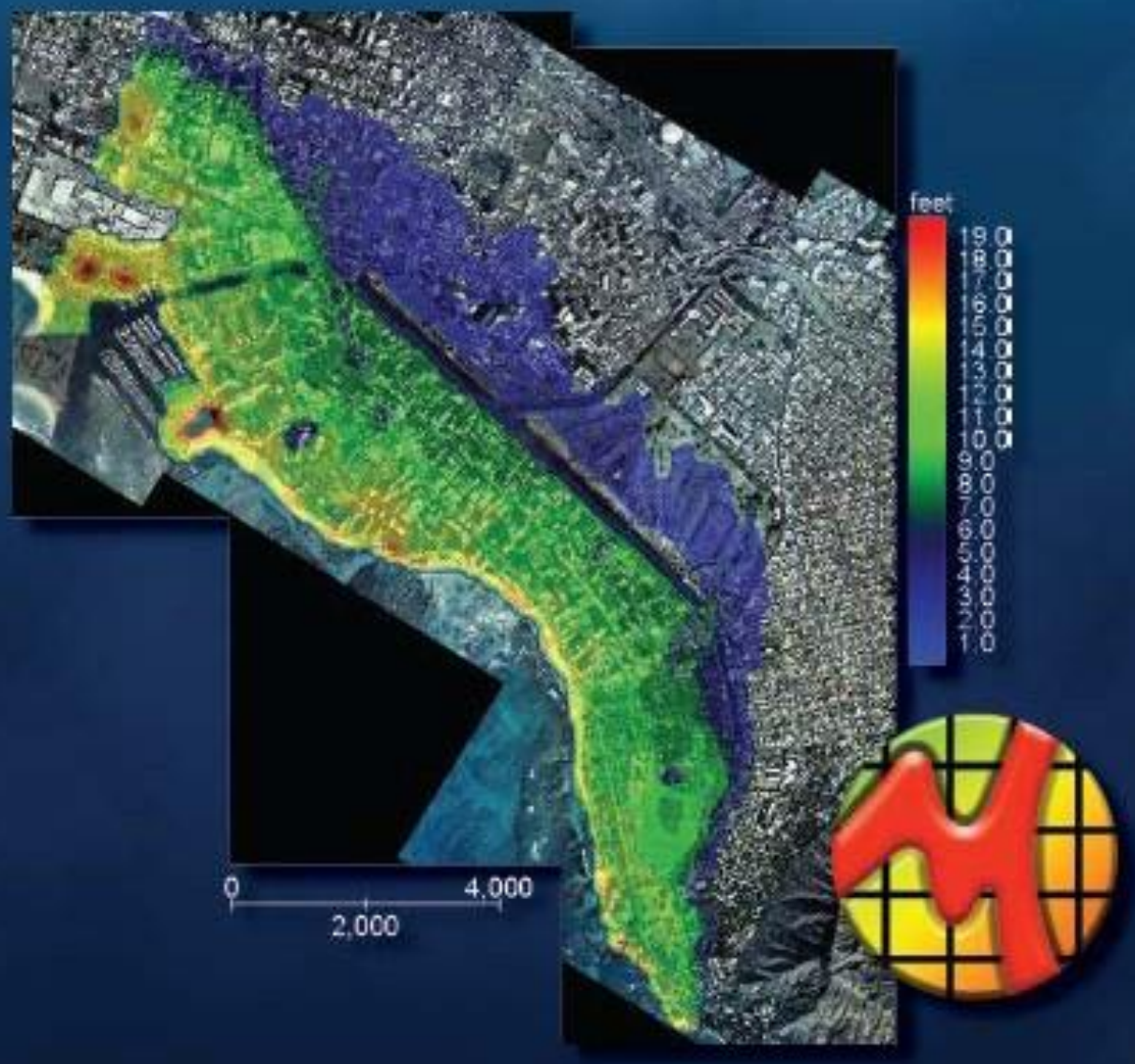
FLO-2D

MAPPER MANUAL



Version Pro 2017

Table of Contents

I. Introduction 5

1.1 Getting Started with Mapper 6

1.2 Display the Initial Flow Depth Plots 9

II. Toolbar Plotting Buttons 13

Grid element based plots 13

DTM based plots 13

2.1 Plot of grid element ground surface elevation 14

2.2 Plot of grid element maximum water surface elevation 14

2.3 Plot of grid element maximum flow depth 14

2.4 Plot of grid element velocities 15

2.5 Impact force and other variable plots 15

2.6 Time for Depth 16

2.7 Plot of grid element maximum deposition, maximum scour and final bed elevation 16

2.8 Plot of DTM point ground surface elevation 16

2.9 Plots of DTM point maximum flow depth 16

III. Mouse Button Commands 17

3.1 Zoom in (left mouse button) 17

3.2 Color scale repositioning (left mouse button) 17

3.3 Distance scale repositioning (left mouse button) 17

3.4 Right Click on Contour Graphs 18

IV. Legend and Scale Controls 19

V. Hazard Maps 20

VI. Flood Inundation Contour Maps 25

6.1 Contour Controls 26

6.2 Label Controls 27

VII. Example Plots 28

VIII. Menus and Toolbar 32

8.1 File Menu Commands 32

8.2 View Menu Commands 46

8.3 Tools Menu Commands 59

8.4 Help Menu Commands: 70
IX. References 71

I. Introduction

FLO-2D Mapper is a post-processor program that creates maps and other plots of the *FLO-2D* model results including hydraulic variables, water surface elevations, duration of inundation, impact force, static pressure, specific energy, sediment scour or deposition and others. Three types of map plots can be generated:

- Grid element plots where each element is assigned a color depending on the value of the selected plot variable.
- Line and shaded contour maps based on the grid element values.
- DTM points to generate detailed flow depth contour plots based on grid element water surface elevations and DTM point ground elevations.

Mapper can also generate depth and velocity versus time graphs at user selected locations, flow depth profiles along user defined sections, flood damage plots, and hazard maps. *Mapper* utilizes the capabilities of the MS-Windows™ operating system. The plots can be constructed interactively using mouse point and click events. *Mapper* supports the English and the SI system of units. *Mapper* includes the following features:

- ESRI shape file formatted data for land use, soil types, and Manning roughness coefficients, etc. can be imported.
- ESRI ArcInfo ASCII grid files containing terrain elevations can be imported.
- Geo-referenced aerial photos in various graphic formats can be imported such as TIFF, BMP, JPG, etc. as background to flooding results.
- ESRI ArcInfo ASCII grid files listed in a tile and index catalog file and referenced to a user defined polygon over the grid system can be imported.
- Multiple layer edit capability, including control of layer properties.
- Zoom features and a pan display enable views to be adjusted.
- Polygon and mouse painting can be used to selected grid elements.
- DTM points can be deleted and DTM point files saved.
- A map template for supporting map creation and editing is available.
- Grid element, line and shaded contour plots of the following FLO-2D results:
    - Ground surface elevation
    - Maximum water surface elevation
    - Floodplain maximum and final flow depth
    - Floodplain maximum and final velocity
    - Channel maximum flow depth
    - Combined maximum channel and floodplain flow depth
    - Combined maximum channel and floodplain flow velocity
    - Street flow maximum depth and velocity
    - Maximum sediment scour and deposition
    - Final bed elevation

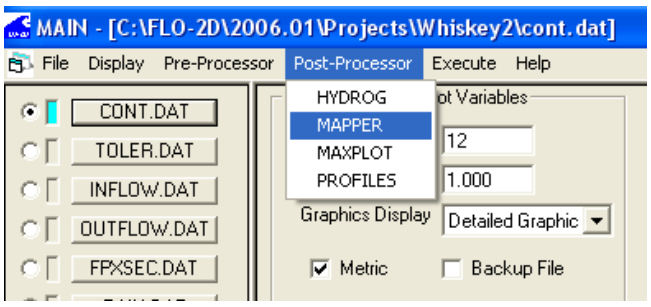
- Duration of inundation
- Impact force
- Static pressure
- Specific energy
- Levee freeboard deficiency
- Time of flood to 1ft, 2ft, and maximum depth.

- Velocity vectors can be displayed corresponding to the velocity magnitude.
- Flood animation can be viewed to review floodwave progress.
- Plot of depths versus time or velocity versus time at any user selected grid element or group of grid elements.
- Flow depths and topography profile cuts can be plotted.
- Flood damage ($$) can be estimated based on cost tables for inundated buildings.
- Hazard maps based on user defined depth and velocity times depth thresholds as function of flood frequency can be generated.
- DTM shaded contour plotting algorithm based on Triangulated Irregular Network (TIN) generation.
- User defined exclusion areas from the shaded contour plots.
- Automatically generated ESRI shape files for all map plots that can be imported into ArcGIS® for further processing.
- Inline help system.

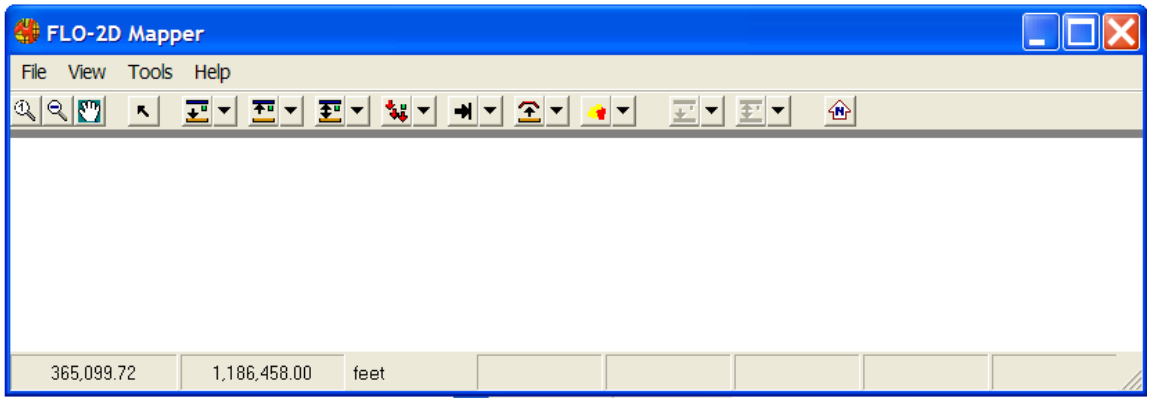
IMPORTANT NOTE: *For the Mapper system to operate properly, the MS-Windows® environment must be set to a number format with decimal point using the International (Regional) option of the Control Panel.*

1.1 Getting Started with Mapper

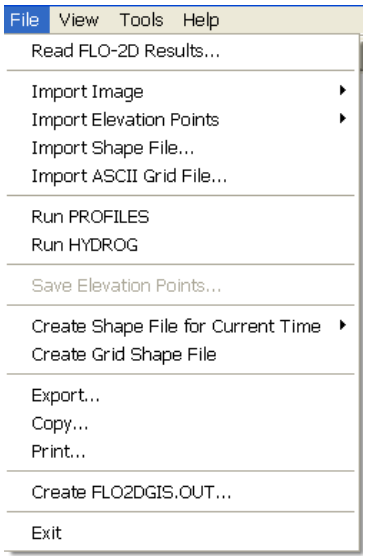
Mapper is automatically installed with the FLO-2D model installation. The *Mapper* program is located in the FLO-2D subdirectory and an icon can be placed on the desktop. To start the program by double-clicking the *Mapper* icon or on the *MAPPER.EXE* file in Explorer. You can also start by clicking on *Mapper* in the GUI Post-Processor pull-down menu:



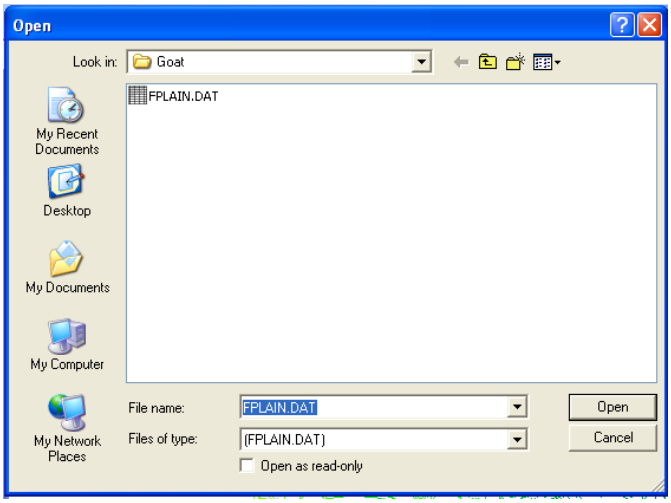
Mapper main window will appear:



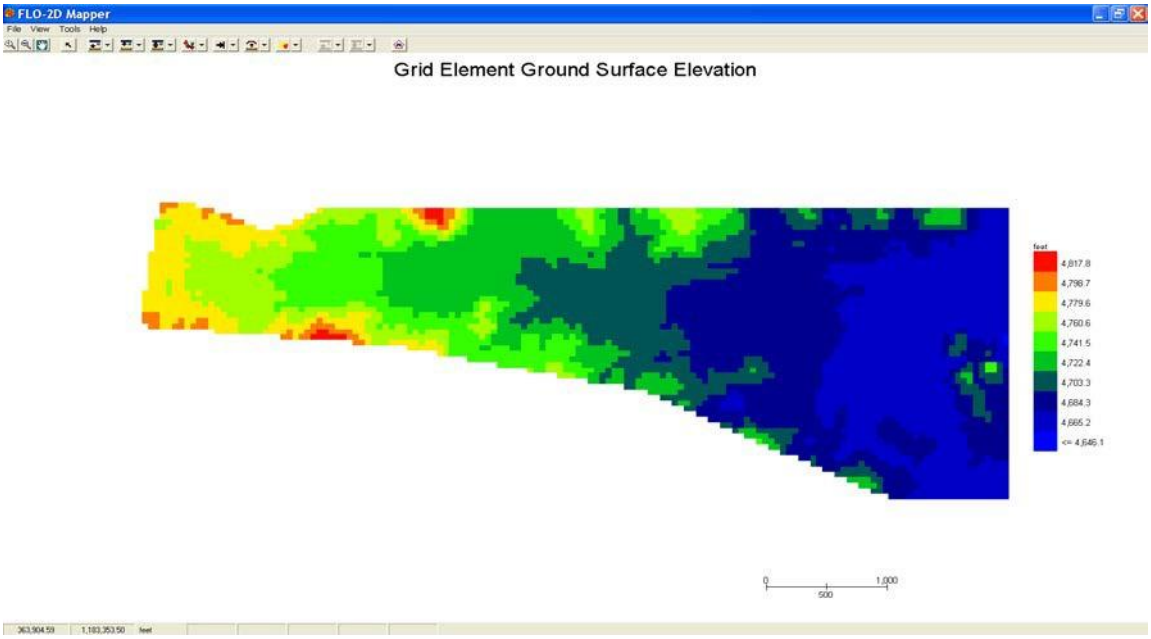
To load FLO-2D results use the *Read FLO-2D Results* Command… in the File Menu.



A dialog box appears to select the project FPLAIN.DAT file:


Open
Look in:
Goat
FPLAIN.DAT
My Recent Documents
Desktop
My Documents
My Computer
My Network Places
File name:
FPLAIN.DAT
Files of type:
(FPLAIN.DAT)
Open as read-only
Open
Cancel

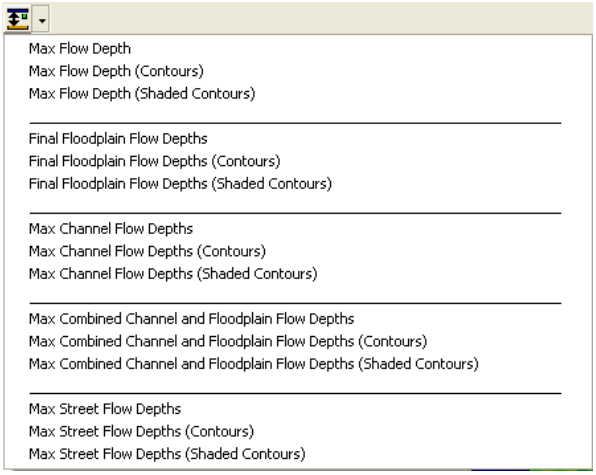
You need only to select the FPLAIN.DAT data file. The other required and companion files are automatically read from the same directory. Once the files are loaded, *Mapper* will display the Ground Surface Elevation density plot:



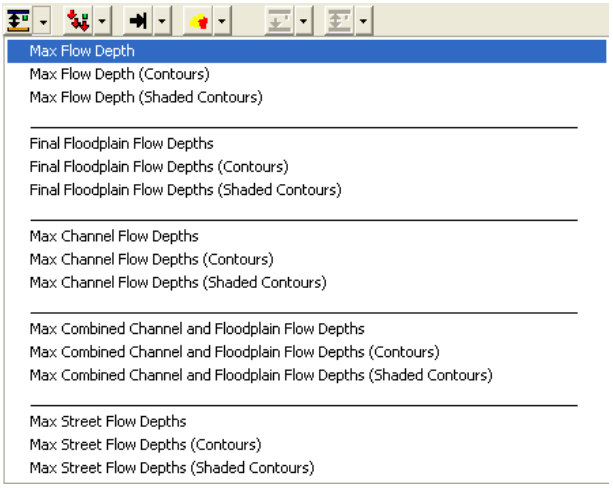
IMPORTANT NOTE: *You must have completed a FLO-2D flood simulation and the *.OUT files have to exist in the same directory as the FPLAIN.DAT file.*

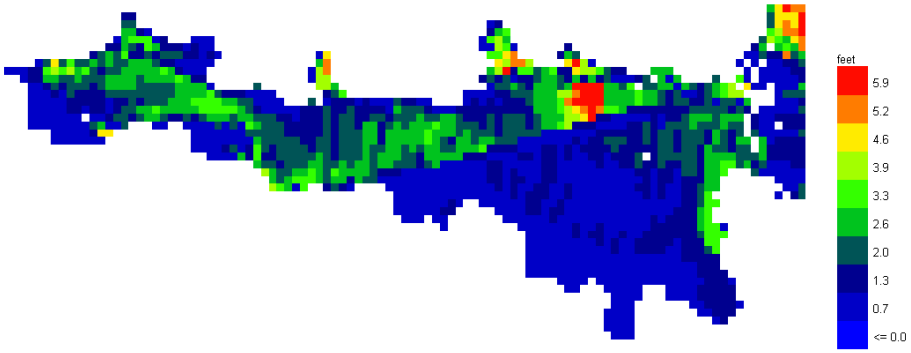
1.2 Display the Initial Flow Depth Plots

The initial flow depth maps that *Mapper* creates are the grid element plots where each grid element is assigned a color depending on the value of the selected plot variable and lines and shaded contours plots. To create a plot of grid element maximum depths, click drop-down arrow besides the Depth Plot Icon . You will get the following drop-down menu:

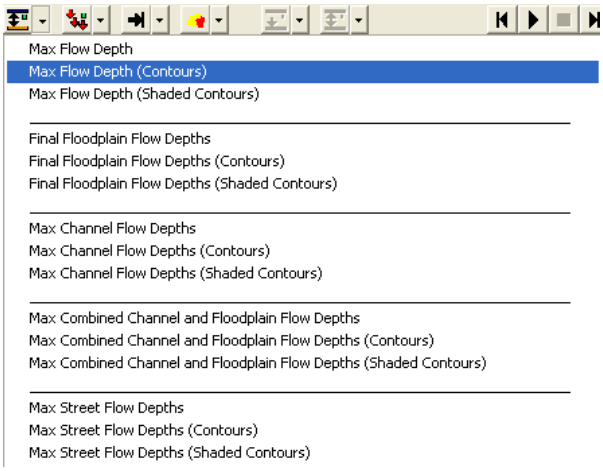


Each plot group has three options: a grid element plot, a line contour plot and a shaded contour plot. To display the grid element maximum flow depth, click *Max Flow Depth*:

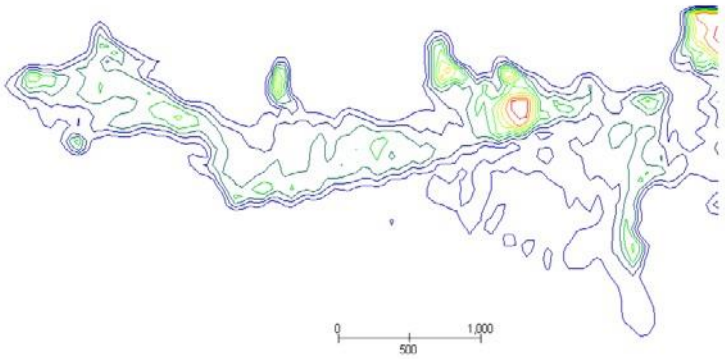




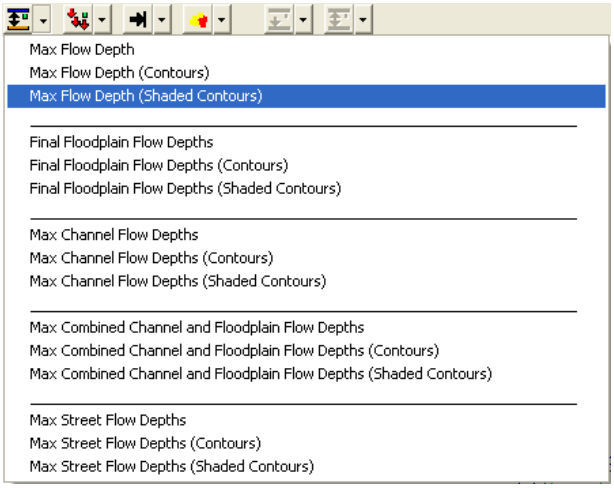
For the maximum depth line contour plot, click on *Max Flow Depth (Contours):*



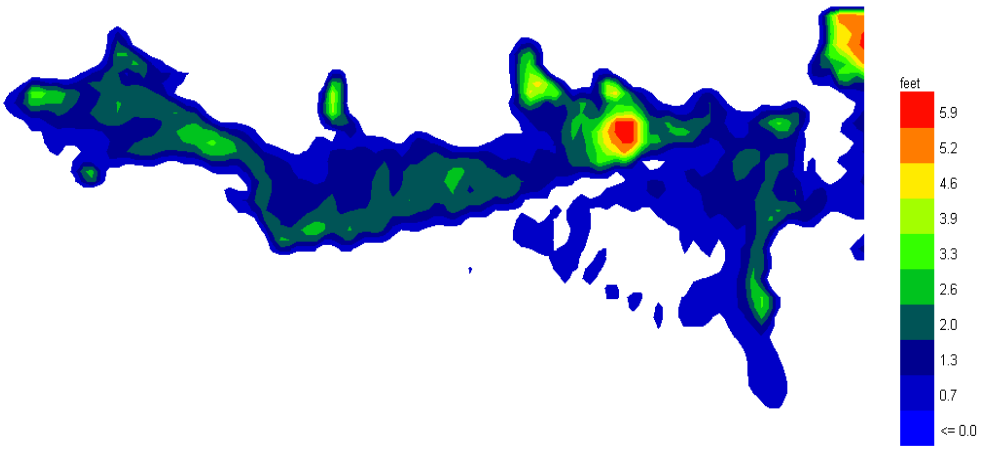
Mapper will display the maximum flow depth contour lines plot:



Finally, to display the shaded contours for the maximum depth, click on *Max Flow Depth (Shaded Contours):*

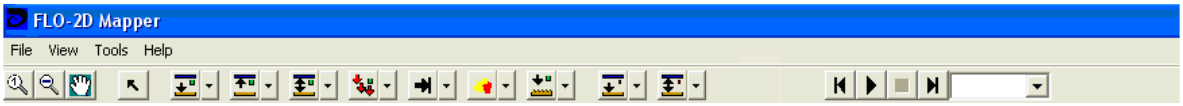


The maximum depth shaded contour plot in *Mapper* is displayed as follows:



II. Toolbar Plotting Buttons

Most *Mapper* plots are generated via the toolbar:



The toolbar contains buttons that generates maps of the *FLO-2D* results. Note that some or the toolbar buttons are grayed out because they are unavailable if *Mapper* does not find the required FLO-2D output files. Each icon button has a drop-down arrow to access the available plots.

