

**RMAGEN**  
**A Program for**  
**Generation of Finite Element Networks.**

**USER INSTRUCTIONS**

**VERSION 8.4**

**JUNE 2020**

**Copyright**  
**Resource Modelling Associates**  
**Sydney, Australia**

1	GENERAL COMMENTS.....	1
2	UPDATE INFORMATION.....	1
3	PROGRAMMING CONSIDERATIONS AND LIMITATIONS.....	16
4	FIL HANDLING.....	16
	(4.1) Files Used in RMAGEN .....	17
	(4.2) FORMAT OF MAP FILE .....	19
	(4.3) MAIN MENU .....	21
	(4.4) WINDOWS MENU OPTIONS SUMMARY.....	22
	(4.5) TOOLBAR OPTIONS SUMMARY .....	23
5	MAIN RMAGEN MENU OPTIONS SUMMARY .....	24
	(5.1) FILE OPTIONS .....	25
	(5.2.) ELEMENT PROCESSING COMMAND.....	26
	(5.3) NODE PROCESSING COMMAND.....	35
	(5.4) DEFINING ORDERING AND ORDERING LISTS FOR RMA-1 INPUT FILE ..	43
	(5.5) DEFINING CONTINUITY LINE LISTS .....	45
	(5.6) DRAWING BOTTOM ELEVATION CONTOURS .....	46
	(5.7) ENTERING THE CROSS-SECTION MENU .....	46
	(5.8) COMPUTING SCREEN DISTANCES.....	46
	(5.9) SELECTING GROUPS OF ELEMENTS OR NODES .....	47
	(5.10) UNDOING PREVIOUS STEPS .....	50
	(5.11) DEFINING SCREEN VIEWS.....	52
	(5.12) REDRAWING OF THE GRID.....	53
	(5.13) ENTERING THE HELP PROCESSOR .....	54
	(5.14) EXITING THE PROGRAM .....	54

(5.15) EDITING NODES AND ELEMENT DATA .....	54
(5.16) OPERATING ON MAP FILES .....	54
(5.17) OPERATING ON MESHES.....	57
(5.18) EXPERIMENTAL OPTIONS OF THE RMAGEN MENU .....	65
6    EXAMPLE OF GENERATION PROCEDURE .....	69
Step 1 Generate an input map file .....	69
Step 2 Begin program execution and define input files.....	69
Step 3 Generate nodes.....	70
Step 4 Generate elements.....	71
Step 5 Move nodes.....	71
Step 6 Refine element layout.....	72
Step 7 Insert bottom elevations .....	72
Step 8 Insert fluid type numbers .....	73
Step 9 Define starting sequence for reordering .....	73
Step 10 Saving files or plots. ....	73
APPENDIX A.....	75
DATA FORMATS FOR THE RM1 FILE.....	75
APPENDIX B.....	81
STEPS FOR GENERATION OF RM1 AND GEO FILE IN RMAGEN.....	81
APPENDIX C .....	82
FILE FORMAT FOR THE CROSS-SECTION DATA FILE .....	82
APPENDIX D .....	85
FILE FORMAT FOR THE LINE BLOCK DATA FILE .....	85

## **1 GENERAL COMMENTS**

The program is designed to run in conjunction with a mouse and a graphics display screen. Its purpose is the creation of network geometry files that can be used as input to the RMA Suite of finite element models. "RM1" ASCII or "GEO" binary files may be created, edited or output. In addition, the "RM1" input file is directly suitable for input to RMA-1 for computer systems where graphics screens are not supported.

## **2 UPDATE INFORMATION**

### **Version 8.4 June 2020**

This update addresses two features of RMAGEN.

1. The treatment of GRD format map files has been modified so that when bed levels are automatically interpolated from the grid defined grid location. In addition, the size capability has been updated so that almost unlimited numbers grid cells can be input.

Finally, the display capability of this input data has been refined to build and then display an image. For very large systems this make display faster and not subject to a situation where a timeout occurs when drawing.

2 The mesh option which allows expansion of a 1-D line of elements to 2-D rectangular elements has been expanded to allow the user to select how many elements there will be across the section.

There are in addition a minor bug fix associated with map triangulation and the addition of an option to read outline lists from a file prior to triangulation.

### **Version 8.3h Nov 2019**

This minor update adds the 2dm (mesh) format file as potential input to or output by RMAGEN. It also corrects a minor display bug for 1-D elements.

### **Version 8.3g Sept 2018**

As a later addition a minor bug fix has corrected display of 2 node junction elements and modified the refine process to help ensure that when control structures are refined the initial 3 nodes that defined the upstream line are preserved. Finally refinement of type 999 elements has been corrected so that clean operation correctly

refines the adjacent 1-D element.  
Input of 6 and 8 node 2dm formats is now supported.

**Version 8.3f November 2017.** This release includes a number of updates designed to refine operation of RMAGEN.

- 1 Bed elevations are now added to 1-D nodes when cross-sections are input
- 2 RMAGEN has been modified to allow addition of a slot in 1-D cross-sections so that 1-D nodes will not go dry during RMA-2 simulations.
- 3 A 3-D view option of the mesh layout has been added. This allows a visual display of the mesh from any angle so that errors/inconsistencies can be detected.
- 4 Element colours have been adjusted for clearer display when a background image is displayed.

**Version 8.3e January 2017.** This release improves performance of RMAGEN in a number of areas

- 1 Treatment of very large systems has been modified so that display does not go into a repeated loop when these systems are redrawn. This is achieved by painting the output to a background file and then projecting it onto the screen. In addition an option has been added to the RDRAW menu that switches this process on and off. Finally the model has been modified so that a key stroke will stop the full network painting (if it accidentally occurs) and replace it with an outline view.
- 2 The process of merging networks has been reviewed and made faster and more reliable when 1-D elements are included. Space is now left to the full width of the 1-D elements.
- 3 To reflect the more frequent use of large networks the standard limits have been increased to 200,000 nodes and 120,000 elements.
- 4 Formats for the GFGEN format network output option have been expanded to allow for larger systems.

**Version 8.3d December 2016** This release modifies the testing to allow some tolerance for matches between coordinate locations and map locations when assigning bed elevations using a triangulated data set. This change helps to minimize assignment failures in this process. A second change modifies the output of file images in jpg format to add a jpgw auxiliary file that provides world registration of the image. In addition the manual registration process has been modified to permit output of jpgw files. Finally, reading of restart files written by the internal backup process has been adjusted to add more chance of recovery after serious failures. The obsolete save box menu item has been removed. All its functions can more easily be undertaken with the file menu.

**Version 8.3c September 2016** This release expands the capabilities of the module to automatically generate triangular grids. Each of these options requires the availability of TRIANG (developed by Sawchuck). This package is not supplied with RMAGEN and must be separately downloaded.

Two features have been added:

(a). The ability to add mesh by defining a succession of outline points and assigning a nominal element scale. This option is accessed from the “MESH/INPUT OUTLINE TO ADD MESH” menu.

(b) The ability to generate a complex mesh with internal break lines from a map data. This option requires a map file that first defines a system outline and then a series of lines that will form the break lines.

In addition the module has been modified to add a test for zero width in cross-section data and to correct a bug in array allocation that appeared when the number of elements exceeded the number of nodes (a very rare occurrence). In addition RMAGEN now allows GFG and TRIANG format files to be properly recorded in the list of mesh filenames

**Version 8.3b June 2016** This release adds a new option designed to permit input of element inflow files, display the appropriate location and if desired reassign the locations to a different element layout and save them to a new file. Additionally, by displaying the element inflows either as maxima or a sum over a period, these functions are also designed to ensure element inflows are correctly defined. Currently these options are implemented RMA-2 and RMA-10 format files. These options are currently available through the experimental menu and should be used with caution.

In additions two bugs have been resolved. One limited the effectiveness of interval reordering for very large systems with high initial front widths. The other resolved an issue arising for very large networks output as shapefiles.

**Version 8.3a Feb 2016** This is a release adds a new option designed to permit generation of so-called “shear stress” files that may be used in RMA-11 as an input file of bed stresses associated with wave activity. It is designed to interpolate onto the finite element network a wave related stress data available on any x-y basis or as an ESRI grid file (that is in one of the available map file formats). This option is entered through the experimental menu option. For further information see section 5.18

A second update allows background files in PNG or JPG format with associated world files (PNGW or JPGW) to be directly imported in RMAGEN.

**Version 8.3 Jan 2016** This is a new release that has several new capabilities

(a) A file menu option that allows multiple map files of varying types to be loaded into the system and combined.

(b) A file menu option that allows networks to be saved in shapefile format for input directly into GIS systems. Networks can be saved in complex polygon form (containing bed elevations at nodes and element type numbers for each polygon), point form (containing bed elevations) and conventional polygon form (containing the element and type numbers).

(c) An option on map input that allows map data to be loaded directly from point shapefiles.

**Version 8.2L Nov 2015** Corrects some issues with the automatic generation of

type 999 elements that connect 1-D elements laterally with 2-D elements

**Version 8.2K Sept 2015** Modifies RMAGEN to allow surfer format map files. Adds more information on status bar. Installs logic to test for whether reordering has been done and add indication as RMAGEN is exited.

**Version 8.2J May 2015** Corrects an issue where the origin and scaling of the background image is incorrectly applied when it is copied to a file or the clipboard.

**Version 8.2I May 2015** Revises the structure of the menu line to allow an experimental option where new and only partly tested options are placed. These are options that have limitations and are not always fully documented. They should be used only after consultation. Four options are currently in this state. See section 5.18 for more details.

**Version 8.2H April 2015** Corrects errors that can arise when GBLOCK is used.

**Version 8.2G March 2015** Updates the ability to find node and element numbers to allow Ctrl F and Ctrl E. Some limits tests are refined.

**Version 8.2F Jan 2015** Expands the format of saves continuity lines and adds a capability to read 2DM files.

**Version 8.2C, D and E Nov 2014** These releases update a number of features of RMAGEN and add a fairly specialized option for creation of weir/levee data.

- (a) Removes bugs associated with deletion and addition of continuity lines and display of these lines when the screen is panned or zoomed.
- (b) Correctly initiates the DeLaunay option.
- (c) Checks and creates error message when the fill and other operations exceed the array limits.
- (d) Corrects some of the labels during various operations.
- (e) Adds an option under the mesh menu to create weir data from a line of elements that border a continuity line. For more detail see the description in Section 5.
- (f) Fixes a bug that allowed junctions to be refined which is not a feasible operation.
- (g) Modifies the split operation so that continuity lines can be used as a source.

**Version 8.2b Sept 2014** This release adds a number of updates to RMAGEN.

- (a) Improves the screen information during the GBLOCK operation of RMAGEN.
- (b) Adds an option to create a block of 2-D elements from a line of 1-D elements.
- (c) Adds an option to create a block of 2-D elements from 2 roughly parallel map lines.

- (d) Adds an option to select and then move a group of nodes
- (e) Adds extra decimal precision to the make ap from nodes menu option

**Version 8.2a**                      **July 2014**    This update adds to the mesh menu an option allows all overlapping nodes (within an input tolerance) to be joined. This option may be used to correct situations where nodes accidentally overlap or for cases where meshes with common nodes are merged.

**Version 8.2**                      **June 2014**    This update adds the ability to process jpg files as background images. In addition further tests have been added to RMAGEN to make merging of meshes more reliable. A check of correct nodal connections have also been added. An option has been added to allow more operations when element types are selected.

**Version 8.1N**                      **August 2013** This update clears some of the difficulty of operation when using add and merge options on two meshes. In addition RMAGEN has been modified to cause the network to be displayed in outline mode when there are more than 100,000 nodes in a network. This is designed to speed initial operations.

**Version 8.1M**                      **July 2013**    This update adds an additional option to the mesh menu to allow deleting of all elements with a particular type number.

**Version 8.1L**                      **February 2013** This update adds an additional option for mesh transformation. Option 3 transforms the coordinate system by an arc rotation (an input number in radians) about input defined coordinates. For details see the input instructions.

**Version 8.1K**                      **January 2013** This minor update refines the precision output and display of bed elevations so that when numerically small numbers are used extra decimal places are shown/saved.

**Version 8.1 I and J**              **December 2012** This update adds an additional option the mesh menu that will provide a framework for future operations on the entire mesh. They are mostly aimed at test use of the models. Currently two options are implemented.

Option 1 moves the geometry to a new coordinate system both as a shift and as a scale, bed elevations may be similarly scaled.

Option 2 transforms the coordinate system into a circular curve.

Full details of the required inputs and methods used are provided in the section describing mesh options.

**Version 8.1G and H**              **July 2012**    This update allows loading of map files that are in the form of an ESRI ASCII format DEM.



**Version 8.1F February 2012** This minor update refines the process for treatment of very large systems that are too large for the initial dimensions. A display is added that allows the user to expand the limits to provide working space when loading very large systems.

**Version 8.1E December 2011** This minor update adds a series of options that allow reading, creation, display and saving of group numbers for input to RMA-2 and/or RMA-11.

**Version 8.1C and D July 2011** These minor updates correct some inconsistencies and adds two options

1 In the menu "Mesh" an option has been added that permits movement/rescaling of the coordinate system.

2 In the "Select/Element" menu an option has been added to allow the user to select elements by element type.

**Version 8.1B March 2011** This minor update designed allows the user to directly select a file name when creating map points from the menu option.

**Version 8.1A January 2011** This minor update

(1) expands the input formats so that free field (comma delimited) element connections can be processed.

(2) revises the 3-D view so that as the view is zoomed in or out the vertical scale is adjusted to maintain the aspect ratio.

**Version 8.1 (Sept 2010)** is an update designed to generate improved network quality.

(1) RMAGEN now offers expanded network checking capability. The purpose is to allow two-dimensional mesh builders to assess the variability of bed levels across elements and for one –dimensional elements to assess variability of bed levels and cross-sections. The Check toolbar function has been expanded to allow two types of network testing. One computes absolute values of bed level/cross-section change and the other computes a normalized value of depth change/cross-section. Once computed these values are displayed as equivalent contours on an element by element basis. An option on the SELECT menu item now allows the user to select the elements with higher values of the differences (the user inputs the fraction at the time of access) and then refine these elements.

(2) A second addition to the SELECT menu item now allows the user to find pairs of adjacent triangular elements that form a quadrilateral that has interior angles greater than 90 deg so that the original diagonal can be reversed and lead to an improved layout (that is, smaller interior angles). The user can select how many pairs are to be reversed in any single step. This option is particularly useful when

element refinement operations have been undertaken.

**Version 8.0D (June 2010)** adds:

- (1) an error message when background images are too large to display.
- (2) increased limits for formation of 1-D and type 999 elements from the "MESH" menu.
- (3) a registration capability when background images are slightly in error.

**Version 8.0A, B and C (April-May 2010)** are minor releases correcting a few bugs that arose from the switch to Intel Visual FORTRAN. Initialization of dialogs is improved. A bug in allocation of cross-section weighting when there are missing sections has been fixed. Some error messages have been improved.

**Version 8.0** is a new release that adds a number of features to RMAGEN. The principal technical update has been a switch to the Intel Visual FORTRAN compiler and the associated Winteracter library and allocatable arrays have been introduced.

RMAGEN has now been revised to permit 3-D views of the network with or without contours once it has been created. The contour option has been modified so that the element layout may be superimposed on top of the contours. This can clarify the perspectives of a 3-D view. Specifically the following additional menu items and buttons have been added.

- 1 In the VIEW menu, the "View in 3-D" item initiates the 3-D view capability and presents a dialog box that allows the user to set view angles and scale and origin values.
- 2 In the VIEW menu, the "Set View Angle" allows the user to reset or adjust the viewing angles.
- 3 A new button has been added that when clicked allows the user to rotate the viewing point in the horizontal plane (by clicking and dragging the mouse horizontally on the lower section of the screen) and rotate the viewing point in the vertical plane (by clicking and dragging the mouse vertically on the right section of the screen).

The user now has control over the size limits. In the FILE menu an option has been added that slows the user to "reset" the limits on the maximum nodes, maximum elements and max map points before files are input. Note that once the maximum number of nodes and elements have been set, they may not be adjusted. However if an oversized map file is being loaded, the user is invited to reset this limit. If a GEO file is loaded that is too large (without the reset option having been used) the "reset" dialog is automatically displayed so that the user can set acceptable limits.

**Version 7.4a** corrects a bug introduced in an earlier update that made merging and adding of networks unreliable.

**Version 7.4** is an update designed to add additional input/output capabilities. The

model is now capable of inputting files generated by TRIANG and outputting files for use by TRIANG. For information on TRIANG which is a free triangular mesh generated program developed by Jonathan R Shewchuk (see web site <http://www.cs.cmu.edu/~quake/triangle.html>).

A second addition has been the option to outline the user to generate a file of points that can be used as a mesh outline. This list can be generated in \*.poly form that can be used as input to TRIANGLE or in \*.dat form for adaptation as an outline in a "map" file. This option is accessed through the MESH menu.

Finally, a few changes have been made to make RMAGEN more user friendly.

- When interpolating bed elevations the user does not have to return to the "single" box.
- When the user selects a group of nodes and then desires to set elevation a number of options are now offered.

**Version 7.3h** expands the CCLINE menu to permit continuity lines to be updated (via a menu choice) when elements have been refined in the area of the CCLINES. A second enhancement insures that 2-d control structures are preserved (in a directional sense) when split into two elements during a refinement process.

**Version 7.3g** adds a series of new options,

(a) the ability to split a line of nodes (or a single node) so that a gap is created. This gap can optionally be filled with elements. This offers an easy method for adding weir elements or adding extra resolution along a line such as a river or navigation channel. The "split a line" option found in the MESH menu allows the user split a line of nodes. It must be used with mid-side nodes deleted. On entry the user is presented with the screen normally used for defining CClines. Clicking a series of nodes creates a line which is finalized with the CONNECT button. A dialog box then offers the user the choice of how far apart to split the nodes and whether or not to add elements into the gap. Note that if a single node is selected the user must define the directions of the split. For the case of points on a line the direction is computed automatically.

