

NAME: Repeating Shapes for ArcGIS

Installation File: repeat_shapes.exe

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TOPICS: hexagon, square, triangle, repeat, sample, tessellation, array, matrix, lattice, point, systematic, grid, extent

AUTHOR: Jeff Jenness

Wildlife Biologist, GIS Analyst
Jenness Enterprises
3020 N. Schevene Blvd.
Phone: 1-928-607-4638
Flagstaff, AZ 86004 USA

Email: jeffj@jennessent.com

Web Site: <http://www.jennessent.com>



DESCRIPTION: Researchers and land managers often require a way to systematically divide the landscape into equal-sized portions. Breaking up the landscape this way simplifies monitoring plans, and is an essential step in developing systematic sampling designs.

This tool generates an array of repeating shapes over a user-specified area. These shapes can be hexagons, squares, rectangles, triangles, circles or points, and they can be generated with any directional orientation.

Shapes can be generated over all selected records of a feature theme, over the entire rectangular extent of a theme, over the rectangular extent of all themes in the view, or over the visual extent of the display.

For those who have access to ArcView 3.x, this extension can be used in conjunction with the "Random Point Generator" extension (http://www.jennessent.com/arcview/random_points.htm) to generate random points within a systematically divided sampling area. This extension can be used to generate systematic polygons over the landscape, and the "Random Point Generator" extension can then be used to generate random sample points within those polygons.

Output: This extension produces either a point or a polygon feature class and adds it as a layer to the map. The new feature class will be created in the projection and datum of the map display.

REQUIRES: ArcView 9.x or 10.x.

UPDATES: See p. 24.

Recommended Citation Format: For those who wish to cite this extension, the author recommends something similar to:

Jenness, J. 2011. Repeating shapes for ArcGIS. Jenness Enterprises. Available at: http://www.jennessent.com/arcgis/repeat_shapes.htm.

Please let me know if you cite this extension in a publication (jeffj@jennessent.com). I will update the citation list to include any publications that I am told about.

Acknowledgments: Jenness Enterprises gratefully acknowledges the **Ontario Ministry of Agriculture, Food and Rural Affairs** for supporting portions of this extension.

Table of Contents

INSTALLING REPEATING SHAPES:	2
<i>For ArcGIS 9.x</i>	2
<i>For ArcGIS 10.0</i>	3
<i>Viewing the Tool:</i>	4
UNINSTALLING REPEATING SHAPES TOOL	6
<i>For ArcGIS 9.x</i>	6
<i>For ArcGIS 10.0</i>	6
TROUBLESHOOTING	9
<i>If Any of the Tools Crash</i>	9
<i>“Object variable or With block variable not set” Error:</i>	9
<i>RIGHTX32.OCX Error (also comct332.ocx, comdlg32.ocx, mscomct2.ocx, mscomctl.ocx, msstdfmt.dll errors):</i>	9
GENERAL INSTRUCTIONS	12
<i>Choose the Region of Interest:</i>	12
With Respect to Selected Features in a Feature Layer:.....	12
Within the Extent of a Particular Layer:.....	14
Within the Extent of All Layers in the Map:.....	14
Within the Extent of the Display:.....	14
<i>Choose the Shape Type to Create</i>	14
<i>Set Shape Parameters:</i>	15
Generating Points in a Square Pattern:.....	15
Generating Points in a Triangular Pattern:.....	16
Generating Circles in a Square Pattern:.....	17
Generating Circles in a Triangular Pattern:.....	17
Generating Squares:.....	18
Generating Rectangles:.....	19
Generating Triangles:.....	20
Generating Hexagons:.....	21
GENERAL NOTES:	23
<i>Stopping the Process:</i>	23
UPDATES	24

Installing Repeating Shapes:

For ArcGIS 9.x

First close ArcGIS if it is open. The tools do not install properly if ArcGIS is running during the installation.

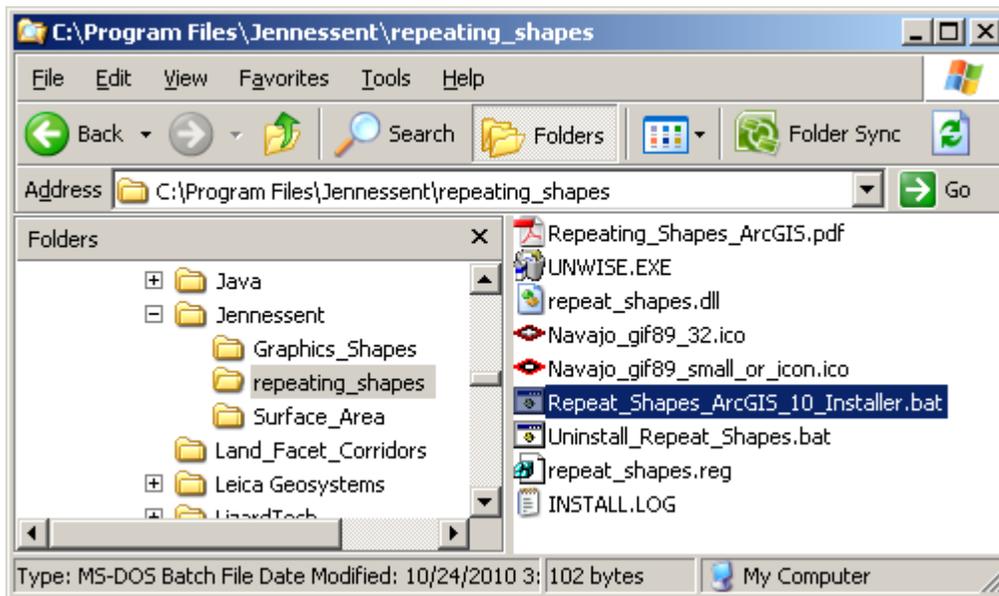
Install the *Repeating Shapes* extension by double-clicking on the file **repeat_shapes.exe** (available at http://www.jennessent.com/downloads/repeat_shapes.zip, or from a link on the page http://www.jennessent.com/arcgis/repeat_shapes.htm) and following the instructions. The installation routine will register the Repeating Shapes DLL with all the required ArcMap components.