Grid element based plots

Ground Surface Elevation

Maximum Water Surface Elevation

Maximum Flow Depth (Floodplain)
Final Floodplain Flow Depth
Maximum Channel Flow Depth
Maximum Combined Channel and Floodplain Flow Depth
Maximum Street Flow Depth

Maximum Velocity (Floodplain)
Maximum Street
Maximum Combined Channel and Floodplain Flow Velocity
Final Flow Velocity

Duration of Inundation
Impact Force
Static Pressure
Specific Energy
Levee Freeboard Deficiency

Time for Depth

Hazard Maps

Maximum Deposition
Max Scour
Final bed elevation

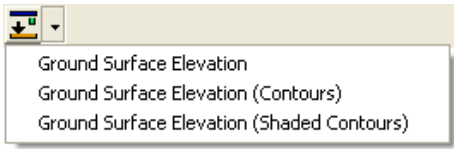
DTM based plots

Ground Surface Elevation

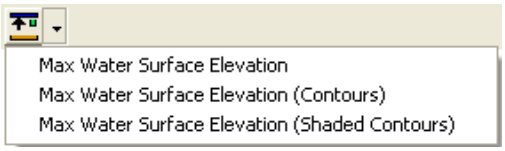
Maximum Flow Depth

Every icon has a drop-down arrow that displays a menu for each available plot as follows:

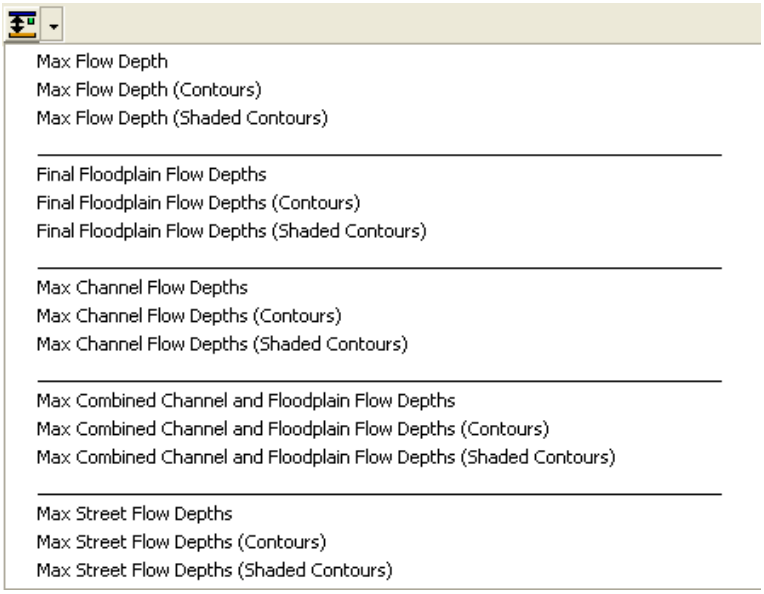
2.1 Plot of grid element ground surface elevation



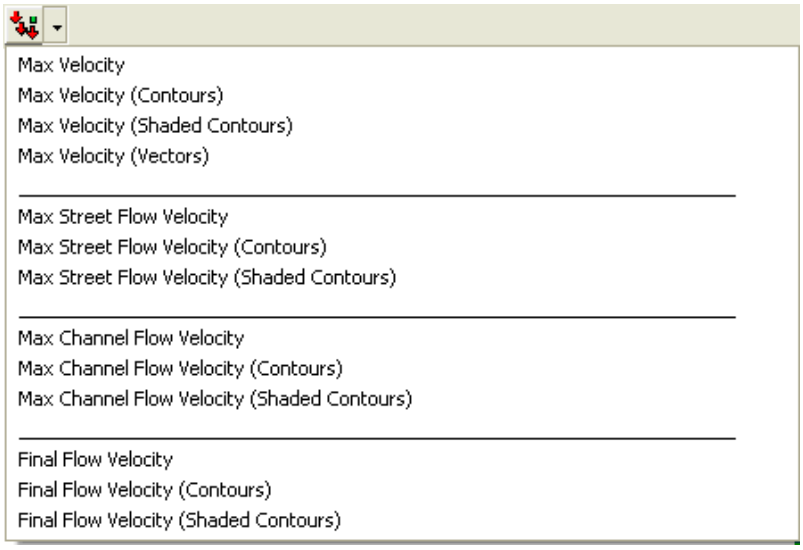
2.2 Plot of grid element maximum water surface elevation



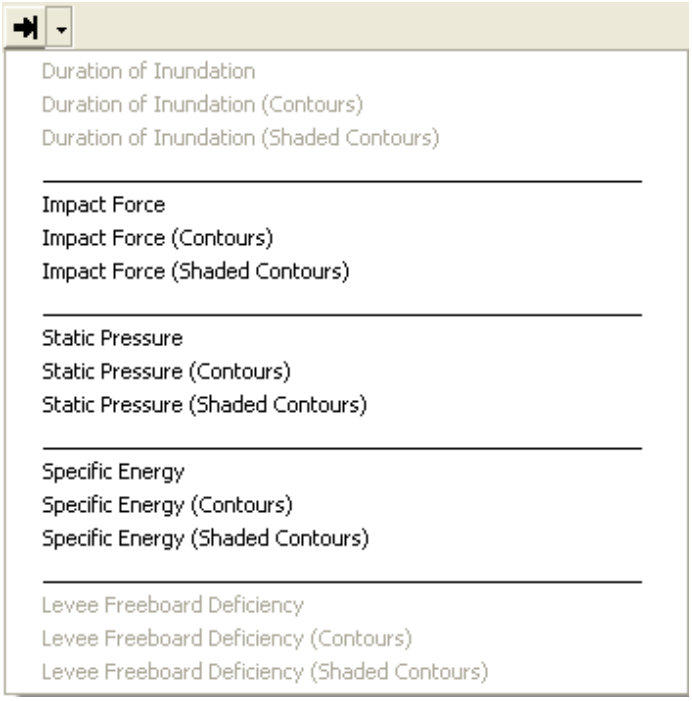
2.3 Plot of grid element maximum flow depth



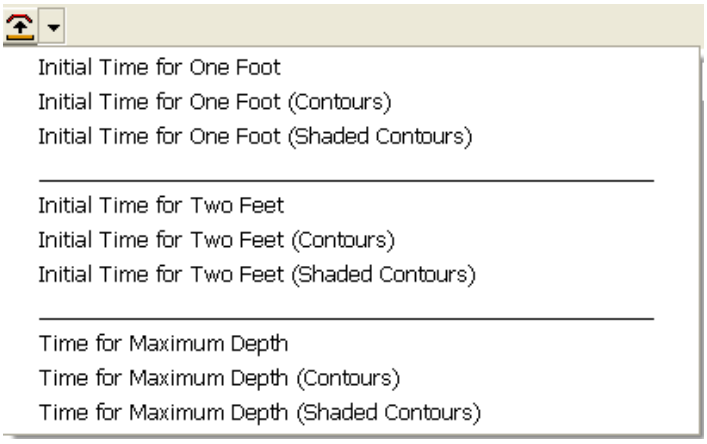
2.4 Plot of grid element velocities



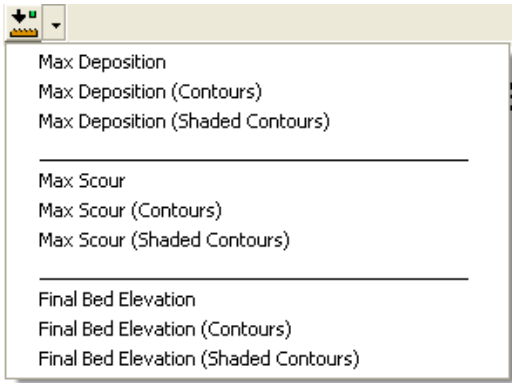
2.5 Impact force and other variable plots



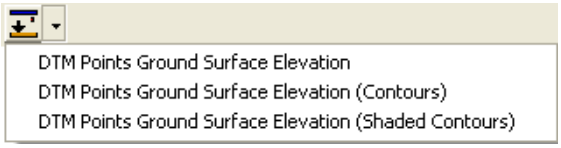
2.6 Time for Depth



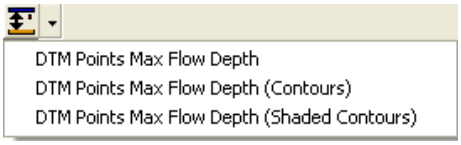
2.7 Plot of grid element maximum deposition, maximum scour and final bed elevation



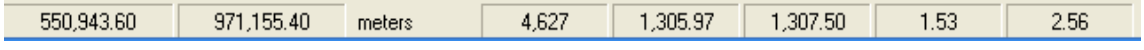
2.8 Plot of DTM point ground surface elevation



2.9 Plots of DTM point maximum flow depth



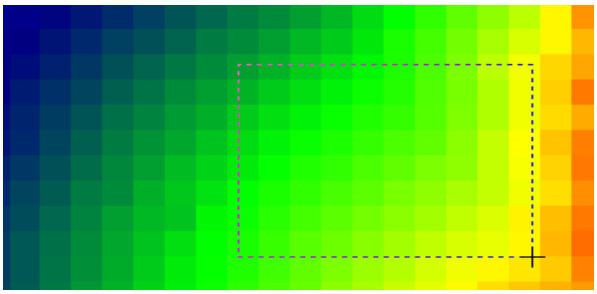
The left side of the bottom tool bar also has data boxes that display the x-coordinate, y-coordinate, grid element number, ground and water surface elevation, and maximum flow depth and velocity when the mouse cursor passes over the grid element point on the flow domain.



III. Mouse Button Commands

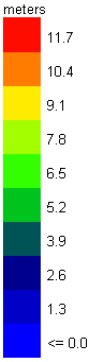
3.1 Zoom in (left mouse button)

You can zoom-in on the working region using a rectangular viewing area. Click the left mouse button to position the pointer on one the vertices of the desired area and drag the mouse to the opposite vertex. The mouse pointer changes to a cross-shaped pointer and a rectangle appears to outline the selected area. When the left button is released, the selected rectangular area is magnified to the full screen.



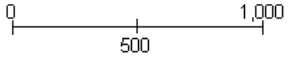
3.2 Color scale repositioning (left mouse button)

A color scale is usually placed at the right of the graphs. The user can reposition it by left clicking the mouse on the scale and dragging it to the desired position.



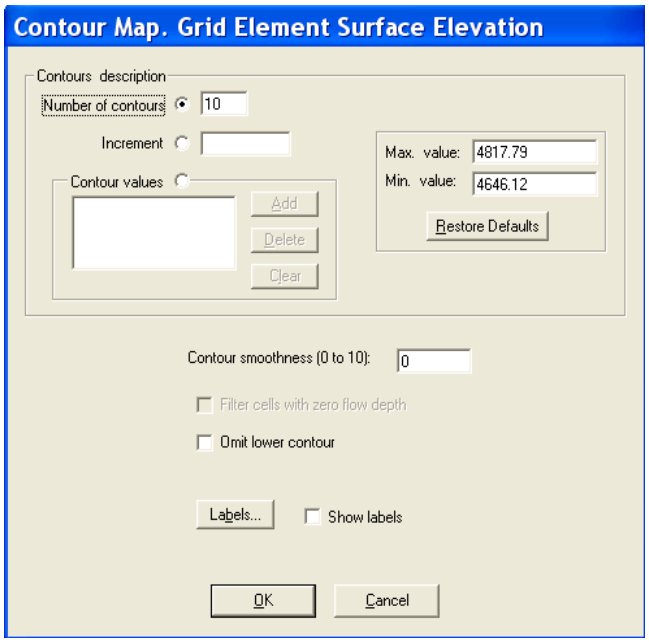
3.3 Distance scale repositioning (left mouse button)

A distance scale is placed at the right of the graph below the color scale. The user can reposition it by left clicking the mouse on the scale and dragging it to the desired position.



3.4 Right Click on Contour Graphs

This option is activated by clicking the right mouse button over the displayed plot. Contour intervals and other options can be adjusted for all line contours and shaded contour plots. After clicking the right mouse button on the plot, a dialog box appears:



In this dialog box, you can select between three options to display contours or shaded contours:

- Define the *Number of contours* to display equal increment contours between the minimum (*Min. value*) and maximum (*Max. value*).
- Specify a contour *Increment* to display the contours in successive increments starting with the minimum value (*Min. value*).
- Specify a list of Contour *values* you want to display. You may *Add* or *Delete* any value from the list and *Clear* the whole list.

The remaining options for all hydraulic variables include:

Contour smoothness (0 to 10) selects a level of resolution for the contours. A higher value for the contour smoothness requires more points for the contour interpolation, but it will also significantly increase the contour computation time.

Omit lower contour eliminates the lower contour.

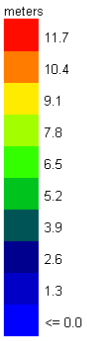
Gradual contour construction selects an alternative contour building algorithm that will produce better contour graphics for certain plots.

Filter cells with zero flow depth works only for flow depth contour plots. When this option is selected, only the grid elements with flow depth greater than zero are considered when

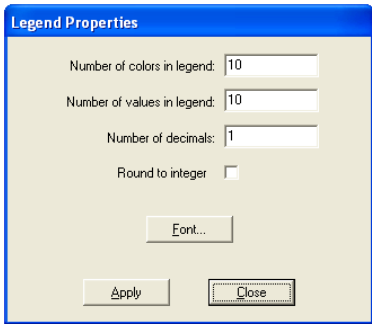
developing the contours.

IV. Legend and Scale Controls

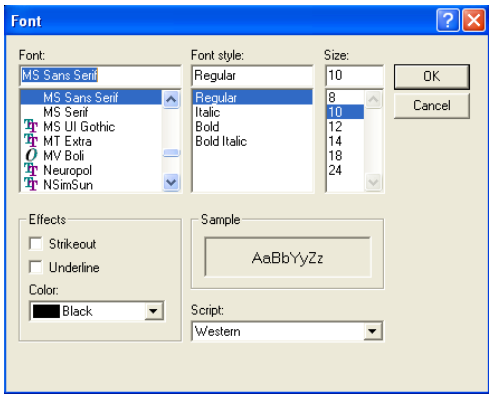
Mapper provides a number of functions to edit and customize the plot legend. Initially the legend is automatically set to the range of values of the selected plot. The legend can be dragged to any location on the plot. The following legend shows 10 ranges using the rainbow colors:



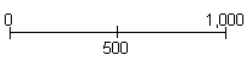
To customize the legend, right click on legend to display the following dialog box:



You may change the number of colors (range values that default to 10), the number of values (numbers associated with the color ranges), and the number of decimal places. You may also use check box to round the numbers to the nearest integer value. Using the *Font…* button, you can display the font editor dialog box to change legend font type, style and size:



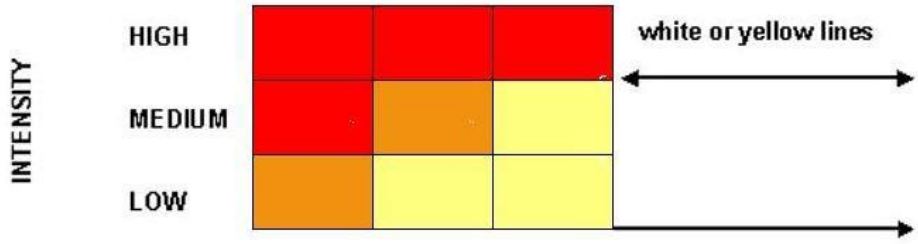
The scale indicates a reference distance corresponding to the plot scale. You can also drag the scale to any position in the plot window.



V. Hazard Maps

Mapper can create flood hazard maps based on a methodology developed by Garcia et al. (2003, 2005). The hazard delineation map criteria used in *Mapper* were first proposed in the PREVENE, 2001 project, where it was applied to two alluvial fans in Caracas, Venezuela and later adapted and applied to other urbanized alluvial fan Garcia et al. (2003, 2005). This approach follows Swiss and Austrian standards that establish three zones to delineation the flood hazard level (for more discussion refer to OFEE et al. 1997, Fiebiger 1997).

Flood hazard level at a specific location is a function of both flood intensity and probability. Flood intensity is defined by the flow depth and velocity. Flood probability is inversely related to flood magnitude. Large flood events occur less frequently. Flood hazard level is then defined as a discrete combined function of the event intensity (severity of the event) and return period (frequency) as shown in the following figure.



	HIGH	MEDIUM	LOW	VERY LOW
PROBABILITY				
Return Period	10	100	500	>>500
Probablity of Exceedence	10%	1%	0.2%	<<0.2%

In the above figure, the probability limits are defined for return periods of 10, 100 and 500 years. The user can select other return periods to construct the flood hazard map. A flood hazard map is based on the three color levels to define high (red), medium (orange) and low (yellow) level. These map colors translate into specific potential hazard areas as shown in the following table.

FLOOD HAZARD DEFINITION		
Hazard Level	Map color	Description
High	Red	Persons are in danger both inside and outside their houses. Structures are in danger of being destroyed.
Medium	Orange	Persons are in danger outside their houses. Buildings may suffer damage and possible destruction depending on construction characteristics.
Low	Yellow	Danger to persons is low or non-existent. Buildings may suffer little damages, but flooding or sedimentation may affect structure interiors.

To define the event intensity, similar methods use a combination of flow depth and velocity. The
Austrian method (Fiebiger et al. 1997) uses the total energy defined by:

$$h + v^2/2g$$

where h is the flow depth, v is the velocity and g is the gravitational acceleration. The Swiss method (OFEE et al. 1997) defines the intensity in terms of a combination of flow depth h and the product of h and v. This approach enables high intensity to be assigned to high flow depths independently of the flow velocities. Following the Swiss method, the flood intensity criteria used in *Mapper* make the distinction between water flooding and mud or debris flows. Intensities are defined in terms of the maximum water depth and the product of the maximum velocity multiplied by the maximum depth. These criteria to define flood intensity differ from the Swiss method in several aspects. For example, the Swiss method for debris flow intensity estimation establishes that a high intensity event occurs when h > 1.0 m AND vh > 1.0 m^2/s. Considering the specific conditions in project, it may necessary to change the hazard level thresholds. In *Mapper* the user can input values for flow depth and velocities that define the intensity thresholds. For the case of water flooding, the flood intensities could be defined by the selection of values in the following table.

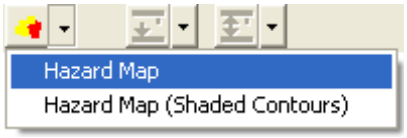
DEFINITION OF WATER FLOOD INTENSITY			
Flood Intensity	Maximum depth h (m)		Product of maximum depth h times maximum velocity v (m^2/s)
High	h > 1.5 m	OR	v h > 1.5 m^2/s
Medium	0.5 m < h < 1.5 m	OR	0.5 m^2/s < v h < 1.5 m^2/s
Low	0.1 m < h < 0.5 m	AND	0.1 m^2/s < v h < 0.5 m^2/s

Mud or debris flow events are more destructive than water floods, therefore, the mudflow intensity criteria are more conservative.

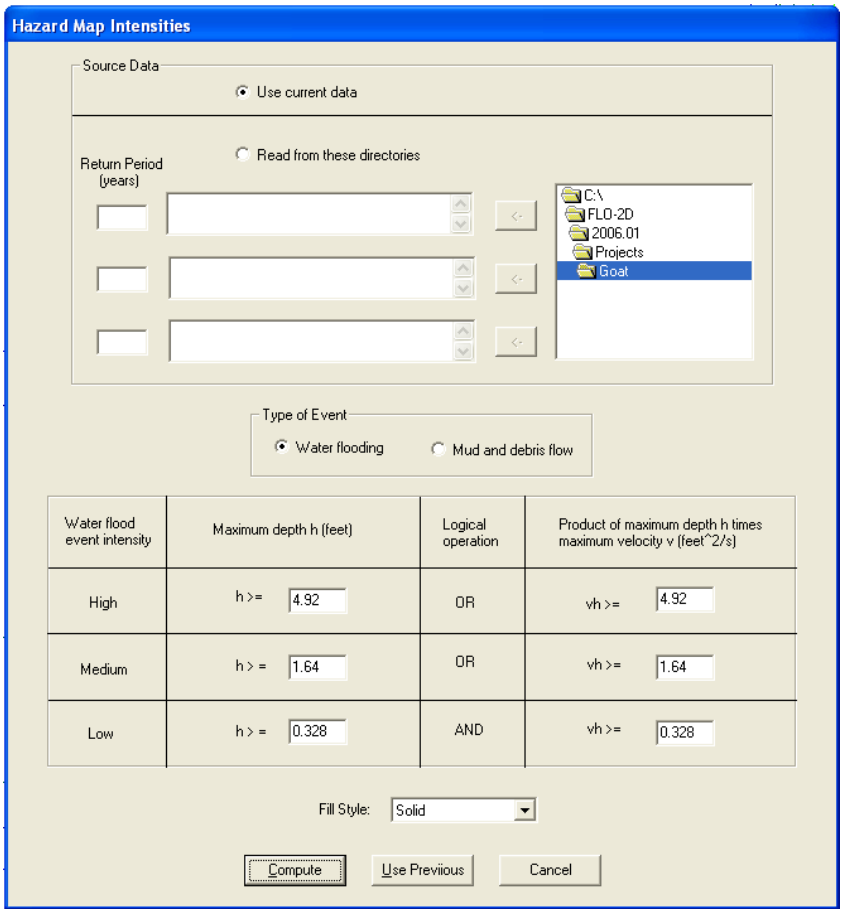
DEFINITION OF MUD OR DEBRIS FLOW INTENSITY			
Flood Intensity	Maximum depth h (m)		Product of maximum depth h times maximum velocity v (m^2/s)
High	h > 1.0 m	OR	v h > 1.0 m^2/s
Medium	0.2 m < h < 1.0 m	AND	0.2 m < v h < 1.0 m^2/s
Low	0.2 m < h < 1.0 m	AND	v h < 0.2 m^2/s

The hazard criteria encompass the probability of occurrence of a water or mudflow event for three selected returns periods. This requires the FLO-2D simulation of the three selected flood events. The model predicts the maximum depths and velocities for each return period flood. For each grid element, the event intensity for a return period flood determines the hazard based on the above criteria.

