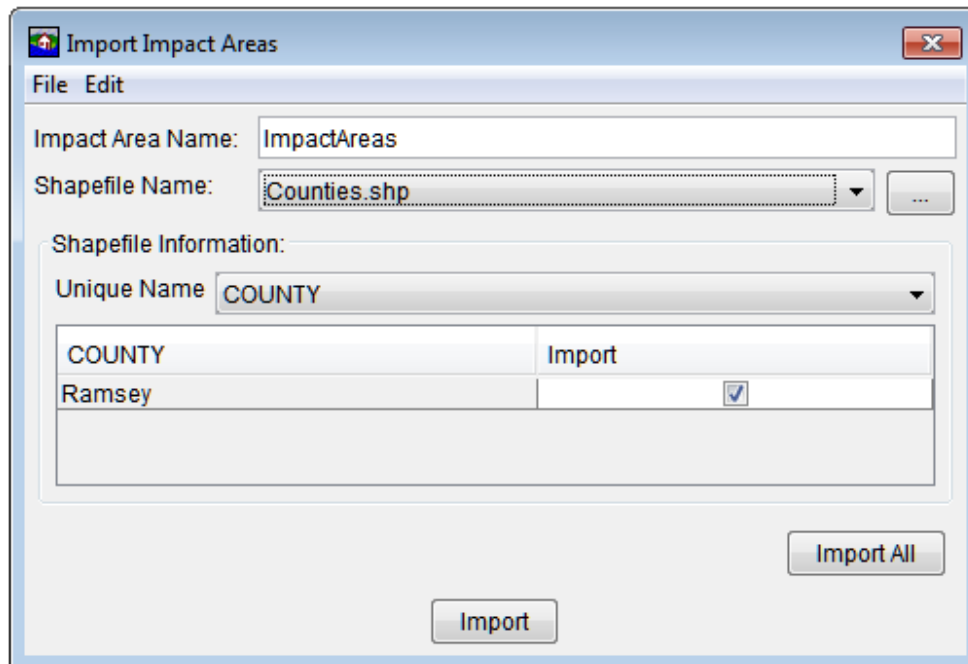


Figure 6.3 Impact Areas - Shortcut Menu

2. From the **Import Impact Areas** dialog box (Figure 6.4), in the **Impact Area Name** text box, a name must be entered (i.e., *ImpactAreas*). This creates an impact area set. Since impact areas allow users to change warning system types and population index factors, typical naming conventions include descriptions of what warning system and population index factor the user is using.





**Figure 6.4** Import Impact Areas Dialog Box

3. From the **Shapefile Name** list (Figure 6.4) select the shapefile that defines the impact areas the user is interested in.
4. From the **Unique Name** list, select from the shapefile the data field that contains the name of the impact areas. Once selected the table on the **Import Impact Areas Shape** dialog box (Figure 6.4) lists the available boundary information. If each impact area is a contiguous polygon, then the check box in the **Import** column of the table (Figure 6.4) is set. If something is wrong with the polygon that represents an impact area, the check box is not set, and the impact area is not imported.
5. Click **Import**, the **Import Impact Areas** dialog box (Figure 6.4) closes. Information from the selected shapefile is now part of an impact area set.

## 6.2.1 Define Life Loss Parameters

Life loss parameters are defined for an existing impact area set. Warning system and mobilization functions can be defined independently for each impact area. User defined warning system and mobilization functions can be defined, which allow the user to enter the most representative function values for an impact area (common procedure when the user conducts an expert elicitation with the local Emergency Management Agency). To define life loss parameters:

1. From the **Study Pane**, from the **Geographic Data** folder, from the **Impact Areas** folder, right-click on a defined impact area data set (i.e., *ImpactArea*). From the shortcut menu (Figure 6.5), click **Edit**; the **Impact Area Editor** opens (Figure 6.6).
2. From the **Impact Area Editor**, click the **Life Loss Parameters** tab (Figure 6.6).

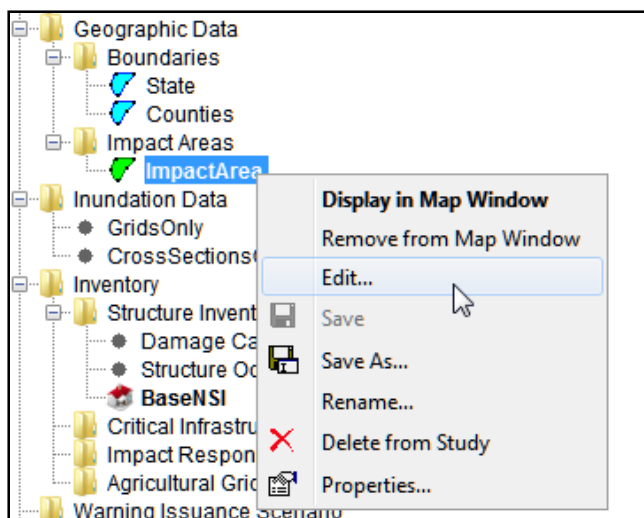


Figure 6.5 Defined Impact Area Set - Shortcut Menu

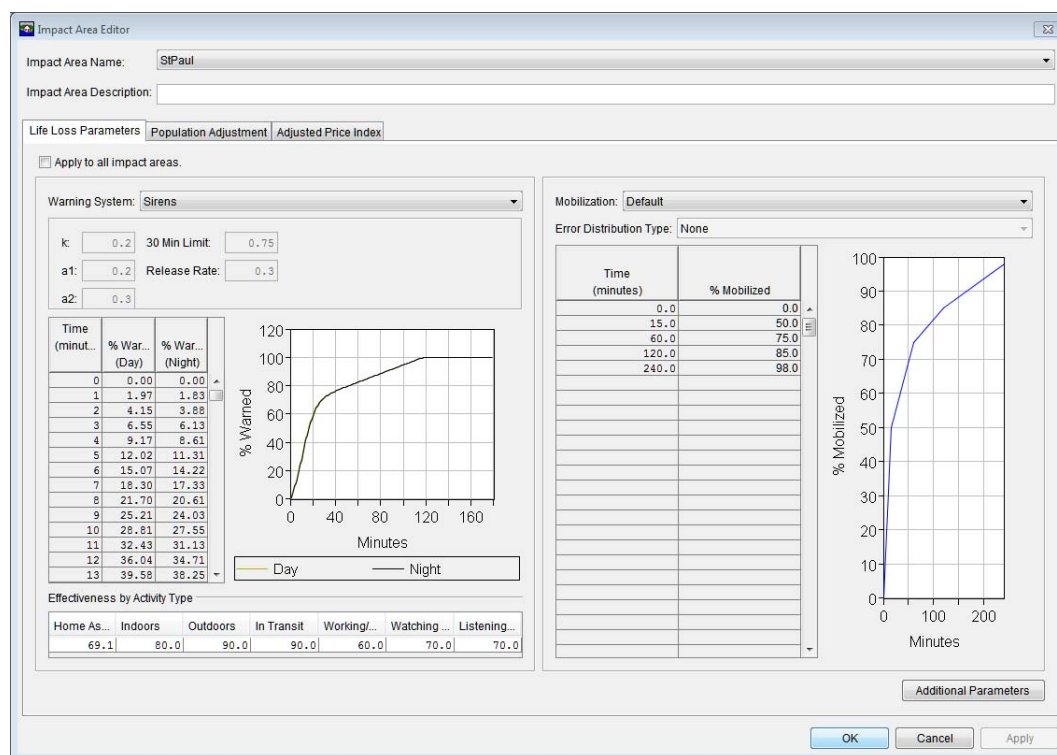


Figure 6.6 Impact Area Editor - Life Loss Parameters

- To apply the same life loss parameters to all impact areas, click **Apply to all Impact Areas** (Figure 6.6).

## Warning System Functions

- To define warning system information for the life loss calculations, from the **Warning System** list (Figure 6.7), select the warning system that is applicable to the community(s) within the selected impact area (i.e., Sirens, Tone-Alert Radios, Auto-Dial Telephones, etc.). The warning system defines the amount of time it takes from a warning issuance to

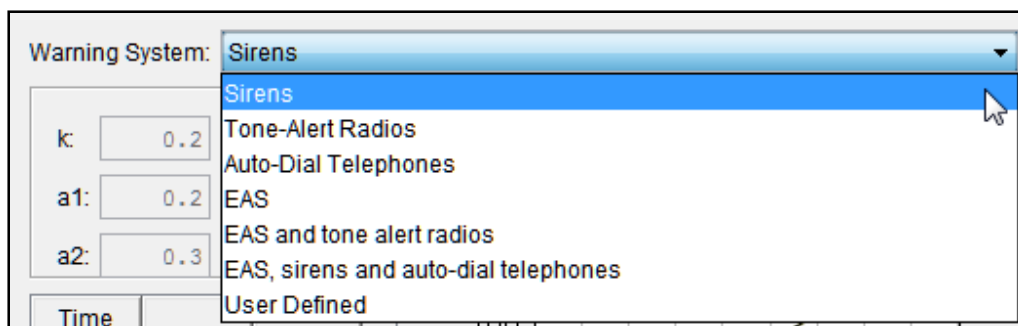


Figure 6.7 Available Warning System Curves

the moment population at risk receives the warning. This information is determined by reviewing local emergency management plans for information on warning systems in the inundated area. Select the emergency warning system that most closely represents the system used by the local Emergency Management Agency.

Additionally, curves can be created through an expert elicitation process which has been created by Drs. Mileti and Sorenson ([\\_adfada\\_](#)). These curves can be created by selecting **User Defined** (Figure 6.7) from the **Warning System** list. An **Input** window opens (Figure 6.8), enter the name of the warning system function, click **OK**. The **Input** window closes, the name of the function appears in the **Warning System** list (i.e., Email) and the user now needs to define the parameters for the new function.

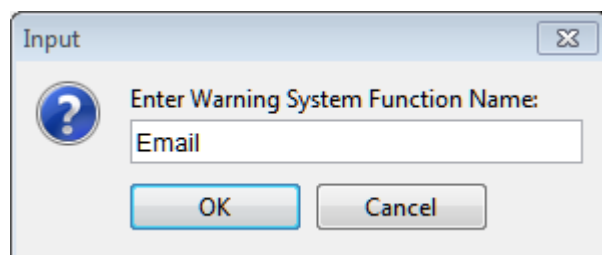


Figure 6.8 Warning System Function - User Defined - Input Window

## Mobilization Functions

- To define mobilization information for the life loss calculations, from the **Mobilization** list (Figure 6.9), select the mobilization function (i.e., Default, Below Average, Above Average, etc.) that is applicable to the community(s) in the selected impact area. A mobilization curve defines the amount of time it takes when an individual(s) receives a warning to the moment when the individual(s) leaves their home. For a typical reconnaissance study, **Default** functions (Figure 6.9) might be used, but a **Default**

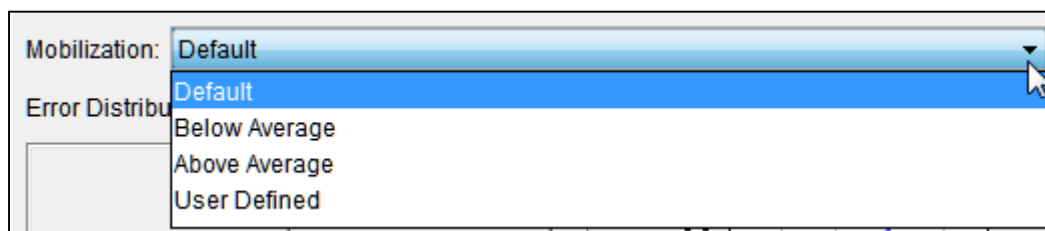


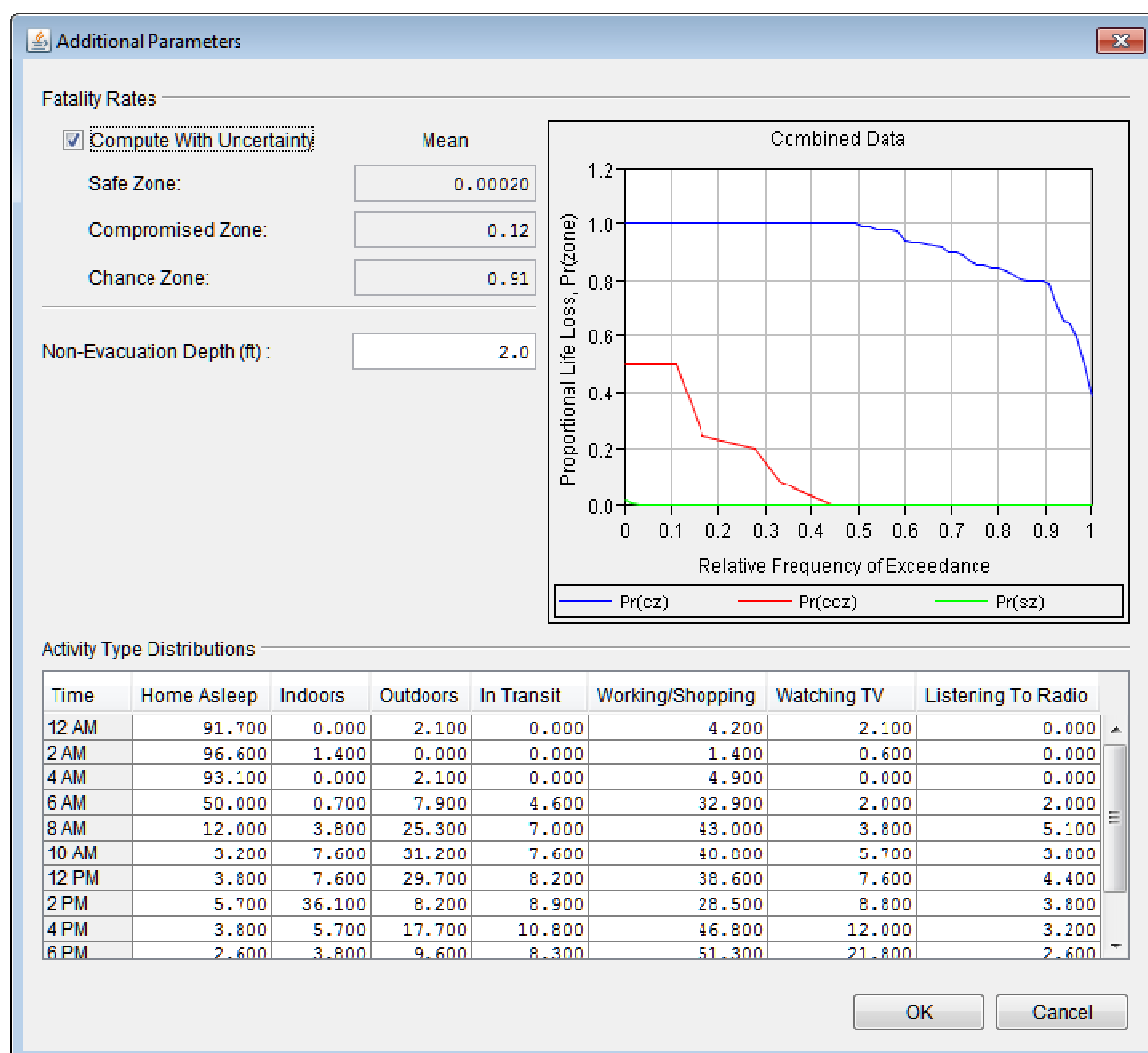
Figure 6.9 Available Mobilization Functions

function is a major source of uncertainty. From the **Error Distribution Type** list (Figure 6.6), the user can select a distribution type and define the proper uncertainty parameters for every ordinate in the curve. When adding uncertainty, HEC-FIA automatically converts the selected curve to a user defined curve if it is not already selected as such.

Additionally, curves can be created by selecting **User Defined** (Figure 6.9) from the **Warning System** list. An **Input** window opens (Figure 6.8), enter the name of the warning system function, click **OK**. The **Input** window closes, the name of the function appears in the **Warning System** list (i.e., Median) and the user now needs to define the parameters for the new function.

## Additional Parameters

- Additional parameters that influence life loss computations can be accessed and modified by clicking **Additional Parameters** (Figure 6.6). The **Additional Parameters** dialog box opens (Figure 6.10). Additional parameters include fatality rates and uncertainties, non-evacuation depth thresholds, and activity distributions throughout the day.



**Figure 6.10** Additional Parameters Dialog Box

## Fatality Rates

If the user wishes, uncertainty in the fatality rates can be turned on. Click Compute with Uncertainty (Figure 6.10), for the following three zones, the user can enter uncertainty (mean):

Safe Zone (sz):

Comprised Zone (cz):

Chance Zone (chz):

## Non-Evacuation Depth

In a gridded inundation configuration, the user can change the non-evacuation depth threshold. The user enters a value in the **Non-Evacuation Depth** box (Figure 6.10), remembering that the arrival time grids must be representative of the specified depth's arrival. In a hydrograph based computation, the non-evacuation depth threshold is retrieved for each structure from the associated hydrographs.

## Activity Distributions

If activity distributions in the **Activity Type Distributions** table (Figure 6.11) are changed the rows must sum to 100 percent across all columns.

Time	Home Asleep	Indoors	Outdoors	In Transit	Working/Shopping	Watching TV	Listening To Radio
12 AM	91.700	0.000	2.100	0.000	4.200	2.100	0.000
2 AM	96.600	1.400	0.000	0.000	1.400	0.600	0.000
4 AM	93.100	0.000	2.100	0.000	4.900	0.000	0.000
6 AM	50.000	0.700	7.900	4.600	32.900	2.000	2.000
8 AM	12.000	3.800	25.300	7.000	43.000	3.800	5.100
10 AM	3.200	7.600	31.200	7.600	40.800	5.700	3.800
12 PM	3.800	7.600	29.700	8.200	38.600	7.600	4.400
2 PM	5.700	36.100	8.200	8.900	28.500	8.800	3.800
4 PM	3.800	5.700	17.700	10.800	46.800	12.000	3.200
6 PM	2.600	3.800	9.600	8.300	51.300	21.800	2.600
8 PM	8.600	1.300	7.900	4.600	43.000	33.100	1.300
10 PM	53.000	0.000	3.400	2.000	22.100	18.800	0.700

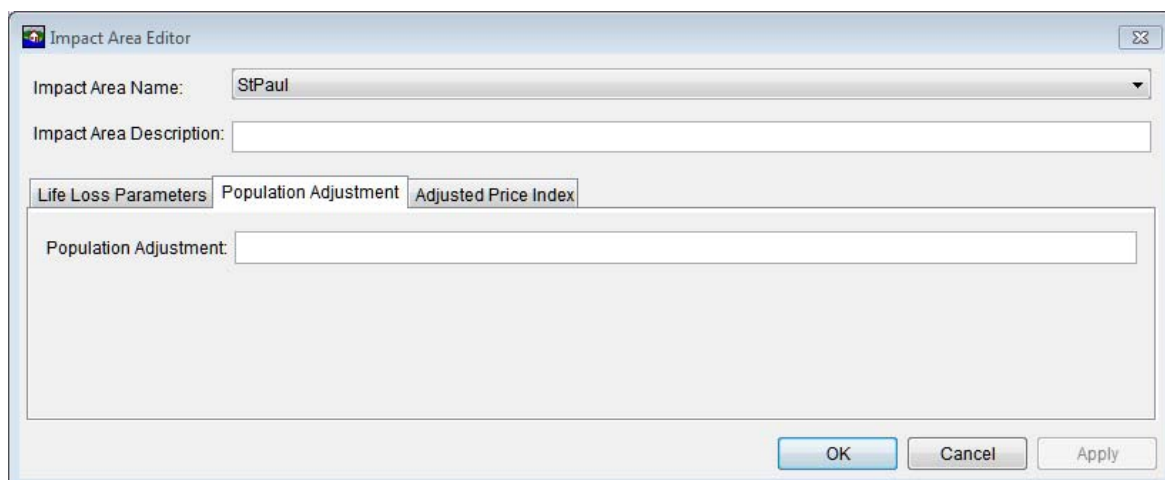
**Figure 6.11** Activity Type Distributions Box

- Click **OK**, the **Additional Parameters** dialog box (Figure 6.7) close.
- Click **OK**, the **Impact Area Editor** closes (Figure 6.6) and parameters for the life loss computation are set.

### 6.2.2 Population Adjustment

The population in each impact area can be indexed by the user. Adjustments to the population increase the number of people in each structure within the impact area; this helps to describe future condition population. To adjust the population:

- From the **Impact Area Editor** click the **Population Adjustment** tab (Figure 6.12).



The screenshot shows the 'Impact Area Editor' dialog box with the 'Population Adjustment' tab selected. The 'Impact Area Name' is set to 'StPaul'. The 'Impact Area Description' field is empty. The 'Population Adjustment' field is also empty. The 'OK', 'Cancel', and 'Apply' buttons are at the bottom right.

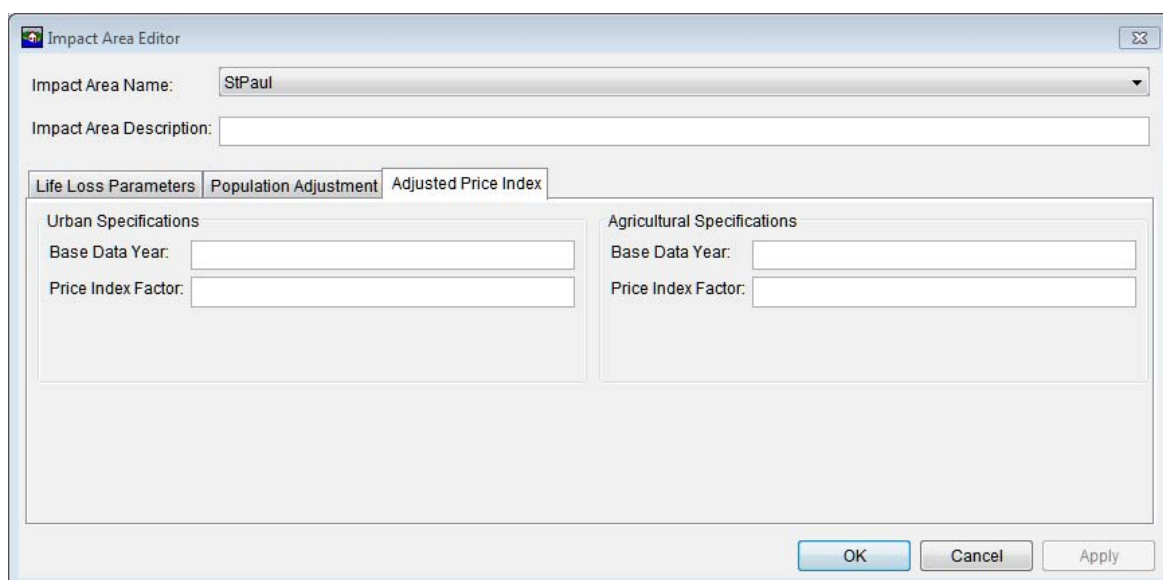
**Figure 6.12** Impact Area Editor - Population Adjustment

2. In the **Population Adjustment** box (Figure 6.12) enter a value that adjusts the population. The values expected are decimal values expressed as a percentage relative to current population. A value of one would cause no change to the population, a value of .9 would be a ten percent reduction, and a value of 1.1 would be a ten percent increase.
3. Click **OK**, the **Impact Area Editor** closes (Figure 6.12) and the population adjustment factor is set.

### 6.2.3 Adjusted Price Index

Urban and agricultural price indexes in each impact area can be adjusted by the user to represent spatial price indexes for future conditions, to adjust prices:

1. From the **Impact Area Editor** click the **Adjusted Price Index** tab (Figure 6.13).



The screenshot shows the 'Impact Area Editor' dialog box with the 'Adjusted Price Index' tab selected. The 'Impact Area Name' is set to 'StPaul'. The 'Impact Area Description' field is empty. The 'Adjusted Price Index' tab is active, showing two sections: 'Urban Specifications' and 'Agricultural Specifications'. Each section has a 'Base Data Year' and a 'Price Index Factor' field. The 'OK', 'Cancel', and 'Apply' buttons are at the bottom right.

**Figure 6.13** Impact Area Editor - Adjusted Price Index

2. To adjust the urban price index, from the **Urban Specifications** box, in the **Base Data Year** box enter a year that represents the price index factor. In the **Price Index Factor** box enter the price index factor.
3. To adjust the agricultural price index, from the **Agricultural Specifications** box, in the **Base Data Year** box enter a year that represents the price index factor. In the **Price Index Factor** box enter the price index factor.
4. Click **OK**, the **Impact Area Editor** closes (Figure 6.13) and the adjusted price factors are set.





# CHAPTER 7

## Inundation Data

Inundation data is required by HEC-FIA for computing consequences. Inundation data provides multiple ways to describe hydraulic characteristics within the study area. The user creates inundation configurations which create a pattern for how the hydraulic characteristics are provided to the computation engine. In HEC-FIA a hydraulic event can be described in many ways, but the minimum requirement is that maximum depth is defined. The parameters that can be defined for an event are as follows:

- Maximum Depth
- Arrival Time (non-evacuation depth)
- Arrival Time (agriculture damage, typically zero depth)
- Duration (for agriculture threshold)
- Maximum Depth Times Velocity

Inundation configurations tell HEC-FIA how input hydraulic data are characterized throughout the floodplain. Four different types of inundation configurations are covered in this chapter:

- Grids only
- Grids and Cross Sections
- Cross Sections only
- Common Computation Points only

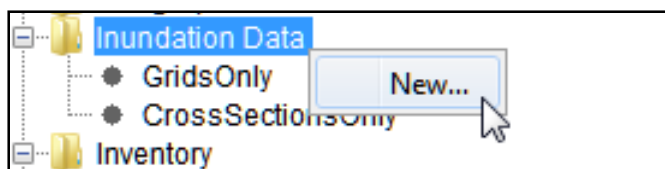
Each configuration calculates hydraulic events differently, for more detail on the computational procedures and common issues consult the Technical Guide Chapter 3 section 3.

From an Inundation configuration, the user can create events. Events are some combination of the previously described hydraulic event parameters. An event can be defined by an F-Part in a DSS file, or it could be a specific set of grids that describe the hydraulic event. One inundation configuration may have many events. Events are combined with time windows and alternatives to create simulations.

### 7.1 Creating New Inundation Configurations

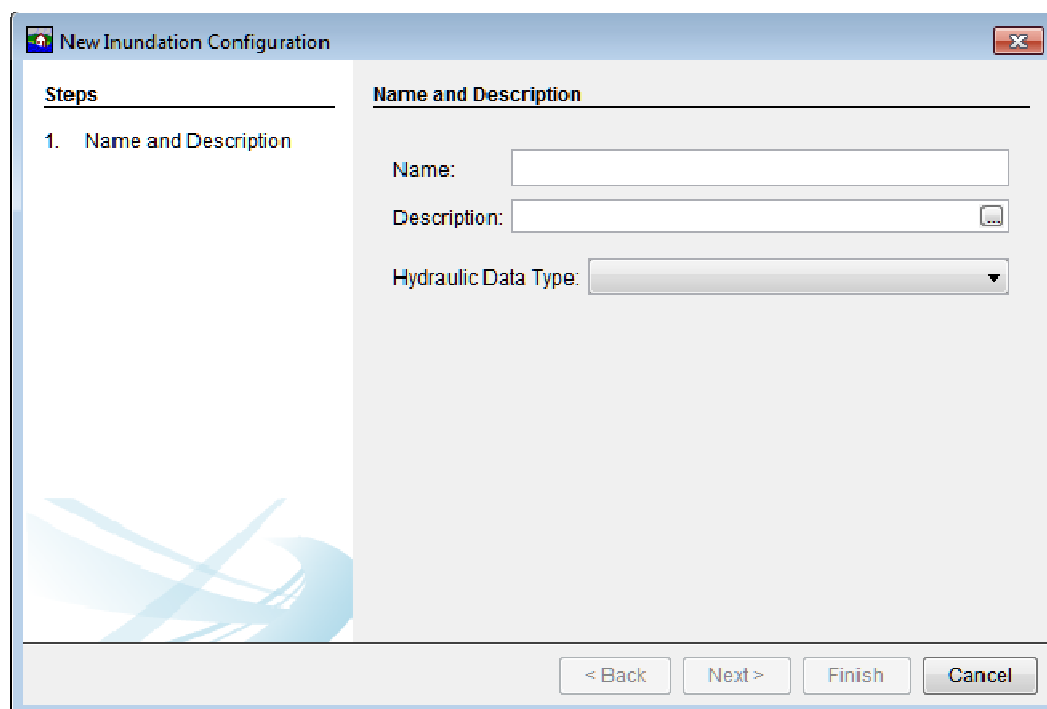
To create new inundation configurations:

1. From the **Study Pane**, right-click on the **Inundation Data** folder. From the shortcut menu (Figure 7.1), click **New**; the **New Inundation Configuration** wizard opens (Figure 7.2).
2. The first step in the **New Inundation Configuration** wizard (Figure 7.2) is to provide a name for the inundation configuration (**Name** box) and a description (**Description** box).



**Figure 7.1** Inundation Data - Shortcut Menu

- From the **Hydraulic Data Type** list (Figure 7.2) select the type of inundation configuration to create. There are four types available - **Grids Only**, **Cross Sections Only**, **Grids and Cross Sections**, and **CCPs only**.



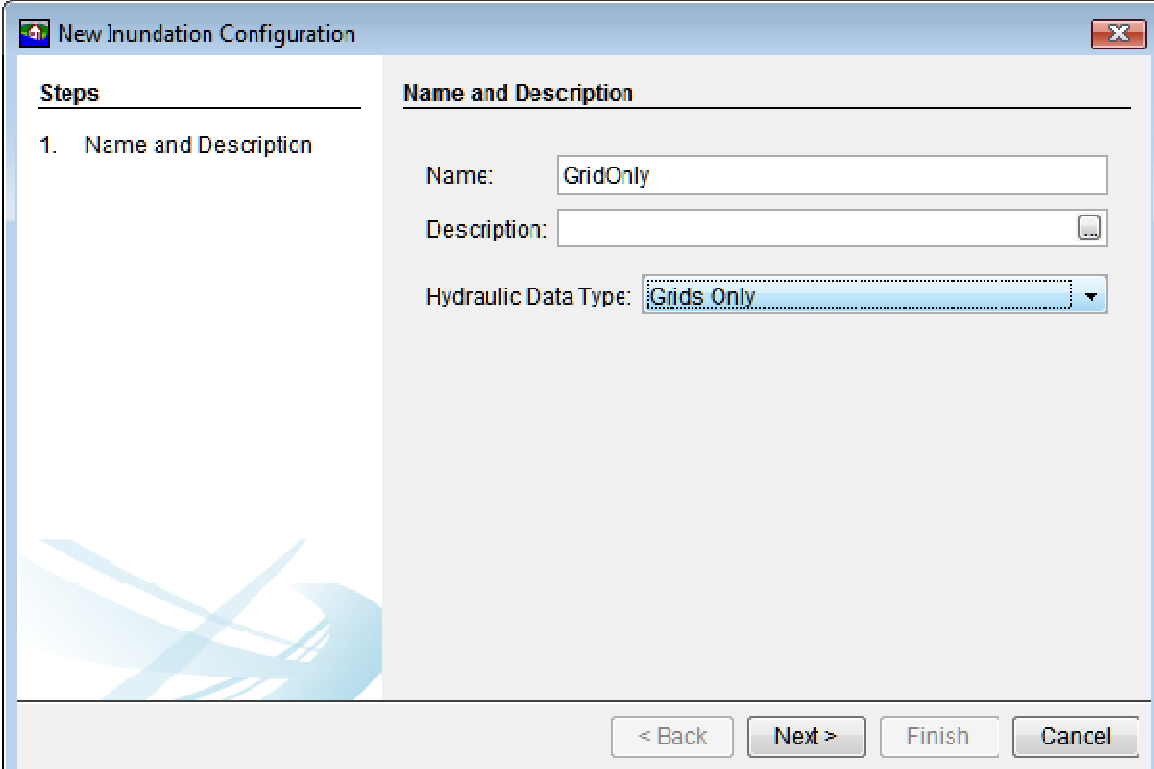
**Figure 7.2** New Inundation Configuration Wizard

- Once a hydraulic data type is selected, the **New Inundation Configuration** wizard (Figure 7.2) asks for information specific to that hydraulic data type.

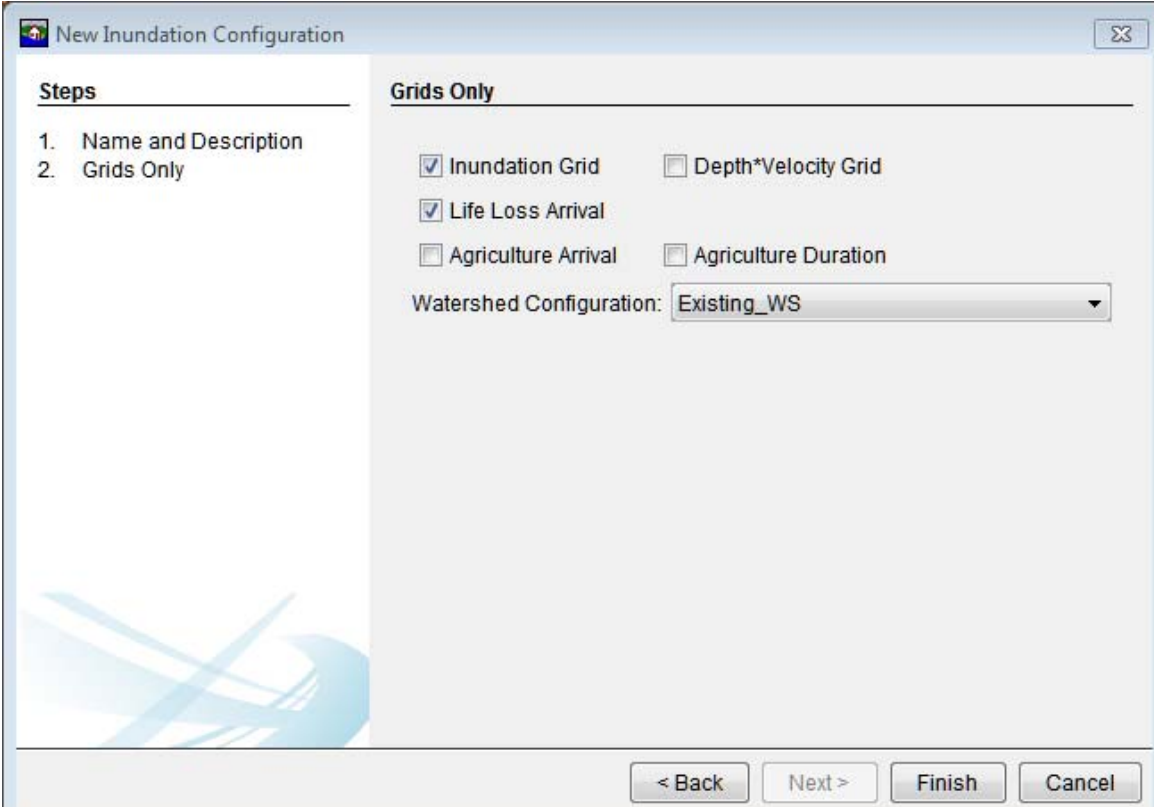
## 7.2 Grids Only

To create a **Grids Only** configuration:

- From the **New Inundation Configuration Wizard** (Figure 7.3), enter a name in the **Name** box (e.g., *GridsOnly*). Entering a description is optional and is done in the **Description** box. From the **Hydraulic Data Type** list, select **Grids Only** (Figure 7.3).
- Click **Next**, the second page of the **New Inundation Configuration** wizard for **Grids Only** displays (Figure 7.4). Select the types of grids that to be used (e.g., Inundation Grid, Life Loss Arrival) by clicking on the appropriate grid type. From the **Watershed Configuration** list select a defined watershed configuration.



The screenshot shows the 'New Inundation Configuration' wizard window. The title bar reads 'New Inundation Configuration'. On the left, a 'Steps' pane lists '1. Name and Description'. The main area is titled 'Name and Description' and contains three fields: 'Name' with the text 'GridOnly', 'Description' which is empty, and 'Hydraulic Data Type' which is a dropdown menu set to 'Grids Only'. At the bottom right, there are four buttons: '< Back', 'Next >', 'Finish', and 'Cancel'.

**Figure 7.3** New Inundation Configuration Wizard - Grids Only

The screenshot shows the 'New Inundation Configuration' wizard window at Step 2. The title bar reads 'New Inundation Configuration'. The 'Steps' pane on the left now lists '1. Name and Description' and '2. Grids Only'. The main area is titled 'Grids Only' and contains four checkboxes: 'Inundation Grid' (checked), 'Depth\*Velocity Grid' (unchecked), 'Life Loss Arrival' (checked), and 'Agriculture Arrival' (unchecked). Below these is a 'Watershed Configuration' dropdown menu set to 'Existing\_WS'. At the bottom right, there are four buttons: '< Back', 'Next >', 'Finish', and 'Cancel'.

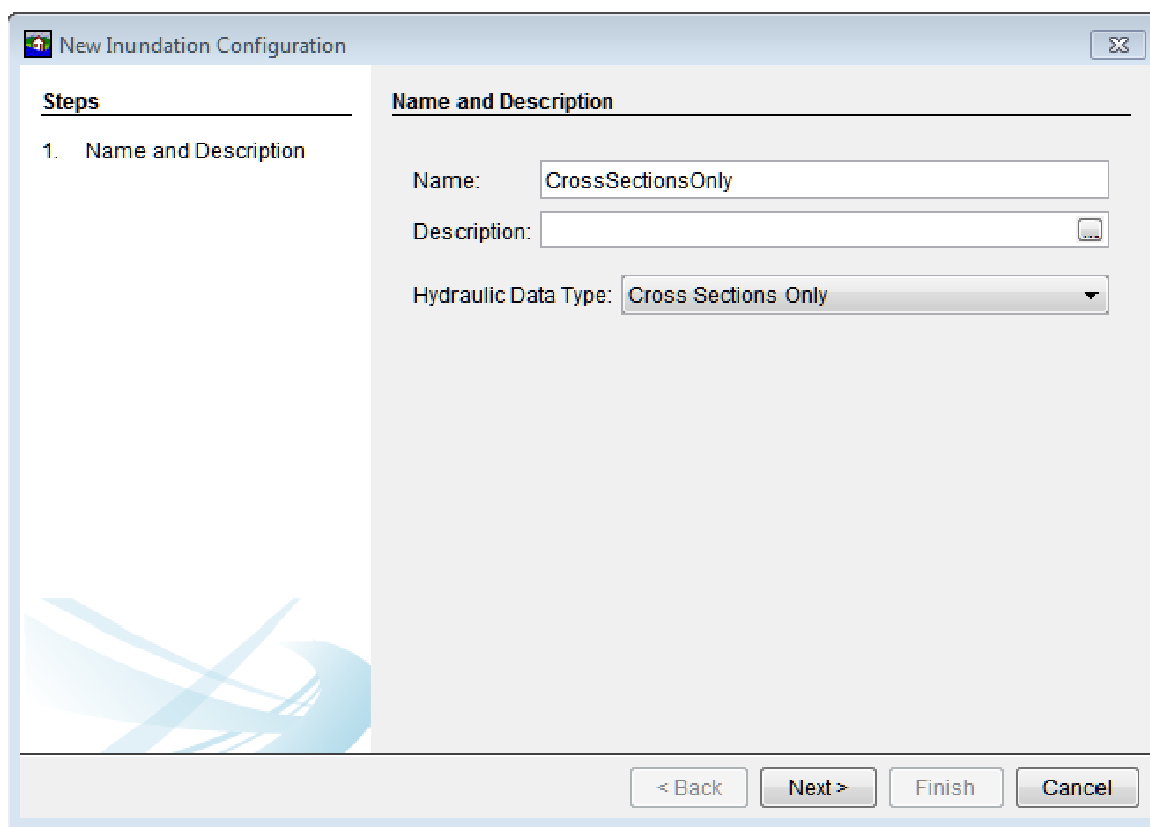
**Figure 7.4** Grids Only - Step 2

3. Click **Finish**, the **New Inundation Configuration** wizard closes and the new inundation configuration appears under the **Inundation Data** folder on the study tree.

## 7.3 Cross Sections Only

To create a cross sections only configuration a watershed configuration must contain a cross section set. Developing inundation configurations with cross section sets removes the need to have grids for each event, and relies on data out of a HEC-DSS file. Once the user has a setup created, the user can develop an inundation configuration and import events. To create a **Cross Sections Only** configuration:

1. From the **New Inundation Configuration Wizard** (Figure 7.5), enter a name in the **Name** box (e.g., *CrossSectionsOnly*). Entering a description in the **Description** box is optional. From the **Hydraulic Data Type** list, select **Cross Sections Only** (Figure 7.5).



**Figure 7.5** New Inundation Configuration Wizard - Cross Sections Only

2. Click **Next**, the second page of the **New Inundation Configuration** wizard for **Cross Sections Only** displays (Figure 7.6). From the **Watershed Configuration** list the user selects a defined watershed configuration.
3. Click **Finish**, the **New Inundation Configuration** wizard closes and the new inundation configuration appears under the **Inundation Data** folder on the study tree.

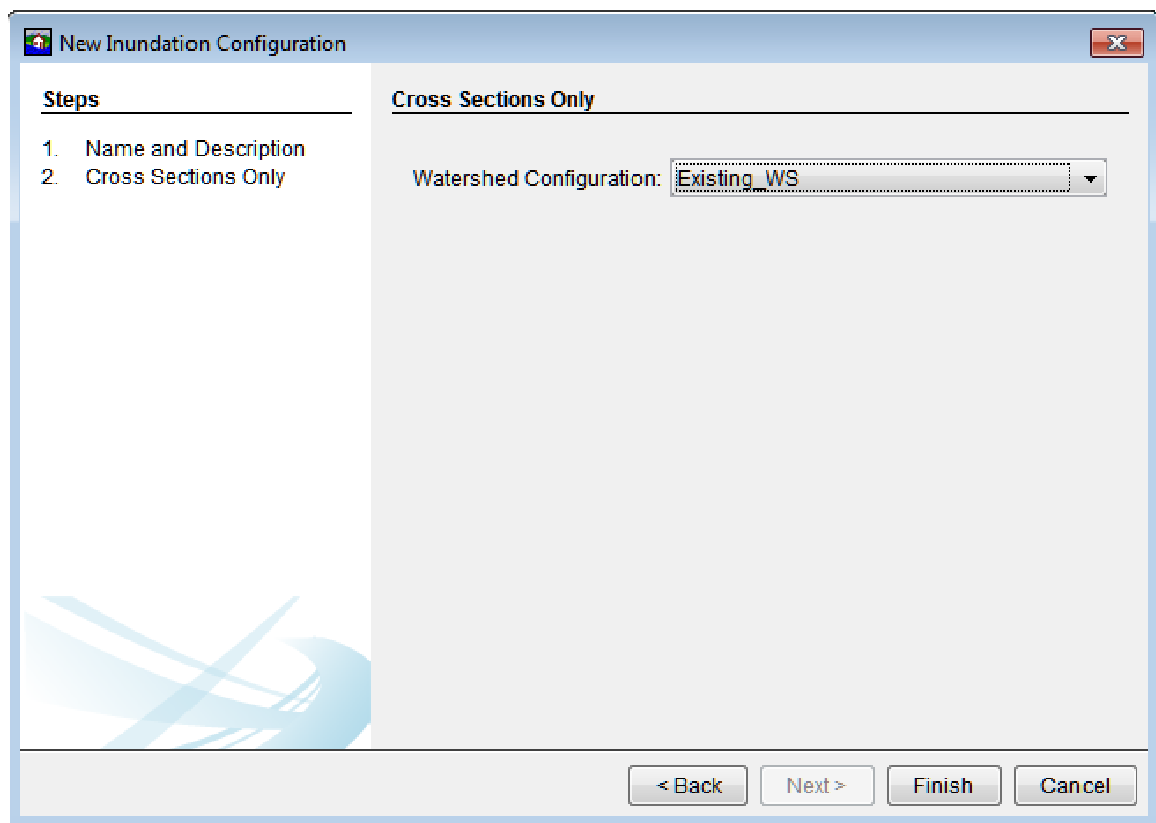
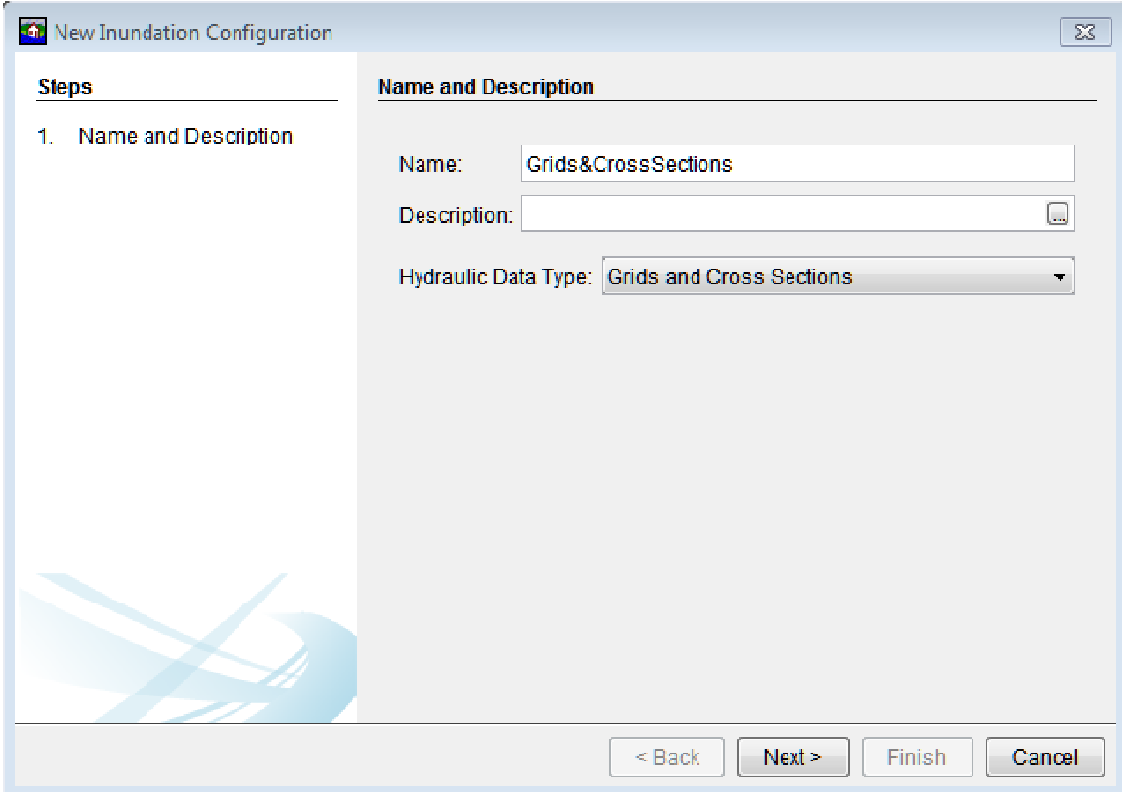


Figure 7.6 Cross Sections Only - Step 2

## 7.4 Grids and Cross Sections

The **Grids and Cross Sections** inundation configuration allows users to use any grid combination to define the hydraulic event at a location, while still allowing the user to define warnings by evaluating a hydrograph at a cross section. To create a **Grids and Cross Sections** configuration:

1. From the **New Inundation Configuration Wizard** (Figure 7.7), enter a name in the **Name** box (e.g., *Grids&CrossSections*). Enter a description in the **Description** box is optional. From the **Hydraulic Data Type** list, select **Grids and Cross Sections** (Figure 7.7).
2. Click **Next**, the second page of the **New Inundation Configuration** wizard for **Grids and Cross Sections** displays (Figure 7.8). The user selects which types of grids to be used (e.g., *Inundation Grid*, *Life Loss Arrival*). From the **Watershed Configuration** list the user selects a defined watershed configuration.
3. Click **Finish**, the **New Inundation Configuration** wizard closes and the new inundation configuration appears under the **Inundation Data** folder on the study tree.



The screenshot shows the 'New Inundation Configuration' wizard at Step 1. The 'Steps' pane on the left lists '1. Name and Description'. The main area is titled 'Name and Description' and contains three fields: 'Name' with the text 'Grids&CrossSections', 'Description' (empty), and 'Hydraulic Data Type' set to 'Grids and Cross Sections' in a dropdown menu. At the bottom are buttons for '< Back', 'Next >', 'Finish', and 'Cancel'.

**New Inundation Configuration**

**Steps**

1. Name and Description

**Name and Description**

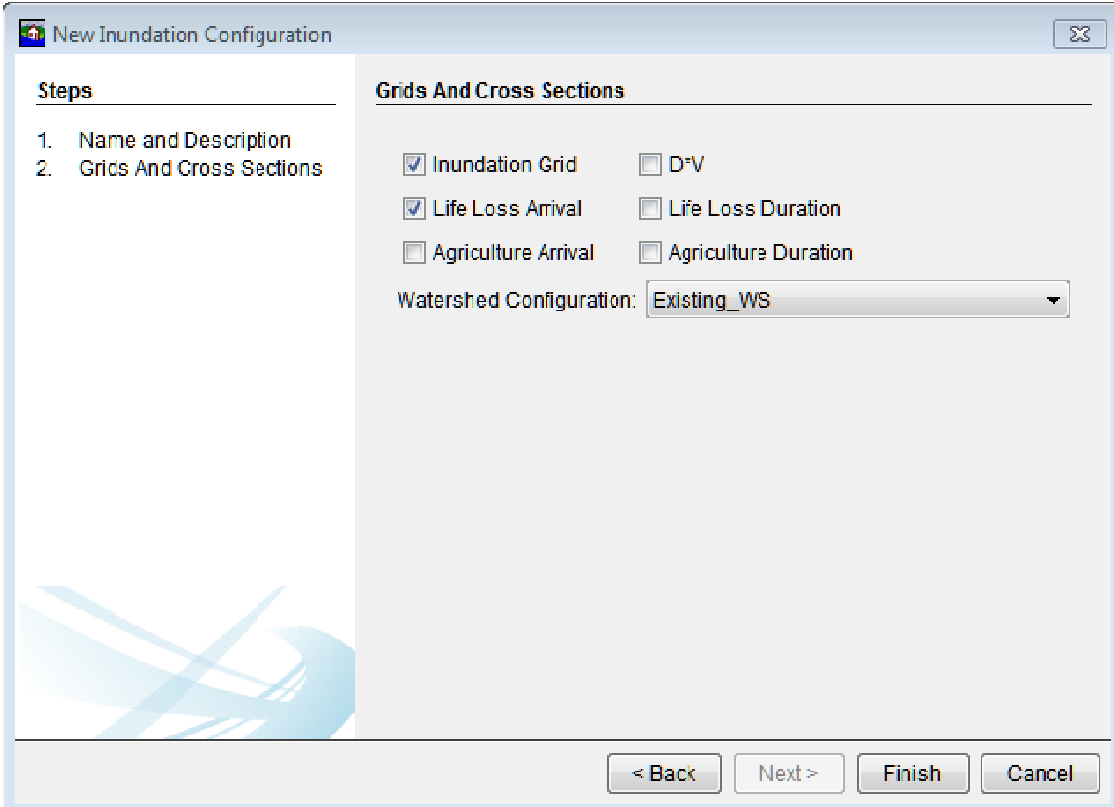
Name: Grids&CrossSections

Description:

Hydraulic Data Type: Grids and Cross Sections

< Back Next > Finish Cancel

**Figure 7.7** New Inundation Configuration Wizard - Grids and Cross Sections



The screenshot shows the 'New Inundation Configuration' wizard at Step 2. The 'Steps' pane on the left lists '1. Name and Description' and '2. Grids And Cross Sections'. The main area is titled 'Grids And Cross Sections' and contains several checkboxes: 'Inundation Grid' (checked), 'D\*V' (unchecked), 'Life Loss Arrival' (checked), 'Life Loss Duration' (unchecked), 'Agriculture Arrival' (unchecked), and 'Agriculture Duration' (unchecked). Below these is a 'Watershed Configuration' dropdown menu set to 'Existing\_WS'. At the bottom are buttons for '< Back', 'Next >', 'Finish', and 'Cancel'.

**New Inundation Configuration**

**Steps**

1. Name and Description
2. Grids And Cross Sections

**Grids And Cross Sections**

☒ Inundation Grid ☐ D\*V

☒ Life Loss Arrival ☐ Life Loss Duration

☐ Agriculture Arrival ☐ Agriculture Duration

Watershed Configuration: Existing\_WS

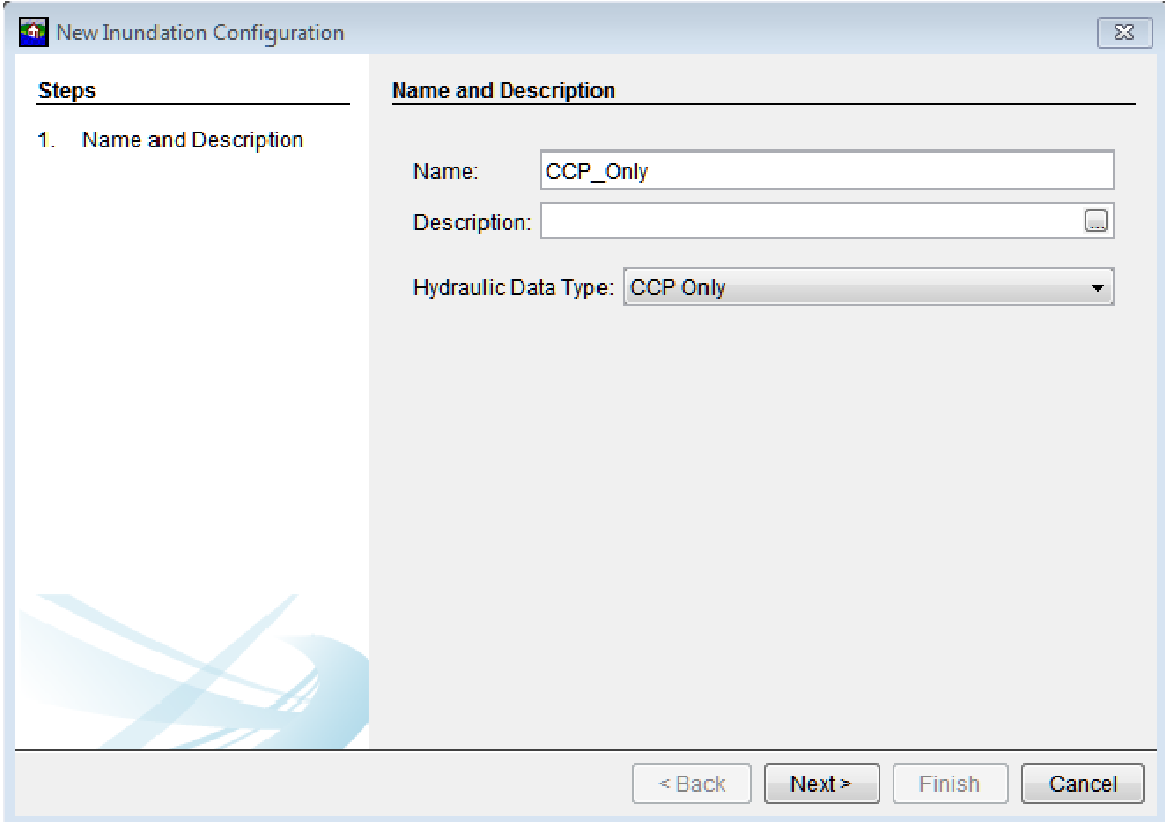
< Back Next > Finish Cancel

**Figure 7.8** Grids and Cross Sections - Step 2

## 7.5 CCP Only

CCP Only configurations are primarily used for setting up a simple watershed for evaluating a rough estimate consequence analysis. To create a **CCP Only** configuration:

1. From the **New Inundation Configuration Wizard** (Figure 7.9), enter a name in the **Name** box (e.g., CCP\_Only). Enter a description in the **Description** box which is optional. From the **Hydraulic Data Type** list, select **CCP Only** (Figure 7.9).

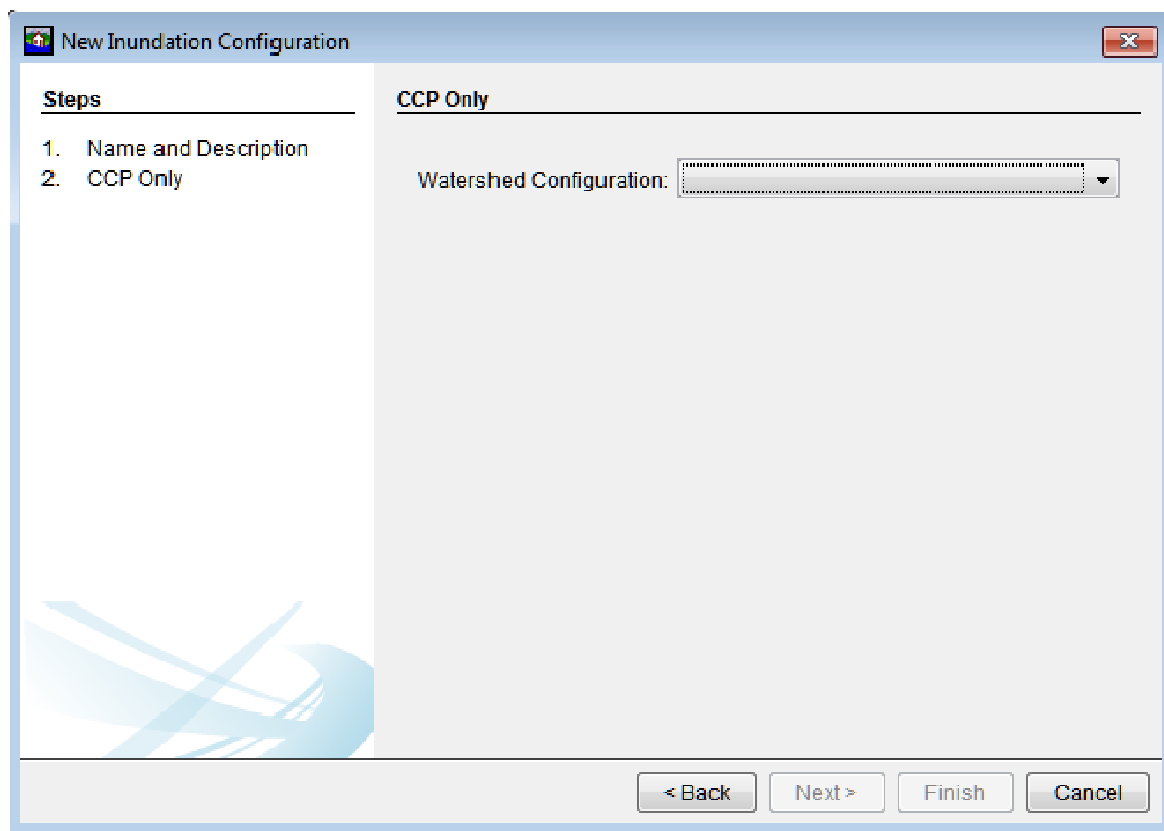
The image shows a software dialog box titled "New Inundation Configuration". On the left, a "Steps" pane lists "1. Name and Description". The main area, titled "Name and Description", contains three input fields: "Name:" with the text "CCP\_Only", "Description:" which is empty, and "Hydraulic Data Type:" which is a dropdown menu set to "CCP Only". At the bottom right, there are four buttons: "< Back", "Next >", "Finish", and "Cancel".

**Figure 7.9** New Inundation Configuration Wizard - CCP Only

2. Click **Next**, the second page of the **New Inundation Configuration** wizard for **CCP Only** displays (Figure 7.10). From the **Watershed Configuration** list the user selects a defined watershed configuration.
3. Click **Finish**, the **New Inundation Configuration** wizard closes and the new inundation configuration appears under the **Inundation Data** folder on the study tree.

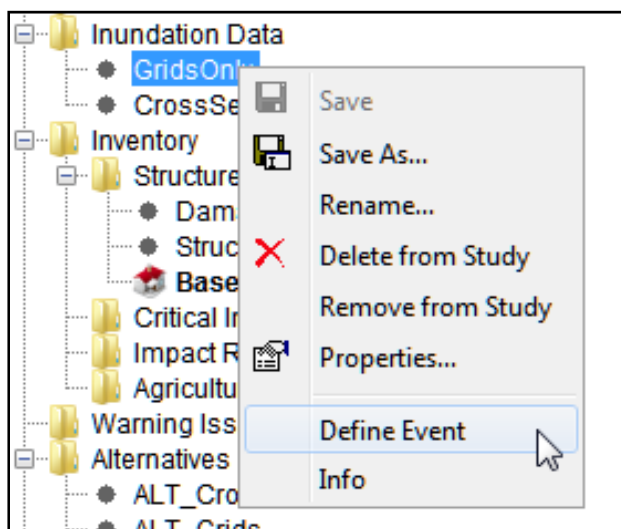
## 7.6 Events

Once the inundation configuration is defined, the hydraulic characteristics of an event must be defined. Hydraulic characteristics include the grids or time-series data computed by the hydraulics model.



**Figure 7.10** CCP Only - Step 2

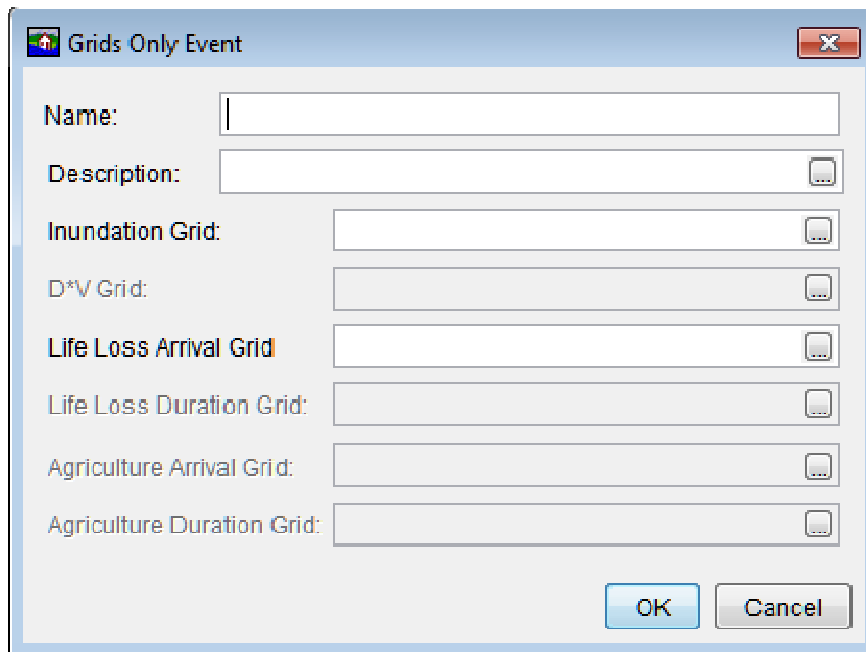
1. From the **Study Pane**, from the **Inundation Data** folder, right-click on the appropriate inundation configuration. From the shortcut menu (Figure 7.11), click **Define Event**; a dialog box opens.



**Figure 7.11** Inundation Configuration - Grids Only Shortcut Menu

2. For a **Grids Only** inundation configuration, the **Grids Only Event** dialog box opens (Figure 7.12). From the **Grids Only Event** dialog box enter a name for the event in the **Name** box and provide a description in the **Description** box (Figure 7.12). Depending on

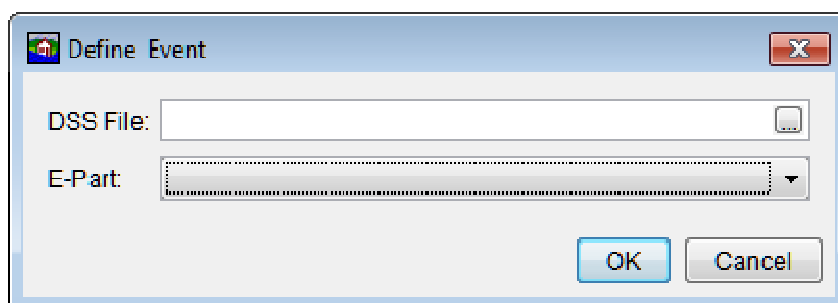




**Figure 7.12** Grids Only Event Dialog Box

which grid types were selected for the **Grids Only** inundation configuration a path to a grid for each grid type required.. Be sure that all event grids come from the same HEC-RAS plan, or hydraulic model output. Click **OK**, the **Grids Only Event** dialog box (Figure 7.12) closes and the defined event displays in the **Study Tree** below the selected **Grids Only** inundation configuration.

3. For all the other inundation configurations, the **Define Event** dialog box opens (Figure 7.13). From the **Define Event** dialog box browse to an existing DSS dataset and define the E Part (which expresses the output time step of the regular time series records; available types are MIN, 15 MIN, 30 MIN or 1 HOUR) and then click **OK**. The **Define Event** dialog box (Figure 7.13) closes and the defined event displays in the **Study Tree** below the selected inundation configuration.



**Figure 7.13** Define Event Dialog Box

4. For Grids and Cross Sections events, once the user has created the events, right-click on an event. From the shortcut menu, click **Edit Event**, and specify the file paths to the grids that were created by an HEC-RAS plan.

5. When events are created using HEC-DSS files, HEC-FIA uses the watershed configuration that was associated with the Inundation configuration to determine where the user has pre-defined output to be required. In a watershed configuration, the user has selected either a cross section set or a CCP set. During the import of those elements, the user was required to define the A, B, and C parts for each cross section, storage area, or CCP that was imported. HEC-FIA utilizes the A, B and C parts defined by the user at each location to compute a hydraulic event. In the **Define Event** dialog, the user selected a HEC-DSS file path, and a computational output (E part). The HEC-DSS file path must coordinate with the A, B, and C parts imported in the CCP or Cross Section set used in the Watershed Configuration. To check if all of the connections are set up correctly, right click on the event (the F part); from the shortcut menu click **Check for missing data**. If an invalid path is found, the cross section, or CCP is highlighted in red, if this occurs; the user should look at the A, B, and C parts imported with the cross section or CCP set, and verify that pathname parts exist in the HEC-DSS path submitted for these events. If the pathname parts do not exist, it is possible that the pathname parts were not in the final HEC-RAS or HEC-ResSim model that produced the HEC-DSS output, or a naming convention issue in the shapefile that defined the pathname parts exists.

# CHAPTER 8

## Inventory Data

HEC-FIA facilitates the evaluation of the following damageable elements:

- Structure Damages
- Structure Content Damages
- Vehicle Damages
- Agricultural Damages
- Direct Economic Damages (from ECAM model)
- Critical Infrastructure Impacts
- Loss of Life Estimations

Data describing key parameters and location for are required for the computation of damages for each element. In this context the element location data links the hydraulic event, described by flood depths, depth times velocity, durations and/or arrival times, to the data describing the susceptibility to the hydraulic event. The chapter below describes the commonly used damageable elements in HEC-FIA.

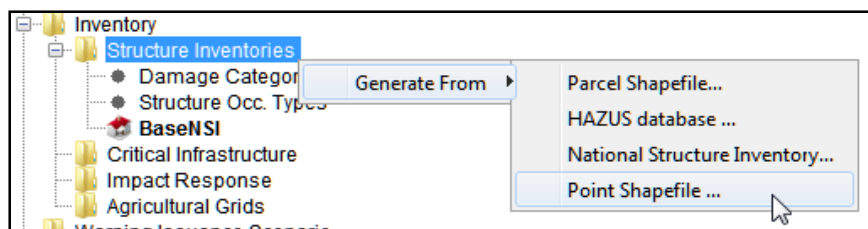
### 8.1 Structure Inventories

As is mentioned above a damageable element is required to estimate flood damages or impacts in HEC-FIA. A variety of types of elements are discussed below. In some cases the inventory must be augmented with additional information. For instance, to estimate loss of life risks the inventory must be supplied with population estimates. Section 8.2 describes the process used to import structure occupancy types. Section 8.3.5 describes how population estimates can be imported from the HAZUS database directly into the structure inventory.

### 8.2 Create a Structure Inventory

Structure inventories can be imported from the National Structure Inventory (NSI), HAZard United States (HAZUS) database, point based shapefile or parcel based shapefile. To create a structure inventory:

1. From the **Study Pane**, from **Inventory** folder, right-click on **Structure Inventories**. From the shortcut menu (Figure 8.1), point to **Generate From**.
2. In HEC-FIA, there are several options available for creating a structures inventory - parcel shapefile, HAZUS database, National Structure Inventory, or point shapefile. The following sections describe each option for creating a structure inventory in HEC-FIA.



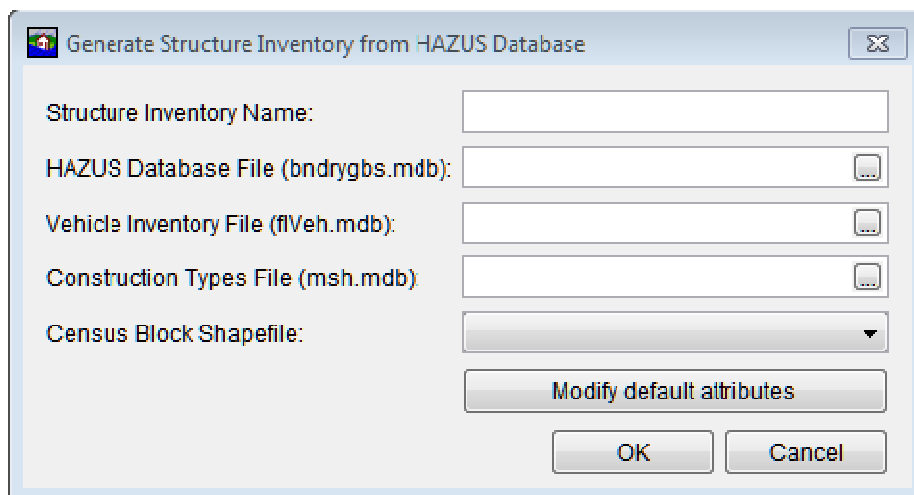
**Figure 8.1** Structure Inventories - Shortcut Menu

## 8.2.1 Generate Structures from the HAZUS Database

HEC recommends that USACE users create structure inventories from the National Structure Inventory. This data source requires less GIS pre-processing and lacks some common issues associated with the HAZUS 2000 database. The National Structure Inventory is currently only available to USACE users; therefore, all other users can use the HAZUS database if better data is not available.