(b) the ability to generate a line of one-dimensional elements and/or type 999 elements that allow lateral transition from two-dimensional elements. The "form a line of 1-D elements" option may be found in the MESH menu. It offers the user the option of either creating nodes and then forming elements or clicking on a line of existing nodes to form the elements. The user can optionally assign the same properties to each node or enter properties through a dialog box. The "form type 999

elements" also in the MESH menu goes one step further. It allows the user either to create 1-D elements as above or input a line of 1-D nodes. Then RMAGEN automatically creates type 999 elements that abut the 1-D line on either side.

There has been a review of treatment of layer data in RMAGEN, as a result it is now possible to save ASCII files of layer data for direct addition to RMA-10 input files.

**Version 7.3f** updates the DEMO option to make it consistent with the latest options for reordering and simplifies initial operation.

**Version 7.3e** restores the ability of RMAGEN to display and generate layer data. An option in the dialog displayed when the DISP toolbar is clicked allows the user to select display of the number of layers on a node by node basis. Only nodes that do not have the default number of layers (9999) are shown. The layer option is selected in the "ELEV" box menu the user may choose the number of layers and the data values needed for the LD2 or LD3 option. A similar set of options now appear when nodes are selected from the "SELECT" menu.

This version also permits the user to select a REORDER/ALL option from the dropdown menus. This executes the reordering processor using as starting seeds each network element. PLEASE NOTE THAT FOR LARGE SYSTEMS THIS CAN BE VERY TIME CONSUMING AND IS ONLY RECOMMENDED WHEN OTHER REORDERING OPTIONS HAVE BEEN FULLY EXPLORED

**Version 7.3d** adds the ability to input and save SMS format "bin" files.

**Version 7.3c** adds the ability to extract parts of a mesh and save them to a file. This option is designed to be used when manipulating large meshes, so that the user is better able to debug a network by first simplifying then adding detail on a block by block basis. See section 1.10. A separate addition to the "CSECT" menu permits display of cross-sections loaded from the cross-section data file, see section 1.7 of the documentation.

**Version 7.3b** adds an initial capability designed to permit automatic construction of networks based on the bathymetry. Two new options have been added to the MESH dropdown menus. One enables construction of contour lines in "MAP" file format from existing nodal point values. The second allows mesh generation based on these contour lines. See section 1.18 for further information on these options. A second addition is additional options for display of cross-section data. on 1-D network views.

**Version 7.3a** adds additional capabilities to RMAGEN that allow the user to input, display, manipulate and save cross-section files that are to be used in RMA-2. The FILE, CSECT and RDRAW menu items have been updated. The FILE menu now allows input and saving of cross-section data files. The CSECT option now has a sub-menu item (COMPUTE WEIGHTING) that permits computation of weighting factors from data in the cross-section file, see Section 1.7. The RDRAW/DRAW

OPTIONS sub-menu now allows the user to select display of cross-section locations and the weighting functions for nodes.

A function update changes the display to a dialog when input of floating point and integer numbers is required.

A change has been made to the UNDO menu item so that users can now undo refine operations and element selections using separate sub-menus.

**Version 7.3** introduces a series of updates associated with manipulation of meshes.

1 The file menu now permits the user to load additional mesh files, so that more than one mesh may be worked on when using RMAGEN.

2 A new menu item "Mesh" has been introduced. The user may select which mesh to activate using a sub menu from the item.

3 The "Add mesh to existing" sub-menu may be used to add to meshes together without any regard to overlap.

4 The "merge mesh to existing" sub menu allows a mesh to be added to the existing with the condition that where elements overlap, elements are deleted from the mesh that is added.

5 The "Generate triangular block" sub-menu allows the creation of a triangular block of elements with different numbers of elements along each side.

6 The "Generate quadrilateral block" sub-menu allows the creation of a quadrilateral block of elements with different numbers of elements along each side.

7 The "Nodes" sub-menu under the "Select" has been expanded to allow the user to select nodes either from a polygon, as all nodes or as all unused nodes.

8 A new form triangles option has been added when a group of nodes has been selected using the "Select" option.

9 A new simplify option has been added when a group of elements has been selected under the "Select" menu. The user may use this option to reduce element density.

10 The create data option has been moved from its own main menu item to a sub-menu of the "Map" menu.

**Version 7.2** is an update designed to add three further map related options and a number of other menu options have been added or changed.

This version of the documentation contains an appendix that offers a short summary of the steps needed to successfully generate a network geometry file.

**NOTE** The user may now drag and drop RM1 or GEO files onto a shortcut to RMAGEN to initiate the program. The correct directory will be selected and the user prompted as to whether a map file is to be used. Remember that a map file is not required and will only be needed when nodal elevation data is to be interpolated.

The "triangulate map data" option allows automatic triangulation of map data using Delaunay triangularization. A set of element connections is developed in this process so that they may be used as part of the new nodal interpolation option discussed below. NOTE that this option can take considerable computing resources if there are many map data points, and that about twice as many elements as map data points are created. To reduce resource demand an additional dialog has been created that allows the user to skip some data points or only process points that are an input spacing from other points.

The "Switch to show Map Data" option allows the user to display a triangulated map file as if it were an RM1 file. At that point the triangulated map file can be operated on in the same way as any network file. In particular elements and nodes can be deleted so that the triangulated map file can be cleaned up to better represent the system.

The "Switch to show RM1 Data" option allows the user to revert back to the RM1 file.

Users may now save the triangulate map data when saving map information in binary format. Users may now load map files in RM1 format, so that externally triangulated networks may be read in. At present, the loading process deletes all mid-side nodes and assumes only a triangular representation of the system.

Within the NODES/ELEV menu for interpolation of bed elevations the user is now prompted to use either a triangulated data set or use the original RMAGEN interpolation.

An additional option has been added to the file menu that permits the user to save binary geometry files with headers (so that they can be used on UNIX or LINUX systems). The file format may be selected as either "big-endian" or "little-endian" as required by the alternate system.

**Version 7.1** is an update designed to add two new menu options, (editing of nodes or elements and an additional map file making capability) and to correct two bugs that have been detected. A further addition allows nodal connections to user 6 column formats (this is needed when element numbers exceed 99999).

The Edit menu allows ASCII editing of nodal coordinates and element connections. See section (5.15)

The new map-making facility allows the user to read in a network (in the usual finite element RM1, GFG or GEO format) and output an interpolated file over a uniformly spaced grid (with the spacing set by the user). Thus the user who has a triangulated set of data from another source can automatically create a high-resolution file.

\*See section (5.16)

Dimension limits on a large capacity RMAGEN have now been set to allow up to 200,000 elements and 400,000 nodes and a 3000 by 3000 output grid. The standard limits have now been set to 50,000 elements 100,000 nodes and a 1000 by 1000 grid. For smaller computers, the medium limits are set to 20,000 elements, 50,000 nodes and a 300 by 300 grid.

NOTE that the parameter NTEMPIN on line B of the data has an expanded set of values (see input format instructions.)

The corrected errors are as follows:

- (a) Double precision coordinates were not always correctly written to RM1 files.
- (b) Some steps when setting element types occasionally caused the elements to be deleted.

**Version 7.0** represents a major revision that has been designed to update the file handling to accommodate revisions to RMA-2, RMA-10 and RMA-11 that allow for double precision storage of coordinates and larger integers for node numbers. RMAGEN has been modified to allow input of geometry files either from old format GEO or RM1 files or from a newly developed format output by version 7.0 of RMAGEN.. The "new" format RM1 file allows 20 columns for the x and y coordinates and is referred to in RMAGEN as the "long format". The "new" format GEO file begins with a 1000 character header that starts with the characters "RMAGEN"

The fonts and general readability of RMAGEN text display has also been improved.

On entry to the "Open" menu the model now first prompts for the network file and then the map file.

In addition to RM1 files the user can now open and save ascii network files generated by SMS. In RMAGEN they are given and use the suffix "GFG" thus they should be renamed as "GEO" to or from use in SMS. Similarly, the user may save "BIN" format binary geometry files for use with SMS.

Bed elevations are now displayed with decimal points.

A number of toolbar options have been implemented for easier zooming, and panning, and filling/deleting of mid-side nodes.

**Version 6.4** adds (a) additional data input for sloping beds in one-dimensional elements, (b) permits the user to display data values as colored points as an alternative to numbers and (c) add the x and y location to a new status bar at the

bottom of the active window.

**Version 6.3** adds a new feature to RMAGEN, namely, the ability to lock/unlock nodal elevation values. The lock/unlock options can be accessed from the node/elev menu or after “selecting/nodes” from the dropdown menu. This feature allows the user to manually set nodal elevations and then allow the interpolation routine to pick up values for other nodes. This option is accessed node/elev box menu. This version also allows the user to load a replacement map file during processing and save the lock/unlock information on the rm1 and geo files. Finally the geo file has now been modified to store reordering data so that this information is available to the user when loading the geo file for processing.

**Version 6.2** adds the capability to register corners of a loaded image using known locations of points within the image. This option is accessed from the Rdraw/Background/Register drop down menu. This version also adds additional information when reordering stops because of a poorly constructed network.

An additional change in revision (a) allows the user to delete all continuity lines by selecting a zero continuity line number when deleting.

**Rev 3 of Version 6.1** is a modification designed to clarify the limitations of RMAGEN when copying and printing files that contain background images. The limitations are those imposed by the graphics library and will be removed as soon as possible.

Copy file limitations.

- 1            Networks only can be copied in any of the available formats.
- 2            Networks with background images can only be saved in “emf” format and the background image must have been input in a vector format, i.e. a non bitmap format.
- 3            At present copied image files may revert to the full size of the image even if there has been a zoom operation. This limitation does not apply to clipboard or printed images. The extent of the image displayed depends on Windows application. In general this means that size of this saved image may be very large. If the user wishes to copy and save images of a small section of the network, it is recommended that an external graphics or GIS program be used to construct a wmf file that covers the area of interest.

**Version 6.1** adds a series of new capabilities designed to enhance usage:

- 1            The capability of displaying background files. These files may be in a variety of formats, either bitmap format (bmp, pcx or png) or vector format (wmf, cgm, or pic). For further details see a new section that describes necessary formats for the background file.
- 2            The addition of an “undo” menu option that may be used following



generation of a block of elements to delete the entire new block or following refinement to remove the last refinement step, even after the “clean” operation

3 During display some of the plotted numbers have been reduced in size to reduce congestion on the screen.

4 The screen display may now be written to the clipboard.

5 The “makemap” option has now been modified to output the map file in a type 2 format.

6 This manual has been expanded by the addition of two appendices. Appendix A lists the formats for the RM1 file and Appendix B gives a series steps to guide users through the use of RMAGEN

**Version 6.0** reflects a significant change to the treatment of continuity lines. In this version they may be:

1. Displayed using the redraw menu. Note that this option replaces the “grid” option that is now only available from the dropdown redraw menu.
2. Assigned a number and re-entered or deleted.
3. Saved on the binary geometry file.

A further change allows the user to construct the reordering list and then “save” it instead of predefining the list number.

**Version 5.4** reflects the continuing expansion of module operation.

1 The select/node option of the main menu has been enhanced to permit the user to define a given number of 3-D layers for those nodes. If not previously defined the user will be prompted for a file name where this 3-D data will stored.

2 The “threed” option of the node/elev menu has been rewritten to store values to a file.

3 Additions have been made to the ordering menu options to permit the user to compact node and element numbers to eliminate missing numbers.

**Version 5** has been compiled with version 4.5 of the Lahey compiler and has been adapted to run under WINTERACTER. This offers the user a more Windows like feel to operation of the module. Several important changes apply:

- 1 File opening and saving is now prompted through Windows boxes.
- 2 The main menu is always available at the top of the window and switching between menus may be accomplished by pointing at the appropriate identifier.
- 3 A number of new features are now available from drop down menus

**Version 4.2** revises the algorithm for computation of bottom elevations from MAP data and shifts a number of the I/O functions to the graphics window. An option has also been added for "Move Node" and "Refine" operations that allows the user to reset bottom elevations to -9999 for nodes that are moved or created during refinement. Version 4.1 allows the user to generate continuity lines for direct input into data files of other RMA models

**Version 3.3(a)** permits the user to optionally save a record of all mouse and keystroke operations and to later play these back. These feature can be used for debugging and producing demonstrations of model use. For instructions on the use of this option see the file handling section below. For information on the status see the "READ.ME" file accompanying this documentation

### 3 PROGRAMMING CONSIDERATIONS AND LIMITATIONS

RMAGEN-V7\* is written in Intel Visual FORTRAN with the WINTERACTER graphics library. The file RMAGENV8\*.HTM IS used by the built-in help processor and must be available if it is to be used during processing.

The following limits are currently applied from a PARAMETER statement in FORTRAN but may be modified through the initial file menu “reset sizes” option:

Max number of nodes	200,000
Max number of elements	120,000
Max number of points in map file	200,000
Maximum number of reordering lines	20
Max number of lines in contour map on map file.	3,000
Max number corner nodes generated in a block generation step. This is the product of the number of elements plus one in each direction See "gener" option	20,000
Maximum number of grid cells in the x and y direction for generation of map files	1000

### 4 FILE HANDLING

On initial startup, the FILE menu offers 4 main options:

- NEW starts RMAGEN with either a scale established from a previously loaded background file or an arbitrarily established scale with neither a “map” file nor a geometry file loaded.

- OPEN requests input of a “network” file and a “map” file. It automatically defines two additional files (see later). If no “map” is available the cancel option automatically moves the user on to display of the network.
- OPEN BACKGROUND FILE requests input of a background file that may be optionally displayed as a layer below the map and network. Note that multiple background files may be loaded and stored for later display.
- OPEN CROSS-SECTION FILE allows the user to input a cross-section data file for viewing of or computation of weighting factors.
- RESET allows the user to set size limits for nodes, elements and map data.

The OPEN and OPEN BACKGROUND FILE or NEW and OPEN BACKGROUND FILE options may be selected in any order. If the background file does not appear after initial loading, it may be displayed by using the RDRAW option.

#### **(4.1) Files Used in RMAGEN**

File number 1: "Map File".

The map file contains the overall map coordinates that define the system and any available lines that define contours of bottom elevation. For further instruction, see the later section headed "Format of Map File". If the file entry is canceled, no map will draw. If the map file is given the suffix ".mpb" then it will be assumed to be a binary format map file saved from a previous execution of RMAGEN

File number 2: "RMA-1 Input file".

This is an input file containing a previously generated RMA-1 format input data set. Note that this file can either be a file previously created by RMAGEN or other sources. For details on the file formats see Appendix A

If the file entry is canceled, startup will assume there are no available node and/or element data, and the program will prompt for a title to act as a heading on the ultimate output file.

The binary ELT.bak file may be used for this input if its name is changed so that it takes the form XXXXXX+.RST. The binary file generated by RMA-1 may also be used as input. In this case its name should take the form XXXXXX.GEO. This file must be generated with a version of RMA-1 that saves width data and has the same integer length for NOP and IMAT in the "BLK1.COM" include files.

File number 3: Background file.

The background file may be in a variety of formats, either bitmap format (bmp, pcx or png) or vector format (wmf, cgm, or pic). This file may be developed outside of RMAGEN using other resources such as GIS or directly from digitized aerial

photographs. An additional ASCII server file must also be created that defines the geographic location of the image in the units used for the network. This file must have the suffix .ORG and an identical prefix to that of the background file that it serves. For example TEST.WMF would have a server file TEST.ORG. The contents of the server file must be the x and y coordinates of the lower left corner of the image and x and y coordinates of the upper right hand corner of the image. They should be entered in 4 fields of 16 including a decimal point for each coordinate. Note that when images are saved from RMAGEN and RMAPLT files of this type are automatically generated.

File number 4: Input Cross-section files.

An ASCII cross section file that is intended for use with RMA-2 may input for manipulation by RMAGEN. The format of this file is delineated in the RMA-2 documentation.

File number 5: Input group data files.

An ASCII group data file that is intended for use with RMA-2/RMA-11 may be input for manipulation by RMAGEN. The format of this file is delineated in the RMA-2 documentation.

File number 6: Output network files.

Two output files may be created during processing by RMAGEN. They are, an ASCII file in the format of an RMA-1 input file and a binary file with the structure of the interface file generated by an RMA-1 run. These files will contain the data generated during the current execution of RMAGEN when either the SAVE or SAVE AS entry on the file menu is entered or the ASAVE (for the ASCII file) or BSAVE (for the binary file) options are executed.

File number 7: Output Cross-section files.

An ASCII cross section file that has been edited with RMAGEN and is intended for use with RMA-2 may saved by RMAGEN. The format of this file is delineated in the RMA-2 documentation.

File number 8: Output Group data files.

An ASCII group data file that has been edited with RMAGEN and is intended for use with RMA-2 may be saved by RMAGEN. The format of this file is delineated in the RMA-2 documentation.

File number 9: Output image files.

Image files may be saved from the FILE menu using the COPY option, a number of bitmap formats (bmp, pcx or png) and vector formats (wmf, cgm, dxf or pic) images are available.

File number 10: "Backup" file. (no prompt)

A file with the name "ELT.BAK" will automatically be created in all runs. This file is binary in structure. This file is continuously updated whenever the program returns to the main menu or when a major process is quit.

File number 11: "Message" file. (no prompt)

A file with the name "MESGEN.OUT" will automatically be created in all runs. This file is continuously updated whenever the program has a message for the user. It should be checked on exit from the system. It will contain information that allows the startup.dat file to be defined, recorded values for continuity lines if generated, and generated map data when this option is chosen.

#### **(4.2) FORMAT OF MAP FILE**

Map files may now take two formats. Data points may be entered in RM1 format as a triangulated network or in the standard map file format.

The standard map file consists of a header indicating the type of line to be drawn followed by lines defining the location and bottom elevation if appropriate. Three types of input are possible that may be used for the system boundary, for definition of a bathymetry contour or for input of spot values of bottom elevation. A terminator indicates the end of a particular data set A header for a subsequent line should then follow.

Files are in free format or commas or spaces may separate data.