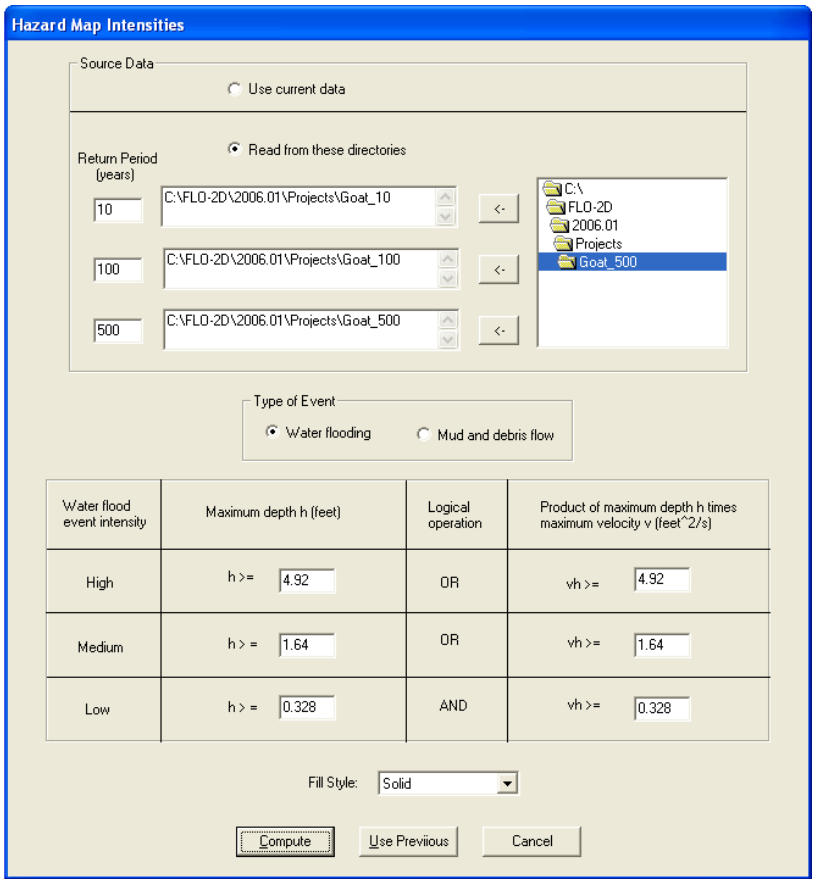
The Hazard mapping function is accessed by the button: . Clicking the drop-down list arrow and Hazard Map:



The following dialog box is displayed:



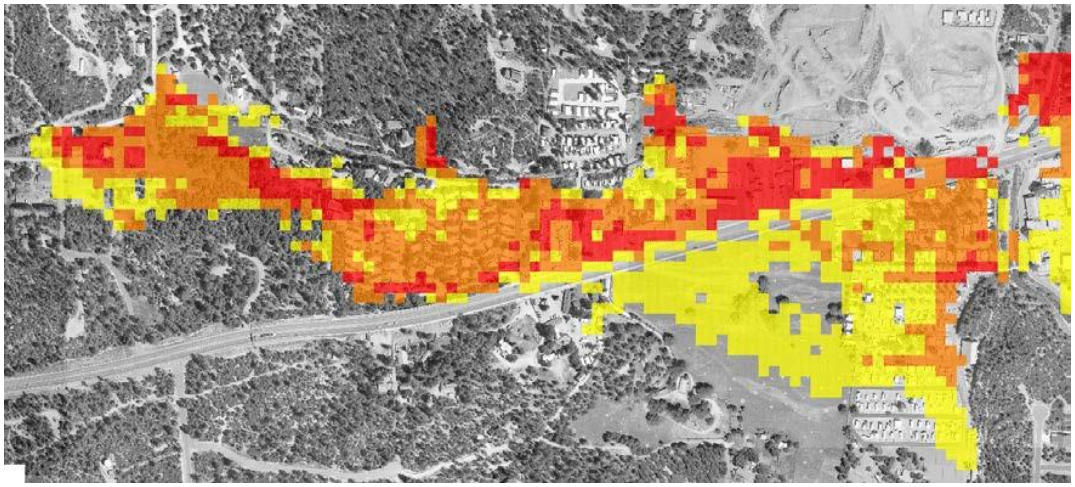
You have two principal options in the dialog box: 1) *Use current data* in the project folder; or 2) Read the FLO-2D results for three completed return period flood events. For the latter case you need to have completed flood simulations in separate directories as shown in the following dialog box.



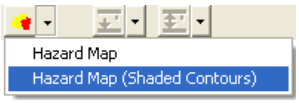
For the above project, there are three flood simulations:

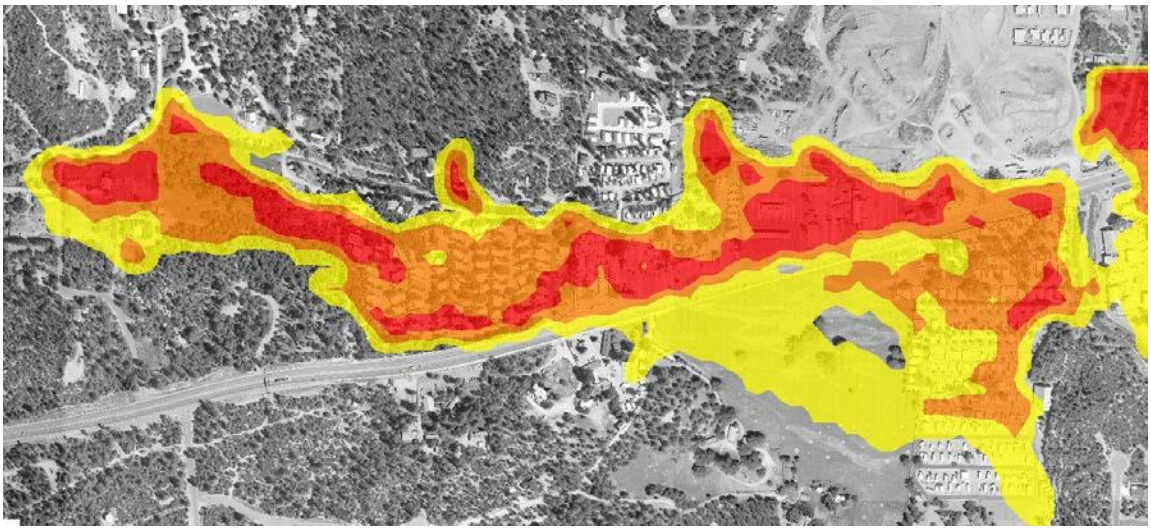
1) A 10-year return period flood in directory C:\FLO-2D\2006.01\Projects\Goat_10.
2) A 100-year return period flood in directory C:\FLO-2D\2006.01\Projects\Goat_100.
3) A 500-year return period flood in directory C:\FLO-2D\2006.01\Projects\Goat_500.

The resulting hazard map appears as follows:



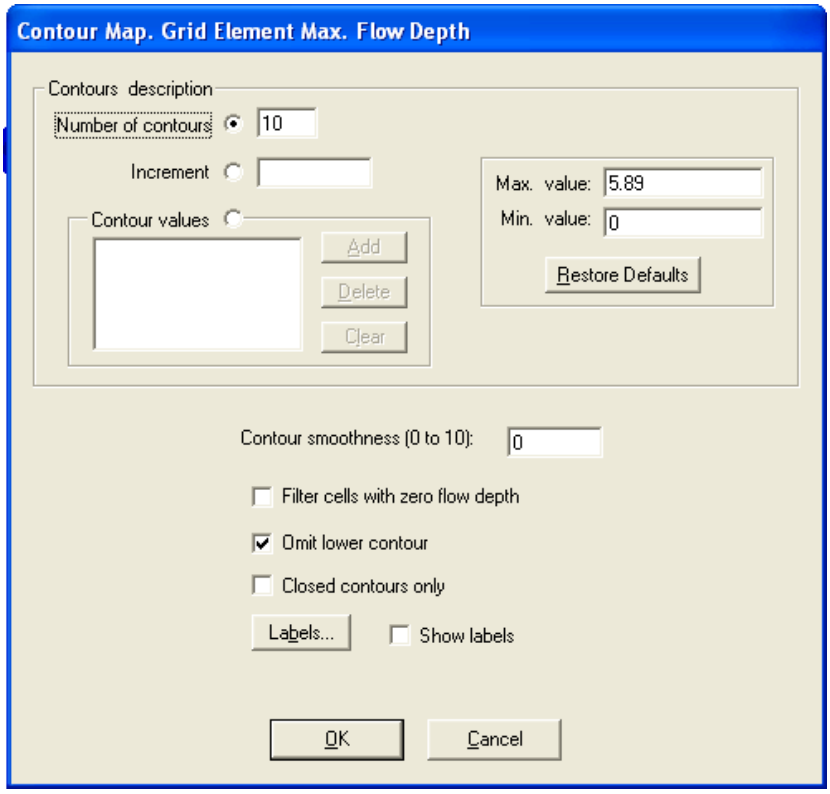
The colored grid elements represent the low, medium and high flood hazard. The corresponding shaded contour plot is initiated from the pull-down menu:


Hazard Map
Hazard Map (Shaded Contours)



VI. Flood Inundation Contour Maps

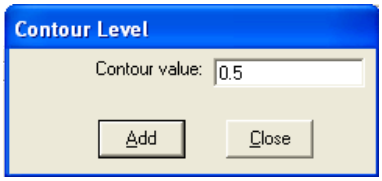
Mapper allows you to customize the line and shaded contour map plots. To initialize the editor dialog box, right-click anywhere on the contour map.



First, you may want to adjust the number of contours or the contour increment. There are three options:

- **Number of Contours:** Edit the number of line or shaded contours. The contour value interval (increment) is equal to (Max. value /Min value)/ (Number of contours).
- **Contour Increment:** Selecting this option requires inputting the contour increment in the text box. The lines or shaded contours will start at the minimum value (Min. value) and continue to the contour closest to the maximum value (Max. value).
- **Individual Contour Values:** Use this option to assign specific contour values.

To enter specific contour increment values, first click the *Contour values* radio button, and then click the Add button. The following input box will be displayed:

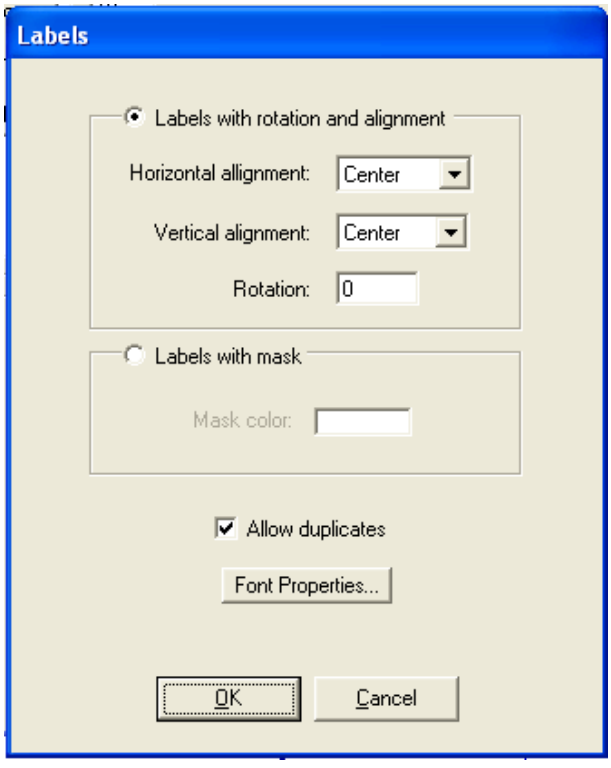


Input the desired contour interval value and click on the *Add* button. Repeat this procedure for all desired contour increment values.

6.1 Contour Controls

The following definitions and controls are available in the above dialog box:

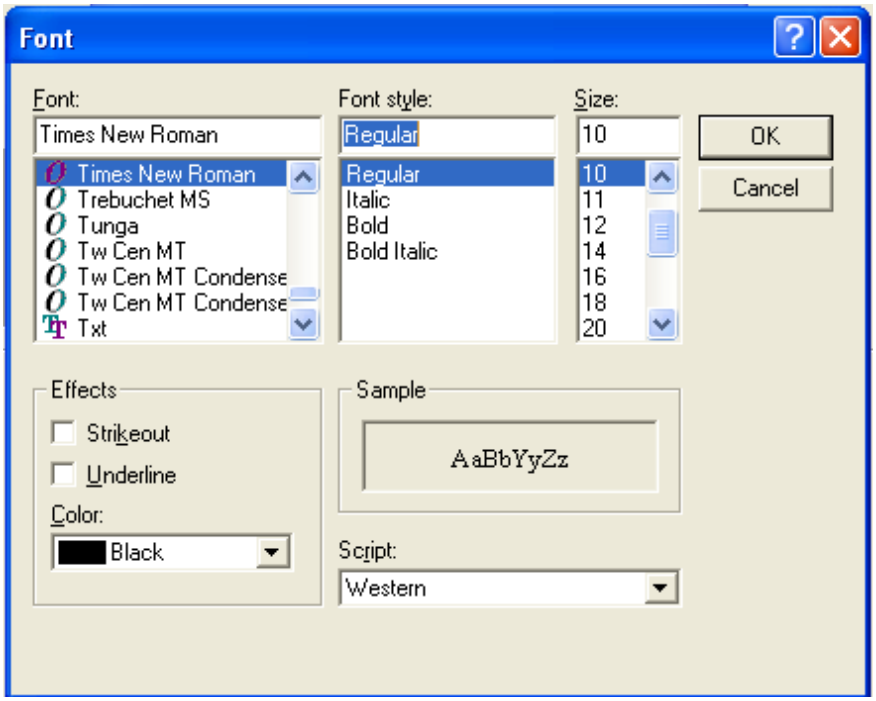
- **Max. value**: The maximum value for the variable being plotted. Mapper automatically determines the Max. value. You can adjust the maximum contour value by editing the value in the text box.
- **Min. value**: The minimum value for the variable being plotted. Mapper automatically determines the Min. value. You can change the minimum contour value by editing the value in the text box.
- **Restore Defaults button**: If you edit the Max and Min values, click this button to recover the original values in the FLO-2D variable output file.
- **Contour smoothness**: Select a value between 0 and 10 to smooth the contour lines and shaded contour outlines. A value of 10 is the maximum contour smoothing and takes the longest computational time. A smoothing factor of 3 is suggested for an initial adjustment.
- **Filter cells with zero flow depth check box**: Checking this box will omit all grid elements that may have zero values from the contour interpolation calculation.
- **Omit lower contour**: Checking this box will eliminate the lowest contour line or shaded contour from the plot.
- **Closed contours only**: Checking this box will result in plotting only closed contour lines or shaded contours that do not end at the grid system boundary.
- **Show labels check box**: Check this box to show the contour line labels.
- **Labels… button**: This button allows editing the contour lines labels. A Labels dialog box is displayed.



6.2 Label Controls

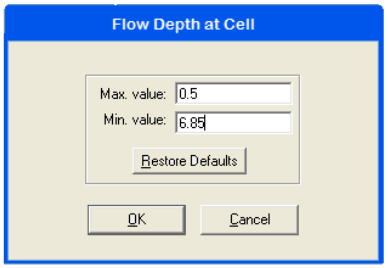
The contour label editor has the following options:

- **Horizontal alignment:** Text alignment in the horizontal direction and can be left, center or right justified.
- **Vertical alignment:** Text alignment in the horizontal direction and can be left, center or right justified.
- **Rotation:** Text rotation angle.
- **Labels with mask:** This option will create labels with a background Mask color to distinguish it from the contour lines.
- **Mask color:** Label background color.
- **Allow duplicates:** Allow more than one label for each contour line.
- **Font properties…** button: Displays Font customization dialog box to change font type, style, size, color, etc. as shown below:



6.2 Max Min Control

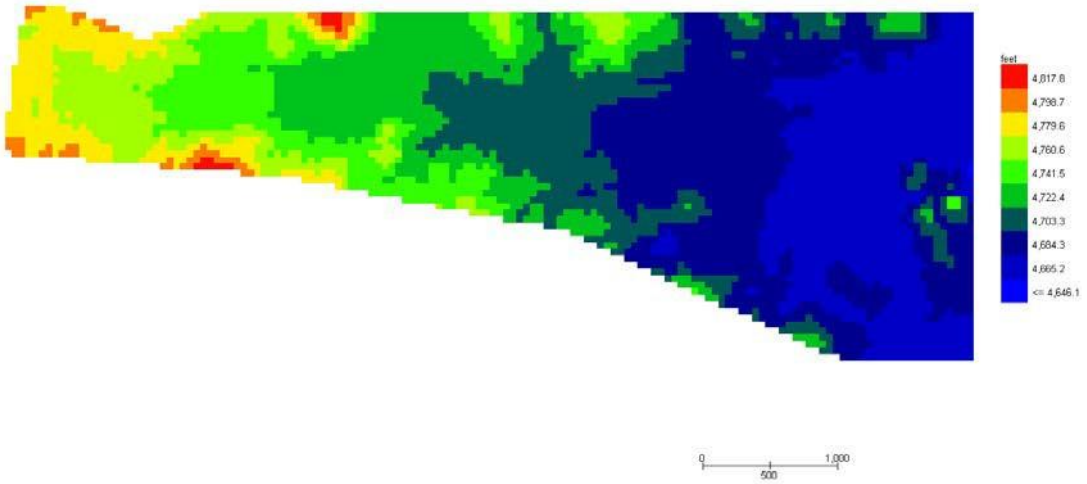
Right click on any “Cell” map to edit the plot Max / Min Values.



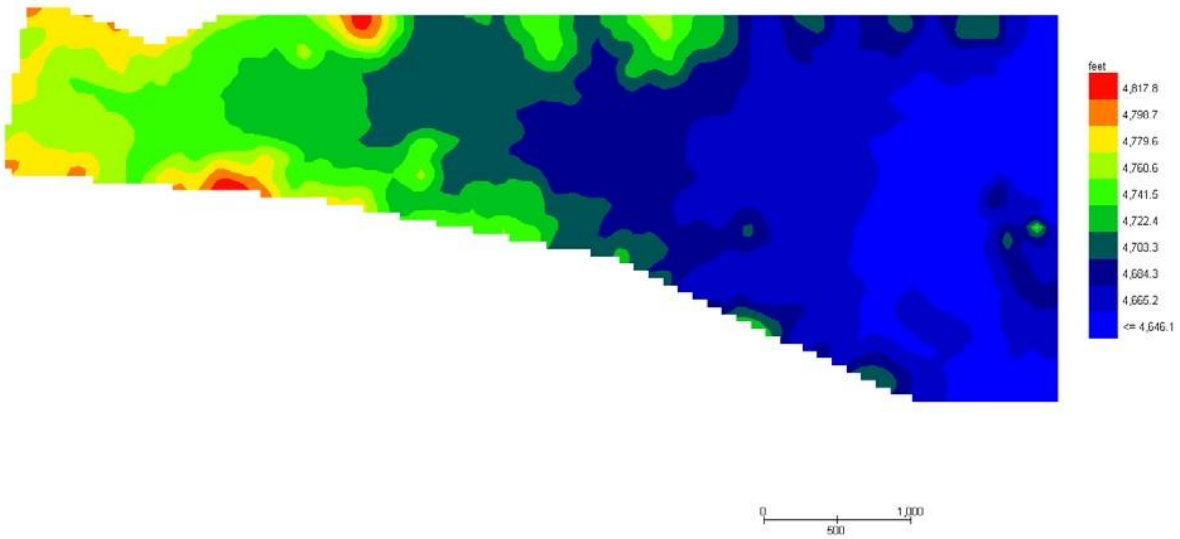
VII. Example Plots

The following are some examples of the *Mapper* plots.

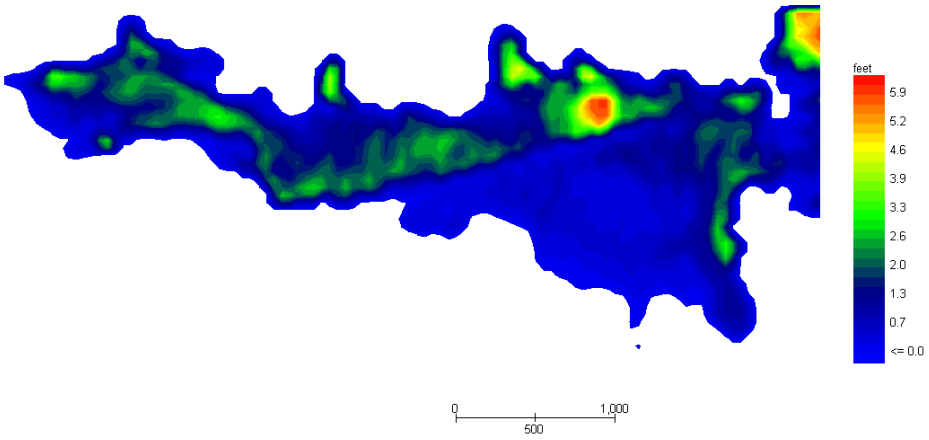
Grid Element Ground Surface Elevations



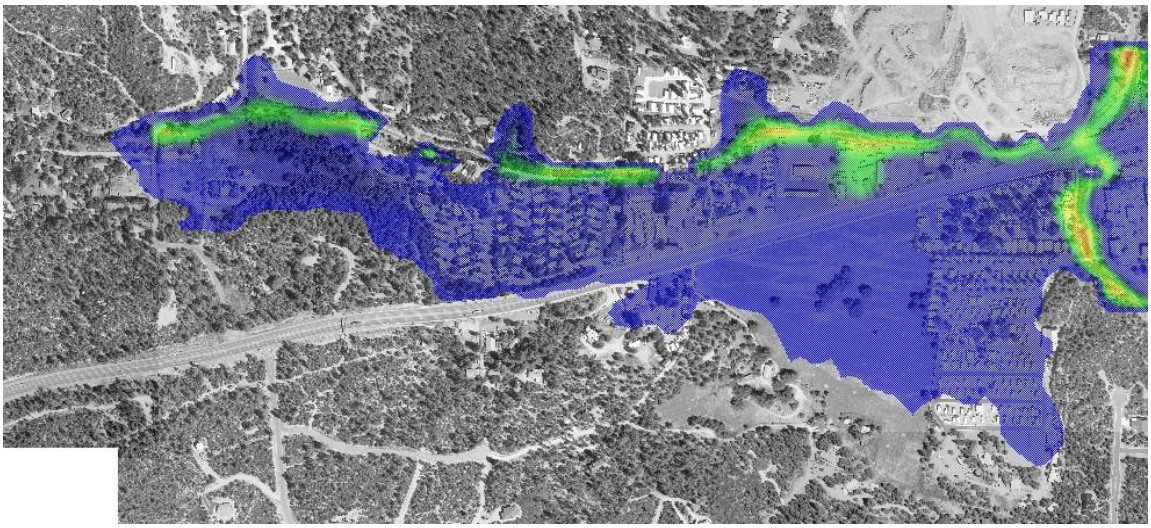
Shaded Contour Map of Grid Element Ground Surface Elevations