To import a structure inventory from the HAZUS database:

1. From the **Study Pane** from the **Inventory** folder, right click on **Structure Inventories**. From the shortcut menu (Figure 8.1), point to **Generate From**, click **HAZUS database**. The **Generate Structure Inventory from HAZUS Database** dialog box opens (Figure 8.2).



**Figure 8.2** Generate Structure Inventory from HAZUS Database Dialog Box

2. In the **Structure Inventory Name** box enter a name for the structure inventory.
3. From the HAZUS database there are three files that are needed:
  - HAZUS Database File (*bndrygbs.mdb*)
  - Vehicle Inventory File (*flVeh.mdb*)
  - Construction Types File (*msh.mdb*)

Browse to the location of these files by clicking or the user can enter the location of these files in the appropriate box.

- From the **Census Block Shapefile** list (Figure 8.2), the user selects the census block shapefile that creates a structure inventory based on the defined census blocks contained in the shapefile. The associated census block geometry file can be created by the user as a GIS pre-process using two files - *hzBndrygrbs.mdb* and *hzCensusBlocks*. Typically users clip out the census blocks that covers the study area and exports those census blocks to a shapefile.
- To edit attributes provided by the HAZUS database, click **Modify default attributes** (Figure 8.2). The **Default Attributes** dialog box opens (Figure 8.3). Once the user is done editing click **OK**, the **Default Attributes** dialog box closes.

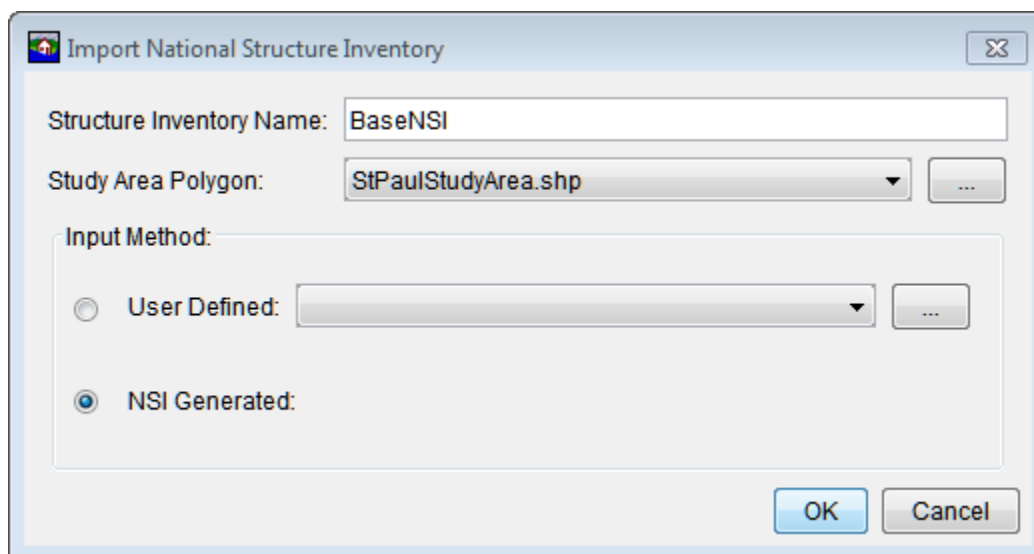
**Figure 8.3** Default Attributes Dialog Box

- From the **Generate Structure Inventory from HAZUS Database** dialog box (Figure 8.2), click **OK**. The dialog box closes and the new structure inventory appears on the **Study Tree** under the **Structure Inventories** folder.

## 8.2.2 Generate Structures from National Structure Inventory

National Structure Inventory (NSI) structure inventories can be downloaded directly from the following link (<https://nsi.hec.usace.army.mil/>) provided that a study area shapefile is supplied and the user is connected to the internet, behind the USACE firewall. The structure inventory can also be downloaded internally to HEC-FIA using the following steps:

- From the **Study Pane** from the **Inventory** folder, right-click on **Structure Inventories**. From the shortcut menu (Figure 8.1), point to **Generate From**, click **National Structure Inventory**; the **Import National Structure Inventory** dialog box opens (Figure 8.4).
- In the **Structure Inventory Name** box (Figure 8.4) enter a name for the structure inventory.



**Figure 8.4** Import National Structure Inventory Dialog Box

3. From the **Study Area Polygon** list (Figure 8.4), select a shapefile that defines the study area.
4. From the **Input Method** box, choose which method to use for creating a structure inventory. The **User Defined** option requires the user to select an NSI shapefile (downloaded externally from HEC-FIA). Information from the NSI shapefile is used to clip structures that are only within the study area shapefile during the import process.

The **NSI Generated** option is where HEC-FIA sends a web call to the National Structure Inventory for the base layer of structures, downloads the structures, and then clips only the structures that exist within the study area shapefile during the import process.

5. Click **OK**, the **Import National Structure Inventory** dialog box (Figure 8.4) closes. A **Progress Window** opens providing the user with information on the importing of the structures.
6. Once the import is finished, the **Progress Window** closes, under the **Structure Inventories** folder in the **Study Tree** the new structure inventory appears.

### 8.2.3 Generate Structures from a Point Shapefile

Users can create structure inventories using external software, and import the inventory as a point based structure inventory. A few required and optional fields are imported during creation of such an inventory. To generate a structure inventory using a point based structure inventory (a point shapefile must be loaded for the HEC-FIA project):

1. From the **Study Pane** from the **Inventory** folder, right-click on **Structure Inventories**. From the shortcut menu (Figure 8.1), point to **Generate From**, click **Point Shapefile**. The **Generate Structure Inventory from Point Shapefile** dialog box opens (Figure 8.5).

**Generate Structure Inventory from Point Shapefile**

Structure Inventory Name:

Shapefile:

First Floor Elevation Source

☐ First Floor Elevation

☒ Use Terrain + Foundation Height

Data Assignments

Inventory Field	Shapefile Field
Structure ID:	<input type="text" value="FD_NAME"/>
Damage Category:	<input type="text" value="ST_DAMCAT"/>
Occupancy Type:	<input type="text" value="ST_DMGFUN"/>
Replacement Value:	<input type="text" value="VAL_STRUCT"/>
User Supplied First Floor Elevation:	<input type="text"/>

Optional Data

Inventory Field	Shapefile Field
Car Value	<input type="text" value="VAL_CAR"/>
Content Value	<input type="text" value="VAL_CONT"/>
Number Stories	<input type="text" value="NUM_STORY"/>
Population Day Over 65	<input type="text" value="POP_2PM_O6"/>
Population Day Under 65	<input type="text" value="POP_2PM_U6"/>
Population Night Over 65	<input type="text" value="POP_2AM_O6"/>
Population Night Under 65	<input type="text" value="POP_2AM_U6"/>

OK Cancel

**Figure 8.5** Generate Structure Inventory from Point Shapefile Dialog Box

- The required fields are the unique name of each structure, a damage category, an occupancy type, and the value of the structure. Optionally there are many more fields; of particular note are the population fields and the number of stories, since those are used in the life loss compute process.
- Click **OK**, the **Generate Structure Inventory from Point Shapefile** dialog box closes. A **Progress Window** opens providing the user with information on the importing of the structures.
- Once the import is finished, the **Progress Window** closes, under the **Structure Inventories** folder in the **Study Tree** the new structure inventory appears.

## 8.2.4 Generate Structures from a Parcel Shapefile

To import a structure inventory from a parcel shapefile, the requirements are the same as the point shapefile import. The only difference is that HEC-FIA calculates a centroid (center point) for each parcel record during the parcel shapefile import process; this center point is the defined location for each structure. To import from a parcel shapefile:

1. From the **Study Pane**, from the **Inventory** folder, right-click on **Structure Inventories**. From the shortcut menu (Figure 8.1), point to **Generate From**, click **Parcel Shapefile**. The **Generate Structure Inventory from Parcel Shapefile** dialog box opens (Figure 8.6).

**Generate Structure Inventory from Parcel Shapefile**

Structure Inventory Name:

Shapefile:

First Floor Elevation Source

☐ First Floor Elevation

☒ Use Terrain + Foundation Height

Data Assignments

Inventory Field	Shapefile Field
Structure ID:	<input type="text"/>
Damage Category:	<input type="text"/>
Occupancy Type:	<input type="text"/>
Replacement Value:	<input type="text"/>
User Supplied First Floor Elevation:	<input type="text"/>

Optional Data

Inventory Field	Shapefile Field
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

OK Cancel

**Figure 8.6** Generate Structure Inventory from Parcel Shapefile Dialog Box

2. Select the appropriate parcel shapefile from the **Shapefile** list. Enter all of the other information required to create a structure inventory from a parcel shapefile. **Replacement Value** is the structure value.



3. Click **OK**, the **Generate Structure Inventory from Parcel Shapefile** dialog box closes (Figure 8.6). A **Progress Window** opens providing the user with information on the importing of the structures.
4. Once the import is finished, the **Progress Window** closes, under the **Structure Inventories** folder in the **Study Tree** the new structure inventory appears.

### 8.3 Structure Inventory Shortcut Menu

Once a structure inventory has been created there are several ways to manipulate the inventory. From the **Study Tree**, from the **Inventory** folder, from the **Structure Inventories** folder, right-click on a structure inventory (e.g., *BaseNSI*). From the shortcut menu (Figure 8.7) the user may: display/remove the structure inventory from the active **Map Window**; edit the structure inventory; import additional structures; delete all structures; export structures to a shapefile; import population data from HAZUS; save as, rename, delete and/or remove the structure inventory from the study; and review properties of the structure inventory file.

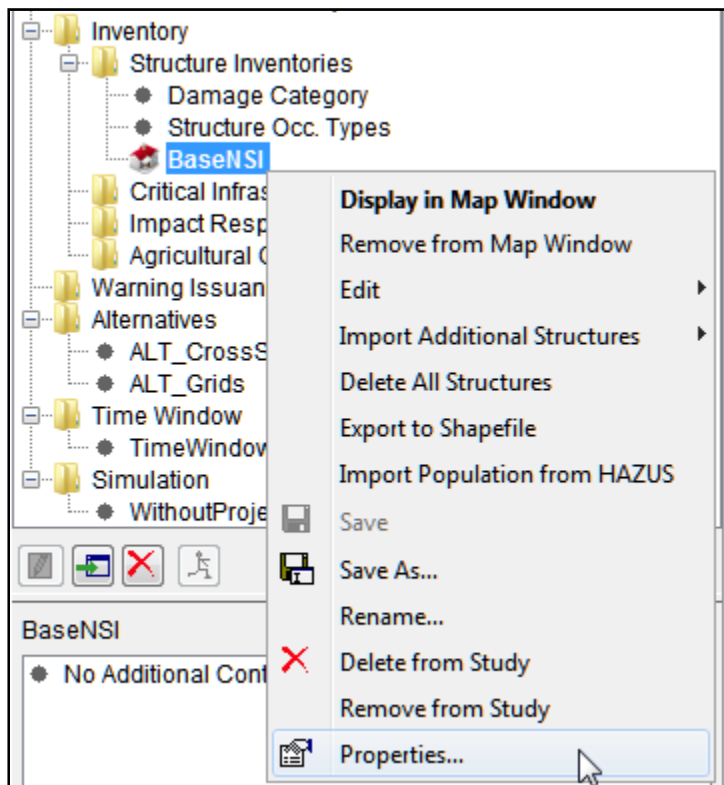


Figure 8.7 Structure Inventory Shortcut Menu

#### 8.3.1 Structure Inventory - Form Editor

From HEC-FIA the user may edit the structure inventory from the **Structure Table Editor** (table form), or from the **Structure Form Editor** on a structure by structure basis. From the structure inventory shortcut menu (Figure 8.7), point to **Edit**, click **Form Editor**, the **Structure Editor** opens (Figure 8.8).

Structure Editor

Structure Edit Records Reports Tools

Name: AGR1 27123 14433 1 of 735

Description:

Location Classification Values Elevations Lethality Zone Parameters

Structure Location Information:

Watershed Configuration: Preview

Stream:

Stream Station:

Ground Elevation ():

Structure Coordinates:

Northings: 8012585.487

Easting: 750497.037

This panel is for information only, this data is assigned at run time based on your watershed configuration.  
If you wish to view these elements select a configuration and press preview

OK Cancel Apply

**Figure 8.8** Structure Editor - Location Tab

The **Location Tab** (Figure 8.8) is informational only, and provides the user with the location of the structure, its ground elevation, and the coordinates of the structure.

## Classification Tab

From the **Classification Tab** (Figure 8.9) of the **Structure Editor**, the user can view and/or edit the damage category, structure occupancy type, and the structure depth-damage functions that have been assigned to the structure.

## Values Tab

From the **Values Tab** (Figure 8.10) of the **Structure Editor**, the user can view the structure/content/other/car values, the year the structure was put in service, number of stories the structure has, the number of cars at the residence and the number of people that can fit into the cars. From this tab, one can also enter information about the people that reside at the structure such as the number or people at the residence at 2AM and 2PM. All other times of the day are interpolated between those two times.

## Elevations Tab

From the **Elevations Tab** (Figure 8.11) of the **Structure Editor**, users can view elevation information concerning a structure. The **First Floor Elevation** and the **Foundation Height** can be changed. The **Ground Elevation** is computed by HEC-FIA and is not editable.

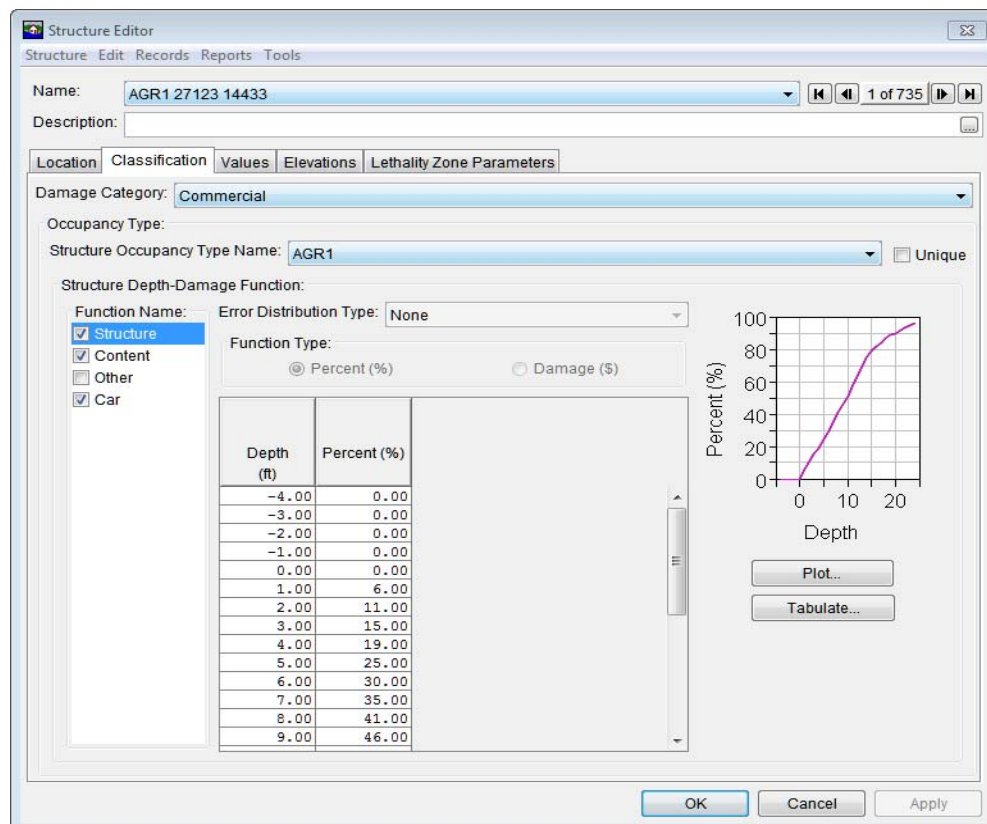


Figure 8.9 Structure Editor - Classification Tab

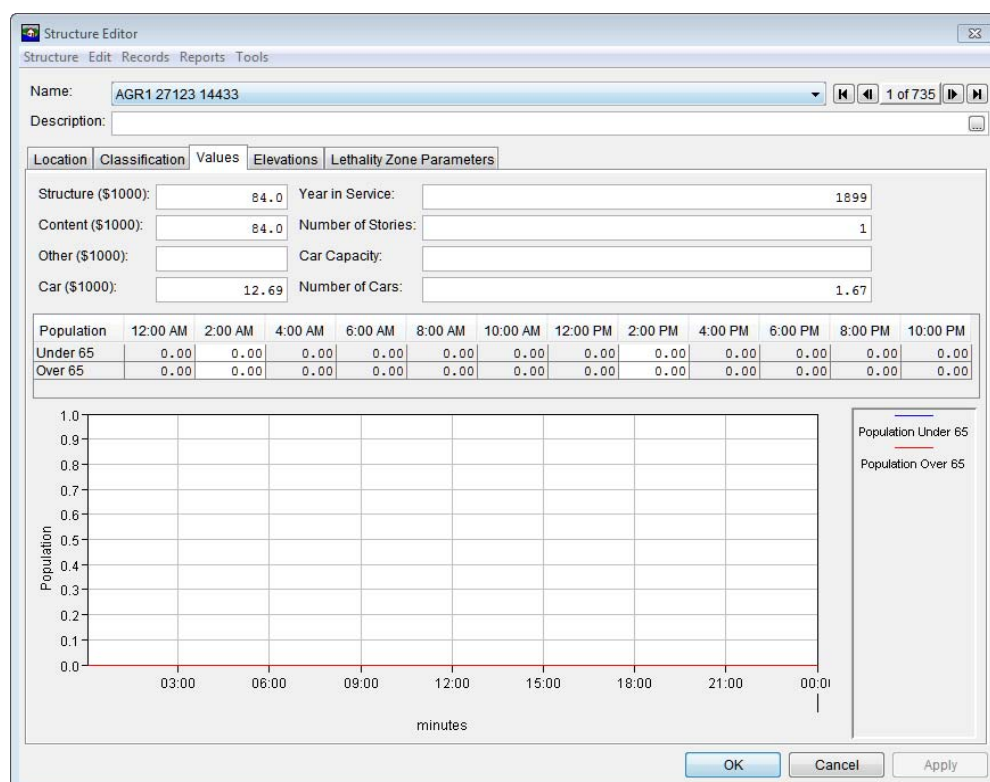


Figure 8.10 Structure Editor - Values Tab

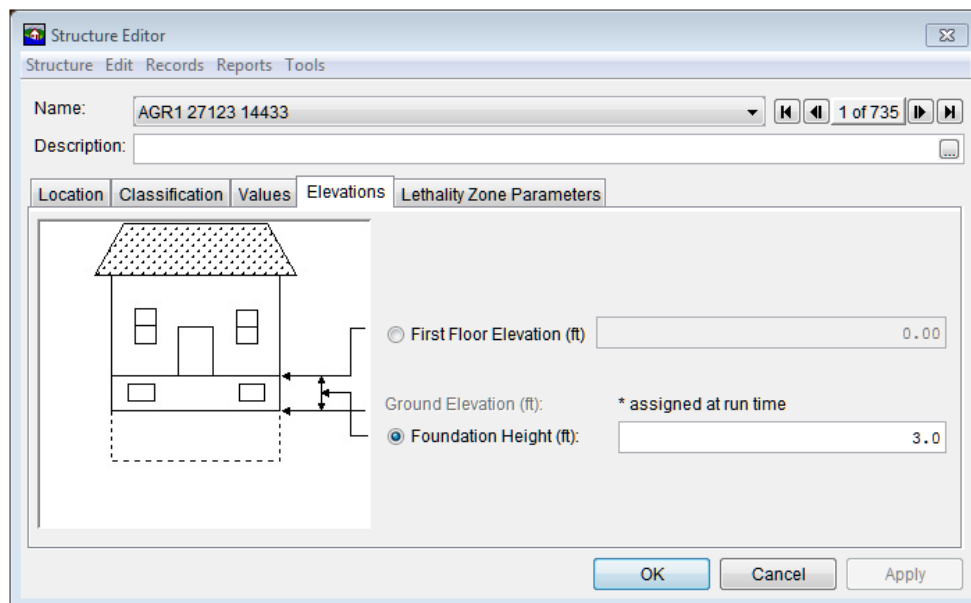


Figure 8.11 Structure Editor - Elevations Tab

## Lethality Zone Parameters Tab

From the **Lethality Zone Parameters Tab** (Figure 8.12) of the **Structure Editor**, users can view information about lethality zones concerning a structure. The user can change the **Foundation Type** and the **Construction Type**. Once either item has been changed, click **Update**. The other values on the tab are automatically updated.

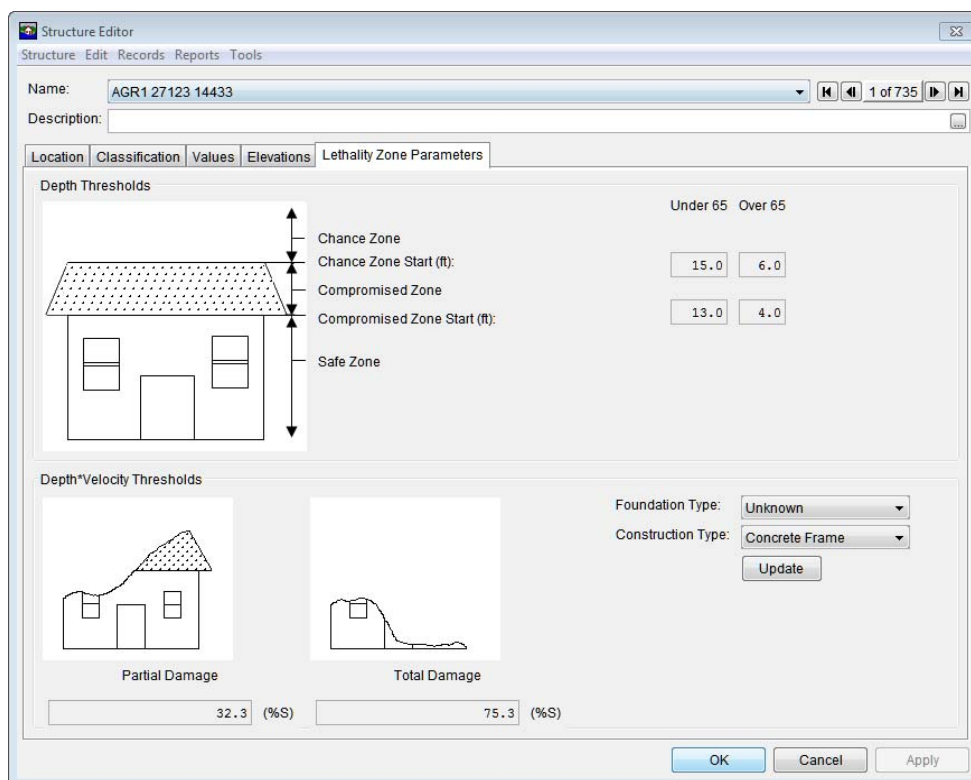
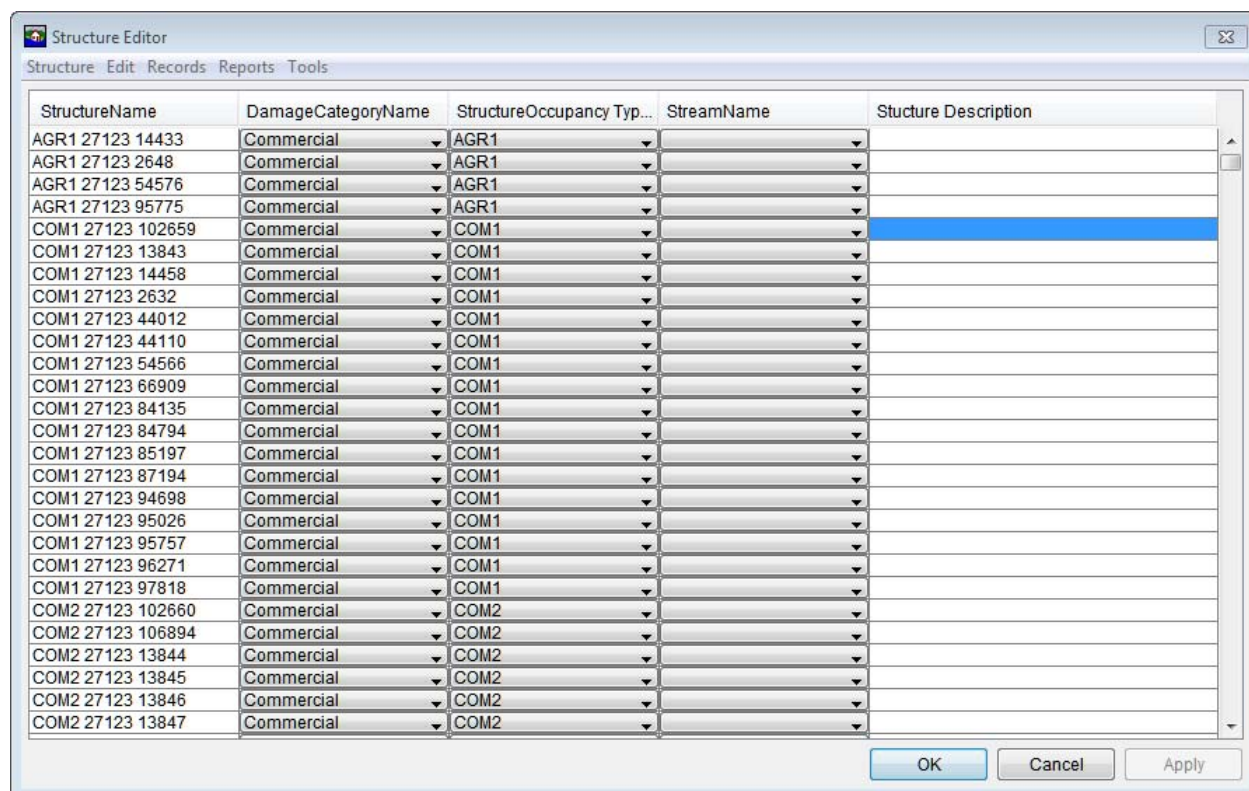


Figure 8.12 Structure Editor - Lethality Zone Parameters Tab

### 8.3.2 Structure Inventory - Table Editor

In the HEC-FIA interface users can edit the structure inventory from the **Structure Table Editor**, in a table form that allows users to edit the entire structure. From the structure inventory shortcut menu (Figure 8.7), point to **Edit**, click **Table Editor**, the **Structure Editor** opens (Figure 8.13).



**Figure 8.13** Structure Editor - Table

From the **Structure Editor** (Figure 8.13) users can edit the structure name, change the damage category, change the occupancy type associated with the structure, assign a stream name, and add a description of the structure. From the table users can make changes easily to multiple structures, filters are available that can make changing entire groups of structures easy. When finished, click **OK**, all changes are automatically made to the selected structure inventory.

### 8.3.3 Importing Additional Structures

Once the user has created a structure inventory additional structures can be added to an existing inventory using the same methods that were used to create the original structure inventory. Section 8.2 provides details on those methods. From the structure inventory shortcut menu (Figure 8.7), point to **Import Additional Structures**, click on the method to use for importing additional structures. These structures are added to the existing structure inventory, be sure not to import new structures in the same geographic location, as this could result in duplication of structures.

### 8.3.4 Delete All Structures

To delete all structures in a structure inventory, from the structure inventory shortcut menu (Figure 8.7), click **Delete All Structures**. A **Warning** window opens (Figure 8.14). Click **Yes** if all structures are to be deleted from the active structure inventory.

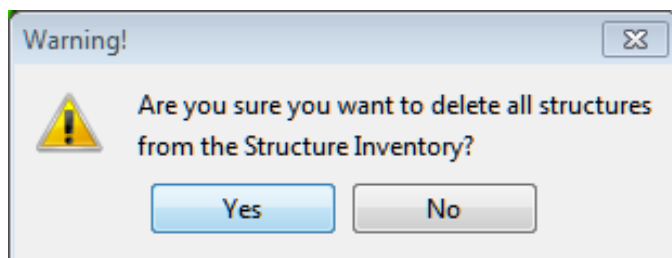


Figure 8.14 Warning Window - Delete All Structures

### 8.3.5 Export to Shapefile

HEC-FIA can create (export) a shapefile of the active structure inventory. From the structure inventory shortcut menu (Figure 8.7), click **Export to Shapefile**, the **Export Structure Inventory to Shapefile** dialog box opens (Figure 8.15).

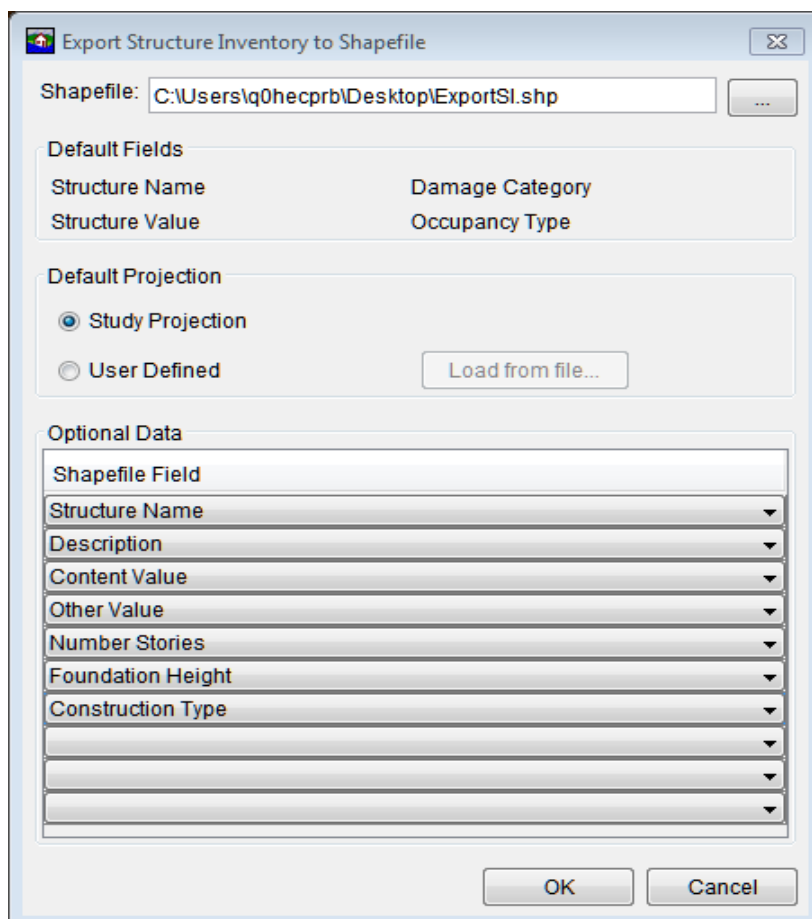

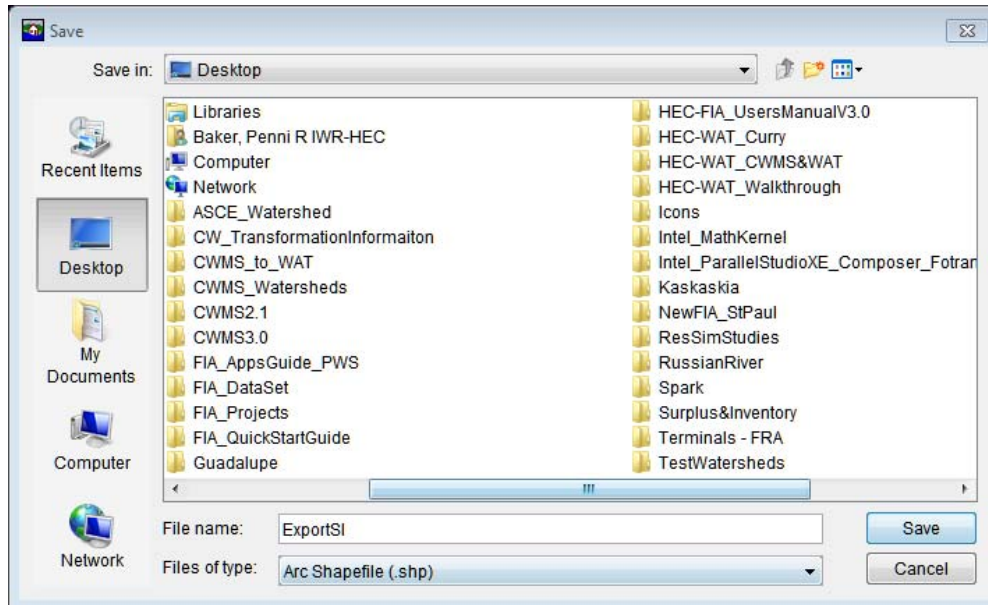


Figure 8.15 Export Structure Inventory to Shapefile Dialog Box



1. Click , a **Save Browser** (Figure 8.16) opens. Select the location where the shapefile is to be exported (created). Enter a name in the **File name** box, click **Save**. The **Save Browser** closes and the name and path of the shapefile is displayed in the **Shapefile** box (Figure 8.15).




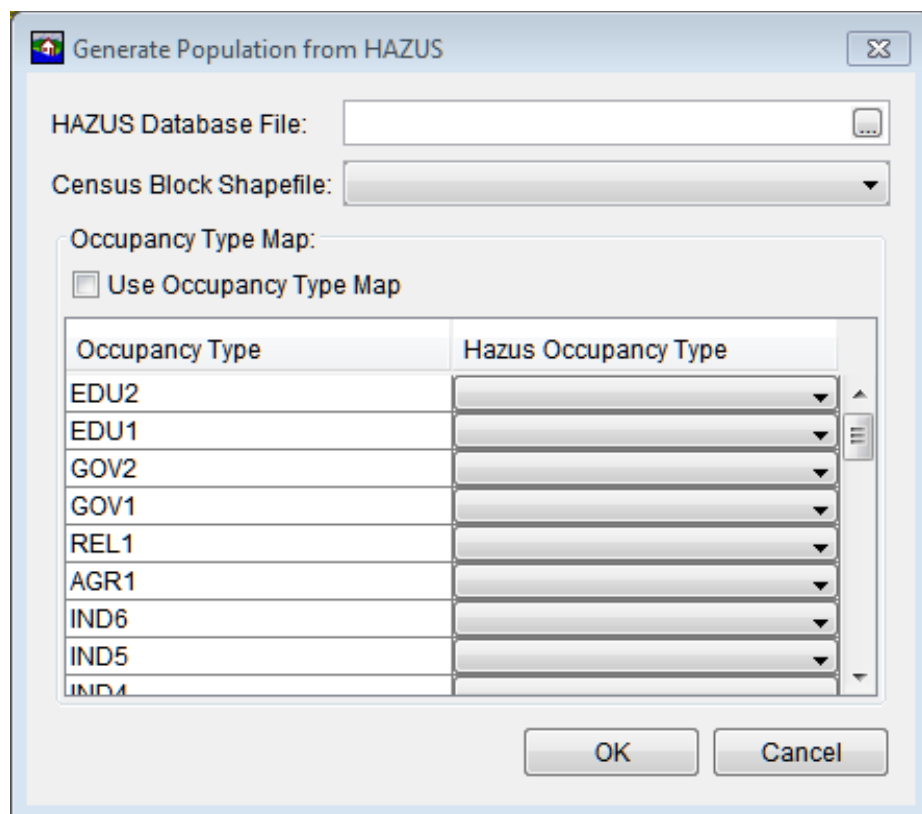
**Figure 8.16** Save Browser

2. Define the projected coordinate system of the shapefile. From the **Default Projection** box (Figure 8.15), select **Study Projection** which is the project of the current HEC-FIA project. **User Defined** allows the user to set the projection from a shapefile. When **User Defined** is selected, the **Load from file** option becomes available. The **Load from file** option opens an **Open Browser** (similar to Figure 8.16). The file type is set to \*.prj, browse to the location of the shapefile that contains the correct projection. Click **Open**, the **Open Browser** closes.
3. Define the fields that the shapefile should contain from the **Optional Data** box (Figure 8.15). The drop down lists contains the fields that are available for selection.
4. Click **OK**, the **Export Structure Inventory to Shapefile** dialog box closes (Figure 8.15). The shapefile (i.e., *ExportSI.shp*) and all of the associated files are created.

### 8.3.6 Import Population from HAZUS

Once a user has created a structure inventory, population information can be imported. From the structure inventory shortcut menu (Figure 8.7), click **Import Population from HAZUS**, the **Generate Population from HAZUS** dialog box opens (Figure 8.17).

Select the HAZUS database file that contains the population information, from **HAZUS Database File** box, click . An **Open Browser** (similar to Figure 8.16) opens, browse to the location of the HAZUS database file. Click **Open**, the **Open Browser** closes, and information about the location of the selected file appears in the **HAZUS Database File** box (Figure 8.17).



**Figure 8.17** Generate Population from HAZUS Dialog Box

Select the correct census block shape file from the **Census Block Shapefile** list (Figure 8.17). From the **Occupancy Type Map** box (Figure 8.17), the user can enter occupancy type information by clicking on the lists available under the **Hazus Occupancy Type** column. Or during the importing process, automatically import occupancy type's information from the HAZUS database by selecting **Use Occupancy Type Map** (Figure 8.17). The **Use Occupancy Type Map** option requires the active structure inventory have occupancy types that match the list (forty standard HAZUS occupancy types) under the **Occupancy Type** column (Figure 8.17). Click **OK**, the **Generate Population from HAZUS** dialog box closes (Figure 8.17) and population information is added to the structure inventory.

### 8.3.7 Save

From the structure inventory shortcut menu (Figure 8.7), click **Save**, to save the structure inventory.

### 8.3.8 Save As

To create a copy of the structure inventory, from the structure inventory shortcut menu (Figure 8.7), click **Save As**, the **Save Structure Inventories As** dialog box opens (Figure 8.18). In the **Name** box enter the name of new structure inventory. A description of the structure inventory can be entered in the **Description** box. From the **Directory** box specify the location of the new structure inventory. Click **OK**, the **Save Structure Inventories As** dialog box closes, and the new structure inventory is created.



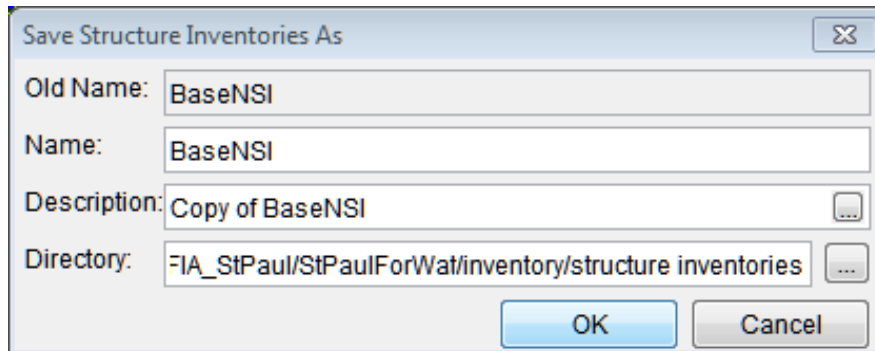


Figure 8.18 Save Structure Inventories As Dialog Box

### 8.3.9 Rename

To rename the structure inventory, from the structure inventory shortcut menu (Figure 8.7), click **Rename**, the **Rename Structure Inventories** dialog box opens (Figure 8.19). In the **Name** box enter the name of new structure inventory. A description of the structure inventory can be entered in the **Description** box. Click **OK**, the **Rename Structure Inventories** dialog box closes, and the structure inventory has been renamed.

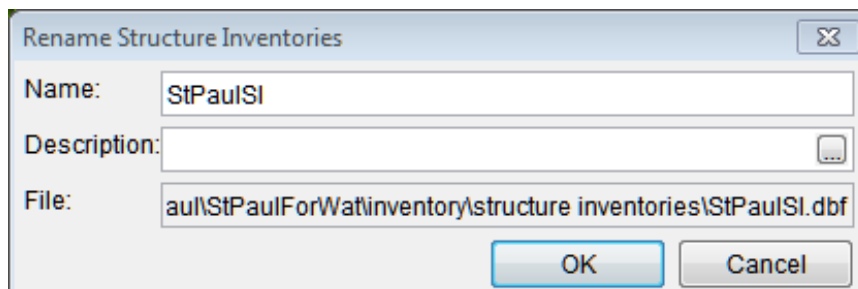


Figure 8.19 Rename Structure Inventories Dialog Box

### 8.3.10 Delete from Study

To delete a structure inventory and its associate files from the HEC-FIA project, from the structure inventory shortcut menu (Figure 8.7), click **Delete from Study**, a **Confirm Manager Delete** window opens (Figure 8.20). By clicking **Yes**, the **Confirm Manager Delete** window closes, and the structure inventory and its associated files are deleted from the HEC-FIA project.

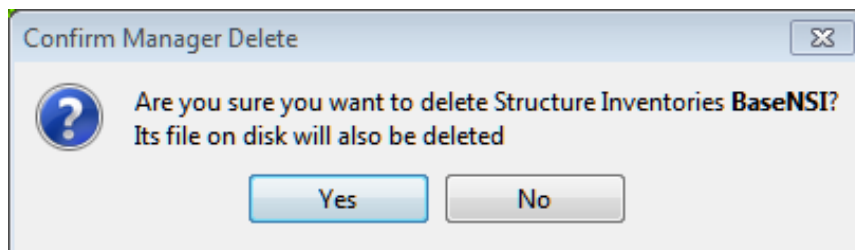


Figure 8.20 Confirm Manager Delete Window

### 8.3.11 Remove from Study

To remove the structure inventory from the HEC-FIA project (does not delete files), from the structure inventory shortcut menu (Figure 8.7), click **Remove from Study**; a **Confirm Removal** window opens (Figure 8.21). By clicking **Yes**, the **Confirm Removal** window closes, and the structure inventory is removed from the HEC-FIA project.

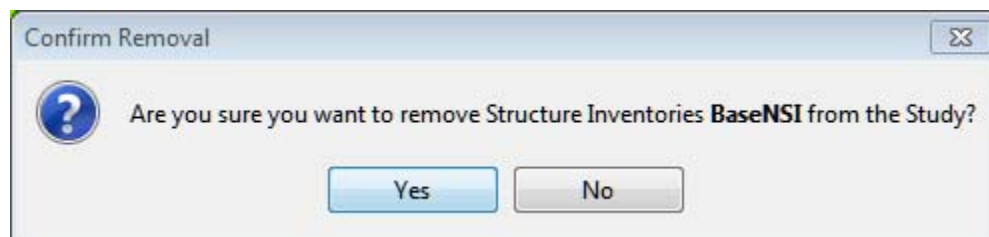



Figure 8.21 Confirm Removal Window

## 8.4 Structure Inventory - Map Window

The structure inventory can be manipulated from the active **Map Window**. Using the **Structure Tool** , a user can right-click on a structure. From the shortcut menu (Figure 8.22) the user can edit, copy, delete, and view information about the structure.

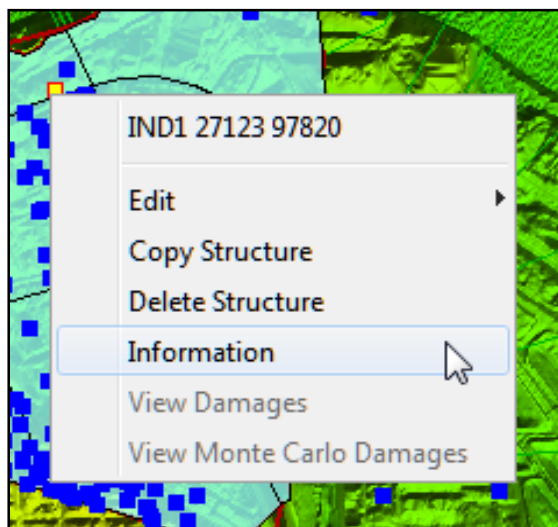


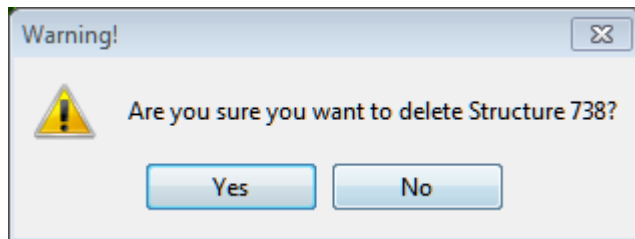
Figure 8.22 Structure Shortcut Menu - Map Window

Editing of structures has been covered in Section 8.3.1, the rest of the editing structure inventory capabilities are covered in the following sections.

### 8.4.1 Copy/Paste/Delete Structure

To copy a structure, right-click on a structure in the **Map Window**, from the structure shortcut menu (Figure 8.22), click **Copy Structure**. On the **Map Window**, find the location where the new structure belongs, right-click, from the shortcut menu click **Paste Structure**. The structure appears with a new name, but with all the same attributes as the original.

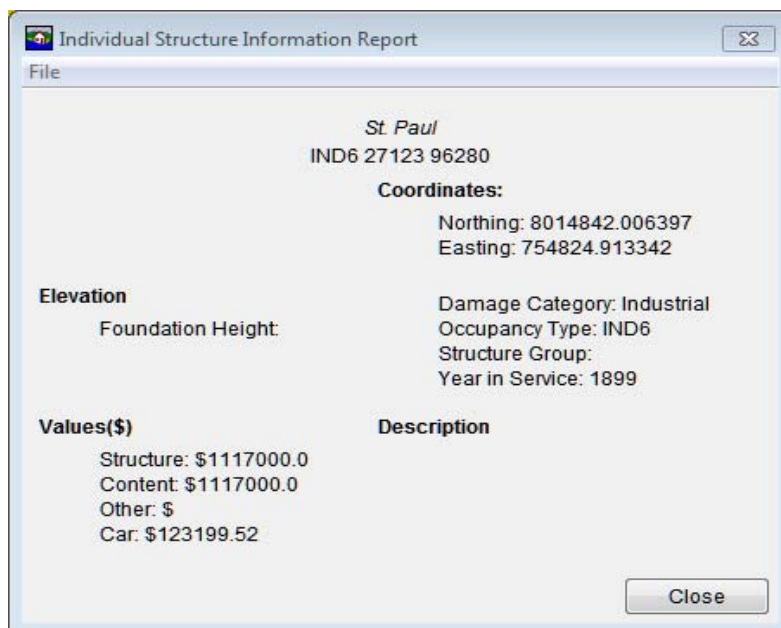
To delete a structure, right-click on a structure, from the structure shortcut menu (Figure 8.22), click **Delete Structure**. A warning window (Figure 8.23) opens. Click **Yes**, the structure no longer appears on the **Map Window**.



**Figure 8.23** Warning Window - Delete Structure

## 8.4.2 Information

To get general information about the selected structure inventory, from the structure shortcut menu (Figure 8.22), click **Information**; the **Individual Structure Information Report** dialog box opens (Figure 8.24). The **Individual Structure Information Report** dialog box provides general information about the selected structure.



**Figure 8.24** Individual Structure Information

## 8.5 Damage Categories

Damage categories are the first aggregation level for flood damages. Damage categories represent a high level grouping for structures, and contain information which is used in the ECAM (Economic Consequence Assessment Model) process to determine loss ratio and capital loss ratio. ECAM requires that the damage categories are "Residential", "Commercial", "Industrial" and "Public". If structures are imported from HAZUS or from an NSI based inventory, the default (which is consistent with the needs of ECAM) damage categories are created during the structure import process.

## 8.5.1 Entering or Editing Damage Categories

To enter or modify damage categories:

1. From the **Study Pane**, from the **Inventory** folder, from the **Structure Inventories** folder, right-click on **Damage Category**. From the shortcut menu (Figure 8.25) click **Edit**, the **Edit Damage Categories** dialog box (Figure 8.26) opens.

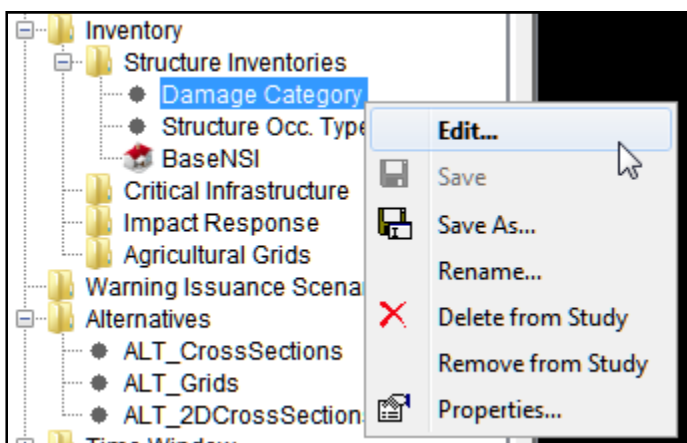


Figure 8.25 Damage Category Shortcut Menu

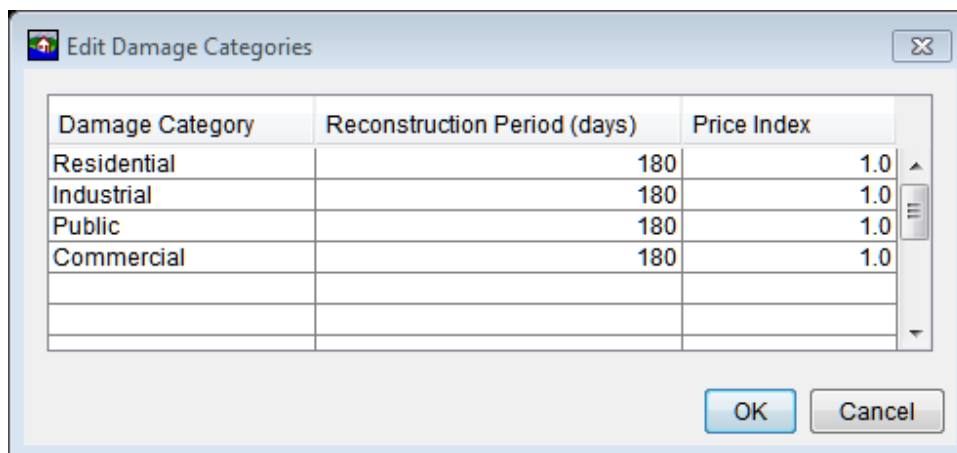


Figure 8.26 Edit Damage Categories Dialog Box

2. From the **Edit Damage Categories** dialog box (Figure 8.26) the user can enter or modify damage category names, enter or modify the reconstruction period (in days), and enter or modify the price index factor.
3. Once the user is finished, click **OK** and the **Edit Damage Categories** dialog box (Figure 8.26) closes.

## 8.5.2 Save As

To create a copy of the damage categories, from the damage category shortcut menu (Figure 8.25), click **Save As**, the **Save Damage Categories As** dialog box opens (similar to Figure 8.18).

In the **Name** box enter the name of the new damage category. The user can enter a description of the damage category in the **Description** box. From the **Directory** box, specify the location of the new damage category. Click **OK**, the **Save Structure Inventories As** dialog box closes, and the new damage category is created.

### 8.5.3 Rename

To rename the damage categories, from the damage category shortcut menu (Figure 8.25), click **Rename**, the **Rename Structure Inventories** dialog box opens (similar to Figure 8.19). In the **Name** box enter the name of new damage category. The user can enter a description of the damage category in the **Description** box. Click **OK**, the **Rename Damage Categories** dialog box closes, and the damage category has been renamed.

### 8.5.4 Delete from Study

To delete damage categories (deletes files) from the HEC-FIA project, from the damage category shortcut menu (Figure 8.25), click **Delete from Study**, a **Confirm Manager Delete** window opens (similar to Figure 8.20). By clicking **Yes**, the **Confirm Manager Delete** window closes, and the damage category and its associated files are deleted from the HEC-FIA project.

### 8.5.5 Remove from Study

To remove the damage category from the HEC-FIA project (does not delete files), from the damage category shortcut menu (Figure 8.25), click **Remove from Study**; a **Confirm Removal** window opens (similar to Figure 8.21). By clicking **Yes**, the **Confirm Removal** window closes, and the damage category is removed from the HEC-FIA project.

## 8.6 Structure Occupancy Types

Structure occupancy types are the next level of aggregation for structures in HEC-FIA, and are imperative for any consequence calculation. The occupancy types describe depth-damage relationships, life loss parameters, general information about the structures, and also contains the information about uncertainty computations for a structure inventory. Each structure is required to have an occupancy type. Structure occupancy types are created during either a HAZUS or NSI based structure inventory import. When importing an inventory from point or parcel, default functions are imported through a table name mapping process after a structure inventory has been developed which pre-populates information with the standard default curves and general information. Users can also input their own depth-damage functions by hand, or use the database of occupancy types that can be accessed through the **Structure Occupancy Type Editor** (Figure 8.27).

### 8.6.1 Entering or Editing Structure Occupancy Types

1. From the **Study Pane**, from the **Inventory** folder, from the **Structure Inventories** folder, right-click on **Structure Occ. Types**. From the shortcut menu (Figure 8.28) point to **Edit**, click **Form Editor**. The **Structure Occupancy Type Editor** (Figure 8.27) opens.

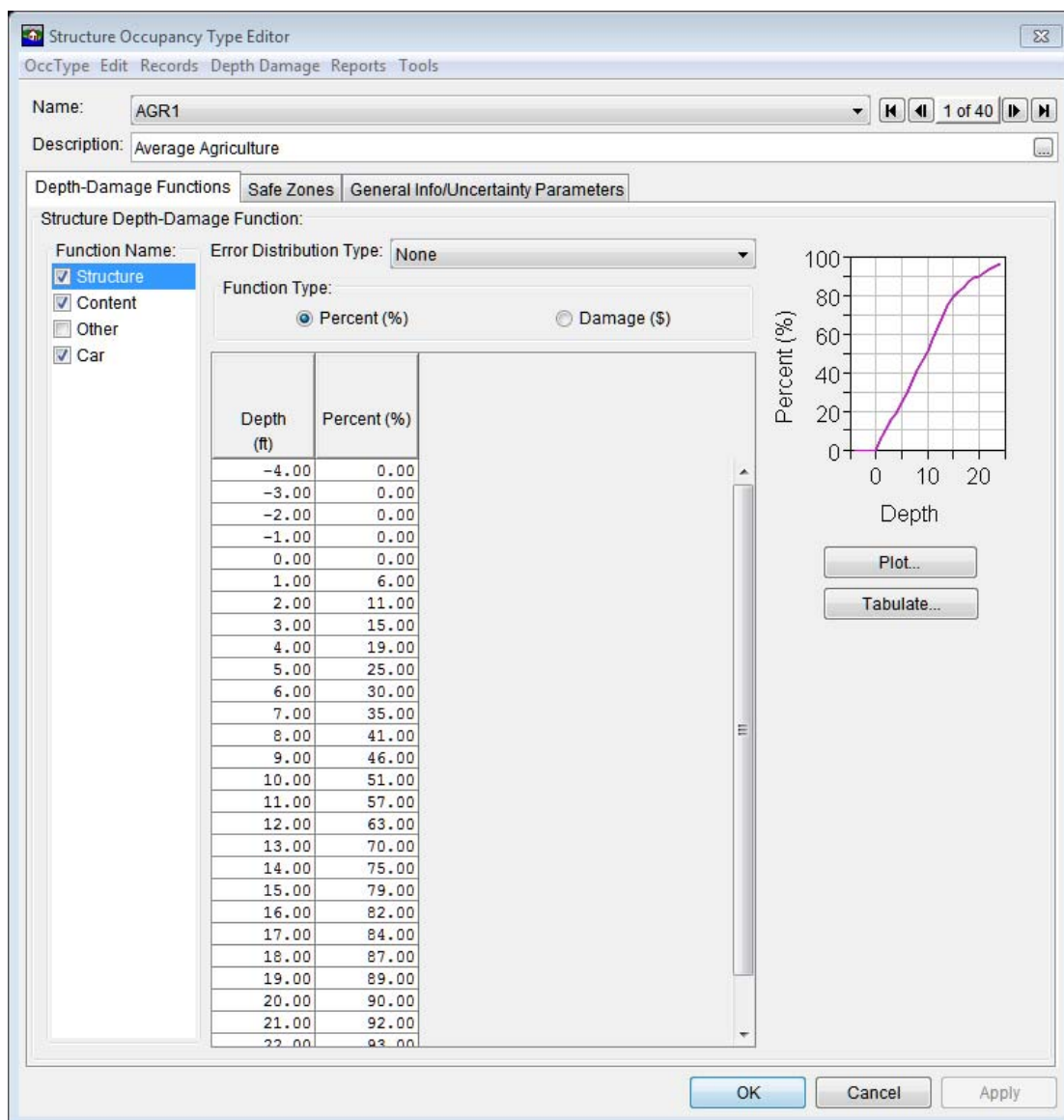


Figure 8.27 Structure Occupancy Type Editor

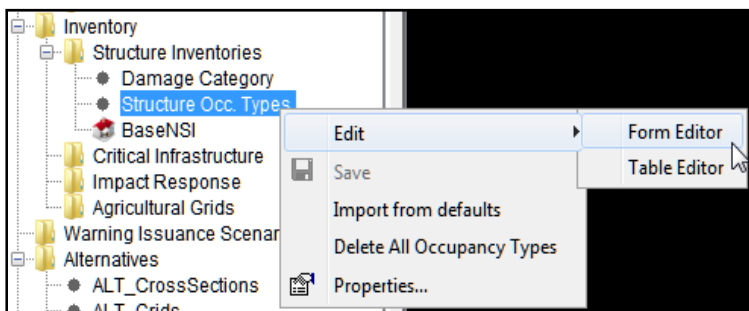


Figure 8.28 Structure Occupancy Type Shortcut Menu

- From the **Structure Occupancy Type Editor** (Figure 8.27) the user can enter or modify the depth-damage functions for structure, content, other, or car. The depth-damage function can either be in percent or damage (dollars). Also, the user can select the

uncertainty distribution for the function. Click the **Depth-Damage Functions Tab** (should be the default) from the **Structure Occupancy Type Editor** (Figure 8.27). Editing the occupancy type information updates all structures of that occupancy type. If the user wishes to update a single structure, the edits can happen at the structure form editor level.

- When calculating life loss, for each structure occupancy type the user can define life loss thresholds. To define these thresholds, from the **Structure Occupancy Type Editor** (Figure 8.27), click the **Safe Zones** tab (Figure 8.29). In the **Number of Stories** box (Figure 8.29) the user provides the structure height information for that particular structure occupancy type. From the **Structure**

Structure Occupancy Type Editor

OccType Edit Records Reports Tools

Name: COM10

Description: Garage

Depth-Damage Functions Safe Zones General Info/Uncertainty Parameters

Structure Height Information:

Number of Stories: 1

Structure Zone Height Information:

Chance Zone

Chance Zone Start (ft): Under 65: 15.0 Over 65: 6.0

Compromised Zone

Compromised Zone Start (ft): Under 65: 13.0 Over 65: 4.0

Safe Zone

Depth \* Velocity Thresholds

Partial Damage Total Damage

Wood Frame - Anchored (ft2): 32.3 75.3

Wood Frame - Unanchored (ft2): 21.5 32.3

Masonry, Concrete, and Steel (ft2): 32.3 75.3

OK Cancel Apply

**Figure 8.29** Structure Occupancy Type Editor - Safe Zones Tab

**Zone Height Information** area (Figure 8.29) the user describes for each zone, occupants that are under 65 or over 65. Finally, in the **Depth \* Velocity Thresholds** area (Figure 8.29), the user describes for the three types of foundations the partial damage or total damage that could occur.



- For certain parameters in HEC-FIA, the user can describe the uncertainty about those parameters. From the **Structure Occupancy Type Editor** (Figure 8.27), click the **General Info/Uncertainty Parameters** tab (Figure 8.30). From the available table the user can describe the uncertainty. Additionally the foundation height is defined at the structure occupancy type level. The foundation height is utilized in the life loss compute, and if uncertainty about the foundation height is to be evaluated as a part of the overall risk analysis process the user can edit that uncertainty at the occupancy type level. Also, from this tab, the user can describe information about cars from the **Automobile Data** area (Figure 8.30).

Structure Occupancy Type Editor  
OccType Edit Records Reports Tools

Name: COM10  
Description: Garage

Depth-Damage Functions | Safe Zones | General Info/Uncertainty Parameters

Misc:

Parameter	Error Distribution Type	Most Likely Value	Standard Deviation	Log 10 Standard Deviation	Minimum Value	Maximum Value
Foundation Height (ft)	None	3.0				
Structure Value As % of Mean	None					
Content To Structure Value Ratio (%)	None	50.0				
Other To Structure Value Ratio (%)	None					
Car To Structure Value Ratio (%)	None					

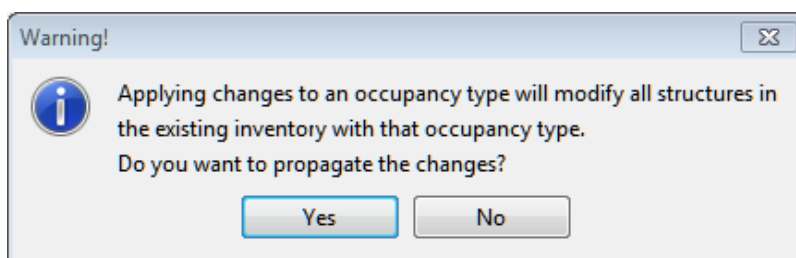
Automobile Data:

Car Height Difference (ft): 0.0  
Car Value (\$1000):  
Number of Cars:  
Car Carry Capacity: 3

OK Cancel Apply

**Figure 8.30** Structure Occupancy Type Editor - General Info/Uncertainty Parameters Tab

- Once the user is finished, click **OK**. A warning message box opens (Figure 8.31). This warning is making the user aware of what making changes to a structure occupancy type entails. Click **Yes**, the warning message box closes, and the **Structure Occupancy Type Editor** (Figure 8.27) closes.



**Figure 8.31** Warning Box - Structure Occupancy Type

## 8.6.2 Incorporating Uncertainty

The majority of the uncertainties pertaining to the economic computations in HEC-FIA are defined at the level of the occupancy type. In other words, uncertainty parameters are typically constant across all structures within a particular occupancy type classification. Thus economic uncertainty is typically entered through the **Structure Occupancy Type Editor - General Info/Uncertainty Parameters** tab (Figure 8.30). There are five major uncertainty parameters, and four major tabular relationships with uncertainty. The five parameters with uncertainty are:



- Foundation Height
- Structure Value (expressed as a percentage of the mean)
- Content to Structure Value Ratio
- Other to Structure Value Ratio
- Car to Structure Value Ratio

When defining these parameters there are two ways the information is input. Either uncertainty is defined as a percentage of the mean, or as a fully specified distribution. In the case of the percentage of the mean, the value of the parameter at an individual structure is used as the mean value for the structure and the standard deviation is defined as a percentage of the mean. This coefficient of variation is multiplied by the value of the parameter at the structure, and then sampled using the chosen distribution; the resulting value is used for the structure. In this case, all structures have different results, but the distance from the mean is the same relative distance. In the case where parameters are defined as distributions, there is one sampled value for all structures of that occupancy type, the sampled value is enforced at the structure level.

The four major tabular relationships are:

- Structure Depth-Damage Relationship
- Content Depth-Damage Relationship
- Car Depth-Damage Relationship
- Other Depth-Damage Relationship

The depth-damage relationships are all computed using curve sampling, for more detail on how this works please review the Chapter 9 in the HEC-FIA Technical guide.

### 8.6.3 Import from Defaults

In order to make it easier to populate the depth-damage curve information for each occupancy type, an ability to import from defaults has been added to the program. This is usually an issue if the structure inventory was not imported from HAZUS or the National structure inventory. If the structure inventory occupancy types are not given the same name as the forty default HAZUS based occupancy types, the program has the ability to perform name mapping whereby the occupancy names in the structure inventory are mapped to the equivalent HAZUS occupancy types. This allows depth-damage relationships and other occupancy type parameters to be quickly imported. The imported information can then be reviewed and modified to meet user needs.

### 8.6.4 Delete All Occupancy Types

To delete all occupancy types, from the occupancy type shortcut menu (Figure 8.28), click **Delete All Occupancy Types**, a **Warning** window opens (Figure 8.32). By clicking **Yes** occupancy types are deleted from the structure inventory.

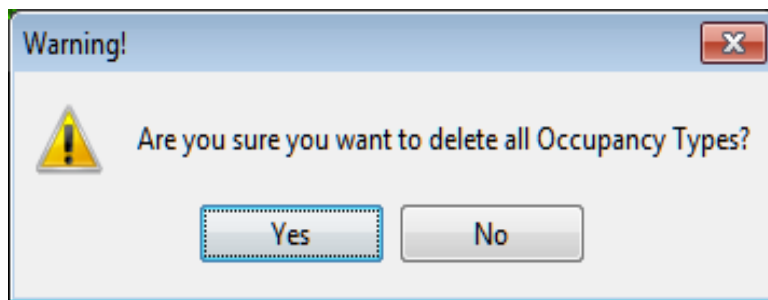


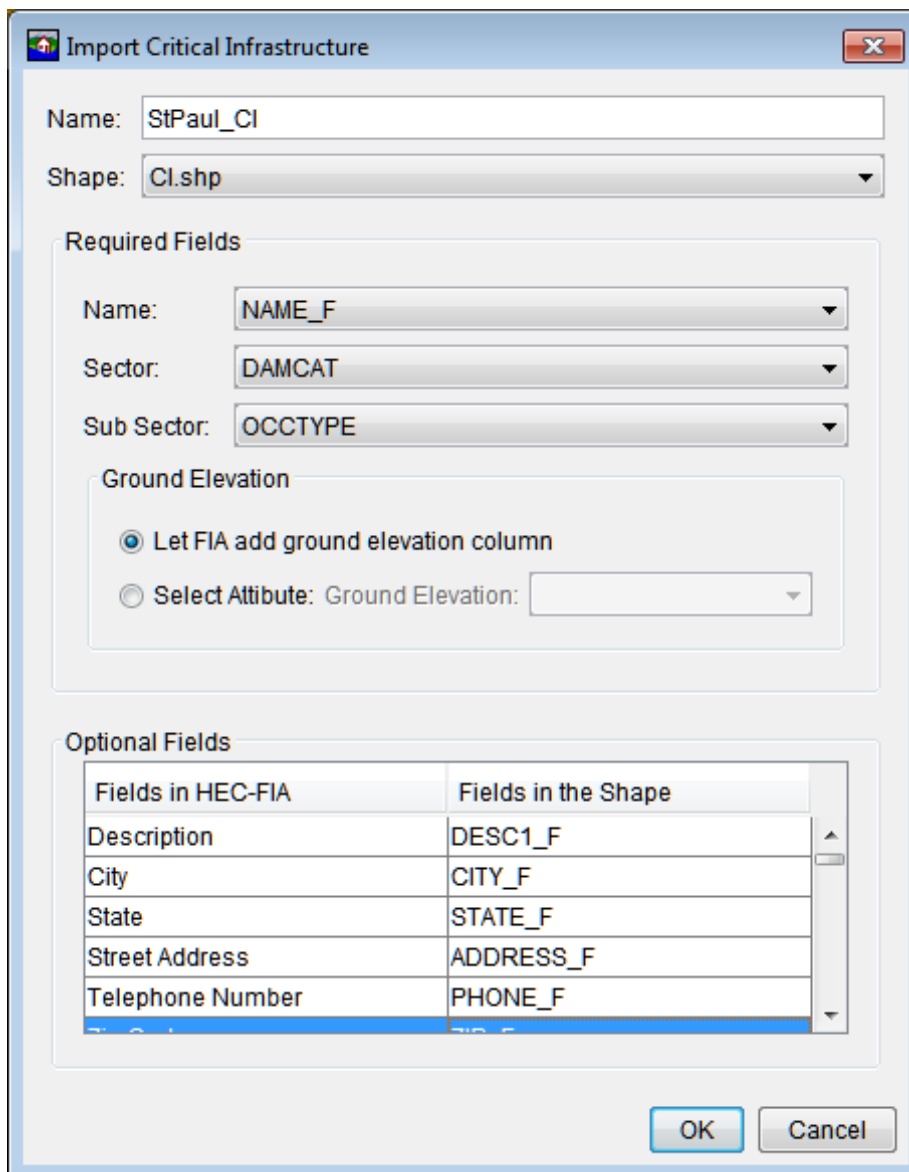
Figure 8.32 Warning Window - Delete All Occupancy Types

## 8.7 Critical Infrastructure

Critical infrastructure includes structures in the floodplain that are critical to the Nation or that region, but not part of a traditional structure inventory. These critical infrastructure elements may be elements that have tremendous service value such as utilities or bridges; or they may also pose risks to the population due to the presence of hazardous materials such as chemical facilities. It can be difficult to assign a dollar value to these structures or describe the impacts to the economy based on inundation. However, it is critical to describe when these locations are inundation and duration of flooding. HEC-FIA does not evaluate economic losses at critical infrastructure elements. Instead it tracks and reports hydraulic event parameters using a shapefile format. This allows the user to identify timing, depth and durations of flooding at the critical infrastructure. The import process via point shapefile is similar to the structure inventory import process.

To create a critical infrastructure:

1. From the **Study Pane**, from the **Inventory** folder, right-click on the **Critical Infrastructure** folder. From the shortcut menu, click **Import**; the **Import Critical Infrastructure** dialog box opens (Figure 8.33).
2. Provide a name for the critical infrastructure in the **Name** box on the **Import Critical Infrastructure** dialog box (Figure 8.33).
3. Select the shapefile from the **Shape** list.
4. In the **Required Fields** box, the user needs to provide information from the shapefile fields for **Name**, **Sector** (damage category), and **Sub Sector** (structure occupancy type).
5. For ground elevation HEC-FIA can calculate the ground elevation from the terrain grid (**Let FIA add ground elevation column**) or the user can select the attribute (**Select Attribute**) that best describes the ground elevation. Some elements (like bridges) do not provide good values from the terrain grid if the terrain represents the river surface rather than the bridge surface, so if HEC-FIA adds the ground elevation, make sure to enter an override elevation for elevations that describe when damages would begin to occur.
6. Optional information can be provided from the **Optional Fields** box. Suggested optional fields are Description, Street Address, City, State, Zip Code, and Telephone Number.