As indicated above the type of each line is defined by the header values:

= 0 defines a continuous line (recommended for boundary outlines or contours), it should be followed by a number which can be used, when interpolating for new nodes, as the bottom elevation for each location defining the line. To cause this elevation to be ignored during interpolation set this value to -9999.0

= 1 defines a dashed line (recommended for contours of bathymetry), it should be followed by a number that defines the bottom elevation for the line that follows.

= 2 defines spot values for bottom elevation that will be used during interpolation. Values of this type are not plotted as map lines

= 3, 4, 5, 6, 7, 8, defines line with identical properties to line type = 0 except that different color lines will be drawn. An option under the map selection allows the user to choose which line type numbers are drawn.

Listed below is an example of a Map file

0, -9999.

```
1.,1.  
2.,1.  
2.,2.  
1.,2.  
1.,1.  
end  
1,2.5  
1.5,1.  
1.,1.5  
end  
1,3.5  
2.,1.5  
1.5,2.  
end  
2,0.  
2.,1.,3.  
2.,2.,4.  
1.,2.,3.  
1.,1.,2.  
end  
end
```

### **(4.3) MAIN MENU**

Menu display is composed of three components. The Windows style dropdown menus that are always on show, toolbars and screen drawn buttons that change as different options are selected. The screen menus are fully compatible with earlier versions of RMAGEN and will be referred to as RMAGEN menus. The RMAGEN main menu is automatically entered on completion of file opening and working backwards through a "quit" entries from sub menus. At startup available map and element data may be drawn using the redraw option on the main menu.

To enter an option on an RMAGEN menu the user should either click with the left mouse button within the box of the desired option, or enter from the keyboard the appropriate letter in parentheses. Sub-menus and option menus are displayed as control is passed from the main and sub menus respectively. Windows menus may be entered either by selecting the appropriate location or using the ALT keyboard button and indicated letter.



#### (4.4) WINDOWS MENU OPTIONS SUMMARY

At present the following 18 menu options are implemented. The control letter for each option is in underlined>.



1	File	To control file operations	See section 5.1
2	Edit	To enter the Node/Element edit sub-menu	See section 5.15
3	Node	To enter the RMAGEN Node sub-menu	See section 5.3
4	Elts	To enter the RMAGEN Elt sub-menu	See section 5.2
5	Order	To enter the RMAGEN Order sub-menu	See section 5.4
6	Mesh	To initiate mesh manipulation	See section 5.17
7	Map	To enter the RMAGEN Map sub-menu	See section 5.16
8	Ccline	To enter the RMAGEN Ccline sub-menu	See section 5.5
9	Contour	To set contour intervals and draw contours	See section 5.6
10	Csect	To enter the RMAGEN Cross section processing sub-menu	See section 5.7
11	Distance	To compute distance apart of two points	See section 5.8
12	Select	To enter the node or element selection process	See section 5.9
13	Undo	To undo either generation of a block of elements, a refine step or an element selection	See section 5.10
14	View	To change the network view	See section 5.11
15	Rdraw	To redraw the network with new display options	See section 5.12
16	Help	To enter the main help processor	See section 5.13

17	Experimental	To enter the section with new experimental options	See section 5.18
18	Exit	To exit from RMAGEN	See section 5.14

**(4.5) TOOLBAR OPTIONS SUMMARY**

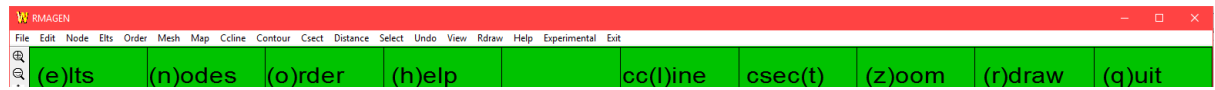
At present the following 10 toolbar options are implemented. They are displayed on the upper left of the screen. As shortcuts, they duplicate many of the menu entries.



1	Zoom in	To zoom in	See section 5.11a
2	Zoom-out	To zoom out	See section 5.11b
3	Pan	To pan/drag the mesh location on the screen	See section 5.11c
4	RST	To reset the original full screen view	See section 5.11h
5	DEL	To delete all mid-side nodes	See section 5.3.3.1
6	FILL	To initiate filling of mid-side nodes	See section 5.2.6
7	JOIN	To join nodes by deleting one	See section 5.3.3.6
8	DISP	To enter display options dialog	See section 5.12.2
9	CHK	To enter the check options	See section 5.17.13
10	Rotate	To change the angle of view	See section 5.11k

## 5 MAIN RMAGEN MENU OPTIONS SUMMARY

At present the following main menu options are implemented. The control letter for each option is in parentheses.



- |    |          |   |
|----|----------|---|
| 1  | (e)lts.  | To enter the elements sub-menu for element processing commands.   |
| 2  | (n)odes. | To enter the nodes sub-menu node processing commands.   |
| 3  | (o)rder  | To enter the reordering sub-menu to develop reordering and process reordering sequences.                                |
| 4  | (h)elp   | To enter the help processor for this menu.  |
| 5  | blank    |   |
| 6  | cc(l)ine | To enter the process of generating continuity lines   |
| 7  | c(s)ect  | This option may be used to select from sub-menus for cross-section analysis. It is only partially functional at present |
| 8  | (z)oom   | To change the scale of plotting   |
| 9  | (r)draw  | To enter the drawing sub-menu   |
| 10 | (q)uit   | To terminate execution of RMAGEN  |

## (5.1) FILE OPTIONS

New	
Open	Ctrl+O
Open Additional Mesh Files	
Open Background file	
Open Layer Data File	
Open New Map file	
Open Additional Map File (Combine)	
Open Cross-Section file	
Open Group File	
Reset Limits	
Save ascii	Ctrl+S
Save binary	Ctrl+B
Save as bin map	
Save as ascii	
Save as binary	
Save as binary with header	
Save Cross-Section Data	
Save Layer Data File	
Save ASCII Group File	
Copy to File	
Copy to Clipboard	
Copy to Shapefile	
Print	
Demo	
Exit	

The file menu is the controlling option for input of files.

- a. Starting a new network from scratch.
- b. Opening files, the first request is for a map file followed by the RM1, GEO or other format mesh file .
- c. Opening additional mesh files
- d. Opening background image files
- e. Opening layer data file
- f. Opening new map files
- g. Adding and combining mesh files
- h. Opening a cross-section file
- i. Opening group file
- j. Setting maximum node/element/map line limits
- k. Saving the RM1 or other format ASCII file after it has been previously defined

- l. Saving the GEO or other format binary file after it has been previously defined
- m. Initialize saving the Map file in binary format
- n. Initialize saving the RM1 file in ASCII format at an alternate folder location
- o. Initialize saving the GEO file in binary format at an alternate folder location
- p. Initialize saving the GEO file in binary format with a header
- q. Saving a cross-section file
- r. Saving the layer data file
- s. Saving the group data file
- t. Copying the current screen to a file
- u. Copying the current screen to the clipboard
- v. Copying the mesh data as a shapefile
- w. Printing the current screen
- x. Initializing the Demo option
- y. Exiting completely

### **(5.2.) ELEMENT PROCESSING COMMAND**

Enter by clicking on panel with the left hand mouse button or typing "e".

A sub-menu is displayed with a number of options:

(s)el	(j)oin	(f)ind	(g)blok	(t)ype	f(i)ll	(h)elp	(z)oom	(r)draw	(q)uit
-------	--------	--------	---------	--------	--------	--------	--------	---------	--------

- (1) (s)el. To highlight elements for later processing.
- (2) (j)oin To enter the manual element connection process.
- (3) (f)ind To find a given element number and replot with it at center screen.
- (4) (g)blok To start the element block generation process.
- (5) (t)ype To initiate element typing or grouping.
- (6) (f)ill To enter the element refinement process.
- (7) (h)elp To enter the help processor.
- (8) (z)oom To zoom in or out on the screen drawing.

- (9) (r)draw To redraw the screen.
- (10) (q)uit To return to the main menu

(5.2.1) (s)el. Element selection

Enter by clicking on panel with the left hand mouse button or typing "s". The grid will automatically be re-plotted displaying only the element numbers and the grid layout. A sub-menu will be displayed providing the user with several options

(d)el	r(e)fin	(n)umb	(a)ll	rectn(g)	(t)riang	(h)elp	(z)oom	(r)draw	(q)uit
-------	---------	--------	-------	----------	----------	--------	--------	---------	--------

- (1) (d)el. Deleting the highlighted elements
- (2) r(e)fin Refining the highlighted elements
- (3) (h)elp Entering the help processor
- (4) (z)oom Zooming in or out of the drawn screen
- (5) r(d)raw Redrawing the grid
- (6) (q)uit Quitting the process

The user must first highlight any number of elements by clicking with the left hand mouse button. The elements clicked will form a list for the subsequent operations, i.e. deleting or refining.

(5.2.1.1) (d)el Deleting a group of elements

Enter by clicking on panel with the left hand mouse button or typing "d". This option may be used for to delete the selected group of elements.

(5.2.1.2) r(e)fin Refining a group of elements

Enter by clicking on panel with the left hand mouse button or typing "e". This option may be used for to refine the selected group of elements.

(5.2.1.2.1) r(e)fin To enter the element refinement process.

The refine option presents five alternative schemes for refining triangular and quadrilateral elements. All the alternatives are entered by clicking on the panel with the left hand mouse button or typing "e". As the process is entered a sub-menu is displayed providing several options

(f)our	two(l)g	two(s)h	spli(t)	re(v)rs	clea(n)	(e)lsw	s(m)plfy		(q)uit
--------	---------	---------	---------	---------	---------	--------	----------	--	--------

- 1 Splitting the elements into four (4) new elements.
- 2 Splitting the elements into two (2) new elements using the longest element sides.
- 3 Splitting the elements into two (2) new elements using the shortest element sides.
- 4 Splitting a quadrilateral element into two triangles
- 5 Reversing the connections of two adjacent triangles to create a system with the diagonal joining the other two nodes.
- 6 Providing cleanup to ensure that all new nodes are correctly transitioned to the remaining grid.
- 7 During refinement a menu option switch lights that allows the user to select between linear interpolation of bottom elevations or setting the values to –9999 for later interpolation from a map file. Clicking on the box changes the switch from interpolation (the default) to no interpolation.
- 8 An experimental option that allows simplification of the area covered by the selected elements.

There are two possible entry paths during refinement. The first, which is preferred, is to use the element select option to highlight a series of elements and then to enter the refine option to carry the refinement on these elements. Refinement occurs when the options (a), (b) and (c) are entered by clicking on the panel or entering the appropriate letter at the keyboard.

Alternately the refine option may be entered with no list, the method is selected as above. Then elements are highlighted by clicking within the elements, finally this process is terminated by clicking on the "quit" panel (or entering "q" at the keyboard) the processor will then execute the refine process and return to the refine sub-menu.

The cleanup option should be executed as the final step in the refinement process.

To terminate the entire refinement process click on the "quit" panel (or enter "q" at the keyboard) the processor.

(5.2.1.3) (h)elp      *To enter the help processor*

Enter by clicking on panel with the left hand mouse button or entering "h" at the keyboard.

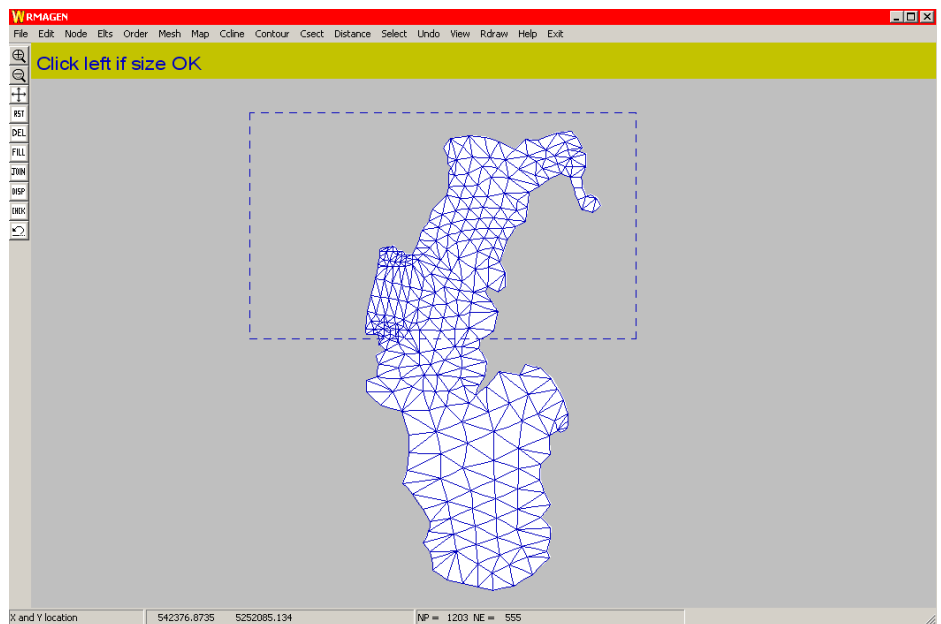
The help processor will display a help index and explain processor options to the user.

(5.2.1.4) (z)oom To zoom in or out of the drawn screen

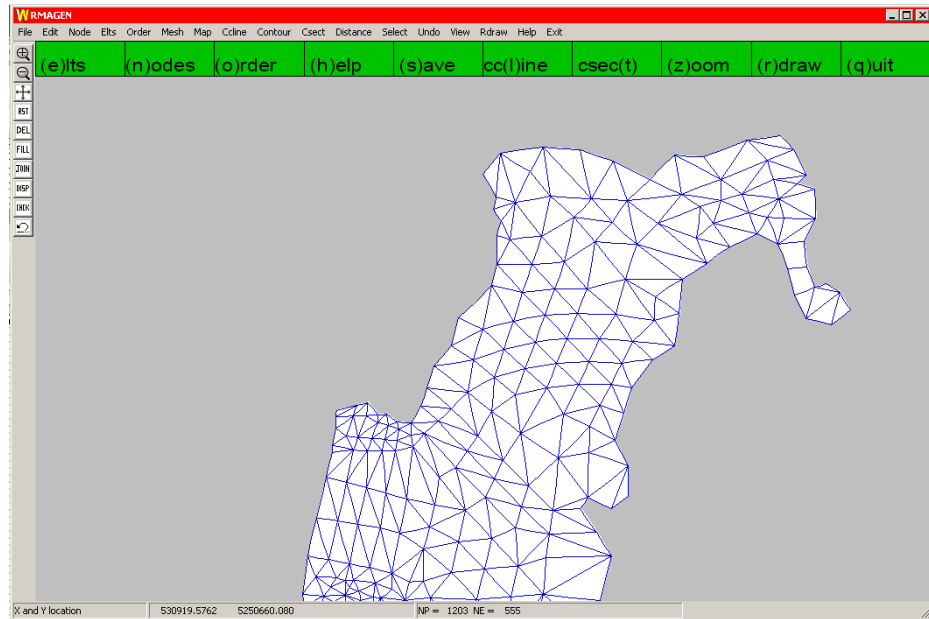
Enter by clicking on panel with the left hand mouse button or typing "z". The control panel will display the word ZOOMING.

Four alternatives are possible at this point:

- (1) Close up zooming This is achieved by clicking the left hand mouse button successively at the lower left and upper right locations of the desired new screen. At this point a dotted line will outline the screen form that will occur after zooming. The control panel will inquire if this screen is satisfactory. If it is click with the left hand button and the screen will be redrawn. If it is not satisfactory enter "e" on the keyboard to restart the process







- (2) Left pan redrawing This is achieved by clicking the mouse on the screen and entering "l" from the keyboard. The image will be redrawn at the same scale but shifted almost one screen left of the point. This is a largely obsolete option
- (3). Right pan redrawing This is achieved by clicking the mouse on the screen and entering "r" from the keyboard. The image will be redrawn at the same scale but shifted almost one screen right of the point. This is a largely obsolete option
- (4). Zooming out To enlarge the drawn area, place the mouse at the desired center of the screen and press the right mouse button. The grid will then be re-plotted at 0.5 the previous scale

After execution of the zoom command control returns automatically to the menu that initiated the command.

(5.2.1.5) (r)draw To redraw the network.

Enter by clicking on panel with the left hand mouse button or typing "r". A sub-menu is displayed with a number of options. As each option is activated the menu colour is changed. The options available are



- |    |          |  |
|----|----------|--|
| 1  | (m)ap    | To draw the map data   |
| 2  | (o)utln  | To draw outline of the network   |
| 3  | (e)lts   | To display the element numbers   |
| 4  | (n)odes  | To display the node numbers.   |
| 5  | ne(t)w   | To display the network   |
| 6  | ty(p)e   | To display element type or group numbers <sup>1</sup> .  |
| 7  | cc(l)ine | To display continuity lines.   |
| 8  | (d)ata   | To draw the data points for elevation defined in the map file. Note that when data points are activated the user is requested to enter the frequency of the displayed points and decide on the optional display of the data points as colours with one colour for each unit of range. This can serve to reduce the display of very large numbers of map points. The user can also decide on the optional display of the data points as colours with one colour for each unit of range. |
| 9  | (b)elev  | To display the bottom elevation (note that they are displayed as integers and multiplied by 10).   |
| 10 | d(r)aw   | To execute the redraw operation  |

Only the map option offers further choices

(m)ap To select map options. This option displays a panel that allows the user to select which type numbers associated with the map file are to be displayed

(5.2.1.6) (q)uit To return to the element sub-menu.

Terminate the process and return to the element sub-menu by clicking on panel with the left hand mouse button or entering "q" at the keyboard.

(5.2.2) (j)oin Manual element connection

Enter by clicking on panel with the left hand mouse button or typing "j". This option

---

<sup>1</sup> The choice between type numbers and group numbers is set in the RDRAW/TYPE/GROUP OPTIONS menu location

may be used for creation of all element types including control structure element. When generating two-dimensional elements ensure that the clicking generates a counter-clockwise sequence of node numbers. All clicking should use the left-hand mouse button unless otherwise indicated.

The operational process for each element type is described below.