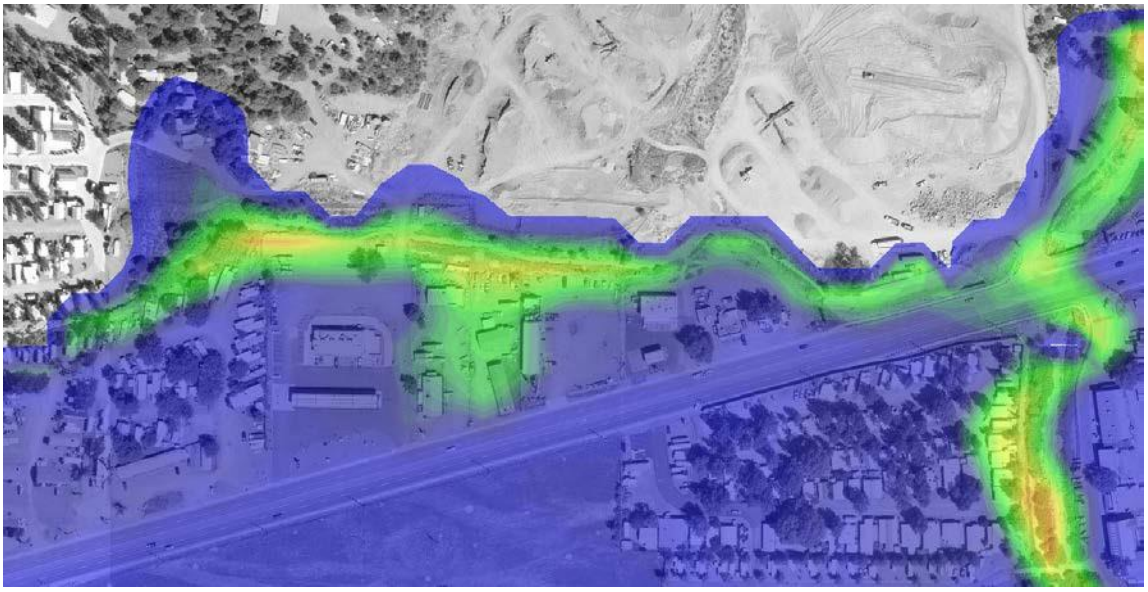
Shaded Contour Map of the Grid Element Maximum Flow Depth



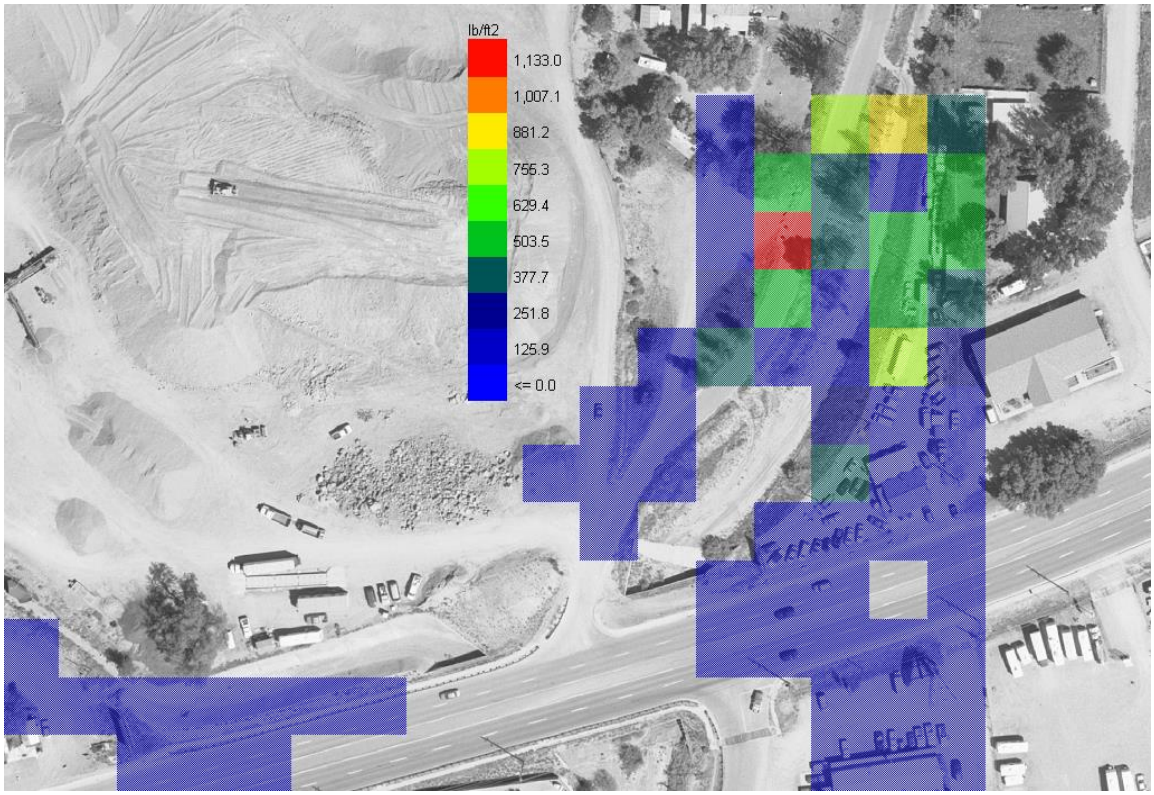
Shaded Contour Map of the Grid Element Maximum Flow Depth with Background Aerial Photograph



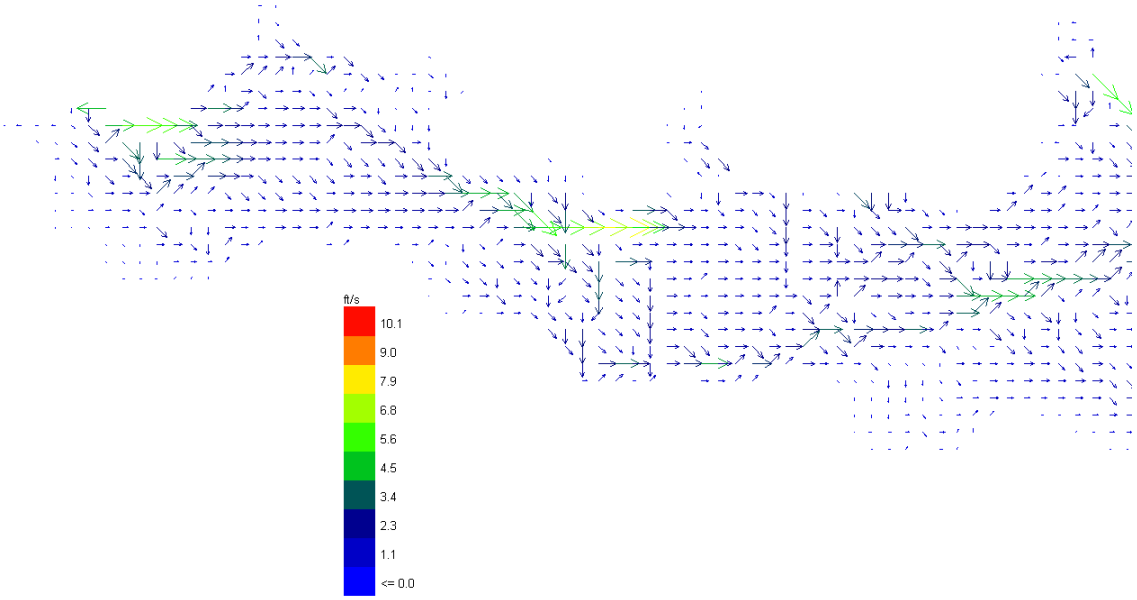
Zoomed Shaded Contour Map of the Grid Element Maximum Flow Depth with Background Aerial Photograph



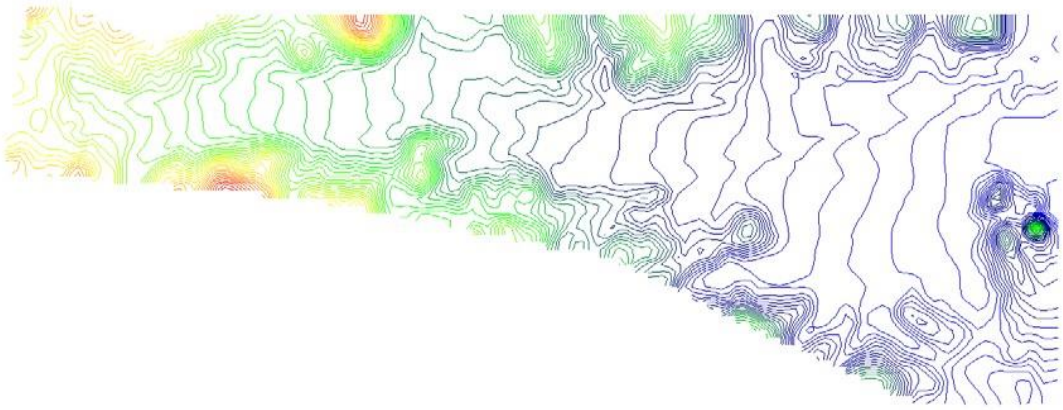
Grid Element Impact Force



Grid Element Maximum Velocity Vectors



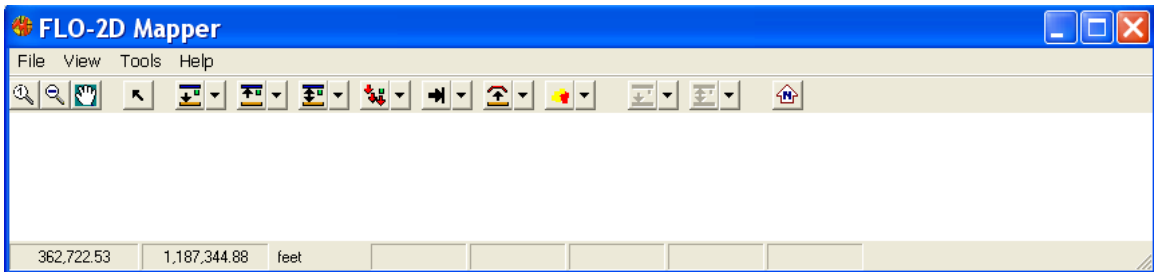
Line Contour Map of the Grid Element Ground Surface Elevations



Line Contour Map of the Grid Element Ground Surface Elevations with Labels

VIII. Menus and Toolbar

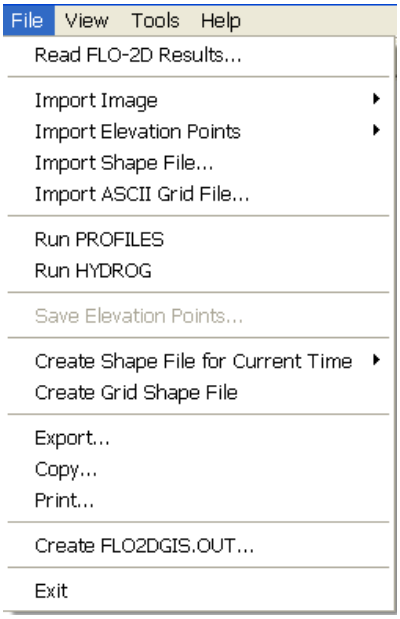
This section describes the *Mapper* commands in the main menu and the information toolbar:



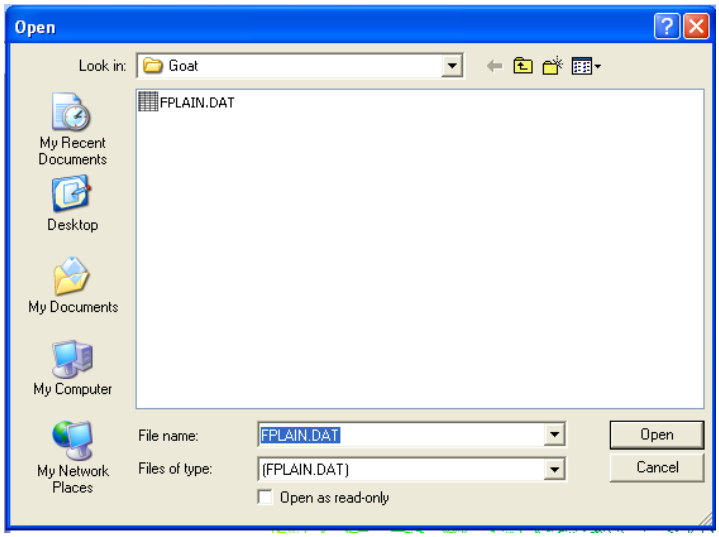
Each main menu command may contain one or more subcommands.

8.1 File Menu Commands

Read FLO-2D Results Command… (*File Menu*)

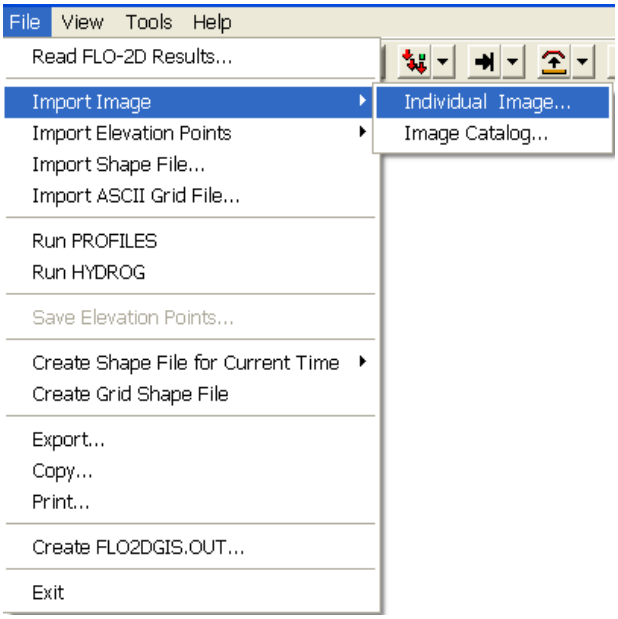


This command reads *FLO-2D* data files (*.DAT) and result files (*.OUT). A dialog box appears to allow selection of the FPLAIN.DAT file:



It is only necessary to select the FPLAIN.DAT data file. The other required and companion files are automatically read from the same directory.

Import Image/Individual Image (File Menu)



Use this command to import images such as aerial photos. Several images can be imported at the same time. To correctly position the image, each image must be accompanied by a "world" file containing its geo-referenced data. The world file must have the same file name as the corresponding image file and an extension name depending on the image type according to the table below.

Image File Extension	World File Extension
bmp	bmpw or bpw
jpg; jpeg	jpgw or jgw tif;
tff; tiff	Tfw
gis	Gsw
lan	Lnw
bil	Blw
bip	Bpw
bsq	Bqw
sid	Sdw
sun	Snw
rs; ras	Rsw
rlc	rcw

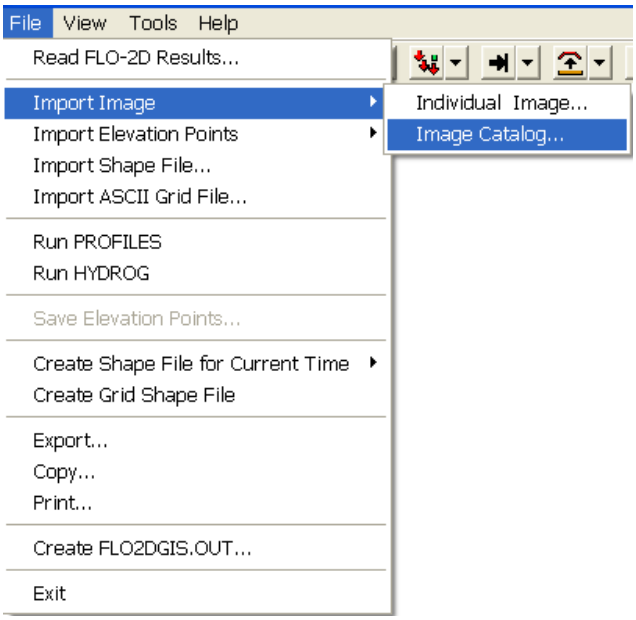
The world file has the following format:

Line1: Dimension (width) of a pixel in map units in the x-direction (ft or m)
Line 2: 0
Line 3: 0
Line 4: Dimension (height) of a pixel in map units in the y-direction (ft or m). This value is negative because the image space is top-down, whereas map space is bottom-up.
Line 5: x-origin (x-coordinate of the center of the upper left pixel)
Line 6: y-origin (y-coordinate of the center of the upper left pixel)

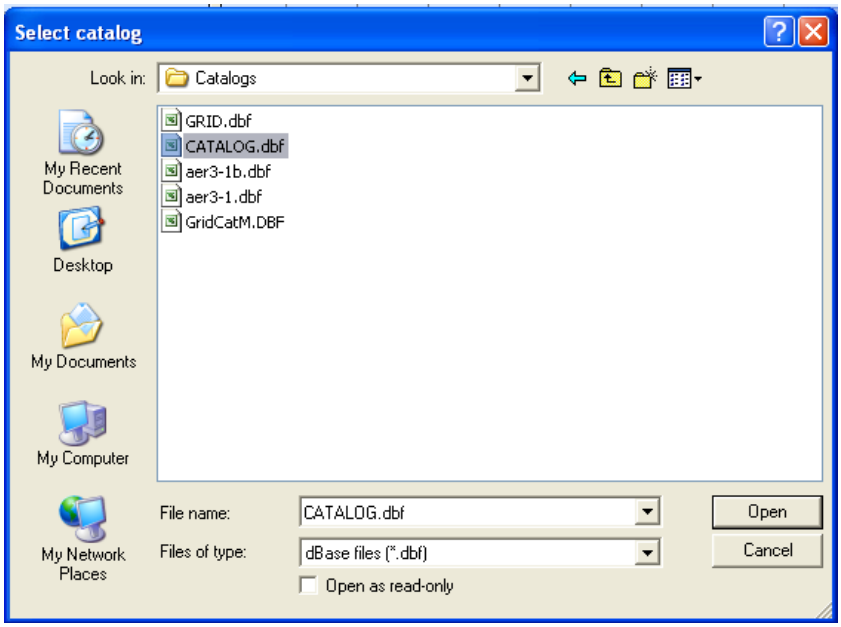
In this example the pixel width and height is 20 ft and the coordinate of the center of the upper left pixel is 637510, 1032490. To determine the pixel size of an image you can use an image editing program. For example in MS-Paint load the image and use the Image/Attribute command to query the number of pixels in x and y directions. Then divide the x and y widths of the image in real coordinates by the number of pixels in each direction.

Example:
20
0
0
-20
637510
1032490

Import Image/Image Catalog (File Menu)



This command allows importing of several image files stored in any subdirectory. First draw a polygon on the grid and then select an image catalog file.

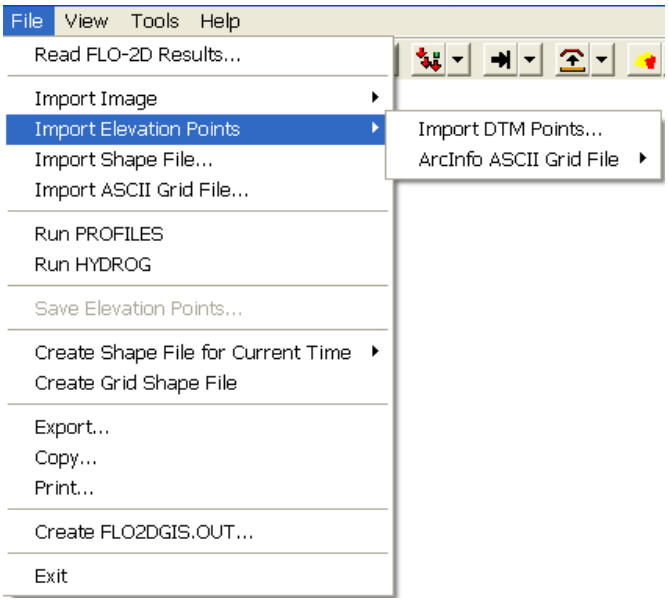


The catalog file may be in DBASE or ASCII format and has the following format:

IMAGE	XMIN	YMIN	XMAX	YMAX
C:\Projects\MaricopaCounty\Data\ 6401030-5.TIF	640000	1000000	670000	1400000
C:\ Projects \MaricopaCounty\Data\ 6401035-5.TIF	660000	1300000	770000	1500000
\\Agua\IMF\Publico IMF\ 6401055-5.TIF	630000	1300000	750000	1510000

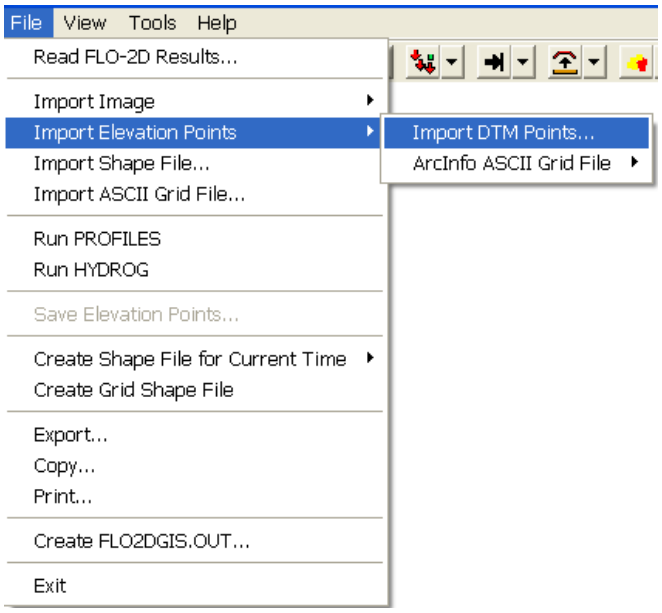
The first column is the file name including its path and the following four columns are the image limit coordinates. *Mapper* will find all images from the catalog that are contained or intersect the user defined polygon and will retrieve the appropriate ones.

Import Elevation Points Command (File Menu)



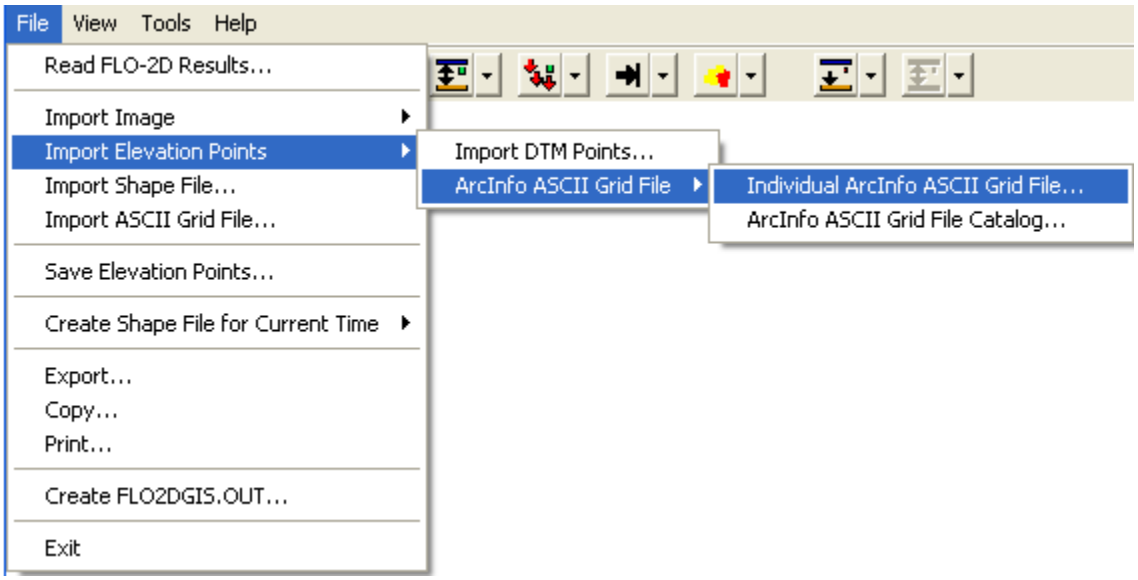
This command will import an existing digital terrain elevation file. There are two submenu commands to import either digital terrain elevation points (DTM Points Command) or ArcInfo ASCII Grid File.