The dialog box is titled "Import Critical Infrastructure". It contains the following fields and options:

- Name:** StPaul\_CI
- Shape:** CI.shp
- Required Fields:**
  - Name:** NAME\_F
  - Sector:** DAMCAT
  - Sub Sector:** OCCTYPE
- Ground Elevation:**
  - ☒ Let FIA add ground elevation column
  - ☐ Select Attribute: Ground Elevation: [dropdown]
- Optional Fields:**

Fields in HEC-FIA	Fields in the Shape
Description	DESC1_F
City	CITY_F
State	STATE_F
Street Address	ADDRESS_F
Telephone Number	PHONE_F

At the bottom right are **OK** and **Cancel** buttons.

**Figure 8.33** Import Critical Infrastructure Dialog Box

- Now that everything is defined, click **OK**. The **Import Critical Infrastructure** dialog box (Figure 8.33) closed. Under the **Critical Infrastructure** folder in the **Study Pane**, the name of the critical infrastructure (*StPaul\_CI*) appears.

### 8.7.1 Critical Infrastructure Shortcut Menu

Once a critical infrastructure inventory has been created there are several ways a user can manipulate the critical infrastructure from a shortcut menu. From the **Study Tree**, under the **Critical Infrastructure** folder, right click on the created critical infrastructure (e.g., *StPaul\_CI*). From the shortcut menu (Figure 8.34) the user can display/remove the critical infrastructure from the active **Map Window**, edit the critical infrastructure, save as, rename, delete/remove the critical infrastructure from the HEC-FIA project, and review properties of the critical infrastructure file.

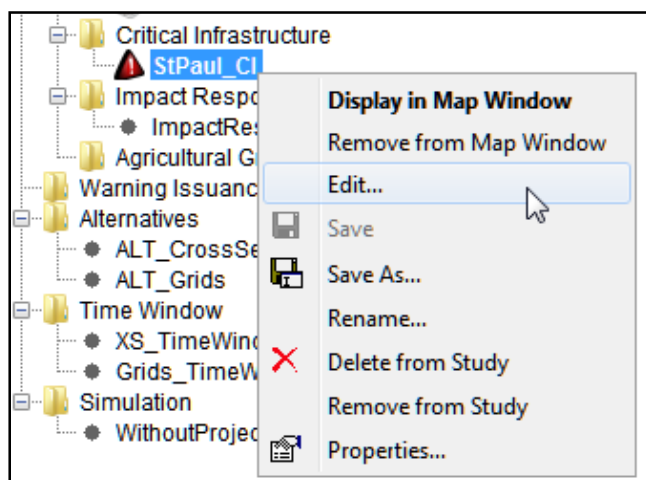


Figure 8.34 Critical Infrastructure Shortcut Menu

## Display in Map Window

To display the critical infrastructure locations in the HEC-FIA project, from the critical infrastructure shortcut menu (Figure 8.34), click **Display in Map Window**. The **Map Window** now includes the critical infrastructure locations (Figure 8.35). To turn off the critical infrastructure locations in the HEC-FIA project, from the critical infrastructure shortcut menu (Figure 8.34) click **Remove from Map Window**.

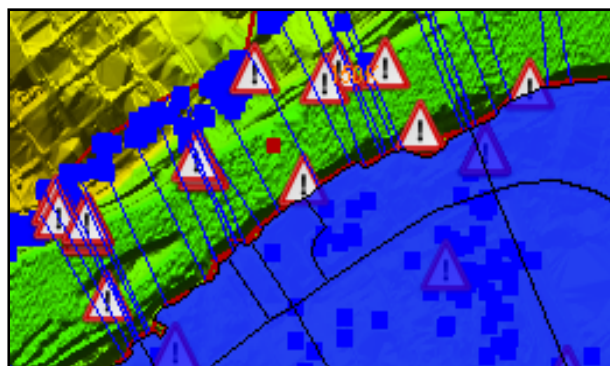


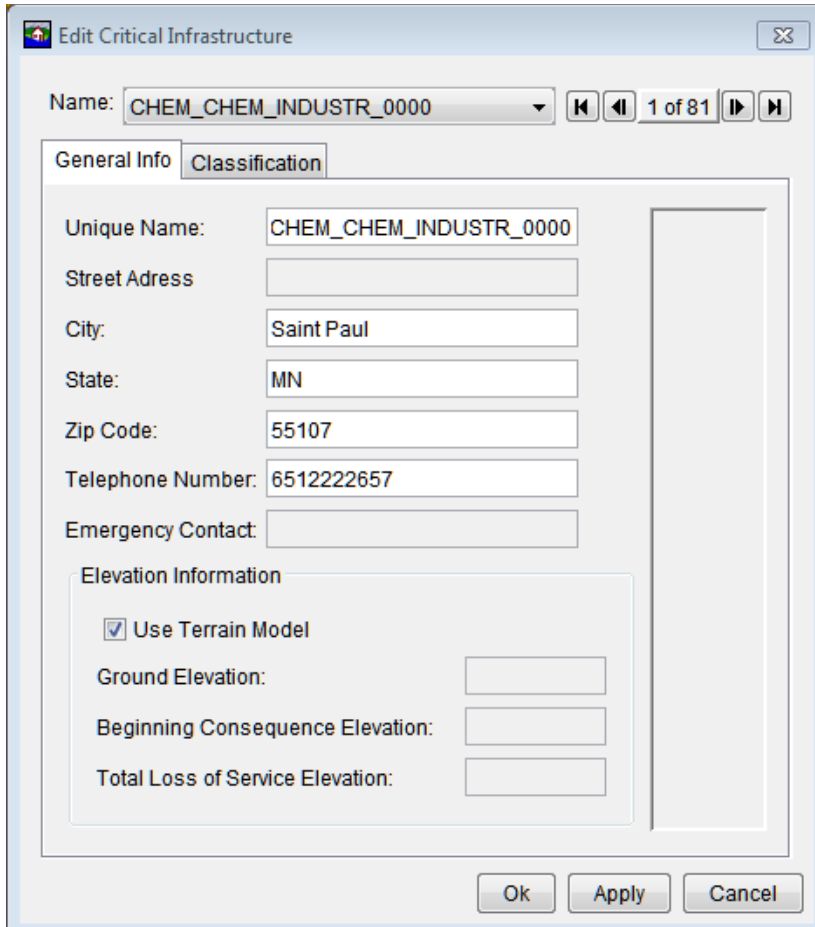
Figure 8.35 Critical Infrastructure Locations

## Edit

To edit a defined critical infrastructure, from the critical infrastructure shortcut menu (Figure 8.34), click **Edit**, the **Edit Critical Infrastructure** dialog box opens (Figure 8.36). If user wants to override the terrain model elevation for the critical infrastructure element, uncheck the **Use Terrain Model** check box and define the ground elevation in the appropriate text box.

## Save As

To create a copy of a critical infrastructure, from the critical infrastructure shortcut menu (Figure 8.34), click **Save As**, the **Save Critical Infrastructure As** dialog box opens (similar to



**Figure 8.36** Edit Critical Infrastructure Dialog Box

Figure 8.18). In the **Name** box enter the name of new critical infrastructure. The user can enter a description of the critical infrastructure in the **Description** box. From the **Directory** box specify the location of the new critical infrastructure. Click **OK**, the **Save Critical Infrastructure As** dialog box closes, and the new critical infrastructure is created.

## Rename

To rename the critical infrastructure, from the critical infrastructure shortcut menu (Figure 8.34), click **Rename**, the **Rename Critical Infrastructure** dialog box opens (similar to Figure 8.19). In the **Name** box enter the new name of critical infrastructure. The user can enter a description of the critical infrastructure in the **Description** box. Click **OK**, the **Rename Critical Infrastructure** dialog box closes, and the critical infrastructure has been renamed.

## Delete from Study

To delete the critical infrastructure and its associated files from the HEC-FIA project, from the critical infrastructure shortcut menu (Figure 8.34), click **Delete from Study**, a **Confirm Manager Delete** window opens (similar to Figure 8.20). By clicking **Yes**, the **Confirm Manager Delete** window closes, and the critical infrastructure and its associated files are deleted from the HEC-FIA project.

## Remove from Study

To remove the critical infrastructure from the HEC-FIA project (does not delete files), from the critical infrastructure shortcut menu (Figure 8.34), click **Remove from Study**; a **Confirm Removal** window opens (similar to Figure 8.21). By clicking **Yes**, the **Confirm Removal** window closes, and the critical infrastructure is from the HEC-FIA project.

## 8.8 Impact Response

Impact response tables allow the user to define an impact and associate it with a stage or flow threshold at a specific hydrograph location. The user can define a threshold to be either a ">" sign or a "<" sign. The greater than sign evaluates when the DSS hydrograph becomes greater than the threshold, thus it is a flood stage threshold. The less than sign evaluates when the DSS hydrograph is less than the threshold, thus it is a low stage threshold (i.e., navigation can no longer occur). In HEC-FIA each time the threshold is crossed, the threshold is tracked when the opposite condition becomes true again within the same event, and if the threshold is then crossed again, that time and date is recorded.

To create an impact response:

1. From the **Study Pane**, from the **Inventory** folder, right-click on the **Impact Response** folder. From the shortcut menu, click **New**; the **New Impact Response** dialog box opens (Figure 8.37).

**New Impact Response**

Name:

Description:

Inundation Configuration: CrossSectionsOnly

Name	Cross Sections	Operator	Threshold	Flood Impact	Action Required
Flood Stage at Bridge	MissRiver thru_St_Paul:149219.7:ST...	>	954.72	If water levels are above eleva...	Alert the Authorities

**Figure 8.37** New Impact Response Dialog Box

2. Provide a name for the impact response rule set in the **Name** box on the **New Impact Response** dialog box (Figure 8.37).
3. Select a defined inundation configuration from the **Inundation Configuration** list.

4. To generate the rules that define the impact response, click **Add Row**. A blank row appears in the table on the **New Impact Response** dialog box (Figure 8.37). Enter a name for the rule (*Flood Stage at Bridge*) in the **Name** column. From the **Cross Sections** column, select the cross section where the impact is measured. From the **Operator** column, select the operator for the rule. Enter the threshold in the **Threshold** column. Enter the impacts and actions in the **Flood Impact** and **Action Required** columns.
7. Once everything is defined, click **OK**. **New Impact Response** dialog box (Figure 8.36) closes. Under the **Impact Response** folder in the **Study Pane**, the name of the impact response (*StPaul\_Impact Response*) appears.

## 8.8.1 Impact Response Shortcut Menu

Once an impact response has been created there are several ways to manipulate the impact response from a shortcut menu. From the **Study Tree**, under the **Impact Response** folder, right click on the created impact response (e.g., *StPaul\_ImpactResponse*). From the shortcut menu (Figure 8.38) the user can edit the impact response; save as, rename, delete/remove the impact response from the study; or review the properties of the impact response file.

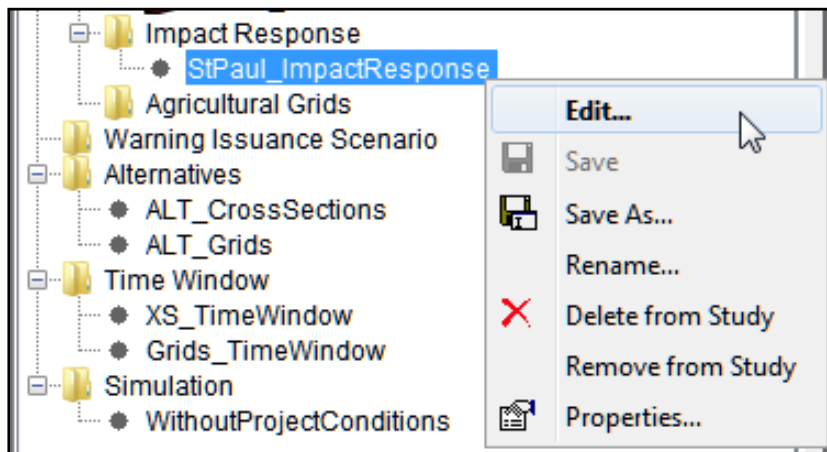


Figure 8.38 Impact Response Shortcut Menu

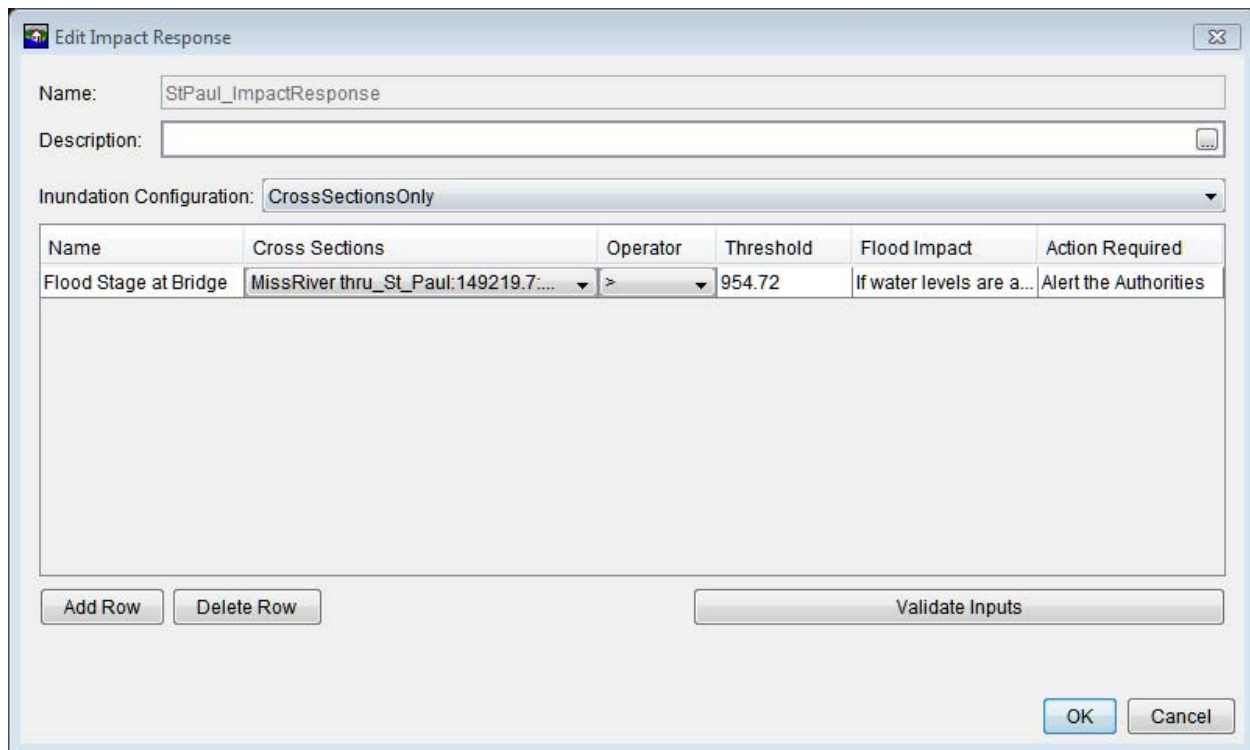
### Edit

To edit a defined impact response, from the impact response shortcut menu (Figure 8.38), click **Edit**, the **Edit Impact Response** dialog box opens (Figure 8.39).

### Save As

To create a copy of a defined impact response, from the impact response shortcut menu (Figure 8.38), click **Save As**, the **Save Impact Response As** dialog box opens (similar to Figure 8.18). In the **Name** box enter the name of new impact response. The user can enter a description of the impact response in the **Description** box. From the **Directory** box the user can specify the location of the new impact response. Click **OK**, the **Save Impact Response As** dialog box closed, and the new impact response is created.





The dialog box is titled "Edit Impact Response". It contains the following fields and controls:

- Name:** A text box containing "StPaul\_ImpactResponse".
- Description:** An empty text box with a help icon on the right.
- Inundation Configuration:** A dropdown menu set to "CrossSectionsOnly".
- Table:** A table with 6 columns: Name, Cross Sections, Operator, Threshold, Flood Impact, and Action Required.
 

Name	Cross Sections	Operator	Threshold	Flood Impact	Action Required
Flood Stage at Bridge	MissRiver thru_St_Paul:149219.7:....	>	954.72	If water levels are a...	Alert the Authorities
- Buttons:** "Add Row", "Delete Row", "Validate Inputs", "OK", and "Cancel".

**Figure 8.39** Edit Impact Response Dialog Box

## Rename

To rename the impact response, from the impact response shortcut menu (Figure 8.38), click **Rename**, the **Rename Impact Response** dialog box opens (similar to Figure 8.19). In the **Name** box enter the new name of the impact response. The user can enter a description of the impact response in the **Description** box. Click **OK**, the **Rename Impact Response** dialog box closes, and the impact response is renamed.

## Delete from Study

To delete a defined impact response and its associated files from the HEC-FIA project, from the impact response shortcut menu (Figure 8.38), click **Delete from Study**. A **Confirm Manager Delete** window opens (similar to Figure 8.20). By clicking **Yes**, the **Confirm Manager Delete** window closed, and the impact response and its associated files are deleted from the HEC-FIA project.

## Remove from Study

To remove the impact response from the HEC-FIA project (does not delete files), from the impact response shortcut menu (Figure 8.38), click **Remove from Study**. A **Confirm Removal** window opens (similar to Figure 8.21). By clicking **Yes**, the **Confirm Removal** window closed, and the impact response is removed from the HEC-FIA project.

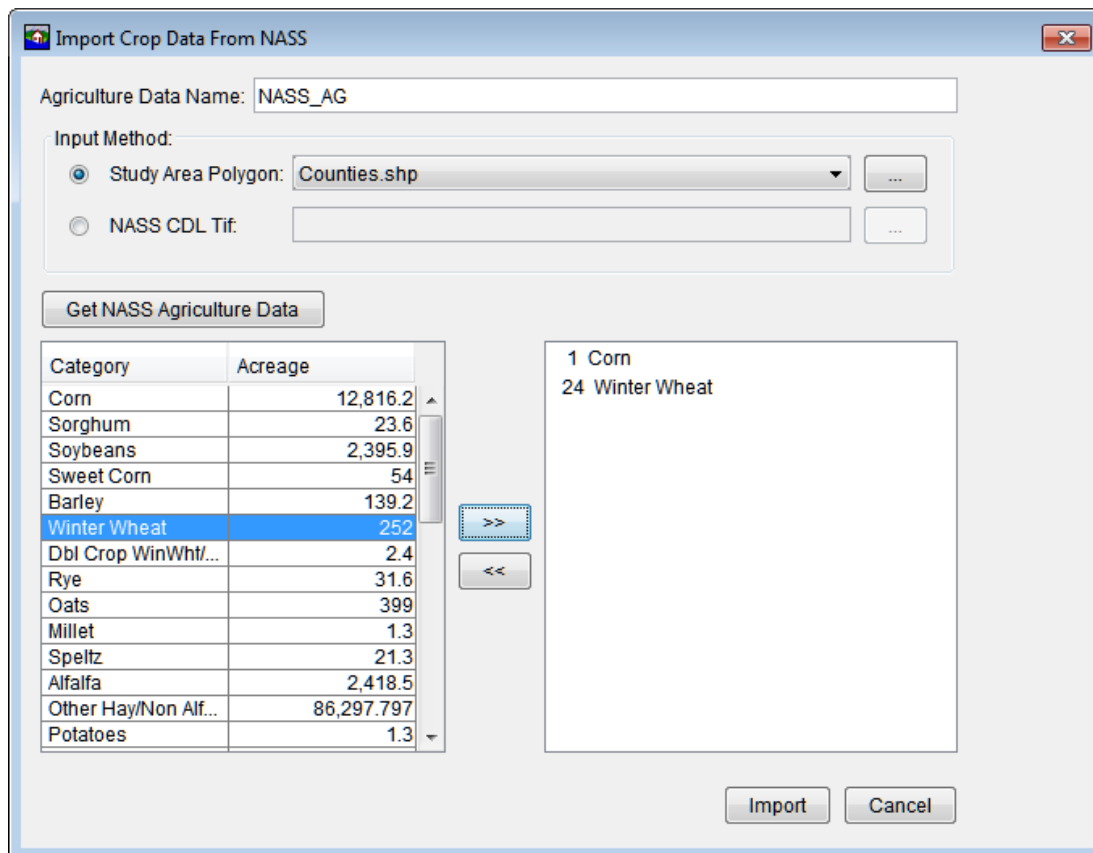


## 8.9 Agricultural Grids

Agriculture data can be downloaded through a link to the NASS data based on the study area shapefile, or the data can be downloaded externally and added through a GeoTif shapefile. Agricultural data is not typically used in a consequence assessment; however it may assist the user in understanding the amount and type of agriculture in the floodplain and potential flood impacts to it. Additionally, users may find it beneficial to download the urban areas and open water to utilize them to verify structure locations.

### 8.9.1 Create an Agricultural Grid

Agricultural grids are generated from NASS CDL grids. To create an agricultural grid, from the **Study Pane** from the **Inventory** folder, right click on **Agricultural Grids**. Point to **Generate From NASS**, click **Load NASS CDL Grid**, the **Import Crop Data From NASS** dialog box opens (Figure 8.40).



**Figure 8.40** Import Crop Data from NASS Dialog Box

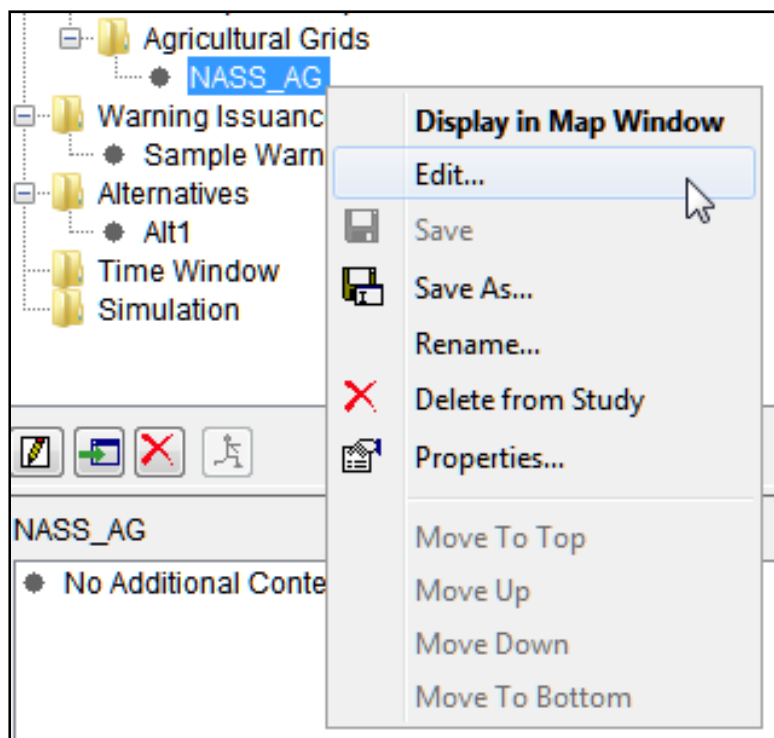
1. Provide a name for the agricultural grid in the **Agriculture Data Name** box on the **Import Crop Data from NASS** dialog box (Figure 8.40).
2. Determine the input method to use. For the example in Figure 8.40, the user has selected a shapefile from the **Study Area Polygon** list; this downloads the data from the NASS website for the Year 2006. The user can use a defined NASSCDL tif. The benefit of

downloading data from the NASS website is that the user can choose what year to download.

3. Click **Get NASS Agriculture Data** (only available on the study area polygon: method), this accesses the NASS website and retrieves information based on the selected shapefile. Otherwise, the category and acreage list comes from the user supplied NASS CDL.tif.
4. Once the data has been retrieved, the table populates the crop information (name, acreage). From that list, the user selects which crops are reported for the HEC-FIA project.
5. Now that everything is defined, click **OK**. The **Import Crop Data from NASS** dialog box (Figure 8.40) closes. HEC-FIA then filters the tif to only include cells with the crop types that were selected for import, and then the tif is clipped to represent the study area. Under the **Agricultural Grids** folder in the **Study Pane**, the name of the agricultural grid (NASS\_AG) appears.

## 8.9.2 Agricultural Grid Shortcut Menu

Once an agricultural grid has been created there are several ways the grid can be manipulated from a shortcut menu. From the **Study Tree**, under the **Agricultural Grids** folder, right-click on the created agricultural grid (e.g., NASS\_AG). From the shortcut menu (Figure 8.41) the user can display/remove the agricultural grid from the active **Map Window**, edit the agricultural grid, save as, rename, delete/remove the agricultural grid from the study, and review properties of the agricultural grid file.



**Figure 8.41** Agricultural Grid Shortcut Menu

## Edit

To edit a defined agricultural grid, from the agricultural grid shortcut menu (Figure 8.41), click **Edit**, the **Crop Loss Editor** opens (Figure 8.42).

Crop Loss Editor

Crop: **Corn** [Navigation icons] 1 of 2 [Navigation icons]

	Date (DDMMM)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fixed Cost		\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00
Variable Cost First Planting	25Mar	\$1.00	\$22.00	\$143.00	\$106.00	\$136.00	\$62.00	\$60.00	\$4.00	\$44.00	\$42.00	\$1.00	\$1.00
Variable Cost Last Planting	30Apr	\$1.00	\$1.00	\$22.00	\$173.00	\$213.00	\$60.00	\$60.00	\$4.00	\$44.00	\$42.00	\$1.00	\$1.00

Substitute Crop: **Soybeans**

Harvest Date	Harvest Cost	Yield	Unit	Unit Price	% Loss from Late Plant
30Sep	\$35.00	6.0	Ton	\$169.50	2.0

Number of Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0.0

Add Duration

Plot Tabulate OK Cancel

**Figure 8.42** Crop Loss Editor

Each crop needs the planting date information filled out; in addition to how much production costs are spent on the crop on a monthly basis. This information typically comes from a local land grant university through an agricultural extension agency. Additionally, price, yield, and harvest cost/date information needs to be populated. This information typically comes from the agriculture extension service or from the NASS website.

## Save As

To create a copy of the agricultural grid, from the agricultural grid shortcut menu (Figure 8.41), click **Save As**, the **Save Agricultural Grids As** dialog box opens (similar to Figure 8.18). In the **Name** box enter the name of new agricultural grid. The user can enter a description of the agricultural grid in the **Description** box. From the **Directory** box specify the location of the new agricultural grid. Click **OK**, the **Save Agricultural Grids As** dialog box closes, and the new agricultural grid is created.

## Rename

To rename the agricultural grid, from the agricultural grid shortcut menu (Figure 8.41), click **Rename**, the **Rename Agricultural Grids** dialog box opens (similar to Figure 8.19). In the **Name** box enter the new name of the agricultural grid. The user can enter a description of the agricultural grid in the **Description** box. Click **OK**, the **Rename Agricultural Grids** dialog box closed, and the agricultural grid has been renamed.

## Delete from Study

To delete the agricultural grid and its associated files from the HEC-FIA project, from the agricultural grid shortcut menu (Figure 8.41), click **Delete from Study**, a **Confirm Manager Delete** window opens (similar to Figure 8.20). By clicking **Yes**, the **Confirm Manager Delete** window closes, and the agricultural grid and its associated files are deleted from the HEC-FIA project.

## Remove from Study

To remove the agricultural grid from the HEC-FIA project (does not delete files), from the agricultural grid shortcut menu (Figure 8.41), click **Remove from Study**; a **Confirm Removal** window opens (similar to Figure 8.21). By clicking **Yes**, the **Confirm Removal** window closes, and the agricultural grid is removed from the HEC-FIA project.

# CHAPTER 9

## Warning Issuance Scenario

In HEC-FIA the warning issuance defines the moment a warning is issued to the population at risk. The issuance of warning can be generated as the result of hydraulic event (e.g. the exceedance of a specified stage at a particular location or appearance of water on the interior side of a levee) or the passage of an amount of time in the simulation (e.g. thirty minutes after the start of the simulation). A lag can be specified to simulate the time between the physical occurrence of the event and the human response of issuing a warning in response to that event. If the user defines a warning issuance relative to a rule that uses a specific location and threshold, the warning issuance is dependent upon a particular inundation configuration and hydraulic event. If the user defines a warning issuance relative to start time, the warning issuance works with any alternative, and is dependent upon the start time of the time window used in the simulation.

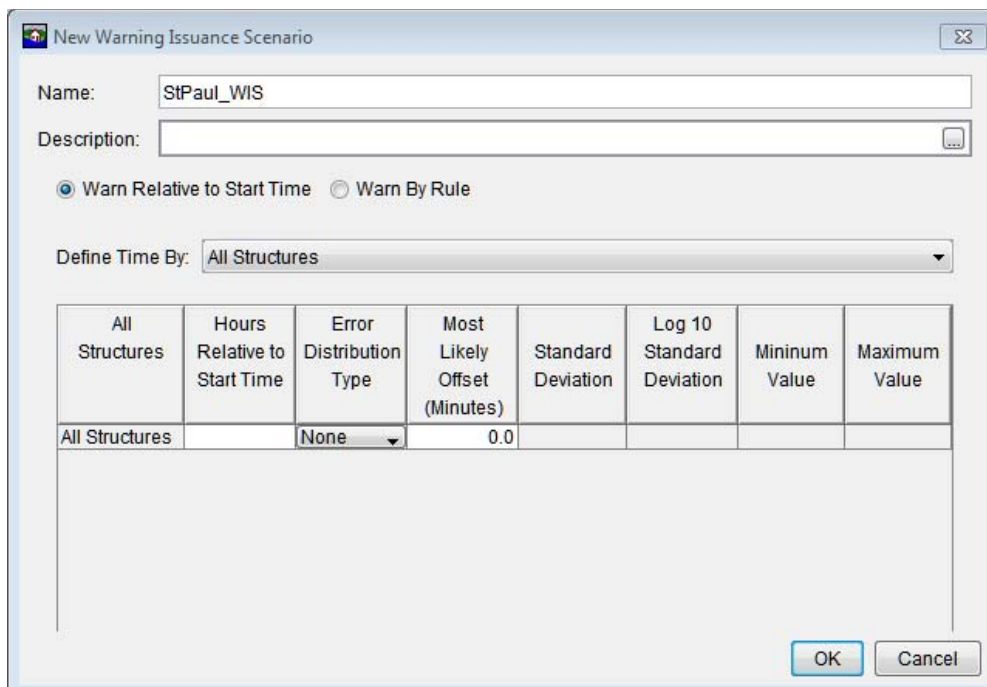
Warning issuance times are a critical component of the life loss computation, and can be a major source of uncertainty in the life loss results. For instance, if a house is located close to the river near a dam, inundation can occur quickly and the warning issuance may drive loss of life estimations. On the other hand, when inundation occurs hours after the occurrence of particular event, warning issuance may not be the most important factor in the computation of loss of life risks.

Warning issuance times also impact economic losses through the evacuation of cars during loss of life computation. Each occupancy type has a car carrying capacity, and each structure has a number of cars and people associated with it. The number of people that evacuate safely determines how many cars are left in the floodplain to be damaged.

### 9.1 Create a Warning Issuance Scenario

To create a warning issuance scenario:

1. From the **Study Pane**, right-click **Warning Issuance Scenario**, from the shortcut menu click **New**. The **New Warning Issuance Scenario** dialog box opens (Figure 9.1).
2. Enter a name in the **Name** box (Figure 9.1), an optional description can be provided in the **Description** box.
3. Warnings can be issued either by **Warn Relative to Start Time** (default) or **Warn By Rule**. The **New Warning Issuance Scenario** dialog box changed dependent upon which warning type is selected.
4. Once a selection is made for how the warning is triggered, a selection has to be made for where the warning is broadcast. In the **Define Time By** dropdown menu one of two options can be selected **All Structures** (default), or by **Warning Region**.



The dialog box is titled "New Warning Issuance Scenario". It contains the following fields and controls:

- Name:** A text box containing "StPaul\_WIS".
- Description:** An empty text box with a help icon.
- Warn Relative to Start Time** (selected radio button) and **Warn By Rule** (unselected radio button).
- Define Time By:** A dropdown menu currently showing "All Structures".
- Table:** A table with 8 columns: "All Structures", "Hours Relative to Start Time", "Error Distribution Type", "Most Likely Offset (Minutes)", "Standard Deviation", "Log 10 Standard Deviation", "Minimum Value", and "Maximum Value". The first row shows "All Structures", an empty cell, "None" (with a dropdown arrow), "0.0", and four empty cells.
- Buttons:** "OK" and "Cancel" buttons at the bottom right.

**Figure 9.1** New Warning Issuance Scenario Dialog Box

- Once the warning issuance scenario has been defined, click **OK**. The **New Warning Issuance Scenario** dialog box (Figure 9.1) closes, and the newly defined warning issuance scenario appears in the **Study Tree**, under the **Warning Issuance Scenario** folder.

### 9.1.1 Warn Relative to Start Time

Warning relative to start time issues a warning that is a fixed number of hours relative to the start time of the simulation regardless of the event being modeled, or the type of inundation configuration. This option is designed to support **Grids Only** inundation configurations, where no logical physical trigger exists in the data. Typically, warning occurs relative to the initiation of a breach condition in the hydraulic model. Through coordination between HEC-FIA and a hydraulic modeler, a breach condition can be defined relative to the start of the simulation. Arrival time grids are defined relative to the start time. Thus an arrival time of zero signifies arrival of water at the beginning of the specified time window. If the hydraulic modeler generates an arrival grid such that the first time in the grid is the breach time, every cell that was wet before the breach maps to zero. Warning time can cause issues if there are a significant amount of structures in the floodplain that are in the cells that were wet before breach. It is very important that the hydraulic modeler and the HEC-FIA user coordinate. However, if the warning issuance relative to start time is also set at zero, the warning goes out on the first time step of the HEC-FIA simulation. If the user sets the warning issuance to be -30, the warning goes out 30 minutes before the simulation start, which would be equivalent to 30 minutes before breach.

When using gridded data, the time in the HEC-FIA time window does not have to be the same as the simulation time in HEC-RAS, but the relative timing must be preserved. When using HEC-DSS time series data, the times in the time window must be within the times in the HEC-DSS time series.

## All Structures

When the warning issuance time is defined by **All Structures** (Figure 9.1) the same warning time is applied to all structures. Applying the same warning time to all structures is useful when a rough estimate is desired but this scenario is also generally a poor representation of reality.

In the **Hours Relative to Start Time** (Figure 9.1) column the user defines the hours between the **Start Time** identified in the **Time Window** (Chapter 11) and the issuance of the warning. Numbers for hours relative to start time can be entered in decimals such that 1.5 is equivalent to 1 hour and 30 minutes after the start time and -.25 would be 15 minutes before the start of the simulation.

From the **Error Distribution Type** list there are five choices - **None**, **Normal**, **Log Normal**, **Triangular**, and **Uniform**. The choice of the error distribution makes the last four columns in the table editable or non-editable (**Standard Deviation**, **Log10 Stand Deviation**, **Minimum Value**, and **Maximum Value**). An offset (in minutes) is entered in the **Most Likely Offset** column.

## Warning Region

Defining the warning issuance time by **Warning Region** (Figure 9.2) allows the user to use a polygon shapefile to define which rule or what time the warning issuance occurs within each polygon in the polygon shapefile.

Warning Region	Hours Relative to Start Time	Error Distribution Type	Most Likely Offset (Minutes)	Standard Deviation	Log 10 Standard Deviation	Minimum Value	Maximum Value
10	10	None	0.0				
11	20	None	0.0				
12	30	None	0.0				
13	40	None	0.0				
14	50	None	0.0				
2	60	None	0.0				
3	70	None	0.0				
4	80	None	0.0				
5	90	None	0.0				
6	100	None	0.0				
7	110	None	0.0				
8	120	None	0.0				
9	130	None	0.0				

**Figure 9.2** New Warning Issuance Scenario Dialog Box - Define Time by Warning Region

1. From the **New Warning Issuance Scenario** dialog box (Figure 9.1), from the **Define Time By** list, select **Warning Region**.
2. From the **Warning Region** list (Figure 9.2) select the appropriate shapefile.
3. The selected shapefile contains a unique name field that contains the warning regions. From the **Attribute** list (Figure 9.1), select the appropriate field name. The table on the **New Warning Issuance Scenario** dialog box (Figure 9.2) now has a row for each polygon contained in the shapefile (a multi-part polygon should only have one record in the table). As described in the **All Structures** section, the user provides information for the remainder of the table.

### 9.1.2 Warn By Rule

Warning by rule is an option that allows users to input stage based warning issuance rules. For instance the user may specify that a warning is issued whenever the river stage exceeds a flood stage at a gage of interest in the study area. The specified rules depend upon the dynamics of the study area and its hydraulic characteristics. This option should not be utilized when using a Grids Only inundation configuration.

From the **New Warning Issuance Scenario** dialog box (Figure 9.1) select **Warn by Rule**, the **New Warning Issuance Scenario** dialog box changes (Figure 9.3). To define rules proceed with the following steps:

**New Warning Issuance Scenario**

Name: Warn By Rule

Description: This option is useful when you have a hydrograph to define a threshold on.

☐ Warn Relative to Start Time ☒ Warn By Rule

Inundation Configuration: crosssections

Rules:

DownStreamControlPoint

Name: DownStreamControlPoint

☒ Match any of the following ☐ Match all of the following

Location	Operator	Threshold
MissRiver thru St Paul:144740.3	>	1.24

New Remove More Fewer

Define Time By: All Structures

All Structures	Rule	Error Distribution Type	Most Likely Offset (Minutes)	Standard Deviation	Log 10 Standard Deviation	Minimum Value	Maximum Value
All Structures		None	0.0				

OK Cancel

**Figure 9.3** New Warning Issuance Scenario Dialog Box - Warn By Rule



1. From the **Inundation Configuration** list (Figure 9.3), select the inundation configuration that is intended to be used for this warning issuance scenario. Rules can only be defined at locations where a hydrograph is present, so only inundation configurations that contain cross sections or CCPs can be used for rule based warnings.
2. Click **New**, this creates a new rule and provides a default name in the **Name** box (Figure 9.3). The **Name** box is editable so the user can change the name to a more meaningful name.
3. There are two options for how the rule is executed:
  - **Match any of the following** is an OR logical statement. An example would be: "if condition one is met OR condition two is met, then the warning has been triggered".
  - **Match all of the following** is an AND logical statement. An example would be: "if condition one is met AND condition two is met, then the warning has been triggered".
4. Once the user has made a selection on how the rule is executed, click **More** to add a **location**, **operator** and **threshold** to the table (Figure 9.3). A **location** is a specific cross section or common computation point. This provides HEC-FIA with information to know which hydrograph to use (a record in a HEC-DSS file), so that the condition can be tracked.

An **operator** is an expression symbol which defines how to evaluate the condition. For instance if the user chooses the "=" operator, the warning is only initiated when stage is exactly equal to the threshold. If the user uses the operator ">", the warning is issued as soon as the hydrograph exceeds the threshold value, if the first time step of the hydrograph is greater than the threshold, the warning goes out on the first time step.

A **threshold** is a value that is used to compare to the hydrograph based on the operator symbol. Be sure to define the threshold in the same units and type as the hydrograph data supplied at the location.

5. Once the rules are defined, specify the geographic extent and the offset time using the options outlined in Section 9.1.1.

### 9.1.3 Incorporating Uncertainty

Many factors may influence when a warning is actually issued. In HEC-FIA, the user is able to define uncertainty about the warning issuance. However, the components of this uncertainty are lumped into a single distribution. Examples scenarios contributing to this lumped sum uncertainty distribution include the chance that a warning is issued in anticipation of a particular condition being met; the chance that a warning is not issued because it occurs without anyone being aware; or the chance that the warning is delayed due to decision making processes at the Emergency Management Agency, or delays due to the time between identification of the natural event, and notifying the Emergency Management Agency of disaster potential.

To define uncertainty on a warning issuance:

1. The first step is to select a distribution type, from the **New Warning Issuance Scenario** dialog box (Figure 9.2), from the **Error Distribution Type** column in the table (Figure 9.4), select the error distribution type from the available list. The available types are **Normal**, **LogNormal**, **Triangular**, and **Uniform**.

Warning Region	Hours Relative to Start Time	Error Distribution Type	Most Likely Offset (Minutes)	Standard Deviation	Log 10 Standard Deviation	Minimum Value	Maximum Value
10	1.0	None	0.0				
11	2.0	None	0.0				
12	3.0	None	0.0				
13	4.0	None	0.0				
14	5.0	None	0.0				
2	6.0	None	0.0				

**Figure 9.4** New Warning Issuance Scenario Dialog Box - Uncertainty

2. Each distribution type has different values which are required to define the entire distribution, but there are a few things to note when filling out the parameters:
  - The values of the uncertainty distribution parameters are in minutes not hours.
  - The values of the uncertainty distribution parameters are relative to the time defined in the second column of the table. (Hours relative to start or when the rule is executed for the specific event.)
  - The values of the uncertainty are added to the value in the second column of the table, thus negative values make the warning go out earlier, and positive values make the warning issuance happen later.

During a Monte Carlo compute (if this option is selected for an HEC-FIA alternative), a random number is selected for each row in the table (Figure 9.4), and a warning issuance time is calculated for each structure depending on the geo-location of the structure for **Warning Region** or **All Structures**.

## 9.2 Warning Issuance Scenario Shortcut Menu

Once a warning issuance scenario has been created the user can perform various functions on the created warning issuance scenario using the shortcut menu. From the **Study Tree**, under the **Warning Issuance Scenario** folder, right click on the created warning issuance scenario (e.g., *StPaul\_WIS*). From the shortcut menu (Figure 9.5) the user can edit the warning issuance scenario, save as, rename, delete from the FIA project, remove from the FIA project, and review properties of the warning issuance scenario file.

### 9.2.1 Edit

To edit a warning issuance scenario, from the warning issuance scenario shortcut menu (Figure 9.5), click **Edit**, the **Edit Warning Issuance Scenario** dialog box opens (Figure 9.2).

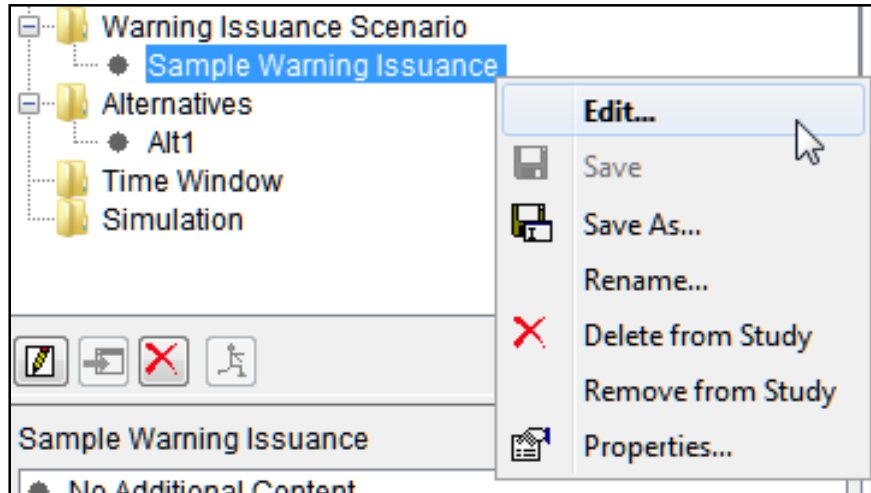


Figure 9.5 Warning Issuance Scenario Shortcut Menu

## 9.2.2 Save As

To create a copy of the warning issuance scenario, from the warning issuance scenario shortcut menu (Figure 9.5), click **Save As**, the **Save Warning Issuance Scenario As** dialog box opens (Figure 9.6). In the **Name** box enter the name of new warning issuance scenario. The user can enter a description of the warning issuance scenario in the **Description** box. From the **Directory** box the user specifies the location of the new warning issuance scenario. Click **OK**, the **Save Warning Issuance Scenario As** dialog box closes, and the new warning issuance scenario is created.

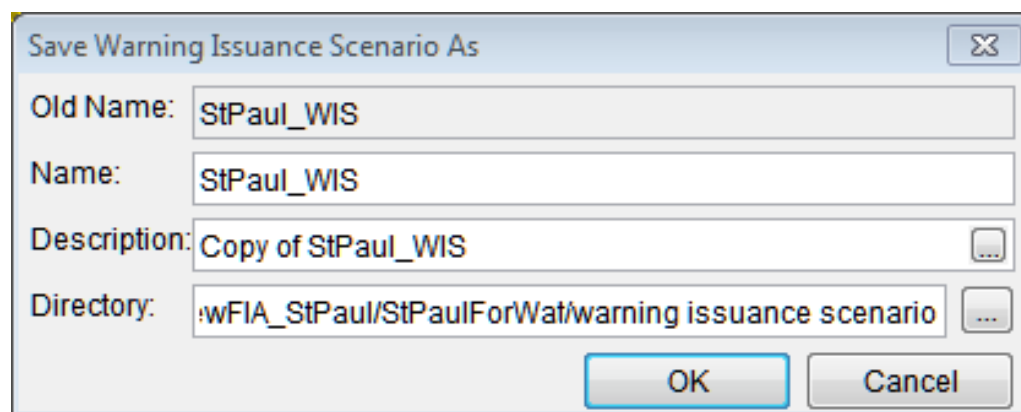


Figure 9.6 Save Warning Issuance Scenario As Dialog Box

## 9.2.3 Rename

To rename the warning issuance scenario, from the warning issuance scenario menu (Figure 9.5), click **Rename**, the **Rename Warning Issuance Scenario** dialog box opens (Figure 9.7). In the **Name** box enter the new name of the warning issuance scenario. The user can enter a description of the warning issuance scenario in the **Description** box. Click **OK**, the **Rename Warning Issuance Scenario** dialog box closes, and the warning issuance scenario has been renamed.

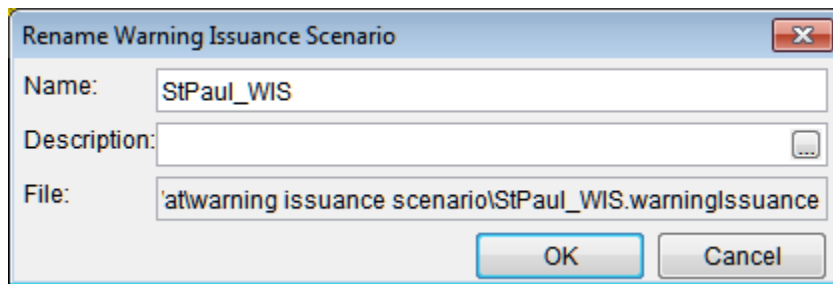


Figure 9.7 Rename Warning Issuance Scenario Dialog Box

## 9.2.4 Delete from Study

To delete the warning issuance scenario and its associated files from the HEC-FIA project, from the warning issuance scenario shortcut menu (Figure 9.5), click **Delete from Study**, a **Confirm Manager Delete** window opens (Figure 9.8). By clicking **Yes**, the **Confirm Manager Delete** window closes, and the warning issuance scenario and its associated files are deleted from the HEC-FIA project.

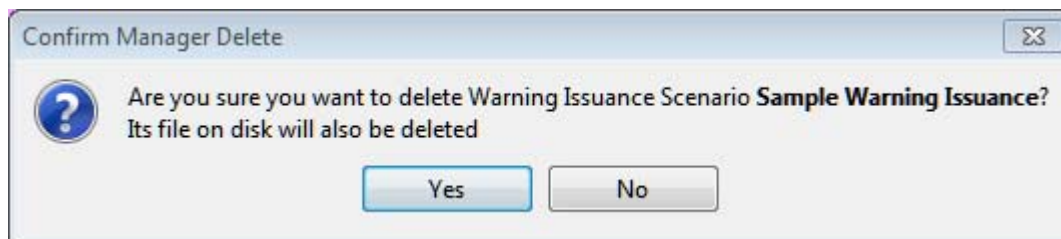


Figure 9.8 Confirm Manager Delete Window

## 9.2.5 Remove from Study

To remove the warning issuance scenario from the HEC-FIA project (does not delete files), from the warning issuance scenario shortcut menu (Figure 9.5), click **Remove from Study**; a **Confirm Removal** window opens (Figure 9.9). By clicking **Yes**, the **Confirm Removal** window closes, and the warning issuance scenario is removed from the HEC-FIA project.

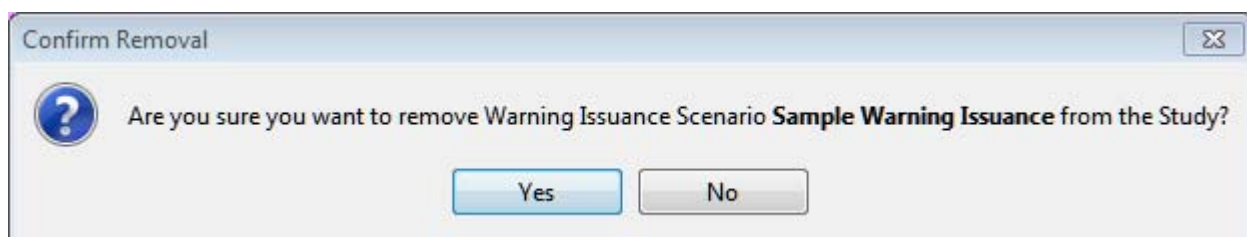


Figure 9.9 Confirm Removal Window

# CHAPTER 10

## Alternatives

In HEC-FIA an alternative is a combination of an Inundation Configuration (includes watershed configurations), Impact Areas, Structure Inventory, Critical Infrastructure, Impact Response Curves, Agricultural Data, and computation settings.

An alternative describes the data used during an HEC-FIA computation and the computations HEC-FIA performs. In addition to defining the internal data HEC-FIA needs, an alternative is also a mechanism for defining the external data elements that are required to fully define a hydraulic event. HEC-FIA alternatives are important for linking HEC-FIA to other models through the HEC-WAT (Watershed Analysis Tool) software and the CWMS (Corps Water Management System) software.

### 10.1 Create an Alternative

1. From the **Study Pane**, right click on **Alternatives** from the shortcut menu, click **New**. The **New Alternative** dialog box opens (Figure 10.1).

The screenshot shows the 'New Alternative' dialog box. The 'Name' field is 'Alt1'. The 'Description' field is empty. The 'Impact Area Set' dropdown is 'Impact Areas'. The 'Inundation Configuration' dropdown is 'CrossSectionsOnly'. The 'Structure Inventory' dropdown is 'Base\_NSI'. The 'Critical Infrastructure' dropdown is 'Critical\_Infrastructure'. The 'Impact Response' dropdown is 'Impact Response'. The 'Agriculture Inventory' dropdown is 'NASS\_AG'. The 'Warning Issuance' dropdown is 'Sample Warning Issuance'. Below these are five tabs: 'Life Loss', 'Agriculture', 'Uncertainty', 'ECAM', and 'Output'. The 'Life Loss' tab is selected. It contains a checkbox 'Compute Life Loss' which is checked. Below it is a checkbox 'Compute Life Loss for Relative Times' which is checked, and a 'Choose Times' button. Below that is a section 'Evacuation Information' with a dropdown 'Define Time By:' set to 'All Structures' and a text field 'EvacuationTime (minutes):' set to '10'. At the bottom are 'OK' and 'Cancel' buttons.

**Figure 10.1** New Alternative Dialog Box

2. In the **Name** box (Figure 10.1) enter a name for the alternative.
3. In the **Impact Area Set** list select an impact area set. This defines the warning systems being used across the study area.
4. From the **Inundation Configuration** list (Figure 10.1), select an inundation configuration. By selecting an inundation configuration, the alternative now has knowledge of a watershed configuration, terrain grid, stream alignment, cross section geometry, common computations points, and a set of gridded results, or a stream and CCP set.
5. From the **Structure Inventory** list, select a structure inventory.
6. If a critical infrastructure has been defined, select one from the **Critical Infrastructure** list (Figure 10.1).
7. If an impact response has been defined, select on from the **Impact Response** list (Figure 10.1).
8. If the HEC-FIA project includes agricultural economics, and agricultural grids have been defined, from the **Agriculture Inventory** list (Figure 10.1), select the appropriate grid.
9. In the bottom half of the **New Alternative** dialog box (Figure 10.1) the available HEC-FIA computation options are available for selections. Depending on what the user selected in Steps 3 thru 8 from above, certain compute options might not be available. Only the economic loss calculation occurs when the lower half of the alternative window is left blank. The following sections describe the input for each computation option.
10. Click **OK**, the **New Alternative** dialog box closes (Figure 10.1). The alternative has been created and the name (*Alt1*) appears in the **Study Tree** under the **Alternatives** folder.

## 10.2 Compute Options for an Alternative

HEC-FIA can analyze a variety of flood damages and impacts through a variety of computational methods. For instance, damage to structures can be computed using grids, cross sections, grids and cross sections, or from common computation points. Flood damages and impacts as well as the methods used to estimate them are selected as part of an alternative definition. The selection of elements in the top half of the **New Alternative** dialog box (Figure 10.1) govern which options are available in the lower half of the **New Alternative** dialog box (Figure 10.1).

### 10.2.1 Life Loss Compute

From the **Life Loss** tab (Figure 10.1), the user can select several options. For instance, the user can compute life loss for relative times, which allows the user to select time of day other than 2 AM and 2 PM. If the user selects **Compute Life Loss** (Figure 10.1), HEC-FIA only computes for 2 AM and 2 PM.

HEC-FIA users can also select options impacting the evacuation time at the structures in the floodplain. These options and their data inputs are described below.

## Compute Life Loss for Relative Times

The **Compute Life Loss for Relative Times** option (Figure 10.1) allows users to define relative times for the loss of life computations and results. To define the relative time, click **Choose Time**, the **Life Loss Computation Time** dialog box opens (Figure 10.2). Users can select up to twelve times per event. Note, while all HEC-FIA life loss computations are based on relative times, this option allows the user to increase the number of relative times, from the 2 AM and 2 PM default times to any other two-hour increment.

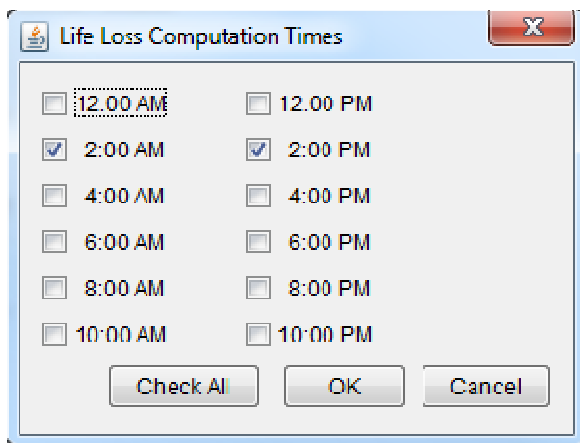


Figure 10.2 Life Loss Computation Times Dialog Box

## Let HEC-FIA Compute

The **Let HEC-FIA Compute** option (Figure 10.3) allows the user to define a hazard area shapefile that represents the areas that are hazardous during the computation. HEC-FIA computes a shortest straight line distance from the structures in this area to the edge of this boundary, and divide that distance by the nominal evacuation speed to determine an amount of time required to evacuate each structure.

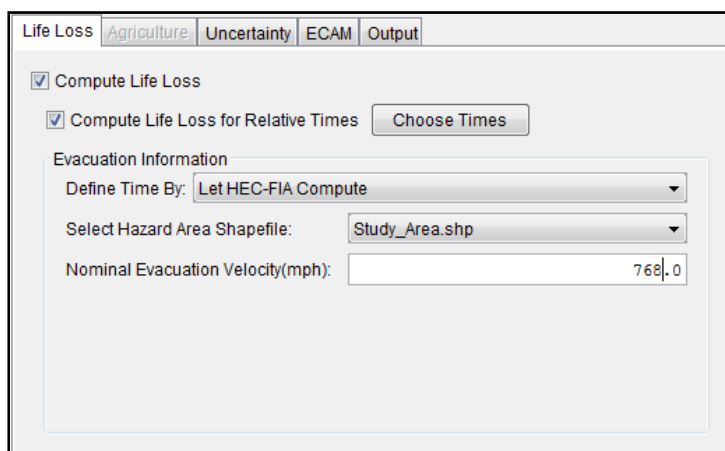


Figure 10.3 Life Loss Compute Option - Let HEC-FIA Compute Option

## All Structures

The **All Structures** option (Figure 10.4) allows the user to define the time in minutes evacuation takes. The same value is used for every structure in the study area.

The screenshot shows the 'Life Loss' dialog box with the 'Agriculture' tab selected. The 'Compute Life Loss' checkbox is checked. Below it, the 'Compute Life Loss for Relative Times' checkbox is also checked, and a 'Choose Times' button is visible. The 'Evacuation Information' section has a dropdown menu set to 'All Structures'. Below this, the 'EvacuationTime (minutes):' is set to 314159.

**Figure 10.4** Life Loss Compute Option - All Structures

## Impact Area

The **Impact Area** option (Figure 10.5) allows the user to define time based on the impact area polygons. HEC-FIA uses the time defined for evacuation for every structure in the impact area.

The screenshot shows the 'Life Loss' dialog box with the 'Agriculture' tab selected. The 'Compute Life Loss' checkbox is checked. Below it, the 'Compute Life Loss for Relative Times' checkbox is also checked, and a 'Choose Times' button is visible. The 'Evacuation Information' section has a dropdown menu set to 'Impact Area'. Below this, there is a table with two columns: 'Impact Area Name' and 'Evacuation Time (minutes)'. The table contains two rows: 'Protected Area' with a value of 271,828 and 'Ramsey' with a value of 314,159.

Impact Area Name	Evacuation Time (minutes)
Protected Area	271,828
Ramsey	314,159

**Figure 10.5** Life Loss Compute Option - Impact Area

## Individual Structures

The **Individual Structure** (Figure 10.6) allows the user to define time for evacuation for each individual structure.



Life Loss **Agriculture** Uncertainty ECAM Output

☒ Compute Life Loss

☒ Compute Life Loss for Relative Times Choose Times

Evacuation Information

Define Time By: Individual Structure

Structure Name	Evacuation Time (minutes)

Figure 10.6 Life Loss Compute Option - Individual Structure

## 10.2.2 Agriculture Compute

**Agriculture Compute** (Figure 10.7) is based on the selected grid and associated budget/duration information for each crop in the grid, the hydraulic event, and the time window. In order to compute agricultural damages the user must select the compute agriculture check box.

Life Loss **Agriculture** Uncertainty ECAM Output

☒ Compute Agriculture

Figure 10.7 Agriculture Compute Option

## 10.2.3 Uncertainty

HEC-FIA 3.0 computes with or without uncertainty (Figure 10.8). Uncertainty settings are available at the parameter level. . For instance, if the user wishes to sample the foundation height for single family residences with no basement, this uncertainty parameter is set where the foundation height for this occupancy time is defined. Thus only alternative level uncertainty options are found in the Uncertainty Compute Option box (Figure 10.8). For instance, users can specify that computations run until convergence is reached, or fixed number of iterations have been simulated. If compute until convergence is selected the parameter to define convergence must be selected; the options are life loss or economic loss.

Users may also select initial input seed; this ensures the reproducibility of the results. Finally, the parameters **Convergence Tolerance** and **Convergence Confidence Interval** (Figure 10.8) define the necessary parameters to establish that a convergence criterion has been met. For more details on the specifics of these settings please visit the Technical Reference guide Chapter 9.

The screenshot shows the 'Uncertainty' tab selected in the HEC-FIA software. The 'Compute With Uncertainty' checkbox is unchecked. Under 'Iteration Controls', 'Until Convergence' is selected with 'Total Damage' as the convergence variable. Under 'Monte Carlo Controls', the 'Initial Seed' is 0, 'Convergence Tolerance' is 0.05, and 'Convergence Confidence Interval' is 0.9.

**Figure 10.8** Uncertainty Compute Option

## 10.2.4 ECAM

Economic Consequences Assessment Model (ECAM) is a computable general equilibrium model of the economy used to evaluate impact of shocks to the economy in terms of reductions in labor and/or capital. HEC-FIA allows users to access the ECAM model through the Internet during simulations (Figure 10.9). To use ECAM during an HEC-FIA simulation an internet connection is required. In the context of HEC-FIA the model is used to evaluate the indirect economic damages associated with a flood event. As stated above, the ECAM model requires estimates of the reductions in labor and capital due to flood events. Since labor reduction

The screenshot shows the 'ECAM' tab selected in the HEC-FIA software. The 'Compute ECAM' checkbox is checked. Under 'County Data Source', 'Manually Define' is selected with an 'Enter County Data' button. 'Path To Hazus' is also an option with a file browser icon. At the bottom, 'Duration (h)' is 24, 'Reconstruction (h)' is 670, and 'Cleanup (h)' is 670.

**Figure 10.9** ECAM Compute Option

calculations take life loss risks into account, ECAM cannot be run unless the life loss compute option is turned on. The labor reductions are based on the number of man hours reduced due to people being displaced from their homes due to flooding and life loss. Capital reductions are based on the damages to commercial, industrial, and public structures and their contents. To

convert these to ratios, a total supply of available labor and capital must be supplied. Because ECAM runs each county independently values for labor and capital must be provided for each county in the study area. The total labor and capital must represent the total for the whole county not the portion of the county in the study area. Available capital is entered as the total value of commercial, industrial and public structures. Labor should be entered as the total under 65 years of age population at all structures at 2AM. For more detail on the assumptions please refer to the paper titled "Using HEC-FIA to Identify the Consequences of Flood Events" (Lehman, W.P., Dunn, C.N., and Light, Dr. M., 2014)

The user must estimate in hours the duration of the flood, reconstruction, and cleanup after the flood. This estimate is used to determine the number of work hours that a laborer is unavailable to perform his or her job.

## 10.2.5 Output

By default HEC-FIA turns off most output options during Monte Carlo runs due to the size of those outputs. However, HEC-FIA allows users to output hydraulic input data at each structure for QA/QC purposes (Figure 10.10).

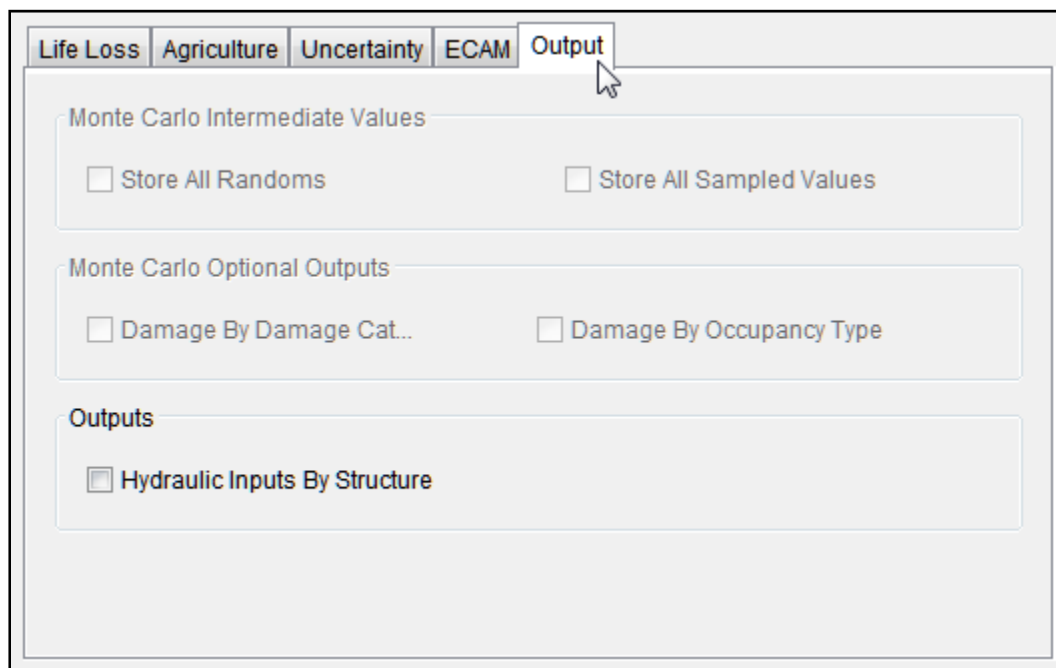


Figure 10.10 Output Compute Option

## 10.3 Alternative Shortcut Menu

Once an alternative has been created the user can perform various functions on the alternative from a shortcut menu. From the **Study Tree**, under the **Alternatives** folder, right click on a defined alternative (e.g., *Alt\_CrossSections*). From the shortcut menu (Figure 10.11) the user can display the alternative in the active map window, edit the alternative, save as, rename, delete from the HEC-FIA project, remove from the HEC-FIA project, and review properties of the alternative file.

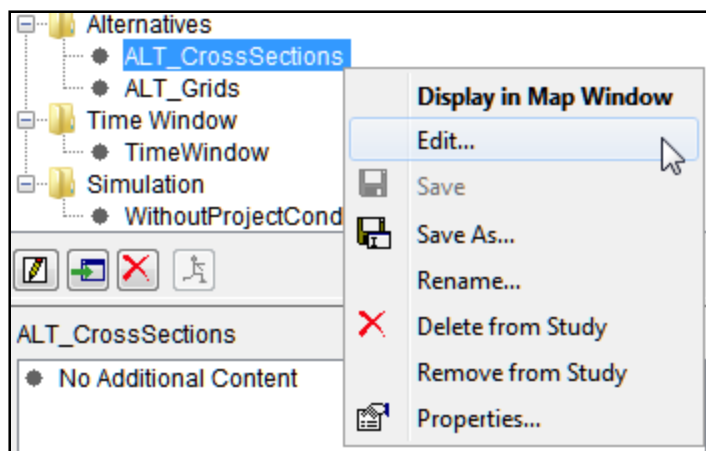


Figure 10.11 Alternative Shortcut Menu

### 10.3.1 Edit

To edit an alternative, from the alternative shortcut menu (Figure 10.11), click **Edit**, the **Edit Alternative** dialog box opens (Figure 10.12). The user can edit the various elements that define the alternative, and any of the compute options.

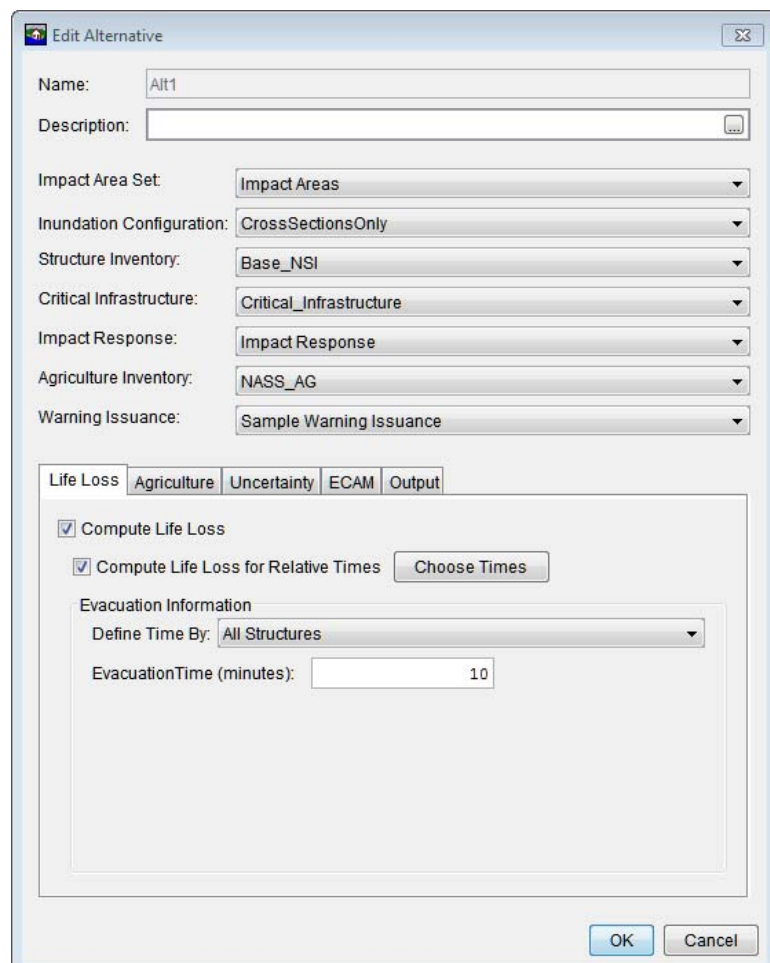


Figure 10.12 Edit Alternative Dialog Box

### 10.3.2 Save As

To create a copy of an alternative, from the alternative shortcut menu (Figure 10.11), click **Save As**, the **Save Alternative As** dialog box opens (Figure 10.13). In the **Name** box enter the name of the new alternative. The user can enter a description for the alternative in the **Description** box. From the **Directory** box specify the location of the alternative. Click **OK**, the **Save Alternatives As** dialog box closes, and the new alternative is created.

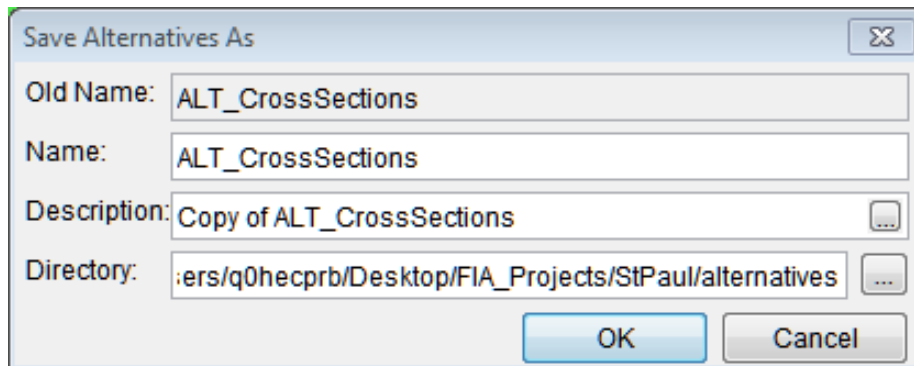


Figure 10.13 Save Alternatives As Dialog Box

### 10.3.3 Rename

To rename an alternative, from the alternative shortcut menu (Figure 10.11), click **Rename**, the **Rename Alternatives** dialog box opens (Figure 10.14). In the **Name** box enter the new name of the alternative. The user can enter a description for the alternative in the **Description** box. Click **OK**, the **Rename Alternatives** dialog box closes, and the alternative has been renamed.