- |     |                         |  |
|-----|-------------------------|--|
| (a) | Quadrilateral elements. | Click* on the four nodes that are to form the corner nodes of this element, then a final click generates and plots the element. If a mid-side node is desired at any point in the sequence place the mouse pointer over the node and type "m".   |
| (b) | Triangular elements.    | Click on the three nodes that are to form the corner nodes of this element, then type "t" to generate and plot the element. If a mid-side node is desired at any point in the sequence place the mouse pointer over the node and type "m".   |
| (c) | Line elements.          | Click on the two nodes that are to form the corner nodes of this element, then type "l" to generate and plot the element. If a mid-side node is desired place the mouse pointer over the node and type "m".  |
| (d) | Transition elements     | Click on the two nodes that are to form the corner nodes of the line element, then click on the two corner nodes of the connecting two dimensional element. Finally type "f" to generate and plot the element. If a mid-side node is desired for the line element place the mouse pointer over the node and type "m" after clicking on the first node. Note that the second corner node of this element must be a mid-side node for the adjacent two-dimensional element. It is recommended that transition elements be constructed after two dimensional element generation is completed. |
| (e) | Junction elements       | Click on the node that forms the connection point for more than two line elements, then type "j" to complete the generation and plotting of this element. In this case additional nodes will be created at this point. It is recommended that users create junction elements only as a last step in the generation process. Additional elements cannot be added to a generated junction. The same nodal depths and widths will be assigned for each node at the junction, the user must separately edit the RMA1 input file to adjust depths and widths at these nodes                     |

During execution of element generation the top panel displays the current element number being created followed by the node numbers as they are defined. If duplicate node numbers are accidentally defined the element will not be created and an error

message will be displayed.

When an element is completed and plotted the mouse is available to generate the next element or the current grid can be redrawn by clicking in the "redraw" panel (or entering "r" at the keyboard). To terminate the process click on the "quit" panel (or enter "q" at the keyboard). The processor will return to the element sub-menu.

(5.2.3) (f)ind To find a given element number and replot with it at centre screen.

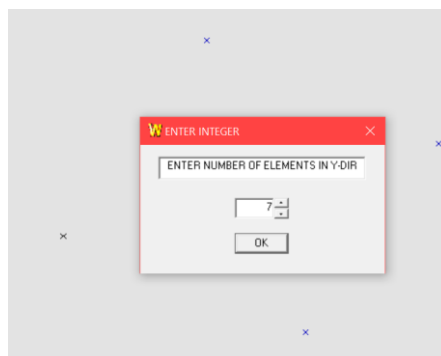
This option is designed to find an element and then replot the grid with this element at the centre. The option is entered by clicking on the panel with left hand mouse or by entering "f" at the keyboard. The process is executed by clicking over an individual element. After the process is completed, control automatically returns to the elements sub-menu.

(5.2.4) (g)blok Generation of a block of elements

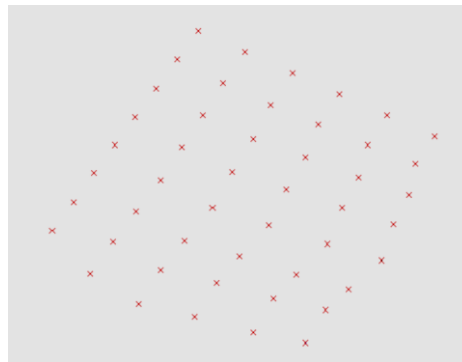
This option provides the capability to generate a block of elements. It is entered by clicking on the panel with left hand mouse or by entering "g" at the keyboard. The user first has the option to use any four existing nodes. This allows a precise definition of nodal locations to be used.

This option directs the user to click at four points in anti-clockwise direction to form a box and then enter the number of elements along the sides formed by clicks 1-2 and 2-3 (these are labelled the x and y directions). A grid of generated nodes is then displayed and the user invited to move any of the outside points to distort the shape of the box to fit a desired boundary. When this step is completed a grid of rectangular elements is generated. The actual steps are thus

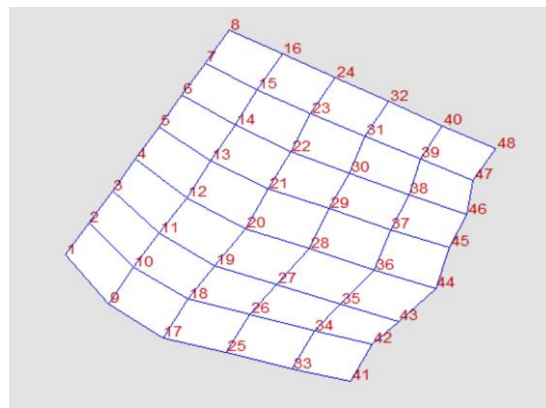
- a. four left hand mouse clicks to define the area,
- b. entering two integers, The first number defines the number of elements on the first and third sides and the second the second and fourth sides.



- c. moving boundary nodes by clicking at the node and clicking a new desired location, The generated nodes are displayed as x's and are updated as needed.



- d. terminating the moving process by clicking on the "quit" panel (or enter "q" at the keyboard). The processor will then return to the element sub-menu.



(5.2.5) (t)ype Element type/group insertion

Enter by clicking on panel with the left hand mouse button or typing "t". By default all elements (except junction elements) are assigned type and group number 1 when they are first generated. The user may alter this designation with this option. Note that the choice between type numbers and group numbers is set in the RDRAW/TYPER/GROUP OPTIONS menu location. When the option is entered the user is prompted for the new desired element type or group number, then the plot will display all current element type or group numbers. When the mouse is clicked on an element centre the newly entered type or group number will apply for this element and be displayed. Multiple element type or group numbers may be modified during this process.

As a special case the element type number zero may be entered. Then, when an element is clicked, this element will be deleted from the network. Note that the option to redraw that appears at this time is not applicable.

To terminate the process click on the "quit" panel (or enter "q" at the keyboard) the processor will return to the element sub-menu.

(5.2.6)      f(i)ll              Fill mid-side node numbers.

The fill process detects any zero mid-side node numbers and replaces them with an actual node number at the exact middle of the side.

(5.2.7)      (h)elp              To enter the help processor

Enter by clicking on panel with the left hand mouse button or entering "h" at the keyboard. The help processor will display a help index and explain processor options to the user.

(5.2.8)      (z)oom              To zoom in or out on the screen drawing

See instructions under entry (5.2.1.4) for the select sub-menu.

(5.2.9)      (r)draw              To redraw the screen.

See instructions under entry (5.2.1.5) for the select sub-menu.

(5.2.10)     (q)uit              To return to the main menu.

Terminate the process and return to the main menu by clicking on panel with the left hand mouse button or entering "q" at the keyboard.

### **(5.3) NODE PROCESSING COMMAND**

Enter by clicking on panel with the left hand mouse button or typing "n".

A sub-menu is displayed with a number of options.

(a)dd	(m)ove	(d)el	(f)ind	(g)line	(e)lev	(h)elp	(z)oom	(r)draw	(q)uit
-------	--------	-------	--------	---------	--------	--------	--------	---------	--------

(1)      (a)dd.              To initiate addition of nodes

(2)      (m)ove              To initiate moving of nodes

(3)      (d)el              To delete nodes

(4)      (f)ind              To find a given node number and re-plot with it at center screen.

(5)      (g)line              To start the line of nodes generation process.

- (6) (e)lv/wd To initiate insertion of nodal bottom elevations, nodal widths and number of layers for three-dimensional simulation.
- (7) (h)elp To initiate the help processor.
- (8) (z)oom To zoom in or out on the screen drawing.
- (9) (r)draw To redraw the screen.
- (10) (q)uit To return to the main menu.

(5.3.1) (a)dd Addition of nodes

Enter by clicking on panel with the left hand mouse button or entering "a" at the keyboard. A node will then be created and plotted by each clicking of the left hand mouse button. Node numbers are created filling any gaps in the current nodal sequence. At creation each node is assigned a bottom elevation of "-9999".

At any time in this operation a zoom or redraw process may initiated by clicking in the appropriate panel or entering the key letter at the keyboard.

To terminate the process click on the "quit" panel (or enter "q" at the keyboard) the processor will return to the node sub-menu.

(5.3.2) (m)ove Moving individual node locations.

Enter by clicking on panel with the left hand mouse button or entering "m" at the keyboard. An existing node may be moved by clicking with the left hand mouse button at the location of the node, then pointing to the desired location and clicking the left hand mouse button again. If the node is moved to the very top of the screen it will automatically be deleted from the grid. If there are elements connected to this node they too will be deleted.

To replot the grid at any time in this process, enter "r" at the keyboard or click the appropriate panel display. To terminate the process click on the "quit" panel (or enter "q" at the keyboard) the processor will return to the element sub-menu.

During the move operation a menu option switch lights that allows the user to select between preserving bottom elevations or setting the values to -9999 for later interpolation from a map file. Clicking on the box changes the switch from preservation of values (the default) to no preservation.

(5.3.3) (d)el Deleting nodes.

Enter by clicking on panel with the left hand mouse button or entering "d" at the keyboard.

A sub-menu is displayed with a number of options.

al(l)mid	cen(m)id	sin(g)le	un(u)sed	(f)ill	(j)oin	(h)elp	(z)oom	(r)draw	(q)uit
----------	----------	----------	----------	--------	--------	--------	--------	---------	--------

- (1) al(l)mid Delete all the mid-side nodes.
- (2) cen(m)id Delete only exact mid-side nodes.
- (3) sin(g)le To delete only individual nodes.
- (4) un(u)sed To delete all unused nodes.
- (5) (f)ill To define mid-side nodes.
- (6) (j)oin To join connections to two nodes and delete one node.
- (7) (h)elp To initiate help processor
- (8) (z)oom To zoom in or out on the screen drawing.
- (9) (r)draw To redraw the screen.
- (10) (q)uit To return to the main menu

Description of the delete sub-menu

(5.3.3.1) al(l)mid (1) To delete all the mid-side nodes.

Enter by clicking on panel with the left hand mouse button or entering "l" at the keyboard. All the mid-side nodes will be deleted. Control is returned to the delete sub-menu.

(5.3.3.2) cen(m)id (2) To delete only exact mid-side nodes.

Enter by clicking on panel with the left hand mouse button or entering "m" at the keyboard. Only exact mid-side nodes are deleted. In other words mid-side nodes that define curved sides are not deleted.

(5.3.3.3) sin(g)le (3) To delete only individual nodes.

Enter by clicking on panel with the left hand mouse button or entering "g" at the



keyboard. Delete only the single node pointed to by the mouse.

(5.3.3.4) un(u)sed (4) To delete all unused nodes.

Enter by clicking on panel with the left hand mouse button or entering "u" at the keyboard. Delete all of the nodes that are currently unconnected to an element.

(5.3.3.5) (f)ill (5) To define mid-side nodes.

Enter by clicking on panel with the left hand mouse button or entering "f" at the keyboard. The fill process detects any zero mid-side node numbers and replaces them with an actual node number at the exact middle of the side. RMAGEN will prompt the user to type 1, in which case mid-side nodes are added using all nodes, or to type 0 when mid-side node numbers are generated starting at the last corner node number.

(5.3.3.6) (j)oin (6) To join two nodes.

Enter by clicking on panel with the left hand mouse button or entering "j" at the keyboard. This option allows the user to join two nodes. This means that effectively one node is deleted but all connections assigned to that node are moved to the remaining node. The operation is completed by clicking on successive nodes. The second clicked node is the one that is deleted.

(5.3.3.7) (h)elp (7) To enter the help processor

Enter by clicking on panel with the left hand mouse button or entering "h" at the keyboard. The help processor will display a help index and explain processor options to the user.

(5.3.3.8) (z)oom (8) To zoom in or out on the screen drawing

See instructions under entry (5.2.1.4) for the select sub-menu.

(5.3.3.9) (r)draw (9) To redraw the screen.

See instructions under entry (5.2.1.5) for the select sub-menu.

(

Terminate the process and return to the node sub-menu by clicking on panel with the left hand mouse button or entering "q" at the keyboard.

(5.3.4) (f)ind Finding nodes.

This option is designed to find a node and then replot the grid with this node at the centre. The option is entered by clicking on the panel with left hand mouse or by entering "f" at the keyboard. The process is executed by entering a node number at the keyboard and pressing enter. After the process is completed, control



- (9) (h)elp Enter the help processor.
- (10) (q)uit Return to the nodes sub-menu.

#### Description of the elevation/width sub-menu

##### (5.3.6.1) (m)an/el (1) Manual insertion of elevations.

Enter by clicking on panel with the left hand mouse button or entering "m" at the keyboard. When this option is first asked to choose between adjusting values or setting absolute levels and to decide whether to lock the value for these nodes after they are set. Then the user is prompted for the desired bottom elevation or adjustment to insert. After it is entered existing bottom elevations will be displayed. The mouse may then be clicked at a node with the left-hand mouse button and the new bottom elevation will automatically be inserted in the network.

To automatically insert the same value at all nodes, the user may type "a" instead of clicking with a mouse button. The current value will then be inserted at all active nodes.

To automatically insert the same value at all nodes that have the value "-9999.", the user may type "f" instead of clicking with a mouse button. The current value will then be inserted at those nodes.

To re-plot the grid at any time in this process, enter "r" at the keyboard or click the appropriate panel display. To terminate the process click on the "quit" panel (or enter "q" at the keyboard) the processor will return to the element sub-menu.

To terminate the process click on the "quit" panel (or enter "q" at the keyboard) the processor will return to the node sub-menu.

##### (5.3.6.2) (a)ll/el (2) Automatic interpolation for all nodes.

Enter by clicking on panel with the left hand mouse button or entering "a" at the keyboard. The user is first asked to choose between interpolating using a triangulated data set or by RMA local interpolation method and whether the user will use this method for subsequent entries to this process. The processor then either uses linear interpolation from the triangulated data network or uses the standard method that uses values for bottom elevation entered in the map data file to compute bottom elevations for all nodes. For each node it computes the nearest locations and develops a polygon of map data points around it. A least square error linear plane is passed approximately through these values and a bottom elevation is then computed for the node. Control returns to the sub-menu.

NOTE If the automatic interpolation routine is unable to develop a consistent

polygon for a given node the process is terminated and the bottom elevation set to -9998 for easier identification.

(5.3.6.3) (f)il/el (3) Automatic interpolation for all nodes with an undefined bottom elevation.

Enter by clicking on panel with the left hand mouse button or entering "f" at the keyboard. The processor uses the process described above for all nodes to define bottom elevations for all nodes with an undefined bottom elevation. That is, with a bottom elevation set equal to -9999.0. Control returns to the sub-menu. See note for section 5.3.6.2.

(5.3.6.4) (s)in/el (4) Automatic interpolation for single nodes.

Enter by clicking on panel with the left hand mouse button or entering "s" at the keyboard. The process described above is now used for a single node only and the processor waits for a node to be pointed to and clicked. The processor then waits either for a new node to be selected or for an operation from the sub-menu. See note for section 1.3.6.2

(5.3.6.5) lo(c)k(5) To set individual nodes so that the elevations are regarded as fixed when elevation interpolation is applied

(5.3.6.6) (u)nlock(6) To set free individual nodes that were previously locked so that the elevation can be reset when elevation interpolation is applied

(5.3.6.7) (t)hree (7) Manual insertion of nodal layer numbers for use in RMA-10

Enter by clicking on panel with the left hand mouse button or entering "t" at the keyboard. When this option is entered the user is prompted for the file name where the layer data is to be stored (if not previously defined) followed by a dialog box that allows the user to select the desired number of layers and data values. After it is entered existing number of layers will be displayed for all nodes. The mouse may then be clicked at a node with the left hand mouse button and the new layer data will automatically be inserted in the network and displayed.

To automatically insert the same value at all nodes, the user may type "a" instead of clicking with a mouse button. The current value will then be inserted at all active nodes.

To automatically insert the same value at all nodes that have the default value "-15",

the user may type "f" instead of clicking with a mouse button. The current value will then be inserted at those nodes.

To replot the grid at any time in this process, enter "r" at the keyboard or click the appropriate panel display. To repeat the process enter "n" at the keyboard or click on the (n)ext panel.

To terminate the process click on the "quit" panel (or enter "q" at the keyboard) the processor will return to the elevation sub-menu and the layer data output to the named file in "LD2" format ready to be merged into an RMA-10 input file.

(5.3.6.8)      man/(w)d      (8)      Manual insertion of nodal widths.

Enter by clicking on panel with the left hand mouse button or entering "w" at the keyboard. When this option is entered RMAGEN displays a series of boxes that allow the user to select from the following six options for insertion one-dimensional element properties and the usual zoom rdraw and quit options.

(w)idth	ss(1)	ss(2)	strw(d)	str(e)lv	str(s)lp	(b)s1	(z)oom	(r)draw	(q)uit
---------	-------	-------	---------	----------	----------	-------	--------	---------	--------

- |   |          |  |
|---|----------|--|
| 1 | (w) idth | Manual insertion of bottom widths at one-dimensional nodes   |
| 2 | ss(1)    | Manual insertion of side slope number 1 at one-dimensional nodes (rise/length)   |
| 3 | ss(2)    | Manual insertion of side slope number 2 at one-dimensional nodes (rise/length)   |
| 4 | strw(d)  | Manual insertion of off-channel storage widths at one-dimensional nodes. See below under storage slope for an alternative interpretation of this value.  |
| 5 | str(e)lv | Manual insertion of bottom elevation of off-channel storage widths at one-dimensional nodes. If set exactly equal to 0.0, the storage elevation is assumed to be equal to the bed elevation.   |
| 6 | str(s)lp | Manual insertion of storage slope. If non-zero, value of slope associated with off-channel storage. Storage width is then computed as height above storage bottom elevation multiplied by storage slope. Storage width is then interpreted as a maximum value. |
| 7 | (z)oom   | To zoom in or out on the screen drawing  |

- |   |         |   |
|---|---------|---|
| 8 | (r)draw | To redraw the screen                    |
| 9 | (q)uit  | Return to the nodes-elevation sub-menu. |

After an option is entered existing values will be displayed for all nodes connected to one-dimensional elements and the user prompted to enter a new value. The mouse may then be clicked at a node with the left-hand mouse button and the new width etc data will automatically be inserted in the network and displayed.

To terminate the process click on the "quit" panel (or enter "q" at the keyboard) the processor will return to the node elevation sub-menu.