Import DTM Points…Command (File Menu)



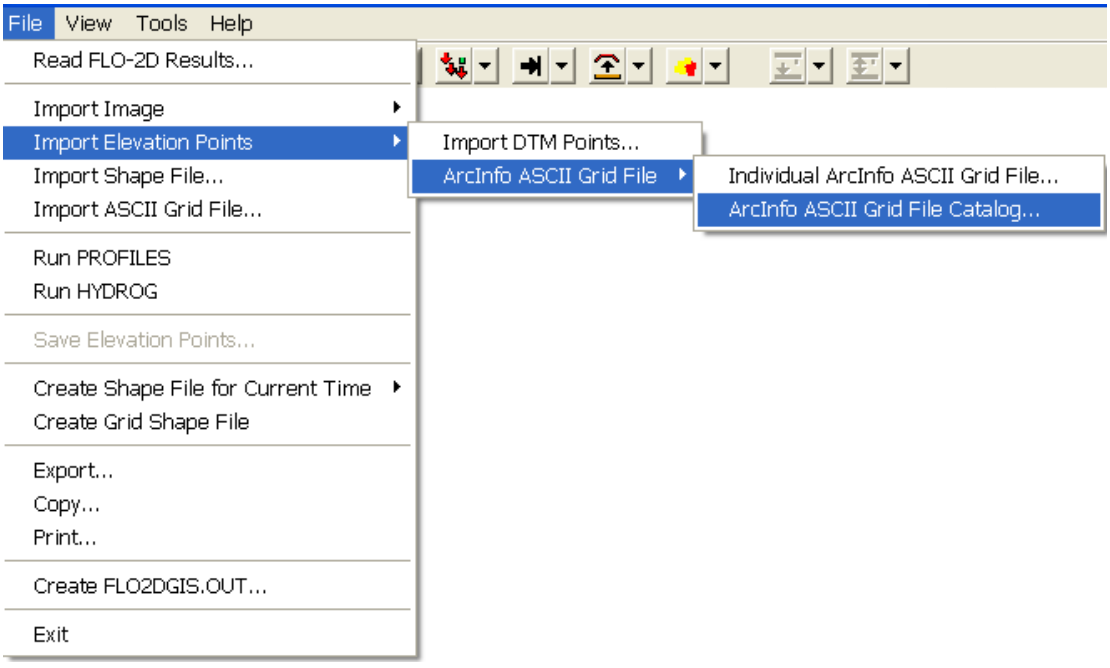
This command imports DTM elevation points from an existing file. You may import several data files. The new points are added to the existing data. You may also mix or combine DTM points with other random elevation points from an ArcInfo ASCII grid files.

Individual ArcInfo ASCII Grid File Command (File Menu)

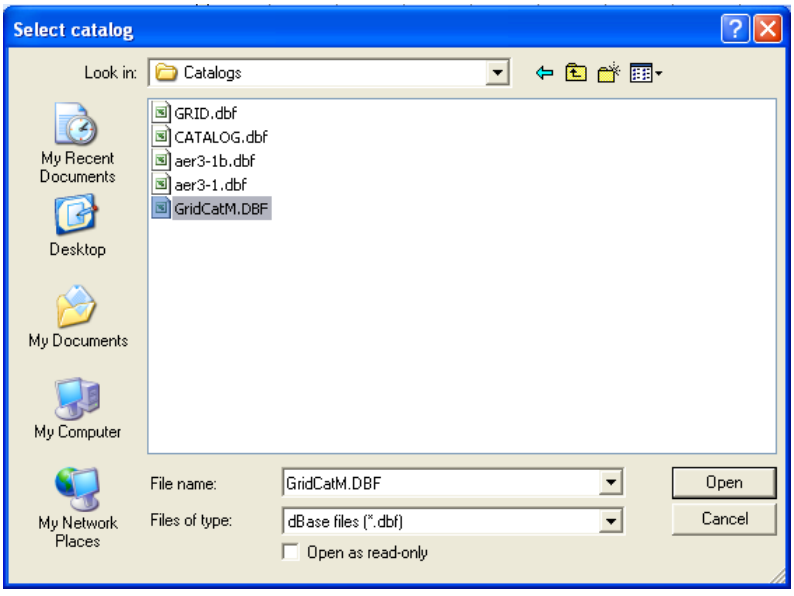


Use this command to import an individual ArcInfo ASCII grid files. Several grid files can be imported. The new points are added to the existing data. This data can also be mixed or combined with the DTM points.

ArcInfo ASCII Grid File Catalogue (File Menu)



This command will import several ArcInfo ASCII grid files stored in any subdirectory. First draw a polygon on the working region or grid system and then select a catalog file.

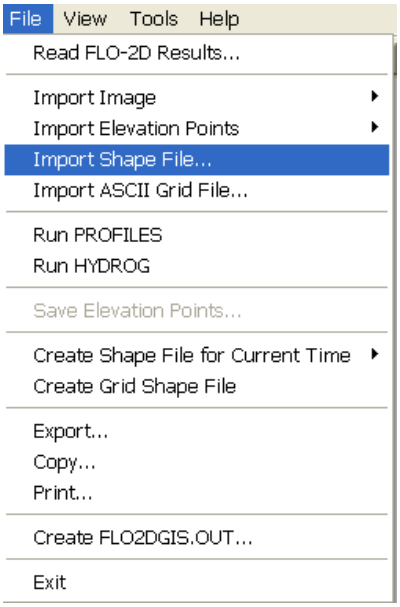


The catalog file may be in DBASE or ASCII format and has the following format:

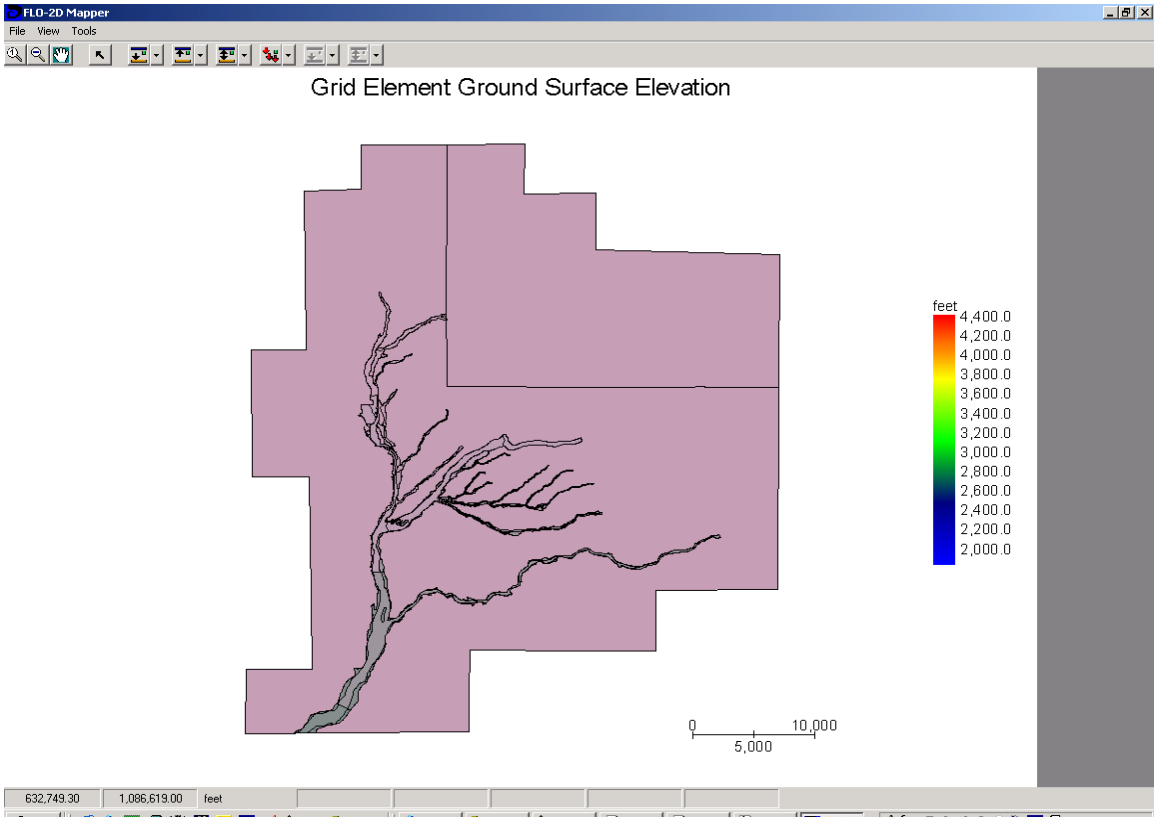
ASCII_GF	XMIN	YMIN	XMAX	YMAX
C:\Projects\MaricopaCounty\Data\grd2375-100.asc	640000	1000000	670000	1400000
C:\ Projects \MaricopaCounty\Data\grd2376-100.asc	500000	1000000	900000	1500000
\\Agua\IMF\Publico IMF\grd2476-100.asc	510000	1000000	740000	1510000

The first column is the file name including its path. The following four columns are the data limits in each file. *Mapper* will find all data files that are contained or intersect the user defined polygon and retrieve the relevant files.

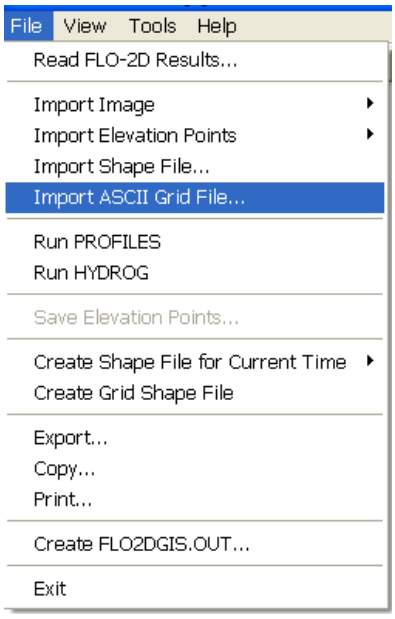
Import Shape File Command (File Menu)



This command will import ESRI shape files. The shape file data map can be related to soil properties, land use, vegetation, Manning roughness coefficients or similar data. Once read, the shape file is displayed in the screen like the following example from Maricopa County Manning coefficients shape file.

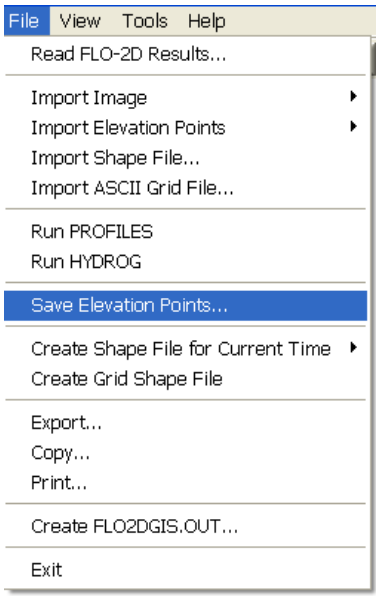


Import ASCII Grid File Command (File Menu)

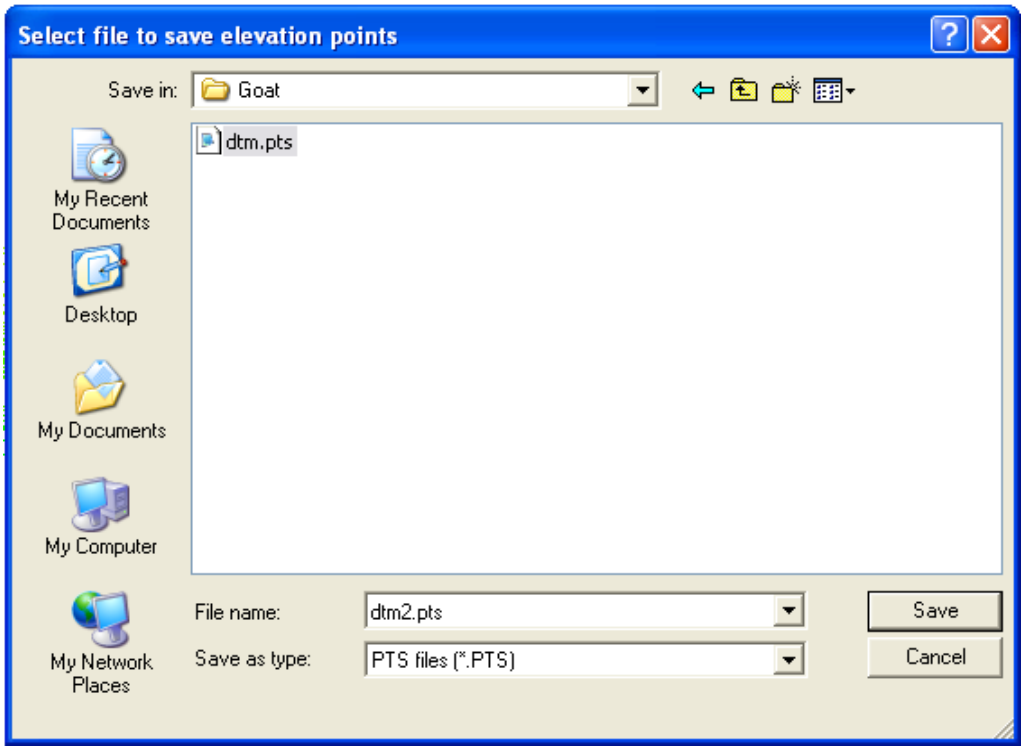


This command will import ArcInfo ASCII grid files stored in any folder.

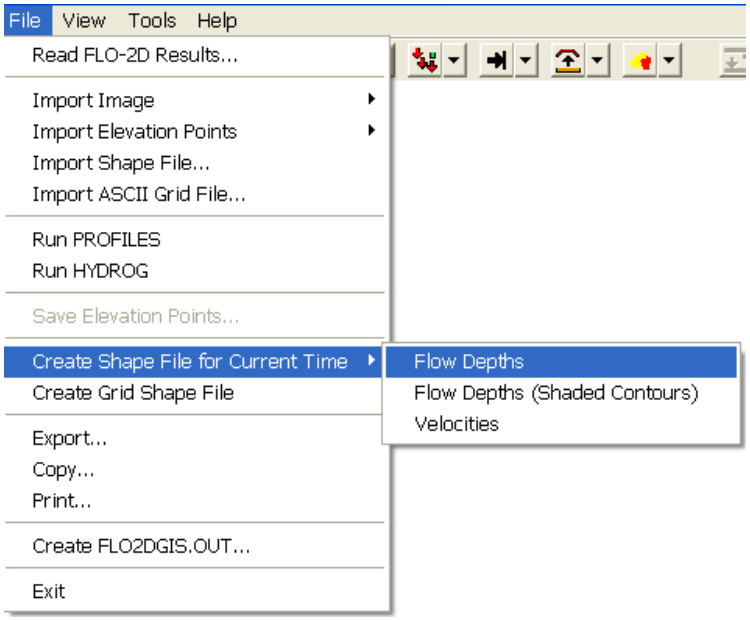
Save Elevation Point Command (File Menu)



This command is used for saving the DTM elevation points to an ASCII file. You may have imported a set of DTM points and then deleted selected points that are outside the computational grid system. With this command you can export save the remaining DTM points in a file. After clicking the *Save Elevation Points*... command, the following dialog enables you to define the DTM point ASCII file:



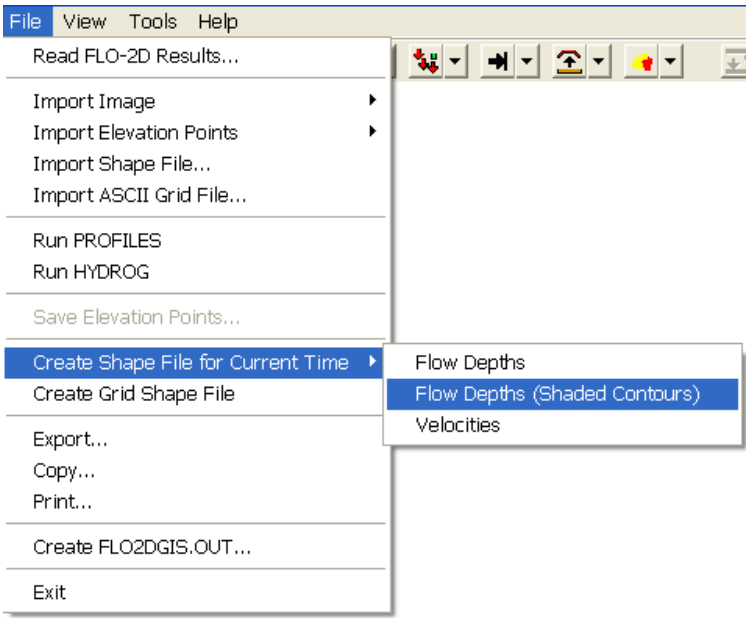
Create Shape File for Current Tim/Flow Depths (File Menu)



This command will export an ESRI polygon Shape File with the current grid element

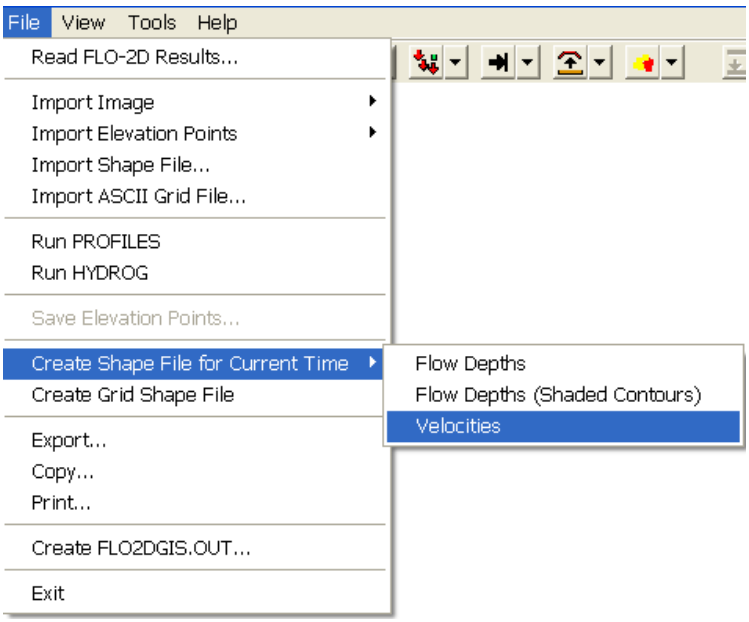
based flow depth time plot shown in the animation. The shape file name will indicate the time and that it is a grid element flow depth plot.

Create Shape File for Current Tim/Flow Depth (Shaded Contours) (File Menu)



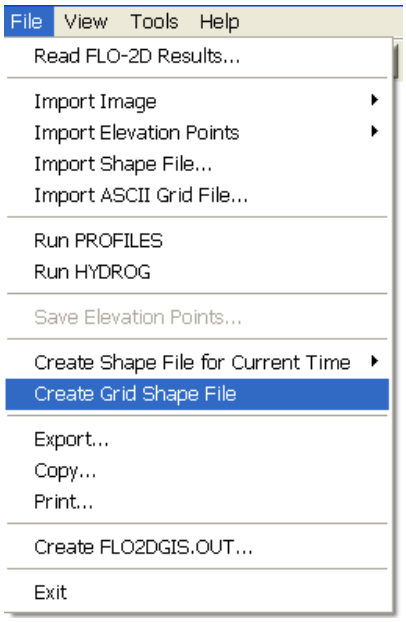
This command will export an ESRI polygon Shape File with the current flow depth time shaded contour plot constructed from the results shown in the animation. The shape file name will indicate the time and that it is a flow depth shaded contour plot.

Create Shape File for Current Tim/Velocities (File Menu)



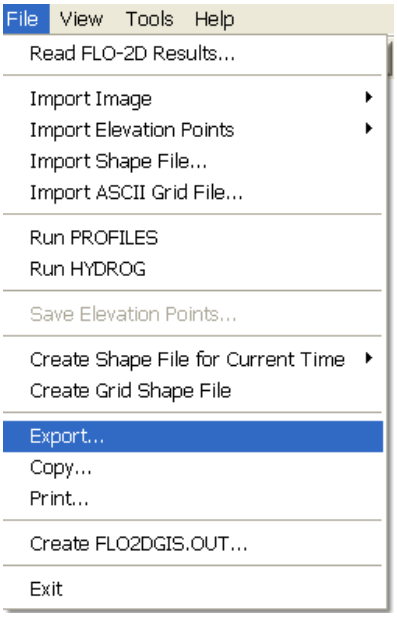
This command will export an ESRI polygon Shape File with the grid element velocities for the current time plot shown in the animation. The shape file name will indicate the time and that it is a grid element velocity plot.

Create Grid Shape File (File Menu)

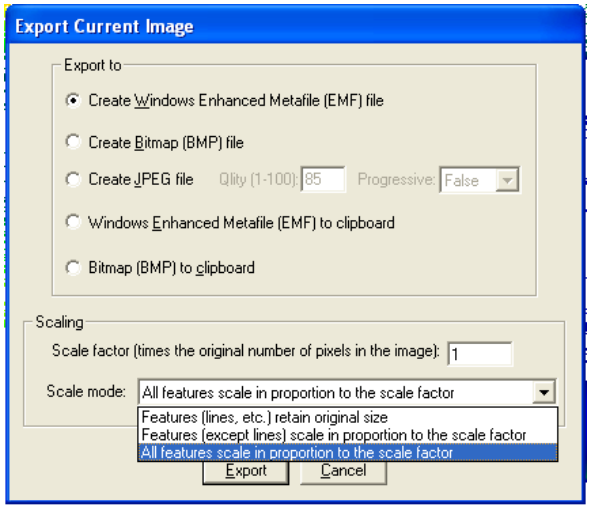


This command will create a polygon shape file named *MGrid* that has the grid element numbers as attributes for each grid element.

Export…Command (File Menu)

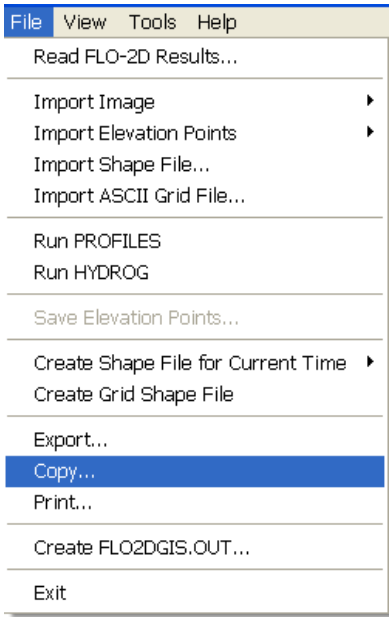


Using this command you can export the current screen view to a different image format. Click on the Export Command the following dialogue box will appear:

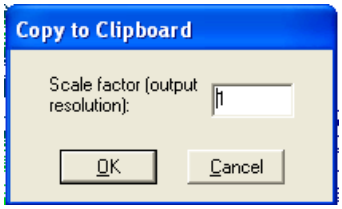


With this dialog box, you can select various image export formats such as Bitmap, JPEG, Windows Metafile, etc. The scale factor of the image can be adjusted to improve print quality of the image. When you click on the Export button, input the image file name and select the directory to save the image in the subdirectory/file dialogue box.