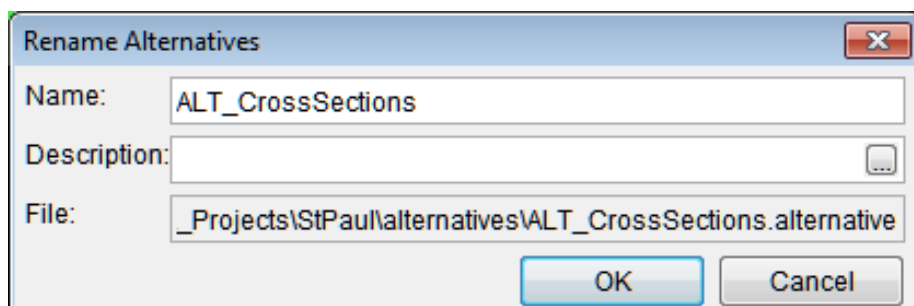
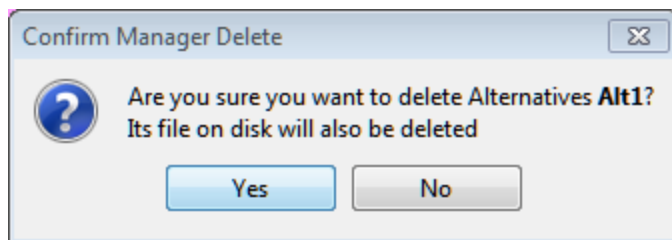


Figure 10.14 Rename Alternatives Dialog Box

### 10.3.4 Delete from Study

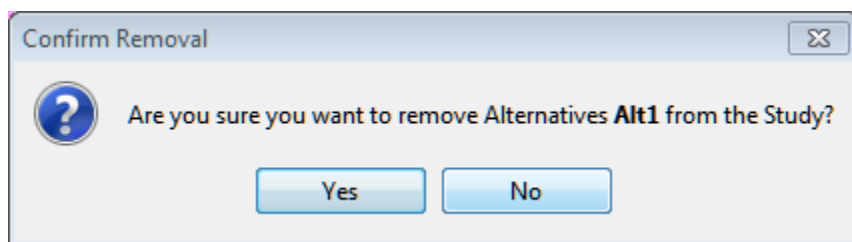
To delete the alternative and its associated files from the HEC-FIA project, from the alternative shortcut menu (Figure 10.11), click **Delete from Study**, a **Confirm Manager Delete** window opens (Figure 10.15). By clicking **Yes**, the **Confirm Manager Delete** window closes, and the alternative and its associated files are deleted from the HEC-FIA project.



**Figure 10.15** Confirm Manager Delete Window

### 10.3.5 Remove from Study

To remove the alternative from the HEC-FIA project (does not delete files), from the alternative shortcut menu (Figure 10.11), click **Remove from Study**; a **Confirm Removal** window opens (Figure 10.16). By clicking **Yes**, the **Confirm Removal** window closes, and the alternative is removed from the HEC-FIA project.



**Figure 10.16** Confirm Removal Window

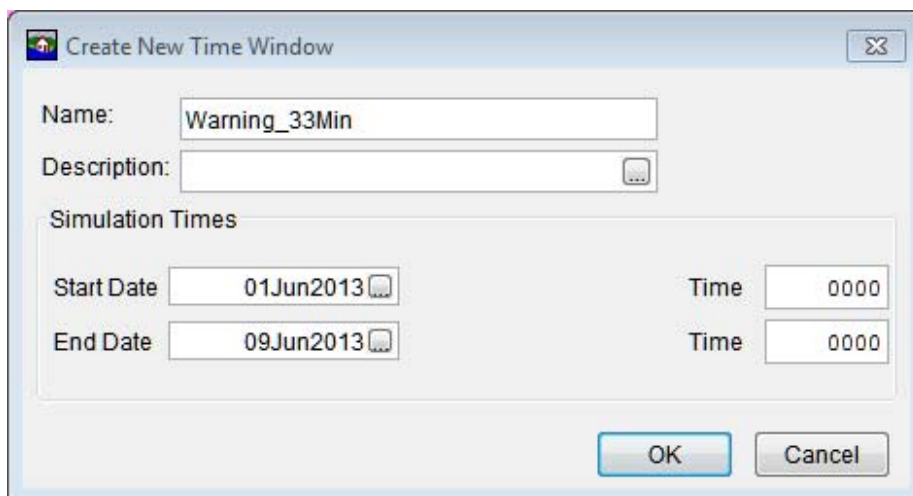
# CHAPTER 11

## Time Windows

A time window defines the simulation start and end dates and times for a simulation. When creating time windows for cross section based simulations, the time window has to be set to match the time-window of the data in the HEC-DSS file, the time window can be set to a subset of the length of the time series, but it cannot be extended on either end of the time series. When creating time windows for gridded data everything is set relative to the start time of the time window since the gridded data does not contain date time information. However, the FIA simulation time-window should contain the full length of time used by the hydraulic simulation to compute arrival time grids, if life loss is being computed by the HEC-FIA project.

### 11.1 Create a Time Window

1. From the **Study Pane**, right-click on **Time Window** from the shortcut menu, click **New**. The **Create New Time Window** dialog box opens (Figure 11.1).

The image shows a Windows-style dialog box titled "Create New Time Window". It has a standard Windows icon in the top-left corner and a close button (X) in the top-right corner. The dialog contains several input fields: a "Name:" field with the text "Warning\_33Min", a "Description:" field which is empty and has a small icon to its right, and a section titled "Simulation Times". Inside this section, there are four input fields: "Start Date" with the value "01Jun2013", "End Date" with the value "09Jun2013", "Time" (for start) with the value "0000", and "Time" (for end) with the value "0000". At the bottom of the dialog are "OK" and "Cancel" buttons.

**Figure 11.1** Create New Time Window Dialog Box

2. In the **Name** box (Figure 11.1) enter a name for the time window.
3. For the start date enter a date using the format *ddmmmyyyy* in the **Start Date** box (Figure 11.1). The start time is entered in twenty-four hour clock time in the **Time** box this time needs to occur after or at the start of the data referenced in the HEC-DSS record.
4. For the end date, enter a date using the format *ddmmmyyyy* in the **End Date** box (Figure 11.1). The **End Date** must be later than the **Start Date**; the simulation ends when the end date occurs, so it must include all of the hydrographs that are to be modeled. The end time is entered in twenty-four hour clock time in the **Time** box.

- Click **OK**, the **Create New Time Window** dialog box (Figure 11.1) closes. The time window has been created and the name appears in the **Study Tree** under the **Time Window** folder.

## 11.2 Time Window Shortcut Menu

Once a time window has been created, the user can manipulate the time window from a shortcut menu. From the **Study Tree**, from **Time Window**, right-click on a defined time window (e.g., *XS\_TimeWindow*). From the shortcut menu (Figure 11.2) the user can edit, save as, rename, delete from the HEC-FIA project, and review properties of the selected time window. If more than one time window has been defined, the user can adjust the order of the time windows under the **Time Window** folder.

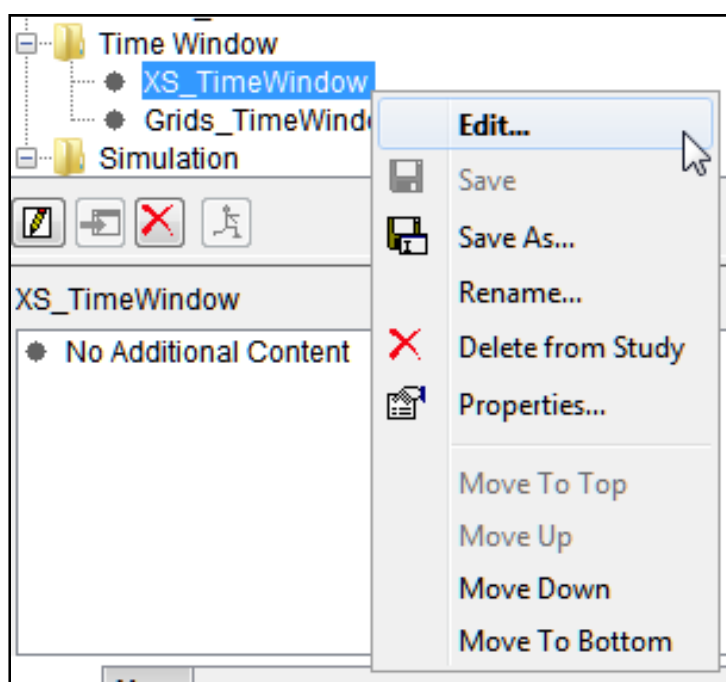


Figure 11.2 Time Window Shortcut Menu

### 11.2.1 Edit

To edit a time window, from the time window shortcut menu (Figure 11.2), click **Edit** and the **Time Window** dialog box opens (Figure 11.3). The user can edit the **Start Date** and time and the **End Date** and time.

### 11.2.2 Save As

To create a copy of the time window, from the time window shortcut menu (Figure 11.2), click **Save As**, the **Save Time Window As** dialog box opens (Figure 11.4). In the **Name** box enter the name of the new time window. The user can enter a description for the time window in the **Description** box. From the **Directory** box the user can specify the location of the time window. Click **OK**, the **Save Time Window As** dialog box closes, and the new time window is created.



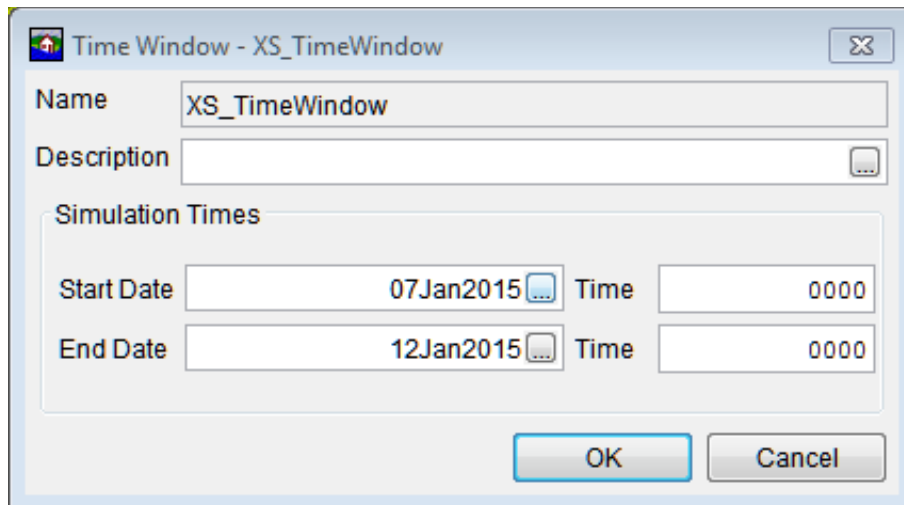


Figure 11.3 Time Window Dialog Box

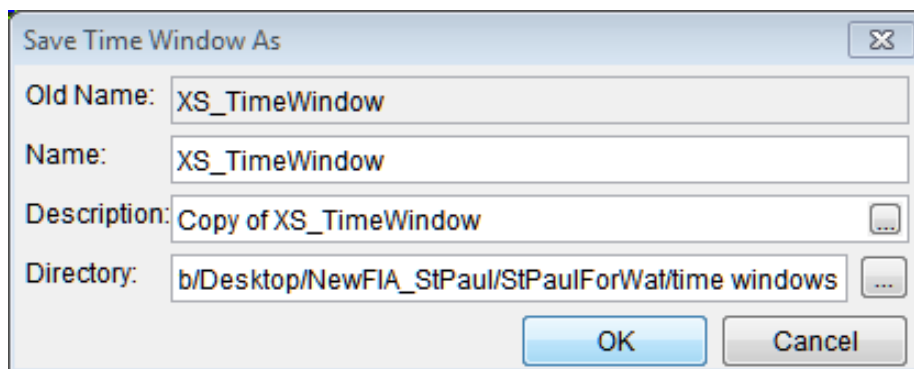


Figure 11.4 Save Time Window As Dialog Box

### 11.2.3 Rename

To rename a time window, from the time window shortcut menu (Figure 11.2), click **Rename**, the **Rename Time Window** dialog box opens (Figure 11.5). In the **Name** box enter the new name of the time window. The user can enter a description for the time window in the **Description** box. Click **OK**, the **Rename Time Window** dialog box closes, and the time window has been renamed.

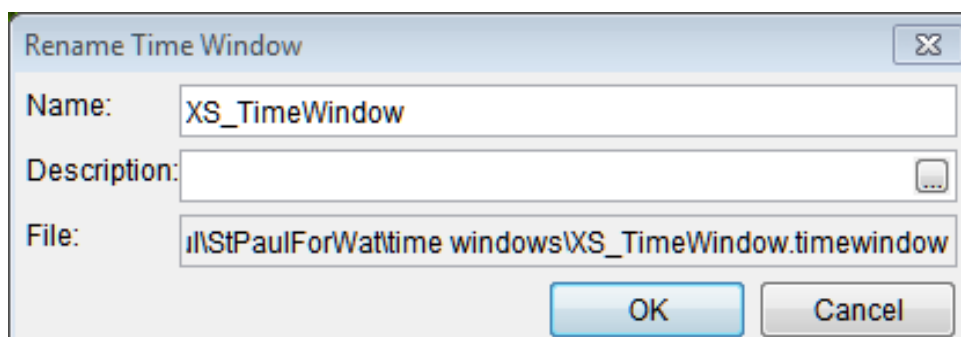


Figure 11.5 Rename Time Window Dialog Box

### 11.2.4 Delete from Study

To delete a time window and its associated files from the HEC-FIA project, from the time window shortcut menu (Figure 11.2), click **Delete from Study**, a **Confirm Manager Delete** window opens (Figure 11.6). By clicking **Yes**, the **Confirm Manager Delete** window closes, and the time window and its associated files are deleted from the HEC-FIA project.

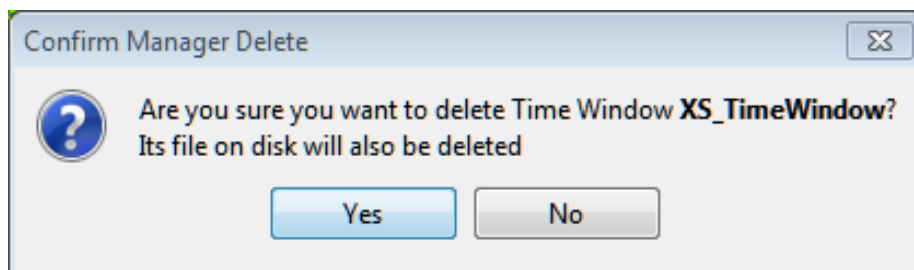


Figure 11.6 Confirm Manager Delete Window

### 11.2.5 Move Up/Move Down, Move To Top/Move To Bottom

The time window order can be adjusted when more than one time window is defined in an HEC-FIA project. From the time window shortcut menu (Figure 11.2), the **Move To Top**, **Move Up**, **Move Down**, and **Move To Bottom** items are available. By clicking on one of those menu items the user can adjust the location of the time window in the tree.

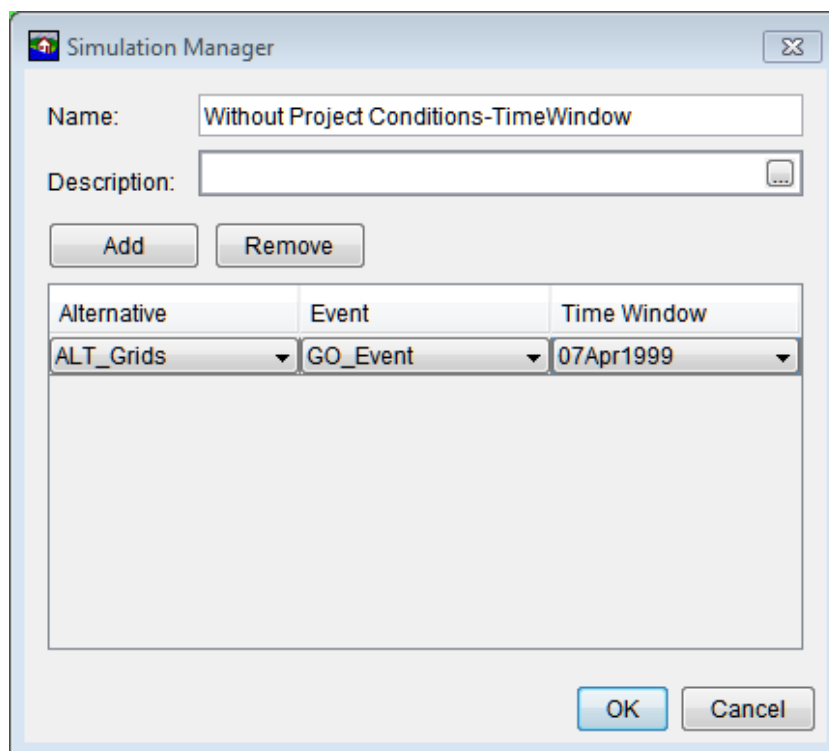
# CHAPTER 12

## Simulations and Results

A simulation manager in HEC-FIA is a combination of individual simulations. A simulation connects an alternative with an event and a time window.

### 12.1 Create a Simulation

1. From the **Study Pane**, right-click on **Simulation**, from the shortcut menu, click **New**. The **Edit Simulation** dialog box opens (Figure 12.1).



**Figure 12.1** Simulation Manager Dialog Box

2. Enter a name in the **Name** box for the simulation. A description for the simulation group can be added in the **Description** box.
3. Next the user must add an alternative (or multiple alternatives) to the simulation group. Click **Add**, a row is added to the table. The user can add the same alternative for multiple events, allowing them to be run in the same simulation group. Alternatively, multiple alternatives can be matched to the same event, allowing the evaluation of damages to be based on changes in the floodplain (such as structural and non-structural measures) identified in the alternative, through the watershed configuration or other changes in the alternative. To do this, from the **Alternative** column the user selects the defined

alternative from a list; from the Event column, selects events that have been defined for the selected alternative; and, from the **Time Window** column select defined time windows.

4. Once the simulation is defined, click **OK**. The **Edit Simulation** dialog box closes (Figure 12.1). The name of the simulation (i.e., *Without Project Conditions-TimeWindow*) appears in the **Study Tree** below the **Simulation** folder.

## 12.2 Simulation Shortcut Menu

Once a simulation has been created the user can perform various functions on the simulation from a shortcut menu. From the **Study Tree**, under the **Simulation** folder, right-click on the created simulation (e.g., *Without Project Conditions-TimeWindow*). From the shortcut menu (Figure 12.2) the user can edit the simulation, compute the simulation, save as, rename, delete from the HEC-FIA project, remove from the HEC-FIA project, and review properties of the simulation file.

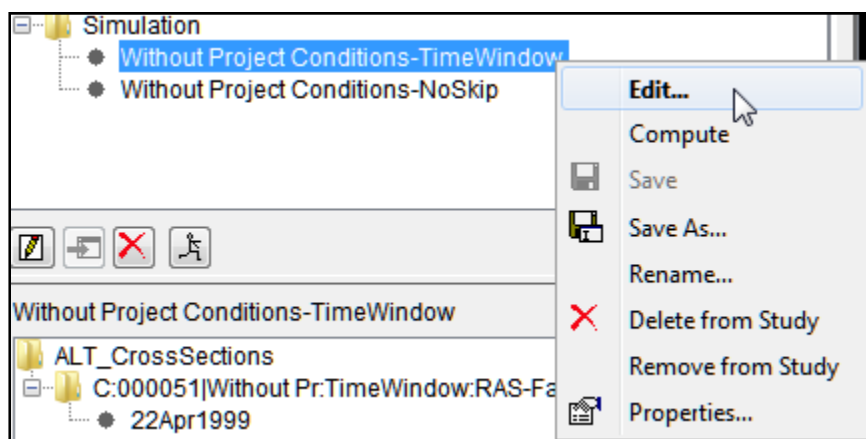


Figure 12.2 Simulation Shortcut Menu

### 12.2.1 Edit

To edit a simulation, from the simulation shortcut menu (Figure 12.2), click **Edit**, the **Edit Simulation** dialog box opens (Figure 12.1).

### 12.2.2 Compute

Run a simulation group:

1. From the **Study Pane**, from the **Simulation** folder, right-click on a defined simulation (i.e., *Without Project Conditions-TimeWindow*). From the simulation shortcut menu (Figure 12.2) click **Compute**.
2. The **Compute Progress** dialog box opens (Figure 12.3). This dialog box provides the user with information on the progress of the selected simulation.

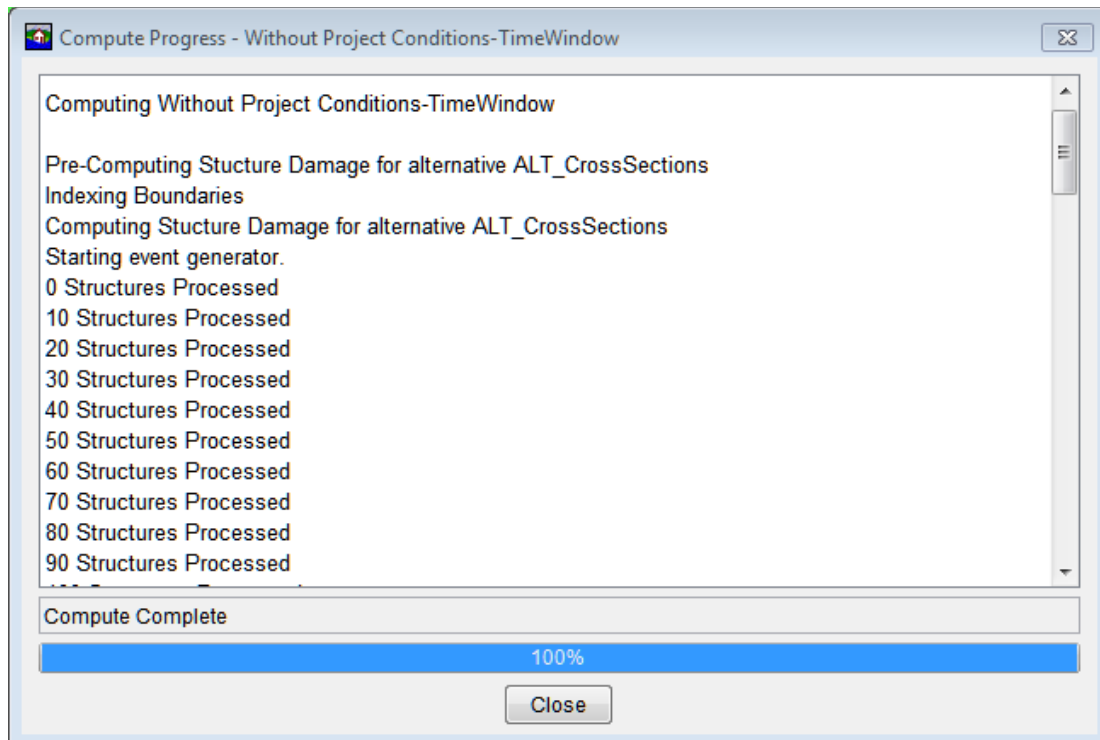


Figure 12.3 Compute Progress Dialog Box

### 12.2.3 Save As

To create a copy of a simulation, from the simulation shortcut menu (Figure 12.2), click **Save As**, the **Save Simulation As** dialog box opens (Figure 12.4). In the **Name** box enter the name of the new simulation. The user can enter a description for the simulation in the **Description** box. From the **Directory** box the user specifies the location of the simulation. Click **OK**, the **Save Simulation As** dialog box closes, and the new simulation is created.

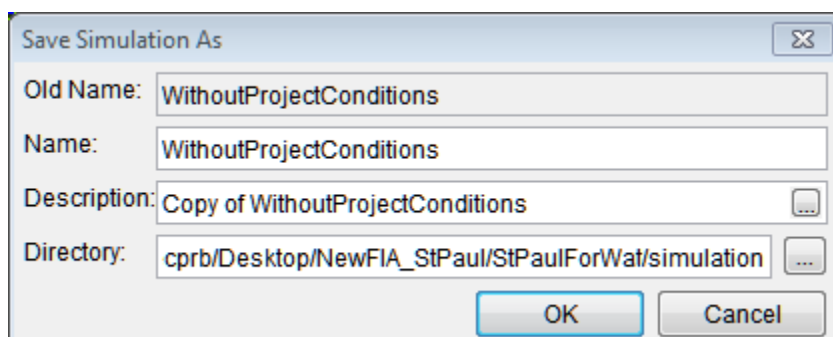


Figure 12.4 Save Simulation As Dialog Box

### 12.2.4 Rename

To rename a simulation, from the simulation shortcut menu (Figure 12.2), click **Rename**, the **Rename Simulation** dialog box opens (Figure 12.5). In the **Name** box enter the new name of the simulation. The user can enter a description for the simulation in the **Description** box. Click **OK**, the **Rename Simulation** dialog box closes, and the simulation has been renamed.

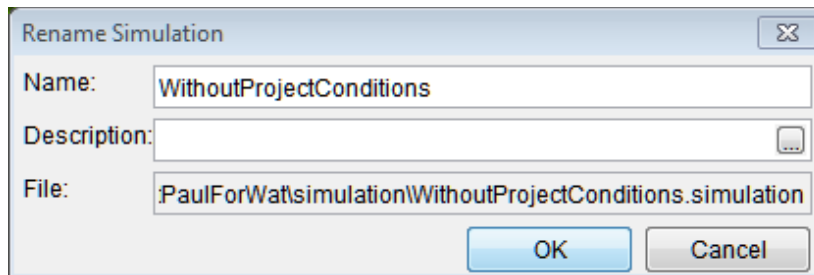


Figure 12.5 Rename Simulation Dialog Box

## 12.2.5 Delete from Study

To delete a simulation and its associated files from the HEC-FIA project, from the simulation shortcut menu (Figure 12.2), click **Delete from Study**, a **Confirm Manager Delete** window opens (Figure 12.6). By clicking **Yes**, the **Confirm Manager Delete** window closes, and the simulation and its associated files are deleted from the HEC-FIA project.

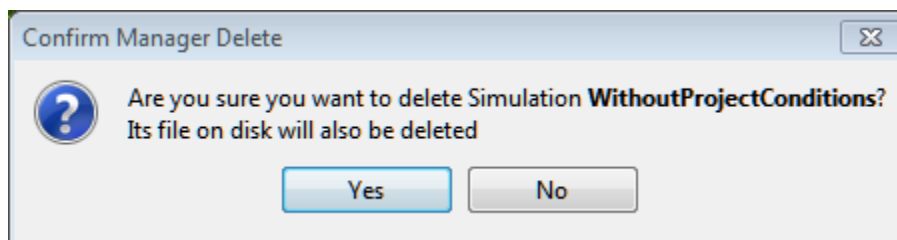


Figure 12.6 Confirm Manager Delete Window

## 12.2.6 Remove from Study

To remove a simulation from the HEC-FIA project (does not delete files), from the simulation shortcut menu (Figure 12.2), click **Remove from Study**; a **Confirm Removal** window opens (Figure 12.7). By clicking **Yes**, the **Confirm Removal** window closes, and the simulation is removed from the HEC-FIA project.

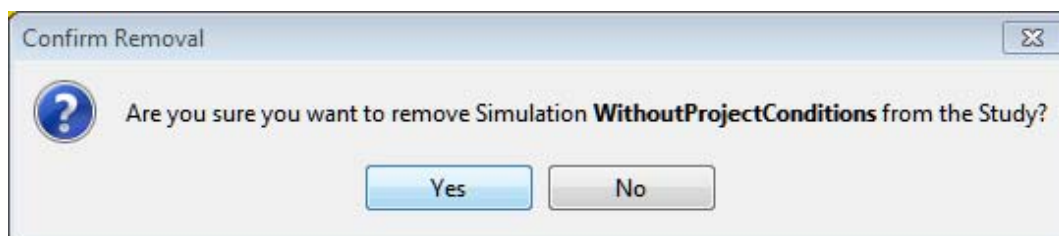
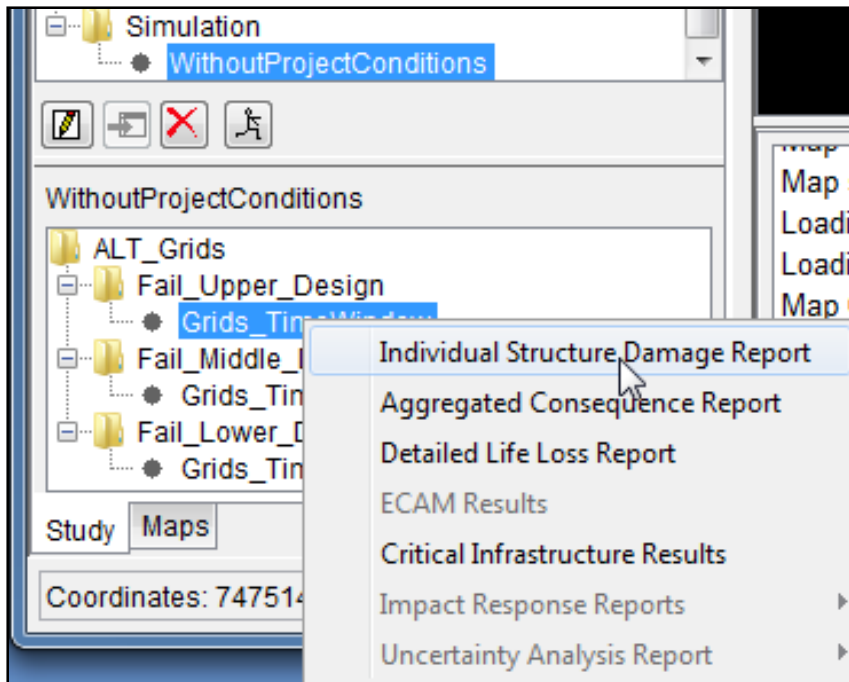


Figure 12.7 Confirm Removal Window

## 12.3 Viewing Results

Simulation results can be viewed in several internally generated reports. The next few sections outline the general properties of the available reports. When a simulation is run in HEC-FIA, a file structure is developed to store the results. The file structure begins in the root directory with the folder "runs", the next folder in the directory is the alternative name, followed by a subfolder with the event name, and finally a subfolder with the time window name. Inside of the last

folder are the results from that simulation. The **Content Pane** displays this general folder structure when the simulation is selected in the study window. When the node named by the time window is right clicked (Figure 12.8), the user receives the options for reporting available based on the selections in the alternative.

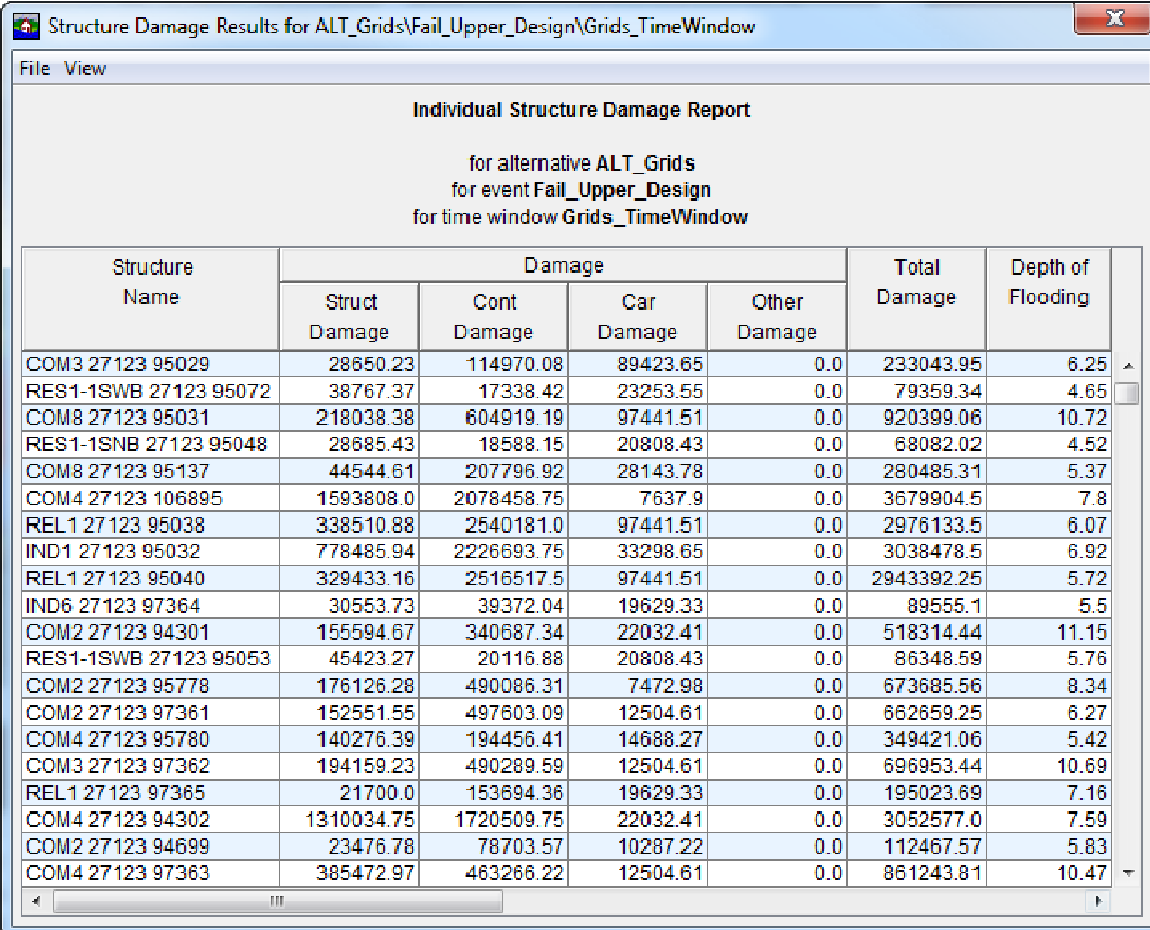


**Figure 12.8** Content Pane - Results Shortcut Menu

### 12.3.1 Individual Structure Damage Report

To view individual structure damage results:

1. From the **Content Pane** (Figure 12.8), information about the simulations that have been computed is available. Under each alternative, is a list of associated events. Under each event is a list of time windows. By right-clicking on a time window, the **Results** shortcut menu appears (Figure 12.8) displaying the available reports.
2. The **Individual Structure Damage Report** dialog box opens (Figure 12.9).
3. This report contains a row for each structure damaged by the event. Notice that there are more columns available than are shown in the default window. To access the additional rows the user can expand the width of the report, or scroll using the horizontal scroll bar.
4. If the user selects the row of a structure of interest (or group of structures), the option to zoom to those structures in the map window is possible by right clicking on one of the selected rows and clicking "Zoom to structures".
5. The columns can be sorted by double clicking on the header of the column.
6. The final row in the table summarized values in each column.



Structure Name	Damage				Total Damage	Depth of Flooding
	Struct Damage	Cont Damage	Car Damage	Other Damage		
COM3 27123 95029	28650.23	114970.08	89423.65	0.0	233043.95	6.25
RES1-1SWB 27123 95072	38767.37	17338.42	23253.55	0.0	79359.34	4.65
COM8 27123 95031	218038.38	804919.19	97441.51	0.0	920399.06	10.72
RES1-1SNB 27123 95048	28685.43	18588.15	20808.43	0.0	68082.02	4.52
COM8 27123 95137	44544.61	207796.92	28143.78	0.0	280485.31	5.37
COM4 27123 106895	1593808.0	2078458.75	7637.9	0.0	3679904.5	7.8
REL1 27123 95038	338510.88	2540181.0	97441.51	0.0	2976133.5	6.07
IND1 27123 95032	778485.94	2226693.75	33298.65	0.0	3038478.5	6.92
REL1 27123 95040	329433.16	2516517.5	97441.51	0.0	2943392.25	5.72
IND6 27123 97364	30553.73	39372.04	19629.33	0.0	89555.1	5.5
COM2 27123 94301	155594.67	340687.34	22032.41	0.0	518314.44	11.15
RES1-1SWB 27123 95053	45423.27	20116.88	20808.43	0.0	86348.59	5.76
COM2 27123 95778	176126.28	490086.31	7472.98	0.0	673685.56	8.34
COM2 27123 97361	152551.55	497603.09	12504.61	0.0	662859.25	6.27
COM4 27123 95780	140276.39	194456.41	14688.27	0.0	349421.06	5.42
COM3 27123 97362	194159.23	490289.59	12504.61	0.0	696953.44	10.69
REL1 27123 97365	21700.0	153694.36	19629.33	0.0	195023.69	7.16
COM4 27123 94302	1310034.75	1720509.75	22032.41	0.0	3052577.0	7.59
COM2 27123 94699	23476.78	78703.57	10287.22	0.0	112467.57	5.83
COM4 27123 97363	385472.97	463266.22	12504.61	0.0	861243.81	10.47

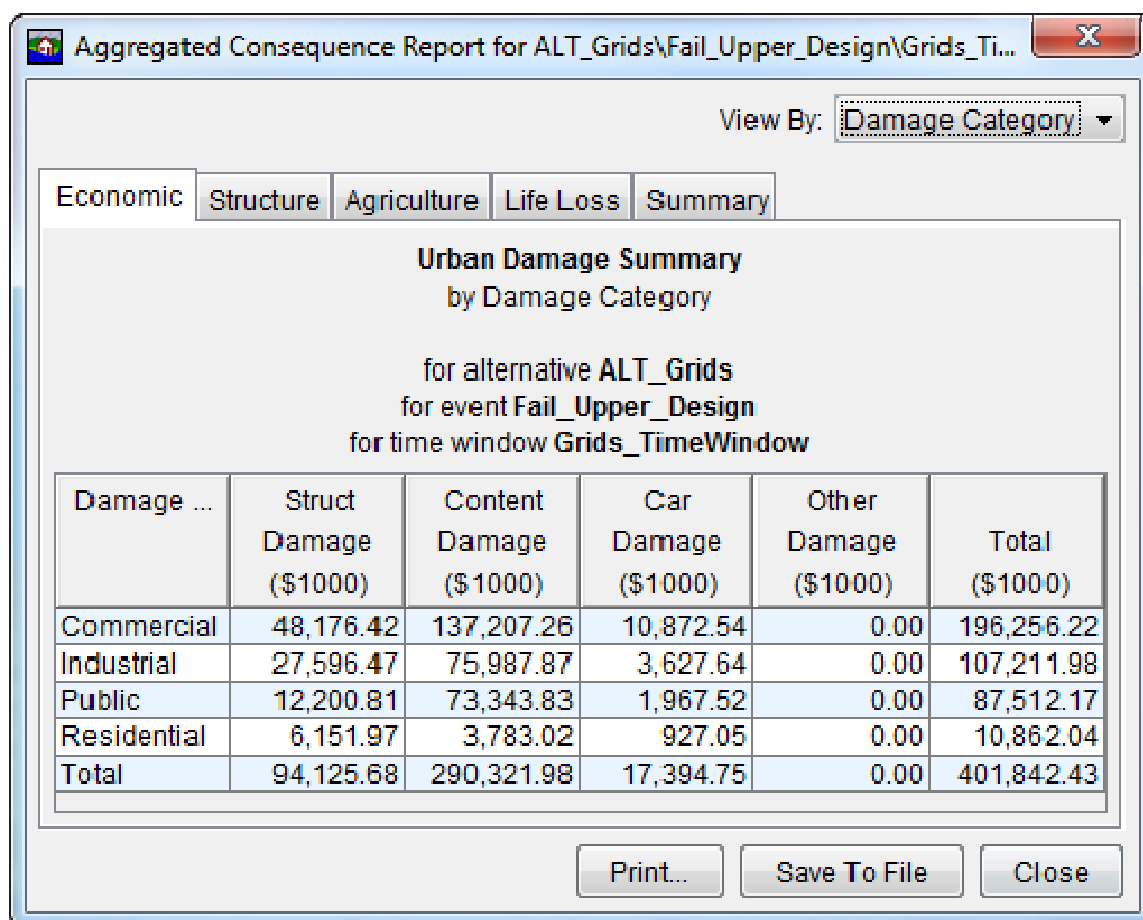
Figure 12.9 Individual Structure Damage Report

### 12.3.2 Aggregated Consequence Report

To view the consequences of the modeled event, the **Aggregated Consequence Report** (Figure 12.10) groups the data by various methods and is summarized in a tabular format:

1. From the **Content Pane** (Figure 12.8), right-click on a time window, from the shortcut menu (Figure 12.8) click **Aggregated Consequence Report**.
2. The **Aggregated Consequence Report** opens (Figure 12.10).
3. The report has a title block explaining what is being reported. The first line in the title block is a description of the type of data, and is based on which tab has been selected. The second line is based on the option selected from the **View By** list (Figure 12.10), which governs how the data is aggregated. The remaining lines define the alternative, event and time window used to produce these specific results.
4. To aggregate the results based on any polygon shapefile, the shapefile must be added to the study tree as a "Boundary", the boundary appears in the **View By** list. If the user selects





**Figure 12.10** Aggregated Consequence Report

the boundary, the data is processed to represent all points within the polygons that make up the polygon shapefile. Additionally, the report can be displayed using attributes available in the results shapefile.

### 12.3.3 Detailed Life Loss Report

To view the detailed life loss report, the alternative, event, time window combination must be set up to run life loss. This requires the event to have the necessary hydraulic data, and the alternative to be set to compute life loss. If the alternative is not set to compute life loss, this report is not enabled. To view the detailed life loss report:

1. From the **Content Pane** (Figure 12.8), right-click on a time window, from the shortcut menu (Figure 12.8) click **Detailed Life Loss Report**.
2. The **Detailed Life Loss Report** opens (Figure 12.11).
3. The **Detailed Life Loss Report** provides information about how HEC-FIA calculated life loss for the study area (Figure 12.12). The report aggregates data to explain how life loss was computed. When computing deterministic runs, the results are deterministic, when computing Monte Carlo runs, the results represent averages.

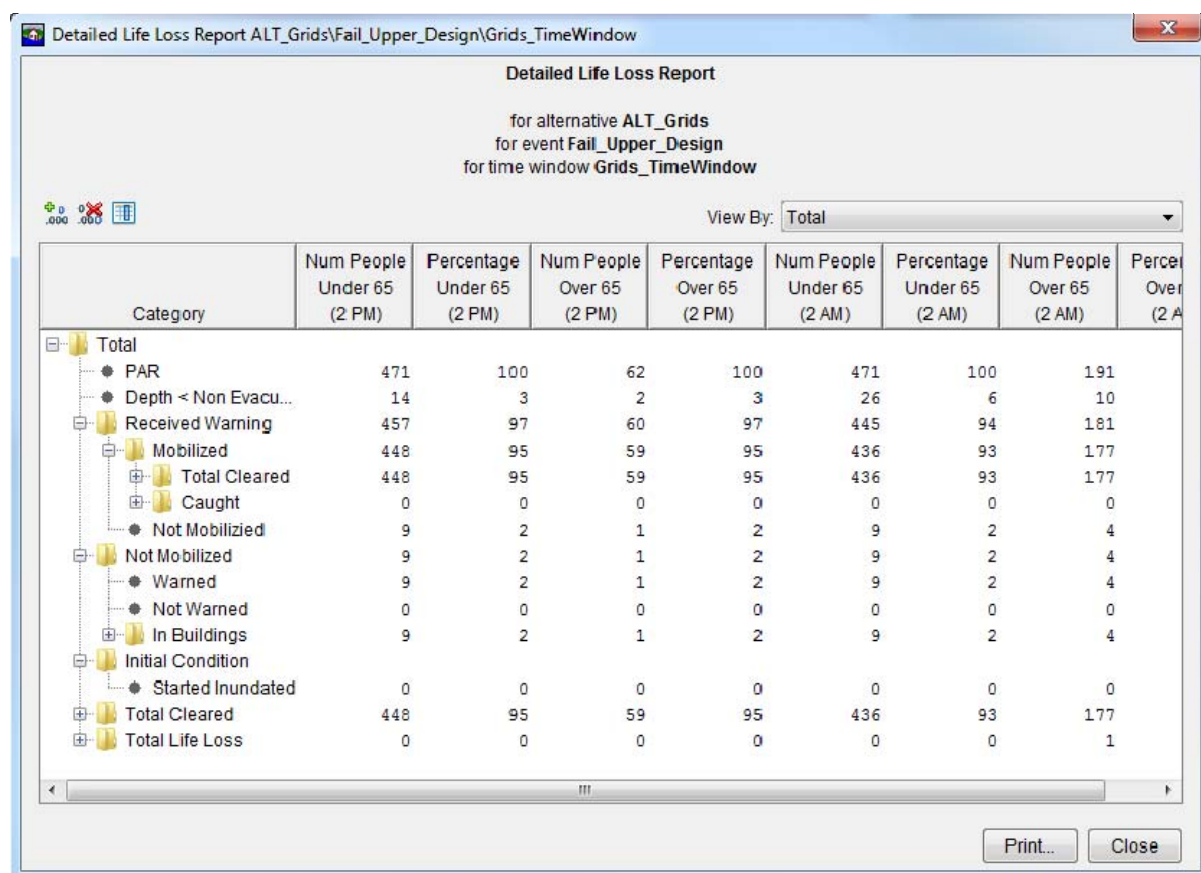


Figure 12.11 Detailed Life Loss Report

### 12.3.4 ECAM Results

The ECAM report (Figure 12.12) is only enabled if the alternative, event, time window combination has been set to run life loss and ECAM. If those conditions are met, the output for ECAM is written during the compute, and the report is enabled. This report has two tabs, one representing the changes in the output of the economy, the other representing the changes in labor employed by the sectors for the County. Each tab reports at the sector level for the selected county.

1. From the **Content Pane** (Figure 12.8), right-click on a time window, from the shortcut menu (Figure 12.8) click **ECAM Results**.
2. The **ECAM Indirect Economics Employment Report** opens (Figure 12.12).
3. The report has a title block explaining what is being reported. The first line in the title block is a description of the type of data, and is based on which tab has been selected. The second line is based on the county selected in the **County** list (Figure 12.2). The remaining lines define the alternative, event and time window used to produce these specific results.

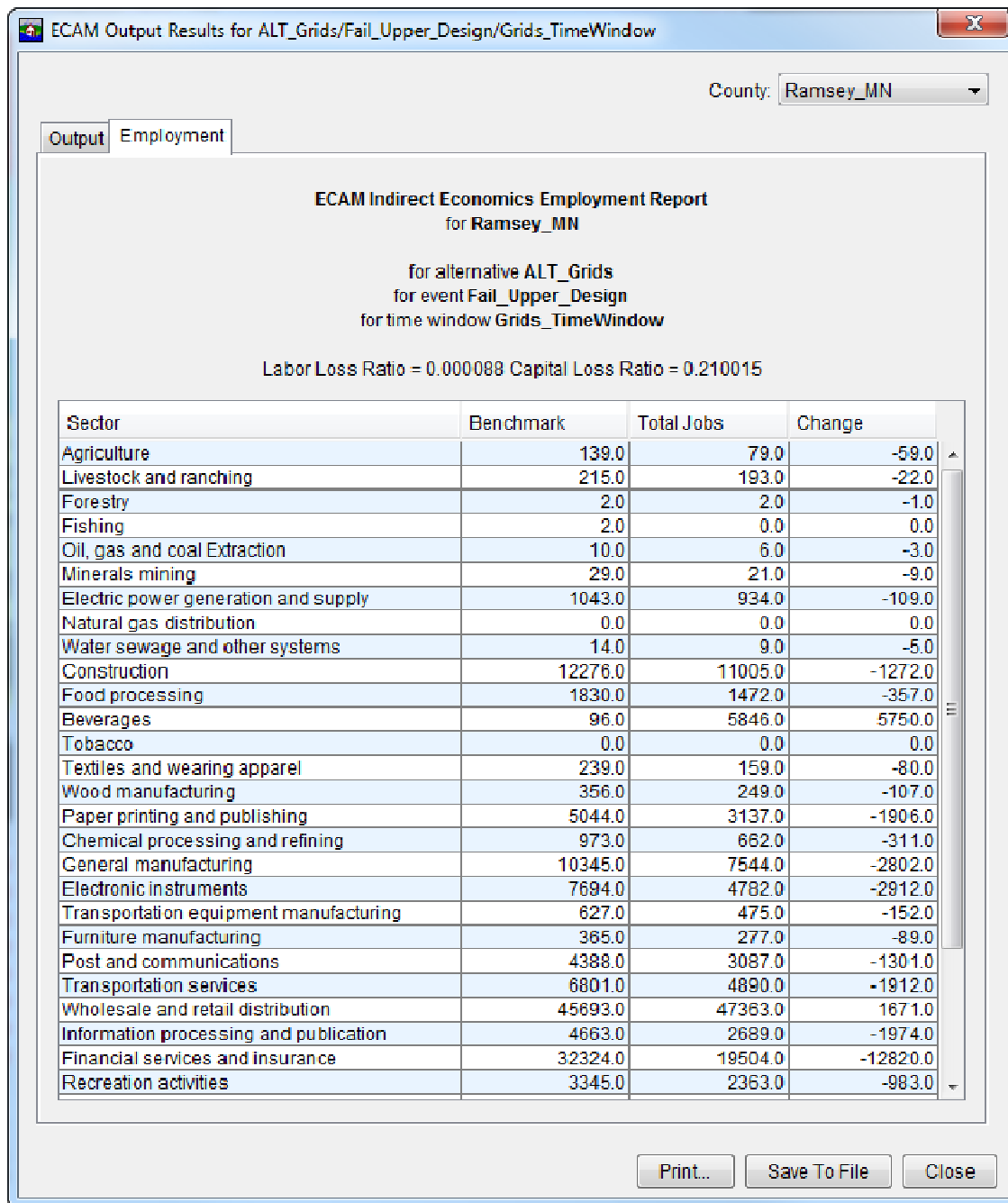


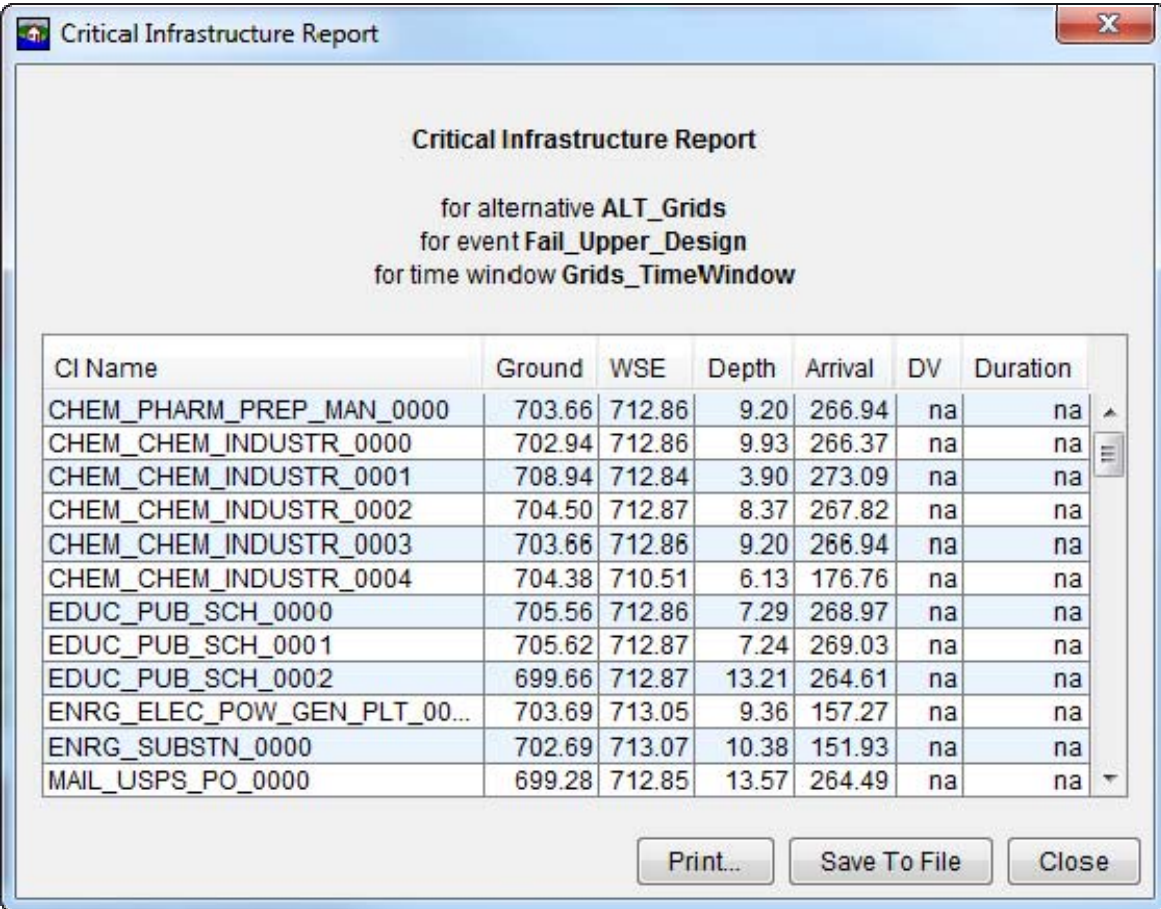
Figure 12.12 ECAM Indirect Economics Employment Report

### 12.3.5 Critical Infrastructure

Critical Infrastructure results (Figure 12.13) are available if the alternative, event, time window combination has a Critical Infrastructure element defined in the alternative. The report only includes critical infrastructure elements which were inundated by the event based on the user defined elevation, or the elevation of the terrain grid.

1. From the **Content Pane** (Figure 12.8), right-click on a time window, from the shortcut menu (Figure 12.8) click **Critical Infrastructure Results**.

- The **Critical Infrastructure Report** opens (Figure 12.13).



CI Name	Ground	WSE	Depth	Arrival	DV	Duration
CHEM_PHARM_PREP_MAN_0000	703.66	712.86	9.20	266.94	na	na
CHEM_CHEM_INDUSTR_0000	702.94	712.86	9.93	266.37	na	na
CHEM_CHEM_INDUSTR_0001	708.94	712.84	3.90	273.09	na	na
CHEM_CHEM_INDUSTR_0002	704.50	712.87	8.37	267.82	na	na
CHEM_CHEM_INDUSTR_0003	703.66	712.86	9.20	266.94	na	na
CHEM_CHEM_INDUSTR_0004	704.38	710.51	6.13	176.76	na	na
EDUC_PUB_SCH_0000	705.56	712.86	7.29	268.97	na	na
EDUC_PUB_SCH_0001	705.62	712.87	7.24	269.03	na	na
EDUC_PUB_SCH_0002	699.66	712.87	13.21	264.61	na	na
ENRG_ELEC_POW_GEN_PLT_00...	703.69	713.05	9.36	157.27	na	na
ENRG_SUBSTN_0000	702.69	713.07	10.38	151.93	na	na
MAIL_USPS_PO_0000	699.28	712.85	13.57	264.49	na	na

**Figure 12.13** Critical Infrastructure Report

- The report has a title block explaining what is being reported. The remaining lines in the title block define the alternative, event and time window used to produce these specific results.

### 12.3.6 Impact Response Reports

If an impact response element is defined in the alternative, an impact response report is available whether or not the thresholds were exceeded. There are three ways to view the impact response reports, by rule, by location, and summary.

The by rule report reports each rule independently.

The By Location report is by each location that has been defined in the impact response rules set, if there are many rules for one location, then the rules are displayed together.

The Summary report displays all rules that were applied and the number of times the threshold conditions were met. The appropriate impact and response is defined each time a threshold is met.

The "By Rule" and "By Location" reports displays the hydrograph at the location of the rule, and the threshold elevation relative to the hydrograph, if no threshold is exceeded, the summary is be empty.

### 12.3.7 Uncertainty Analysis Reports

The Uncertainty Analysis reports can be viewed two different ways, through **Results by Iteration** or **Life Loss By Warning Issuance**.

1. From the **Content Pane** (Figure 12.8), right-click on a time window, from the shortcut menu (Figure 12.8), point to **Uncertainty Analysis Report**, click **Results by Iteration**.
2. The **Results by Iteration** report (Figure 12.14) displays a paired data record that an output variable for each iteration. To view values that were sampled to produce the output, the user must first check the option in the uncertainty tab of the alternative editor, and then view the output HEC-DSS file using HEC-DSSVue. The variable can be changed by selecting a different record using the combo box on the upper right corner of the report.

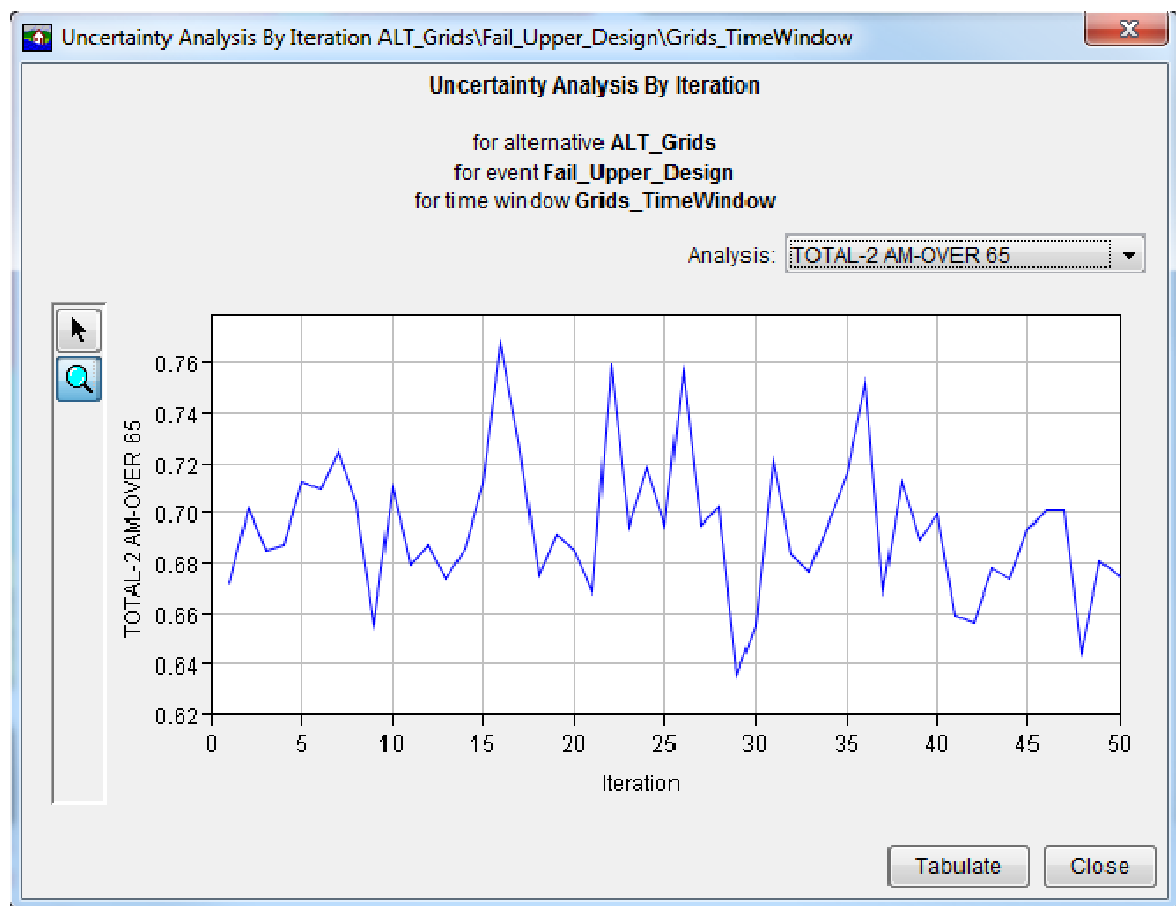
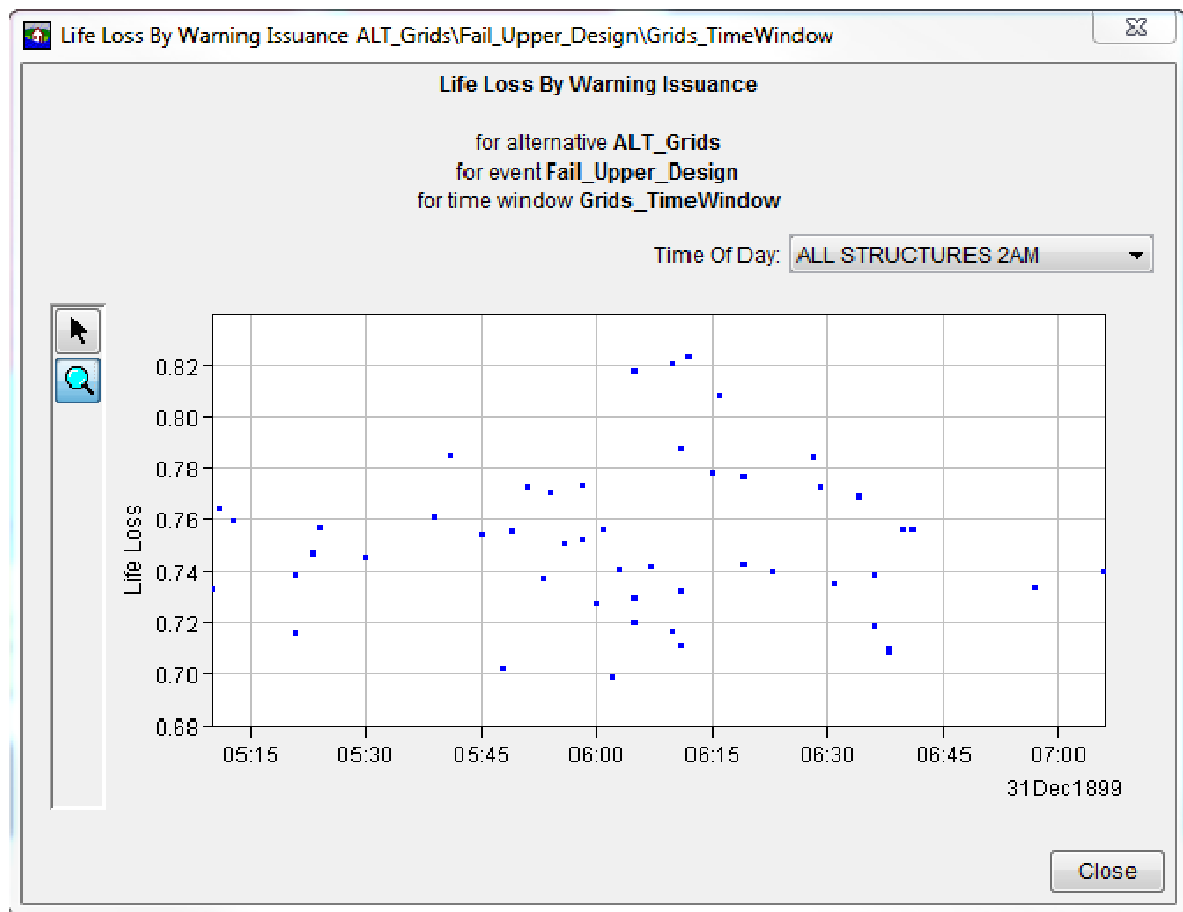


Figure 12.14 Results by Iteration Report

3. From the **Content Pane** (Figure 12.8), right-click on a time window, from the shortcut menu (Figure 12.8), point to **Uncertainty Analysis Report**, click **Life Loss By Warning Issuance**.

4. The **Life Loss by Warning Issuance** report (Figure 12.15) displays a point graph which plots warning issuance time on the x axis, and life loss on the right axis.



**Figure 12.15** Life Loss By Warning Issuance Report

# Appendix A

## References

Hydrologic Engineering Center, 2006b. *HEC-DSSVue, HEC Data Storage System Visual Utility Engine User's Manual, Version 1.2, CPD-79*, U. S. Army Corps of Engineers, Davis, CA.

Hydrologic Engineering Center, 2009. *HEC-RAS, River Analysis System User's Manual, Version 4.0.1, CPD-68*, U.S. Army Corps of Engineers, Davis, CA.

Hydrologic Engineering Center, 1995. *HEC-PBA Project Benefit Accomplishment Package User's Manual, CPD-67*, U.S. Army Corps of Engineers, Davis, CA.

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Rogers, G. O. and J. H. Sorensen, 1991. "Diffusion of Emergency Warning: Comparing Empirical and Simulation Results," in *Risk Analysis Prospects and Opportunities*, C. Zerros et al. (eds.), Plenum Press, New York, p. 117 - 134.

Lehman, W.P., Dunn, C.N., and Light, Dr. Miles, 2014. "Using HEC-FIA to Identify the Consequences of Flood Events". 6<sup>th</sup> International Conference on Flood Management (ICFM6), Sao Paulo, Brazil





# Appendix B

## Data Preparation

This appendix is written to explain steps for converting data to input types that are supported by HEC-FIA; it is for users who have not upgraded to the latest version of HEC-RAS 5.0. To see the steps for getting the correct data for input to HEC-FIA from HEC-RAS 5.0, go to Appendix G.

The geographic information system (GIS) pre-processing that is required for an HEC-FIA study can be handled through the use of the ESRI ArcGIS® Desktop software. Information and availability about the ArcGIS® Desktop software is available from ESRI ([www.esri.com](http://www.esri.com)). The software should include ArcMap®, the ArcGIS® 3D Analyst extension, and the ArcGIS® Spatial Analyst extension. Optionally, users can use other GIS platforms like GRASS (<http://grass.osgeo.org/>) or QGIS (<http://www.qgis.org/en/site/>)

There are several GIS pre-processing steps that need to be completed before creating a study in HEC-FIA. Depending on the level of detail in the study, not all of the following need to be utilized:

1. Preparation of maximum inundation depth grids
2. Preparation of duration and arrival time grids
3. Creation of maximum inundation area polygon
4. Generation of the hazard area boundary
5. Preparation of a digital terrain model
6. Preparation of arrival time grid for depths two feet and greater
7. Preparation of FEMA (US Department of Homeland Security, Federal Emergency Management Agency) HAZUS (HAZards United States) data
8. Preparation of various items developed by HEC-GeoRAS (Hydrologic Engineering Center's ArcGIS extension for processing geospatial data for HEC-RAS)
9. Preparation of impact area polygons
10. Preparation of double warning time polygon
11. Agricultural grid preparation

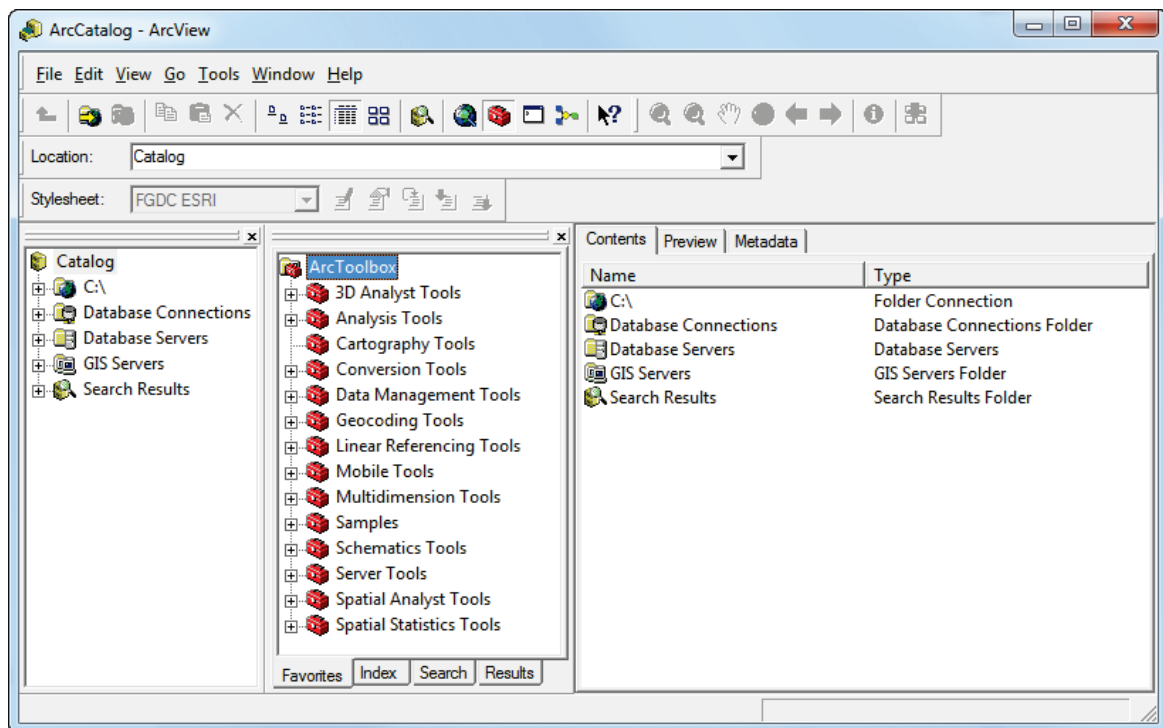
Each of these steps is explained in the following sections.

### B.1 Preparing Maximum Inundation Depth Grids

For rapid consequence assessment, flood inundation information for a specific flood scenario is supplied to HEC-FIA in the form of depth grids. Depth grids used for the assessment are typically generated by a hydraulic engineer using HEC-GeoRAS, RAS Mapper (a tool that is part of the HEC-RAS software) or another hydraulic model. The maximum inundated depth grid is required for each flood scenario to be analyzed. The GeoRAS maximum inundation depth grid is located in the "Max WS" folder of the RAS Mapper results directory.