(5.3.6.9) (h)elp (9) To enter the help processor

Enter by clicking on panel with the left hand mouse button or entering "h" at the keyboard. The help processor will display a help index and explain processor options to the user.

(5.3.6.10) (q)uit (10) To return to the node sub-menu.

Terminate the process and return to the node sub-menu by clicking on panel with the left hand mouse button or entering "q" at the keyboard.

(5.3.7)(h)elp To enter the help processor

Enter by clicking on panel with the left hand mouse button or entering "h" at the keyboard. The help processor will display a help index and explain processor options to the user.

(5.3 8) (z)oom To zoom in or out on the screen drawing

See instructions under entry (5.1.1.4) for the select sub-menu.

(5.3.9) (r)draw To redraw the screen.

See instructions under entry (5.1.1.5) for the select sub-menu.

(5.3.10)(q)uit To return to the main menu.

Terminate the process and return to the main menu by clicking on panel with the left hand mouse button or entering "q" at the keyboard.

**(5.4) DEFINING ORDERING AND ORDERING LISTS FOR RMA-1 INPUT FILE**

Enter by clicking on panel with the left hand mouse button or typing "o". This option

is designed to permit addition to the input file being generated, of the starting elements numbers for the element reordering processor of RMAGEN and to compact node and element lists that have missing components.

pr(l)st	get(g)rp	(p)rgrp	c(o)ptnd	cop(t)el	(h)elp		(z)oom	(r)draw	(q)uit
---------	----------	---------	----------	----------	--------	--	--------	---------	--------

(5.4.1) pr(l)st          Process current reordering list.

Enter by clicking on panel with the left hand mouse button or entering "l" at the keyboard. The current list of element reordering numbers will be processed. If the element connections have been changed the numerical element order will be processed. The text screen will display the results of the renumbering process. The element reordering number and the maximum front width (one degree of freedom per node) are listed for each starting sequence. The ordering sequence with the lowest reordering number will be saved for output to the binary file. To develop list see get(g)rp option. When "return" is pressed control returns to the reordering sub-menu.

(5.4.2) get(g)rp          Get a new list of elements for potential reordering.

Enter by clicking on the panel with the left hand mouse button or entering "g" at the keyboard. The user is prompted to click on elements using the left mouse button to create entries for the list. When the user has completed the desired list the s(a)ve panel may be clicked to generate a dialog panel that displays the proposed reordering list number. This may be adjusted by the user and accepted by clicking "OK". If an existing list number is used the entered numbers over-ride.

The user may then form a new list by clicking on elements or quit the menu clicking the (q)uit panel.

To replot the grid at any time in this process, enter "r" at the keyboard or click the appropriate panel display. To terminate the list entry click on the "quit" panel (or enter "q" at the keyboard) the processor will return to the reordering sub-menu.

(5.4.3) (p)rgrp          Process the newly added list.

Enter by clicking on panel with the left hand mouse button or entering "p" at the keyboard. The last list entry will be processed for its element ordering numbers. The element reordering number and the maximum front width (one degree of freedom per node) is listed. If the new reordering number is superior the selected element order will be replaced with the new order. After the "return" button is pressed the processor will return to the reordering sub-menu.

(5.4.4)          c(o)ptnd          To compact node numbers.

Enter by clicking on the panel with the left hand mouse button or entering "o" at the keyboard. The sequence of node numbers used in the model will be compacted so that there are no missing node numbers.

(5.4.5) cop(t)el To compact element numbers.

Enter by clicking on the panel with the left hand mouse button or entering "to" at the keyboard. The sequence of element numbers used in the model will be compacted so that there are no missing element numbers.

(5.4.6) (h)elp To enter the help processor.

Enter by clicking on the panel with the left hand mouse button or entering "h" at the keyboard. The help processor will display a help index and explain processor options to the user.

(5.4.7)(z)oom To zoom in or out of the drawn screen

See instructions under entry (5.1.1.4) for the select sub-menu.

(5.4.8)(r)draw To redraw the screen.

See instructions under entry (5.1.1.5) for the select sub-menu.

(5.4.9)(q)uit To return to the main menu.

Terminate the process and return to the main menu by clicking on panel with the left hand mouse button or entering "q" at the keyboard.

## **(5.5) DEFINING CONTINUITY LINE LISTS**

This menu choice allows the user to create continuity line node lists for addition into the RMA-2 input file or for saving in the geometry files. When entered from the menu the user has;

(a) the basic definition option where at the first prompt the user is invited to select a file where the continuity line will be saved and to decide between saving only corner nodes or to save mid-side and corner nodes. Note that saving to a separate file is not required and is only useful when selected nodal lists are required for some other purpose. The continuity lines are automatically added to both ASCII and binary network files. Next the user is asked to define a starting node by clicking with the mouse over a corner node or to zoom, re-draw or quit the process. After the first node is selected sub-menu options additionally allow the user to either (a) go backwards [(b)ack], that is, delete the choice, or (b) connect up and finalize the list [cn(n)ec] for storing in the selected file, and as an addition onto the end of any geometry file that is saved. Finally, the user is asked to enter a continuity line number. This number may be a new number, an old number for re-entry or deletion of a list, or zero to delete all continuity lines.

(b) the update option allows the user to update continuity line connections when



element refinement has been undertaken.

### **(5.6) DRAWING BOTTOM ELEVATION CONTOURS**

This menu choice offers the user the option of setting contour spacing options or drawing the contours themselves. When the contour spacing option is selected a dialog screen displays the contour intervals that have been automatically developed and offers the user a number of options for adjusting them. This option must be entered before contours are drawn. Contours may be displayed as flat contours on a plan view or, if the 3-D view has been activated, as a 3-D view of the system with the vertical scale set by input parameters of the 3-D view dialog.

### **(5.7) ENTERING THE CROSS-SECTION MENU**

The cross-section menu offers the principal methods of operating on cross-section data for future uses with the 1-D elements of RMA-2. Note that cross-sections may be loaded and saved from the FILE menu. This menu now has three functions that allow the user to

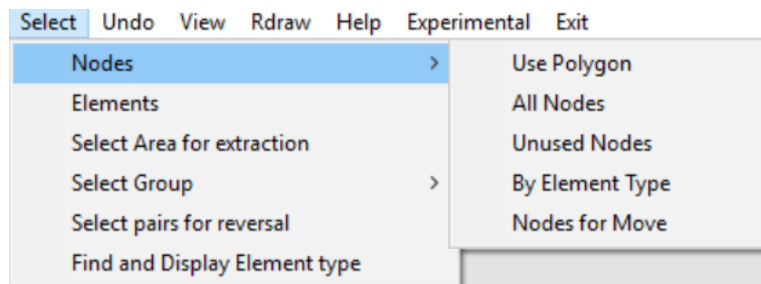
- (1) "ASSIGN CROSS-SECTION LOCATIONS" when they are not defined in input cross section data files. This option allows the user to select a cross-section number and using the mouse, point to a location for the cross-section.
- (2) COMPUTE WEIGHTING parameters for nodal locations using the previously input cross section data files. These properties may then be displayed using the RDRAW/DRAW OPTIONS sub menu. Note that weighting functions are computed using only cross-sections where the element type number and reach number match.
- (3) The VIEW CROSS-SECTION option allows display of up to 5 cross-sections. When selected the user is prompted with a dialog to input the cross-section numbers and given the option of allowing RMAGEN to compute axis scaling or to input limits from a further dialog. The computed cross-section is then displayed in a separate window.

### **(5.8) COMPUTING SCREEN DISTANCES**

This option allows the user to find the distance apart of two consecutive points on the screen expressed in map coordinates. This sub-menu has the "next" option for measuring other distances and has the usual zoom, draw and quit options.

## (5.9) SELECTING GROUPS OF ELEMENTS OR NODES<sup>2</sup>

This option allows two basic choices, selection of nodes or elements.



In addition to selecting all nodes or all unused nodes, the user may:

- 1 Define a polygon surrounding a group of nodes or elements
- 2 Select a group of elements for extraction to form a new mesh.
- 3 Select a group of elements that will be extracted from the network and saved as a separate mesh.
- 4 Select a group elements from a previously executed test on bed-level/cross-section differences
- 5 Select a group of pairs of elements forming quadrilaterals where the largest obtuse angles exist. The diagonals of these pairs are then reversed.
- 6 Select and display a specified element type. (5.9.1) Element/node selection using polygons

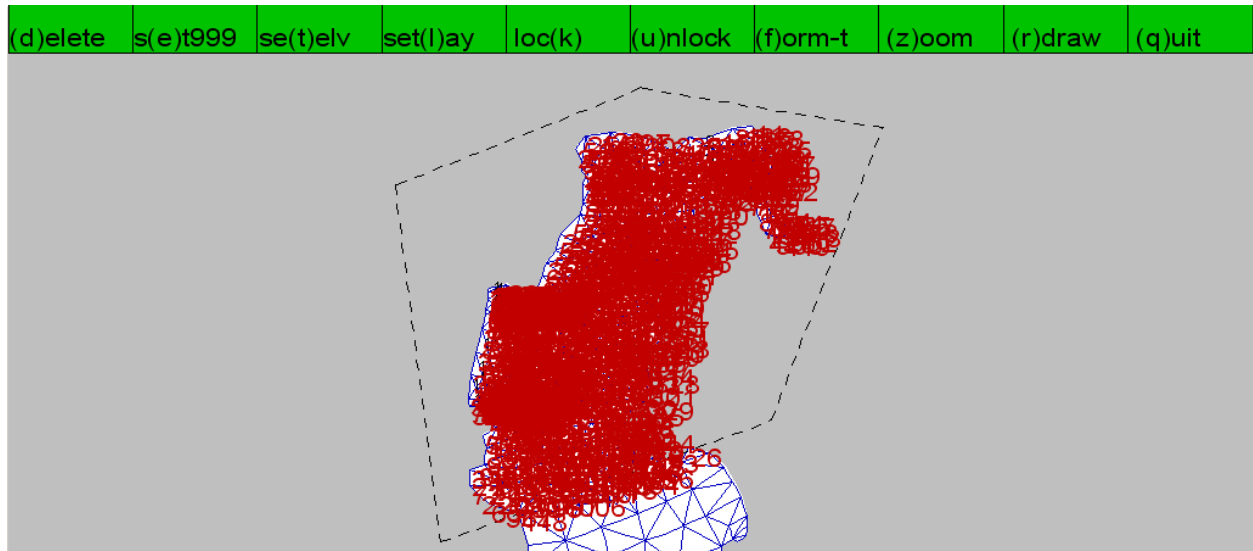
When the basic nodes/element selection process is used, the user may carry out various operations on them. Under both SELECT/NODE/POLYGON and SELECT/ELEMENT options the user may click on a number of locations and develop a polygon (shown by a dashed line). Box options allow the user to go back one click and repeat the operation, or connect to initial location to finalize the polygon. Other options permit zooming, redrawing quitting the operation. Note that at present, if zooming is selected, the screen may lose its origin. THE USE OF THE ZOOM OPTION IS CURRENTLY NOT RECOMMENDED IN THE MIDDLE OF POLYGON CONSTRUCTION. If redrawing is selected the existing polygon will not be displayed until an additional location is selected. (The back option can be used to correct for any errors caused by this limitation.

---

<sup>2</sup> Note that groups of elements are not the same as element group numbers

When the polygon is completed with the connect button the selected nodes or elements are displayed. The user is then offered a series of choices depending on selection of nodes or elements.

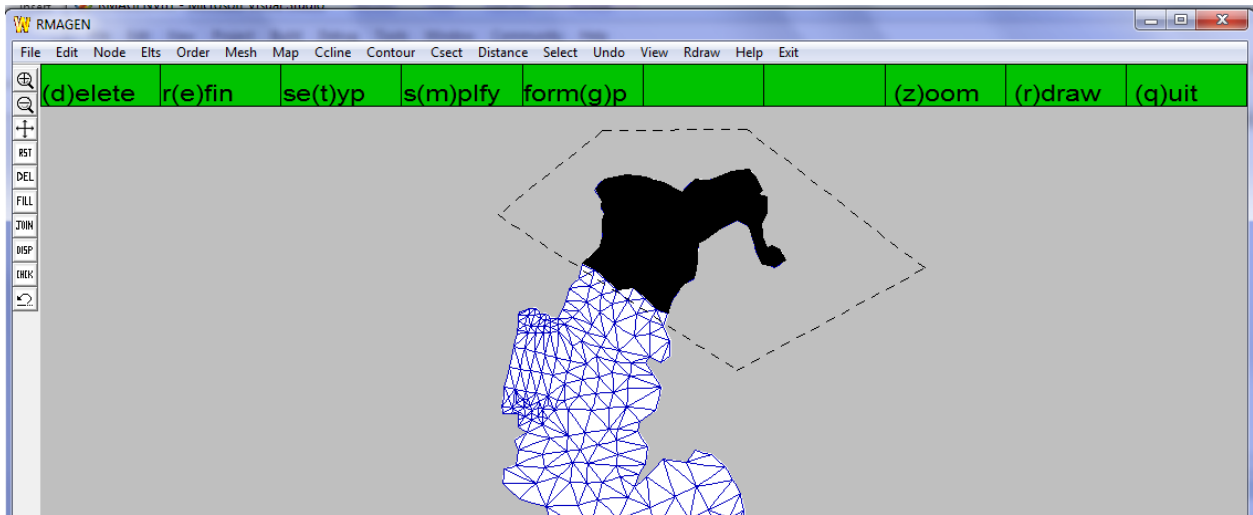
If nodes are selected, then seven options are available in addition to the usual zoom redraw or quit options



- |   |          |   |
|---|----------|---|
| 1 | d)elete  | To delete the displayed nodes   |
| 2 | s(e)t999 | To set the bottom elevation to the default null value (-9999.)  |
| 3 | se(t)elv | To re-compute the bottom elevations by interpolation from the map data file   |
| 4 | set(l)ay | To set the number of layers and data for the selected nodes to the data values input following dialog and to output a listing in "LD2/LD3" format for merging into an RMA-10 input file. (if no file name has been selected the user is prompted for a file name) |
| 5 | loc(k)   | To set all the selected nodes to the <b>locked</b> status during automatic elevation interpolation  |
| 6 | (u)nlock | To reset all the selected nodes to the <b>unlocked</b> status during automatic elevation interpolation  |
| 7 | (f)orm-t | To form triangular elements from the selected nodes   |
| 8 | (z)oom   | To zoom in or out on the screen drawing   |

- 9 (r)draw To redraw the screen
- 10 (q)uit Return to the previous sub-menu.

If elements are selected, then five options are available in addition to the usual zoom redraw or quit options.



- 1 d)elele To delete the displayed elements
- 2 r(e)fin To enter the refine processor for these elements
- 3 se(t)yp To set the element types for these elements
- 4 s(m)plfy To simplify the selected set of elements
- 5 Form(g)p To set the group numbers for these elements
- 6 (z)oom To zoom in or out on the screen drawing
- 7 (r)draw To redraw the screen
- 8 (q)uit Return to the previous sub-menu.

#### (5.9.2) Select area for extraction

If the “select area for extraction” option is selected the user is first prompted to create a surrounding polygon as above then during extraction the user is prompted for a filename that will be assigned to the new mesh and used to save the file initially.

After completion the user may return to the original mesh using the “select mesh file sub menu.

#### (5.9.3) Select group/select processed differences

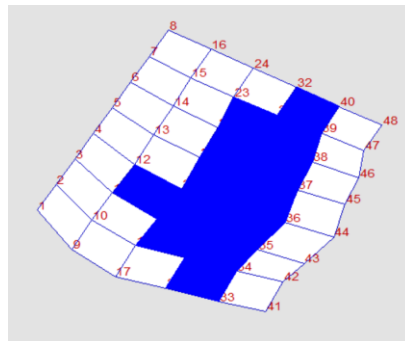
This menu item allows the user to select the previously processed element difference values developed in the check toolbar operation. On entering the user can select the fraction that will be displayed. Thus if 0.1 is entered the element differences that have the highest 10% of the differences will be selected. All the options of the select element process can then be applied.

#### (5.9.4) Select pairs for reversal

This option allows the user to find pairs of adjacent triangular elements that form a quadrilateral that has interior angles greater than 90 deg so that the original diagonal can be reversed and lead to an improved layout (that is, smaller interior angles). The user can select how many pairs are to be reversed in any single step. This option is particularly useful when element refinement operations have been undertaken.

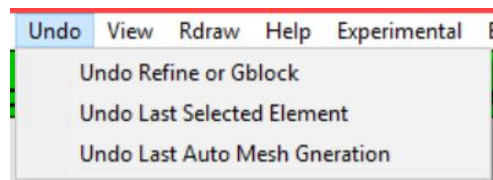
#### (5.9.4) Find and display element type

This option first requests selection of an element type number. Elements of this type are then highlighted and the box menu displayed allowing the user to operate on these elements with the same options as other element operations.



### (5.10) UNDOING PREVIOUS STEPS

At present the undo menu allows the user three sub-menus:



#### (5.10.1) Undo block generation

An option that undoes either a previous step generating a block of elements or a previous refine step, operation is fully automatic once the option is selected.

#### (5.10.2) Undo refine

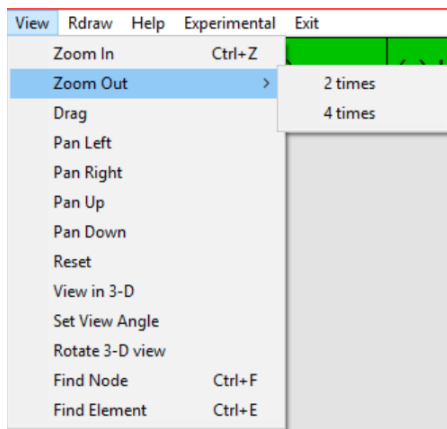
An option that allows the user to de-select an element that may have been selected whilst using the various.

#### (5.10.3) Undo last automesh generation

An option that allows the user to undo an automatic mesh generation option.