The default install folder for the extension is named “repeating_shapes” and is located inside the folder “Program Files\Jennessent”. This folder will also include some additional files and this manual.

For ArcGIS 10.0

Note: This function will only work if you have ArcGIS 10 installed.

1. **First close ArcGIS if it is open.** The tools do not install properly if ArcGIS is running during the installation.
2. Install the *Repeating Shapes* extension onto your hard drive by double-clicking on the file **repeat_shapes_10.exe** (available at http://www.jennessent.com/downloads/repeat_shapes_10.zip, or from a link on the page http://www.jennessent.com/arcgis/repeat_shapes.htm) and following the instructions. This installation routine will install the Repeating Shapes DLL and several ancillary files on your hard drive, but will **not** register the tools with ArcGIS.
3. Use Windows Explorer to open your installation folder (if you used the default values, then this folder will be located at "Program Files\Jennessent\repeating_shapes"). This folder will also include some additional files and this manual.



4. **For Windows XP:** Double-click the file "Repeat_Shapes_ArcGIS_10_Installer.bat" to register all the tools with ArcGIS 10.0.

For Windows 7/Vista: Double-click the file "Repeat_Shapes_ArcGIS_10_Installer.bat" to register all the tools with ArcGIS 10.0.

If the registration is successful, then you should see a "Registration Succeeded" notice.



Note: For the concerned or curious, the batch file *Repeat_Shapes_ArcGIS_10_Installer.bat* contains the following single line of text:

```
"%CommonProgramFiles%\ArcGIS\bin\ESRIRegAsm.exe" /p:Desktop "repeat_shapes.dll"  
/f:"repeat_shapes.reg"
```

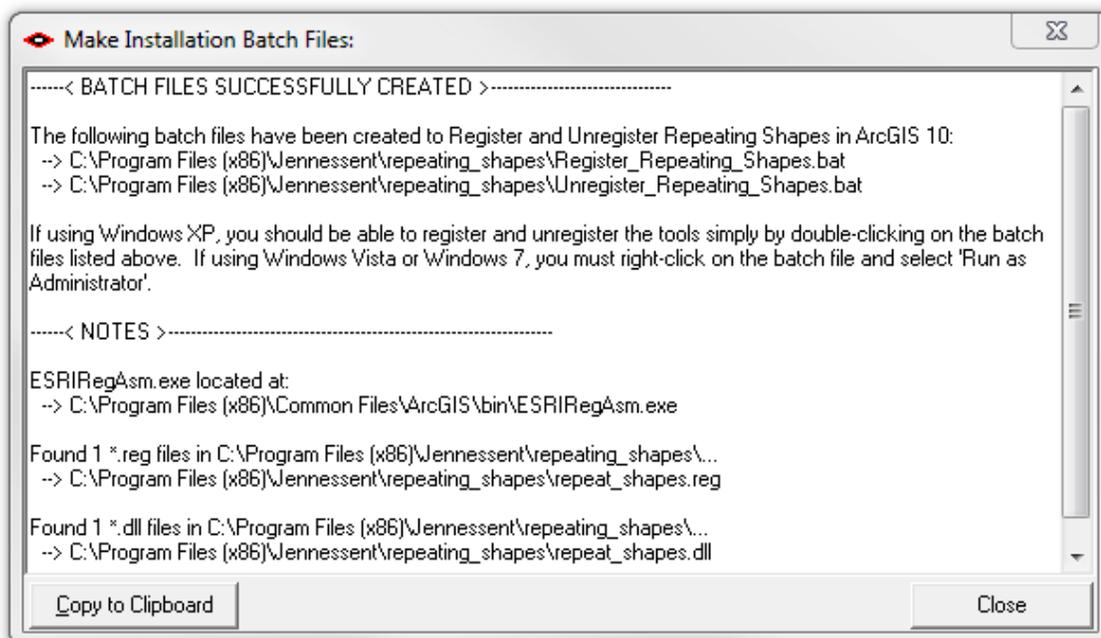
It directs the ESRI installer *ESRIRegAsm* to register the extension DLL *repeat_shapes.dll* within ArcGIS, using GUID and Class ID values from the registry file *repeat_shapes.reg* (also

located in your installation directory). Both *Repeat_Shapes_ArcGIS_10_Installer.bat* and *repeat_shapes.reg* may be opened and viewed using standard text editors such as Notepad or WordPad.

5. **Alternative Method if you do not get the “Registration Succeeded” message:** If the method above does not work, the reason is probably due to the “%CommonProgramFiles” environmental variable pointing to the wrong location, and/or Windows Vista or Windows 7 Security settings. The fix is to use a batch file that includes the full pathnames to “ESRIRegAsm.exe” and to the extension DLL and REG files. You may edit the BAT file yourself, or you may use the tool **Make_Batch_Files.exe** (located in your installation folder) to create new registration and unregistration batch files that are properly formatted to your system.

If using Windows XP: Simply double-click on the file **Make_Batch_Files.exe** to create the new batch files.