If the depth grid(s) are in binary formation (.flt), the user can convert the .flt file to a .tif file outside of HEC-FIA. However, HEC-FIA automatically converts the .flt to a .tif file. When HEC-FIA converts .flt to .tif, the software tiles, pyramids, and compresses the .tif file, which can be very beneficial in terms of data storage:

1. Start **ArcCatalog**, the **ArcCatalog** window opens (Figure B.1).




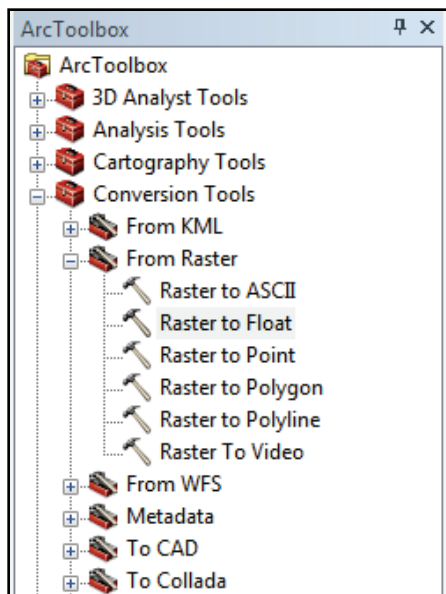
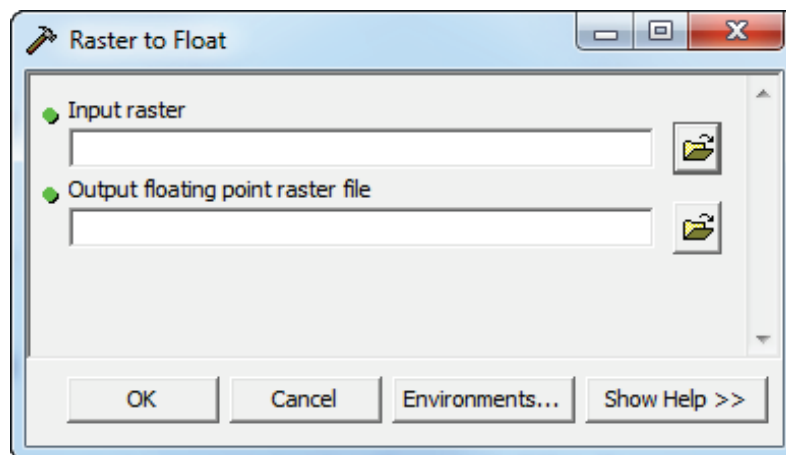
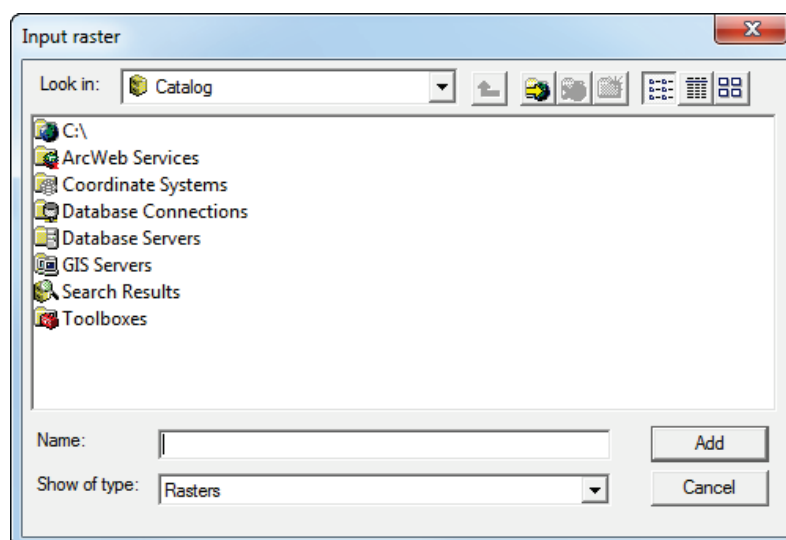
**Figure B.1** ArcCatalog Window

2. If the **ArcToolbox Pane** is not present, click **ArcToolbox** on the **Standard Toolbar** (Figure B.2) and the **ArcToolbox Pane** displays in the **ArcCatalog** window (Figure B.1).

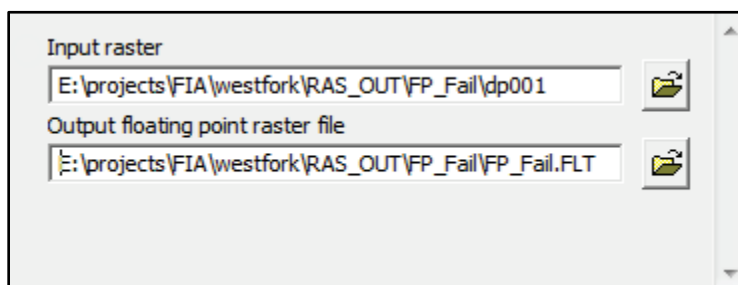


**Figure B.2** ArcCatalog Window - Standard Toolbar

3. From the **ArcToolbox Tree**, double-click **Conversion Tools**, double-click **From Raster**, and then double-click **Raster to Float** (Figure B.3).
4. The **Raster to Float** dialog box opens (Figure B.4). Click  next to the **Input raster** box to select a grid.
5. The **Input raster** browser opens (Figure B.5). Browse to the location of the depth grid file select it. Click **Add**, the **Input raster** browser closes, and the path and the name of the selected depth grid file is displayed in the **Input raster** box on the **Raster to Float** dialog box (Figure B.4).

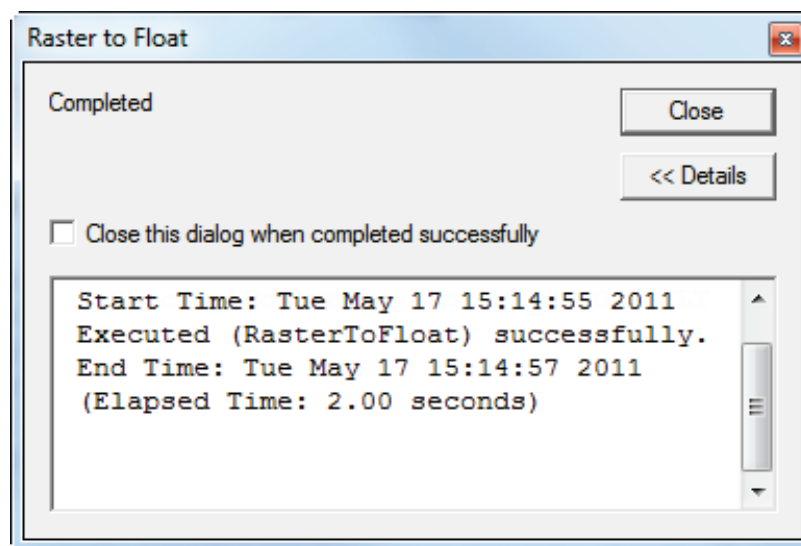
**Figure B.3** ArcToolbox Tree**Figure B.4** Raster to Float Dialog Box**Figure B.5** Input Raster Browser

6. By default the output floating raster file is stored to the same directory as the selected depth grid file. In the **Output floating point raster file** box (Figure B.6) the path and the default name for the binary file appears. The default name is the depth grid filename with *RasterT\_* appended to the front, and appended to the end if *1.FLT* (i.e., *RasterT\_dp001.FLT*). Modify this to represent flood scenario represented by the depth grid (i.e. *FP\_Fail.flt*).



**Figure B.6** Output Floating Point Raster File Default Name

7. Click **OK**. The **Raster to Float** dialog box closes and the **Raster to Float Compute** dialog box opens (Figure B.7). This dialog box notifies the user of the status of the compute and how long it took to create the binary file. When finished viewing information, click **Close** to close the **Raster to Float Compute** dialog box.



**Figure B.7** Raster to Float Dialog Box

8. Now in the selected directory, there are two files, \*.flt and \*.hdr. The depth grid has been successfully converted to a binary format.

## B.2 Preparing Duration and Arrival Time Grids

This step is only required if using duration and arrival time grids in place of hydrograph data. Duration grids are only required for agricultural damages. If agricultural damage is not part of the assessment then duration grids do not need to be prepared. Arrival time grids are required for both agricultural and life loss calculations.

Duration grids and arrival time grids are generally produced from either ArcGIS® plug-ins or RAS Mapper. The duration grid is defined as the duration of time a grid cell is wet. The arrival time grid contains the amount of time it takes for water stage to reach a predefined threshold at each cell. Typically the arrival time threshold is two (2) feet. If life loss calculations are to be computed with arrival time grids, make sure the threshold for arrival time (default of two feet) is the same threshold used to define the hazard boundary for each scenario.

For an agricultural damage assessment, the arrival time threshold is typically zero (0) feet.


## B.2.1 Duration Grid Preparation

To convert the duration grid to binary format (.flt):

1. Start **ArcCatalog**. The **ArcCatalog** window opens (Figure B.1).
2. If the **ArcToolbox Pane** is not present, click **ArcToolbox** on the **Standard Toolbar** (Figure B.2) and the **ArcToolbox Pane** displays in the **ArcCatalog** window.
3. From the **ArcToolbox Tree**, double-click **Conversion Tools**, double-click **From Raster**, and then double-click **Raster to Float** (Figure B.3).
4. The **Raster to Float** dialog box opens (Figure B.4). Browse to the location of the duration grid file by clicking next to the **Input raster** box.
5. The **Input raster** browser opens (see Figure B.5). Browse to the location of the duration grid file, click on the duration grid filename. Click **Add**, the **Input raster** browser closes (Figure B.5), and the path and the name of the selected duration grid file ( i.e., *E:\projects\FIA\westfork\Duration\FP\_Fail\FP\_F\_Duration*) appears in the **Input raster** box on the **Raster to Float** dialog box (Figure B.4).
6. By default the software creates the output floating point raster file to the same directory as the selected duration grid file. In the **Output floating point raster file** box (Figure B.6) the path and the default name for the binary file (i.e., *E:\projects\FIA\westfork\Duration\FP\_Fail\RasterT\_FP\_F1.FLT*) appears. Modify the float filename to represent the flood scenario represented by the duration grid (i.e. *FP\_Fail\_Duration.FLT*).
7. Click **OK**, the **Raster to Float** dialog box closes. The **Raster to Float Compute** dialog box opens (Figure B.7). This dialog box notifies the user of the status of the compute and how long it took to create the binary file. When finished viewing information, click **Close**. The **Raster to Float Compute** dialog box closes.
8. Now in the selected directory, there are two files, \*.flt and \*.hdr. The duration grid has been successfully converted to a binary format.

## B.2.2 Arrival Time Grid Preparation

To convert the arrival time grid to binary format (.flt):

1. Start **ArcCatalog**. The **ArcCatalog** window opens (Figure B.1).
2. If the **ArcToolbox Pane** is not present, click **ArcToolbox** on the **Standard Toolbar** (Figure B.2) and the **ArcToolbox Pane** displays in the **ArcCatalog** window.
3. From the **ArcToolbox Tree**, double-click **Conversion Tools**, double-click **From Raster**, and then double-click **Raster to Float** (Figure B.3).
4. The **Raster to Float** dialog box opens (Figure B.4). Browse to the location of the arrival time grid file by clicking  next to the **Input raster** box.
5. The **Input raster** browser opens (Figure B.5). Browse to the location of the arrival time grid file, click on the grid filename. Click **Add**, the **Input raster** browser closes, and the path and the name of the selected arrival time grid file appears in the **Input raster** box on the **Raster to Float** dialog box.
6. By default the software creates the output floating point raster file to the same directory as the selected arrival time grid file. In the **Output floating point raster file** box (Figure B.6) the path and the default name for the binary file (i.e., *E:\projects\FIA\westfork\ArrivalTime\FP\_Fail\RasterT\_FP\_F1.FLT*) appears. Modify the float filename to represent the flood scenario represented by the arrival time grid (i.e. *FP\_Fail\_Arrival.FLT*).
7. Click **OK**. The **Raster to Float** dialog box closes and the **Raster to Float Compute** dialog box opens (Figure B.7). This dialog box notifies the user of the status of the compute and how long it took to create the binary file. When finished viewing information, click **Close**. The **Raster to Float Compute** dialog box closes.
8. Now in the selected directory, there are two files, \*.flt and \*.hdr. The arrival time grid has been successfully converted to a binary format.

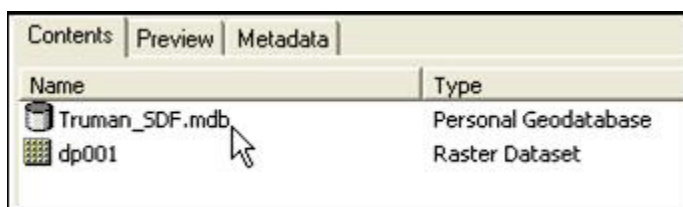
## B.3 Maximum Inundated Area Polygon

A polygon that represents the maximum inundated area for the largest flood scenario is necessary to trim other required data down to a manageable size. The inundated area polygon for the maximum flood inundation scenario is typically generated by the hydraulic engineer while performing inundation mapping in HEC-GeoRAS (bounding polygons). These bounding polygons are stored in the HEC-GeoRAS geodatabase for a given study. This maximum inundated area needs to be converted to a shapefile for later use.

To convert the maximum inundated area bounding polygon to a shapefile:

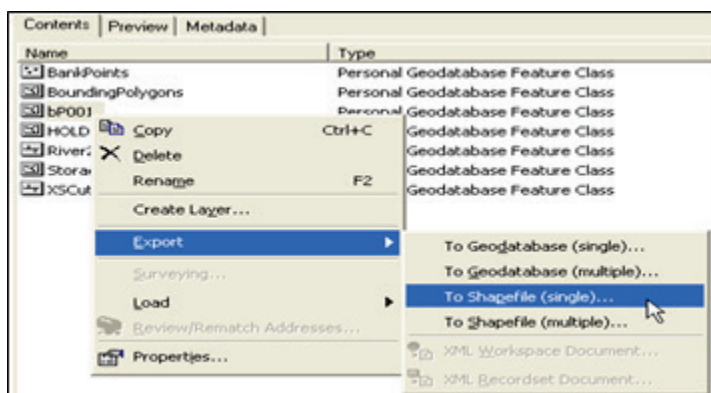
1. Start **ArcCatalog**. The **ArcCatalog** window opens (Figure B.1).
2. From the first pane (the **Catalog Tree**), browse to the folder that contains the geodatabase file for the study.

- Once the geodatabase file appears in the **Contents** tab of the main window (Figure B.8), double-click on the geodatabase filename (i.e., *Turman\_SDF.mdb*). Next, double-click on the geodatabase feature dataset (i.e., *RasResults*).



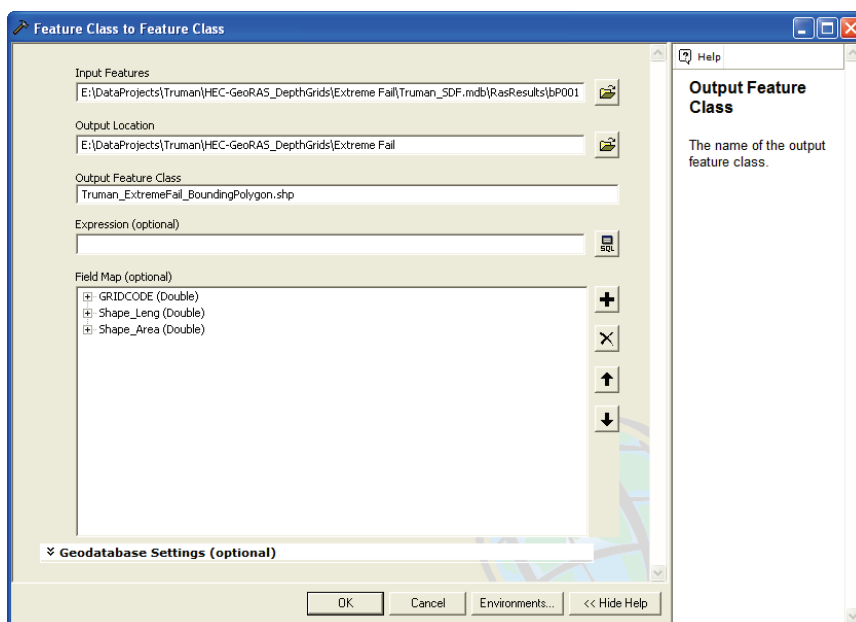
**Figure B.8** Contents Tab - Geodatabase File

- The bounding polygon file created by HEC-GeoRAS should appear in the list (i.e., *bp001*). Right-click on the bounding polygon filename (Figure B.9). From the shortcut menu, point to **Export** and select **To Shapefile (single)**.




**Figure B.9** Export Shortcut Menu

- The **Feature Class to Feature Class** dialog box opens (Figure B.10).



**Figure B.10** Feature Class to Feature Class Dialog Box

- The **Input Features** box should contain the name of the selected bounding polygon file. Choose the location to store the shapefile by clicking  next to the **Output Location** dialog box. The **Output Location** browser opens (Figure B.11). Browse to the folder to store the shapefile, click **Add**. The **Output Location** browser closes, and the pathname with the selected folder appears in the **Output Location** box of the **Feature Class to Feature Class** dialog box.

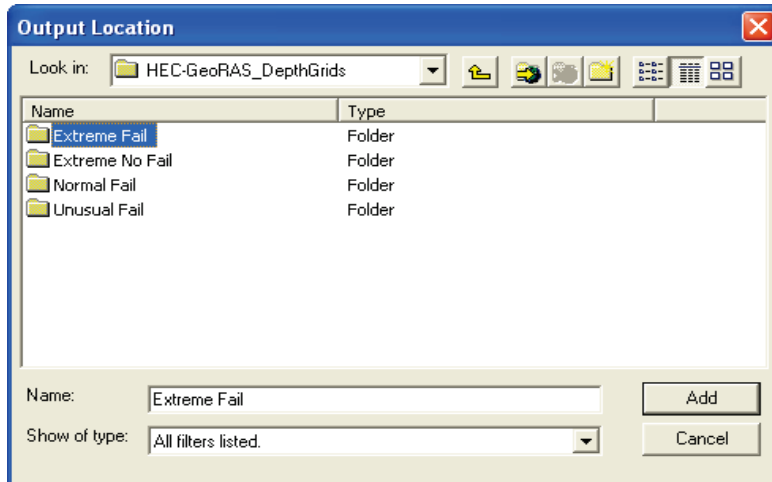


Figure B.11 Output Location Browser

- In the **Output Feature Class** box, provide a name for the shapefile (i.e., *Truman\_ExtremeFail\_BoundingPolygon*).
- Click **OK**. The **Feature Class to Feature Class** dialog box closes, and the **Feature Class to Feature Class Compute** dialog box opens (Figure B.12). This dialog box contains information on if the creation of the float file was successful and how long it took to create the binary file. Click **Close**. The **Feature Class to Feature Class Compute** dialog box closes and the shapefile appears in the location selected.

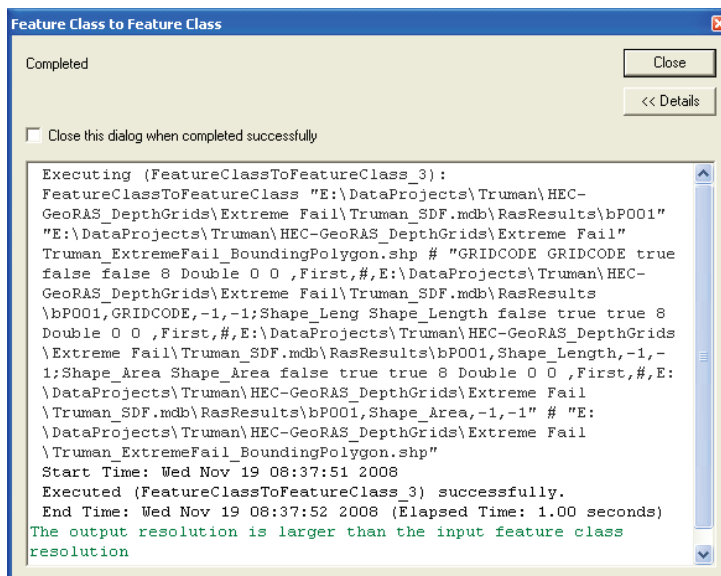


Figure B.12 Feature Class to Feature Class Compute Dialog Box



## B.4 Generate Hazard Area Boundary

During the evacuation portion of the life loss computation in HEC-FIA, the time it takes for people in a given structure to evacuate safely (defined as the time from leaving a structure to reaching a safe location) can be defined by either:

- Entering the exact time (minutes) it takes for the inhabitants of each structure to reach a safe location, or
- Providing a hazard area boundary and nominal evacuation velocity (mph) and letting HEC-FIA compute the time required for the inhabitants of each structure to evacuate to safety.

Typically, a hazard area boundary and nominal velocity is entered in HEC-FIA to estimate the evacuation times for a given event. The hazard area boundary should be determined by creating a polygon that represents the extents of flooding where depth is greater than two feet. Each flood event being simulated has a separate hazard area boundary. To create a hazard area boundary, follow the steps in the following sections.

### B.4.1 Reclassify Depth Grid Cells

The following steps assist the user in creating a polygon representing the Hazard Boundary, which represents everything with two feet of flooding or greater. This polygon can be utilized for evaluating where structures evacuate in an HEC-FIA simplified LifeSim computation. Reclassify depth grid cells for the maximum depth grid to values of one (1) if greater than two feet deep and two (2) if less than or equal to two feet deep:

1. Start **ArcMap**. The **ArcMap** window opens (Figure B.13). By default, a **new empty map** is selected, click **OK**.

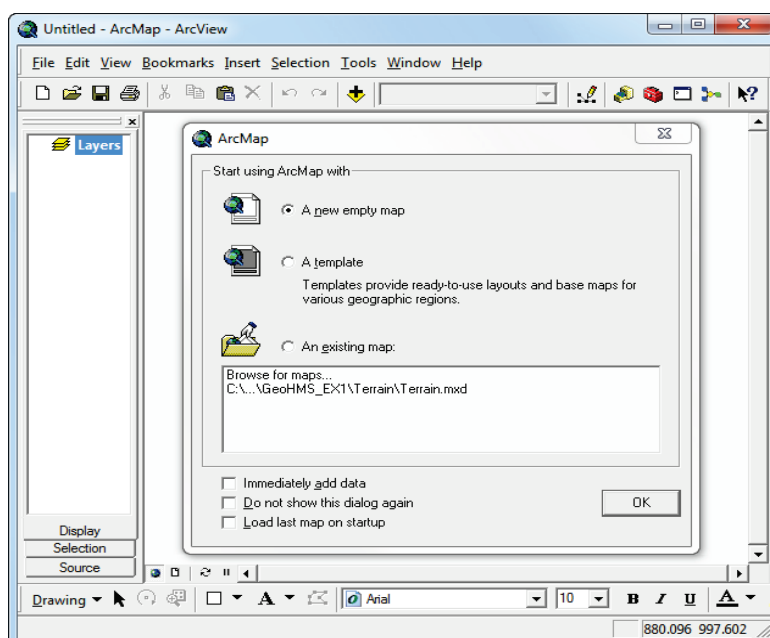
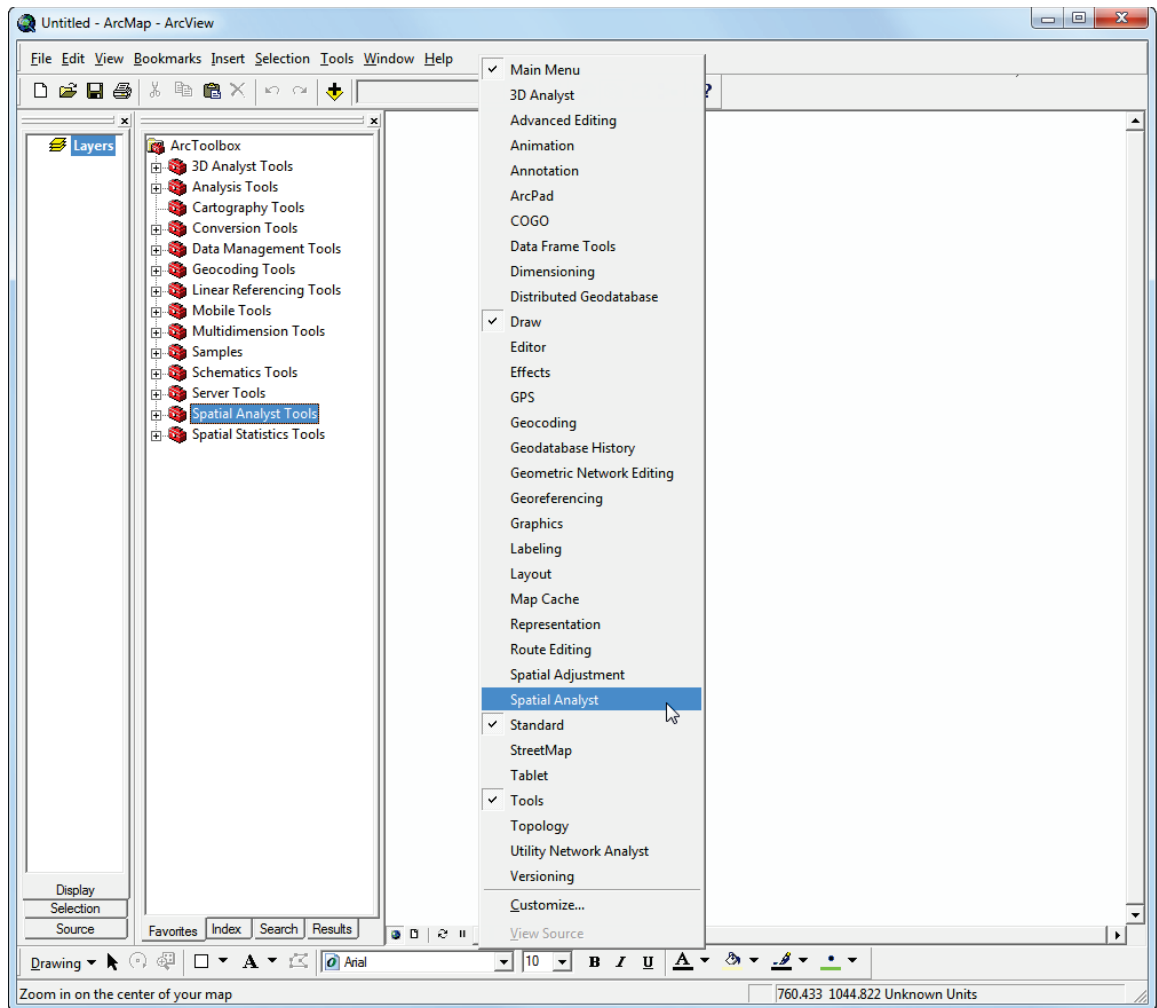
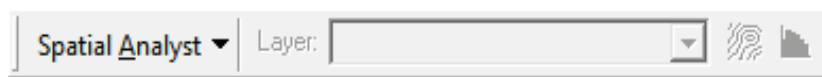


Figure B.13 ArcMap® Window


2. If the **Spatial Analyst Toolbar** is not available from the **ArcMap** window, right-click on the empty area next to the **Menu Bar** (Figure B.14). From the shortcut menu, click **Spatial Analyst**, the **Spatial Analyst Toolbar** (Figure B.15) appears in the toolbar area.

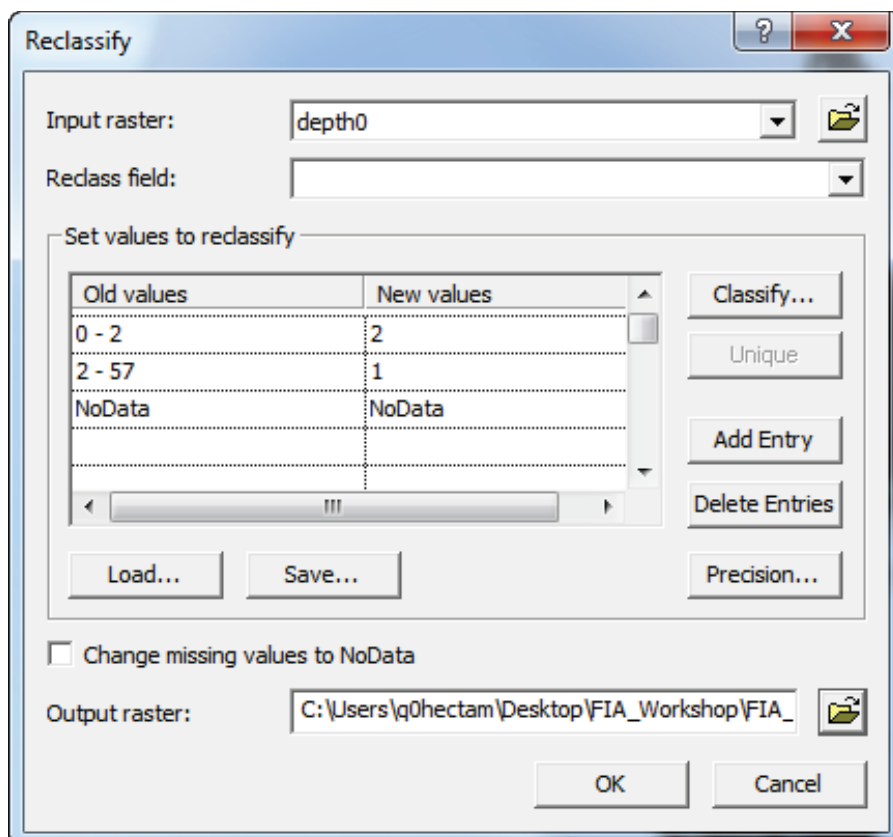


**Figure B.14** Toolbar Setup Shortcut Menu



**Figure B.15** Spatial Analyst Toolbar

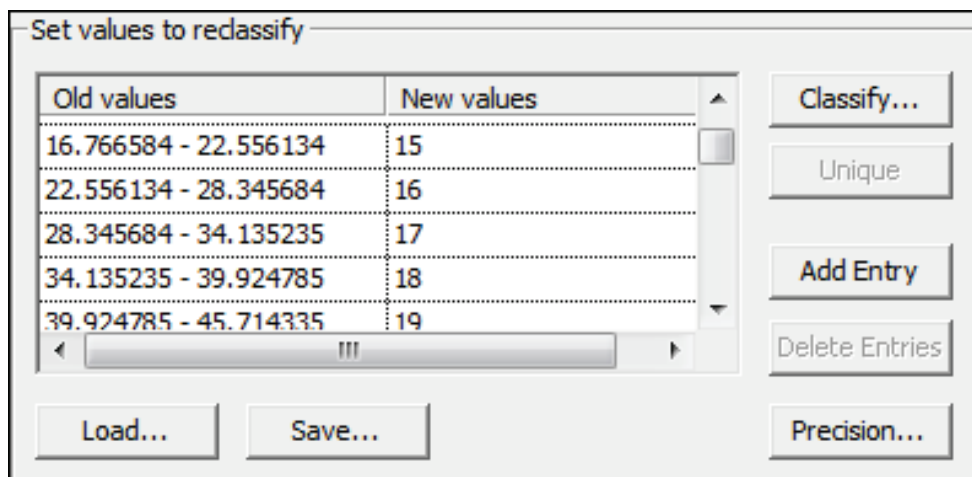
3. From the **Spatial Analyst Toolbar**, click **Spatial Analysis** and then select **Reclassify** from the shortcut menu. The **Reclassify** dialog box opens (Figure B.16).
4. Input raster is the maximum depth grid (*depth0*) for the flood scenario being assessed. From the **Input raster** list, select the depth grid file or by clicking  next to the **Input raster** list.
5. A **Choose an input raster** browser opens. Browse to the location of the depth grid file, click on the depth grid filename and then click **Add**. The **Choose an input raster**



**Figure B.16** Reclassify Dialog Box


browser closes, and the filename of the grid appears in the **Input raster** box on the **Reclassify** dialog box.

6. Leave the **Reclass field** box blank.
7. Default values appear in the **Set values to reclassify** box (Figure B.17). These values (both old and new) need to be reset. Set all values less than or equal to two (2) feet to a new value of two (2) and values from two (2) feet up to the highest value in the depth grid




**Figure B.17** Set Values to Reclassify

to a new value of one (1). For an example, see Figure B.16. Note that when entering the old value range a space is required on both sides of the dash (enter 0 - 2, not 0-2).

8. In the **Output raster** box, type the desired pathname for the depth grid or click  to browse to the place where the grid is to be saved.
9. Click **OK**. The hazard area grid is created. When that is finished, the **Reclassify** dialog box closes and the hazard area boundary grid displays in the ArcMap® window.

## B.4.2 Generate a Polygon Shapefile of the Hazard Area Boundary

Generate a polygon shapefile that represents the hazard area boundary (can be done in ArcMap or ArcCatalog):

1. If the **ArcToolbox Pane** is not present, click **ArcToolbox**  on the **Standard Toolbar** (Figure B.1) and the **ArcToolbox Pane** displays in the ArcMap or ArcCatalog window.
2. From the **ArcToolbox Tree**, double-click **Conversion Tools**, double-click **From Raster**, and then double-click **Raster to Polygon** (Figure B.3). The **Raster to Polygon** dialog box opens (Figure B.18).

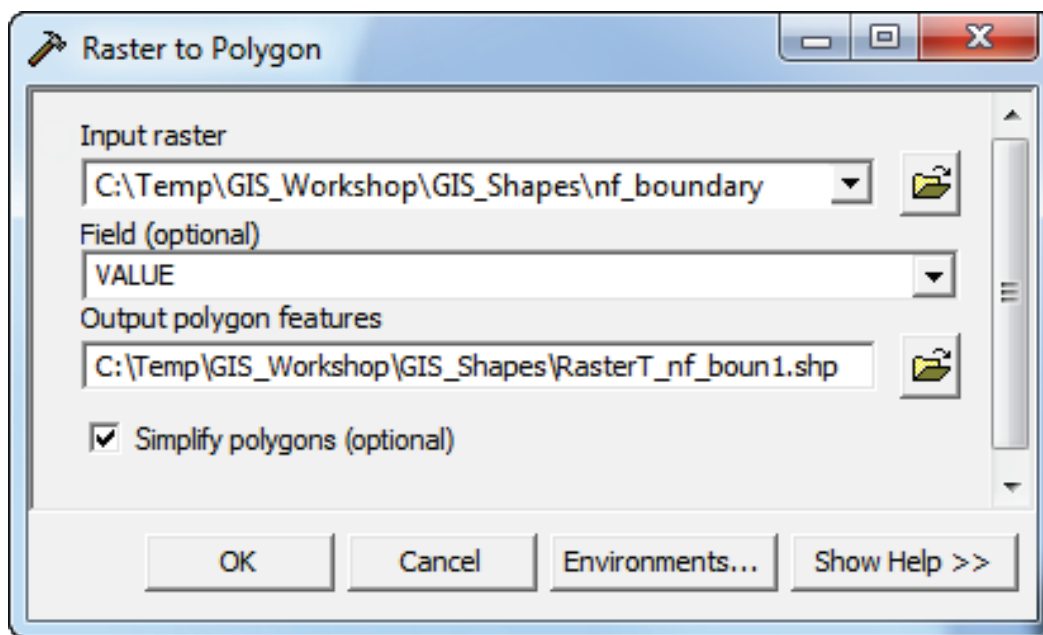



Figure B.18 Raster to Polygon Dialog Box

3. The input raster file is the hazard area boundary grid that was created in the previous section. Select the location of the hazard area boundary grid by clicking  next to the **Input raster** box (Figure B.18). Browse to the location of the hazard area boundary grid, and select it. Click **Add**, the **Input raster** browser closed, and the path and the name of the selected hazard area boundary file appears in the **Input raster** box on the **Raster to Polygon** dialog box.

4. The **Field** box should be set to **VALUE**; this option is used to assign values from the cells in the hazard area boundary file to the polygons in the shapefile.
5. By default the software stores the output shapefile to the same directory as the selected hazard area boundary grid. In the **Output polygon features** box, the path and the default name for the shapefile appears. Change this name to symbolize the depth grid it represents (i.e. *normal\_fail\_hazardarea.shp*).
6. Select **Simplify polygons** so that the software smoothes the polygons into simpler shapes.
7. Click **OK**. The **Raster to Polygon** dialog box closes and the **Raster to Polygon Compute** dialog opens. This dialog box notifies the user of the status of the compute and how long it took to create the binary file. When finished viewing information, click **Close**. The **Raster to Polygon Compute** dialog box closes.

### B.4.3 Editing the Hazard Area Boundary Shapefile

All polygons with a value of one (1) in the output polygon dataset represent the hazard area boundary. Edit the polygon shapefile and select all polygons with a value of two (2) and delete them.

To edit the hazard area boundary shapefile:

1. From the **Editor Toolbar** click **Editor** (Figure B.19), from the shortcut menu click **Start Editing**.

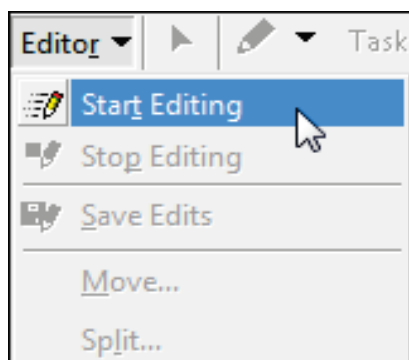


Figure B.19 Start Editing

2. Right click on the shapefile that was created in the previous section. From the shortcut menu (Figure B.20), click **Open Attribute Table**. The attribute table for the hazard area polygon file opens (Figure B.21).
3. Click **Options** (Figure B.21). From the shortcut menu, click **Select by Attributes**. The **Select by Attributes** dialog box opens (Figure B.22).
4. Double-click on "GRIDCODE", in the **SELECT \* FROM shapefile name WHERE** box "GRIDCODE" appears. Click the equals sign button and then enter 2.

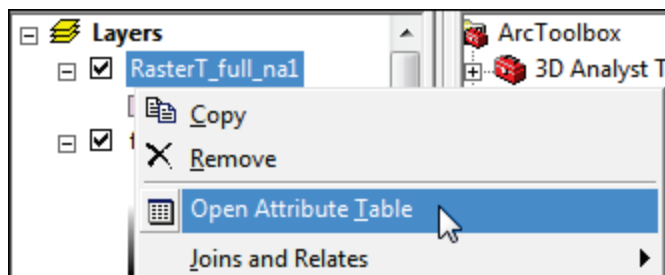


Figure B.20 Open Attribute Table Menu Item

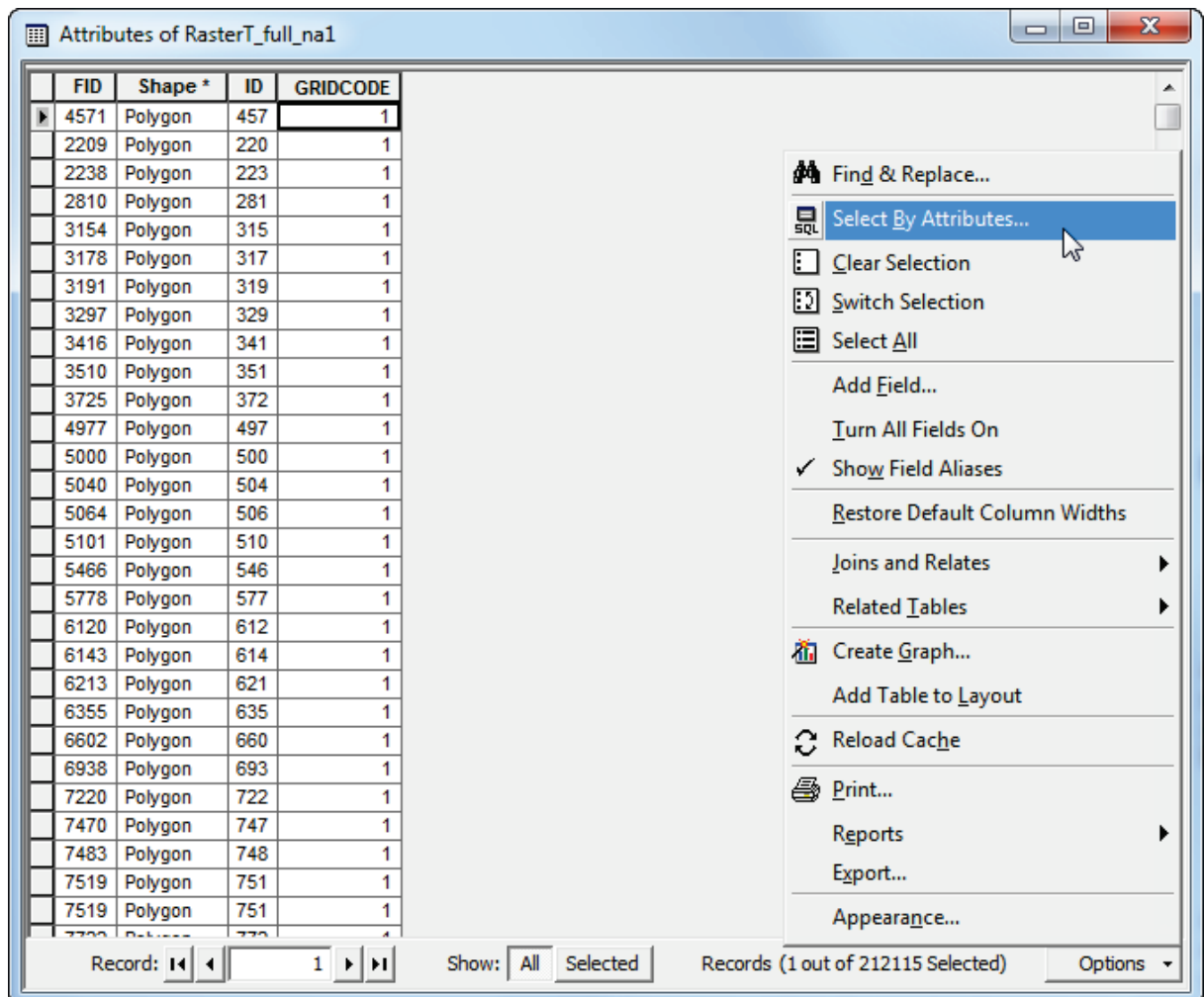

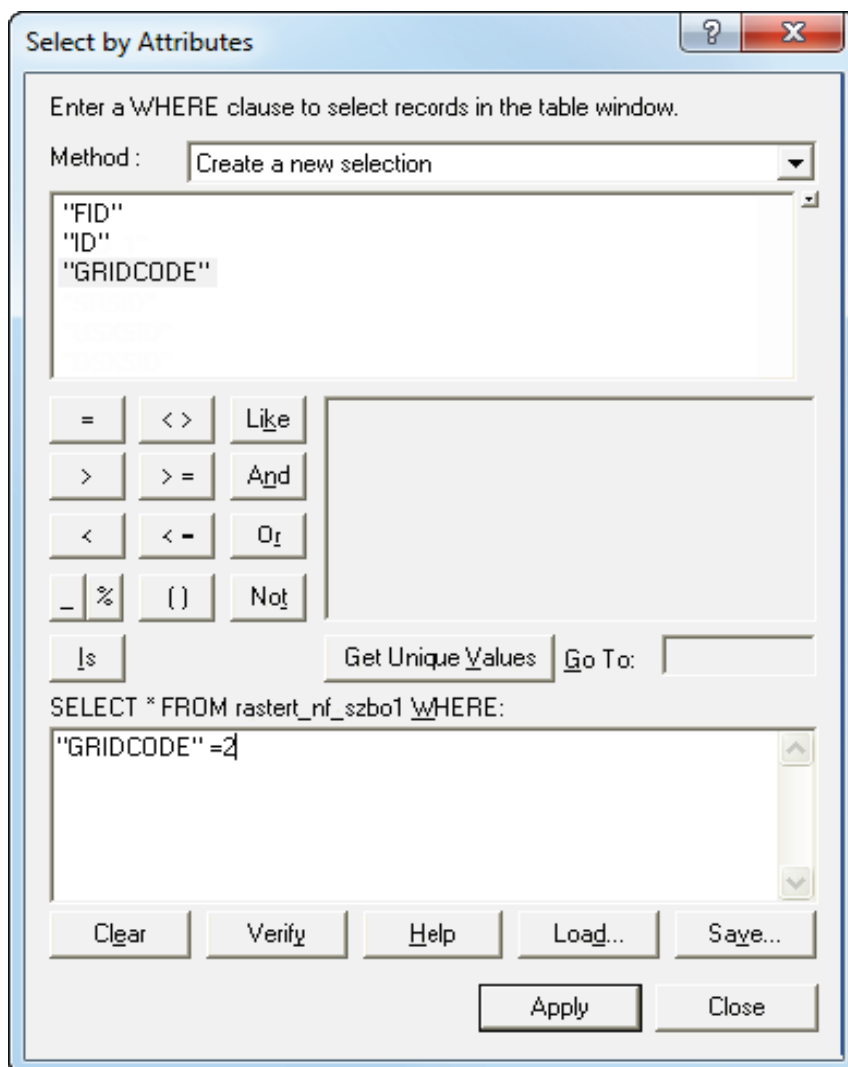


Figure B.21 Attribute Table

5. Click **Apply**, in the attribute table all the rows with a *GRIDCODE* equal to two (2) are highlighted in a cyan color. If the shapefile is displayed in the ArcMap window, the same items are highlighted in cyan.
6. Click **Close**, the **Select by Attributes** dialog box closes.
7. From the attribute table dialog box click the **Delete** key. All of the highlighted rows are deleted. Click  to close the attribute table.



**Figure B.22** Select by Attributes Dialog Box

8. From the **Editor Toolbar** click **Editor** (Figure B.19). From the shortcut menu click **Save Edits**. Now the hazard area boundary shapefile has been edited to contain only the polygons that delineate areas where the maximum depth is greater than two feet.
9. Repeat all steps in this section for each depth grid in the study.


## B.5 Preparing Digital Terrain Model

Terrain data can be in binary grid format for use in HEC-FIA, or in the .tif format. HEC-FIA and HEC-RAS 5.0 utilize .tif files; this section explains the steps to convert from ESRI Raster to .flt so that the file can be imported into HEC-FIA 3.0. HEC-FIA converts the file to .tif for the user. Terrain information is required to assign ground elevations to a structure inventory generated in HEC-FIA, to update ground elevations in an existing structure inventory, and to determine the arrival time at the hazard boundary during the evacuation stage of the life loss compute. To prepare a terrain grid for importing into HEC-FIA, follow the steps in this section.

## B.5.1 Clip the Original Digital Terrain Grid

If an existing terrain grid extends far beyond the limits of the study, the terrain grid can be clipped to the same area that is covered by the maximum inundated depth grid. This allows HEC-FIA to use the terrain grid in a more efficient manner. If the terrain grid is of manageable size (less than 1GB in size), then skip to Section B.5.2.

To clip the digital terrain grid:

1. Start **ArcMap**. The **ArcMap** window opens (Figure B.13).
2. If the **ArcToolbox Pane** is not present, click **ArcToolbox**  on the **Standard Toolbar** (Figure B.1) and the **ArcToolbox Pane** displays in the **ArcMap** window.
3. From the **ArcToolbox Tree**, double-click **Spatial Analyst Tools**, double-click **Extraction**, and then double-click **Extraction by Mask** (Figure B.23).

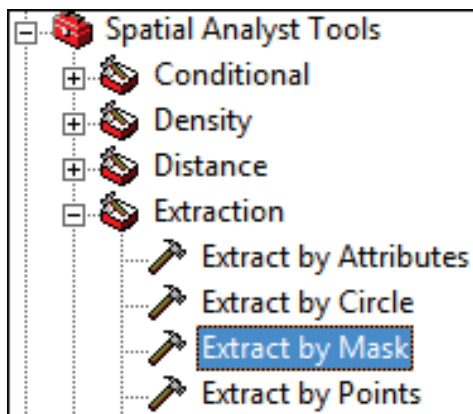



Figure B.23 Spatial Analyst Tools

4. The **Extract by Mask** dialog box opens (Figure B.24). Browse to the location of the digital terrain grid file by clicking  next to the **Input raster** list.

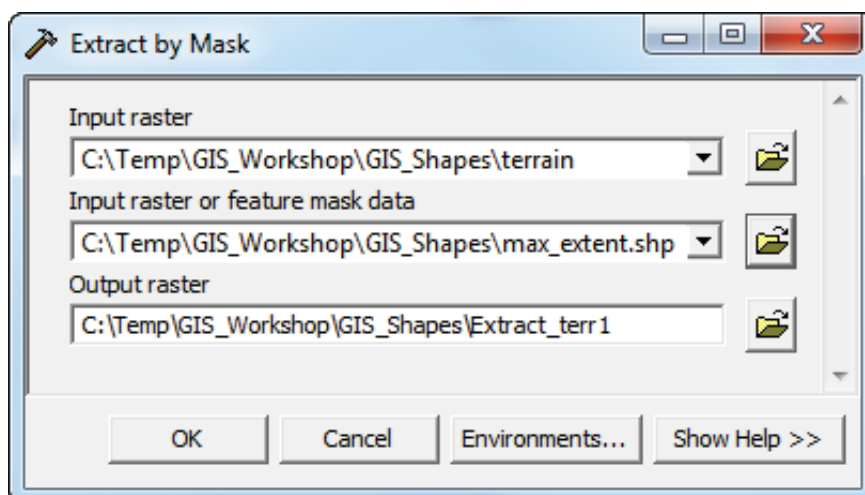
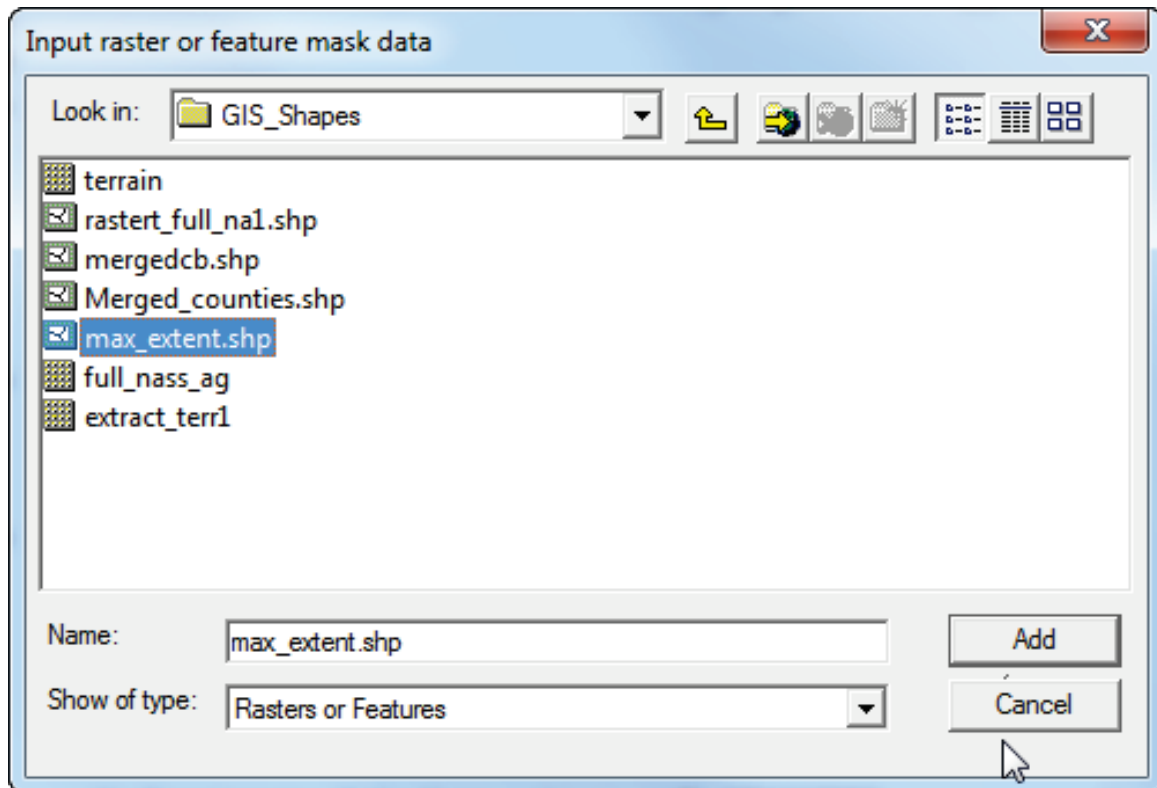



Figure B.24 Extract by Mask Dialog Box

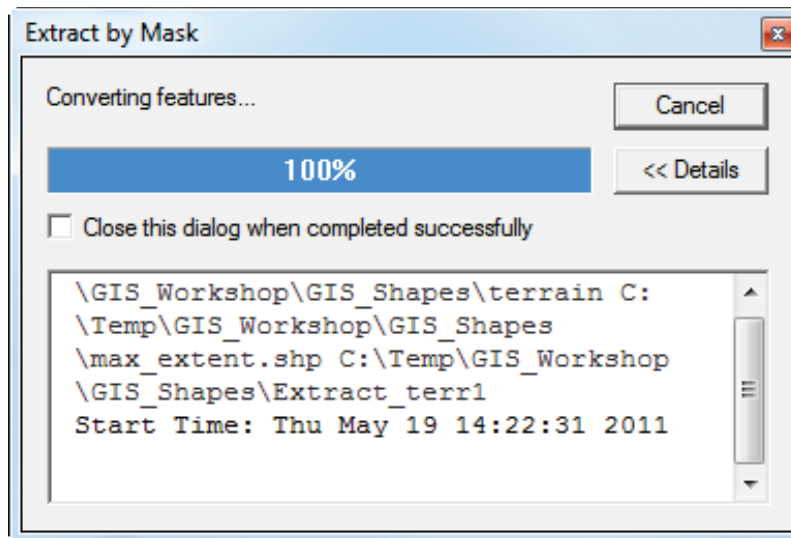


5. The **Input Raster** browser opens (see Figure B.25). Browse to the location of the digital terrain grid file, click on the digital terrain grid filename. Click **Add**, the **Input raster** browser closed, and the pathname of the selected digital terrain grid file (i.e., *C:\Temp\GIS\_Workshop\GIS\_Shapes\terrain*) appears in the **Input raster** list on the **Extract by Mask** dialog box (Figure B.24).



**Figure B.25** Input Raster or Feature Mask Data Browser



6. Browse to the location of the maximum inundated area bounding polygon shapefile (created in Section B.3) by clicking  next to the **Input raster or feature mask data** list (Figure B.24). The **Input raster or feature mask data** browser opens (Figure B.25).
7. Browse to the location of the maximum inundated area bounding polygon shapefile, click on the shapefile filename. Click **Add**, the **Input raster or feature mask data** dialog box closes, and the path and the name of the selected maximum inundated area bounding polygon shapefile appears in the **Input raster or feature mask data** list on the **Extract by Mask** dialog box (Figure B.24).
8. By default the software creates the masked terrain digital grid in the same location as the original terrain digital grid.
9. Click **OK**, the **Extract by Mask** dialog box closes and the **Extract by Mask Compute** dialog box opens (Figure B.26). This dialog box notifies the user of the status of the compute and how long it took to create the masked digital terrain grid file. When finished viewing information, click **Close**, the **Extract by Mask Compute** dialog box closes and the shapefile appears in the selected location.



**Figure B.26** Extract by Mask Dialog Box

Now in the selected directory, the masked terrain digital grid file appears.

## B.5.2 Convert Terrain Grid to a Binary Format

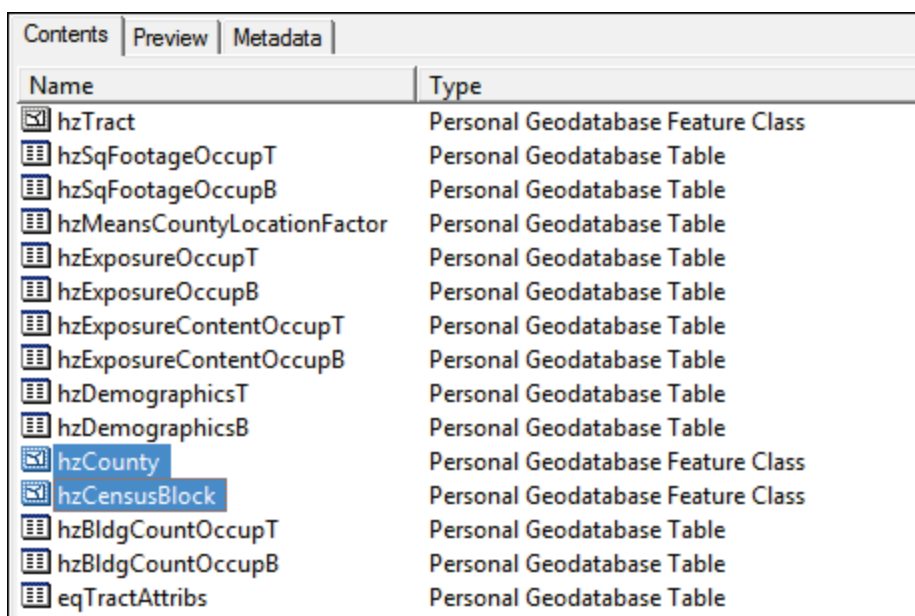
1. Start **ArcMap**. The **ArcMap** window opens (Figure B.13).
2. If the **ArcToolbox Pane** is not present, click **ArcToolbox**  on the **Standard Toolbar** (Figure B.1) and the **ArcToolbox Pane** displays in the **ArcMap** window.
3. From the **ArcToolbox Tree**, double-click **Conversion Tools**, double-click **From Raster**, and then double-click **Raster to Float** (Figure B.3).
4. The **Raster to Float** dialog box opens (Figure B.4). Browse to the location of the clipped digital terrain grid file by clicking  next to the **Input raster** box.
5. The **Input raster** browser opens (Figure B.5). Browse to the location of the clipped digital terrain grid file, click on the clipped digital terrain grid filename. Click **Add**, the **Input raster** browser closes, and the pathname of the selected clipped digital terrain grid file appears in the **Input raster** box on the **Raster to Float** dialog box.
6. By default the software creates the output floating point raster file to the same directory as the selected clipped digital terrain grid file. In the **Output floating point raster file** box (Figure B.6) the path and the default name for the binary file appears.
7. Click **OK**, the **Raster to Float** dialog box closes. The **Raster to Float Compute** dialog box opens (Figure B.7). This dialog box notifies the user of the status of the compute and how long it took to create the binary file. When finished viewing information, click **Close**, the **Raster to Float Compute** dialog box closes.
8. Now in the selected directory, there are two files, \*.flt and \*.hdr. The clipped digital terrain grid has been successfully converted to a binary format.

The grid can also be converted to ASCII file format for importing into HEC-FIA using **Raster to ASCII**. However, binary format is preferred due to smaller file sizes and faster processing time.

## B.6 Preparing HAZUS Data

For a typical rapid consequence assessment, the required structure inventory can be generated using data that accompany FEMA's HAZUS-MH software. If better data exists in the form of a current structure inventory (point shapefile) or parcel database (polygon shapefile), those should be used. In order to use HAZUS county, census block and agricultural data, the geodatabase feature classes must be exported from the geodatabase to shapefile format.

1. Start **ArcCatalog**. The **ArcCatalog** window opens (Figure B.1).
2. From the first pane, from the **Catalog Tree**, browse to the folder that contains the HAZUS county and census block geodatabase file for the state that contains the study area (i.e., *bndrygbs.mdb*).
3. Double-click on *bndrygbs.mdb*, in the **Contents Pane** to display the contents of the geodatabase file.
4. In the **Contents Pane**, hold down the **CTRL** key and click to select both **hzCounty** and **hzCensusBlock** (Figure B.27).



**Figure B.27** ArcCatalog® Contents Pane

5. With both feature classes selected, right click on one of the features. From the shortcut menu, point to **Export** and select **To Shapefile (multiple)** (Figure B.28).
6. The **Feature Class to Shapefile (multiple)** dialog box opens (Figure B.29). The two geodatabase feature classes that were selected in Step 5 are shown in the table under the **Input Features** box.

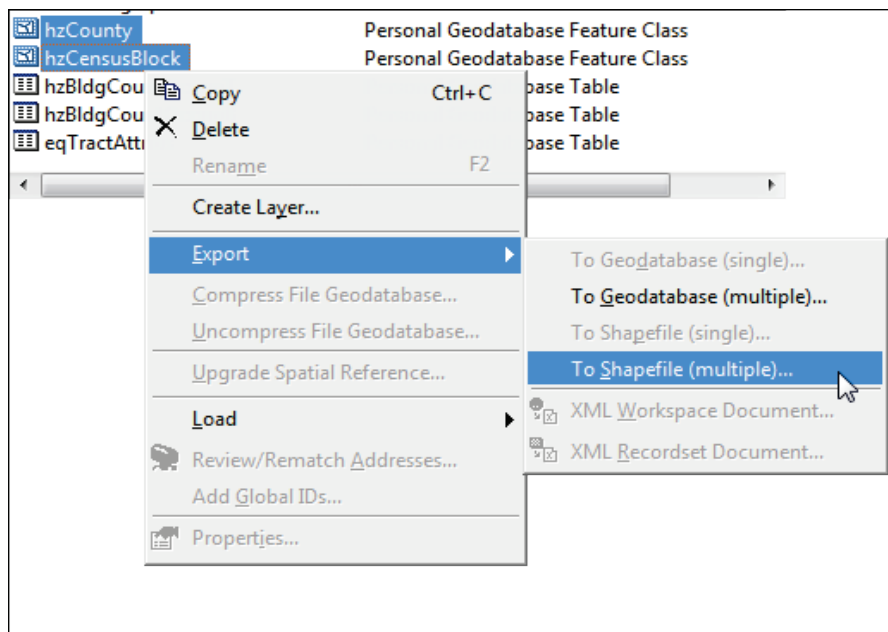


Figure B.28 Export Geodatabase to Shapefile (ArcCatalog® Contents Pane)

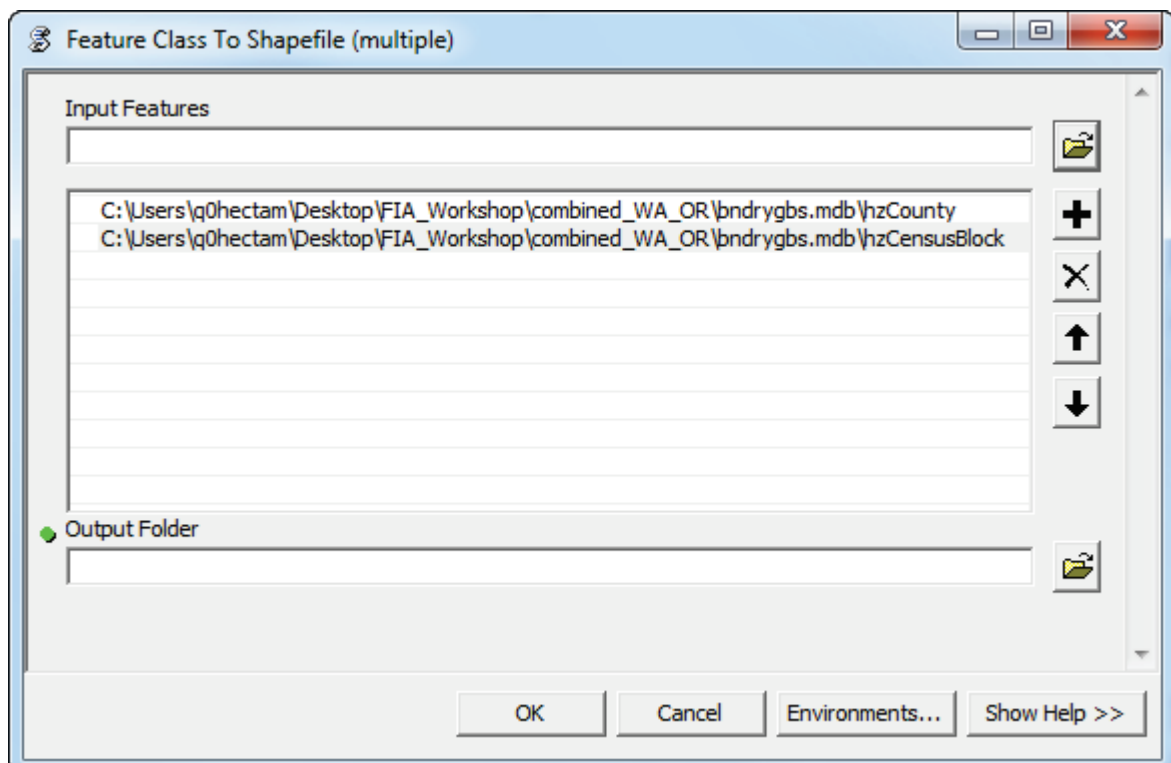

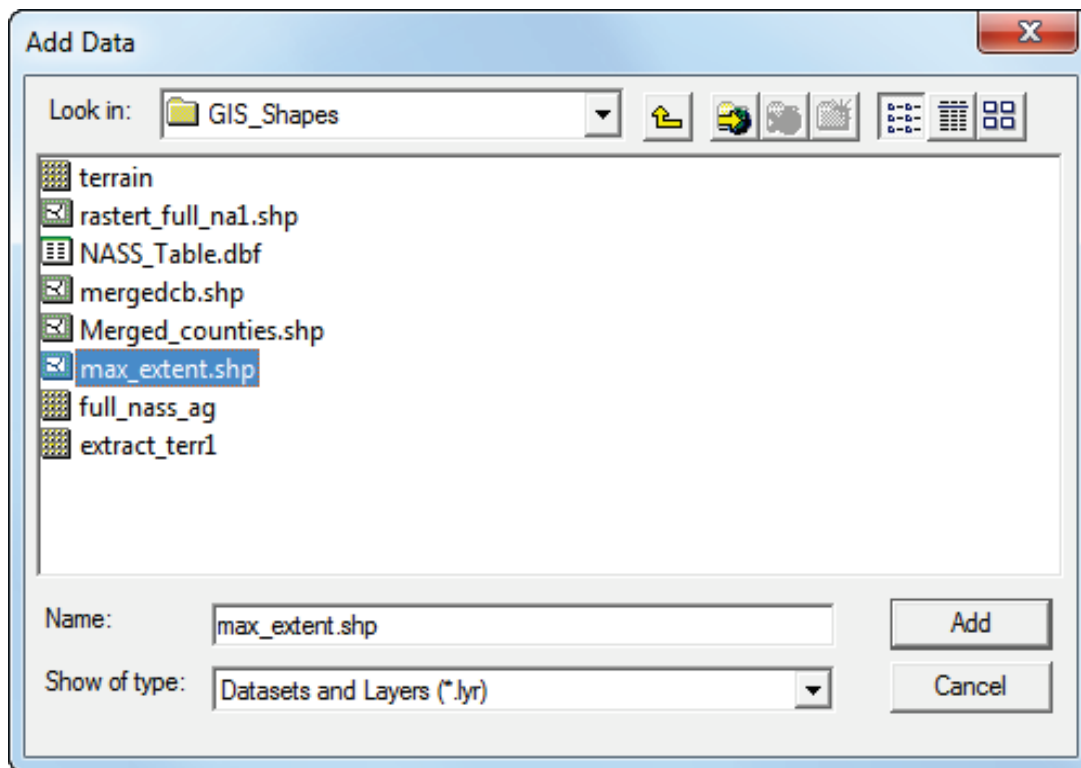


Figure B.29 Feature Class To Shapefile (multiple) Dialog Box


7. Browse to where the shapefiles are to be stored, click  next to the **Output Folder** box (Figure B.29). The **Output Folder** browser opens (Figure B.30). Browse to the folder where shapefiles are to be stored, click **Add**. The **Output Folder** browser closes, and the pathname with the selected folder appears in the **Output Location** box of the **Feature Class to Shapefile (multiple)** dialog box (Figure B.29).

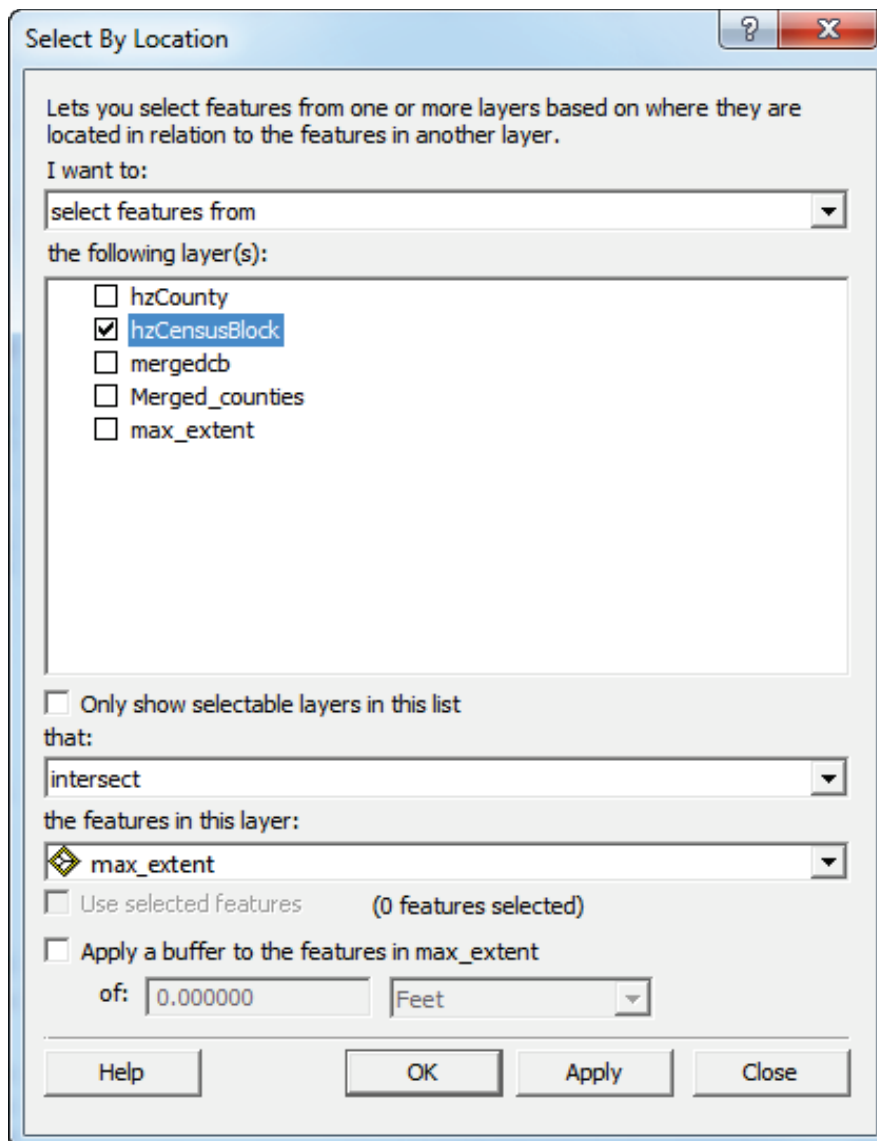


**Figure B.30** Add Data Browser

8. Click **OK**, the **Feature Class to Shapefile (multiple)** dialog box closes (Figure B.29), and the **Feature Class to Shapefile (multiple) Compute** dialog box opens. This dialog box notifies the user of the status of the compute and how long it took to create the files. When finished viewing information, click **Close**, the **Feature Class to Shapefile (multiple) Compute** dialog box closes and the multiple shapefiles (i.e., *hzCensusBlock.shp*, *hzCounty.shp*) appears in the selected location.

To select only the data that is needed for the study area, use the inundated area bounding polygon shapefile created in Section B.3 to clip the HAZUS shapefiles. Make sure the inundated area polygon used in this step represents the maximum possible water surface elevation (i.e., PMF with failure for a typical IES).