## (5.11) DEFINING SCREEN VIEWS

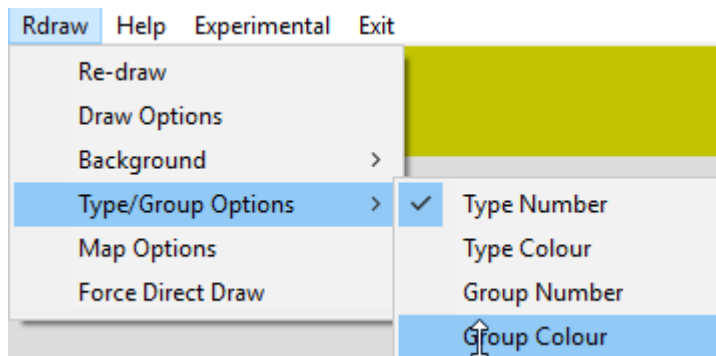
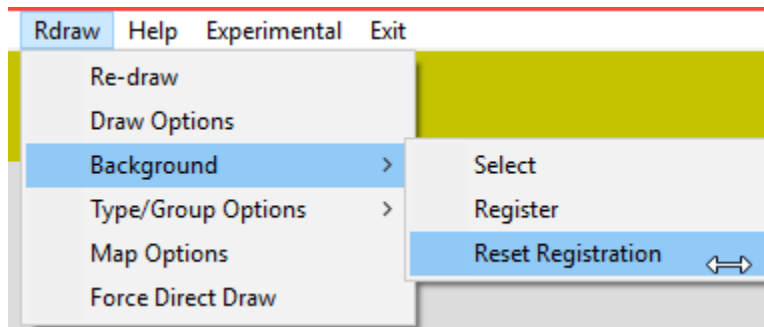
This option is an alternative to the zoom option of the RMAGEN menu. On a dropdown basis the user may optionally:



- a. **Zoom in** by drawing a rubber band style rectangle with a left mouse dragging of the shape and a right mouse confirmation of the final shape.
- b. **Zoom out** by optional factors of 2 or 4
- c. **Drag** the image across the screen
- d. **Pan left**
- e. **Pan right**
- f. **Pan up**
- g. **Pan down**
- h. **Reset** to the original screen size so that all data is shown.
- i. **View in 3-D** initiated by filling a dialog box that sets the horizontal and vertical view angles and establishes a vertical origin and scale.
- j. **Set view angle** initiated by filling a dialog box that resets the horizontal and vertical view angles and establishes a vertical origin and scale.
- k. **Rotate 3-D view** allows the user to change 3-D view angles by dragging the mouse up/down the screen to change the vertical of view and by dragging the mouse left/right to rotate the plan view
- l. **Find node** allows the user to find and centre the display about an input node
- m. **Find element** allows the user to find and centre the display about an input element

## (5.12) REDRAWING OF THE GRID

The dropdown menu offers the user 5 options



- |   |              |  |
|---|--------------|--|
| 1 | Redraw       | Causes the module to redraw the data set with the currently selected options   |
| 2 | Draw options | Displays a dialog box that allows the user to change the display options Note that when node and bottom elevation are both selected, the node numbers are preferentially displayed. When element and type are both selected the element number is displayed. The user may also select the option for display of continuity lines if they have been generated.  |
| 3 | Background   | This option pops up a sub-menu choice between “select” for choice between white and grey backgrounds for the display and “Register” which initiates the register process for adjusting the corner location of the “ORG” file. When the “Register” option is selected the user is guided through a series of choices to define two known map locations and allow RMAGEN to recalculate the appropriate locations for the “ORG” file |



4	Type/Group Options	This option pops up a sub-menu choice between coloured and numerical display of element types or element groups. It allows the user to switch between operations/display of element types and groups.
5	Map options	Displays a dialog box that allows the user to change the map types that are active when the map is displayed
6	Force Direct Draw	Switches between background screen drawing and direct drawing

### ***(5.13) ENTERING THE HELP PROCESSOR***

Enter by clicking on panel with the left hand mouse button or entering "h" at the keyboard. The help processor will display a help index and explain processor options to the user.

### ***(5.14) EXITING THE PROGRAM***

Enter by clicking on panel with the left hand mouse button or entering "q" at the keyboard. This option may be used to terminate execution of RMAGEN.

### ***(5.15) EDITING NODES AND ELEMENT DATA***

This menu allows the user direct access to nodal coordinate and element connectivity data.

(5.15.1) The Node sub-menu displays nodal data for editing, any node number may be entered and the values edited.

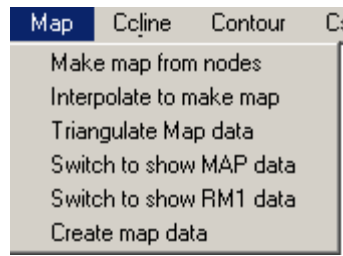
(5.15.2) The Element sub-menu displays element connectivity, any element number may be selected and the values edited.

(5.15.3) The Element select sub-menu allows the user to select the element for editing directly from the screen.

The rotate option allows the user to rotate connections to conform to model requirements for control structures.

### ***(5.16) OPERATING ON MAP FILES***

This menu allows the user six sub-menu options for manipulating map and



mesh files.

(5.16.1) The “Make map from nodes” sub menu allows the user to convert existing nodal coordinates and bed elevations to a map format directly.

(5.16.2) The “Interpolate to make map” sub menu allows the user to interpolate the nodal values to a regular grid.

On entry a dialog appears that allow the user select either the number of cells in either direction or the precise x and y spacing. When an x and/or y spacing is specified; this over-rides the number of cells in that direction.

**NOTE** that the map file is created from the area of the network currently on screen and not automatically from the entire network

(5.16.3) The "triangulate map data" option allows automatic triangulation of map data using Delaunay triangularization.

A set of element connections is developed in this process so that they may be used as part of the new nodal interpolation option discussed below.

NOTE that this option can take considerable computing resources if there are many map data points, and that about twice as many elements as map data points are created. To reduce resource demand an additional dialog has been created that allows the user to skip some data points or only process points that are an input spacing from other points.

(5.16.4) The "Switch to show RM1 Data" option allows the user to revert back to the RM1 file.

(5.16.5) The "Switch to show Map Data" option allows the user to display a triangulated map file as if it were an RM1 file.

At that point the triangulated map file can be operated on in the same way as any network file. In particular elements and nodes can be deleted so that the triangulated map file can be cleaned up to better represent the system.

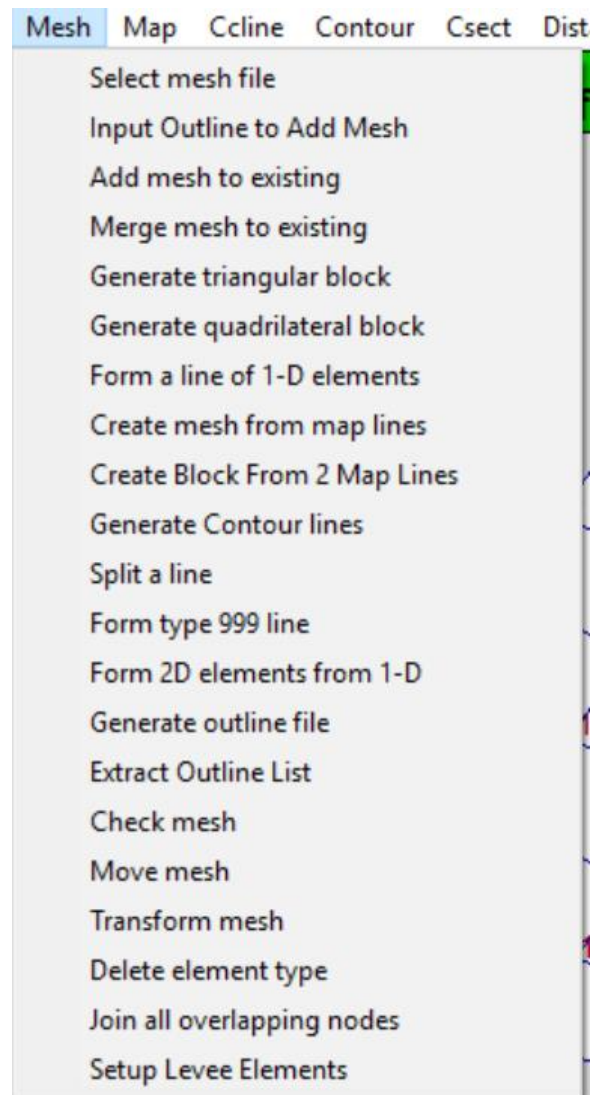
(5.16.6) The “Create map data” option allows manual insertion of bottom elevation values in same form as those input from the map file.

These values may be used for the interpolation process. The data are also output to the message file for conversion to map file input values. Enter by clicking on panel with the left hand mouse button or entering "d" at the keyboard. When this option is entered the user is prompted for the desired

bottom elevation to insert. After it is entered existing bottom elevations will be displayed. The mouse may then be clicked at any point with the left hand mouse button and a new bottom elevation will be created as if it were in the map file. The location and value will be sent to the MESGEN.OUT file in a format suitable for copying to a map file. To replot the grid at any time in this process, enter "r" at the keyboard or click the appropriate panel display. To terminate the process click on the "quit" panel (or enter "q" at the keyboard) the processor will return to the element sub-menu. To repeat the process enter "n" at the keyboard or click on the (n)ext panel. To terminate the process click on the "quit" panel (or enter "q" at the keyboard) the processor will return to the node sub-menu.

## (5.17) OPERATING ON MESHES

This menu allows the user seventeen sub-menu options for operating on mesh files.



(5.17.1) The “Select mesh” sub menu allows the user to switch between currently loaded files.

Note that the model will reload from the named file location when selected so that any updates must have been stored.

(5.17.2) The “Add mesh to existing” sub menu prompts the user to add a mesh to the existing mesh that is being displayed.

Node and element numbers are adjusted to avoid duplication; however no attempt is made to avoid overlap of the meshes.

- (5.17.3) The “Merge mesh to existing” sub menu prompts the user to add a mesh to the existing mesh that is being displayed.

Node and element numbers are adjusted to avoid duplication; where elements overlap the elements of the added mesh are deleted.

- (5.17.4) The “generate triangular block” sub menu may be used to create a triangular block of elements over an area defined by the user.

RMAGEN prompts the user to define the locations of the vertices of the triangle, and then it displays a dialog box that allows selection of the number of elements on each side.

- (5.17.5) The “generate quadrilateral block” sub menu may be used to create a quadrilateral block of elements over an area defined by the user.

RMAGEN prompts the user to define the locations of the vertices of the quadrilateral, and then it displays a dialog box that allows selection of the number of elements on each side.

- (5.17.6) The "form a line of 1-D elements" option allows the user to generate a line of one-dimensional elements.

It offers the user the option of either creating nodes and then forming elements or clicking on a line of existing nodes to form the elements. The user can optionally assign the same width etc. properties to each node or enter properties through a dialog box.

- (5.17.7) The “create a mesh from map lines” sub menu may be used to create elements from existing map based contour lines.

The user is first prompted to define the spacing along the contour lines and to select whether all contour lines are to be used and whether the spacing is to be the same for all lines. It is recommended that the user set the spacing based on the scale of the problem. When the dialog options are checked and OK is pressed the model then prompts with an option that allows the user to select a data frequency along the lines to use. Typically this will be left at the default value. A triangular mesh is then generated based on the map values available. Note that before creating a mesh it is essential that the user completely deletes any existing mesh.

- (5.17.8) The “create block from two maps lines” sub menu may be used to create elements from two roughly parallel map lines.

When activated the user is prompted by a dialog box to define the map lines

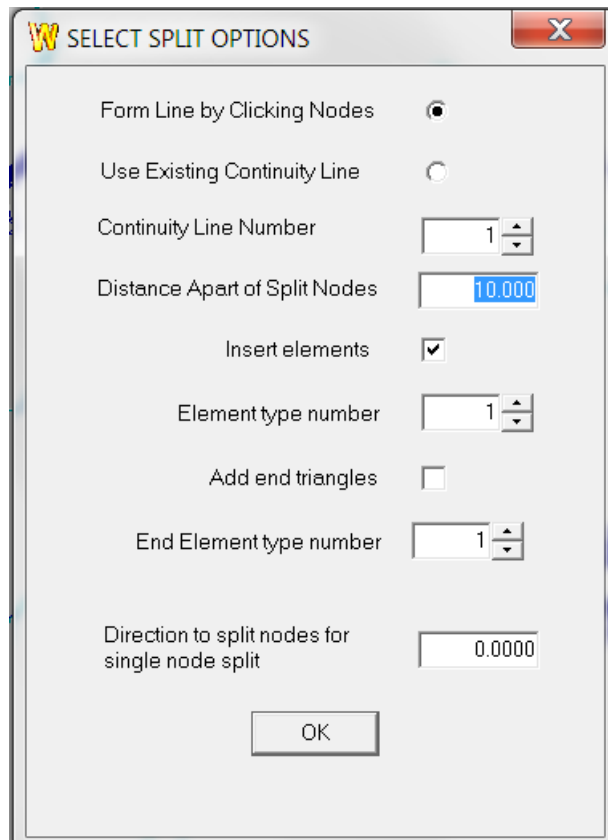
and element sizes required.

- (5.17.9) The “generate contour lines” sub menu may be used to create contour lines from existing nodal points. These nodes may have been created from a triangulated mesh or from an input network.

When activated the model displays the contour lines selected and allows the user to reset these to any desired number. The model then forms the contour lines in map format. They may then be saved as a map file for later use or displayed by turning on the map display option.

- (5.17.10) The “split a line” option allows the user to split a line of nodes.

It must be used with mid-side nodes deleted. On entry the user is presented with a dialog box that can be used to define either the line to be split or to initiate point selection.



If the option to form a line by clicking nodes is used the same process as forming continuity lines is used. That is, a series of nodes are clicked to create a line which is finalized with the CONNECT button. The dialog box also offers the user the choice of how far apart to split the nodes, whether or not to add elements into the gap and the various types to assign. Note that if a single node is selected the user must define the directions of the split. For

the case of points on a line, the direction is computed automatically.

- (5.17.11) The "form type 999 elements" allows the user either to create 1-D elements as in (5.17.6) or input a line from existing 1-D nodes.

Then RMAGEN automatically creates type 999 elements that abut the 1-D line on either side.

- (5.17.12) The "Form 2D elements from 1-D" option is designed to expand 1-D elements into 2-D elements. The user is prompted first to create 1-D elements if none exist. Next a check is made as to the effective width to be used. Finally each 1-D element is converted to two 2-D elements (one on either side of the existing centreline).

- (5.17.13) The "generate outline file" option allows the user either to create a list of x,y points in a data file (\*.dat) that is suitable for use as an outline part of an RMAGEN "map" file or in a \*.poly form that may be used as input to TRIANGLE for generation of a mesh.

When this menu item is selected the user is invited to select an output file name and the suffix then determines the final content of the output file. The data points are created by successively clicking on the location that will form the outline.

- (5.17.14) The "extract outline file" option allows the user either to generate a list of x,y points in a data file (\*.dat) that is suitable for use as an outline part of an RMAGEN "map" file or in a \*.poly form that may be used as input to TRIANGLE for generation of a mesh.

When this menu item is selected the user is invited to select an output file name and the suffix then determines the final content of the output file. The data points are created from the outline of the existing mesh.

- (5.17.15) The "check mesh" option allows the user to apply a series of tests to a mesh to assess its overall "quality".

The user is presented with a series of dialogs that offer three basic options and make additional choices when 1-D elements are involved.

Option 1 "Check areas" causes a computation of element areas. This serves to assure that all areas are mathematically positive and thus numbered in the correct order.

Option 2 "Check bed elevation/section differences". This option is designed

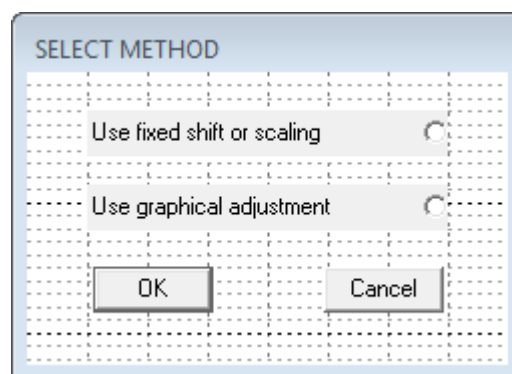
to compute elevation differences across each element and plot each value as colour contour. This serves to identify which elements have the largest changes across each element and thus may need refinement. If 1-D elements are in the mesh and the 1-D option is checked on the dialog box a further dialog allows the user to choose between bed elevations, and for a given elevation, the channel widths and cross-sectional areas.

Option 3 "Check normalized bed elevation/section differences". This option is designed to compute elevation differences across each element normalized by a mean depth for that element. If the mean depth is less than 1.0 the normalizing depth is set equal to 1.0. A reference elevation for computation of depth is entered in the dialog box. Each value is then plotted as colour contour. This serves to identify which elements have the largest changes across the each element and thus may need refinement. If 1-D elements are in the mesh and the 1-D option is checked on the dialog box a further dialog allows the user to choose between bed elevations, and for a given elevation, the channel widths and cross-sectional areas.

Note that the choice between options 2 and 3 can depend on the future purpose of the mesh. If three-dimensional application is envisaged then option 2 is appropriate to identify which locations may have multiple vertical element connections. For two-dimensional applications are anticipated then option 3 can identify locations where bed levels change most relative to depth.

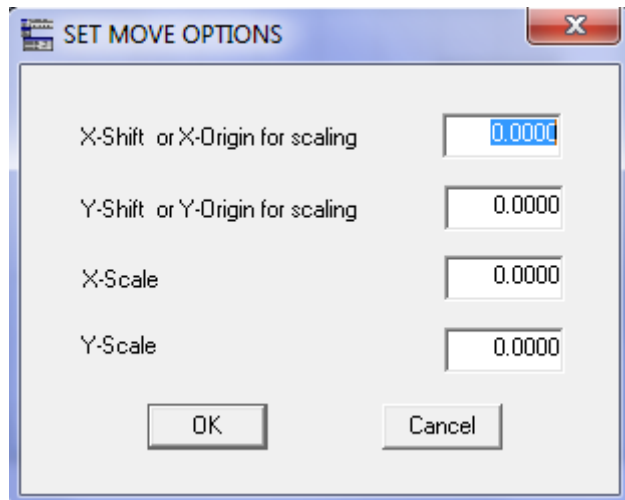
(5.17.16) The "Move mesh" option is a two pronged approach rescaling of a mesh to a new coordinate system.