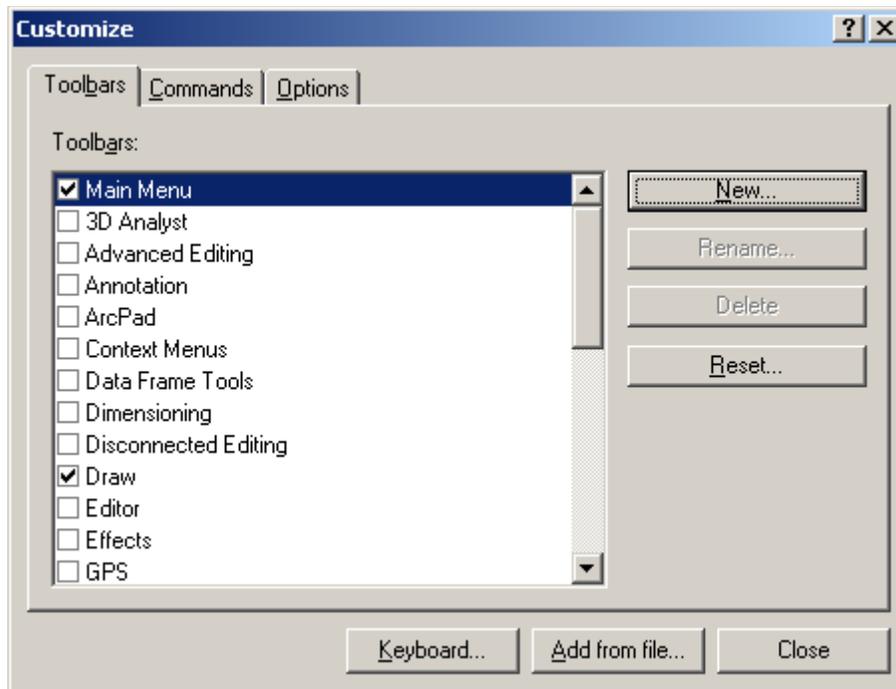
If using Windows Vista or Windows 7: Right-click on the file **Make_Batch_Files.exe** and click “Run as Administrator” to create the new batch files.



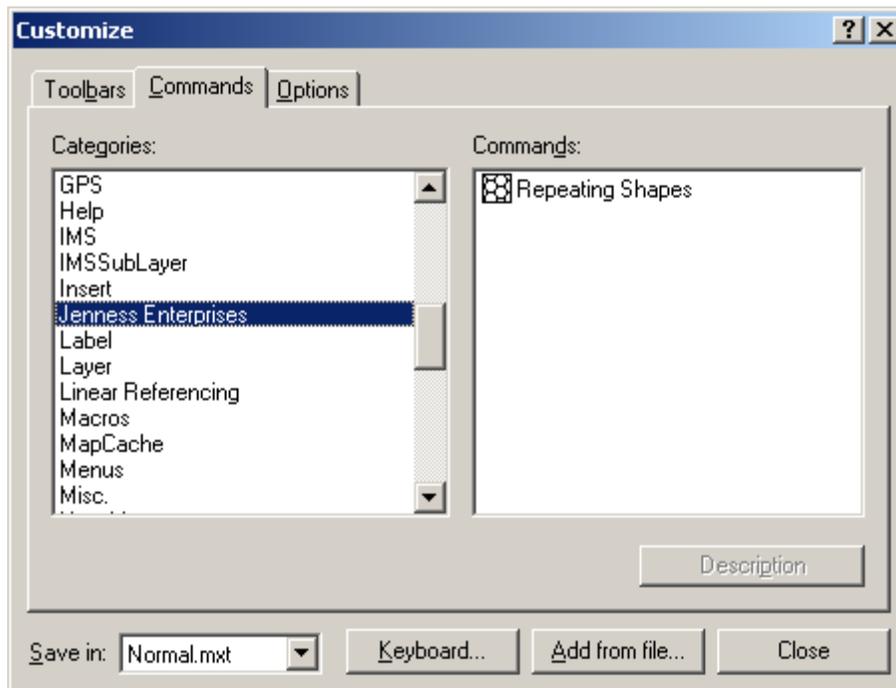
Repeat Step 4 above to register the tool in ArcGIS 10, but this time use the new BAT file *Register_Repeating_Shapes.bat*.

Viewing the Tool:

- 1) After installing Repeating Shapes, open ArcMap and then open the “Customize” window (either by clicking the “Customize” menu item in the “Tools” menu, or by simply double-clicking on a blank portion of the button bar):



- 2) Click on the “Commands” tab and scroll down until you see the “Jenness Enterprises” category:

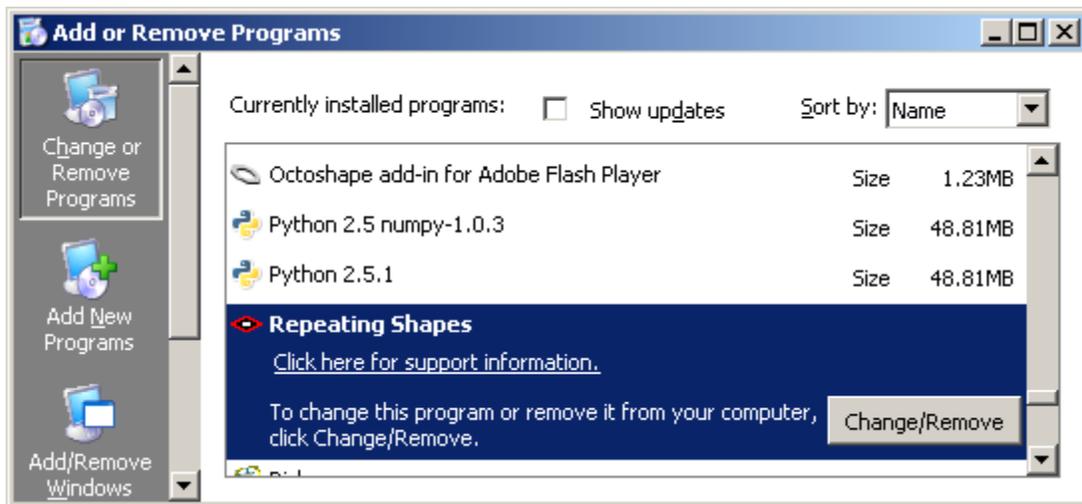


- 3) In the “Jenness Enterprises” category, find the command named “Repeating Shapes”. Simply drag this command up to your button bar. **IMPORTANT:** If you want the Repeating Shapes button to always be available whenever you open ArcMap, make sure you have “Normal.mxt” selected in the bottom right corner of the dialog. If you only want Repeating Shapes to be available within this particular map document, change the selection to your map document (which should be right under “Normal.mxt” in the drop-down box).
- 4) Close the “Customize” dialog box and you will be ready to go.