Copy… Command (File Menu)

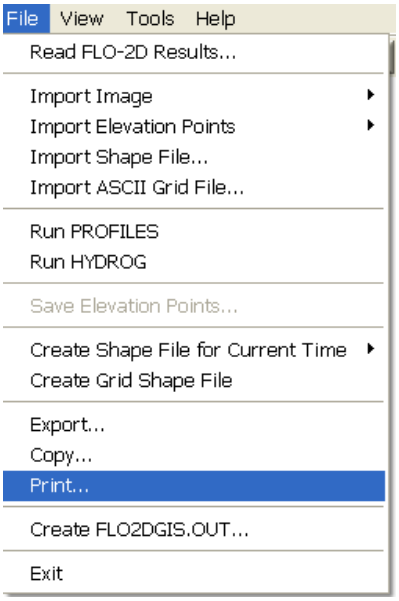


Use this command to copy the current plot to the clipboard. The plot may then be pasted into other documents. When you select the copy command the following dialog appears:



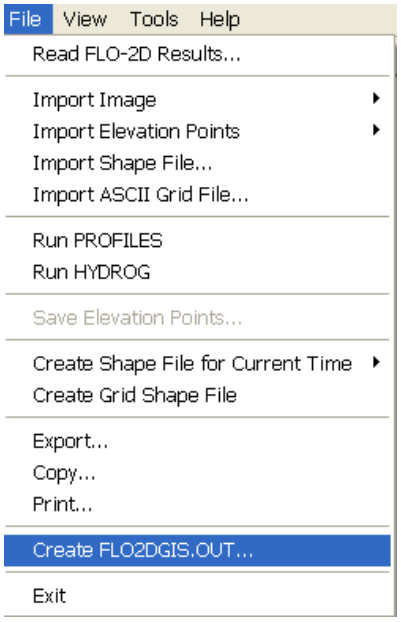
The default *Scale factor* is 1, but you may set higher values to improve output resolution. It is not recommended to use values higher than 3, since plots with this resolution require substantial amount of memory that may result in a very slow print process.

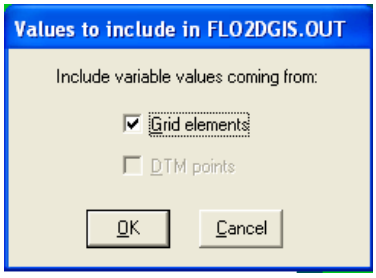
Print… Command (File Menu)



Use this command to print the current plot. When you select this command, the standard printer management dialog allows you to choose the printer.

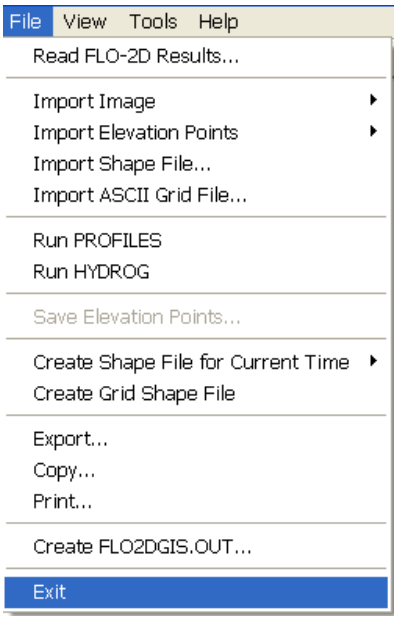
Create FLO2DGIS.OUT… Command (File Menu)





Use this command to create a GIS output file. The FLO2DGIS.OUT file contains the x- and y-coordinates of each DTM point and their associated ground elevation, water surface elevation, flow depth and water velocity. It is necessary to first interpolate the flow depth by subtracting the DTM ground points from the grid element water surface elevation. This is accomplished by using the *Interpolate to DTM Points* command in the Tools Menu. This GIS output file can be imported to ArcView™. The flow depth values assigned to the DTM points can only be written to the FLO2DGIS.OUT file if the flow depth interpolation by subtracting the DTM point ground elevations from the grid element water surface has been completed.

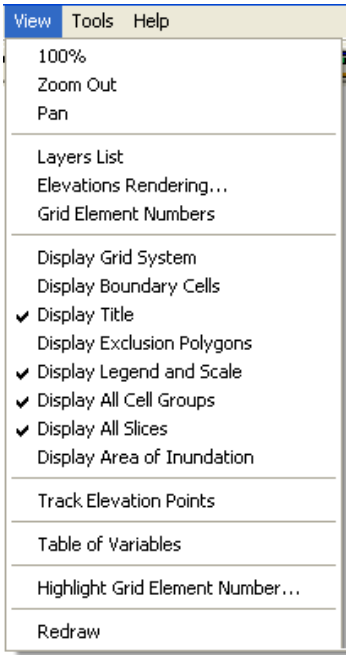
Exit (File Menu)



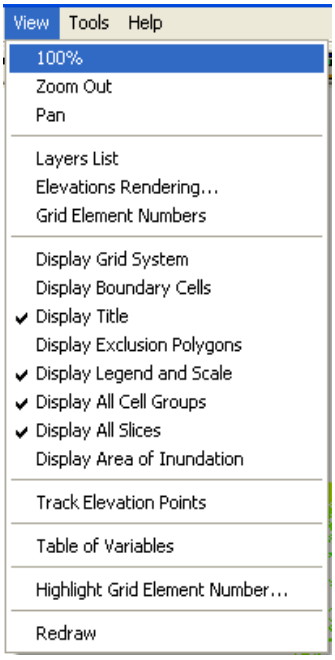
This command ends the *MAPPER* session. You can also use the *Close* command on the application Control menu.

Shortcuts: Mouse: double-click the application Control-menu button.
Keys: Alt-F4

8.2 View Menu Commands

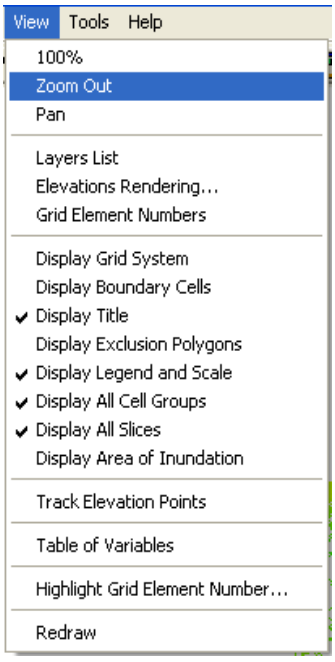


100% Command (View Menu)



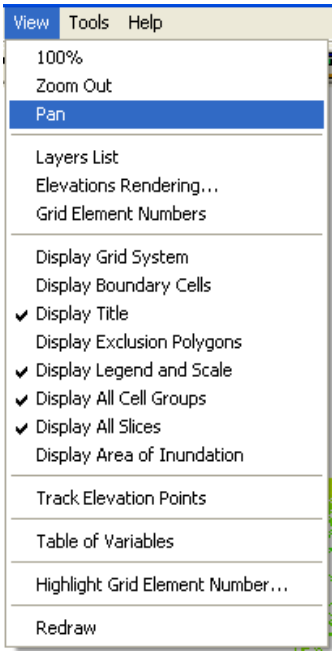
Use the *100%* command view the project extent. The *100% is also run with the* toolbar icon . To zoom-in, left- click in the working region and drag the mouse for set the zoom rectangle.

Zoom Out Command (View Menu)



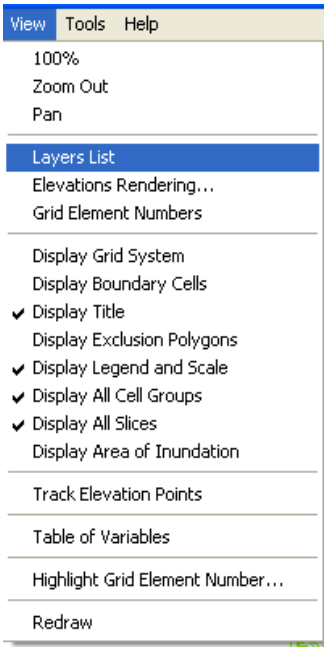
Use the *Zoom Out* command to return the working region to its previous zoom extent.

Pan Command (View Menu)



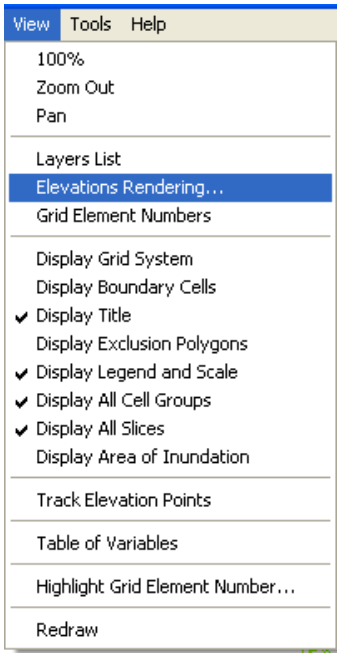
Use the *Pan* command to move around and redisplay the working region view. When activated the mouse cursor changes to *Pan* mode. The *Pan* toolbar icon performs the same task.

Layers List Command (View Menu)



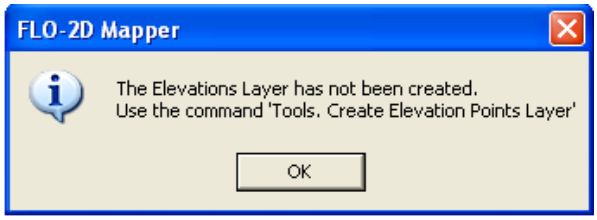
This command is used to manage existing layers. Please refer to GDS Layer List Command for instructions. The commands are identical.

Elevation Rendering… Command (View Menu)

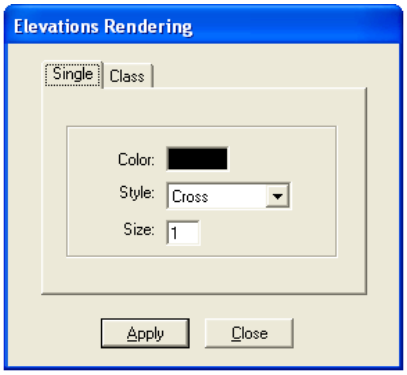


This command may be used to select how the elevation points are displayed.

To optimize display times, *Mapper* does not automatically create the Elevation layer. For certain functions like the *Elevation Rendering* this layer is required. If the layer does not exist, you will get the following message:

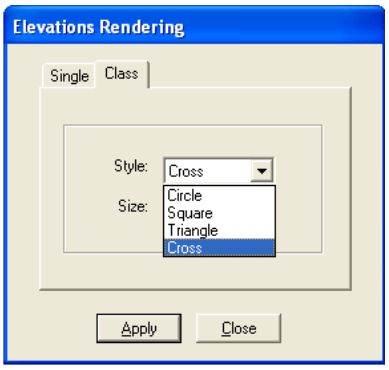


To create this layer use the *Create Elevation Layer* command in the Tools menu. After the elevation layer is created, click on Elevation Rendering again to get the dialog:

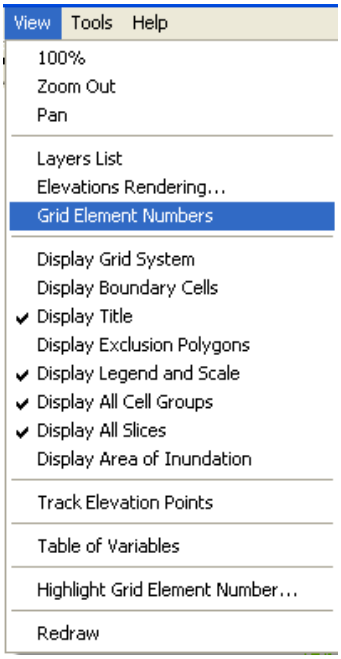


The “Single” tab selects a single color, style, and size for all elevations.

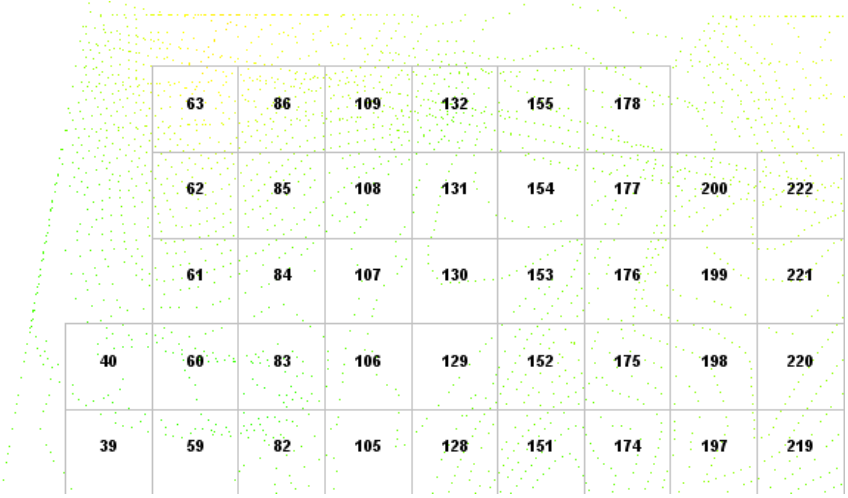
The “Class” tab selects a style (point descriptor) and size for the points.



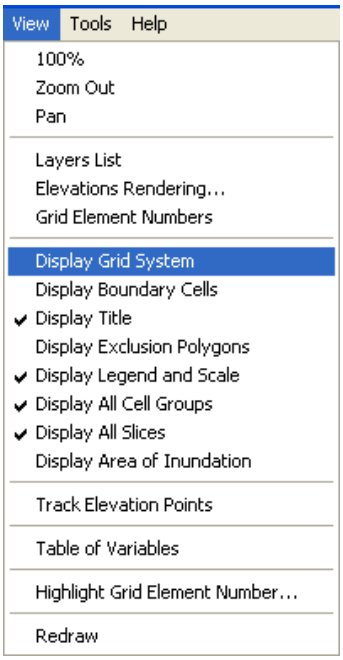
Grid Element Numbers Command (View Menu)



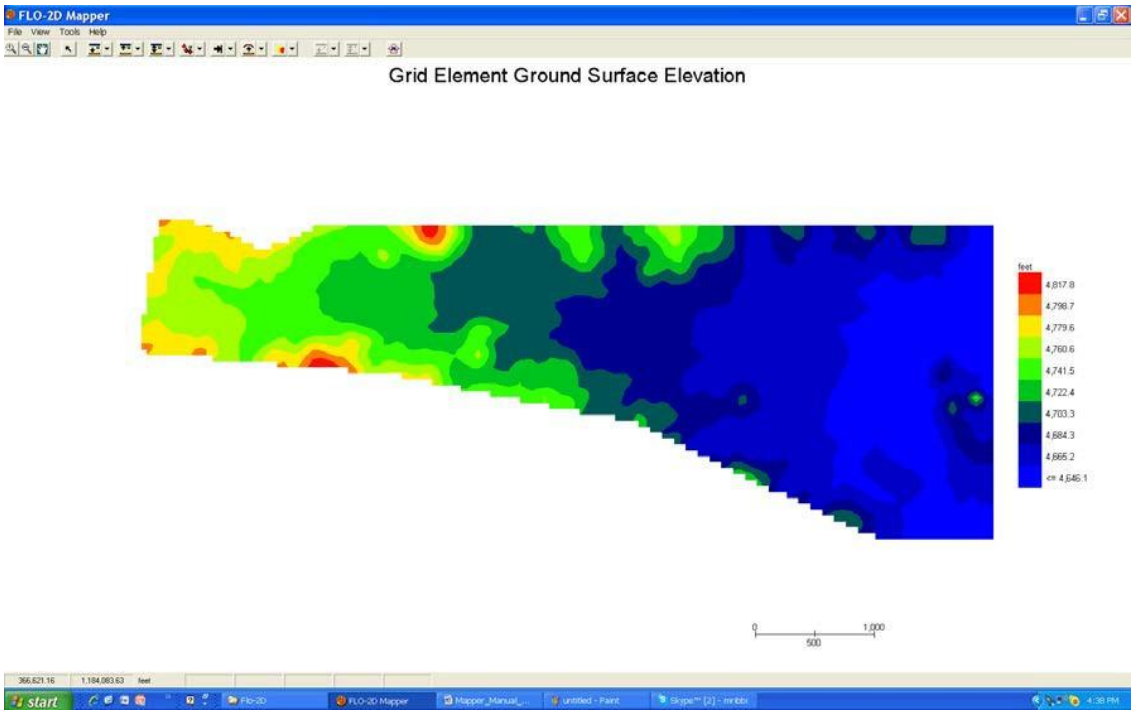
By default Mapper does not display grid element numbers. Use this command to display grid element numbers. Note that if the grid system is very large, the higher number grid element numbers may not fit into the elements. Zoom in to enlarge the view and allow clear view of grid element numbers.



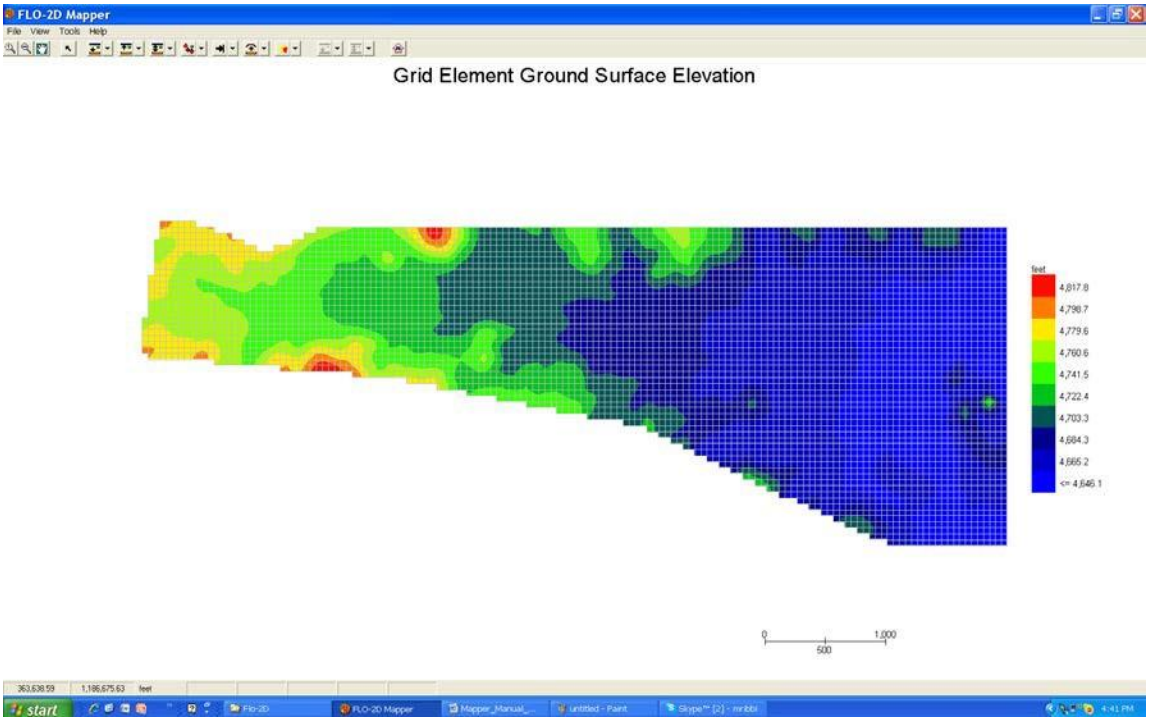
Display Grid System Command (View Menu)



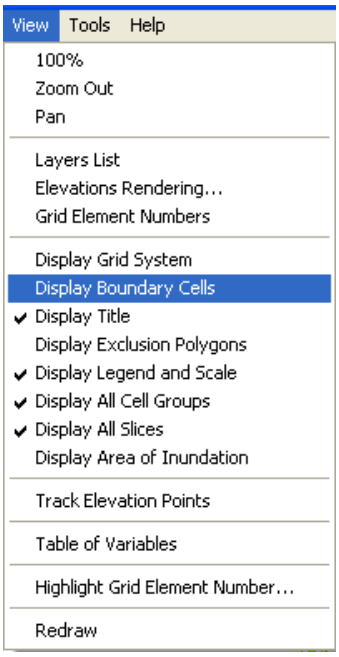
Click on this command to view the *FLO-2D* grid system as an overlaid image. The following plot does not display the grid system:



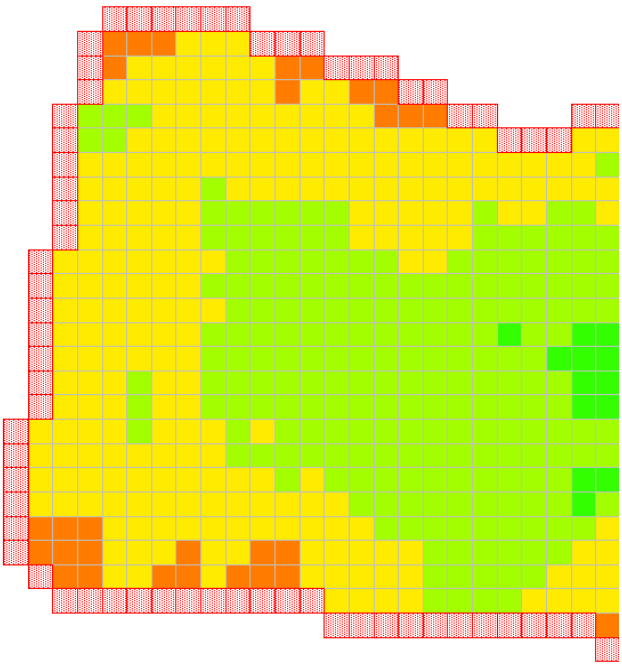
The following plot does displaying the grid system:



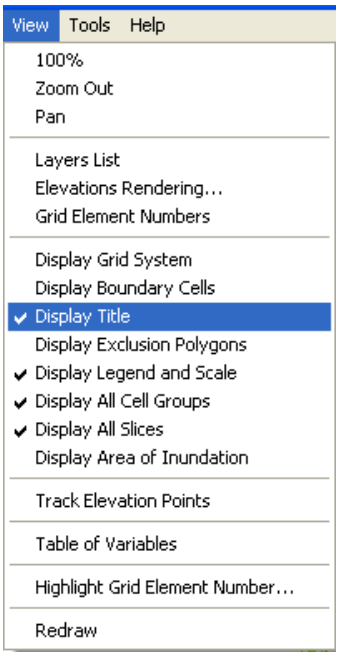
Display Boundary Cells Command (View Menu)



This command displays the *FLO-2D* grid boundary cells.