This option is useful when the mesh needs adjustment to fit a background map. Note, bed elevations are not changed.



The first option allows the user to input from a dialog box a new origin and a scale factor. If scale factors are not entered (set = 0.0) a simple coordinate shift is applied.

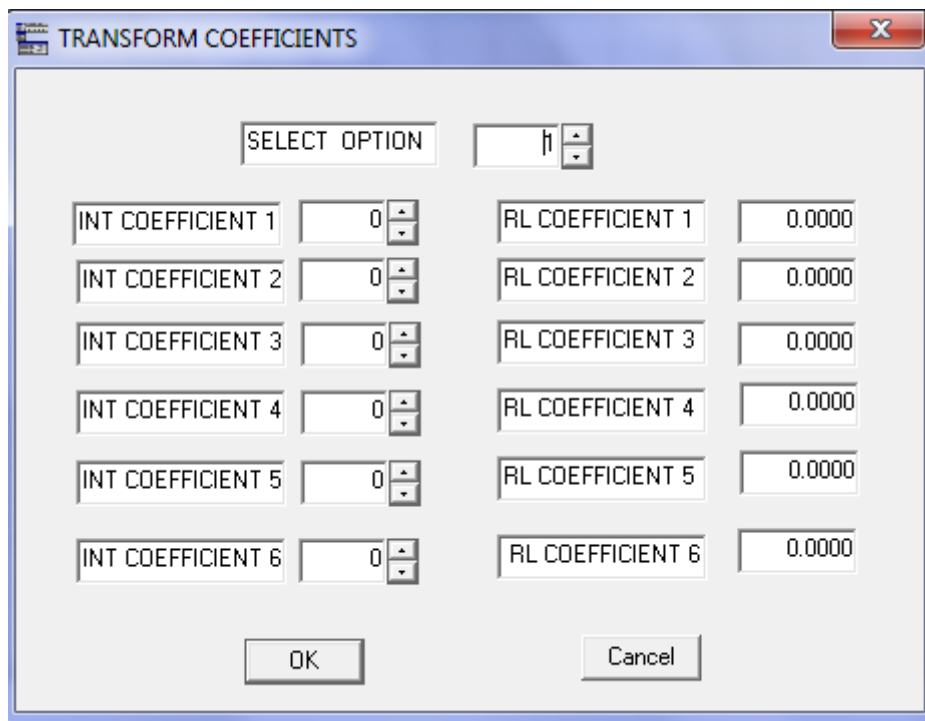




Option 2 (the graphical method) allows the user to click first on a reference point that will stay fixed in the new system and then to click on two more points. These points are effectively a move operation. The initial click indicates the point to be moved and the final click locates where it will be moved to. The OK operation then initiates the appropriately scaled translation.

The final step allows the user to accept or reject the proposed new locations.

(5.17.17) The "Transform mesh" option is designed as a vehicle to apply transform operators from a general dialog box.



Three options are currently implemented.

Option 1 uses 6 real coefficients from the right column to apply a linear transformation. That is:

$$X_{\text{new}} = \text{COEF1} * X_{\text{orig}} + \text{COEF2}$$

$$Y_{\text{new}} = \text{COEF3} * T_{\text{orig}} + \text{COEF4}$$

$$\text{ELEV}_{\text{new}} = \text{COEF5} * \text{ELEV}_{\text{orig}} + \text{COEF6}$$

Option 2 uses

$$\text{Angle} = (X_{\text{orig}} - \text{COEF1}) / \text{COEF3}$$

$$X_{\text{new}} = \text{COEF3} * \sin(\text{Angle}) - (Y_{\text{orig}} - \text{COEF2}) * \sin(\text{Angle})$$

$$Y_{\text{new}} = (Y_{\text{orig}} - \text{COEF2}) * \cos(\text{Angle}) + \text{COEF3} * (1 - \cos(\text{Angle}))$$

This transformation modifies a mesh to form it as a circular arc about an origin at COEF1, COEF2 with a radius COEF3. The bed elevations are not changed.

Option 3 transforms the coordinate system by an arc rotation about input defined coordinates. COEF1 is the angle in radians and COEF2- COEF3 are the origin for the rotation. So that

$$X_{\text{new}} = (X_{\text{orig}} - \text{COEF1}) * \cos(\text{COEF3}) - (Y_{\text{orig}} - \text{COEF2}) * \sin(\text{COEF3})$$

$$Y_{\text{new}} = (X_{\text{orig}} - \text{COEF1}) * \sin(\text{COEF3}) + (Y_{\text{orig}} - \text{COEF2}) * \cos(\text{COEF3})$$

For these transformations, any loaded cross-section geometry is also transformed. Finally the user is offered the option to accept the new mesh or return to the original layout.

(5.17.18) The “Delete element type” option permits the user to select an element type and then delete all elements with this type number.

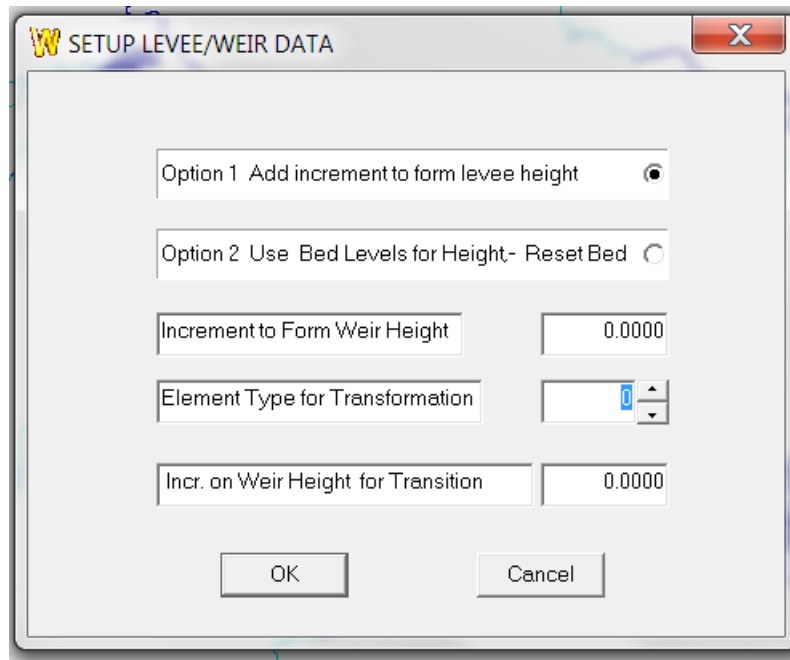
If type number 0 is entered no elements will be deleted.

(5.17.19) The “Join all Overlapping Nodes” option allows the user to merge all coincident nodes single nodes.

On entry the user is invited to select a tolerance so that round-off does not impact the merging of nodes.

(5.17.20) The “Setup Levee Elements” option allows the user to setup a weir data file and modify possibly modify bed levels for these elements

On entry a dialog box is displayed that offers the user two options and allows the user to select which element type will be defined or redefined as levee elements. If the element type number is greater than 900 then it is preserved. If less than 900 then it is reset by adding 900.



Option 1 allows the user to define the levee heights (for the weir data file) as a fixed increment above the bed levels in the network file

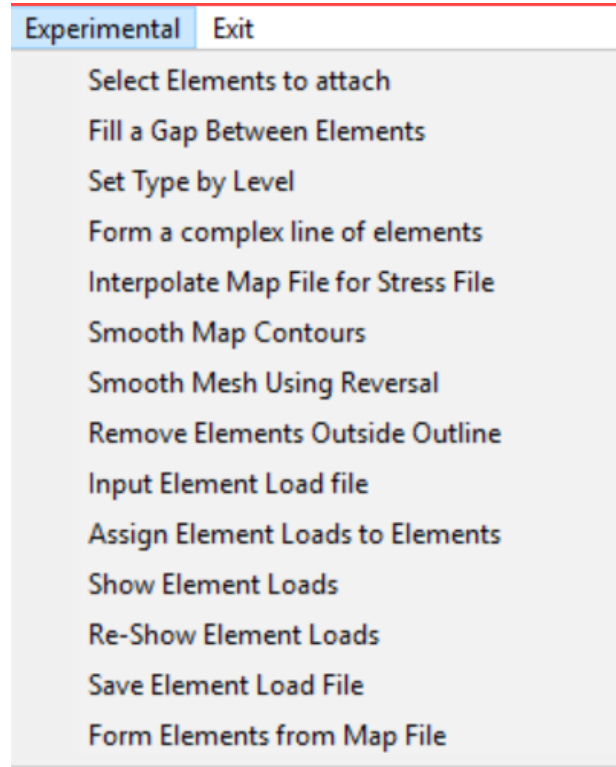
Option2 allows the user to set the levee height from the bed elevation of weir element and redefines the bed elevation at the weir nodes as that of adjacent elements. If this computed level is above the elevation of the weir then the weir type is reset to be a conventional element.

Other entries allow the user to define the increment applied the weir crest for option 1 and the increment above the weir crest to the transition level.

## (5.18) EXPERIMENTAL OPTIONS OF THE RMAGEN MENU

Enter by clicking on panel with the left hand mouse button.

Fourteen options are currently displayed



### (5.18.1) *Select Elements to Attach*

This option automatically generates a quadrilateral element that will connect two element faces. Currently it selects the face formed by the nearest mid-side nodes of the two elements. The process can be repeated for successive pairs and the process is terminated by clicking on the "quit" panel (or entering "q" at the keyboard)

### (5.18.2) *Fill a Gap between elements*

This option permits gaps between two areas of elements to be filled using automatic triangulation. It is designed for use when two meshes have been merged with a resultant gap that needs to be filled. First an option is offered to select an element type for these filled elements. Then, click in a clockwise direction at the first and last elements along one face of the boundary, then continue by clicking (still in a clockwise sense) on the first and last elements along the second face. Note that it is not necessary to have the same number of faces on each side of the gap although a more appropriate connection will be made if the numbers of faces are approximately the same.

(5.18.3) *Set Type by Level*

This option is designed for use in flood plains so that users can automatically assign different element types for situations where all nodes in an element are above a given elevation. This can be useful either to automatically exclude this element type when flood levels never reach a given height or to allow different friction characteristics for given terrain levels.

(5.18.4) *Form a Complex Line of Elements*

This option is designed to create blocks of 1-D or 2-D elements that follow the line of a node or river. The block may be up to 4 elements wide (it can be increased using the refine option) from an input file that defines a sequence of x and y locations together with a width. The elements will be equally spaced along the defined sequence fitting to approximate length given in the dialog. Element type numbers may also be defined in the dialog. Finally an additional option in the input file allows culverts and bridges to be defined in the generated block. The section of the option that adds bridges and culverts is very experimental and will be fully documented in a later release. See Appendix D

(5.18.5) *Interpolate Map for Stress File*

This option is designed to interpolate a data file in map format (data in x, y, value or ESRI grid format) onto the nodal values of a finite element network.

- (a) On entry the user is prompted for a map file name. Note that the processor will preserve existing bed levels during this process.
- (b) After entry the user is offered the option to use a previously triangulated map file and whether to repeat this offer.
- (c) Values will then be interpolated either for all nodes or corner nodes depending on the network state.
- (d) On completion the user is offered the option to plot contours from these values.
- (e) If selected the usual process of contour plotting is displayed. Note that if only corner node values are defined the processor will temporarily fill mid-side values.
- (f) Next, if there are undefined interpolations (-9998.) the user is offered the option to assign adjacent values to these points. If not all "undefineds" are removed this offer is repeated.
- (g) Next the user is invited to define the filename to be created.
- (h) After selecting a file, a dialog box allows the user to define the date header for the file
- (i) Finally the user is offered an option that allows the user to add further files or terminate. If terminate is selected the system is restored to its original state ready for further processing.

(5.18.6) *Smooth Map Contours*

This option is designed to take a map file that has been generated as a series of contours from an original digitised map data file and remove data points that are close to together. This occurs when a contour is very close to an original point that has been triangulated.

(5.18.7) *Smooth Mesh Using Reversal*

This option is designed to examine adjacent pairs of triangular elements and reverse the connection if the resulting alignment of element boundaries would better fit the contours of bathymetry. In order to reduce the risk of poorly shaped elements (that is very long and thin) this reversal is only undertaken when the length of the new diagonal is no more than 150% of the original diagonal. Note that continuity line connections may be damaged by this process and may need to be re-constructed. The step can be reversed using the “Undo/last auto mesh generation” menu.

(5.18.8) *Remove Elements Outside Outline*

This option is designed to review a network layout and remove elements where the centroid is outside the outline as defined in the outline file that has previously been opened using the file menu. Note that only elements are removed from the network so that all existing node locations are preserved. These may be removed using the “Node/Delete/Unused” option.

(5.18.9) *Input Element Load File*  
*Assign Element Load to Elements*  
*Show Element Loads*  
*Re-Show Element Loads*  
*Save Element Load File*

These five options are designed to allow operations on element inflow files in preparation for their use in RMA-2. They are designed for cases where there are multiple element inflows (such as when catchment runoff is being modelled) and where the process of development layout can change the element numbers or to check that element inflows have been correctly located. The four options operate as follows:

- 1 Allow input of the element inflow file. Note that the x and y location of all inflows must be part of this file.
- 2 Assigns the element inflows to the elements of the current network
- 3 Displays the locations of the various inflows
- 5 Update the display of these locations
- 4 Saves the revised element inflow file

(5.18.10) *Form Elements from Map File*

Uses a currently input map file that contains triangulation and converts it to a node and element file that can be processed as a finite element network.

## 6 EXAMPLE OF GENERATION PROCEDURE

The section that follows will present a series of sample steps indicating how RMAGEN may be used to create an RMA-1 input file.

### ***Step 1 Generate an input map file***

In this step the map file should be created. If bathymetric data is available in digital form it may directly converted to map-file format. As alternatives a digitizer can be used to trace a map or coordinates can be extracted by overlaying the map with a Cartesian axis transparency. The recommended digitizing procedure is:

- First, digitize an outline of the area to be studied (in other words the expected land boundaries of the system), constructing the input file as either one line or a series of lines. These lines should be constructed as solid lines by setting the header selection parameter = 0 and the bottom elevation = -9999.
- Next, additional dotted lines (header selection = 1) may be digitized to create contour lines of the bathymetry. The value of the contour is placed after the header number. Header number 3 to 8 may be used to define additional contour lines which will be displayed in different colours.
- Alternatively individual locations may be entered as a sequence under header selection = 2. For this option map x and y coordinates are entered followed by the elevation at that location.
- Remember, that each sequence terminates with the entry "end" and that if the boundary forms a closed loop the last digitized point should correspond to the first point.
- A final "end" is required to terminate the data set.

### ***Step 2 Begin program execution and define input files.***

Execution of RMAGEN should be initiated by selecting RMAGEN, the program will then display the main selection menu:

When the ***"File"*** option on the main menu is selected a dropdown menu appears that allows the user to select ***"Open"*** to initiate file definition. Windows type file opening options will prompt for the map file and for any available RM1 files (either ASCII with suffix "rm1" or binary with suffix "geo". If files are available from a previous run or alternate source enter the names, if files are not available press the cancel option. Alternate sources include a renamed backup file generated by this program (it must be renamed to have as a suffix ".rst")



When this selection is made the model will load all the defined files and if input is from a binary file the user will be prompted for a title line that will be attached to the output file generated in this run.

After the input files have been defined the user is free to select from the main menu.

At this time the user may also elect to load a background image using the appropriate dropdown File menu option.

It is strongly recommended that on successful completion of each of the steps listed below, the “save” or “save as” option of the main menu, be executed to preserve the progress up to that point.

Save options are accessed through the “**File**” option of the main menu. The “**save as**” option allows the user to define new output files, the “save” option allows overwriting of existing files. Binary “.geo” files or ASCII “.rm1” files may be saved. An additional save option permits saving of “map” files in binary format with the suffix “mpb”. This format speeds reading of map files when they are initially opened.

### **Step 3 Generate nodes**

Starting from a system defined only by a map file, the first generation operation should be that of creating nodes. This function is activated by clicking in the **node** box or menu (or by typing "n") and then clicking the “**add**” box. Nodes are generated and displayed by clicking successively at desired locations on the map. Node numbers are created in increasing order. For the case where an existing file is being amended, the same procedure may be applied. In this case node numbers first fill any gaps in the data set and then are generated in sequence above the original maximum node number. If it is convenient the **zoom** operation may be used at any time to expand the map form. To exercise this capability, type "z" and then follow the zoom instructions of the main menu or go to the **redraw** menu. On completion of the zoom operation, control returns to the node generation process. To exit this operation, type "q" or clicking the “**quit**” box <sup>3</sup>.

An alternative to individual node generation is "nodal block" generation option. This may be entered by clicking in the “**gline**” box (or by typing "g"). The user will be prompted to click at two end points and enter the number of nodes that will be

---

<sup>3</sup> Note that the user may at any time switch out of the current box menu by clicking on the main menu item in the surrounding window. This menu can also be used for the “**zoom**” or “**redraw**” options.

equally spaced along the line. RMAGEN then generates the desired number of nodes and displays them. The maximum number of points in a line is limited to 150 at present. To exit this option and return to the nodes sub-menu type "q" or clicking the **"quit"** box.

The element generation option described below provides an alternate and usually more effective way of defining nodes and element together.

#### **Step 4 Generate elements**

Next, elements may be created after entering the element generation option. This is achieved by clicking in the element box, the **"elts"** option of the main menu or by typing "e", then by clicking the **"join"** box. Clicking nodes in an anti-clockwise direction, following the directions above creates elements. As each element is created it is plotted on the map and assigned an element number. Typing "q" or clicking the **"quit"** box terminates the process when all the desired elements have been generated. Once again the zoom option may be used at any time.