Uninstalling Repeating Shapes Tool

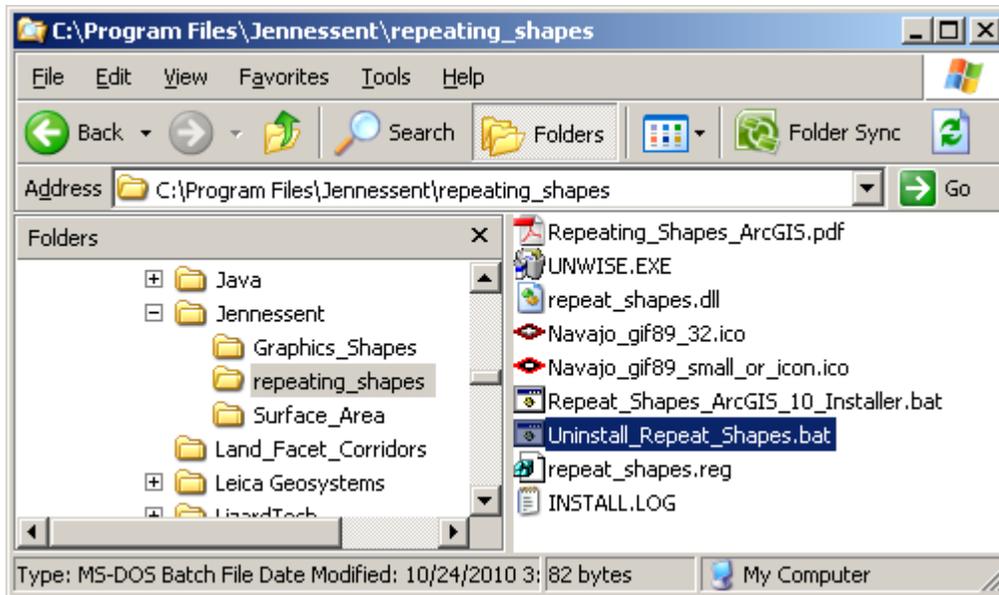
For ArcGIS 9.x.

- 1) Close ArcGIS if it is open.
- 2) Click the Start button.
- 3) Open your Control Panel.
- 4) Double-click "Add or Remove Programs".
- 5) Scroll down to find and select "Repeating Shapes".
- 6) Click the "Remove" button and follow the directions.



For ArcGIS 10.0

- 1) Close ArcGIS if it is open.
- 2) Use Windows Explorer to open your installation folder (if you used the default values, then this folder will be located at "Program Files\Jennessent\repeating_shapes"). This folder will also include some additional files and this manual.



- 3) **For Windows XP:** Double-click the file *Uninstall_Repeat_Shapes.bat* to unregister all the tools with ArcGIS 10.0.

For Windows 7/Vista: Double-click the file *Uninstall_Repeat_Shapes.bat* to unregister all the tools with ArcGIS 10.0.

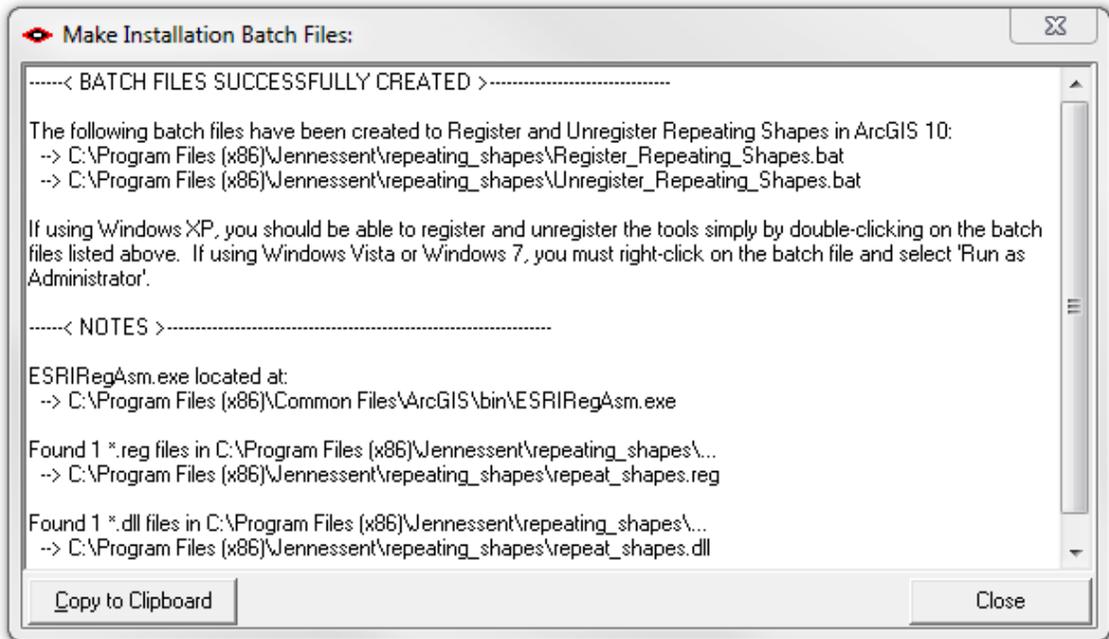
If the unregistration is successful, then you should see an "Unregistration Succeeded" notice.