1. Start **ArcMap**. The **ArcMap** window opens (Figure B.13).
2. Add the two shapefiles generated from Step 5 (i.e., *hzCensusBlock.shp*, *hzCounty.shp*) and the inundated area bounding polygon shapefile created in Section B.3.
3. From the **Table of Contents** pane of the **ArcMap** window, right-click **Layers**, from the shortcut menu click **Add Data** ; the **Add Data** browser opens (Figure B.30). From the browser, locate the inundated area bounding polygon shapefile to be used and click **Add**. The **Add Data** browser closes and the selected shapefile appears in the **Table of Contents** pane under **Layers**.
4. From the **Selection** menu, click **Select by Location**. The **Select by Location** dialog box opens (Figure B.31).



**Figure B.31** Select By Location Dialog Box

5. From the "**I want to**" list, select "**select features from**". In the "**the following layer(s)**" box click **hzCensusBlock**.
6. From the "**that**" list, select **intersect**. From the "**the features in this layer**" list select the inundated area bounding polygon shapefile (i.e., *max\_extent*).
7. Click **OK**, a **Selecting features** window opens. Once all of the census blocks that are touched by the inundation area polygon are selected, the **Select By Location** dialog box closes. On the display, the selected census blocks are displayed in cyan.

Next, export the selected polygons to a shapefile:

1. In the **Table of Contents** pane (Figure B.32), right click the census block shapefile (i.e., *hzCensusBlock*). From the shortcut menu point to **Data**, click **Export Data**; the **Export Data** dialog box opens (Figure B.33).

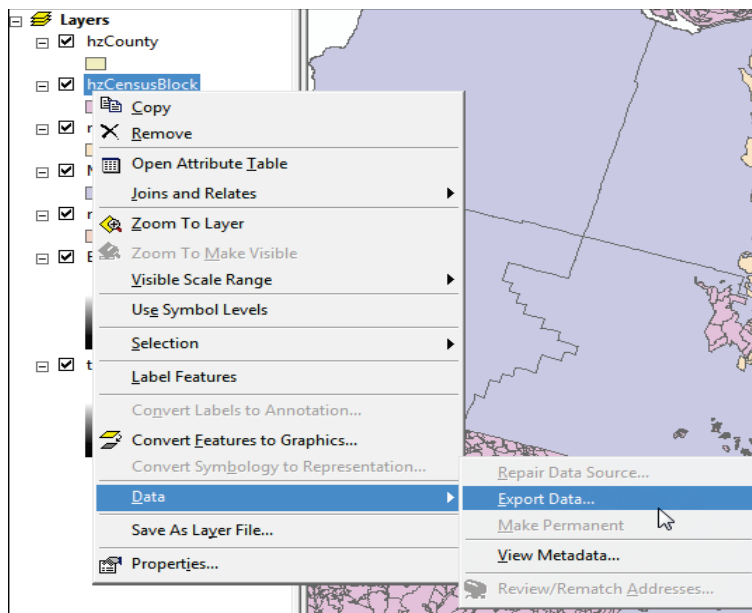


Figure B.32 Table of Contents Pane

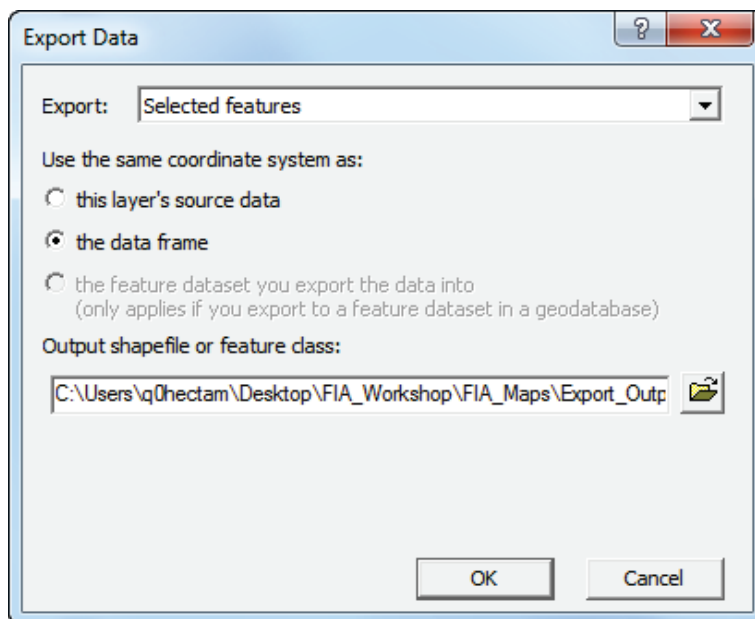



Figure B.33 Export Data Dialog Box

2. From the **Export** list, select **Selected features**.
3. From **Use the same coordinate system as** area, select **the data frame**.
4. Browse to where the shapefile is to be stored by clicking  next to the **Output shapefile or feature class** box. The **Saving Data Browser** opens. Browse to the folder where the shapefile is to be stored. The **Name** box has a default name (i.e., *Export\_Output.shp*); enter a name for the shapefile (i.e., *Truman\_Censusclip.shp*). Click **Save**, the **Saving Data Browser** closes, and the path and the shapefile name appears in the **Output shapefile or feature class** box of the **Export** dialog box (Figure B.33).



5. Click **OK**. An **Export Progress** window appears, displaying the progress of exporting the data. Once the exporting of the data to the shapefile is finished, a window appears asking the user if the shapefile is to be added to the map, click **No**.
6. A shapefile of the clipped HAZUS data has been created in the selected location.

Repeat the above process of selecting only the data in the study area for the county data and export to a shapefile.


## B.6.1 Using HAZUS Data for Multiple States

*In addition to the census, county and agricultural GIS polygon datasets, the supporting HAZUS database(s) must be supplied to the person that is running HEC-FIA. The folder containing the HAZUS data for a state within the study area in question should be copied to the HEC-FIA study folder for easy access during setup and running of HEC-FIA.*

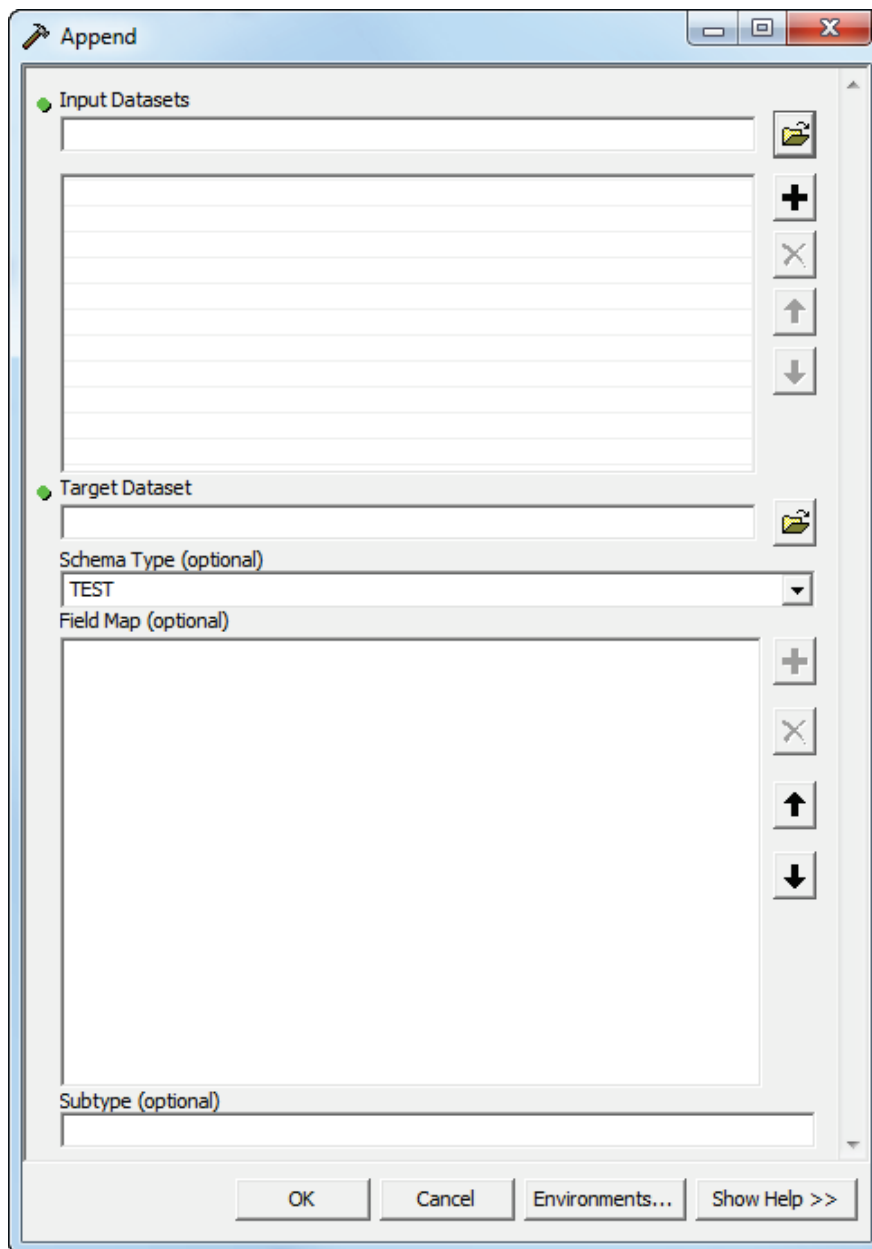
The HEC-FIA program uses one geodatabase for structure inventory and vehicle inventory. The two HAZUS geodatabases that are critical for use in HEC-FIA are named *bndrygbs.mdb* and *flVeh.mdb* and are separate for each state. If the study area crosses a state boundary, follow the same process outlined in the previous section for data in each state, then **append** the shapefiles for each data type (census blocks, counties, agricultural) into a single polygon before importing them into HEC-FIA. The supporting database tables must also be appended into one for each data type before importing into HEC-FIA. These database tables include the *hzBldgCountOccupB*, *hzExposureOccupB*, *hzExposureContentOccupB*, and *hzDemographicB* tables from the **bndrygbs.mdb** database, the *flNightVehicleInv* table in the **flVeh.mdb** database, and the *flAgricultureInventory* table from the **flAG.mdb** database.

Step-by-step instructions on how to append tables using ArcCatalog® follows.

To merge HAZUS data for multiple states, do the following:

1. From the HAZUS data, locate the states of interest for the study area (i.e., **VA1** (Virginia), **WV1** (West Virginia)).
2. Copy the required folders to the HEC-FIA project directory. It would be a good idea to create a backup copy of these folders somewhere else.
3. Start **ArcCatalog**. The **ArcCatalog** window opens (Figure B.1).
4. If the **ArcToolbox Pane** is not present, click **ArcToolbox**  on the **Standard Toolbar** (Figure B.2) and the **ArcToolbox Pane** displays in the **ArcCatalog** window.
5. From the **ArcToolbox Tree**, click **Data Management Tools**, click **General**, and then double-click **Append**. The **Append** dialog box opens (Figure B.34).





**Figure B.34** Append Dialog Box

6. Now select the HAZUS dataset that is to be the input dataset. For example, the HAZUS geodatabase file for the state of Virginia is used as the input dataset. From the **Input Datasets** box, click . The **Input Datasets** browser opens. Select the HAZUS geodatabase file for the structure inventory (i.e., *bndrygbs.mdb*) for the state the represents the study area (i.e., *VA1*) click **Add**. From the list, select the appropriate personal geodatabase table (i.e., *hzBldgCountOccupB*), click **Add**. The **Input Datasets** browser closes and the name appears in the **Input Datasets** table on the **Append** dialog box.
7. Now select the HAZUS dataset that is to be the target dataset (master file). For example, the HAZUS geodatabase file for the State of West Virginia is used as the target dataset. From the **Target Datasets** box click **Open**. The **Target Dataset** browser opens. Select the HAZUS geodatabase file for the structure inventory (i.e., *bndrygbs.mdb*) for the state

that represents the study area (i.e., *WVI*), click **Add**. From the list, select the appropriate personal geodatabase table (i.e., *hzBldgCountOccupB*), click **Add**. The **Target Dataset** browser closes and the name appears in the **Target Dataset** box on the **Append** dialog box.

8. Now the **Append** dialog box should have information about the input dataset in the **Input Datasets** table and information about the target dataset in the **Target Dataset** box. Click **OK**, the **Append** dialog box closes.
9. The **Append** compute dialog box opens. The compute process time is dependent on the amount of information contained in the geodatabase files. Once the computation has finished, click **Close**. The **Append** compute dialog box closes.
10. For the structure inventory, there are three other personal geodatabase tables that need to be merged - *hzDemographicsB*, *hzCensusBlock*, and *hzExposureOccupB*. Repeat Steps 5 through 9 to complete the merging.
11. For the vehicle inventory (i.e., *flVeh.mdb*) repeat Steps 5 through 9, selecting the *flNightVehicleInv* personal geodatabase table.

After appending all the appropriate files and tables it is possible to import the target dataset *bndrygbs.mdb* and *flVeh.mdb* files into the HEC-FIA structure inventory. The census block shapefiles must also be merged into one shapefile prior to importing them into HEC-FIA. For this example, if census blocks exist in one shapefile for the inundated areas within the states of Virginia and West Virginia, then the *bndrygbs.mdb* file for West Virginia (the target dataset above) would be selected during the Generate Inventory using HAZUS database option.


## B.7 Preparing HEC-RAS Data

HEC-FIA requires a stream centerline for all consequence computations. The life loss computation in HEC-FIA also requires a cross-section shapefile, storage area shapefile, and associated HEC-DSS database with stage-hydrograph output at each cross-section and storage area for the flood scenarios being assessed.

### B.7.1 Stream Centerline, Cross-Section, Storage Area

The stream centerline, cross-section, and storage area feature classes are stored in the HEC-GeoRAS geodatabase. To create a shapefile of the stream centerline:

1. Start **ArcCatalog**. The **ArcCatalog** window opens (Figure B.1).
2. From the first pane, from the **Catalog Tree**, browse to the folder that contains the HEC-GeoRAS geodatabase for the HEC-FIA project.
3. Once the geodatabase file appears in the **Contents** tab of the main window, double-click on the geodatabase filename (i.e., *Turman\_SDF.mdb*). Now double-click on the geodatabase feature dataset (i.e., *RasResults*).

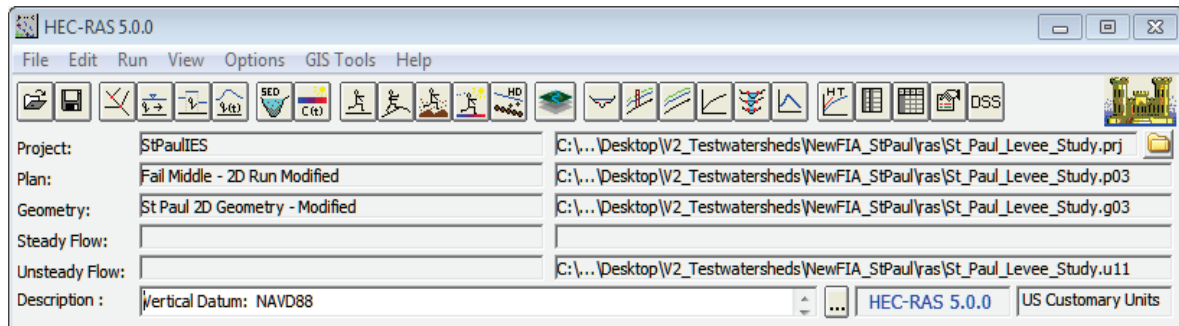
4. The stream centerline file created by HEC-GeoRAS should appear in the list (i.e., *River2D*). Right-click on the stream centerline filename from the shortcut menu point to **Export**, click **To Shapefile (single)**.
5. The **Feature Class to Feature Class** dialog box opens (Figure B.10).
6. The **Input Features** box (Figure B.10) should contain the name of the selected stream centerline file. Browse to location where the shapefile is to be stored by clicking  next to the **Output Location** box (Figure B.10). The **Output Location** browser opens (Figure B.11). Browse to the folder where the shapefile is to be stored, click **Add**. The **Output Location** browser closes, and the pathname with the selected folder appears in the **Output Location** box of the **Feature Class to Feature Class** dialog box.
7. In the **Output Feature Class** box (Figure B.10), provide a name for the shapefile.
8. Click **OK**. The **Feature Class to Feature Class** dialog box closes and the **Feature Class to Feature Class Compute** dialog box opens (Figure B.12). This dialog box contains information on start time, if creation was successful, end time, and how long it took to create the binary file. Click **Close**, the **Feature Class to Feature Class Compute** dialog box closes and the shapefile appears in the selected location.
9. Now in the selected directory, the shapefile appears. The stream centerline has been successfully exported to a shapefile.
10. Repeat Steps 1-10 for the storage area (i.e., *StorageAreas*) shapefile (i.e., *Truman\_StorageAreas*) and the cross sections (i.e., XSCutlines) shapefile (i.e., *Truman\_XSections*).

If HEC-GeoRAS and HEC-RAS were not used to develop the hydraulic results for the study, the stream alignment in HEC-FIA can be imported from an existing line shapefile or digitized using tools in HEC-FIA. Clip the stream centerline to the extents of the study area using the steps described below. Economic consequence can be computed in HEC-FIA using any stream alignment and depth grid as input. However, HEC-FIA cannot compute loss of life consequences unless a cross-section shapefile, storage area shapefile, and associated HEC-DSS database are provided as input, which are output from HEC-RAS and HEC-GeoRAS.

## B.7.2 HEC-DSS File

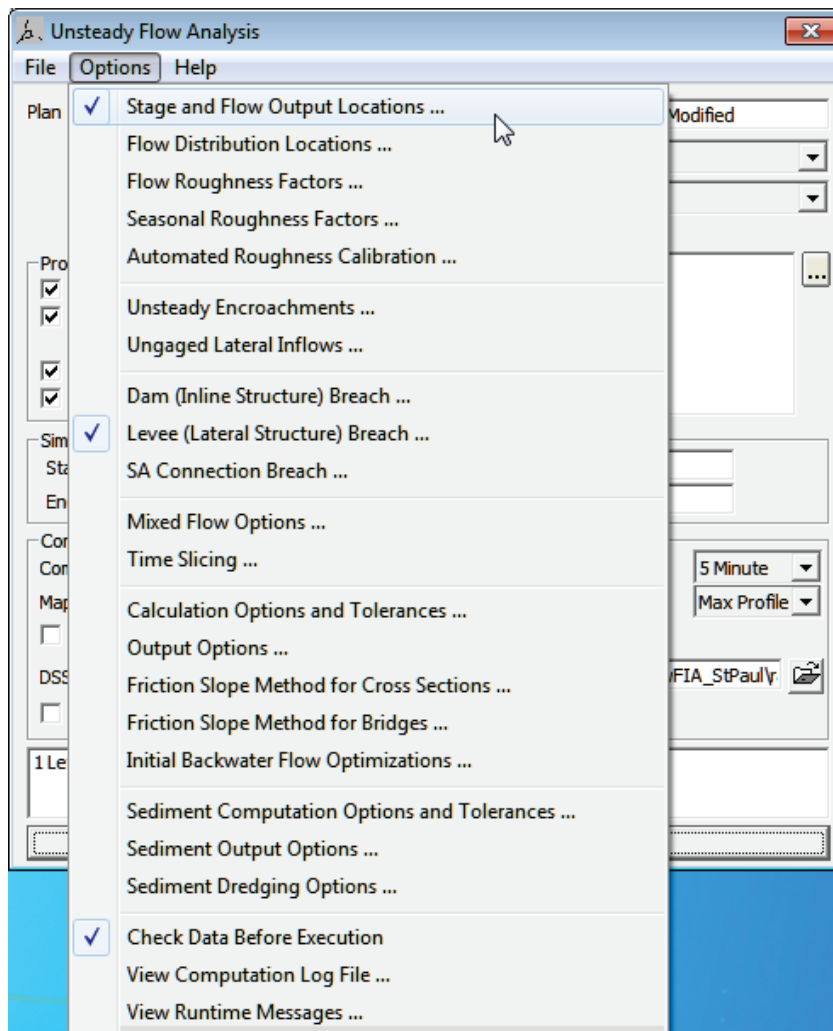
For life loss computation, HEC-FIA can obtain flood wave arrival times for individual structures from arrival time grids or from stage-hydrographs stored by HEC-RAS in an HEC-DSS (Hydrologic Engineering Center's Data Storage System) file. The hydraulic engineer needs to configure HEC-RAS to generate stage-hydrographs at all cross-section and storage area locations before simulating an event. If the HEC-DSS file already contains hydrograph data for each cross-section, skip this section.

1. Start **HEC-RAS**. The **HEC-RAS** window opens Figure B.35



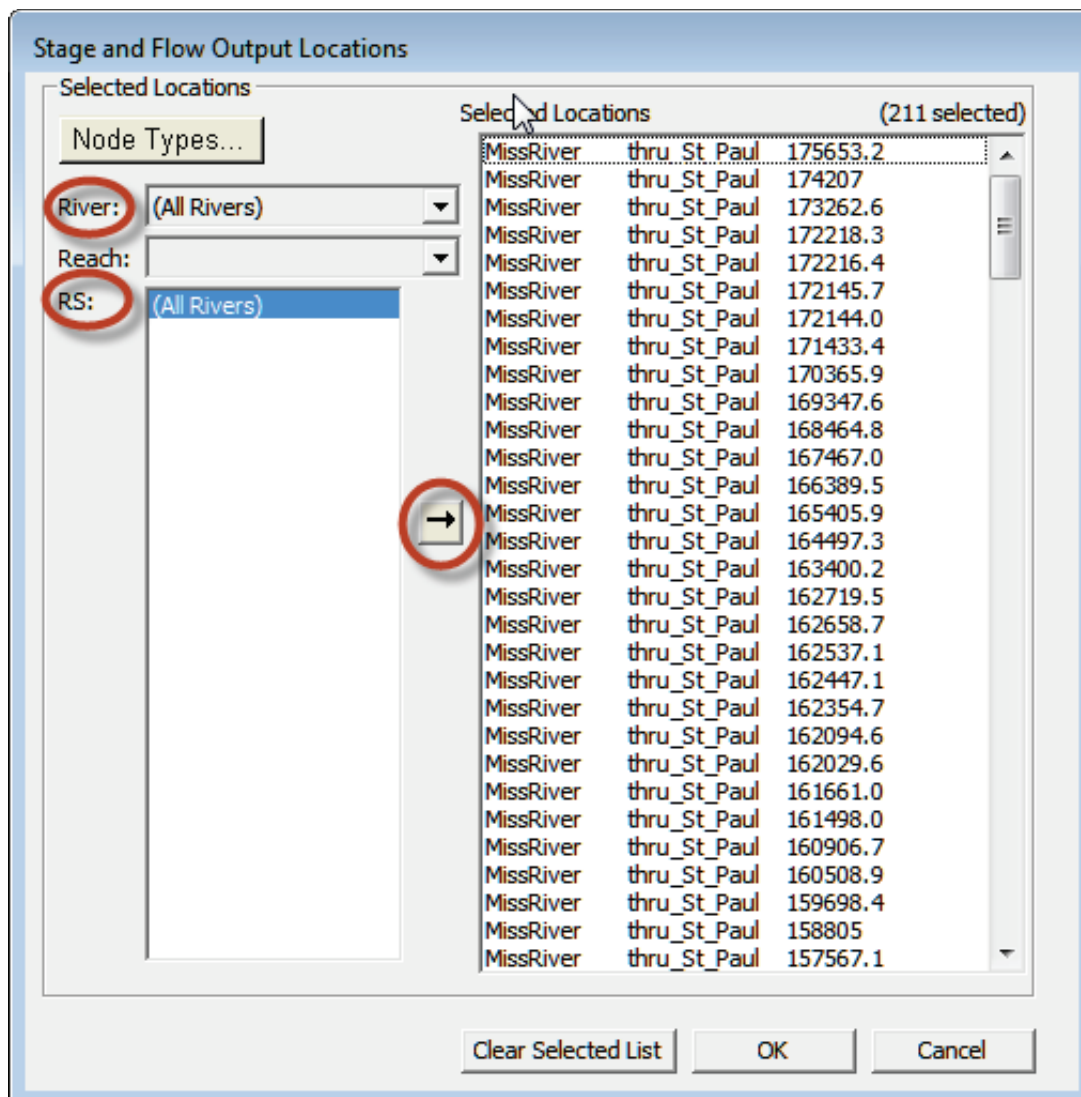
**Figure B.35** HEC-RAS Main Window

2. From the toolbar click , the **Unsteady Flow Analysis** dialog box opens (Figure B.36).



**Figure B.36** Unsteady Flow Analysis Dialog Box

3. From the **Options** menu, click **Stage and Flow Output Locations**, the **Stage and Flow Output Locations** dialog box opens (Figure B.37).



**Figure B.37** Stage and Flow Output Locations Dialog Box

4. From the **River** list, select **(All Rivers)**.
5. From the **RS** box, select **(All Rivers)**.
6. Click the arrow to select all the cross-section locations to the **Selected Locations** box.
7. Click **OK**, the **Stage and Flow Output Locations** dialog box closes.
8. From the **Unsteady Flow Analysis** dialog box (see Figure B.36), in the **DSS Output Filename** box, enter the path and the filename of the DSS file that contains the stage-hydrographs created by HEC-RAS.
9. Click **Compute** and the **HEC-RAS Computations** dialog box opens. When computations are finished, click **Close**, the **HEC-RAS Computations** dialog box closes.
10. The HEC-DSS file is created in the selected location.

## B.8 Impact Areas

Impact areas are required by HEC-FIA. Impact areas are used for defining common input parameters for groups of structures as well as for aggregating consequence results. A county dataset (shapefile) is often the most readily available dataset for defining impact areas. When county boundaries are used as impact areas, damages can be reported by individual structure, county, or larger area.

Impact areas are polygons and the polygon shapefile can contain several discrete polygons, but HEC-FIA cannot import multi-part polygons. So each individual polygon must have a different name.



Geo-referenced county boundaries are available in the HAZUS dataset for all states. Section B.6 outlines the steps necessary for preparing HAZUS data for use in HEC-FIA, so for the impact areas use the county shapefile (i.e., *TrumanCounties*) that was created.

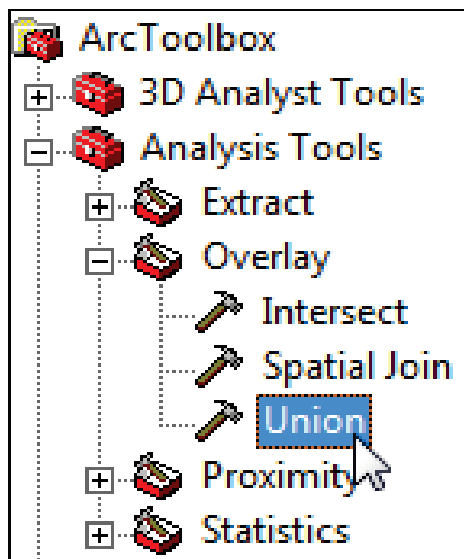
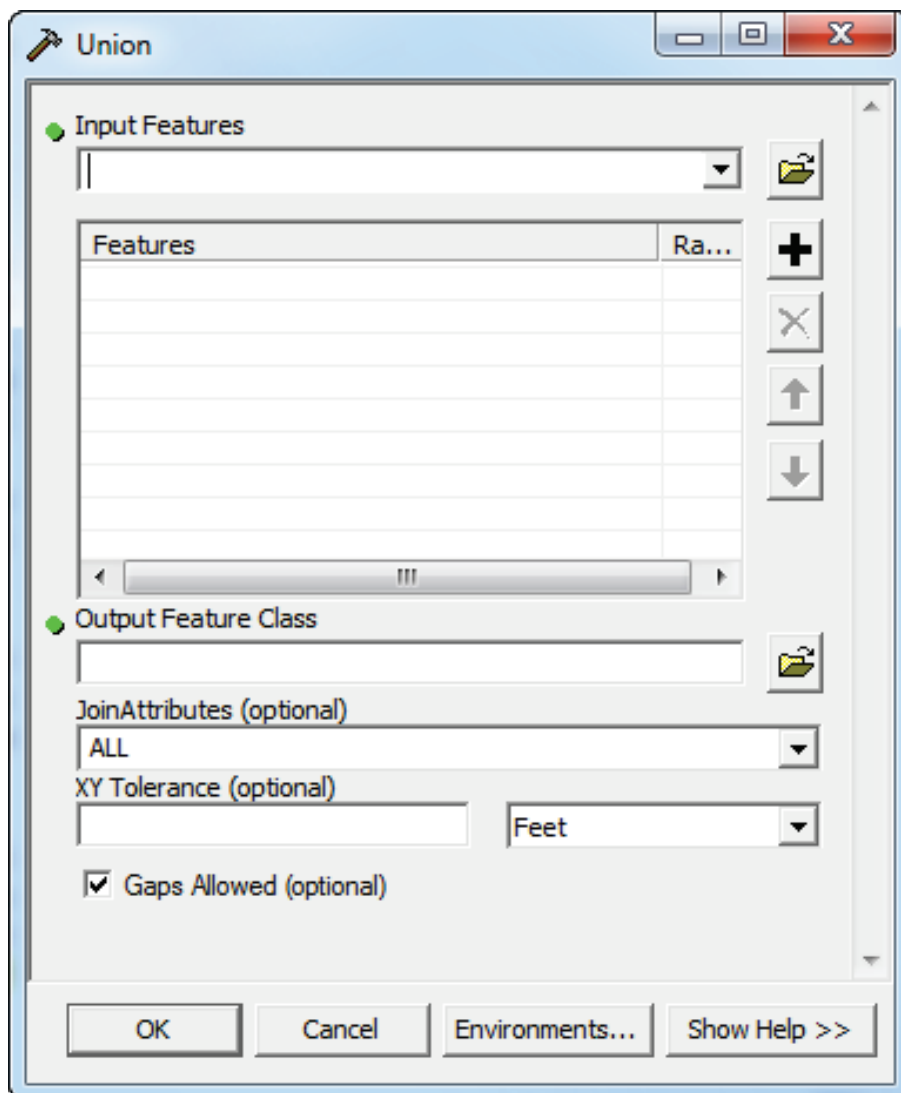
If a geo-referenced polygon shapefile is not available for use as impact areas, or if some polygons do not import because the impact areas are multi-part polygons, the impact areas can be digitized in HEC-FIA.

## B.9 Double Warning Data

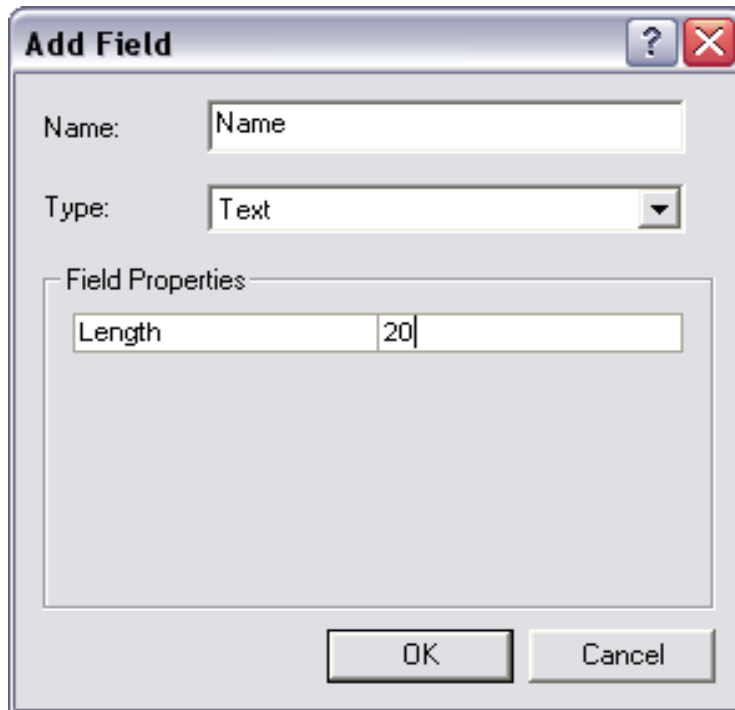
For flood scenarios where warnings would go out to different parts of the inundated area at different times, the double-warning approach may be necessary. For example, for any dam failure flood scenario where the non-fail releases from the dam would cause significant damage (i.e. most PMF events), the double-warning approach is required. The double-warning approach in this example would allow HEC-FIA to warn those people impacted by the non-fail inundation at a different time (earlier) than those impacted by the dam failure inundation.

Follow these steps to prepare the data necessary for the double-warning procedure. The example uses full pool failure (*FP\_Fail*) and full pool non-fail (*FP\_NonFail*) inundations.

1. Open **ArcMap** (Figure B.13), and add the *FP\_Fail* and *FP\_NonFail* shapefiles by clicking  **Add Data**. If the **ArcToolbox Pane** is not present, click **ArcToolbox**  on the **Standard Toolbar** (Figure B.2).
2. From the **ArcToolbox Tree**, double-click **Analysis Tools**, double-click **Overlay**, and then double-click **Union** (Figure B.38). The **Union** dialog box opens (Figure B.39).
3. From the **Input Features** list (Figure B.39), select the *FP\_Fail* and *FP\_NonFail* shapefiles. The selected shapefiles appear in the table below the **Input Features** list.
4. Change the default name in the **Output Feature Class** (Figure B.39) to reflect that it is a union of the two files.
5. Leave all other options as default and press **OK**. The **Union** dialog box closed and the **Union Dialog Compute** box opens indicating when the union tool has completed its task

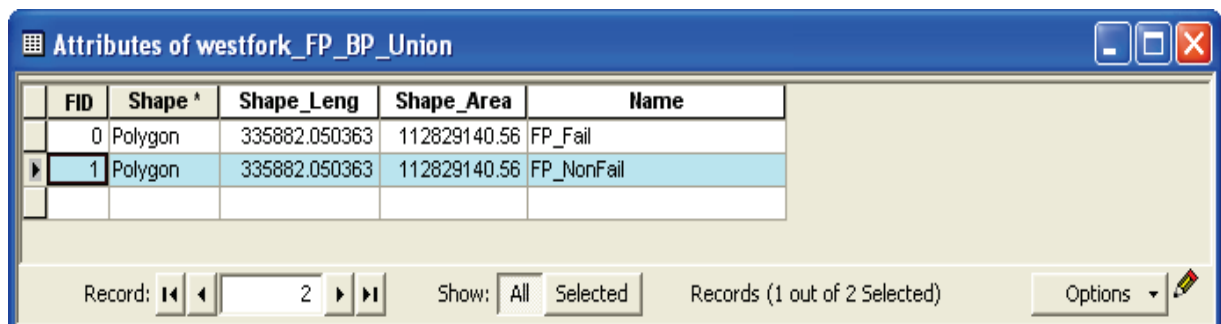
**Figure B.38** ArcToolbox Tree**Figure B.39** Union Dialog Box

6. Open the attribute table of the new shapefile by right clicking on the shapefile in the table of contents pane. Add a new field to the table by clicking **Options** and then clicking on **Add Field**. The **Add Field** dialog box appears (Figure B.40). In the **Name** box enter "Name", in the **Type** list select "Text", and in the **Field Properties** box enter 20 for the **Length** (Figure B.40). Click **OK**.



**Figure B.40** Add Field Dialog Box

7. Next, enter the appropriate name for each polygon feature (*FP\_NonFail*, *FP\_Fail*). From the **Editor** toolbar, select **Start Editing** (Figure B.19).
8. Double-click in the appropriate cell of the attribute table and enter the correct name for each polygon in the table (Figure B.41).



**Figure B.41** Entering Names into the Attribute Table


9. From the editor toolbar, select **Stop Editing**. Save the edits. The double warning time polygon shapefile (*westfork\_FP\_BP\_Union.shp*) is now ready for use in HEC-FIA.

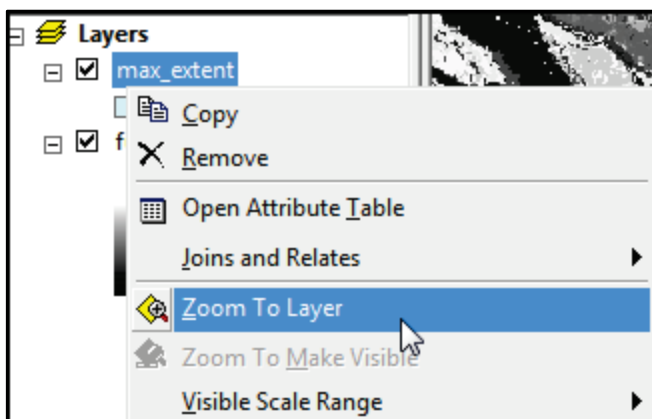


## B.10 Agricultural Grid Preparation

NASS CDL grids are generally the preferred data source for quick assessments of agricultural damage. The NASS CDL agricultural data is available online for the continental United States at the following website: <http://www.nass.usda.gov/research/Cropland/SARS1a.htm>.

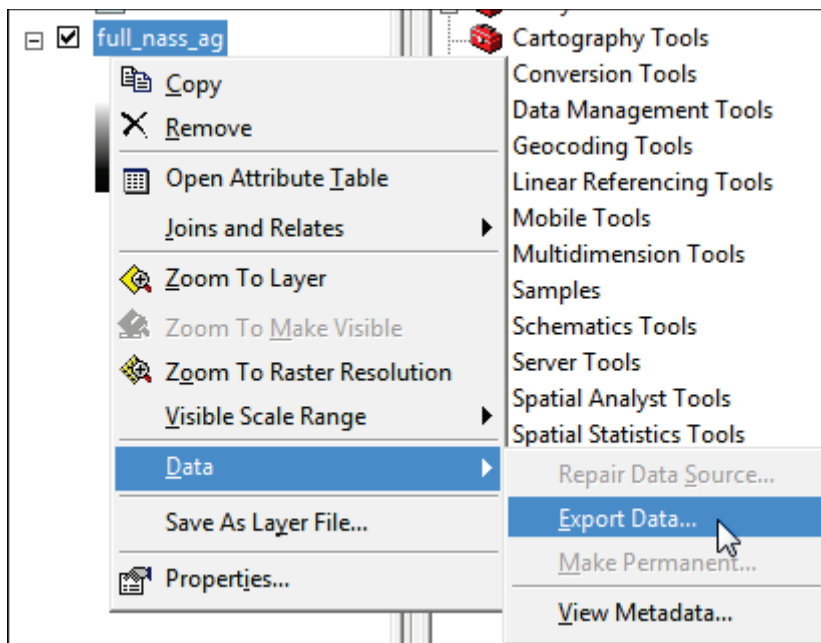
The NASS agricultural grids are in .tif file format. The projection information is contained within a world file (.tfw). Follow these steps to prepare the agricultural data for use in HEC-FIA:

1. Open **ArcMap** (Figure B.13), add the maximum inundation shapefile (i.e., *max\_extent.shp*) obtained in Section B.3 by clicking  **Add Data**.
2. Next, add the NASS agricultural grid file.
3. Not all data in the NASS CDL layer are required; only those within the study area should be selected. Right-click on the shapefile in the table of contents and click **Zoom To Layer** (Figure B.42). This zooms the map window to the shapefile extent.

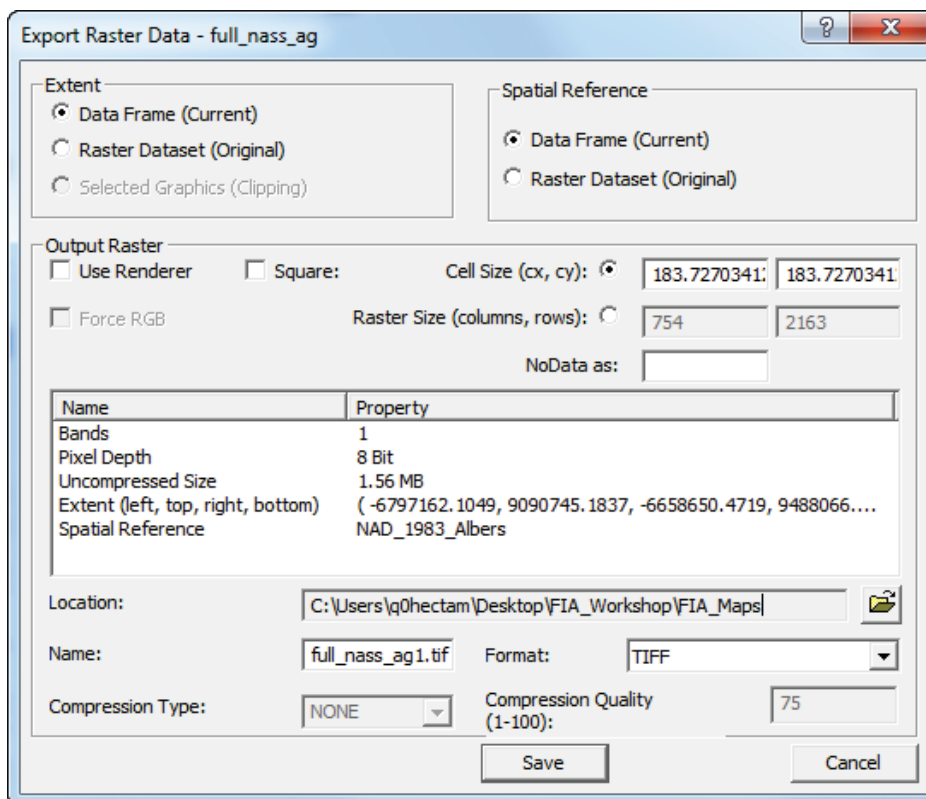


**Figure B.42** Zoom to Layer Menu Option


4. Next, right click on the NASS CDL grid in the table of contents and point to **Data**, click **Export Data** (Figure B.43).
5. The **Export Raster Data** dialog box appears (Figure B.44).
6. Choose **Data Frame (Current)** for the Extent. This exports data to the current frame extent, which is based on the maximum inundation shapefile set in Step 3.
7. Since the shapefile was added first, the data frame should be using the required spatial reference. Choose **Data Frame (Current)** for the spatial reference. This selection projects the NASS CDL data into the same projection as the maximum inundation shapefile, which should be the projection system used for all FIA GIS data.
8. Leave the middle portion of the dialog with the default values. The **Cell Size(cx, cy)** is automatically adjusted to meet the selected spatial reference.



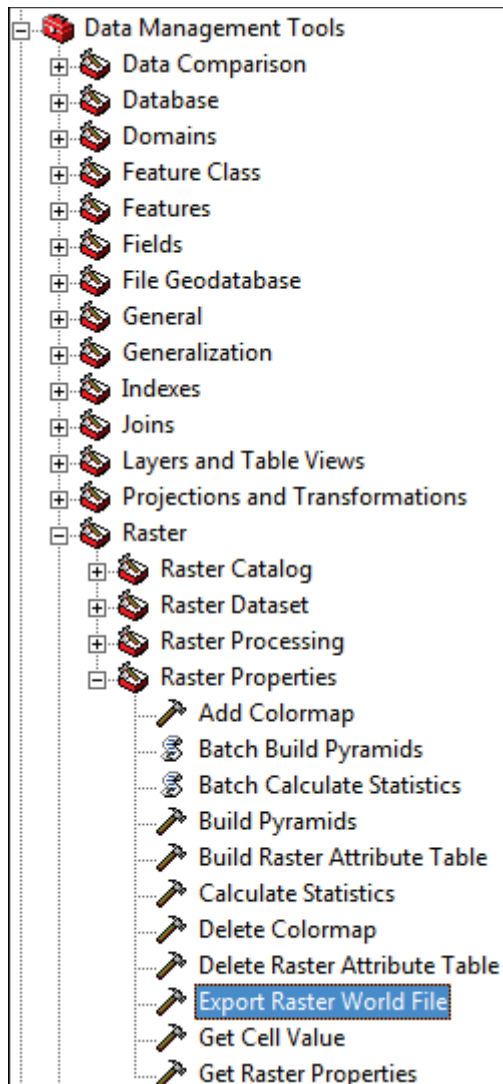
**Figure B.43** Export Data Layer Menu Option




**Figure B.44** Export Raster Data Dialog Box

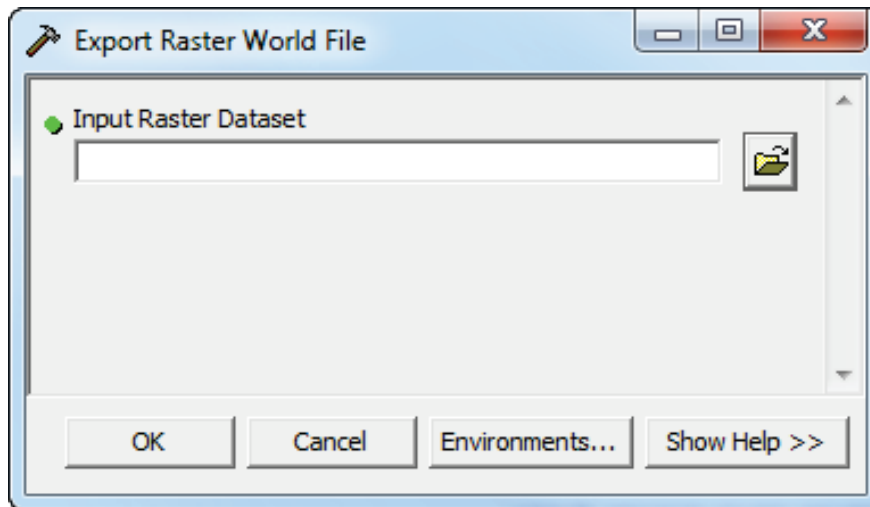
9. Browse to the location where the shapefile is to be stored by clicking  next to the **Location** box (Figure B.44).
10. Next select **TIFF** from the **Format** list (Figure B.44). In the **Name** box, enter the name of the grid that is to be exported.

11. Click **Save**. The **Export Data Dialog** box closes and the user is prompted to add the new data to the ArcMap project. Select **No**, the prompt closes, and the exported data is not added to the ArcMap project.
12. Finally, create a world file for the exported data.
13. From the **ArcToolbox Tree** (Figure B.3), double-click **Data Management Tools**, double-click **Raster**, then **Raster Properties**, and then double-click **Export Raster World File** (Figure B.45). The **Export Raster World File** dialog box opens (Figure B.46).



**Figure B.45** Export Raster World File

14. Browse to the location of the masked digital terrain grid file by clicking  next to the **Input raster** box.
15. Once the exported .tif file is selected (i.e., *westfork\_NASS\_ag.tif*), click **OK**. The associated world file (.tfw) is created in the same directory as the .tif file. The Agricultural grid is now ready to be imported in HEC-FIA.



**Figure B.46** Export Raster World File Dialog Box

# Appendix C

## Coordinate System Setup

To maintain a geographic reference (also called a geo-reference), HEC-FIA uses a user-selected **coordinate system**. This allows HEC-FIA to establish x- and y-coordinates in WCS for each point on the layer, regardless of their actual projected coordinate system. The x-coordinate is referred to as "easting" and the y-coordinate is referred to as "northing" following customary use in surveying and mapping. This appendix focuses on how to setup and edit different coordinate systems.

### C.1 Geographic Referencing

To maintain a geographic reference, the user must specify a coordinate system for each HEC-FIA project. To establish the grid size and coordinate system:

1. From the **Maps** menu, click **Default Map Properties** (Figure C.1).
2. The **Default Map Properties for** dialog box opens (Figure C.2).

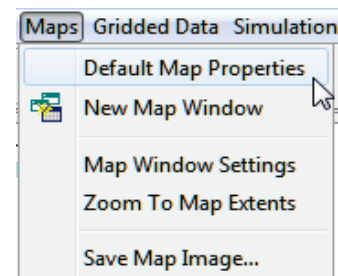


Figure C.1 Maps Menu

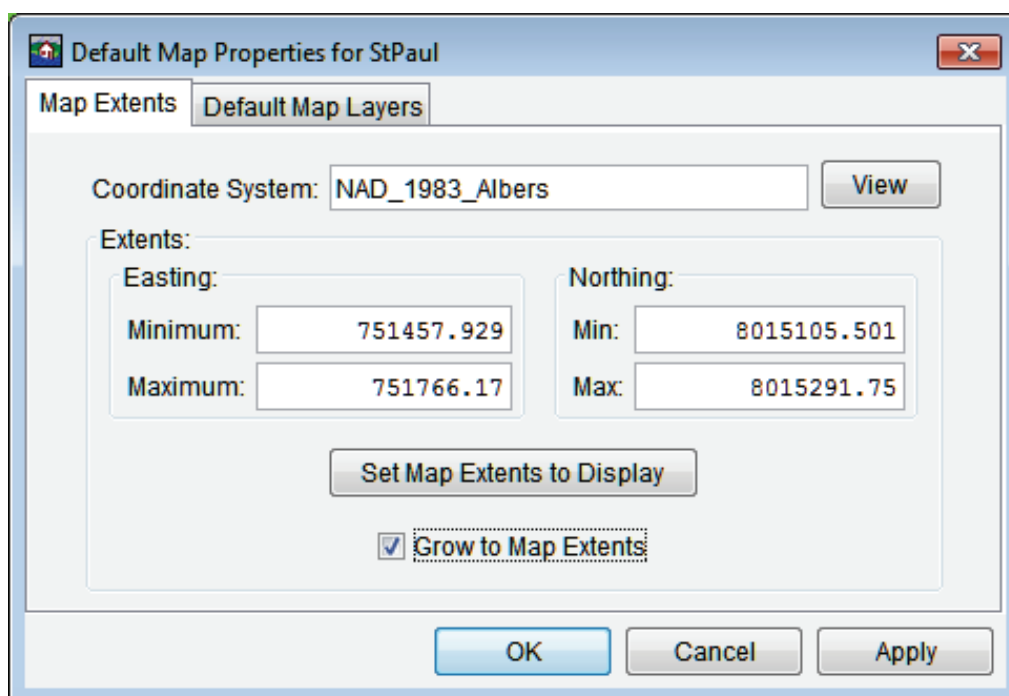


Figure C.2 Default Map Properties for Dialog Box

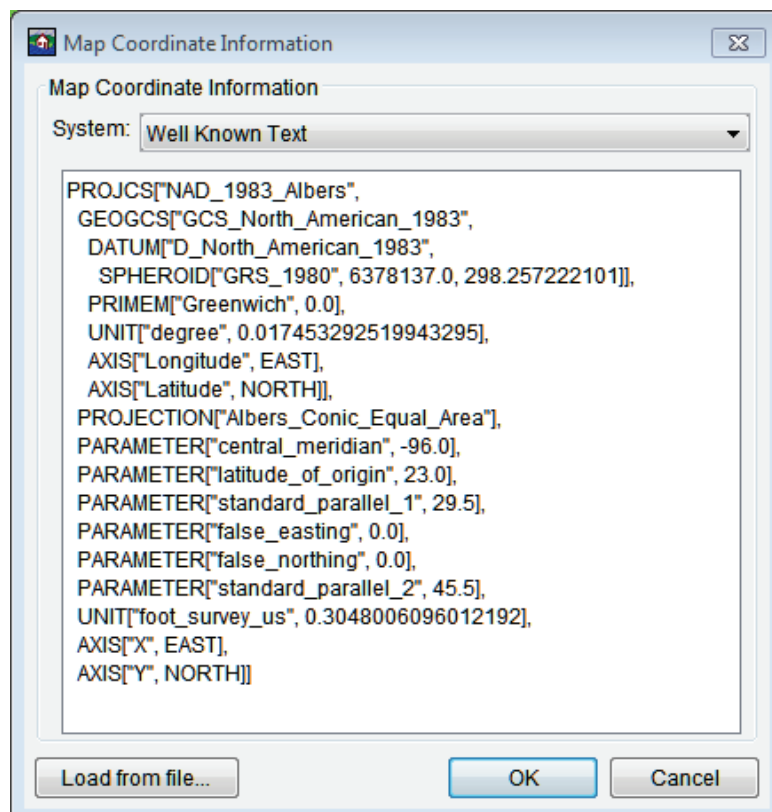
3. The information in the **Map Default Properties for** dialog box (Figure C.2) includes:
  - Coordinate System:** this box identifies the established coordinate system for a watershed. To edit the coordinate system, click **View** (Figure C.2).
  - Extents – Easting Min, Max, Northing Min, and Max.** These values indicate the location of the left, top, right, and bottom borders of the grid in the display area.
  - Grow to Map Extents.** When this check box is selected, HEC-FIA automatically sets the geographic extents to define the smallest rectangle that encompasses all the objects in the workspace.

## C.2 Coordinate System Types

A **coordinate system** is a method of representing points in a space of given dimensions by coordinates. Two coordinate system types of interest to FIA are the geographic coordinate system, which is based on latitude and longitude coordinates, and the project coordinate system, which represents the projection of a geographic coordinate system on a plane.

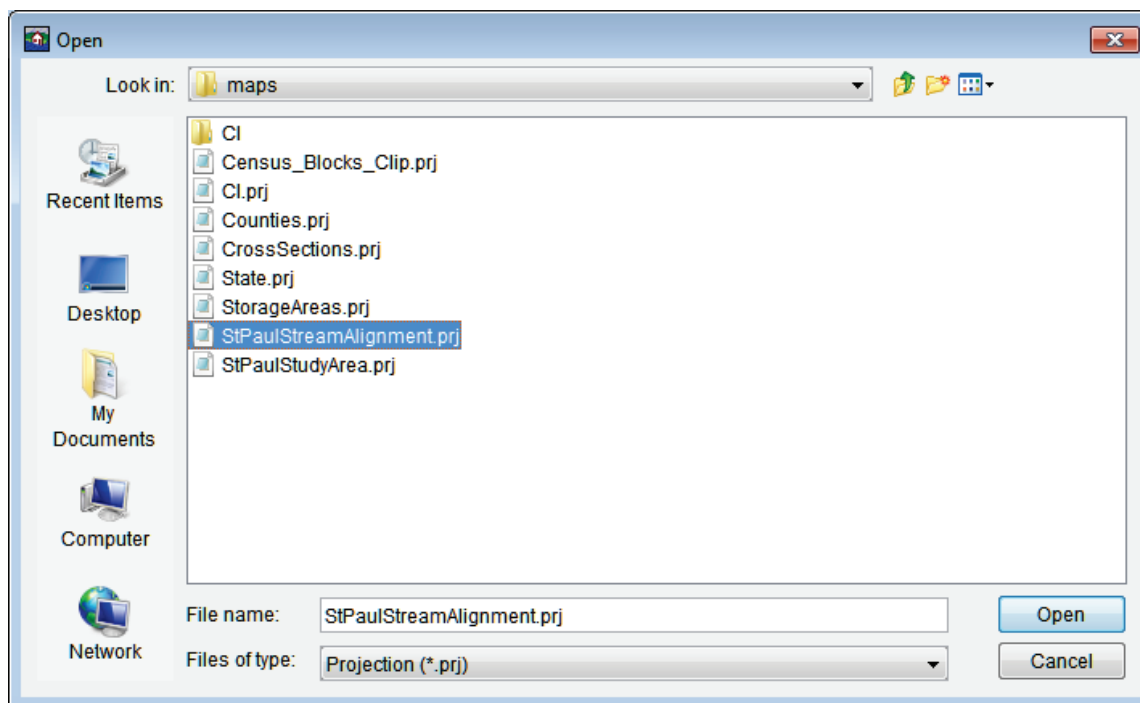
The simplest way to add a coordinate system to an HEC-FIA project is to import a projected shapefile into the map window. The coordinates are set based on the \*.prj file of the first map added to the map window.

Another way to add a coordinate system to an HEC-FIA project is from the **Default Map Properties for** dialog box (Figure C.2), click **View**. The **Map Coordinate Information** dialog box opens (Figure C.3).



**Figure C.3** Map Coordinate Information Dialog Box

Click **Load from file**, an **Open Browser** opens (Figure C.4), browse to a .prj that contains the correct projection for the HEC-FIA project.



**Figure C.4** Open Browser

A few notes on performance, if a background image file or an internet map file is being used, it is best to set the projection to that of the background image map, this speeds up the zooming by re-projecting the data on the fly rather than the background image. Also, the background imagery is better when viewed in the native projection.

The coordinate systems available in HEC-FIA are shown in Table C.1. This table also shows the units and spheroid type for each coordinate system. A **spheroid** (ellipsoid) is the shape of the earth that used in the calculations that transform positions on the curved surface of the earth to positions on a flat map. It is part of the horizontal datum, which approximates the curved surface of the earth over part of the globe.

**Table C.1** Coordinate Systems Available in HEC-FIA

Coordinate Systems	Units	Spheroid
X-Y	U.S. feet	N/A
Google/Bing Web Mercator		WGS 84
Geographic	radians	WGS 72
Universal Transverse Mercator	meters	GRS 1980(NAD83)
State Plane Coordinates	meters	GRS 1980(NAD83)
Albers Equal-Area Conic	Degrees of Arc	Sphere of Radius 6370997 meters
Lambert Conformal Conic	International Feet	
Transverse Mercator	U.S. feet	Clarke 1866(NAD27)
Albers Equal-Area Conic (SHG)	meters	GRS 1980(NAD83)
Polar Stereographic (HRAP)	meters	Sphere of Radius 6371200 meters

## C.2.1 X-Y Coordinate System

The X-Y coordinate system is also known as the World Coordinate System (WCS). This superimposes a grid on layer features to establish x- and y-coordinates for each point on the layer. The origin point (0,0) can be located anywhere, but every object is located in relation to the origin point. The X-Y coordinate system has no spheroid specification.

To set parameters for the X-Y Coordinate System:

1. From the **Maps** menu, click **Default Map Properties**. The **Default Map Properties for** dialog box opens (Figure C.2).
2. The **Coordinate System** field displays the name of the selected coordinate system (X-Y is default). Click **View**. The **Map Coordinate Information** dialog box opens (Figure C.5).

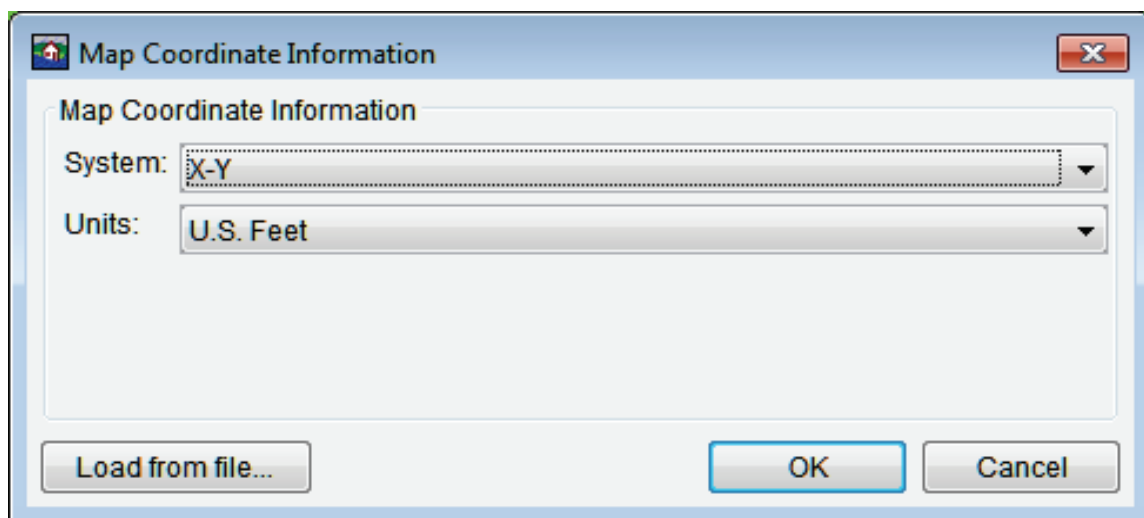


Figure C.5 Map Coordinate Information Dialog Box - X-Y Coordinate System

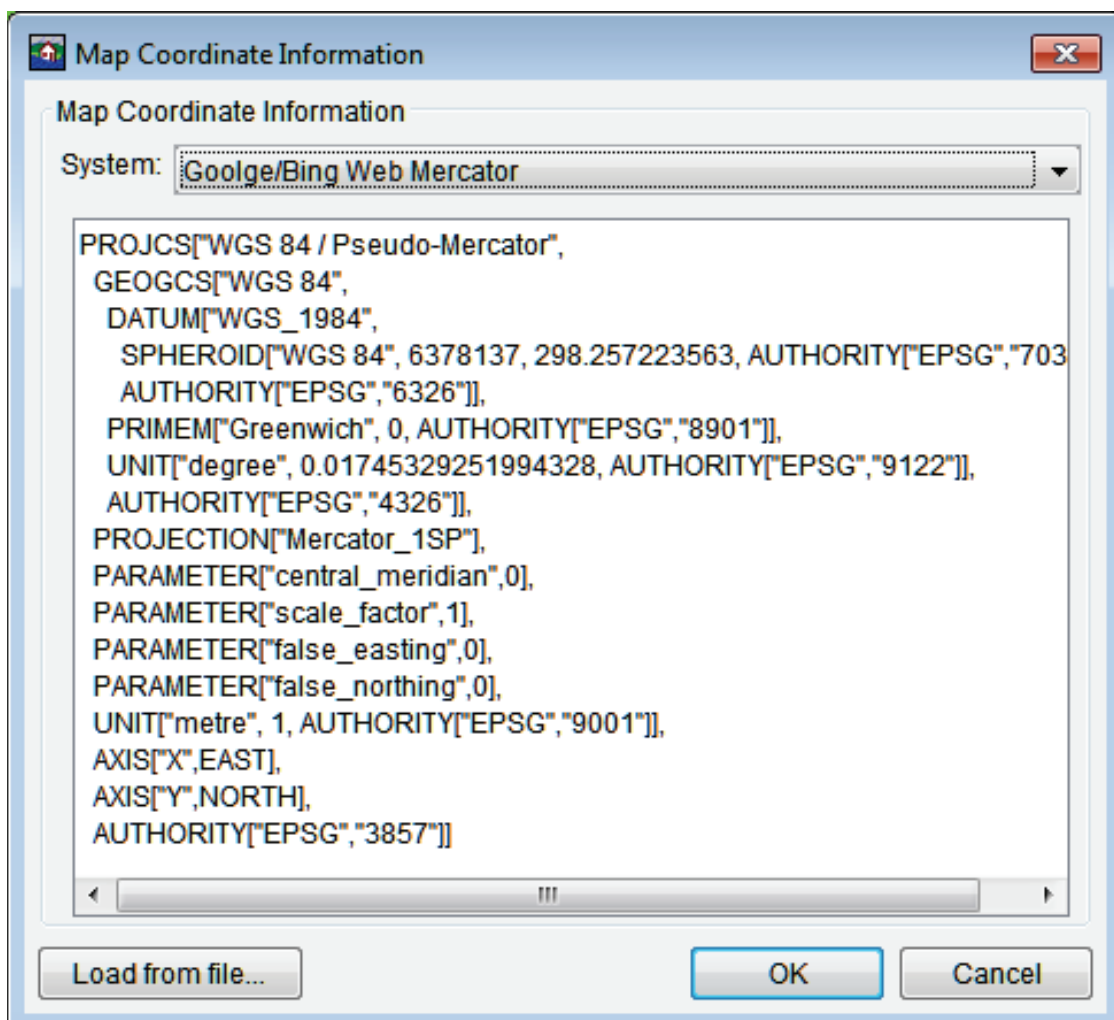
3. From the **System** list, select *X-Y*.
4. From the **Units** list, select the units for the X-Y coordinate system.
5. Click **OK**. The **Map Coordinate Information** dialog box closes (Figure C.5). In the **Coordinate System** box of the **Default Map Properties for** dialog box (Figure C.2), *X-Y* is displayed.

## C.2.2 Google/Bing Web Mercator Coordinate System

The Google/Bing Web Mercator coordinate system (Figure C.6) is a variation of the Mercator projection and is the standard for most web mapping applications. Also, used by Bing and OpenStreet.

1. From the **Maps** menu, click **Default Map Properties**. The **Default Map Properties for** dialog box opens (Figure C.2).



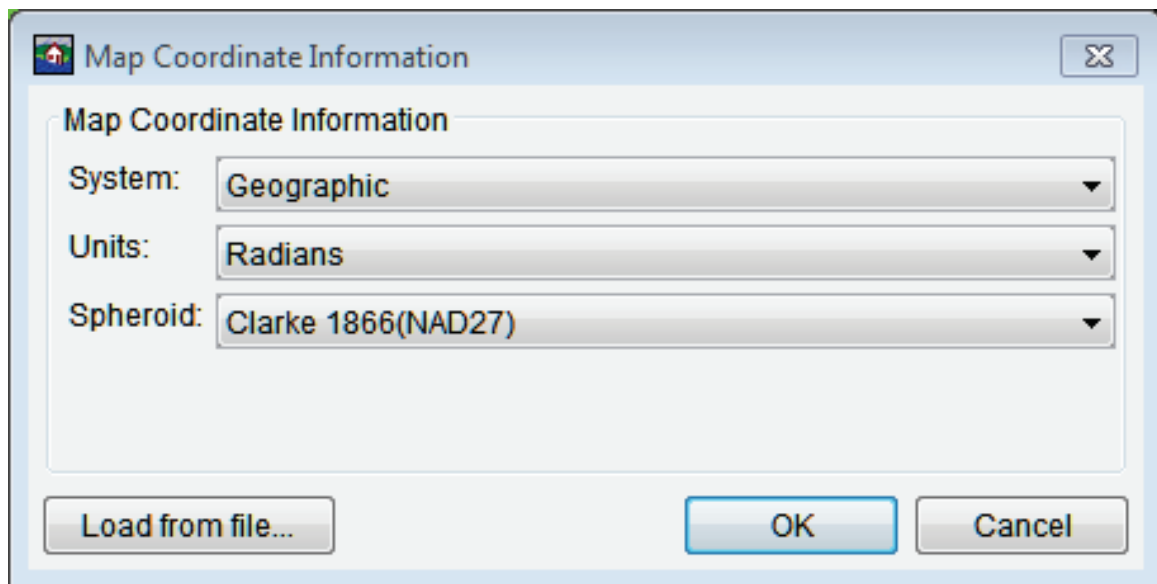


**Figure C.6** Map Coordinate Information Dialog Box - Google/Bing Web Mercator Coordinate System

2. The **Coordinate System** box displays the name of the selected coordinate system (X-Y is default). Click **View**. The **Map Coordinate Information** dialog box opens (Figure C.6).
3. From the **System** list, select *Google/Bing Web Mercator*.
4. The **Map Coordinate Information** dialog box (Figure C.6) displays information about the coordinate system.
5. Click **OK**. The **Map Coordinate Information** dialog box closes (Figure C.6). In the **Coordinate System** box of the **Default Map Properties for** dialog box (Figure C.2), *Google/Bing Web Mercator* should be displayed.

### C.2.3 Geographic Coordinate System

Each of the different coordinate systems has their own set of options editable in the **Map Coordinate Information** dialog box (Figure C.7). For a **Geographic Coordinate System**, users can define **units** and **spheroid**.



**Figure C.7** Map Coordinate Information Dialog Box - Geographic Coordinate System

To set parameters for the Geographic Coordinate System:

1. From the **Maps** menu, click **Default Map Properties**. The **Default Map Properties for** dialog box opens (Figure C.2).
2. The **Coordinate System** field displays the name of the selected coordinate system (X-Y is default). Click **View**. The **Map Coordinate Information** dialog box opens (Figure C.7).
3. From the **System** list, select *Geographic*.
4. From the **Units** list, select the units for the *Geographic* coordinate system. The only units available should be **Radians**, **Degrees of Arc**, and **Seconds of Arc**.
5. From the **Spheroid** list, select a spheroid type for the *Geographic* coordinate system.
6. Click **OK**. The **Map Coordinate Information** dialog box closes (Figure C.7). In the **Coordinate System** box of the **Default Map Properties for** dialog box (Figure C.2), *Geographic* should be displayed.

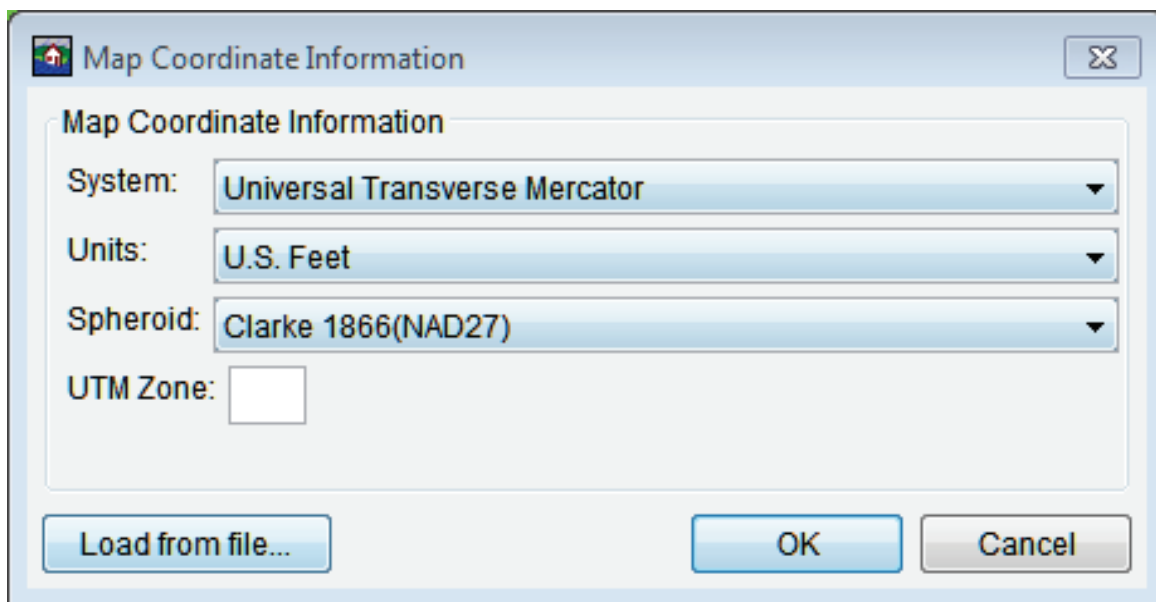
## C.2.4 Universal Transverse Mercator Coordinate System

The Universal Transverse Mercator (UTM) coordinate system is a projection coordinate system. UTM is used to define horizontal positions throughout the world by dividing the surface of the Earth into six-degree zones, with a central meridian in the center of each zone.