An alternative to individual element generation is the "element block" option. This may be entered by clicking in the **"gblock"** box (or by typing "g"). The user will be prompted to click on 4 corners of a quadrilateral block (in anti-clockwise order) to define the outline. Then the user is prompted to enter the number of elements to generate. It is assumed that the first two nodes clicked form a temporary x direction and the second and third nodes form a temporary y direction. After the nodes are generated (using a local numbering system) the user is prompted to permit movement of individual boundary nodes thus distorting the overall shape of the grid. Typing "q" or clicking the **"quit"** box terminates this section of the generation process and the generated elements are displayed. Because of temporary node numbers that are displayed as the generated section is merged into the entire network it is recommended that after termination the grid is redrawn with the "r" option. As currently compiled the user is limited to 2000 points in the newly generated block.

The **"undo"** option of the main menu allows to "undo" the creation of a block of elements if the desired configuration is not achieved.

#### **Step 5 Move nodes**

When the nodes and elements are constructed it may be desirable to move an individual node to improve the layout. The move option of the **nodes** sub-menu is designed for this purpose; it is entered by clicking in the move box (or by typing "m"). Clicking the left mouse button at a node and then clicking at the desired new node location moves a node. The new location will then be displayed although the grid layout will not re-plot. This process may be repeated for as many nodes as desired. At any time the grid layout may be examined by pressing the right mouse button or

typing "r" i.e. **redraw**. Command then returns to the move option for further moves as desired. Note that the same node may be moved more than once and that the zoom option may also be used to refine the display.

Nodes may be deleted from the system by selecting the "**del**" box ( or typing "d") A sub menu the provides the user with options for deletion of either **all** mid-side nodes, **all central** mid-side nodes, **unused** nodes or **single** nodes. When the **single** option is selected nodes that are then clicked will be deleted. For convenience the "**fill**" option described in the element generation section is also available. If a corner node is deleted any elements that are connected to it are also removed. The "**join**" option allows the user to merge pairs of nodes thus joining separate sections of the network. To exit the "**del**" menu, type "q" or click the **quit** box. To exit the **move** or **delete** options type "q" or click the "**quit**" box.

### **Step 6 Refine element layout**

Selecting elements and moving to the refine menu allows element refinement: A number of options are possible once the elements are selected:

- Rectangular or triangular elements into may be split into four
- Rectangular elements may be split in two using a line splitting the longest sides.
- Rectangular elements may be split in two using a line splitting the shortest sides.
- Rectangular elements may be split in two using a line across the diagonal.
- If two adjacent triangles are selected the apparent diagonal formed by the common line of these elements may be reversed.

When refinement is permanently or temporarily completed the network will have nodes located at mid-sides of adjacent elements. A clean operation will add additional elements to construct a consistent layout.

The "**undo**" option of the main menu may be used to return to the pre-refine situation if an undesirable result has been obtained.

### **Step 7 Insert bottom elevations**

When nodes are created they are assigned a bottom elevation of -9999. Desired

values are assigned with the depth option entered by clicking on the **elev** box (or by typing "e"). As this option is entered the user may choose between a number of options for addition of elevation data. If "**man/el**" is selected the user is prompted for an elevation that is to be assigned. After typing the elevation and pressing enter current values are displayed below the nodes. Values are then assigned by clicking at nodes individually, or by typing "a" to assign this value to all nodes or by typing "f" to assign this value only to those nodes with the default value. Control is returned to prompt for a new bottom elevation by typing "n" or clicking on the **next** box and to the main menu by typing "q" or clicking the **quit** box. Other options allow the user to use the map file to interpolate values to all nodes (the **all/el** box), those still with the value -9999. ( the **fil/el** box) or a single node (the **sin/el** box). Other options in this menu allow the user to generate data values for nodes connecting one-dimensional elements.

### **Step 8 Insert fluid type numbers**

When elements are generated they are assigned a type number of "1". The type option is designed to allow the user to assign other values to elements. The option is entered by clicking in the **type** box (or by typing "t") of the "**elt**" menu. The user is prompted for the type number to be inserted for the elements. When the number is entered from the keyboard the current values are displayed below the element number. New numbers are assigned by clicking over the displayed element number. Typing "e" causes the prompt to reappear and the user may input a further element type number. Typing "q" or clicking the "**quit**" box terminates this option.

### **Step 9 Define starting sequence for reordering**

The final necessary step for creation of an RMA-1 input file is to define element numbers for starting reordering in RMA-1. This option is entered from the main menu "**order**" option, by clicking the **order** box or by typing "o". However the user must have first executed the "**fill**" process to define mid-side numbers for all elements. When reordering is selected the user is presented with options that allow reorder processing of an existing list, the generation of additional reordering sequence lists or processing of a newly added list. The program automatically keeps a record of the best list processed. This option may be exited by typing "q" or clicking the "**quit**" box.

### **Step 10 Saving files or plots.**

The processor allows saving of binary ".GEO" files or ASCII ".RM1" files, these options should be selected as desired at the main menu.

At any time in the steps outlined above previously executed steps can be repeated to change element connections, move nodes or refine the grid.

The operations presented above are just an outline of a possible procedure that ensures development of the necessary data for an executable RMA-1 input file.

Note that all other parameters of the RMA-1 input file are either assigned default values or the values that may have been read from the input file. The user is advised to consult the manual section (5.2.1.2) for descriptions of element refinement options.

## APPENDIX A

### DATA FORMATS FOR THE RM1 FILE

The ASCII RM1 file used in RMAGEN is a limited subset of the file used in the module RMA-1 that can be used to process an RM1 file into a binary GEO file structure. The following is a limited extract from the RMA-1 user instructions and lists the relevant data lines that are automatically created and saved when using ASCII files RMAGEN. Many of the switches are automatically set and have no relevance when using RMAGEN

The RM1 file has the following structure:

#### Line Type A Title

01-80	A80 TITLE	Any 80 column comment; this comment will appear on both the printed and plotted output.
-------	-----------	---

#### Line Type B Control data

01-05	I5 ISLP	Enter 1 if the corner node slopes are to be input; otherwise leave blank. Figure 3.1 illustrates this process.
06-10	I5 IPRT	Enter 1 if input data are to be echo printed; otherwise leave blank. Enter 2 if both input data and the complete network specifications are to be printed.
11-15	I5 IPNN	Enter 1 if node numbers are to be plotted; otherwise leave blank.
16-20	I5 IPEN	Enter 1 if element numbers are to be plotted; otherwise leave blank. Enter 2 if the material types are to be plotted; enter 3 if both element numbers and element material types are to be plotted.
21-25	I5 IPO	Enter 1 if a network plot is to be drawn; otherwise leave blank.
26-30	I5 IRO	Enter 1 if the program is to internally arrange the element order for a more efficient numeric solution; otherwise leave

blank. If a 1 is specified additional lines will be required as defined at line type N.

31-35	I5	IPP	0 = plot whole network. 1 = plot subsection defined by node numbers as specified in line type D. 2 = plot subsection defined by coordinates as specified in line type E
36-40	I5	IRFN	Enter a 1 if the program is to refine an existing network by subdivision of existing elements; otherwise set to zero. If a 1 is specified additional lines will be required as specified in line type L. Figure 3.2 illustrates this process.
41-45	I5	IGEN	Enter 1 if a network (or network subsection) is to be generated from specification of its quadrilateral corner points; otherwise enter zero. A non-zero entry here will require inputs at line type M.
46-50	I5	NXZL	Enter 1 to enable input of line segments for which the program will internally calculate exact coordinates to insure a straight line of equal slope. An entry here will require additional input at line type K below; otherwise enter 0.
51-55	I5	NITST	Switch controlling implementation of complete renumbering of 2D elements before transition elements if possible 0 = ignore, 1 = activate.
56-60	I5	ISCTXT	Switch controlling location of plotted node and element numbers 0 = no offset from actual location 1 = offset location by a small amount for clearer reading. Most useful when plotting grids that will no be scaled.
61-65	I5	IFILL	Switch controlling starting point for automatic fill of mid-side node numbers. 1 = start fill at any unused node number. 0 = start fill after highest input node number.
66-70	I5	IALTGM	Switch for control of structure of input and output geometric files. 0 = use original format. 1 = use revised format that includes nodal widths, sides slopes and off channel storage width.

Note that ALTGM = 1 is now the preferred structure.

71-95		Leave blank
96-105	I10 NTEMPIN	0 = Use 5 column format for storage of element connections (type I) and short format coordinates (type J) 1 = Use 6 column format for storage of element connections (type I) and short format coordinates (type J). 2 = Use 5 column format for storage of element connections (type I) and long format coordinates (type J) 3 = Use 6 column format for storage of element connections (type I) and long format coordinates (type J)

Line Type C Scale control data

01-10	F10.0 HORIZ	Maximum horizontal size of plot, inches. If scale plot factors are used, set to zero.
11-20	10.0 VERT	Maximum vertical size of plot, inches. If scale plot factors are used, set to zero.
21-30	F10.0 XSCALE	Plotting scale factor for x (horizontal) inputs; if HORIZ is not zero, set this value to zero.
31-40	F10.0 YSCALE	Plotting scale factor for y (vertical) inputs; if VERT is not zero, set this value to zero.
41-50	F10.0 XFACT	Prototype scale factor for x coordinates (assumed to be 1.0 if left blank).
51-60	F10.0 YFACT	Prototype scale factor for y coordinates (assumed to be 1.0 if left blank).
61-70	F10.0 AR	Plot rotation in degrees from X axis (clockwise).
71-80	F10.0 ANG	Angle of rotation of coordinate system.

Line Type D Element connection data, (I5 format) used when NTEMPIN=0 or 2

01-05	I5 J	Element number
06-45	8I5 NOP(J,K)	Element node numbers; enter 6 or 8 numbers starting at any corner and moving counter clockwise around the element.
46-50	I5 IMAT(J)	Element type number (corresponds to element types



specified for RMA-2).

51-60 F10.0 PAYG(J) Principal axis direction.(As many lines as required.  
Terminate with blank in columns (6-15).

Alternate Line Type D1 Element connection data, (I6 format) used when NTEMPIN=1 or 3

01-06 I6 J Element number

07-54 8I6 NOP(J,K) Element node numbers; enter 6 or 8 numbers starting at any corner and moving counter clockwise around the element.

45-60 I6 IMAT(J) Element type number (corresponds to element types specified for RMA-2).

61-70 F10.0 PAYG(J) Principal axis direction.(As many lines as required.  
Terminate with blank in columns (6-15).

Line Type E Nodal coordinate data (short format), used when NTEMPIN=0 or 1

01-10 I10 J Node number

11-20 F10.0 CORD(J,1) X coordinate

21-30 F10.0 CORD(J,2) Y coordinate

31-40 F10.0 WD(J) Network bottom elevation at node J.

41-50 F10.0 WIDTH(J) Channel width at node J. Used for one-dimensional analysis. Leave blank or 0.0 for two dimensional nodes.

51-60 F10.0 SS1(J) Channel left side slope at node J. Used for one-dimensional analysis. Leave blank or 0.0 for two dimensional nodes.

61-70 F10.0 SS2(J) Channel right side slope at node J. Used for one-dimensional analysis. Leave blank or 0.0 for two-dimensional nodes.

71-80 F10.0 WSTOR(J) Channel storage width at node J. Used for one-dimensional analysis. Leave blank or 0.0 for two-dimensional nodes.

(As many lines as required. Terminate with blank in columns (11-20).

Alternate Line Type E1 Nodal coordinate data (long format), used when NTEMPIN=2 or 3

01-10	I10 J	Node number
11-30	F10.0 CORD(J,1)	X coordinate
31-50	F10.0 CORD(J,2)	Y coordinate
51-60	F10.0 WD(J)	Network bottom elevation at node J.
61-70	F10.0 WIDTH(J)	Channel width at node J. Used for one-dimensional analysis. Leave blank or 0.0 for two-dimensional nodes.
71-80	F10.0 SS1(J)	Channel left side slope at node J. Used for one-dimensional analysis. Leave blank or 0.0 for two-dimensional nodes.
81-90	F10.0 SS2(J)	Channel right side slope at node J. Used for one-dimensional analysis. Leave blank or 0.0 for two-dimensional nodes.
91-100	F10.0 WSTOR(J)	Channel storage width at node J. Used for one-dimensional analysis. Leave blank or 0.0 for two-dimensional nodes.

(As many lines as required. Terminate with blank in columns (11-20).

Line Type F Element reordering data. (Enter only if IRO = 1. 16 values per line. A maximum of 160 values per starting point)

01-80	16I5 NLIST	A list of elements from which the program will reorder the internal sequence of elements to obtain the most efficient operation of the simulation programs. As a general rule at least two starting locations should be tried, one at each end of the network. The end of a each list is a blank value in a field.
-------	------------	--

(As many lists as desired. Terminate with 9999 in columns 2-5.)

Line Type G Continuity Line Control

01-05	I5	NCL	Number of continuity lines to follow
06-25			Blank
26-29	A4	NCLM	'NCLM'

Enter NCL sets of CC1 and CC2 lines

Line Type G1 Continuity Line Data

01-03	A3	ID3	'CC1'
04-08	I5	J	Continuity line number
09-80	918	CLINE	List of corner nodes forming continuity line

Line Type G2 Continuity Line Data Control NCL sets of CC1 and CC2 lines. Repeat P2 lines until the required number of nodes is entered.

01-03	A3	ID3	'CC2'
04-08	I5	J	Blank
09-80	918	CLINE	Continuation of list of corner nodes forming continuity line

## APPENDIX B

### STEPS FOR GENERATION OF RM1 AND GEO FILE IN RMAGEN

- 1 Load MAP file
- 2 Load RM1 file, if there is no RM1 file reply cancel to open request.
- 3 Optionally load background file
- 4 If RM1 file exists, delete all mid-sides NODE/DEL/ALLMID
- 5 Edit, refine and modify file as needed.
- 6 Add bottom elevations NODE/ELEV/ALL
- 7 Fill mid-sides ELTS/FILL
- 8 Check for valid outline REDRAW/OUTLIN
- 9 If needed, go to step 4 and fix errors
- 10 Check match to bathymetry CONTOUR/OPTIONS AND DRAW CONTOUR
- 11 If needed go to step 4 and fix errors.
- 12 Setup reordering lists ORDER/GETGRP
- 13 Process reordering lists ORDER/PRLIST
- 14 Setup continuity lines CCLINE
- 15 Save final RM1 and GEO files FILE/SAVEAS
- 16 Exit

**REMEMBER TO SAVE RM1 FILES AT REGULAR INTERVAL**

## APPENDIX C

### FILE FORMAT FOR THE CROSS-SECTION DATA FILE

Line type **TC** CROSS SECTION TITLE LINE 1 line

01-02 ID A "TC"

09-80 TITLE A Any heading comment

Repeat lines type **RCH**, **ICS** and sets of **CRS** for each cross-section data set.

Line type **RCH** REACH IDENTIFIER LINE 1 line

01-02 ID A "RCH"

09-08 NOREACH I Reach Number. This is used in RMAGEN in association with the element type number to determine which cross-sections are eligible to be used for computation of cross-section weighting factors. In other words when reach

number and element type number match reach may be when computing the weighting factors. Reach number is not used in RMA-2.

Line type **ICS** CROSS-SECTION IDENTIFIER 1 line

01-03 ID A "ICS"

09-16 IVMIL I Cross-section number

16-24 NRIVL I Number of elevations in section data

25-32 XRIV R River mile number (for ID purposes only, not used in RMA-2 or RMAGEN)

33-48 XCRS R X location of cross-section in system coordinates. For ID purposes only, not used in RMA-2 and not used in RMAGEN when a cross-section is defined in a type XYL line (see below).

49-64 YCRS R Y location of cross-section in system coordinates. For ID purposes only, not used in RMA-2) and not used in RMAGEN when a cross-section is defined in a type XYL line (see below).

Line type **CRS CROSS\_SECTION DATA** NRIVL lines

01-03	ID	A	"CRS"
09-16	CRSDAT(1)	R	Elevation
17-24	CRSDAT(2)	R	Cross-section area <sup>4</sup> (no longer used except for the first entry)
25-32	CRSDAT(3)	R	Cross-section surface width

Line type **XYL CROSS-SECTION LOCATION DATA** 1 line for each cross-section (optional)

01-03	ID	A	"XYL"
09-16	IVMIL	I	Cross-section number
17-32	XCRS	R	X location of cross-section in system coordinates. Not used in RMA-2.
33-48	YCRS	R	Y location of cross-section in system coordinates. Not used in RMA-2.

Line type **CRF CROSS\_REFERENCE DATA** 1 line for each corner node.  
Required for RMA-2, optional for RMAGEN

01-03	ID	A	"CRF"
09-16	NODE1	I	Corner node number
17-24	NRIVCR1	i	Cross-section number for weighting factor 1
25-32	WTRIVCR1	R	Weighting factor for cross-section 1

---

<sup>4</sup> Cross-section area is computed as a trapezoidal integration in the vertical direction of the widths, the input value is used for the first level

33-40	NRIVCR2	I	Cross-section number for weighting factor 2
41-48	WTRIVCR2	R	Weighting factor for cross-section 2

Note that WTRIVCR2 is not strictly needed. WTRIVCR1 and WTRIVCR2 must add to 1.0

Line type **ENDDATA** END CROSS SECTION DATA FILE 1 line (Required)

01-07 ID A "ENDDATA"

## APPENDIX D

### FILE FORMAT FOR THE LINE BLOCK DATA FILE

The data line is defined as a sequence of x and y coordinates and each section also has an associated width.

Line type **XYW BLOCK SEQUENCE DATA** 1 line for each cross-section  
(optional) The first 8 columns are fixed, the remainder is free width blank delimited

01-03 ID A "XYW"

04-08 Blank

Free format data follows

XC R X location of sequence

YC R Y location of sequence

WIDTH R Block width at this location of sequence

HLEFT R Bed elevation at left boundary of this location of  
sequence

HMID R Bed elevation at centre-line boundary of this location of  
sequence

HRIGHT R Bed elevation at right boundary of this location of  
sequence

Line type **ENDDATA** End of data set

01-07 ID A "ENDDATA"