- 4) **Alternative Method if you do not get the "Unregistration Succeeded" message:** If the method above does not work, the reason is probably due to the "%CommonProgramFiles" environmental variable pointing to the wrong location, and/or Windows Vista or Windows 7 Security settings. The fix is to use a batch file that includes the full pathnames to "ESRIRegAsm.exe" and to the extension DLL and REG files. You may edit the BAT file yourself, or you may use the tool *Make_Batch_Files.exe* (located in your installation folder) to create new registration and unregistration batch files that are properly formatted to your system.

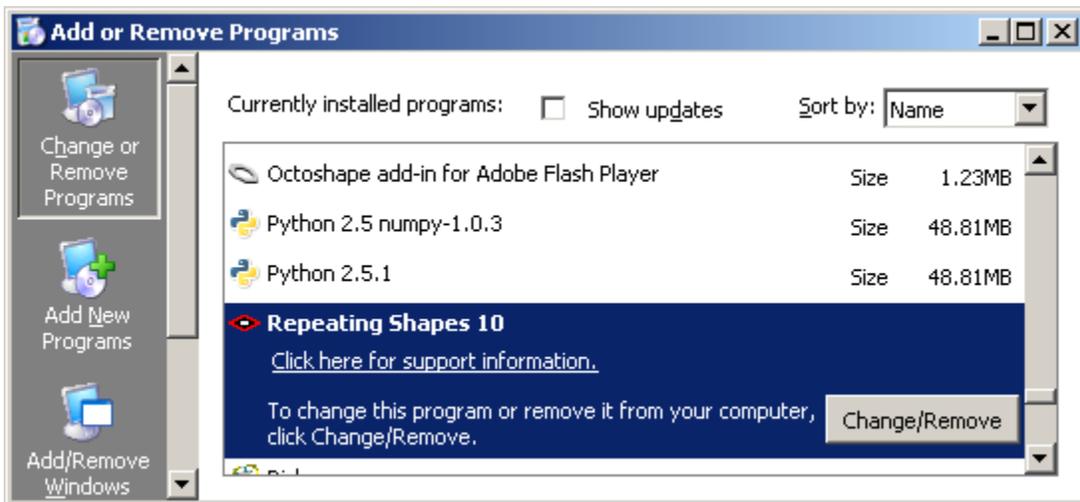
If using Windows XP: Simply double-click on the file *Make_Batch_Files.exe* to create the new batch files.

If using Windows Vista or Windows 7: Right-click on the file *Make_Batch_Files.exe* and click "Run as Administrator" to create the new batch files.



Repeat Step 3 above to unregister the tools in ArcGIS 10, but this time use the new BAT file *Unregister_Repeating_Shapes.bat*.

- 5) Click the Start button.
- 6) Open your Control Panel.
- 7) Double-click "Add or Remove Programs".
- 8) Scroll down to find and select "Repeating Shapes 10".
- 9) Click the "Remove" button and follow the directions.



Note: For the concerned or curious, the batch file *Uninstall_Repeat_Shapes.bat* contains the following single line of text:

```
"%CommonProgramFiles%\ArcGIS\bin\ESRIRegAsm.exe" /p:Desktop /u "repeat_shapes.dll"
```

It directs the ESRI installer *ESRIRegAsm* to unregister the DLL *repeat_shapes.dll* within ArcGIS. *Uninstall_Repeat_Shapes.bat* may be opened and viewed using standard text editors such as Notepad or WordPad.

Troubleshooting

If Any of the Tools Crash

If a tool crashes, you should see a dialog that tells us what script crashed and where it crashed. I would appreciate it if you could copy the text in that dialog, or simply take screenshots of the dialog and email them to me at jeffj@jennessent.com. **Note:** Please make sure that the line numbers are visible in the screenshots! The line numbers are located on the far right side of the text. Use the scrollbar at the bottom of the dialog to make the line numbers visible.

“Object variable or With block variable not set” Error:

If you open ArcMap and immediately see the error dialog appear with one or more error messages stating that “Object variable or With block variable not set”, then 90% of the time it is because ArcGIS was running when you installed the extension. The “Object” variable being referred to is the “Extension” object, and ArcGIS only sets that variable when it is initially turned on.

The solution is usually to simply close ArcGIS and restart it. If that does not work, then:

- 1) Close ArcGIS
- 2) Reinstall the extension
- 3) Turn ArcGIS back on.

RICHTX32.OCX Error (also comct332.ocx, comdlg32.ocx, mscmct2.ocx, mscmctl.ocx, msstdfmt.dll errors):

If you see a line in the error dialog stating:

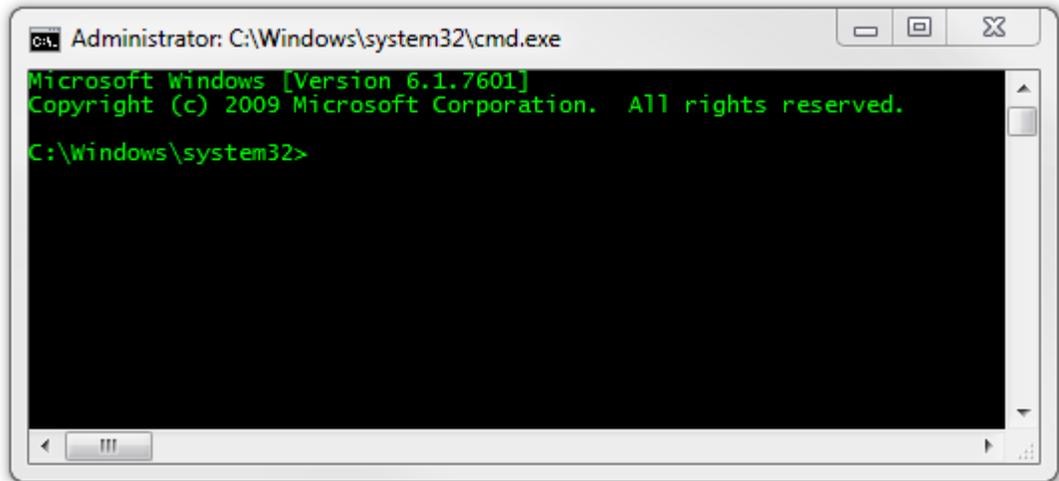
```
Component 'RICHTX32.OCX' or one of its dependencies not correctly registered: a file is missing or invalid
```