To set parameters for the Universal Transverse Mercator Coordinate System:

1. From the **Maps** menu, click **Default Map Properties**. The **Default Map Properties for** dialog box opens (Figure C.2).

2. The **Coordinate System** field displays the name of the selected coordinate system (X-Y is default). Click **View**. The **Map Coordinate Information** dialog box opens (Figure C.8).



**Figure C.8** Map Coordinate Information Dialog Box - Universal Transverse Mercator Coordinate System

3. From the **System** list, select *Universal Transverse Mercator*.
4. From the **Units** list, select the units for the *Universal Transverse Mercator* coordinate system.
5. From the **Spheroid** list, select a spheroid type for the *Universal Transverse Mercator* coordinate system.
6. In the **UTM Zone** box, enter the UTM zone number.
7. Click **OK**. The **Map Coordinate Information** dialog box closes (Figure C.8). In the **Coordinate System** box of the **Default Map Properties for** dialog box (Figure C.2), *Universal Transverse Mercator* should be displayed.

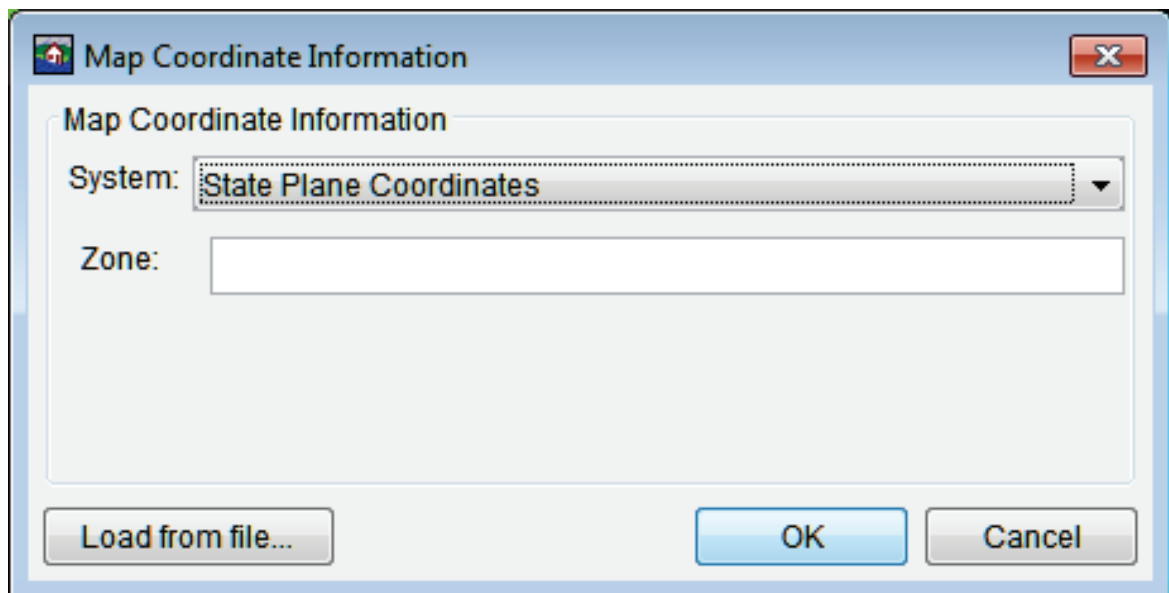
## C.2.5 State Plane Coordinate System

The State Plane Coordinate System (SPCS) was established in the 1930's and now covers all fifty states. Zones were established for each state using either the Lambert Conformal or Traverse Mercator projections. Units are generally in feet (NAD27) or meters (NAD83).

To set parameters for the State Plane Coordinate System:

1. From the **Maps** menu, click **Default Map Properties**. The **Default Map Properties for** dialog box opens (Figure C.2).

2. The **Coordinate System** field displays the name of the selected coordinate system (X-Y is default). Click **View**. The **Map Coordinate Information** dialog box opens (Figure C.9).



**Figure C.9** Map Coordinate Information Dialog Box - State Plane Coordinates Coordinate System

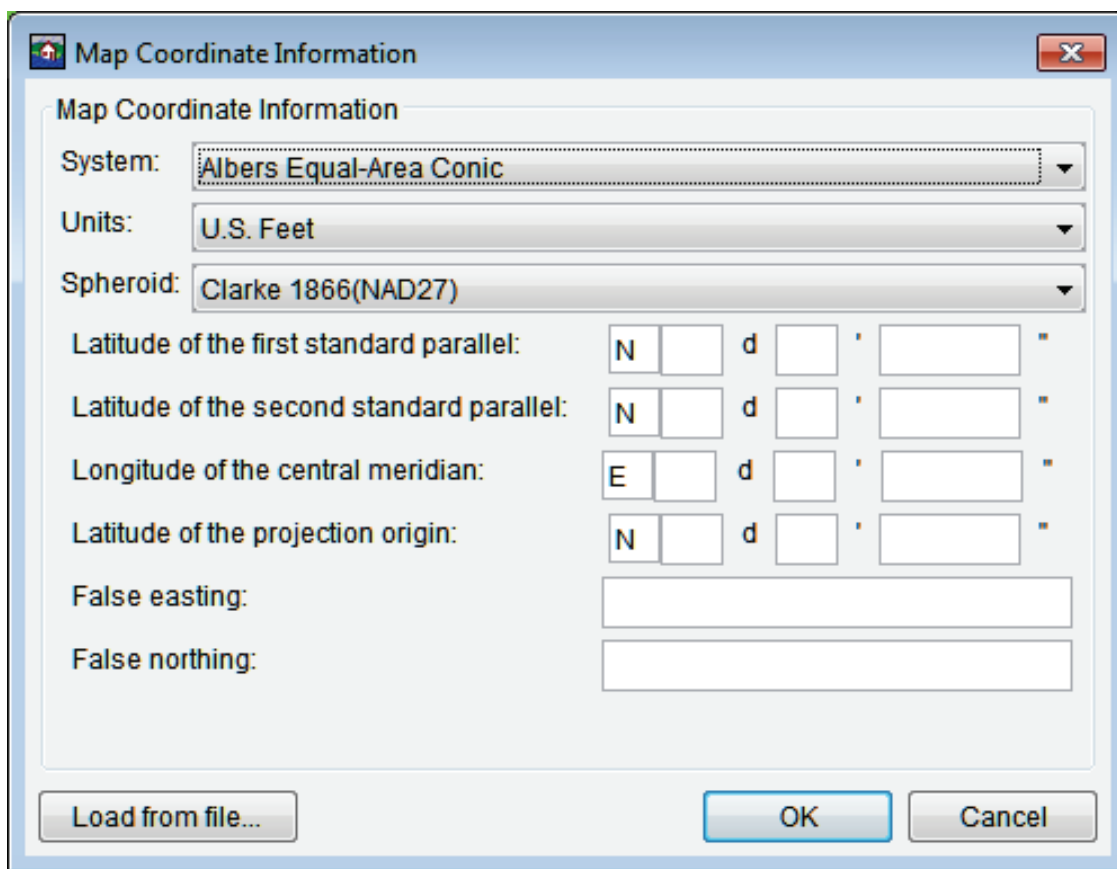
3. From the **System** list, select *State Plane Coordinates*.
4. In the **Zone** box, enter the zone for the state. These codes are FIPS codes.
5. Click **OK**. The **Map Coordinate Information** dialog box closes (Figure C.9). In the **Coordinate System** box of the **Default Map Properties for** dialog box (Figure C.2), *State Plane Coordinates* should be displayed.

## C.2.6 Albers Equal-Area Conic Coordinate System

The Albers Equal-Area Conic projection was established for mapping large areas. The projection is an equivalent projection, where areas are proportional and directions are true in limited areas.

To set parameters for the Albers Equal-Area Conic Coordinate System:

1. From the **Maps** menu, click **Default Map Properties**. The **Default Map Properties for** dialog box opens (Figure C.2).
2. The **Coordinate System** field displays the name of the selected coordinate system (X-Y is default). Click **View**. The **Map Coordinate Information** dialog box opens (Figure C.10).
3. From the **System** list, select *Albers Equal-Area Conic*.



**Figure C.10** Map Coordinate Information Dialog Box - Albers Equal-Area Conic Coordinate System

4. From the **Units** list, select the units for the Albers Equal-Area Conic coordinate system.
5. From the **Spheroid** list (Figure C.10), select a spheroid type for the Albers Equal-Area Conic coordinate system.
6. The remaining items to be entered are the angular parameters that are required to fine-tune the projection. When specifying latitudes enter **N** or **S**, and for longitudes, enter **E** or **W**. Use the **SPACEBAR** to toggle between the entries.
7. Click **OK**. The **Map Coordinate Information** dialog box closes (Figure C.10). In the **Coordinate System** box of the **Default Map Properties for** dialog box (Figure C.2), *Albers Equal-Area Conic* should be displayed.

## C.2.7 Lambert Conformal Conic Coordinate System

The Lambert Conformal Conic projection is used extensively for mapping areas of the world with predominantly east-west orientation. Similar to the Albers Equal-Conic projection, however the projection is not done in an equal-area.

To set parameters for the Lambert Conformal Conic Coordinate System:

1. From the **Maps** menu, click **Default Map Properties**. The **Default Map Properties for** dialog box opens (Figure C.2).
2. The **Coordinate System** field displays the name of the selected coordinate system (X-Y is default). Click **View**. The **Map Coordinate Information** dialog box opens (Figure C.11).

**Figure C.11** Map Coordinate Information Dialog Box - Lambert Conformal Conic Coordinate System

3. From the **System** list, select *Lambert Conformal Conic*.
4. From the **Units** list, select the units for the Lambert Conformal Conic coordinate system.
5. From the **Spheroid** list (Figure C.11), select a spheroid type for the Lambert Conformal Conic coordinate system.
6. When specifying latitudes enter **N** or **S**, and for longitudes, enter **E** or **W**. Use the **SPACEBAR** to toggle between the entries.
7. Click **OK**. The **Map Coordinate Information** dialog box closes (Figure C.11). In the **Coordinate System** box of the **Default Map Properties for** dialog box (Figure C.2), *Lambert Conformal Conic* should be displayed.

## C.2.8 Transverse Mercator Coordinate System

In the Transverse Mercator projection, a sphere is projected onto a cylinder tangent to a central meridian. It is similar to the Lambert Conformal Conic project, but used to portray large areas in a north-south orientation. Many national grid systems are based on the Transverse Mercator projection.

To set parameters for the Transverse Mercator Coordinate System:

1. From the **Maps** menu, click **Default Map Properties**. The **Default Map Properties** dialog box opens (Figure C.2).
2. The **Coordinate System** field displays the name of the selected coordinate system (X-Y is default). Click **View**. The **Map Coordinate Information** dialog box opens (Figure C.12).

**Figure C.12** Map Coordinate Information Dialog Box - Transverse Mercator Coordinate System

3. From the **System** list, select *Transverse Mercator*.
4. From the **Units** list, select the units for the Transverse Mercator coordinate system.
5. From the **Spheroid** list (Figure C.12), select a spheroid type for the Transverse Mercator coordinate system.
6. Enter a scaling factor for central meridian, in the **Scale factor at central meridian** box.

7. When specifying latitudes enter **N** or **S**, and for longitudes, enter **E** or **W**. Use the **SPACEBAR** to toggle between the entries.
8. Click **OK**. The **Map Coordinate Information** dialog box closes (Figure C.12). In the **Coordinate System** box of the **Default Map Properties for** dialog box (Figure C.2), *Transverse Mercator* should be displayed.

## C.2.9 Albers Equal-Area Conic (SHG) Coordinate System

The standard hydrologic grid (SHG) is a variable-resolution square-celled map grid defined for the conterminous United States, based on the Albers Equal-Area Conic projection system. The parameters are set to match USACE map coordinates for SHG.

To view the parameters for the **Albers Equal-Area Conic (SHG) Coordinate System**:

1. From the **Maps** menu, select **Default Map Properties**. The **Default Map Properties for** dialog box opens (Figure C.2).
2. The **Coordinate System** field displays the name of the selected coordinate system (X-Y is default). Click **View**. The **Map Coordinate Information** dialog box opens (Figure C.13).

The screenshot shows the 'Map Coordinate Information' dialog box. The 'System' dropdown is set to 'Albers Equal-Area Conic (SHG)'. The 'Units' dropdown is set to 'Meters'. The 'Spheroid' dropdown is set to 'GRS 1980(NAD83)'. Below these are four rows of input fields for projection parameters, each with a direction/denominator selector, a degree value, a decimal separator, a minute value, and a second value. The parameters are: Latitude of the first standard parallel (N, 29, d, 30, ', 0"), Latitude of the second standard parallel (N, 45, d, 30, ', 0"), Longitude of the central meridian (W, 96, d, 0, ', 0"), and Latitude of the projection origin (N, 23, d, 0, ', 0"). At the bottom are 'False easting' and 'False northing' text boxes, both containing '0'. At the very bottom are 'Load from file...', 'OK', and 'Cancel' buttons.

Parameter	Direction	Degrees	Minutes	Seconds
Latitude of the first standard parallel	N	29	30	0
Latitude of the second standard parallel	N	45	30	0
Longitude of the central meridian	W	96	0	0
Latitude of the projection origin	N	23	0	0

**Figure C.13** Map Coordinate Information Dialog Box - Albers Equal-Area Conic (SHG) Coordinate System

3. From the **System** list, select *Albers Equal-Area Conic (SHG)*.



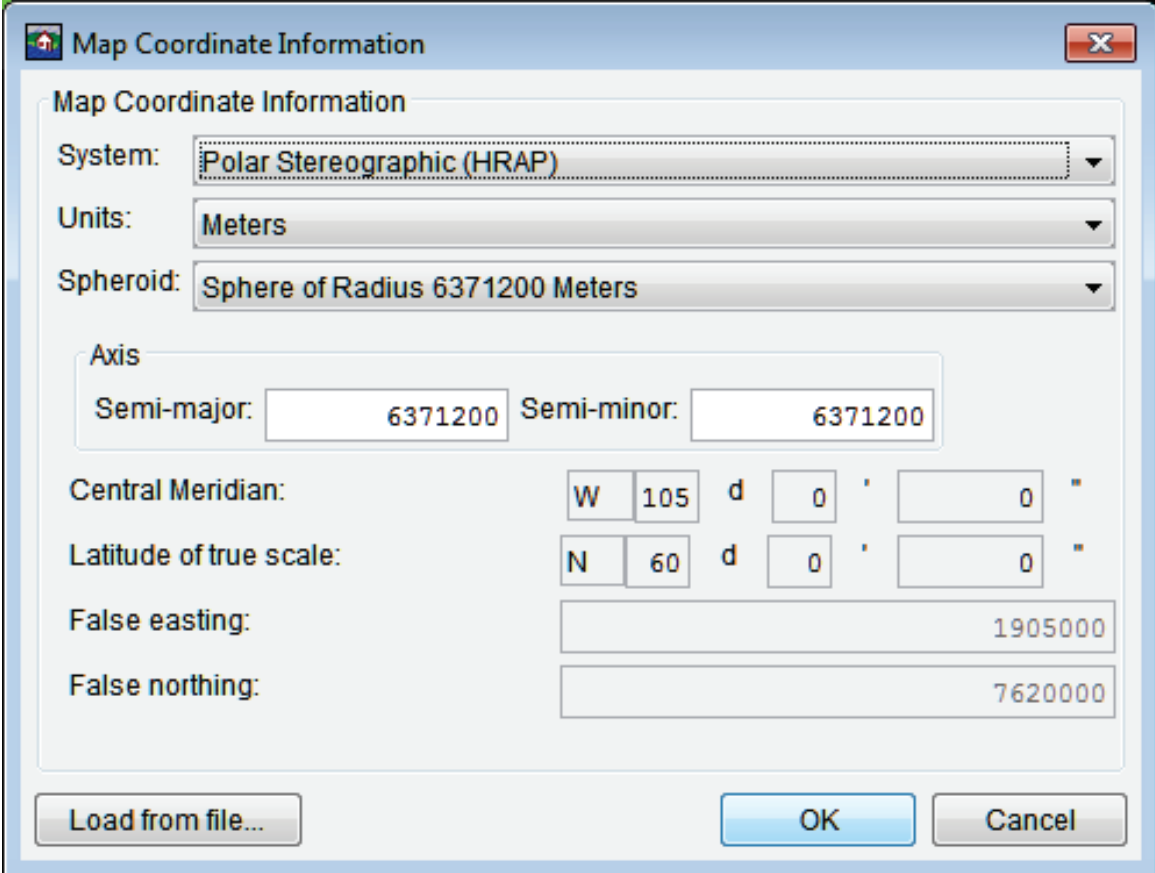
4. From the **Units** list, select the units for the Albers Equal-Area Conic (SHG) coordinate system.
5. From the **Spheroid** list (Figure C.13), select a spheroid type for the Albers Equal-Area Conic (SHG) coordinate system.
6. The remaining parameters are informational and are not editable.
7. Click **OK**. The **Map Coordinate Information** dialog box closes (Figure C.13). In the **Coordinate System** box of the **Default Map Properties for** dialog box (Figure C.2), *Albers Equal-Area Conic (SHG)* should be displayed.

## C.2.10 Polar Stereographic (HRAP) Coordinate System

The Hydrologic Rainfall Analysis Project (HRAP) projection system, is a type of polar stereographic coordinate system. The parameters are set to match NWS map coordinates used for radar grids.

To view the parameters for the Polar Stereographic (HRAP) Coordinate System:

1. From the **Maps** menu, click **Default Map Properties**. The **Default Map Properties for** dialog box opens (Figure C.2).
2. The **Coordinate System** field displays the name of the selected coordinate system (X-Y is default). Click **View**. The **Map Coordinate Information** dialog box opens (Figure C.14).
3. From the **System** list, select *Polar Stereographic (HRAP)*.
4. From the **Units** list, select the units for the Polar Stereographic (HRAP) coordinate system.
5. From the **Spheroid** list (Figure C.14), select a spheroid type for the Polar Stereographic (HRAP) coordinate system.
6. The values entered in the **Semi-major** and **Semi-minor** boxes (Figure C.14) reflect the length of the axes of an ellipse and change according to spheroid selection. In Figure C.14, *Sphere of Radius 6371200 Meters* is selected as the spheroid, and the lengths of the axes have been automatically entered to reflect a sphere of radius 6371200 feet.
7. The remaining parameters are informational and are not editable.
8. Click **OK**. The **Map Coordinate Information** dialog box closes (Figure C.14). In the **Coordinate System** box of the **Default Map Properties for** dialog box (Figure C.2), *Polar Stereographic (HRAP)* should be displayed.



The dialog box is titled "Map Coordinate Information" and contains the following fields and controls:

- System:** A dropdown menu set to "Polar Stereographic (HRAP)".
- Units:** A dropdown menu set to "Meters".
- Spheroid:** A dropdown menu set to "Sphere of Radius 6371200 Meters".
- Axis:** A group box containing:
  - Semi-major:** A text box with the value "6371200".
  - Semi-minor:** A text box with the value "6371200".
- Central Meridian:** A field with a direction dropdown set to "W", a degree text box with "105", a direction dropdown set to "d", a minute text box with "0", a separator "' ", and a second minute text box with "0".
- Latitude of true scale:** A field with a direction dropdown set to "N", a degree text box with "60", a direction dropdown set to "d", a minute text box with "0", a separator "' ", and a second minute text box with "0".
- False easting:** A text box containing the value "1905000".
- False northing:** A text box containing the value "7620000".
- Buttons:** "Load from file...", "OK", and "Cancel".

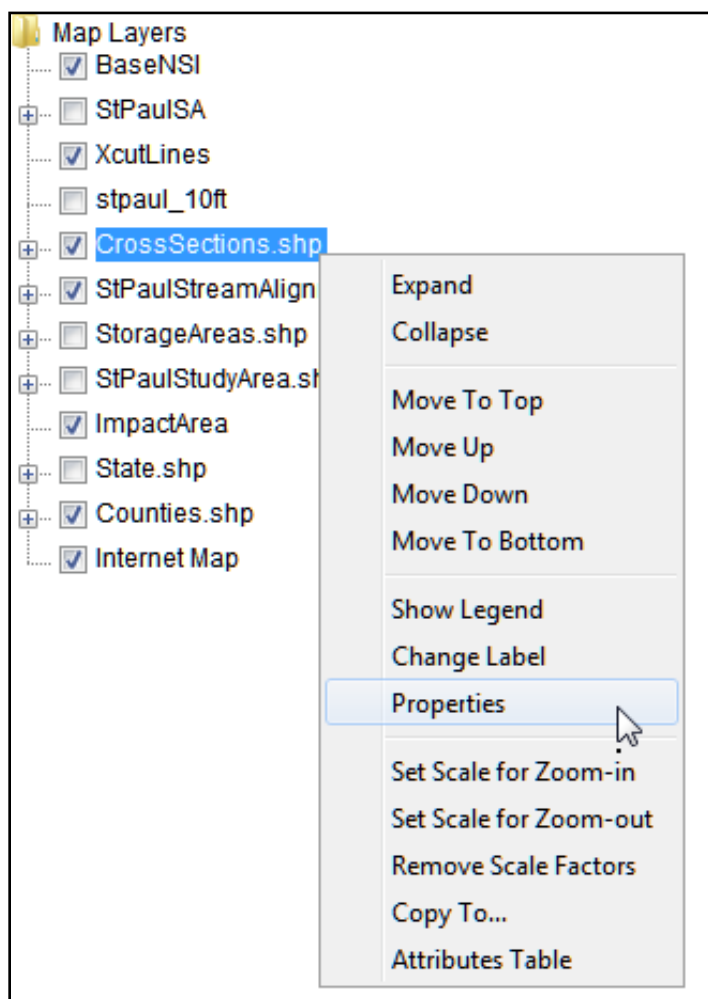
**Figure C.14** Map Coordinate Information Dialog Box - Polar Stereographic (HRAP) Coordinate System

# Appendix D

## Layer Display Properties

There are many map layers supported by HEC-FIA. The different map layers are described in Chapter 4, Section 4.2 (page 4-1) of this manual. Users can edit several display properties for each of these layers, and the different editor dialog boxes are layer-specific to polygon shapefiles, line shapefiles, and gridded data. This Appendix outlines the functions of each of the editors for the different layers in HEC-FIA.

To access the map layer editors, beneath the **Content Pane**, select the **Maps Tab**. The **Content Pane** displays all of the study elements that are represented in the map window. Select the map layer to be edited and right-click. From the shortcut menu (Figure D.1) click **Properties**. An editor specific to the selected map layer opens.



**Figure D.1** Map Layer Shortcut Menu

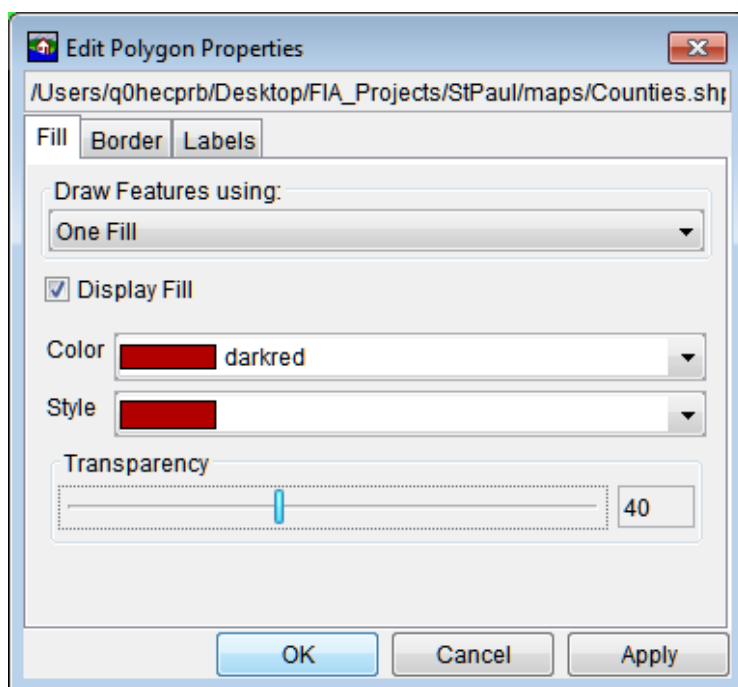
## D.1 Polygon Shapefile Display Properties

Shapefiles store non-topological geometry and attribute information for the spatial features of a data set. There are three types of shapefiles: polygon, line, and point. Each of these has a different set of display options.

User-editable polygon shapefile display properties include **Fill**, **Borders**, and **Labels**.

To edit polygon shapefile fill properties:

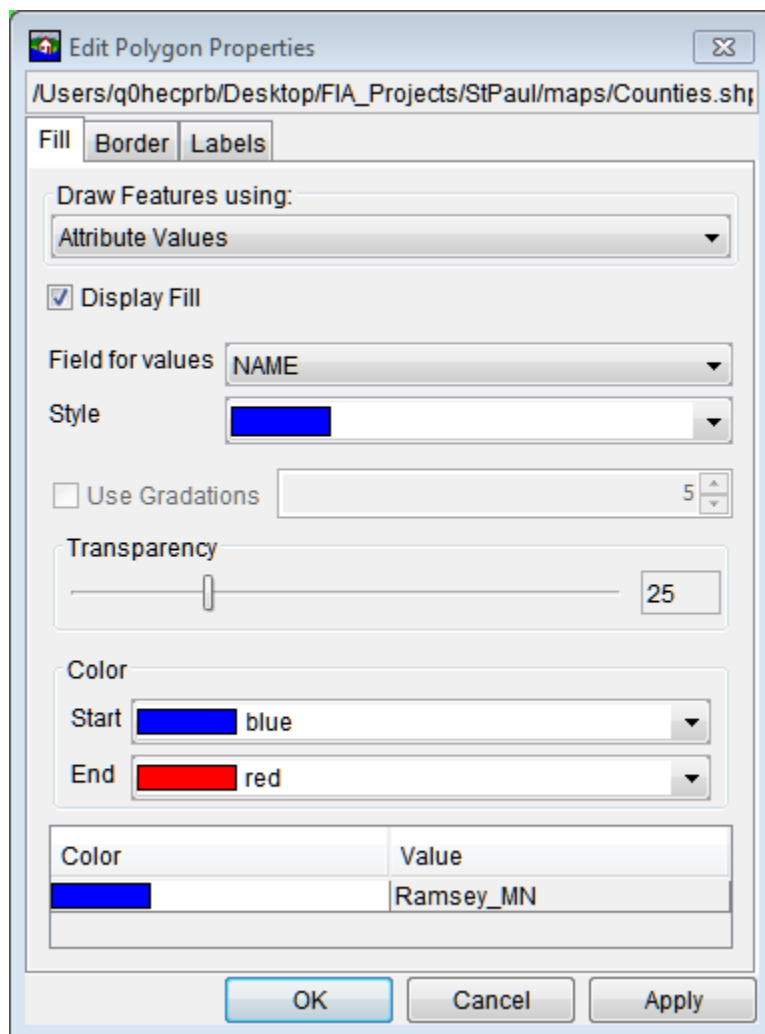
1. From the **Content Pane** with the **Maps Tab** selected, right-click on the name of a polygon shapefile (\*.shp).
2. From the shortcut menu, click **Properties** (see Figure D.1). The **Edit Polygon Properties** dialog box appears (Figure D.2).



**Figure D.2** Edit Polygon Properties Dialog Box

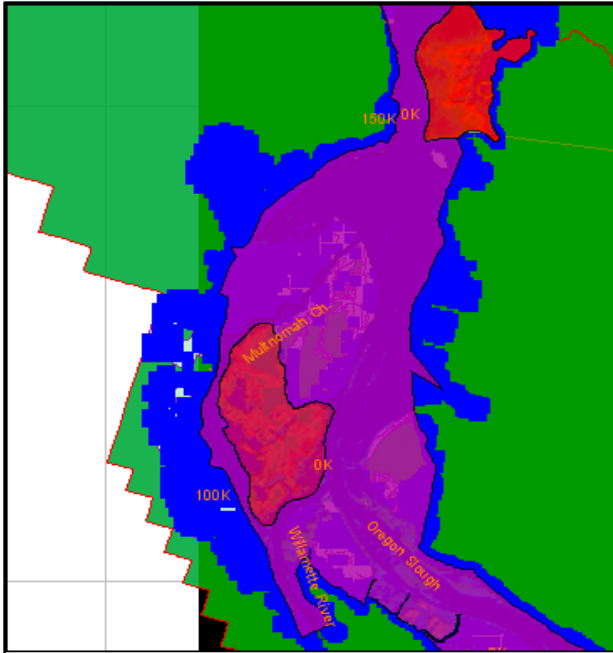
3. Under the **Fill** tab, check the **Display Fill** box to fill the selected shapefile.
4. By default, HEC-FIA draws fill features using **One Fill** for the selected shapefile. To set fill properties for a single fill:
  - a. From the **Color** list, select the fill color. In the example in Figure D.2, dark red has been selected.
  - b. From the **Style** list, select the fill style (e.g., solid color, diagonal lines, etc.).
  - c. Use the **Transparency** slider to select the level of transparency fill.

5. Users can also establish separate fill colors by shapefile attribute:
  - a. From the **Draw Features using** list (Figure D.2), select **Attribute Values**.
  - b. From the **Field for values** list, select the name of the shapefile attribute that represents the separate polygons. In Figure D.3, *Name* has been selected for the shapefile *Counties.shp*.



**Figure D.3** Fill Polygon by Shapefile Attribute

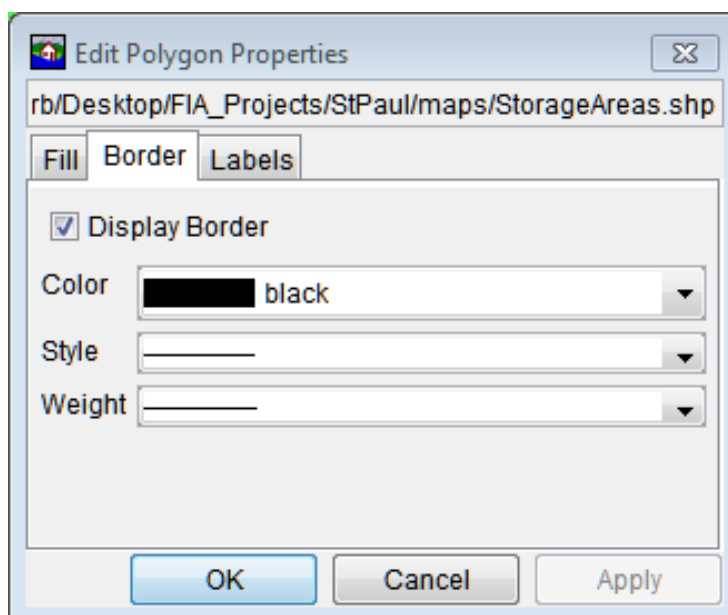
- c. From the **Style** list, select the desired fill style.
  - d. Use the **Transparency** slider to select the level of transparency for the fill.
  - e. From the **Color** box (Figure D.3), select the start and end of the color range for the shapefile. HEC-FIA fills in the colors in between. In Figure D.4, the shapefile has been filled according to the properties entered in Figure D.3.
6. Once fill properties have been edited, click **Apply** to apply the display properties to the layer. When finished editing, click **OK**.



**Figure D.4** Shapefile Polygon Filled by Attribute

To edit shapefile border properties:

1. From the **Content Pane** with the **Maps** tab selected, right-click on the name of a polygon shapefile (\*.shp).
2. From the shortcut menu, click **Properties** (Figure D.1). The **Edit Polygon Properties** dialog box appears (Figure D.2).
3. Click the **Border** tab and select **Display Border** to create a border (Figure D.5).

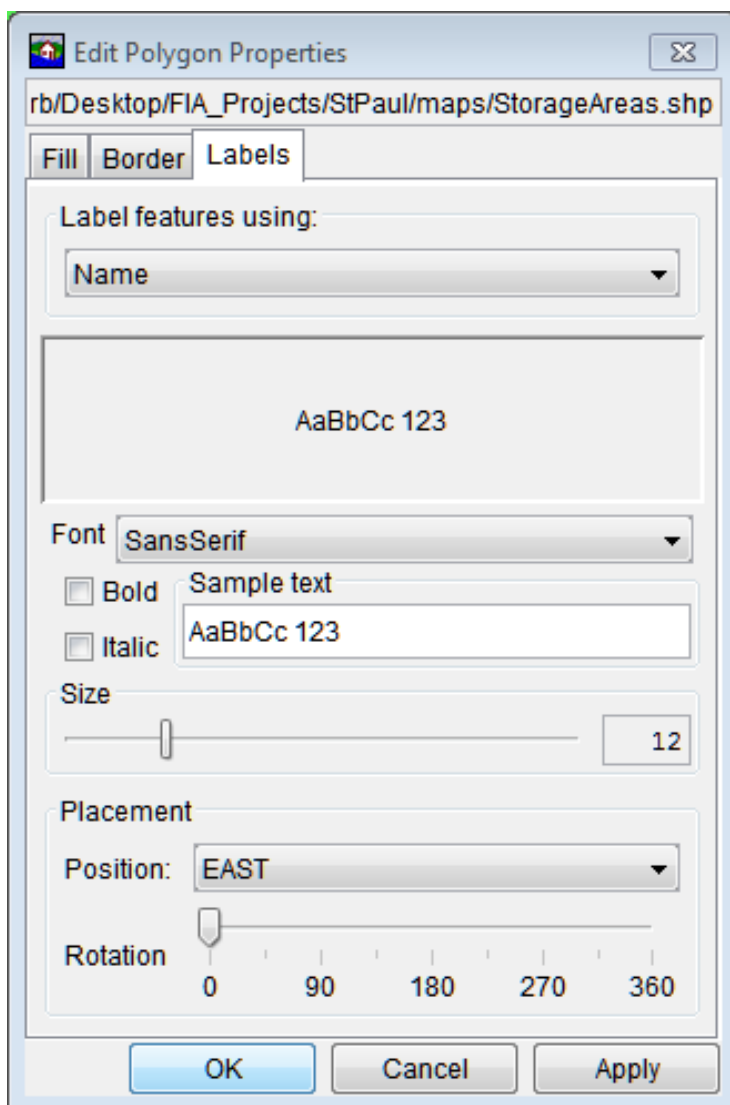


**Figure D.5** Edit Polygon Properties Dialog Box - Border Tab

4. From the **Color**, **Style**, and **Weight** lists (Figure D.5), edit the border color, style (e.g. solid, dashed, etc.), and weight as desired.
5. Click **Apply** to display changes in the **Map Window** and continue editing.
6. When finished editing, click **OK** to close the dialog.

To edit labels for shapefile attributes:

1. From the **Content Pane** with the **Maps** tab selected, right-click on the name of a polygon shapefile (\*.shp).
2. From the shortcut menu, click **Properties** (Figure D.1). The **Edit Polygon Properties** dialog box appears (Figure D.2).
3. Select the **Labels** tab (Figure D.6).



**Figure D.6** Edit Polygon Properties Dialog Box - Labels Tab

4. From the **Label features using** list (Figure D.6), select the name of the shapefile attribute that represents the labels for separate polygons. *Name* has been selected for the shapefile *StorageAreas.shp*.
5. From the **Font** list (Figure D.6) select the desired font for labels, select whether to make the labels bold or italicized, and the **Size** slider adjusts the font size for labels. From the **Placement** box, the user can adjust the placement of labels and rotate labeled.
6. Click **Apply** to display changes in the **Map Window** and keep editing.
7. When finished editing, click **OK** to close the dialog.

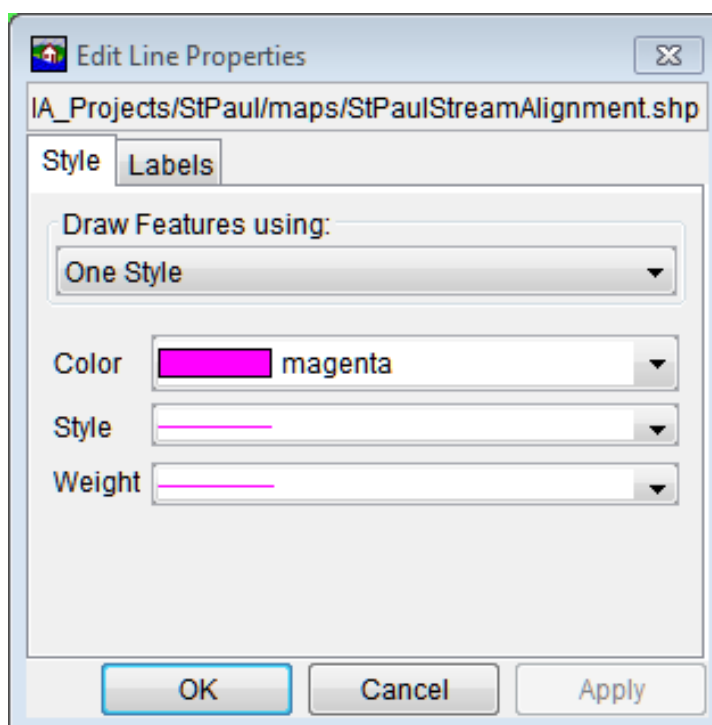
## D.2 Line Shapefile Display Properties

Line shapefiles are usually uploaded to studies as centerlines that represent a stream system for a study (see Chapter 5, Section 5.2, page 5-4).

User-editable line shapefile display properties include **Style** and **Labels**.

To edit line shapefile style properties:

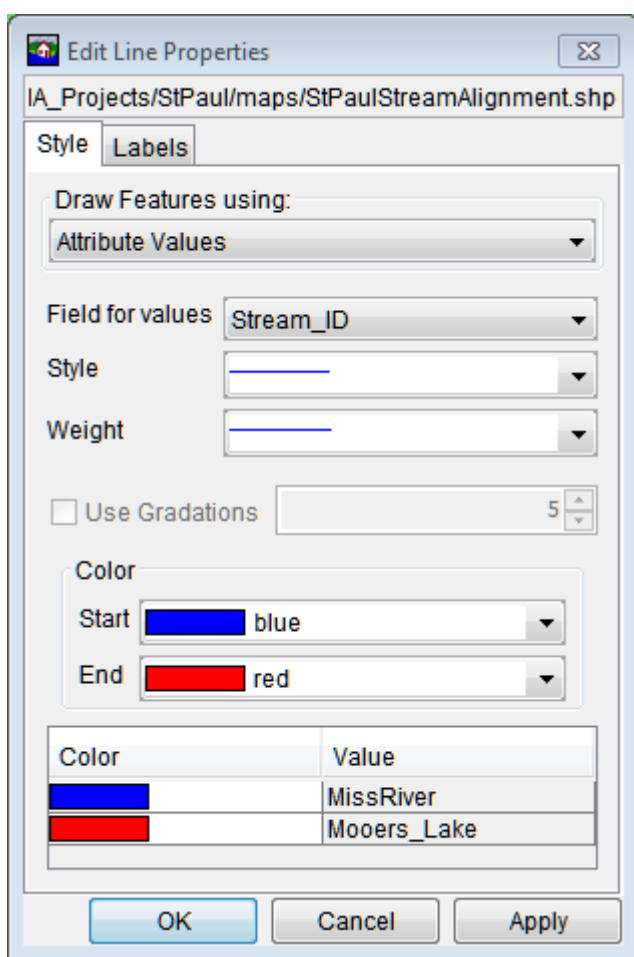
1. From the **Content Pane** with the **Maps** tab selected, right-click on the name of a line shapefile (\*.shp).
2. From the shortcut menu, click **Properties** (Figure D.1). The **Edit Line Properties** dialog box appears (Figure D.7).



**Figure D.7** Edit Line Properties Dialog Box



3. From the **Draw Features using** list, **One Style** is the default. This option applies style properties to all of selected shapefile.
  - a. From the **Color** list, select the display color of the line shapefile
  - b. From the **Style** list, select the line style of the shapefile.
  - c. From the **Weight**, select the desired weight (thickness) of the line.
4. Users can also edit features of a line shapefile by attribute:
  - a. From the **Draw Features using** list (Figure D.7), select **Attribute Values** (Figure D.8).



**Figure D.8** Features Using Shapefile Attribute

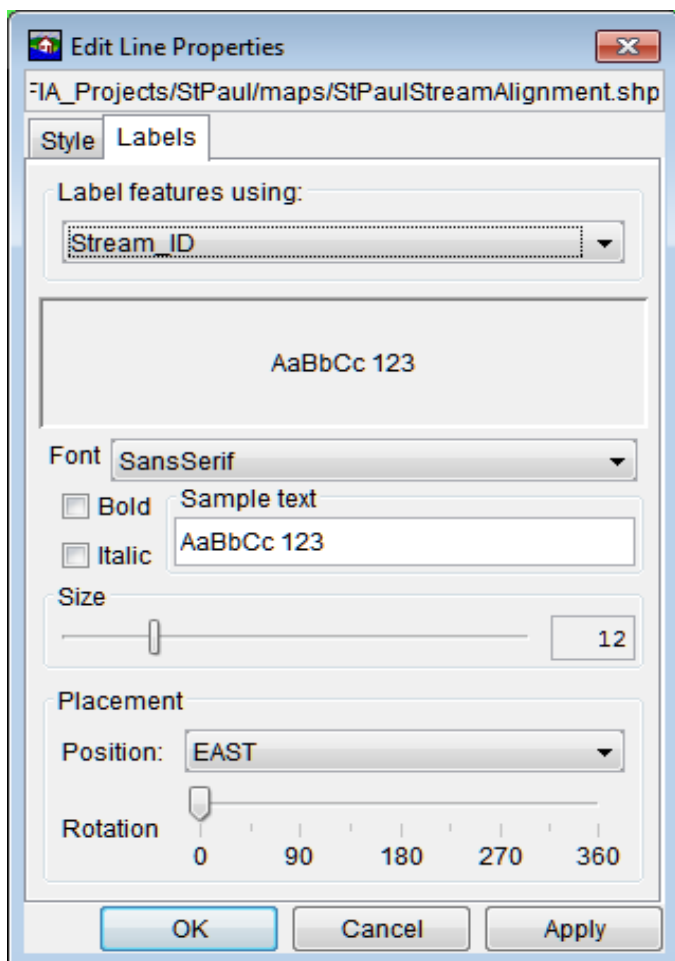
- c. From the **Field for values** list, select the name of the shapefile attribute that represents separate lines. *Stream\_ID* has been selected for the shapefile *StPaulStreamAlignment.shp*.
- d. Select the desired line style from the **Style** list.

- e. Select desired line weight (thickness) from the **Weight** list (Figure D.8).
  - f. Select a **Start** color and an **End** color. HEC-FIA automatically fills in a gradation in between the two colors.
5. When the desired changes have been made, click **Apply** and the changes display in the **Map Window**. When finished editing, click **OK** to close the dialog box.

Users can display labels for attributes of line shapefiles and edit the way they display in the **Map Window**.

To edit label properties for line shapefiles:

1. From the **Content Pane** with the **Maps** tab selected, right-click on the name of a line shapefile (\*.shp).
2. From the shortcut menu, click **Properties** (Figure D.1). The **Edit Line Properties** dialog box appears (Figure D.7).
3. Select the **Labels** tab (Figure D.9).



**Figure D.9** Edit Line Properties Dialog Box - Labels Tab

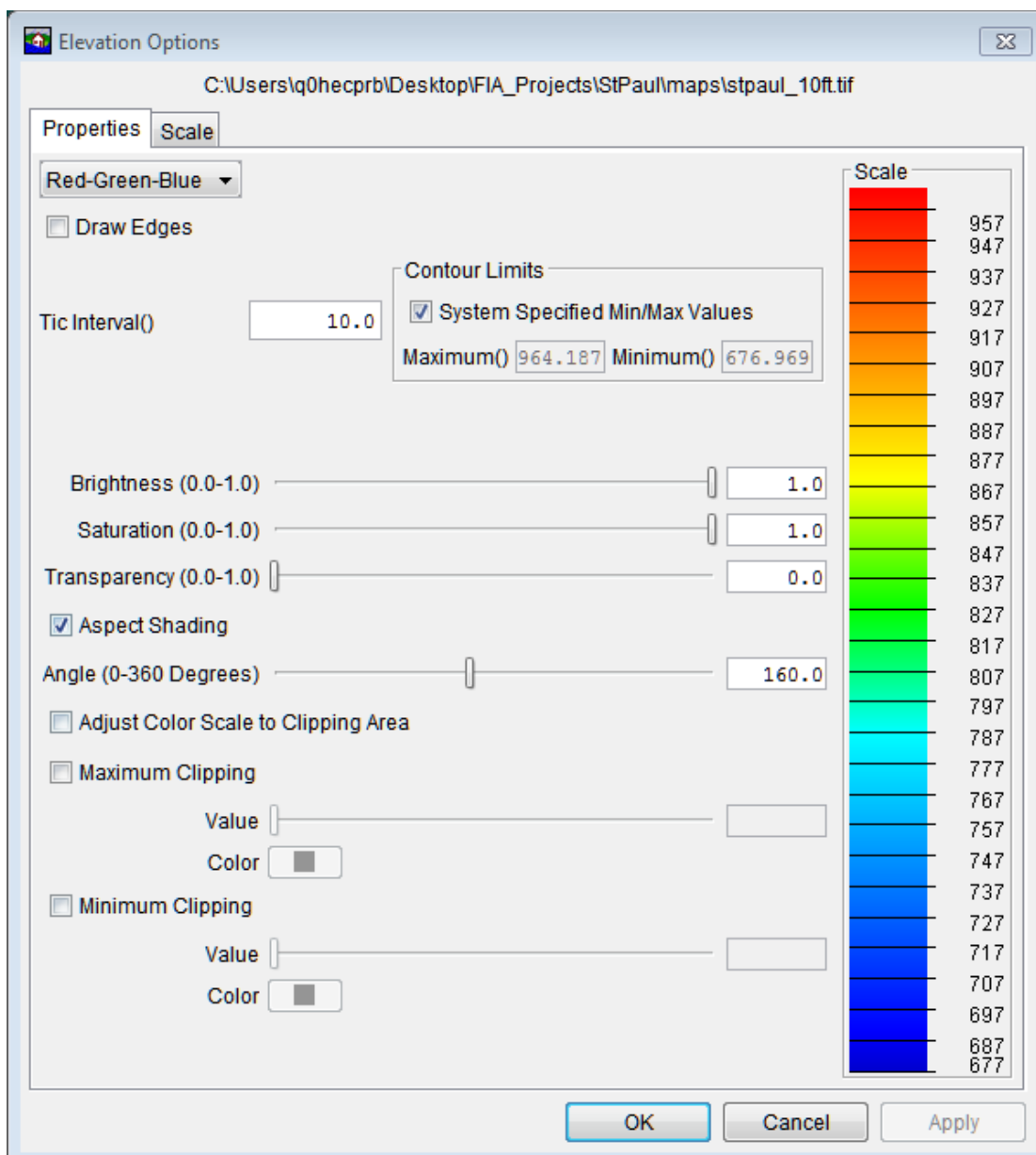
4. From the **Label features using** list (Figure D.9), select the name of the shapefile attribute that represents the labels for separate lines. *Stream\_ID* has been selected for the shapefile *StPaulStreamAlignment.shp*.
5. From the **Font** list (Figure D.9) select the desired font for labels, select whether to make the labels bold or italicized, and the **Size** slider adjusts the font size for labels. From the **Placement** box, the user can adjust the placement of labels and rotate labeled.
6. Click **Apply** to display changes in the **Map Window** and keep editing.
7. When finished editing, click **OK** to close the **Edit Line Properties** dialog box (Figure D.9).

### D.3 Gridded Data Display Properties

For gridded data (.tif), users can adjust display properties for color by elevation as well as toggle at which scales the layer are displayed in the **Map Window**.

To adjust display properties for data grids:

1. From the **Content Pane** with the **Maps** tab selected, right-click on the name of a gridded data file (\*.tif).
2. From the shortcut menu, click **Properties**. The **Elevation Options** dialog box appears (Figure D.10).
3. From the list box (Figure D.10), there are available color contour schemes – **Aspect Shading**, **Grayscale**, **Linear**, **Precipitation**, **Red-Green-Blue**, **Terrain** (default), and **Water Depth**.
4. The **Draw Edges** (Figure D.10) option is specifically for ASCII NetTin files. If selected, the edges of the triangles that make up an ASCII NetTin file are drawn.
5. The contour tic interval can be set by entering a value in the **Tic Interval** box (Figure D.10).
6. HEC-FIA sets the maximum and minimum limits of the contours automatically. To override the maximum and minimum limits, clear **System Specified Min/Max Values** (Figure D.10) and enter new values in the **Maximum** and **Minimum** boxes.
7. Adjust the brightness (amount of white), saturation (amount of black), and transparency (level of opacity or alpha) for the colors using the **Brightness**, **Saturation**, and **Transparency** slider bars or boxes (Figure D.10).



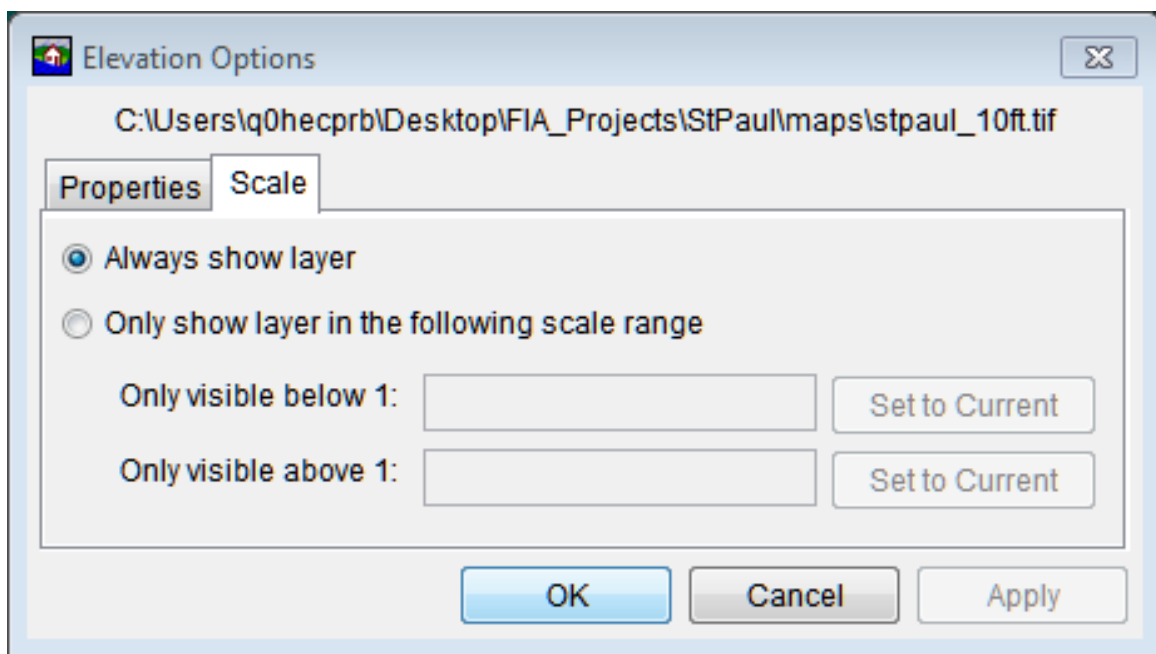
**Figure D.10** Elevation Options Dialog Box

8. By default the **Aspect Shading** option is on. Aspect shading displays the map layer in relief by placing an imaginary light source above the map and shading the contours. The user can adjust the angle of the light source by using the **Angle** slider bar or by entering a value in the box. If aspect shading is not desired, clear **Aspect Shading** (Figure D.10).
9. Clipping allows users to highlight an area using user-definable color choices and values. For maximum clipping, fill the contour with the clip color from the maximum value of the map to the value entered for **Maximum Clipping**. For example, maximum clipping could be used to highlight smog levels, cloud cover, or snow level at a particular elevation. By default, maximum clipping is turned off. To enable, click **Maximum Clipping** (Figure D.10), then choose a color by clicking **Color**, and either enter a maximum clipping value by using the **Value** slider bar or enter a value in the box.

10. Minimum clipping fills the contour with the clip color from the minimum value of the map to the value entered for **Minimum Clipping**. For example, minimum clipping could be used to see where a water level would be if it flooded to a particular elevation. By default, minimum clipping is turned off. To enable, click **Minimum Clipping** (Figure D.10), then choose a color by clicking **Color**, and either enter a minimum clipping value by using the **Value** slider bar or by entering a value in the box.
11. Click **Apply** to display changes in the **Map Window** and keep editing.
12. When finished editing, click **OK** to close the dialog (Figure D.10).

Users may also set the zoom scales at which they would like layers to display in the map window. For example, a user might not want to see their counties shapefile below a particular scale. To toggle these settings:

1. From the **Content Pane** with the **Maps** tab selected, right-click on the name of a gridded data file (\*.tif).
2. From the shortcut menu, click **Properties**. The **Elevation Options** dialog box appears (Figure D.10).
3. Select the **Scale** tab (Figure D.11).



**Figure D.11** Elevation Options Dialog Box - Scale Tab

4. Select **Always Show Layer** (Figure D.11) to display the layer in the **Map Window** at all scales.
5. To make the layer visible only below a certain scale level, select **Only show layer in the following scale range** (Figure D.11). Zoom to the desired scale level, click **Set to**

- Current** for **Only visible below 1**. The layer now appears only when the zoom scale is below this level.
6. To make the layer visible only above a certain scale level, select **Only show layer in the following scale range** (Figure D.11). Zoom to the desired scale level, click **Set to Current** for **Only visible above 1**. The layer now appears only when the zoom scale is higher than this level.
  7. Click **Apply** to display changes in the **Map Window** and keep editing.
  8. When finished editing, click **OK** to close the dialog.

# Appendix E

## Using the Color Chooser

The **Color Chooser** (Figure E.1) provides flexibility in the selection of colors for map layers, labels, and background colors. The **Color Chooser** has three tabs: **Swatches**, **HSB**, and **RGB**, offering three methods for choosing a color. Under each method, the preview area allows the user to preview color choices before applying changes.

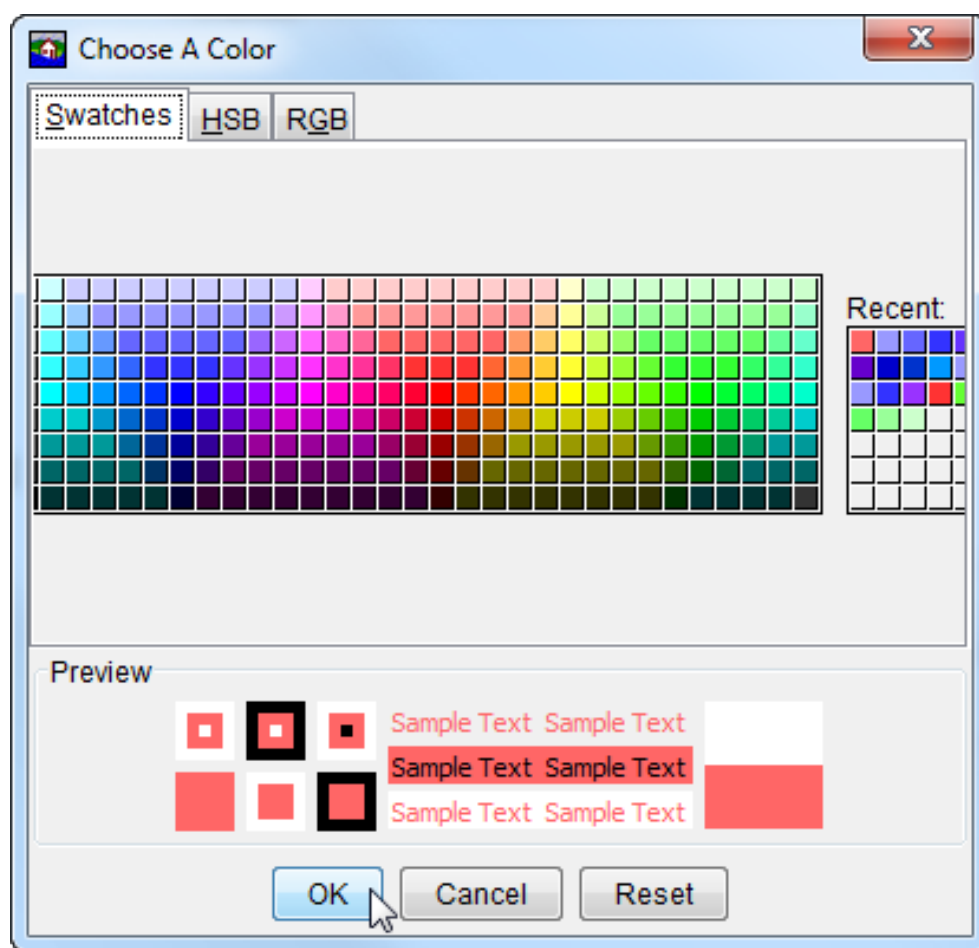


Figure E.1 Color Chooser - Swatches Worksheet

### E.1 Swatches Worksheet

The **Swatches** worksheet provides a palette of pre-defined colors. From the palette, select a color. Once a color has been selected, the **Recent** and **Preview** boxes display that color. Click **OK** and the **Color Chooser** closes (Figure E.1). Depending on where the **Color Chooser** was accessed, the user clicks either **Apply** or **OK** and the color change appears in the display area.

## E.2 HSB Worksheet

**HSB** is the Hue, Saturation, and Brightness color model, which allows the user to set the hue, saturation, and brightness of colors. From the **Color Chooser**, select the **HSB** tab; the **HSB Worksheet** (Figure E.2) becomes available.

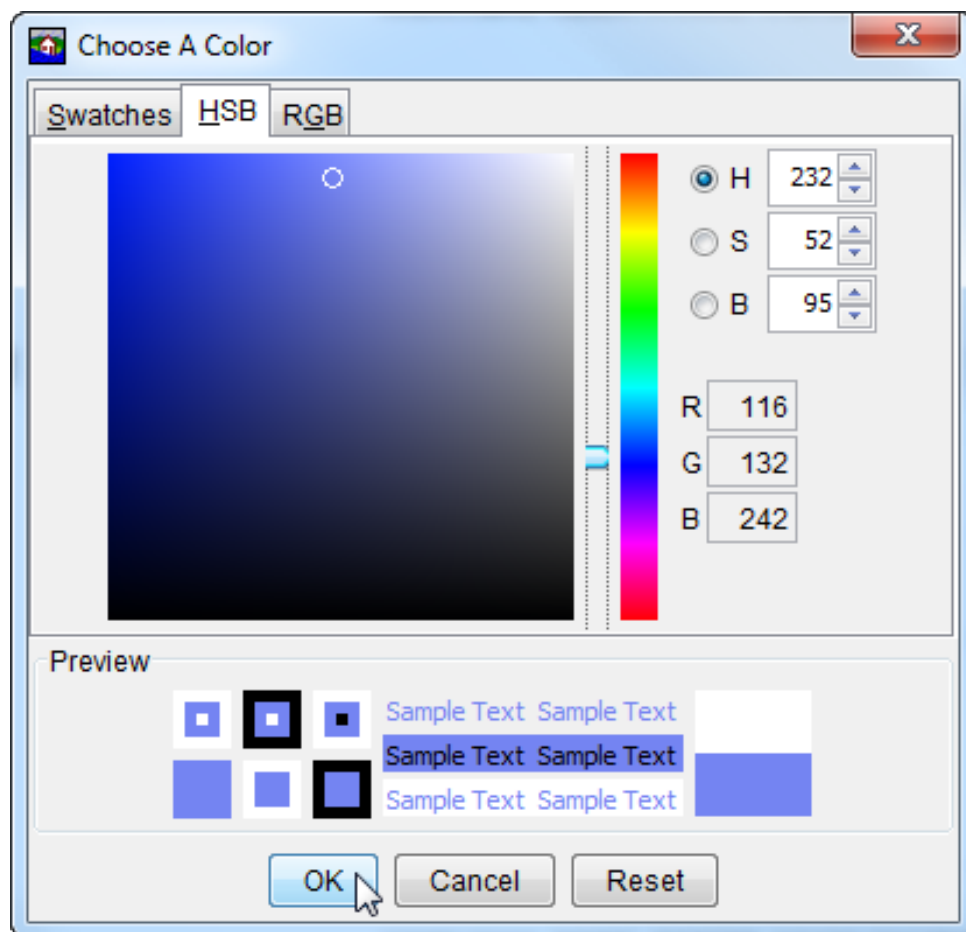


Figure E.2 Color Chooser - Hue, Saturation, and Brightness Worksheet

Several ways are available to adjust the hue, saturation, and brightness of the colors. The slider bar in conjunction with the **H**, **S**, and **B** options changes the color, if the user selects *red* with the **H** option selected, then when the user switches to the **S** and **B** options, the user is changing the saturation and brightness of *red*. Another way to affect the colors is in the **H**, **S**, and **B** boxes, the user can directly enter a value for hue, saturation, and brightness. The following rules apply to the values that can be entered for each box:

**H Box:** Hue is measured in a circle from zero (0) to 359 degrees.

0 = red, 60 = yellow, 120 = green, 180 = cyan

240 = blue, 300 = magenta

**S Box:** Saturation is the amount of black, measured from zero (0) to one hundred (100) percent.

**B Box:** Brightness is the amount of white, measured from zero (0) to one hundred (100) percent.

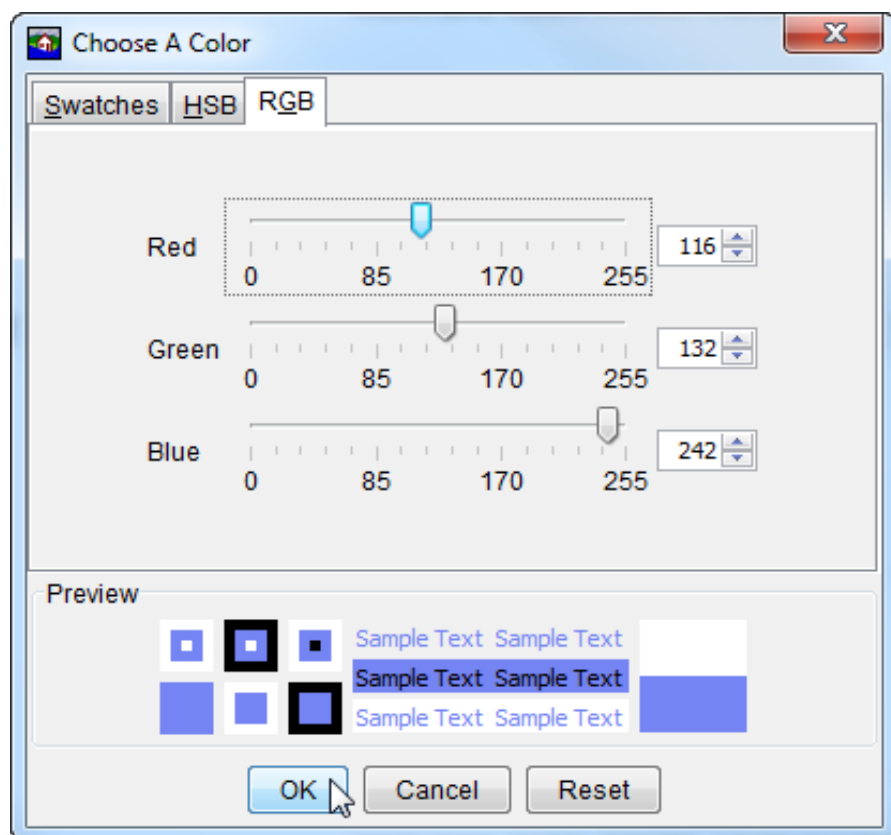


A final method for setting the color on the HSB worksheet is from the color palette, click and drag the little white circle. As the little white circle is dragged, the hue, saturation, and brightness values, along with the red, green and blue color values area atomically changed. The red, green, and blue values in the **R**, **G**, and **B** boxes are not editable and informational only.

Click **OK**, the **Color Chooser** closes (Figure E.2). Depending on where the **Color Chooser** was accessed, the user clicks either **Apply** or **OK** and the color change appears in the display area.

### E.3 RGB Worksheet

**RGB** is the Red, Green, and Blue color model, which allows the user to set the red, green, and blue values colors. From the **Color Chooser**, select the **RGB** tab; the **RBB Worksheet** (Figure E.3) becomes available.



**Figure E.3** Color Chooser - RGB Worksheet

The user has two ways to adjust the red, green, and blue value of colors. A slider bar is available for **Red**, **Green**, and **Blue**. As the user changes the slider bar for each one, in the **Preview** box, the color being produced is displayed. Another way to affect colors is in the **Red**, **Green**, and **Blue** boxes the user can directly enter a value. Click **OK**, the **Color Chooser** closes (Figure E.3). Depending on where the **Color Chooser** was accessed, the user clicks either **Apply** or **OK** and the color change appears in the display area.



# Appendix F

## Using HEC-DSSVue

HEC-DSSVue (Hydrologic Engineering Center Data Storage System Visual Utility Engine) is a graphical user interface program for viewing, editing, and manipulating data in HEC-DSS database files. With HEC-DSSVue, data may be plotted, tabulated, edited, and manipulated with over fifty mathematical functions. Along with these functions, HEC-DSSVue provides several utility functions, such as entering data sets into a database, renaming data set names, copying data sets to other DSS database files, and deleting data sets.

In HEC-FIA, HEC-DSSVue is used mainly as a viewing tool for DSS data. This Appendix reviews some of the general functions in HEC-DSSVue. For further detail, see the HEC-DSSVue User's Manual.

### F.1 HEC Data Storage System Concepts

HEC-DSS is a database system designed to efficiently store and retrieve typically sequential, scientific data. Such data types include, but are not limited to, time series data, curve data, spatial-oriented gridded data, textual data (such as this manual), and others. The system facilitates users and application programs retrieval and storage of data.

The data are arranged into blocks. For example, one year of daily-interval data is stored in a single **record** in the DSS. Each record is given a unique name called a **pathname**. The **pathname** is formulated in a way that makes it easy to group related data together. Software from HEC has the ability to read from and write to DSS. This capability facilitates data exchange among applications. For example, HEC-ResSim can be used to generate the time series input for FIA.

### F.2 Overview of HEC-DSSVue in FIA

From the **Tools** menu, choose **HEC-DSSVue**. The **HEC-DSSVue** main window opens (Figure F.1).

The **Menu Bar** contains the menus for the main window of HEC-DSSVue.

The **Toolbar** contains shortcut buttons to the most-used features of HEC-DSSVue:



**Open File Button** - opens an **Open File Browser**, which allows users to select a DSS file.



**Plot Button** - plots the data of the selected pathname(s).



**Tabulate Button** - displays the data of the selected pathname(s) in a tabular form.

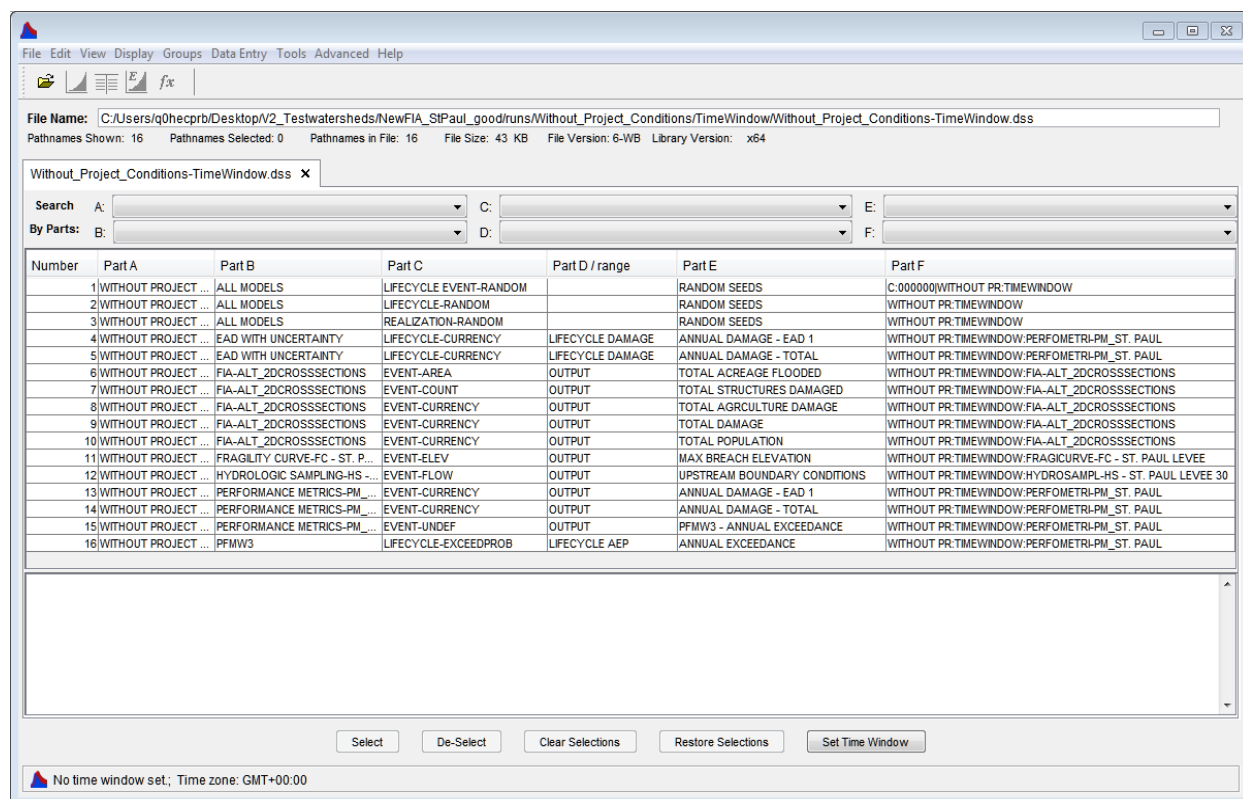


Figure F.1 HEC-DSSVue Main Window



**Graphical Edit Button** – provides a shortcut to an editor for data manipulation.



**Function Button** - provides a shortcut to the mathematical function tools for editing DSS data.


The **DSS File Information** (Figure F.1) box displays the filename of the DSS file, and statistics about the pathnames in the DSS file and the size of the DSS file.