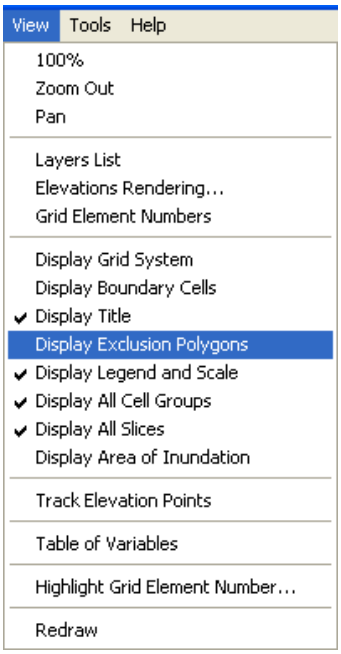


Display Title Command (View Menu)



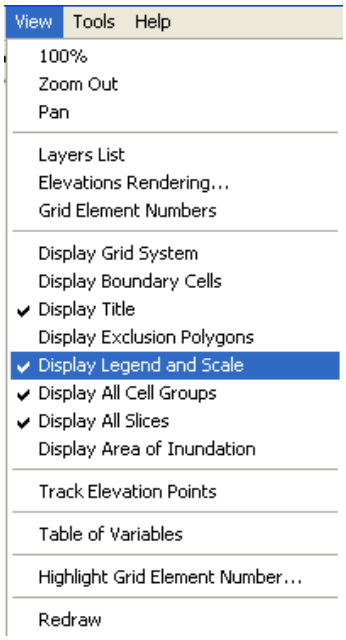
This command allows you to display or hide the plot title.

Display Exclusion Polygons Command (View Menu)



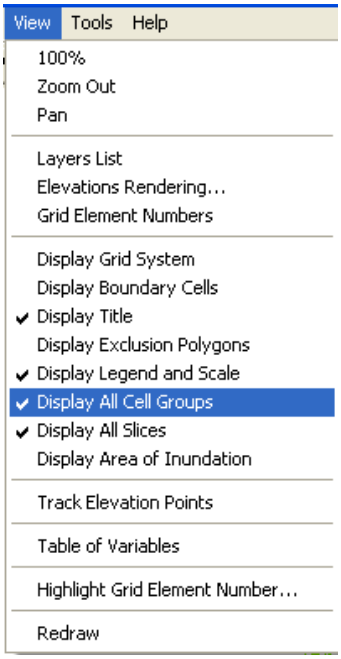
This command allows you to display or hide the polygons used to delete unwanted parts of shaded contour plots based on DTM data. To see Exclusion Polygons they have to be created using the *Tools/Exclusion Polygons/Create Exclusion Polygons*.

Display Legend and Scale (View Menu)



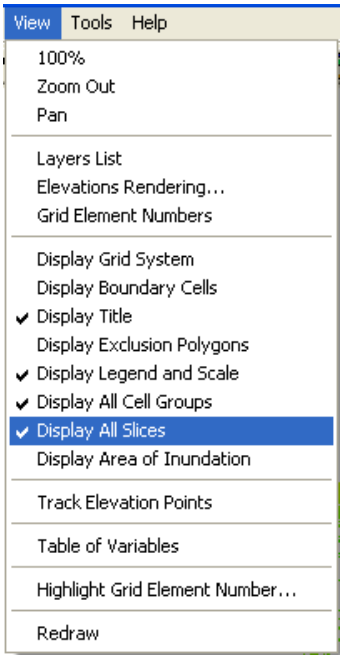
For the various flood variable plots, this command displays the map legend and scale.

Display All Cells Groups (View Menu)



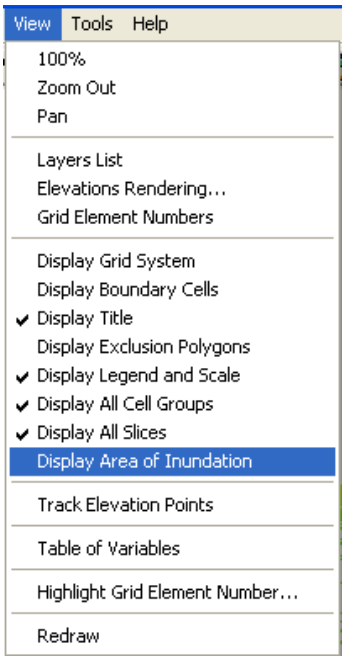
This command highlights all grid elements (cells) that are being used for plotting Flow depth and velocity vs. time plots.

Display All Slices (View Menu)



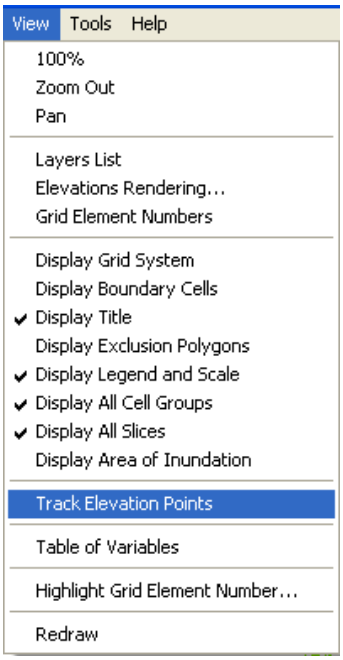
This command highlights all slices used for plotting flow depth and bottom elevation profiles.

Display Area of Inundation (View Menu)



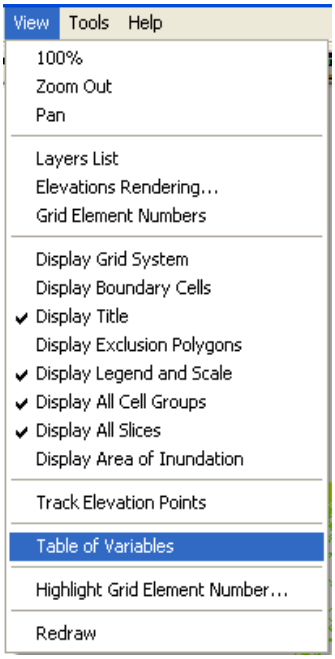
This command highlights the contour that limit the area inundated simulated by the FLO-2D model. This plot must have been previously created using the *Create Area of Inundation Layer* in the *Tools* menu.

Track Elevation Points Command (View Menu)

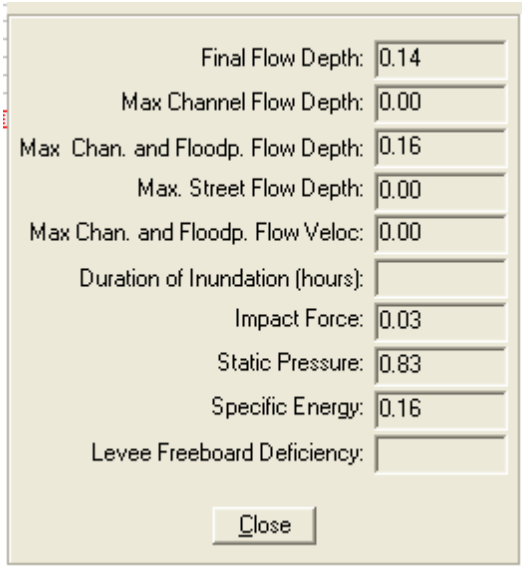


With this command, the elevation of any DTM point is displayed in a dialog box. When the mouse pointer is placed in the vicinity of a point, its elevation is displayed in the right text box of the bottom toolbar.

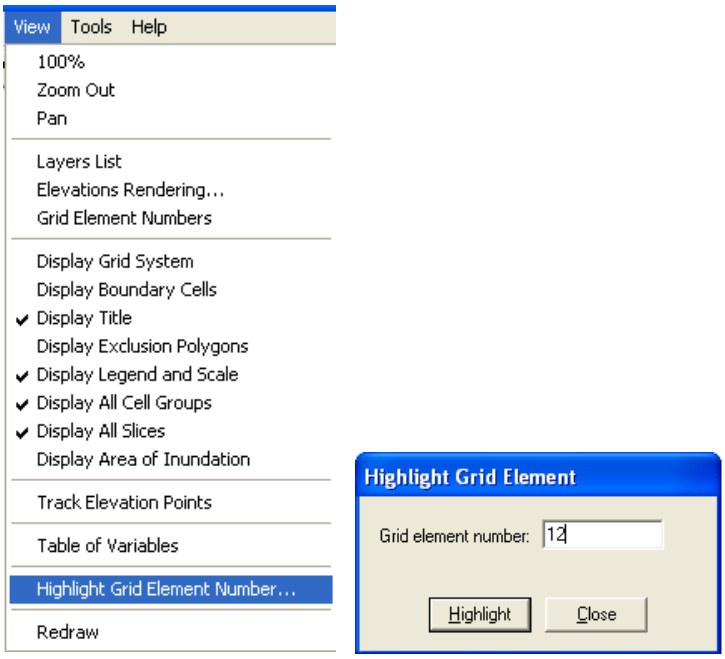
Table of Variables (View Menu)



This command displays a floating window with a table of FLO-2D hydraulic output data. When you move the mouse over the grid, the values are displayed for each grid under the cursor.

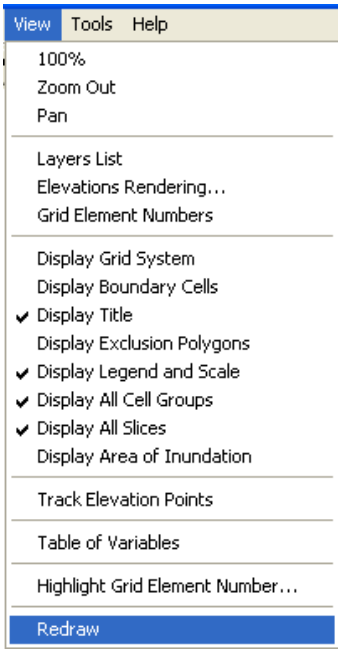


Highlight Grid Element Number… (View Menu)



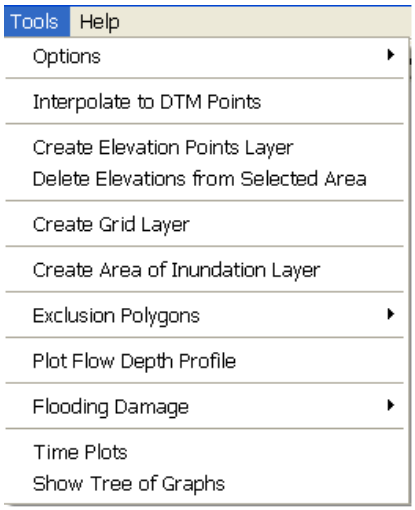
This command enables you to enter a grid element number in the following dialog box and locate it in the FLO-2D grid system. Mapper will prompt for the grid element number. When you click the Highlight button, the grid element will blink. Note that if the selected element number is not in the current view, you may have to zoom out to view the entire grid system in order to locate the grid element.

Redraw Command (View Menu)

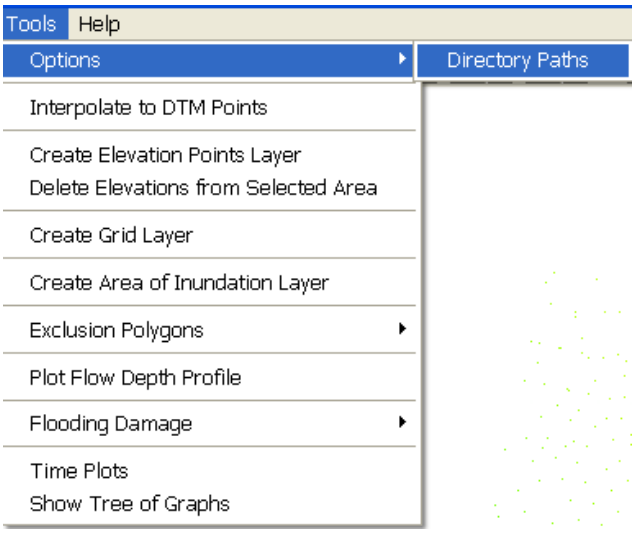


Use this command to redraw the visual objects in the *working region*.

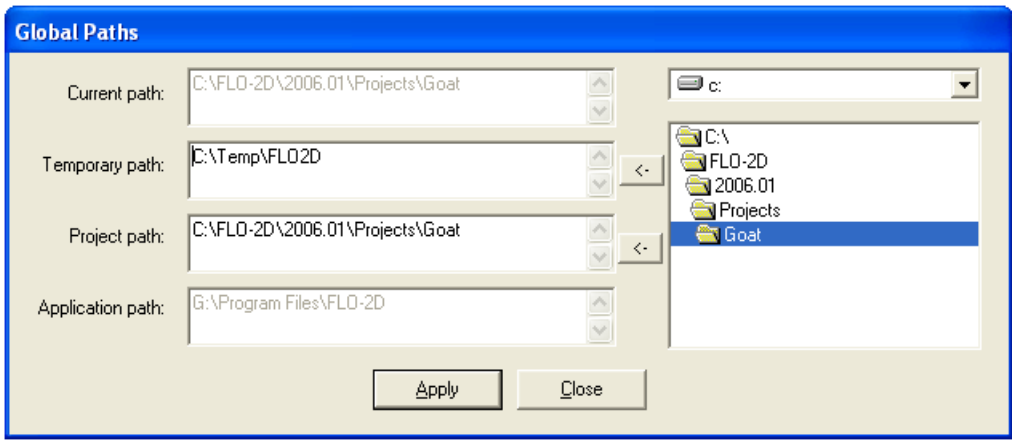
8.3 Tools Menu Commands



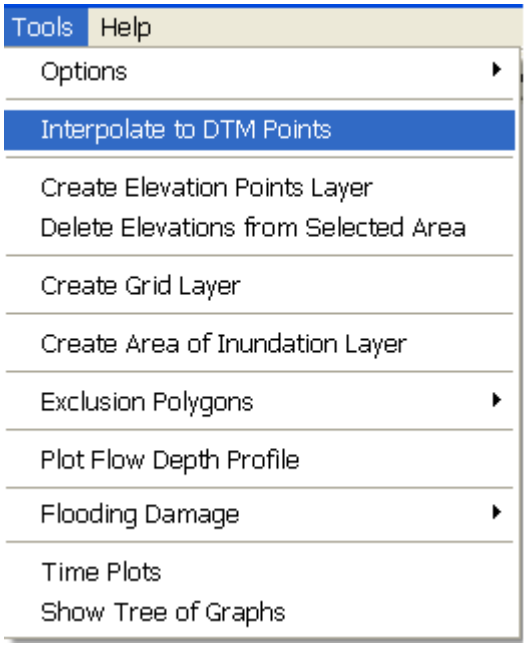
Option Directory Paths Command (Tools Menu)



This command allows you to change the *Mapper* default path by editing the settings in the following dialog box:

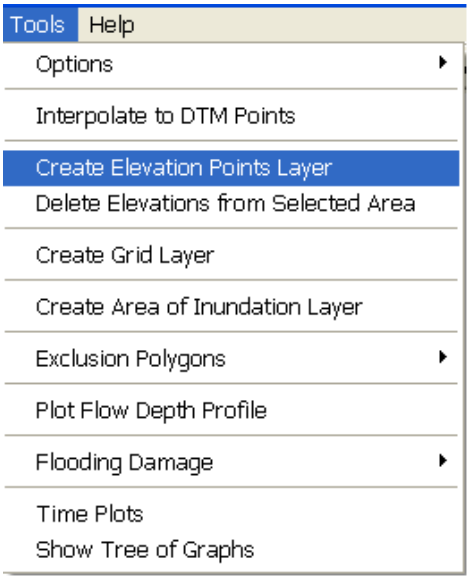


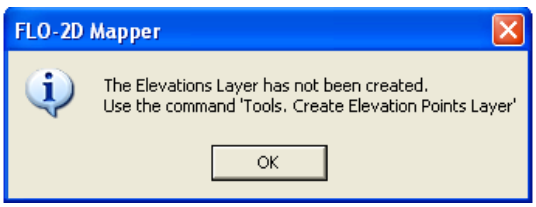
Interpolate to DTM Points Command (Tools Menu)



The purpose of this command it to create a TIN (Triangulated Irregular Network) based on the flow depths at each DTM point. The TIN is later used to construct the DTM Max Flow Depth Shaded Contour. To use this tool you first need to import the DTM points using the *Import DTM Elevation Points* command in the *File* menu. When this command is activated, the flow depth at each DTM point is computed by subtracting the DTM ground surface elevation from the grid element water surface elevation. You can import the DTM point file that was originally used in the *GDS* to interpolate grid element elevations.

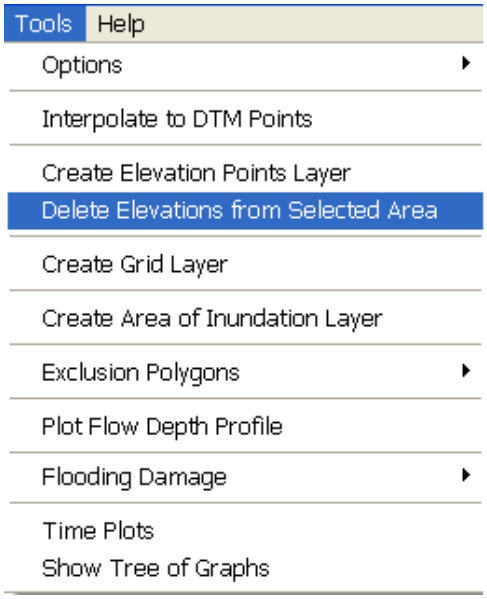
Create Elevation Points Layer Command (Tools Menu)





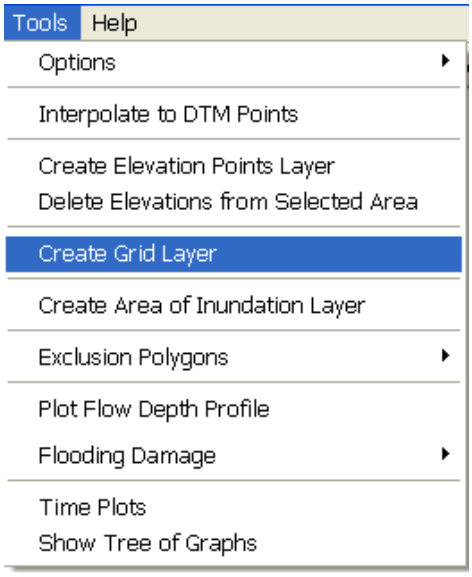
To optimize display times *Mapper* does not automatically create the Layer that contains the DTM Elevation points. For certain functions in *Mapper* this layer is required. If you try to perform to initialize a component in *Mapper* that requires this layer and it does not exist, the following message will appear. This command will create the Elevation Point Layer.

Delete Elevations From Selected Area Command (Tools Menu)



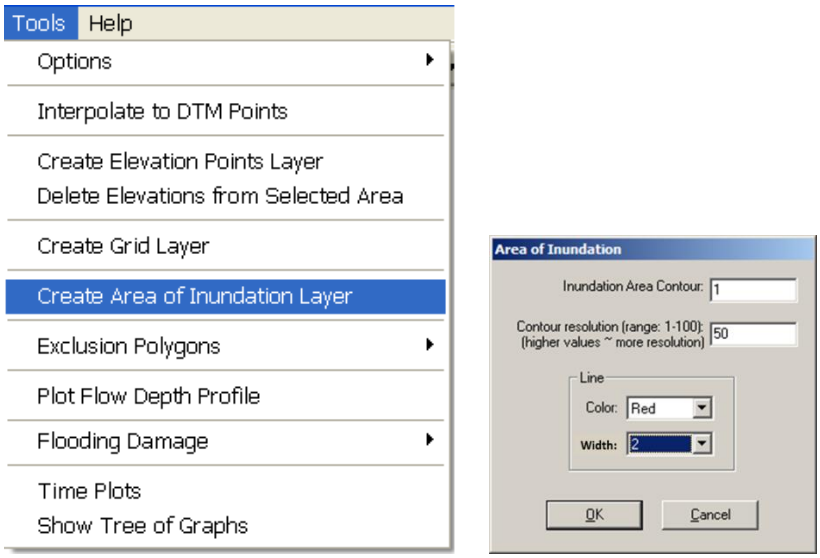
This command will delete unwanted DTM elevation points from the working region. The points are deleted by enclosing them in a polygon. The dialog box will appear instructing you to draw a polygon around the area will the DTM points that will be deleted. Close the polygon with a double click and another dialog box will be displayed asking you to confirm the deletion. You can save the edited points file using the *Save Elevation Points…*command in the *File* menu.

Create Grid Layer Command (Tools Menu)



This command creates the Grid Layer that is necessary for some operations performed on the grid.

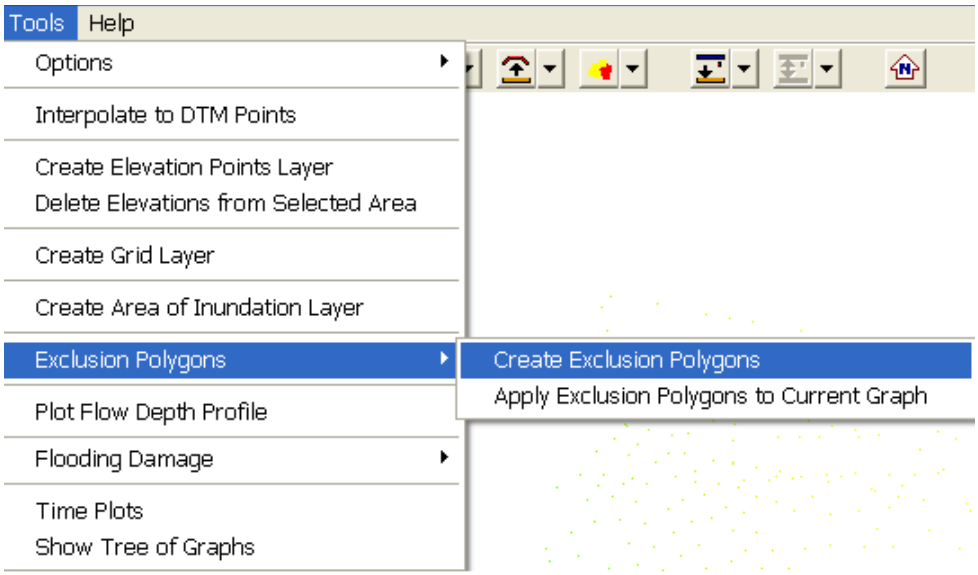
Create Area of Inundation Layer Command (Tools Menu)



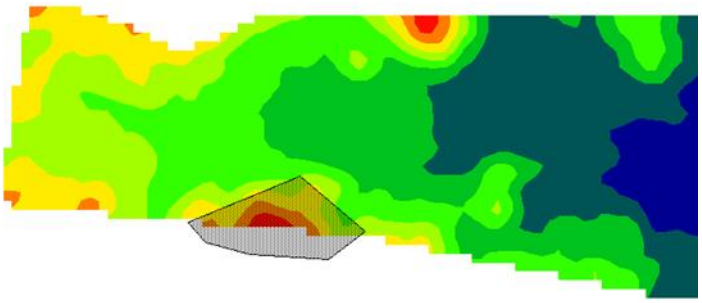
This command creates contour lines that enclose the areas inundated.