Or if you see a similar error stating that one or more of the files *comct332.ocx*, *comdlg32.ocx*, *mscmct2.ocx*, *mscmctl.ocx* or *msstdfmt.dll* are missing or invalid, then simply follow the instructions for *RICHTX32.OCX* below, but substitute the appropriate file for *RICHTX32.OCX*.

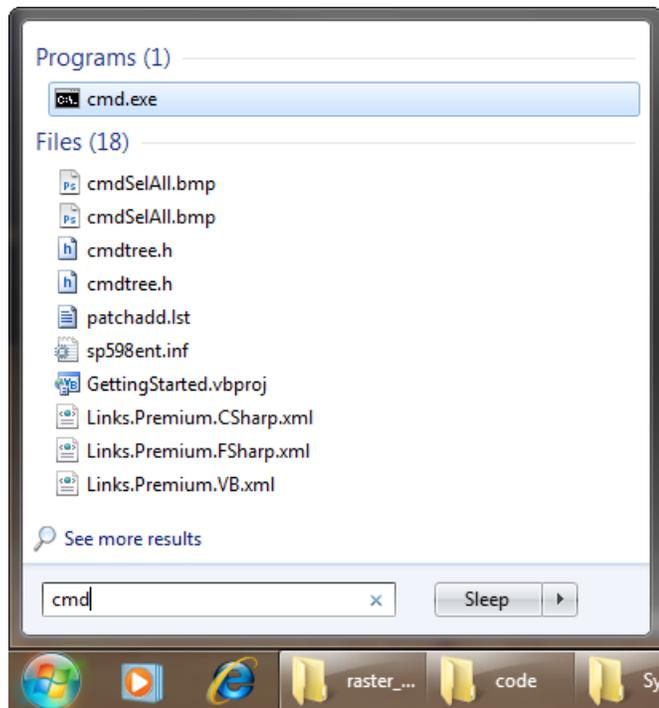
This error is almost always due to the fact that new installations of Windows 7 and Windows Vista do not include a file that the extension expects to find. For example, the file “richtx32.ocx” is actually the “Rich Text Box” control that appears on some of the extension dialogs. The other files refer to other common controls that might appear on the various extension dialogs.

The solution is to manually install the missing file (*richtx32.ocx*) yourself. Here is how to do it:

- 1) Open Windows Explorer and locate the file *richtx32.ocx* in your extension installation file.
- 2) If you are running a **32-bit version of Windows**, then copy *richtx32.ocx* to the directory
C:\Windows\System32\
If you are running a **64-bit version of Windows**, then copy *richtx32.ocx* to the directory
C:\Windows\SysWOW64\
- 3) Open an “Elevated Command Prompt” window. This is the standard Windows Command Prompt window, but with administrative privileges enabled. You need these privileges enabled in order to register the OCX with Windows. **Note:** The Elevated Command Prompt opens up in the “..\windows\system32” directory, not the “..\Users\[User Name]” directory. The window title will also begin with the word “Administrator.”



- a. **Method 1:** Click the "Start" button, then "All Programs", then "Accessories" and then **right-click** on "Command Prompt" and select **Run as Administrator**.
- b. **Method 2:** Click the "Start" button, and then click on the "Search Programs and Files" box. Type "cmd" and then click CONTROL+SHIFT+ENTER to open the Command window with Administrator privileges.



For more help on opening an Elevated Command Prompt, please refer to:

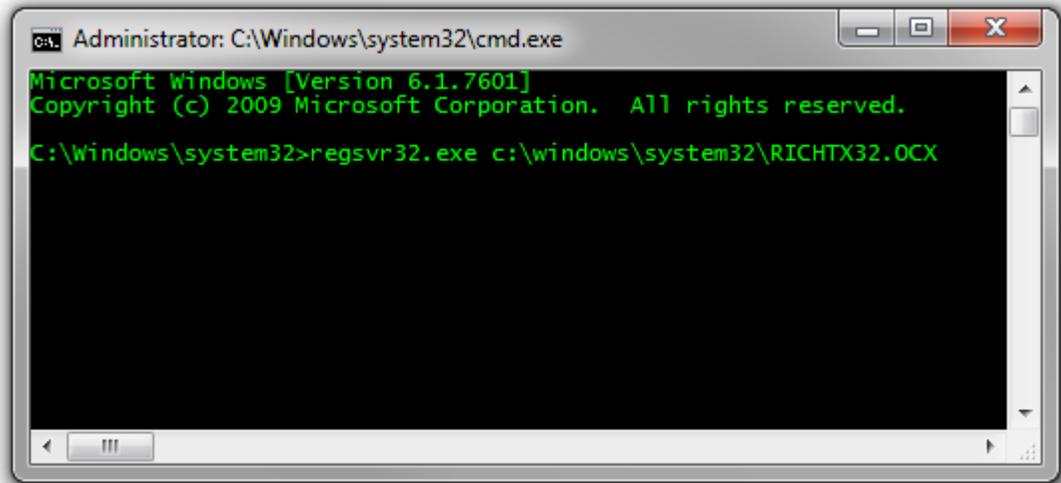
<http://www.sevenforums.com/tutorials/783-elevated-command-prompt.html>