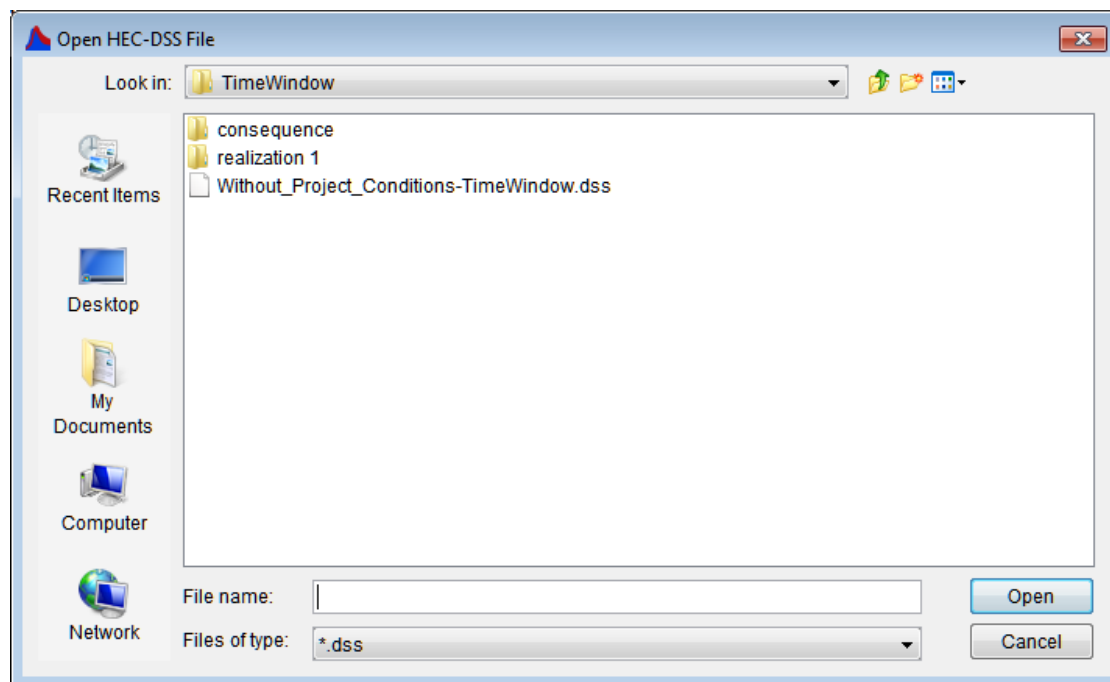
The **Filter Lists** are used to sort DSS pathnames by parts. A filter list for each individual part, A through F is available. The **Pathname Table** displays the filtered pathnames contained in the DSS file. The pathnames are displayed by the individual parts. The **Selected Pathname List** displays the pathnames that have been selected from the **Pathname Table**.

The **Select Commands** are available after pathnames have been selected. Available commands are **Select**, **De-Select**, **Clear Selections**, **Restore Selections**, and **Set Time Window**.

## F.3 Opening a DSS File

There are several ways to open a DSS file from HEC-DSSVue. One way is to type in the location and filename of the DSS file in the **File Name** box of the **HEC-DSSVue** main window (Figure F.1). After entering the correct information, press **ENTER**. The **Pathname Table** displays the pathnames of the selected DSS file, and the **DSS File Information** box displays statistics about the DSS file.

Alternatively, select **Open** from the **File** menu or click **Open File**  from the **Toolbar**. Either method opens the **Open HEC-DSS File** browser (Figure F.2).



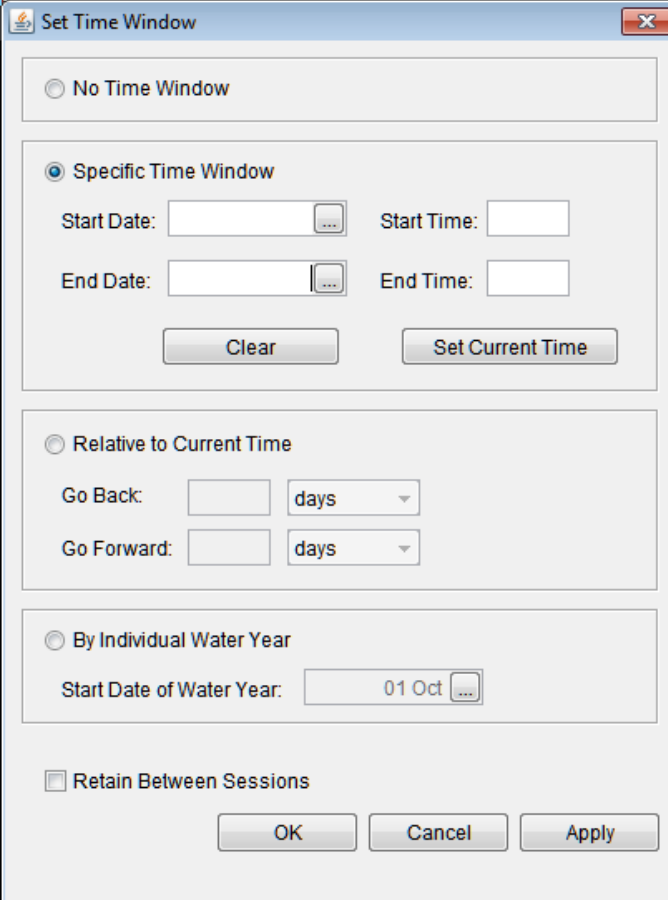
**Figure F.2** Open HEC-DSS File Browser

Locate the DSS file to open, click **OK**. The **Open HEC-DSS File** browser closes, and the HEC-DSSVue main window displays the name of the DSS file and all of the pathnames associated with that DSS file appear in the **Pathname Table** (Figure F.1).

## F.4 Set Time Window

To view data for a particular block of time, users can define a time window. Users can define a time window by specific start and end dates and times, time relative to the current date, or individual water years.

1. Click **Set Time Window**, the **Set Time Window** dialog box opens (Figure F.3). By default, **No Time Window** is selected.
2. To enter specific start date and time:
  - a. Select **Specific Time Window**.
  - b. In the **Start Date** box type a date in the format ddmmyyyy (i.e., 26Nov1993), and in the **Start Time** box type a time in the format hhmm (i.e., 0630).
  - c. Enter an **End Date** and **Time** in the provided fields.
  - d. If the user wants to use the current date and time, click **Set Current Time**. All time window boxes are filled, the ending date and times need to be reviewed and edited.



The dialog box is titled "Set Time Window" and contains the following sections:

- No Time Window:** A radio button option.
- Specific Time Window:** A radio button option that is selected. It includes:
  - Start Date: [text box] [calendar icon]
  - Start Time: [text box]
  - End Date: [text box] [calendar icon]
  - End Time: [text box]
  - Buttons: "Clear" and "Set Current Time"
- Relative to Current Time:** A radio button option. It includes:
  - Go Back: [text box] [dropdown menu showing "days"]
  - Go Forward: [text box] [dropdown menu showing "days"]
- By Individual Water Year:** A radio button option. It includes:
  - Start Date of Water Year: [text box showing "01 Oct"] [calendar icon]
- Retain Between Sessions:** A checkbox option.
- Buttons:** "OK", "Cancel", and "Apply" at the bottom.

**Figure F.3** Set Time Window Dialog Box

3. To set a time window relative to current time:
  - a. Select **Relative to Current Time**.
  - b. From the dropdown list, select time units (days, hours, months, or years).
  - c. In the **Go Back** field, enter the number of days/hours/months/years the user would like DSSVue to show prior to the current time.
  - d. In the **Go Forward** field, enter the number of days/hours/months/years the user would like HEC-DSSVue to display after the current time.
4. To set a time window by individual water year, in the **Start Date of Water Year** field select the date that represents the start of each water year.
5. To retain time window settings for all data viewing in HEC-DSSVue, select **Retain Between Sessions**.
6. Click **OK**, the **Set Time Window** dialog box closes (Figure F.3), the time window is set, and the time window is displayed in the **Status Bar** of the **HEC-DSSVue** main window (Figure F.1).

## F.5 DSS Pathnames

DSS data is stored in blocks, or records, within a file each record is identified by a unique name called a **pathname**. Each time that data is stored or retrieved from the file, its pathname must be given. The pathname is the key to the data's location within a database. A pathname is analyzed by DSS to determine an index number. This index determines where the data set is stored within the database. This design ensures that very few disk accesses are made to retrieve or store data sets. One data set is not directly related to another, so updating other areas of the database when a new data set is stored is not required.

DSS references records (data sets) by a pathname. The pathname of a DSS record can be three hundred and ninety-one (391) characters or less, and is, by convention, separated into **six parts**. The parts can be sixty-four (64) characters or less and are delimited by slashes in the pathname. The pathname parts are designated **A** through **F**. Table F.1 provides an example naming convention for regular-interval time series:

**Table F.1** DSS Pathname Parts

A	project, river, or basin name
B	
C	data parameter (e.g., FLOW, PRECIP)
D	starting block data; format ddmmyyyy
E	time interval
F	additional user-defined descriptive information

### F.5.1 Viewing of DSS Pathnames

The **Pathname Table** displays all of the pathnames by their different parts (Figure F.1). Users can toggle display options from the **View** menu. Available commands are **Pathname List**, **Pathname Parts**, **Condensed Catalog**, **No Pathnames**, and **Unsorted List**. The **Pathname List** command (Figure F.4) displays the pathnames in the **Pathname Table**, while **No Pathnames** displays nothing.

Number	Pathname
1	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/ALL MODELS/LIFECYCLE EVENT-RANDOM//RANDOM SEEDS/C:000000/WITHOUT PR:TIMEWINDOW/
2	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/ALL MODELS/LIFECYCLE-RANDOM//RANDOM SEEDS/WITHOUT PR:TIMEWINDOW/
3	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/ALL MODELS/REALIZATION-RANDOM//RANDOM SEEDS/WITHOUT PR:TIMEWINDOW/
4	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/EAD WITH UNCERTAINTY/LIFECYCLE-CURRENCY/LIFECYCLE DAMAGE/ANNUAL DAMAGE - EAD 1/WITHOUT PR:TIM...
5	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/EAD WITH UNCERTAINTY/LIFECYCLE-CURRENCY/LIFECYCLE DAMAGE/ANNUAL DAMAGE - TOTAL/WITHOUT PR:TI...
6	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/FIA-ALT_2DCROSSSECTIONS/EVENT-AREA/OUTPUT/TOTAL ACREAGE FLOODED/WITHOUT PR:TIMEWINDOW:FIA-A...
7	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/FIA-ALT_2DCROSSSECTIONS/EVENT-COUNT/OUTPUT/TOTAL STRUCTURES DAMAGED/WITHOUT PR:TIMEWINDOW:...
8	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/FIA-ALT_2DCROSSSECTIONS/EVENT-CURRENCY/OUTPUT/TOTAL AGRICULTURE DAMAGE/WITHOUT PR:TIMEWINDO...
9	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/FIA-ALT_2DCROSSSECTIONS/EVENT-CURRENCY/OUTPUT/TOTAL DAMAGE/WITHOUT PR:TIMEWINDOW:FIA-ALT_2D...
10	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/FIA-ALT_2DCROSSSECTIONS/EVENT-CURRENCY/OUTPUT/TOTAL POPULATION/WITHOUT PR:TIMEWINDOW:FIA-ALT...
11	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/FRAGILITY CURVE-FC - ST. PAUL LEVEE/EVENT-ELEV/OUTPUT/MAX BREACH ELEVATION/WITHOUT PR:TIMEWINDO...
12	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/HYDROLOGIC SAMPLING-HS - ST. PAUL LEVEE 30YEARS/EVENT-FLOW/OUTPUT/UPSTREAM BOUNDARY CONDITIO...
13	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/PERFORMANCE METRICS-PM_ST. PAUL/EVENT-CURRENCY/OUTPUT/ANNUAL DAMAGE - EAD 1/WITHOUT PR:TIMEW...
14	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/PERFORMANCE METRICS-PM_ST. PAUL/EVENT-CURRENCY/OUTPUT/ANNUAL DAMAGE - TOTAL/WITHOUT PR:TIME...
15	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/PERFORMANCE METRICS-PM_ST. PAUL/EVENT-UNDEF/OUTPUT/PFMW3 - ANNUAL EXCEEDANCE/WITHOUT PR:TIME...
16	/WITHOUT PROJECT CONDITIONS-TIMEWINDOW/PFMW3/LIFECYCLE-EXCEEDPROB/LIFECYCLE AEPI/ANNUAL EXCEEDANCE/WITHOUT PR:TIMEWINDOW:PERFORMETRI...

**Figure F.4** Pathname List

## F.5.2 Sorting DSS Pathnames by Parts

Users can also filter the display by pathname parts. Sorting the DSS pathnames by parts is the command **Search pathnames by part** (default). However, another way to sort the pathnames is available from the **View** menu, choose **Search pathnames by string**. The details for this method are described in the HEC-DSSVue User's Manual.

To filter by pathname parts, from the **Filter Lists** (Figure F.5) decide which pathname parts are to be used to sort the pathname list; a **Filter List** for each individual pathname part exists. In the example in Figure F.5, the **D Part Output** has been selected to show all pathnames with that **D Part**.

Number	Part A	Part B	Part C	Part D	Part E	Part F
1	WITHOUT PROJECT CONDI...	FIA-ALT_2DCROSSECTIONS	EVENT-AREA	OUTPUT	TOTAL ACREAGE FLOODED	WITHOUT PR.TIMEWINDOW:FI...
2	WITHOUT PROJECT CONDI...	FIA-ALT_2DCROSSECTIONS	EVENT-COUNT	OUTPUT	TOTAL STRUCTURES DAMAG...	WITHOUT PR.TIMEWINDOW:FI...
3	WITHOUT PROJECT CONDI...	FIA-ALT_2DCROSSECTIONS	EVENT-CURRENCY	OUTPUT	TOTAL AGRICULTURE DAMAGE	WITHOUT PR.TIMEWINDOW:FI...
4	WITHOUT PROJECT CONDI...	FIA-ALT_2DCROSSECTIONS	EVENT-CURRENCY	OUTPUT	TOTAL DAMAGE	WITHOUT PR.TIMEWINDOW:FI...
5	WITHOUT PROJECT CONDI...	FIA-ALT_2DCROSSECTIONS	EVENT-CURRENCY	OUTPUT	TOTAL POPULATION	WITHOUT PR.TIMEWINDOW:FI...
6	WITHOUT PROJECT CONDI...	FRAGILITY CURVE-FC - ST. P...	EVENT-ELEV	OUTPUT	MAX BREACH ELEVATION	WITHOUT PR.TIMEWINDOW:FR...
7	WITHOUT PROJECT CONDI...	HYDROLOGIC SAMPLING-HS ...	EVENT-FLOW	OUTPUT	UPSTREAM BOUNDARY CON...	WITHOUT PR.TIMEWINDOW:H...
8	WITHOUT PROJECT CONDI...	PERFORMANCE METRICS-PM...	EVENT-CURRENCY	OUTPUT	ANNUAL DAMAGE - EAD 1	WITHOUT PR.TIMEWINDOW:PE...
9	WITHOUT PROJECT CONDI...	PERFORMANCE METRICS-PM...	EVENT-CURRENCY	OUTPUT	ANNUAL DAMAGE - TOTAL	WITHOUT PR.TIMEWINDOW:PE...
10	WITHOUT PROJECT CONDI...	PERFORMANCE METRICS-PM...	EVENT-UNDEF	OUTPUT	PFMW3 - ANNUAL EXCEEDAN...	WITHOUT PR.TIMEWINDOW:PE...

Figure F.5 Sort DSS Pathnames by Parts

## F.5.3 Selecting Pathnames

Once the **Pathname Table** is sorted, users can select the pathnames to view or manipulate. To select a pathname, double-click on a pathname in the **Pathname Table**, the selected pathname appears in the **Selected Pathname List** (Figure F.6). The user can also click on a pathname in the **Pathname Table**, and then click the **Select** button.

19	AG RESOR
20	AG RESOR
21	AG RESOR
//AG RESORT/FLOW/01FEB2014/15MIN/MOH0/	
//AG RESORT/PRECIP-CUM/01FEB2014/15MIN/MOH0/	

Figure F.6 Selected Pathname List

To select multiple consecutive pathnames, in the **Pathname Table**, click on the first pathname in the consecutive series. Find the last pathname in the series and click on it while holding down the **SHIFT** key. The block of pathnames highlights. Click **Select**, and all the pathnames within that block are added to the **Selected Pathname List**.

Users can also select multiple pathnames by selecting them while holding down the **CTRL** key. Once all of the appropriate pathnames are selected, release the **CTRL** key and click **Select**. All the pathnames that have been selected are added to the **Selected Pathname List**.

Users can select all of the pathnames displayed in the **Pathname Table**. From the **Edit** menu, choose **Select All**. All of the pathnames now appear in the **Selected Pathname List**.



## F.5.4 Clearing Selected Pathnames

To clear a pathname from the **Selected Pathname List**, select a pathname and click **De-Select**. The pathname is cleared from the **Selected Pathname List**. To clear all pathnames from the **Selected Pathname List**, click **Clear Selections**, and the **Selected Pathname Box** is empty. Groups of pathnames can also be cleared using the same concepts described in the previous section and selecting pathnames by using the **SHIFT** and **CTRL** keys. Once pathnames have been cleared from the **Selected Pathname Box**, the pathnames can be restored to the **Selected Pathname Box** by clicking **Restore Selections**.

## F.6 Visualizing Data

Once pathname(s) are selected, users can visualize pathnames in graphical form (plots) or in tabular form. Further details on plots and tables are discussed in the HEC-DSSVue User's Manual.

### F.6.1 Plots

To view a plot of the pathnames in the **Selected Pathname List** (see Figure F.1), either click the **Plot** button from the **Toolbar** or choose **Plot** from the **Display** menu. Both of these options open the **Plot Window** (Figure F.7).

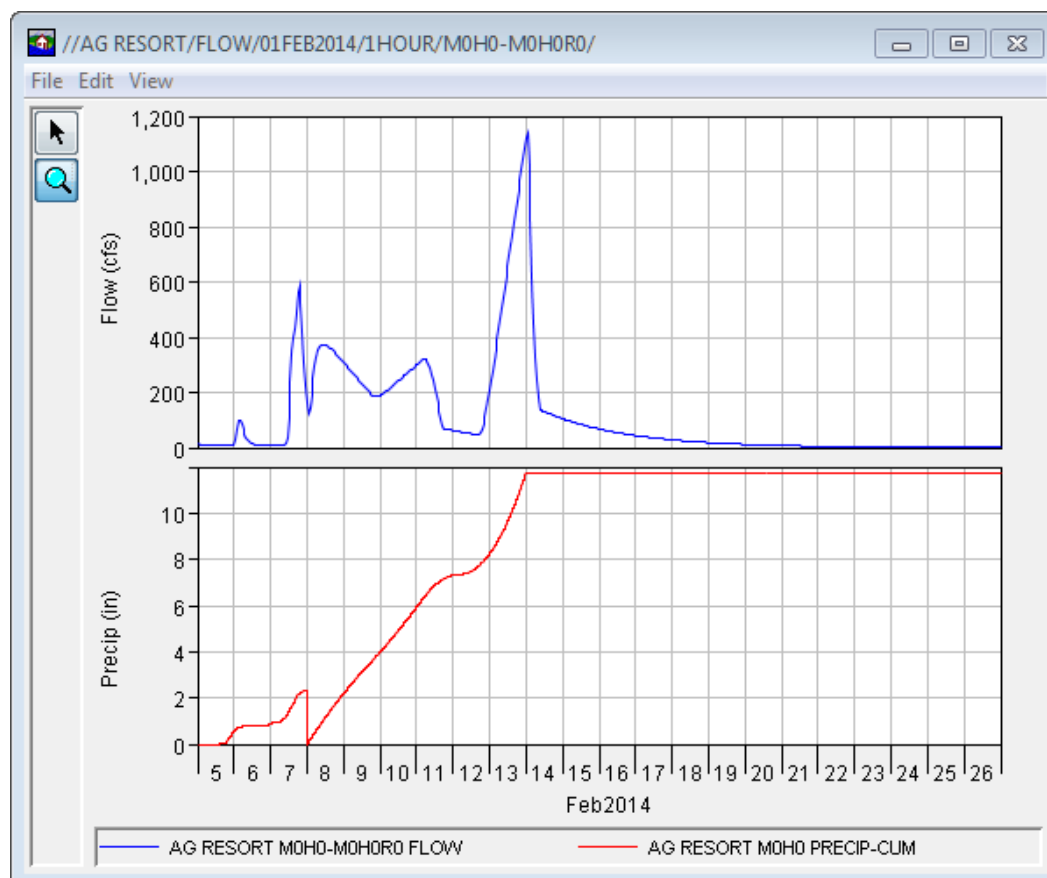
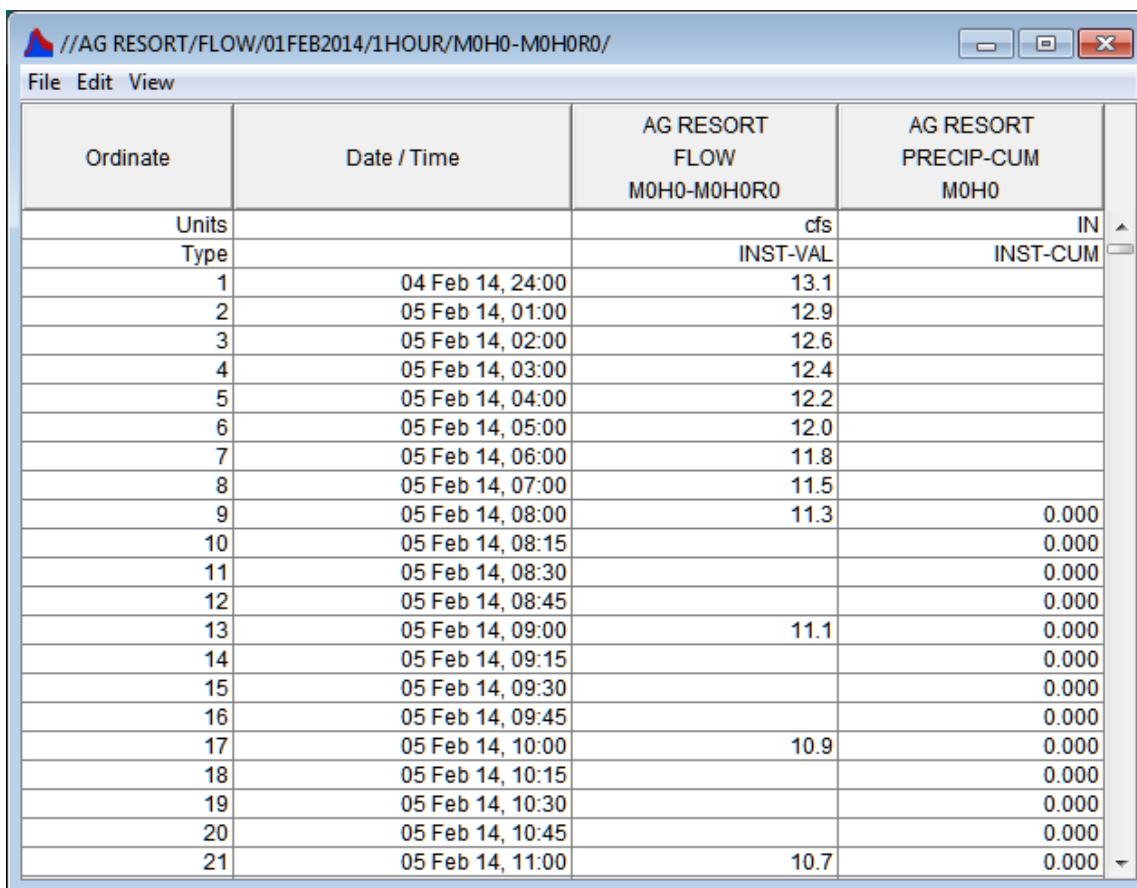


Figure F.7 HEC-DSSVue Plot Dialog Box

The parameters for the plots are labeled and color-coded. Date ranges are specified along one axis, and the units of measure are specified along the other axis. The **Plot Window** can be resized by clicking on the corner of the window and dragging it to the desired size. Using the **Zoom Tool** also zooms in and out on areas of the plot.

## F.6.2 Tables

To view a table of the pathnames in the **Selected Pathname List** (Figure F.6), either click the **Tabulate** button  from the **Toolbar** or choose **Tabulate** from the **Display** menu. The **Tabulate Window** (Figure F.8) opens.



The screenshot shows a window titled "AG RESORT/FLOW/01FEB2014/1HOUR/M0H0-M0H0R0/". It contains a table with the following data:

Ordinate	Date / Time	AG RESORT FLOW M0H0-M0H0R0	AG RESORT PRECIP-CUM M0H0
Units		cfs	IN
Type		INST-VAL	INST-CUM
1	04 Feb 14, 24:00	13.1	
2	05 Feb 14, 01:00	12.9	
3	05 Feb 14, 02:00	12.6	
4	05 Feb 14, 03:00	12.4	
5	05 Feb 14, 04:00	12.2	
6	05 Feb 14, 05:00	12.0	
7	05 Feb 14, 06:00	11.8	
8	05 Feb 14, 07:00	11.5	
9	05 Feb 14, 08:00	11.3	0.000
10	05 Feb 14, 08:15		0.000
11	05 Feb 14, 08:30		0.000
12	05 Feb 14, 08:45		0.000
13	05 Feb 14, 09:00	11.1	0.000
14	05 Feb 14, 09:15		0.000
15	05 Feb 14, 09:30		0.000
16	05 Feb 14, 09:45		0.000
17	05 Feb 14, 10:00	10.9	0.000
18	05 Feb 14, 10:15		0.000
19	05 Feb 14, 10:30		0.000
20	05 Feb 14, 10:45		0.000
21	05 Feb 14, 11:00	10.7	0.000

**Figure F.8** Tabulate Dialog Box

The **Tabulate Window** displays the ordinate (starting from the start date/time), the date and time stamp, and the values for the selected data sets. From the **Tabulate Window**, users have several options for displaying the tabular data (e.g. displaying commas in the number formatting, setting the precision of decimal places for data).

## F.7 DSS Records

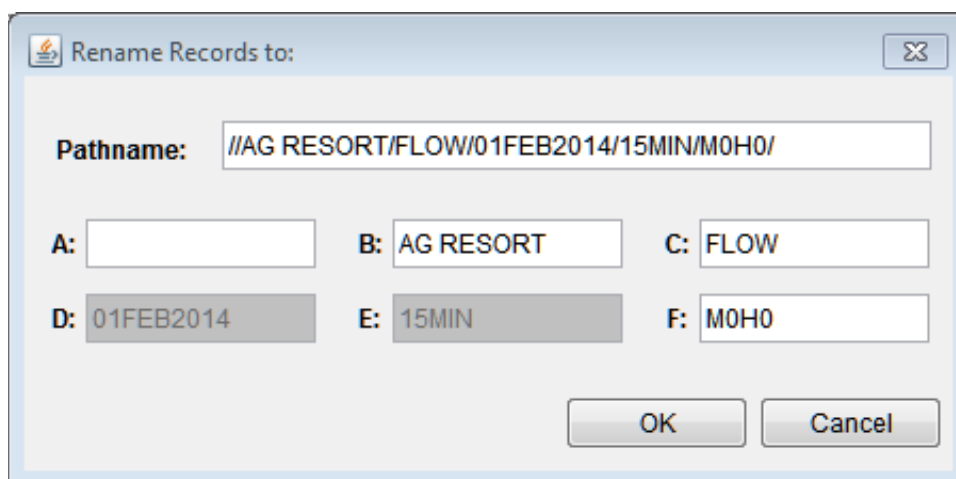
HEC-DSS uses a block of sequential data as the basic unit of storage. Each block contains a series of values of a single variable over a time span appropriate for most applications. The basic purpose of DSS is the organization of data into records of continuous, applications-related

elements, as opposed to individually addressable data items. This approach is more efficient for scientific applications than that of a conventional database system because it avoids the processing and storage overhead required for assembling an equivalent record from a conventional system. Data is stored in blocks, or records, within a file, and each record is identified by a unique name called a **pathname**.

## F.7.1 Renaming Records

To change the pathname parts of a pathname:

1. One or more pathnames must be selected for this command to be available (see Section F.5.3, page F-6 for pathname selection).
2. From the **Edit** menu, click **Rename Records**. The **Rename Records to:** dialog box (Figure F.9) opens.



**Figure F.9** Rename Records to Dialog Box

3. Each of the boxes (**A** - **F**) represents the different pathname parts. Users can change the parts by typing the new information in the appropriate box.
4. Click **OK**. The **Rename Records to:** dialog box closes (Figure F.9) and a message appears displaying the number of records renamed. The selected pathname is no longer displayed in the **Selected Pathname Box** and the pathname displays in the **Pathname Table** (Figure F.1) with the new pathname parts.

## F.7.2 Duplicating Records

Users can duplicate records to make a copy of a record with an altered pathname part. To duplicate records:

1. One or more pathnames must be selected (see Section F.5.3, page F-6) for this command to be available.

2. From the **Edit** menu, choose **Duplicate**. The **New pathname parts for duplicate records:** dialog box opens (similar to Figure F.8).
3. Each of the boxes (**A - F**) represents the different pathname parts. Users can enter new names for each of the parts in the fields.
4. Click **OK**, the **New pathname parts for duplicate records:** dialog box closes, a message appears informing the user of the number of records that were duplicated. A new pathname is displayed in the **Pathname Table** (Figure F.1).

### F.7.3 Deleting Records

To delete records:

1. One or more pathnames must be selected (see Section F.5.3, page F-6) for this command to be available.
2. A warning message dialog box appears, stating that records are going to be deleted .
3. To delete, click **Yes**. The warning message dialog box closes. A message appears displaying the number of records deleted.
4. The deleted records no longer appear in the **Pathname Table**.

### F.7.4 Editing Data Associated with Records

Users can edit the data associated with a pathname, if the users have the appropriate permissions. To edit, from the **Edit** menu click **Tabular Edit**. Users can edit data directly, enter new time-series data or paired data, or use math functions to manipulate the data. All of these features are detailed in the HEC-DSSVue User's Manual.

# Appendix G

## Export Data from HEC-RAS

The HEC-RAS software is an integral part of the process for running HEC-FIA. HEC-FIA relies on data from HEC-RAS in the form of Storage Area and Cross Section shapefiles; Terrain grids, Inundation grids, Arrival Time grids, and HEC-DSS output. This Appendix shows the basic steps in HEC-RAS to export data for use by HEC\_FIA.

### G.1 Preparing HEC-RAS Data

The consequence computation in HEC-FIA can be done using a cross-section shapefile, storage area shapefile, and associated HEC-DSS database with stage-hydrograph output at each cross-section and storage area for the flood scenarios being assessed. Another way to compute consequences is to use gridded data containing the various hydraulic parameters that HEC-FIA needs. This Appendix covers the steps to prepare that data in HEC-RAS for HEC-FIA.

### G.2 Opening a Project

To run HEC-RAS, make sure the software has been installed; if it is installed there should be a shortcut on a user's desktop. Double click the shortcut; the main window of the HEC-RAS software opens (Figure G.1).

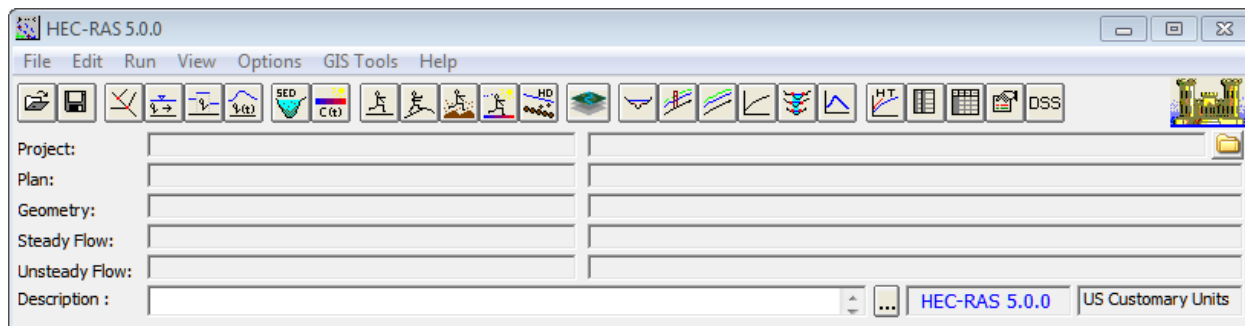
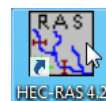


Figure G.1 HEC-RAS Main Window

From the **File** menu, click **Open Project**. The **Open Project Browser** (Figure G.2) opens. Browse to the file location of the "ras.prj" file, select the file from the table on the browser, click **OK**. The **Open Project Browser** closes, and the information about the selected project appears in the HEC-RAS main window (Figure G.1).

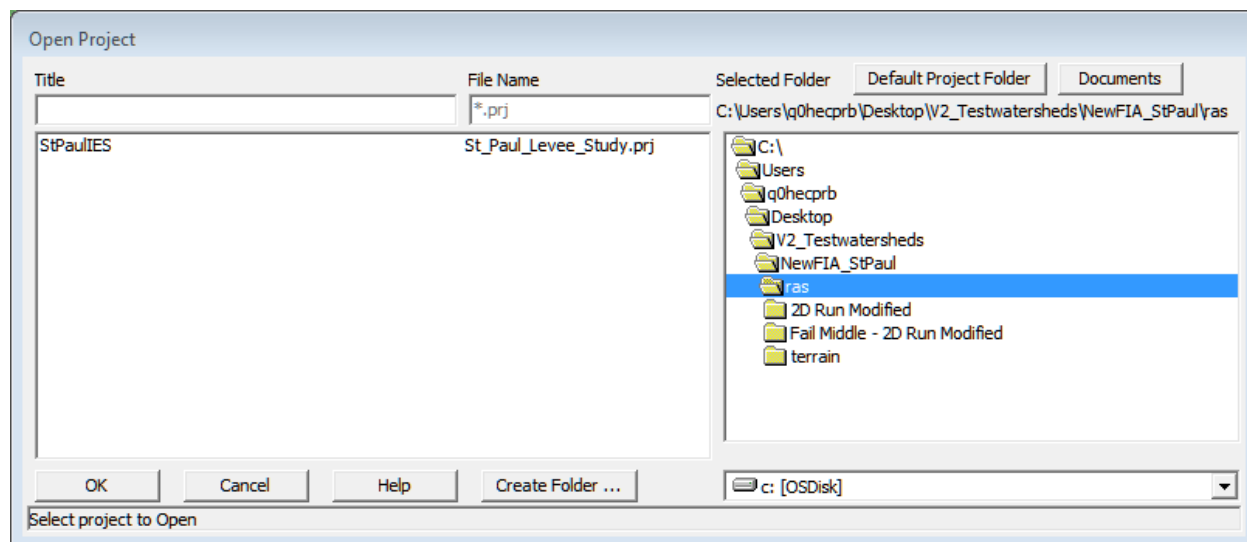


Figure G.2 Open Project Dialog Box

### G.3 Exporting Cross Sections and Storage Areas

HEC-FIA can utilize HEC-RAS cross section and storage area shapefiles to calculate depth, arrival time, and duration at points in the floodplain. HEC-FIA doesn't need the geometry of the cross sections; it only requires the line that represents the cross section. HEC-FIA also needs to be able to identify the DSS A B C parts as attributes on the shapefile.

To export the cross sections and storage area shapefiles follow these steps:

1. To start the RAS Mapper tool, click RAS Mapper from the HEC-RAS toolbar (Figure G.3). The **RAS Mapper** main window opens (Figure G.4)

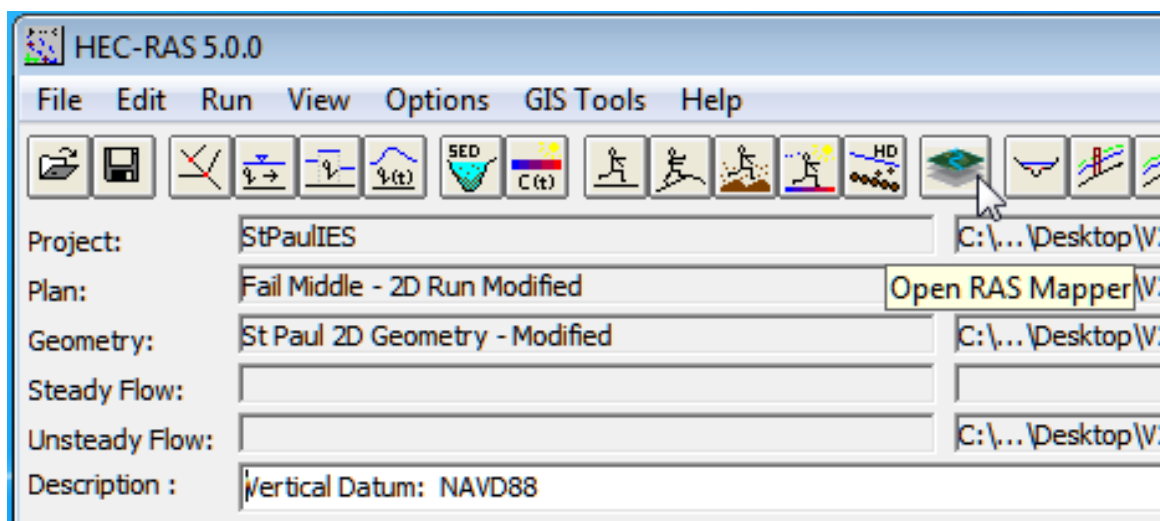


Figure G.3 Open RAS Mapper

2. The geometry associated with the selected HEC-RAS project is loaded. This includes Storage Areas and cross sections (XS).

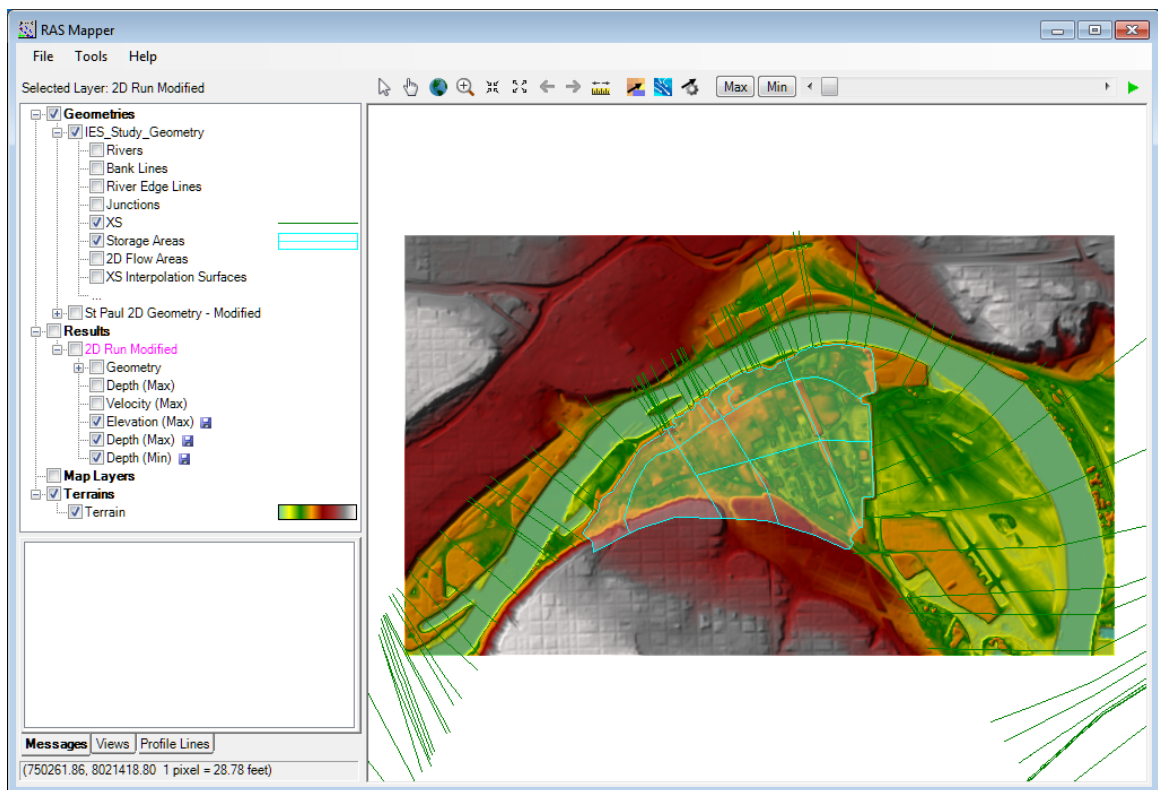


Figure G.4 RAS Mapper Main Window

3. Right click **Storage Areas**, from the shortcut menu point to **Export Layer**, click **Save features to Shapefile** (Figure G.5). The **Enter Shapefile Name** browser opens (Figure G.6).

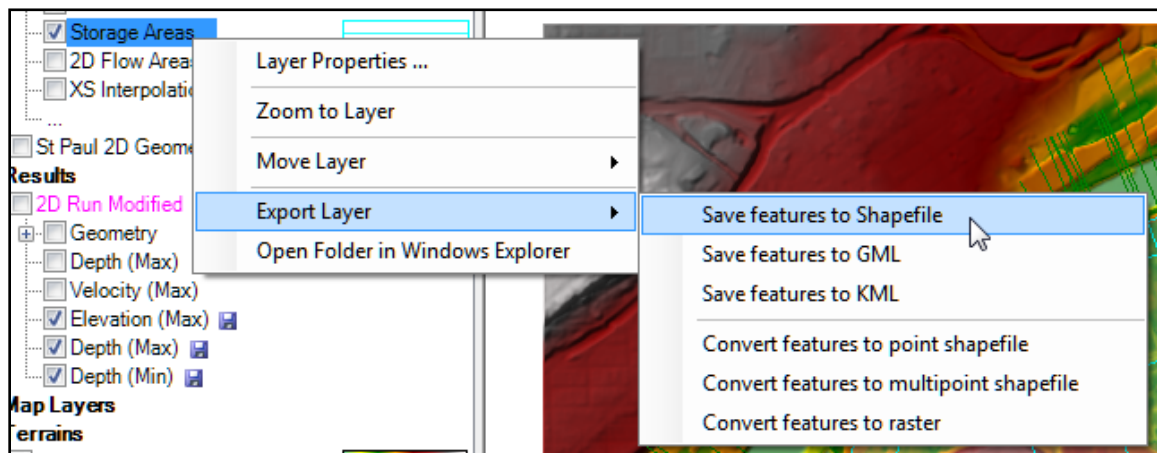
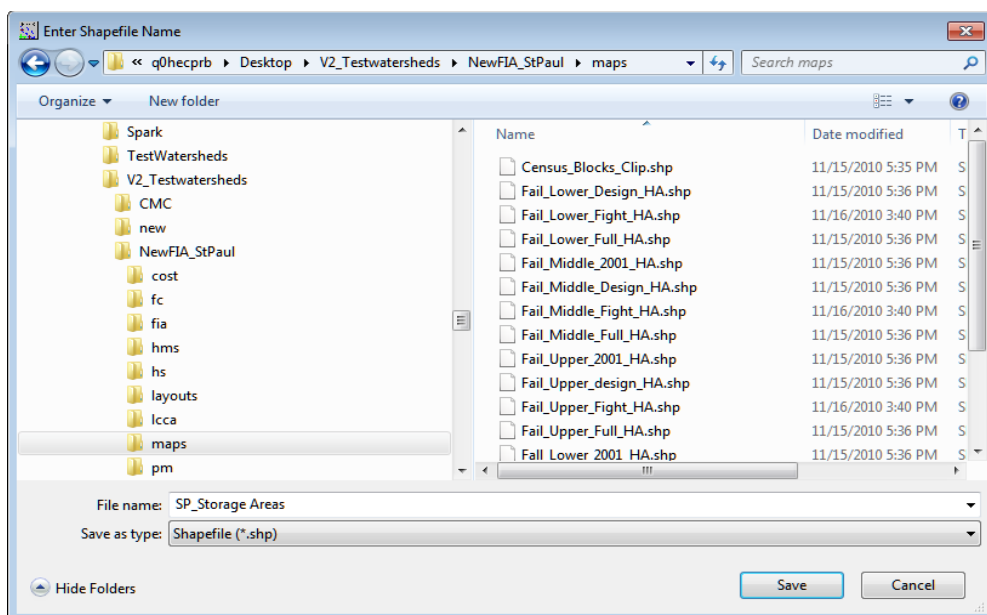


Figure G.5 RAS Mapper - Storage Areas - Export Layer

4. Browse to the location where the shapefile is to be stored, in the **File name** list (Figure G.6) enter a name for the shapefile. Click **Save**, the **Enter Shapefile Name** browser closes (Figure G.6), and the shapefile is created.



**Figure G.6** Save Layer As Browser

5. Right click **XS** (cross sections), from the shortcut menu point to **Export Layer**, click **Save features to Shapefile** (Figure G.5). The **Enter Shapefile Name** browser opens (Figure G.6).
6. Browse to the location where the shapefile is to be stored, in the **File name** list (Figure G.6) enter a name for the shapefile. Click **Save**, the **Enter Shapefile Name** browser closes (Figure G.6), and the shapefile is created.
7. Shapefiles for the storage areas and cross sections have been created.

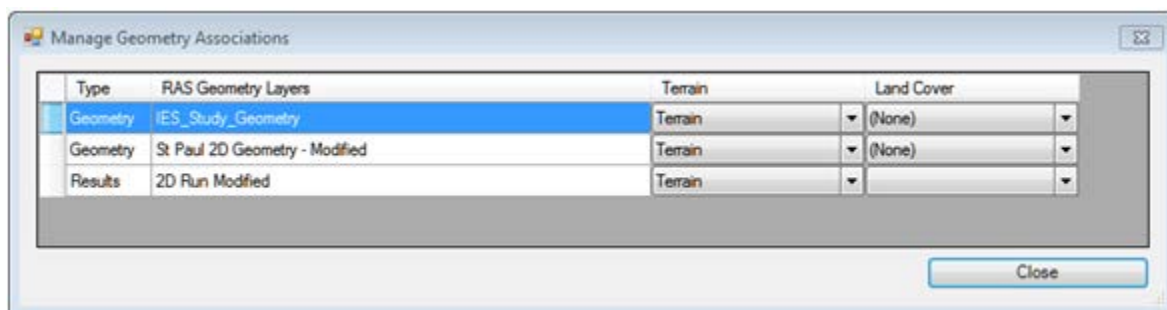
## G.4 Preparing Digital Terrain Model

Terrain data can be in binary grid format, or in the tiled image format (\*.tif) for use in HEC-FIA. The tiled image format is the suggested file type in HEC-FIA. HEC-FIA converts the file to .tif if it is not already in that format. HEC-RAS also uses the .tif format, so if the HEC-RAS model has a terrain, the user should use the terrain in .tif format as created by HEC-RAS. Terrain information is required to assign ground elevations to a structure inventory generated in HEC-FIA or to update ground elevations in an existing structure inventory. To prepare a terrain grid through RAS Mapper, follow the steps below:

1. Open RAS Mapper (Figure G.3).
2. The node at the bottom of the map tree is titled "Terrains", and should have a sub node which represents the terrain for the RAS Mapper Project.
3. It is possible for there to be many terrains in the RAS Mapper project. To make sure that the proper terrain is being used, the user should check which terrain is associated with the geometry that is producing the results being provided to HEC-FIA. To do this, right click on the appropriate **Geometry in the Results Node** of the **Map** tree, and select **Associate**

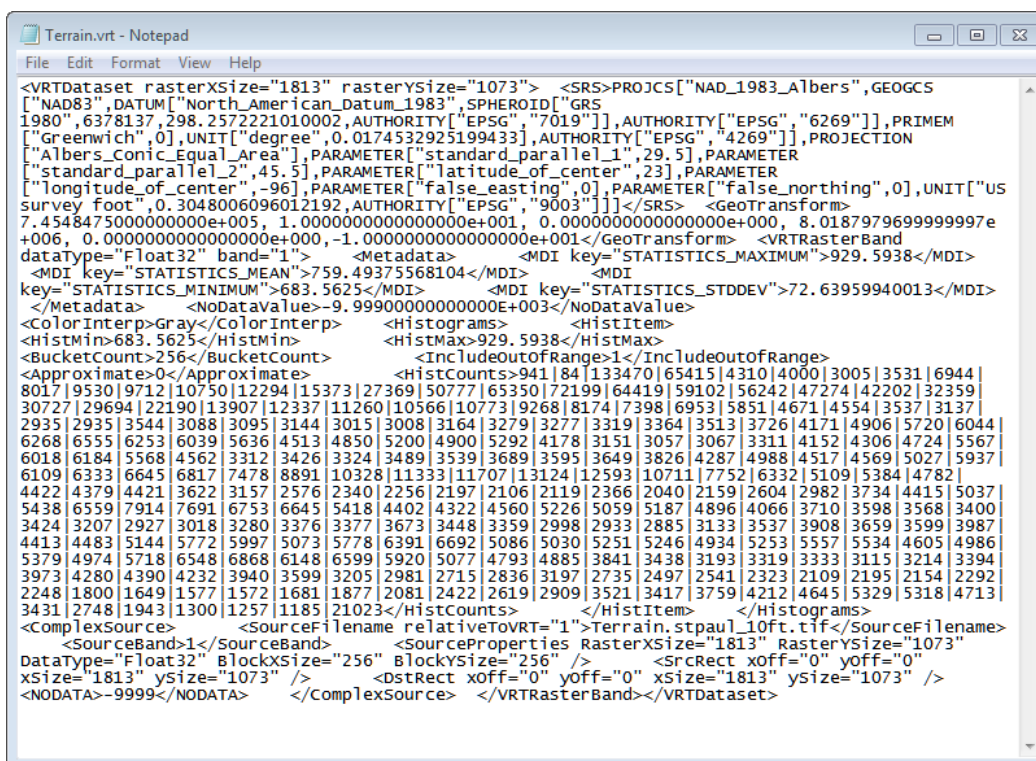


**Terrain Layer.** The **Manage Geometry Associations** dialog box opens (Figure G.7) and the user should be able to identify the terrain for the results in question in the third column of the form.



**Figure G.7** Manage Geometry Associations Dialog Box

- Now that the name of the terrain file is known, go to the root directory of the HEC-RAS project directory, and find a terrain titled "Terrain.tif", or "Terrain.vrt". A terrain grid can be represented by more than one "Terrain.tif", or "Terrain.vrt".
- To check a .vrt file, open the file in a text editor, (Figure G.8. using Notepad++®) there is an xml node <ComplexSource> which contains at least one xml node <SourceFilename>. The file path in the SourceFilename is the path to the data file for the terrain .vrt, The path is relative to the .vrt file. If there are many files, make sure to grab all of the referenced files and the .vrt file to send to the HEC-FIA modeler. HEC-FIA can import .vrt files as well.



**Figure G.8** Editing the XML File Associated with a .vrt File

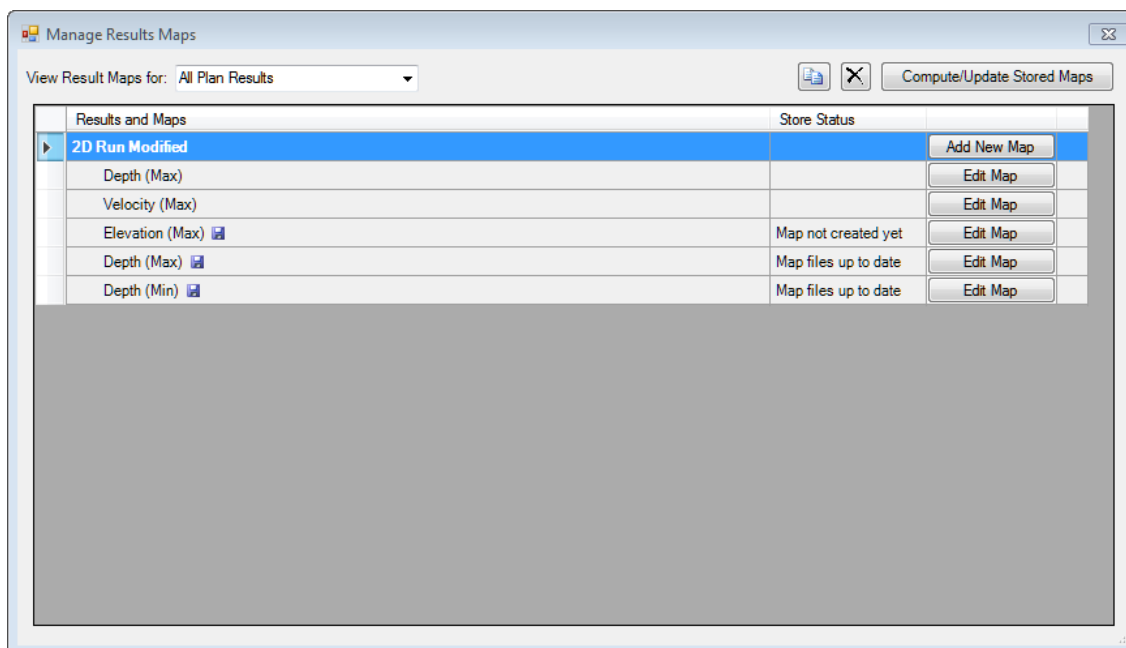
## G.4.1 Creating Gridded Output

Flood inundation information for a specific flood scenario is supplied to HEC-FIA in the form of depth grids, when the consequence assessment uses gridded data. Depth grids used for the assessment are typically generated by a hydraulic engineer using RAS Mapper. The typical output format is a GeoTif \*.tif for HEC-RAS 5.0 with RAS Mapper. This section describes how to output data to grids. The procedure works for unsteady one-dimensional hydraulics modeling, modeling with two-dimensional flow areas, or plans with combinations of both.

HEC-FIA uses two main grids, the maximum depth grid, and the arrival time grid. The maximum depth grid describes the highest depth in a grid cell throughout the entire simulation. The arrival time grid defines when a grid cell had depth that exceeds some user defined threshold. HEC-FIA can also use a duration grid for agriculture computations describing how long a grid cell is wet, starting with the first time the threshold is crossed on the rising limb, until the last time the threshold is exceeded on the falling limb.

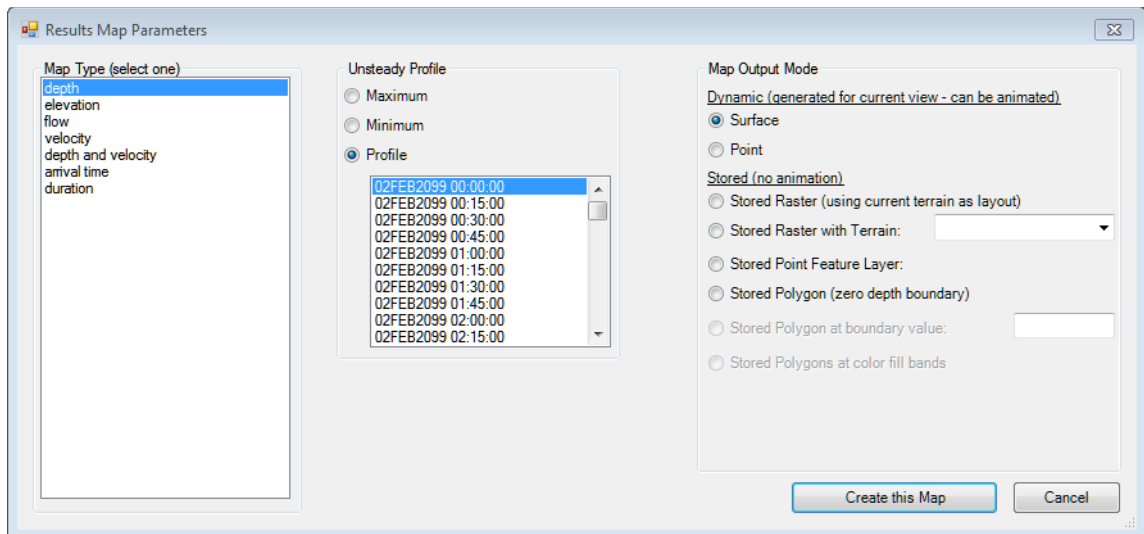
To create a stored grid in RAS Mapper:

1. From the **RAS Mapper** main window (Figure G.4), from the **Tools** menu, click **Manage Map Results**.
2. The **Manage Results Maps** dialog box opens (Figure G.9). From the table, click **Add New Map**, the **Results Map Parameters** dialog box opens (Figure G.10).



**Figure G.9** Manage Results Maps Dialog Box

3. To create a *maximum depth grid*, from the **Map Type** list box, select **depth**. From the **Unsteady Profile** box, select **Maximum**. From the **Map Output Mode** box, select **Stored Raster (using current terrain as layout)**. To create a *maximum depth grid*, click **Create this map**.



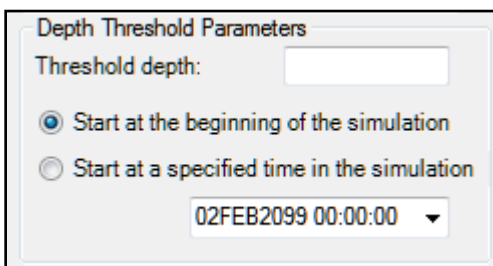
**Figure G.10** Results Map Parameters Dialog Box

4. The **Manage Results Maps** dialog box (Figure G.9); now has an added row for the *maximum depth grid* that was just created (Figure G.11). From the **Store Status** column, the status for the *maximum depth grid* is **Map not created yet**. To actually write the file to disk, click **Compute/Update Stored Maps**, status is now **Map files up to date**.

Results and Maps		Store Status	
<b>Unsteady Plan</b>			Add New Map
	Depth (Max)		Edit Map
	Velocity (Max)		Edit Map
	Elevation (Max)		Edit Map
	Depth (Max)	Map not created yet	Edit Map

**Figure G.11** New Maximum Depth Grid

5. To add an *arrival time grid*, from the **Manage Results Maps** dialog box (Figure G.9), click **Add New Map**, the **Results Map Parameters** dialog box opens (Figure G.10).
6. From the **Map Type** list, select **arrival time**, from the **Unsteady Profile** box, select **Hours**. HEC-FIA expects the arrival time grid to be in decimal hours not decimal days.
7. If the *arrival time grid* being created includes loss of life, from the **Depth Threshold Parameters** box (Figure G.12) in the **Threshold depth** box enter a value if the study team decides this is an important threshold to evaluate (sensitivity). When creating any *arrival time grid*, it is important to communicate the start time of the *arrival time grid* to HEC-FIA.




**Figure G.12** Depth Threshold Parameters

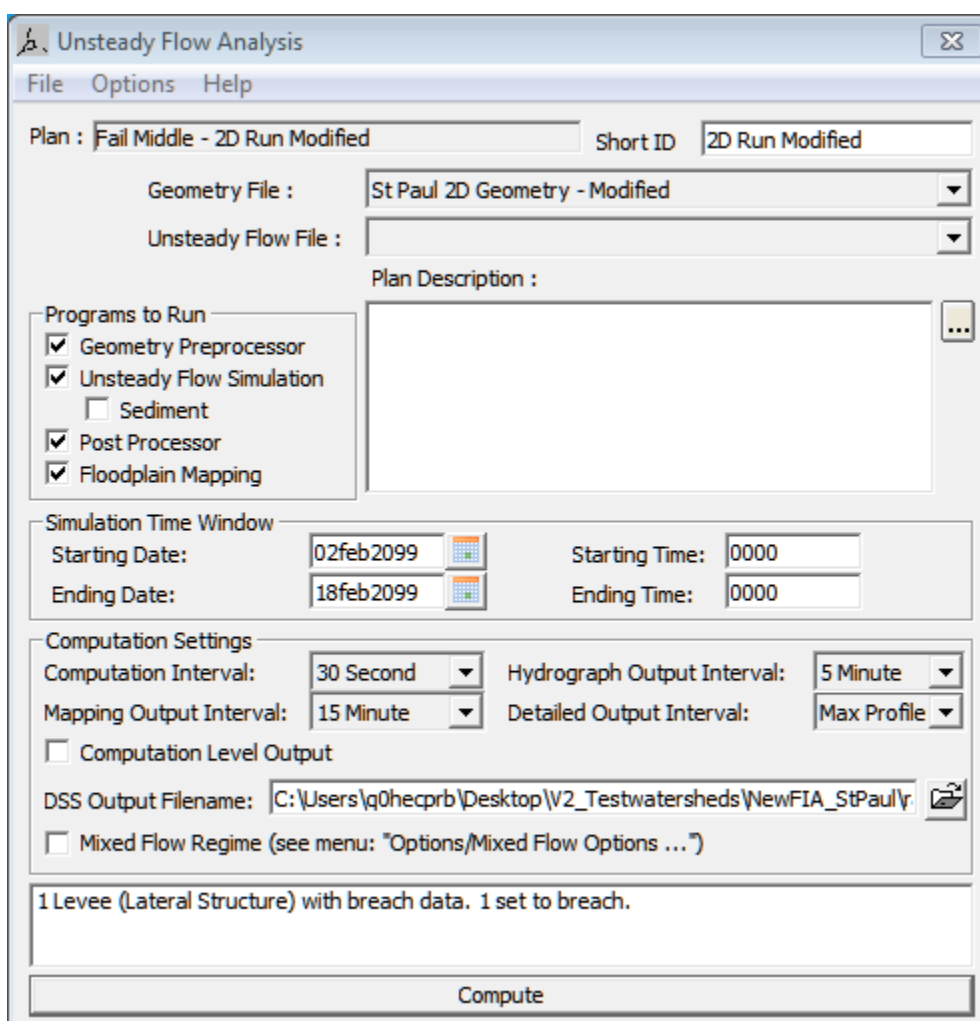
If an agriculture arrival time grid is being created, the **Threshold depth** needs to be reviewed by the PDT, which hopefully includes an economist. Once the PDT has come to an agreement on the parameters for the *arrival time grid*, from the **Map Output Mode** box, click **Stored Raster (using current terrain as layout)**. From the **Results Map Parameters** dialog box (Figure G.10) click **Create this Map**, and the *arrival time grid* has been created.

8. From the **Manage Results Maps** dialog box (Figure G.9), on the table a row has been added for the *arrival time grid* that was just created. From the **Store Status** column, the status for the *arrival time grid* is **Map not created yet**. To actually write the file to disk, click **Compute/Update Stored Maps**, status is now **Map files up to date**.
9. Commonly in dam failure studies, *depth and velocity grids* are important for life loss analysis. *Depth and velocity grids* are used by HEC-FIA to compute building stability criteria, and can have large impacts on the life loss computes. To create a *depth and velocity grid*, from the **Results Map Parameters** dialog box (Figure G.10), from the **Map Type** list, select **depth and velocity**. From the **Unsteady Profile** box, the default is **Maximum**. From the **Map Output Mode** box, select **Stored Raster (using current terrain as layout)**.
10. To create the *depth and velocity grid*, from the **Results Map Parameters** dialog box (Figure G.10) click **Create this Map**, and the *depth and velocity grid* has been created.
11. From the **Manage Results Maps** dialog box (Figure G.9), on the table a row has been added for the *depth and velocity grid* that was just created. From the **Store Status** column, the status for the *depth and velocity grid* is **Map not created yet**. To actually write the file to disk, click **Compute/Update Stored Maps**, status is now **Map files up to date**.
12. Finally, for *duration grids*, from the **Results Map Parameters** dialog box (Figure G.10), from the **Map Type** list, select **duration** (Figure G.12).
13. From the **Unsteady Profile** box (Figure G.13) select **Hours**. From the **Depth Threshold Parameters** box (Figure G.14) in the **Threshold depth** box enter 0 (zero). From the **Map Output Mode** box select **Stored Raster (using current terrain as layout)**.
14. To create the *duration grid*, from the **Results Map Parameters** dialog box (Figure G.10) click **Create this Map**, and the *duration grid* has been created.
15. From the **Manage Results Maps** dialog box (Figure G.9), on the table a row has been added for the *duration grid* that was just created. From the **Store Status** column, the status for the *duration grid* is **Map not created yet**. To actually write the file to disk, click **Compute/Update Stored Maps**, status is now **Map files up to date**.
16. For more information on these grids and how they are created, consult the documentation for HEC-RAS Version 5.0 and RAS Mapper.

## G.4.2 HEC-DSS File

HEC-FIA obtains flood wave arrival times for individual structures for life loss computations from stage-hydrographs stored by HEC-RAS in an HEC-DSS (Hydrologic Engineering Center's Data Storage System) file. For this information to be useful to HEC-FIA, the hydraulic engineer must configure HEC-RAS to generate stage-hydrographs at all cross-section and storage area locations before simulating an event. Since HEC-FIA interpolates the stage between cross sections, and minutely information is important, it is advised that the output time step be set to a relatively small time step. Typically fifteen- to five-minutes are used.

1. From the main **HEC-RAS** window (see Figure G.1).
2. Click **Unsteady Flow Analysis**,  the **Unsteady Flow Analysis** dialog box (Figure G.13) opens.



**Figure G.13** Unsteady Flow Analysis Dialog Box

3. From the **Options** menu, (Figure G.14) click **Stage and Flow Output Locations**, the **Stage and Flow Output Locations** dialog box opens (Figure G.15).

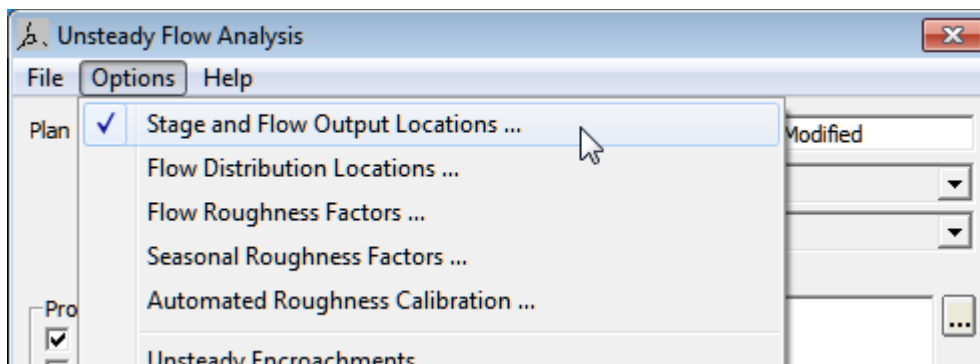


Figure G.14 Options Menu - Stage and Flow Out Locations

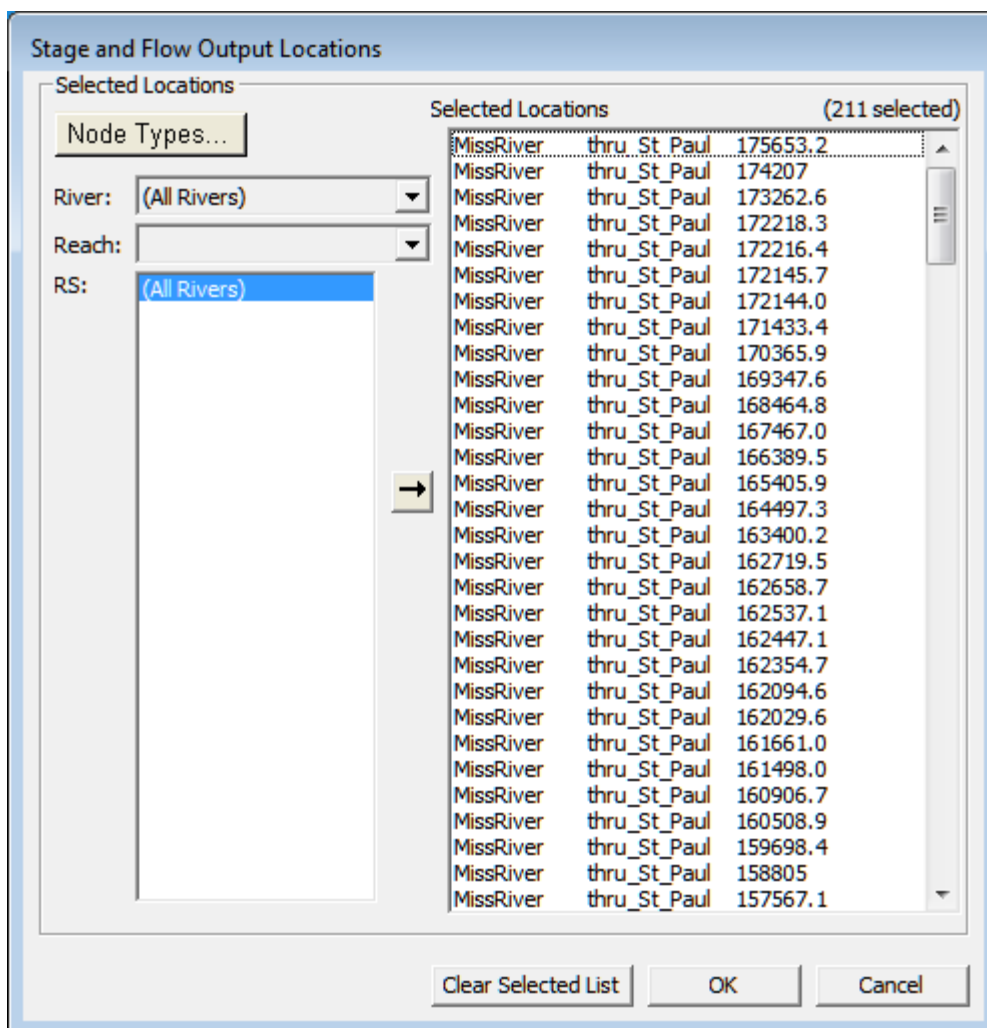


Figure G.15 Stage and Flow Output Locations Selector

4. From the **River** list (Figure G.15), select **(All Rivers)**.
5. From the **RS** box (Figure G.15), select **(All Rivers)**.
6. Click the right-arrow button to select all the cross-section locations to the **Selected Locations** box (Figure G.10).

7. Click **OK**; the **Stage and Flow Output Locations** dialog box closes (Figure G.15).
8. From the **Unsteady Flow Analysis** dialog box (Figure G.13), in the **DSS Output Filename** box, enter the path and the filename of the DSS file that contains the stage-hydrographs created by HEC-RAS.
9. Click **Compute**, the **Unsteady Flow Analysis** dialog box closes (Figure G.16), and the **HEC-RAS Computations** dialog box opens. When computations are finished, click **Close**, the **HEC-RAS Computations** dialog box closes.
10. The HEC-DSS file is created during the HEC-RAS simulation in the location that the user selected.





# Appendix H

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