Exclusion Polygons Command (Tools Menu)

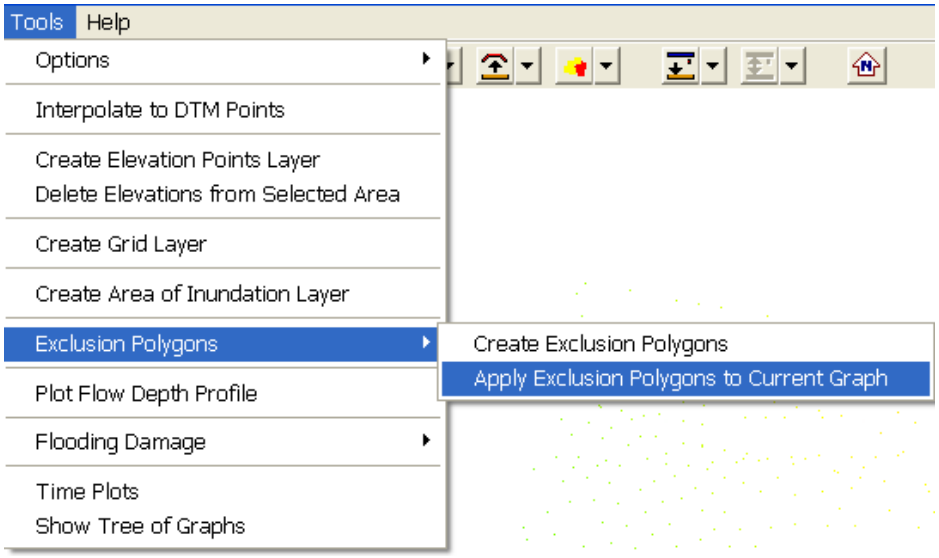
This function will erase unwanted areas from line or shaded contour plots. This is a useful tool when *Mapper* creates contour plots in convex regions or other areas where the contour lines have spilled over physical features should as levees or hillsides. This may occur because of either a grid element may straddle a physical feature or because there are DTM points located on the other side of the feature. It may also occur because of the finite thickness of contour lines and shade contour outlines. This tool allows you to delete the contour graphics inside an exclusion polygon. First click on the *Create Exclusion Polygon*:



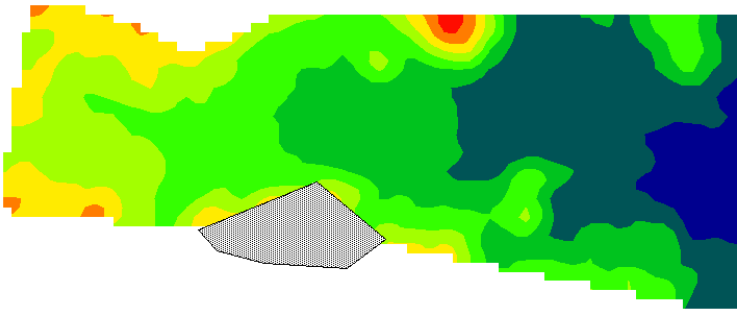
Then draw the polygon area that you want to erase. *Mapper* will hatch the polygon:



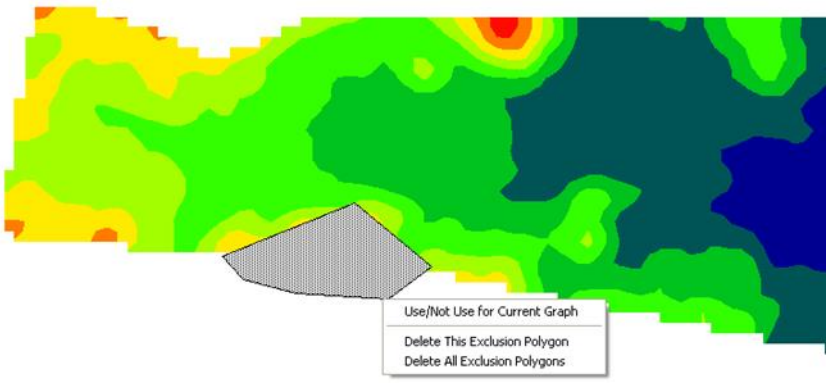
Next use the Apply Exclusion Polygons to Current Graph Command:



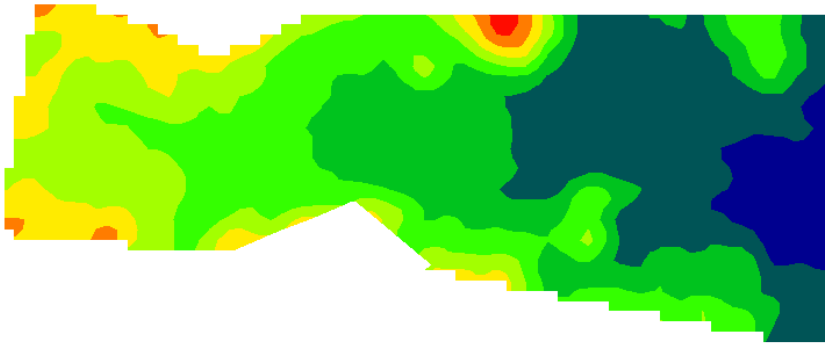
Mapper will erase the plot under the polygon:



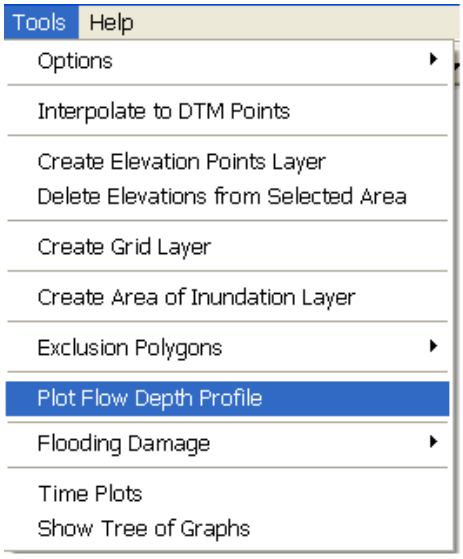
Click on the polygon border, a shortcut menu will appear:



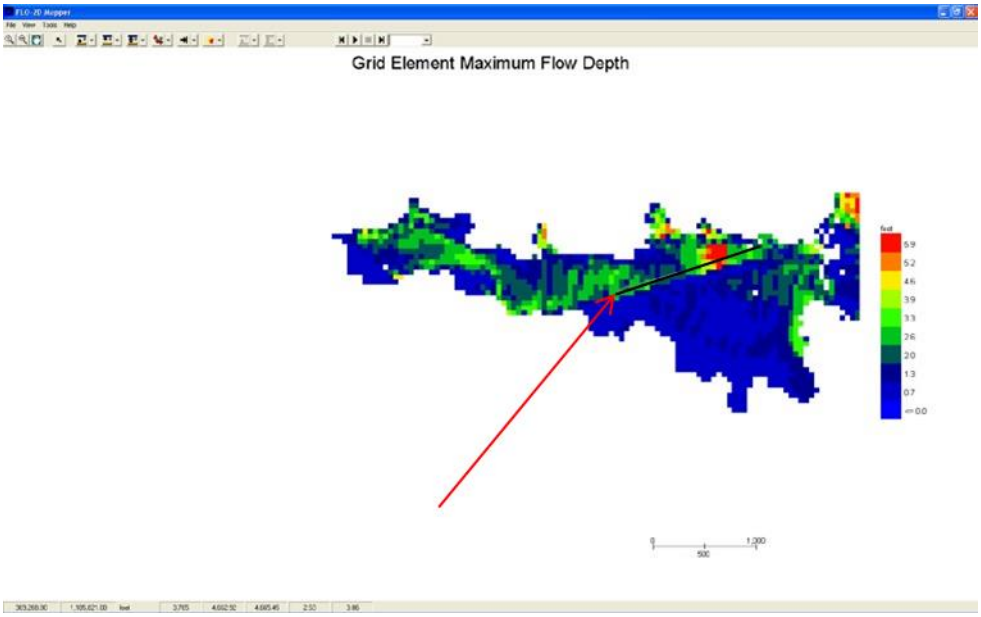
Click *Delete This Exclusion Polygon* to erase this portion of the contour plot.



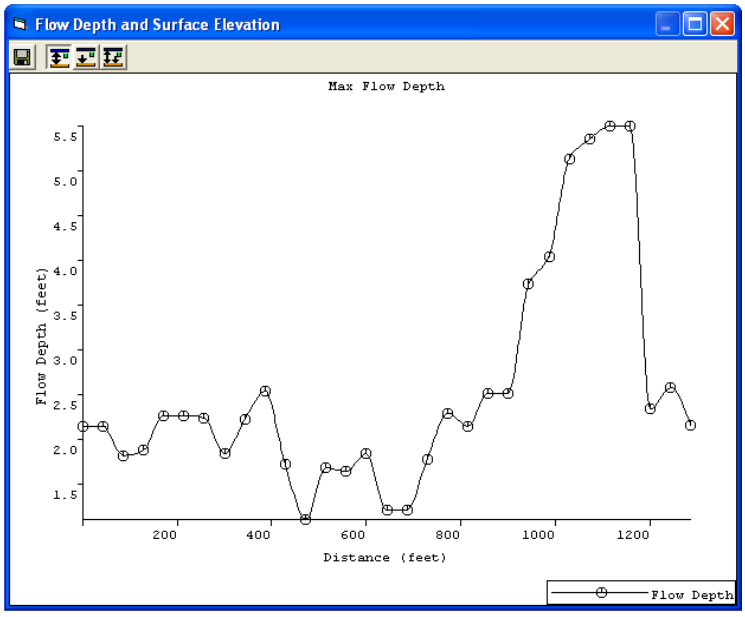
Plot Flow Depth Profile Command (Tools Menu)



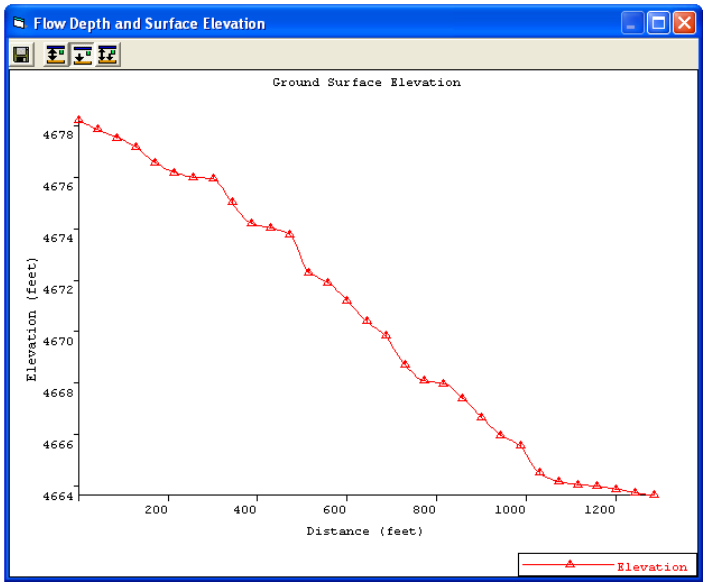
This feature will plot profiles of maximum flow depths, maximum elevations and bed elevation profiles. Click on *Plot Flow Depth Profile* command and draw a line where you want to create the profile. To draw the profile line, click on the first point and locate the mouse cursor on the second point and double click. The profile line must be within the computational domain.



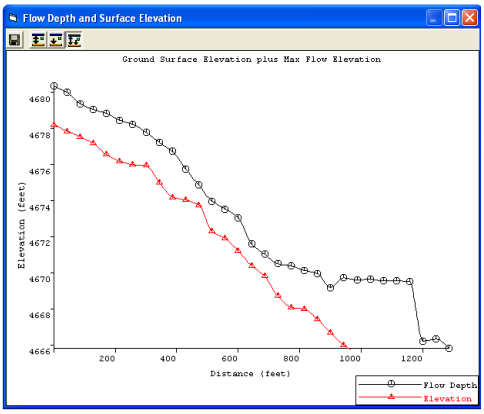
After double clicking on the second point of the line, the following window appears showing the maximum depth profile:



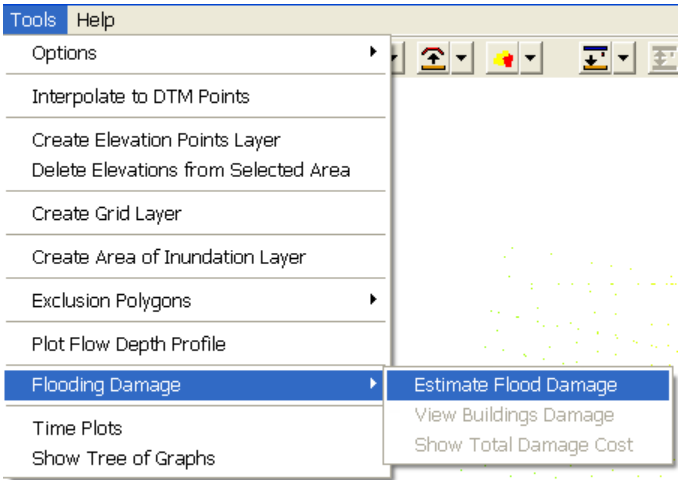
In the upper left corner of the window there are three icons: . The first icon plots the Maximum Flow Depth profile (shown above). The second icon will plot the Ground Surface Elevation profile:



The third icon is used to plot the combined maximum depth and ground elevation profile:



Flooding Damage/Estimate Flood Damage Command (Tools Menu)

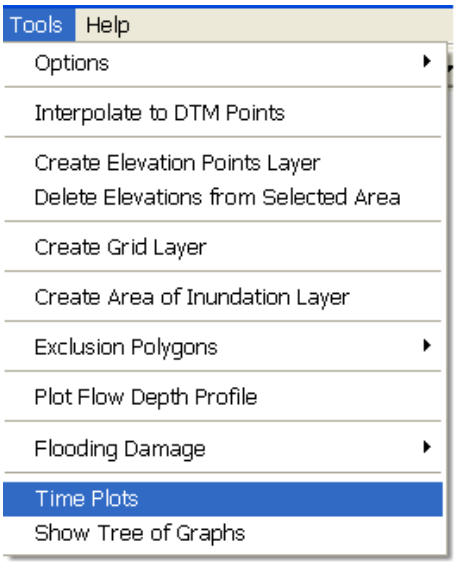


Use this command to estimate the flood damage. It can be used for any type of structure or land use such as agricultural crops. To use this option, you must have the following data:

- A polygon shape file containing an index for each polygon. Each polygon represents a building or house.
- A table file (*.TBL) containing damage ($) data as function of flood depth for each building type in the polygon shape file. This table file is organized as follows

The tutorial for generating a flood damage map and total value is in the Workshop Lesson Folder: Mapper Classic Pro Lesson.

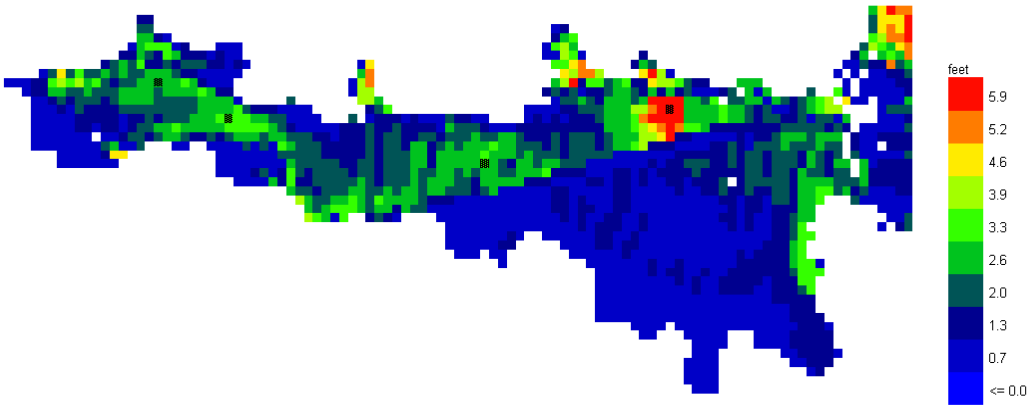
Time Plots Command (Tools Menu)



Use this command to select the grid elements and plot flow depth or velocity vs. time.

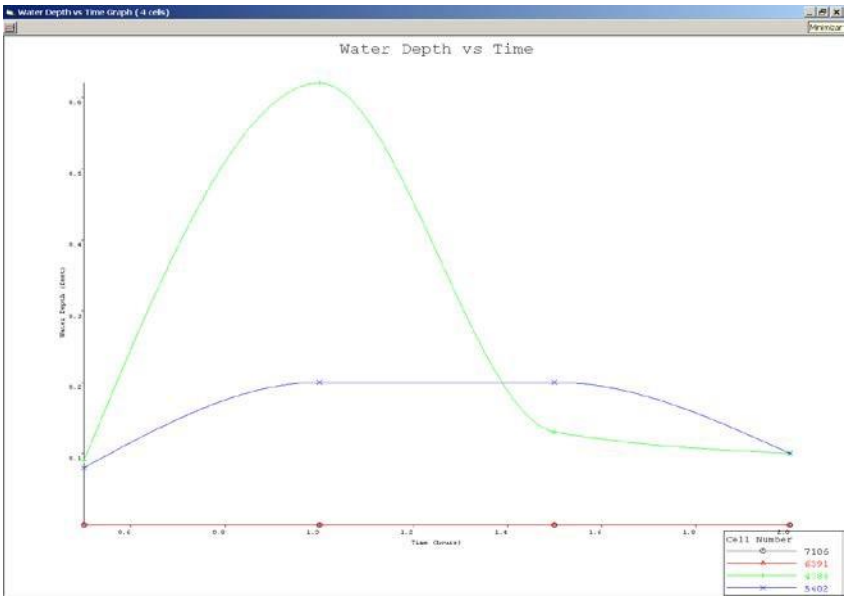
NOTE: This command is only available when the *Time Lapse Output* option was selected in GDS (assign ITIMTEP and TIMTEP variables in the CONT.DAT file for the FLO-2D model simulation). The model will then create the TIMDEP.OUT file that contains the depth and velocity time history by output interval for all grid elements. If this option was not

selected before running the model the *Time Plot* Command will be available in the *Mapper* menu.



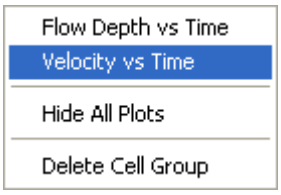
In the above figure displaying the maximum flow depth, four grid elements were selected. Right click on any of the selected elements and the following menu appears:

Choose for example the *Flow Depth vs. Time* option. The following graph is displayed:

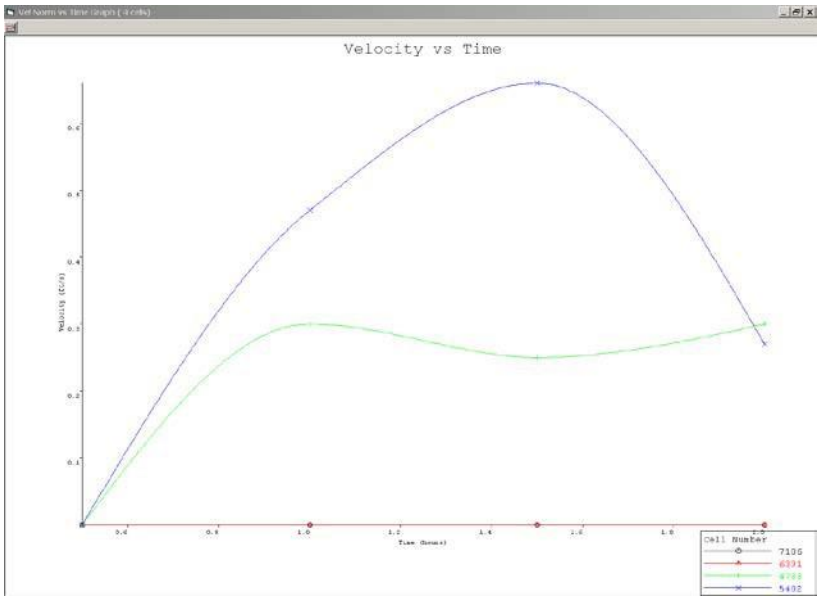


The legend indicates the grid element number. Only those grid elements with a flow depth greater than zero are plotted.

The other menu option is a plot of *Velocity vs. Time*:



Click on this command to plot the velocity versus time for each selected grid element:

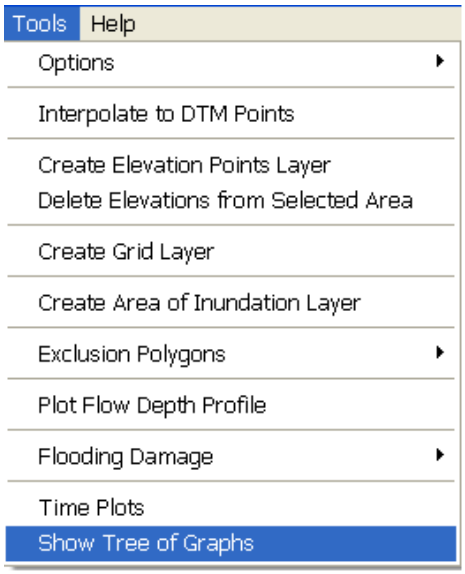


Hide All Plots (Time Plots Shortcut Menu):
This command hides all plots.

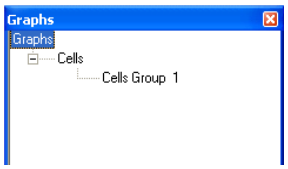
Delete Cell Group (Time Plots Shortcut Menu):
Deletes the selected cell or grid element group

Show Tree of Graphs (Tools Menu):

Displays all the existing plots associated with the grid elements groups.



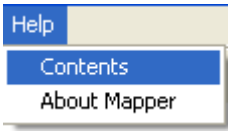
The following window is displays all selected group of Cells or Grid elements.



Use this tree to select any available group.

8.4 Help Menu Commands:

Contents Command (Help Menu)



This command initiates the help system that describes all the *Mapper* functions and menu items. The user may access the help system from any *Mapper* also using the F1 key and a window displaying the corresponding information will be presented.

IX. References

Fiebiger, G., 1997. "Hazard Mapping in Austria." *Journal of Torrent, Avalanche, Landslide and Rockfall Engineering* No.134,Vol.61.

Garcia, R. & Lopez, J.L, 2005. "Debris Flows of December 1999 in Venezuela." *Chapter 20th of Debris-flow Hazards and Related Phenomena*. Jakob, Matthias, Hungr, Oldrich Eds. Springer Verlag Praxis, Berlin.

Garcia, R, J.L. López, M. Noya, M.E. Bello, M.T. Bello, N. González, G. Paredes, M.I. Vivas & J.S. O'Brien, 2003. "Hazard mapping for debris flow events in the alluvial fans of northern Venezuela." *Third International Conference on Debris-Flow Hazards Mitigation: Mechanics, Prediction and Assessment*. Davos, Switzerland. September 10-12.

García, R., López, J.L., Noya, M.E., Bello, M.E., González, N. Paredes, G. & Vivas, M.I., 2002. "Hazard maps for mud and debris flow events in Vargas State and Caracas." *Avila Project Report*. Caracas, Venezuela, (In Spanish).

JICA. Japan International Cooperation Agency, 2000. *Maps of distribution of sediments in Vargas state*. Caracas, Venezuela, 2000.

O'Brien, J.S., Julien, P.Y. & Fullerton, W.T., 1993. "Two-Dimensional Water Flood and Mudflow Simulation," *Journal of Hydraulic Engineering*, ASCE, Vol.119(2).

OFEE, OFAT, ODEFP (Switzerland) Ed., 1997. "Prise en compte des dangers dus aux crues dans le cadre des activités de l'aménagement du territoire," Office fédéral de l'économie des aux (OFEE), Office fédéral de l'aménagement du territoire (OFAT), Office fédéral de l'environnent, des forets et du paysage (OFEFP), Bienne.

PREVENE. 2001. *Contribution to "Natural" Disaster Prevention in Venezuela*. Cooperation: Venezuela - Switzerland - PNUD (Project VEN/00/005).