<http://www.winhelponline.com/articles/158/1/How-to-open-an-elevated-Command-Prompt-in-Windows-Vista.html>

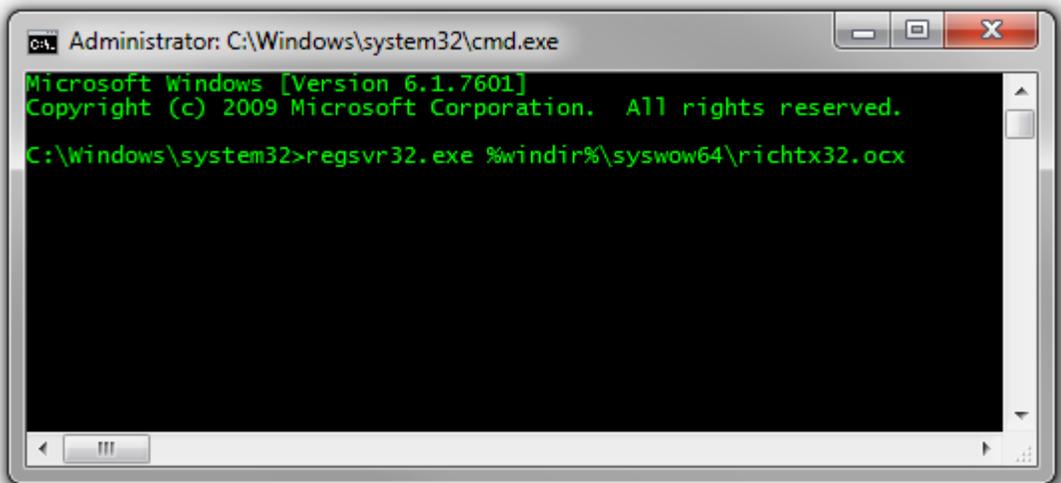
Or simply do a search for "Elevated Command Prompt".

- 4) Register the file *richtx32.ocx* using the Windows RegSvr function:

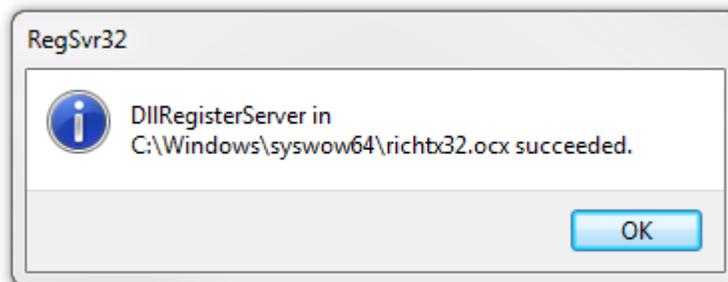
- a. If using a **32-bit version of Windows**, type the line
`regsvr32.exe c:\windows\system32\richtx32.ocx`



- b. If using a **64-bit version of Windows**, type the line
`regsvr32.exe %windir%\syswow64\richtx32.ocx`



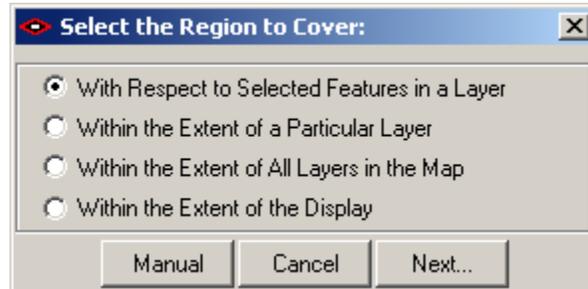
- c. Click [ENTER] and you should see a message that the registration succeeded.



General Instructions

Choose the Region of Interest:

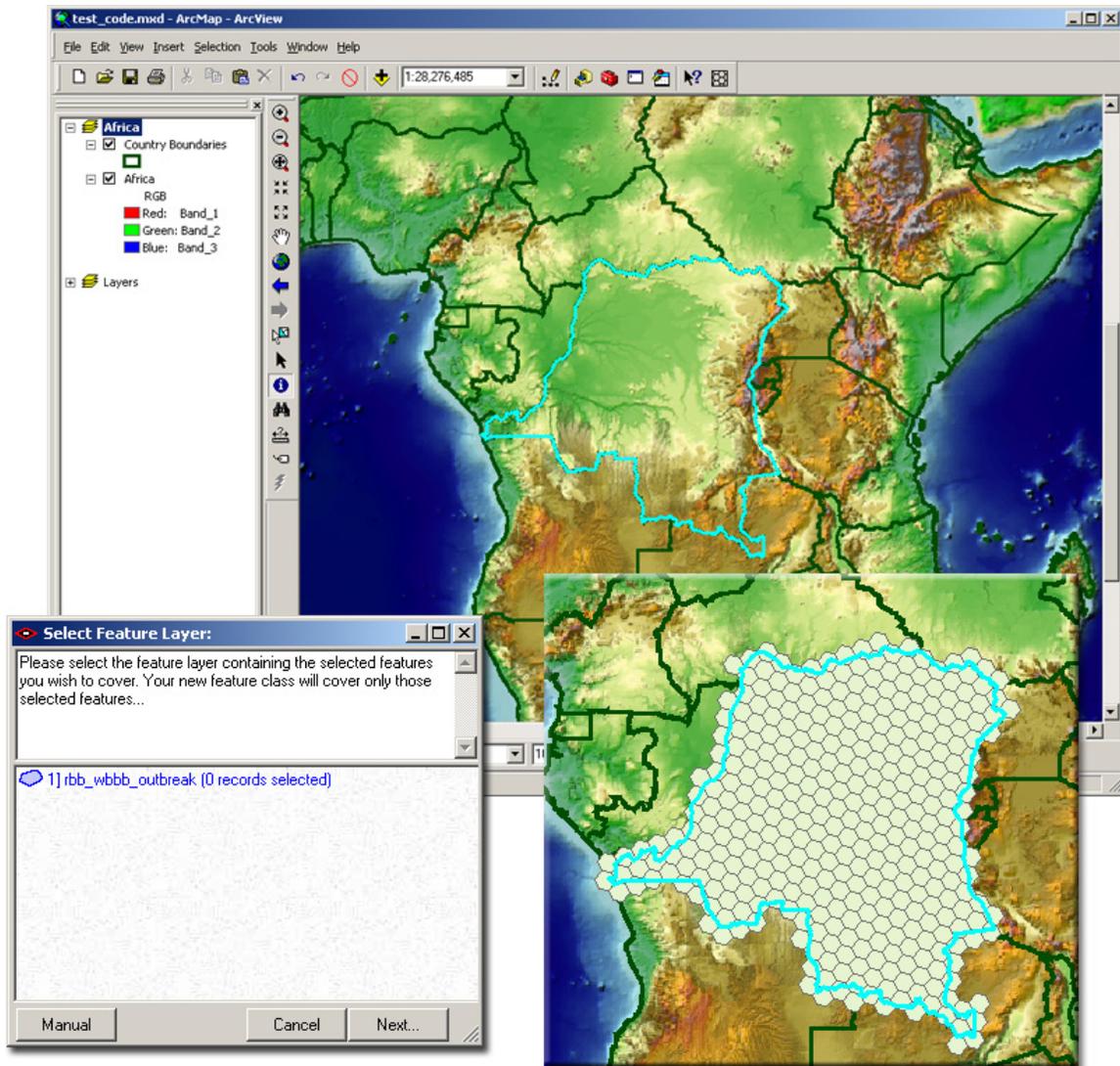
Click the  button and choose your region of interest:



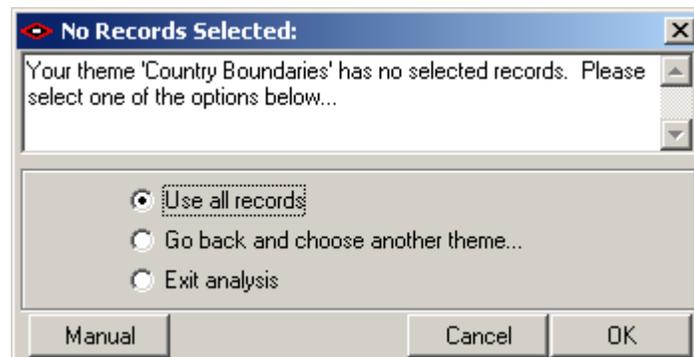
The first option, “With Respect to Selected Features in a Theme”, will generate shapes that will completely cover all the selected features in some point, line or polygon theme. The other three options will generate shapes that completely cover some rectangular area encompassing either a single theme, all the themes in the view, or the visible extent in the view.

With Respect to Selected Features in a Feature Layer:

This option will generate shapes that completely cover all the selected features in a feature layer. You will be asked which feature theme to use:

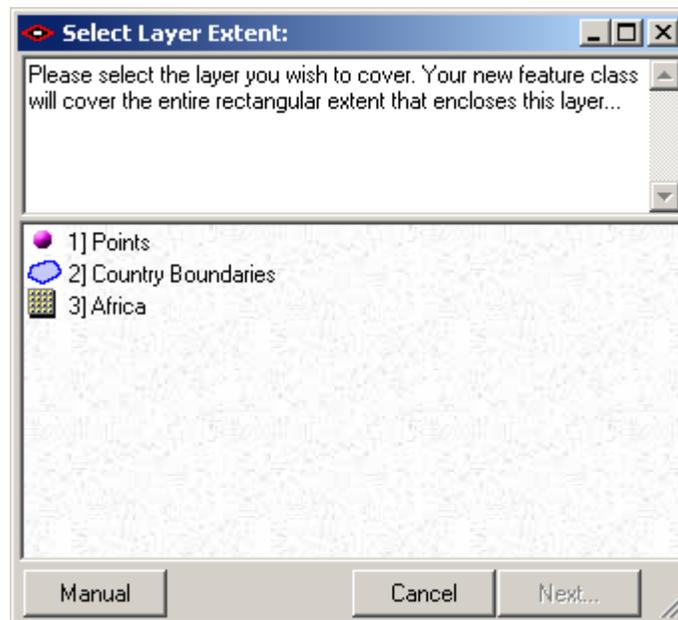


If you choose a theme with no records selected, then you will have the option to either generate shapes over all features or go back and choose another theme:



Within the Extent of a Particular Layer:

This option will generate shapes that completely cover the entire rectangular area that encompasses your layer. You will be asked with layer to use, and you are not restricted to feature layers for this function:



Within the Extent of All Layers in the Map:

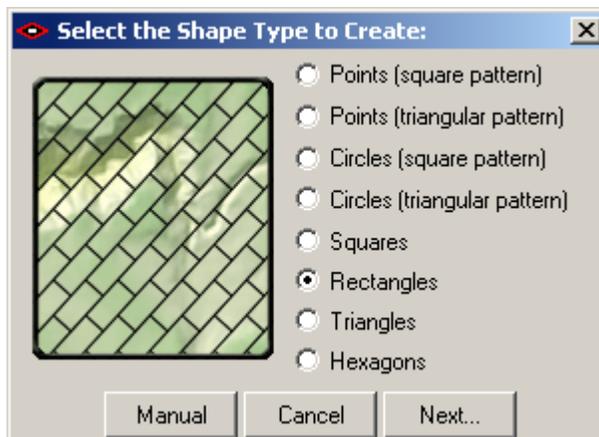
This option will cover all the themes in your view; essentially equal to the rectangular region that you see when you click the “Zoom to Full Extent” button .

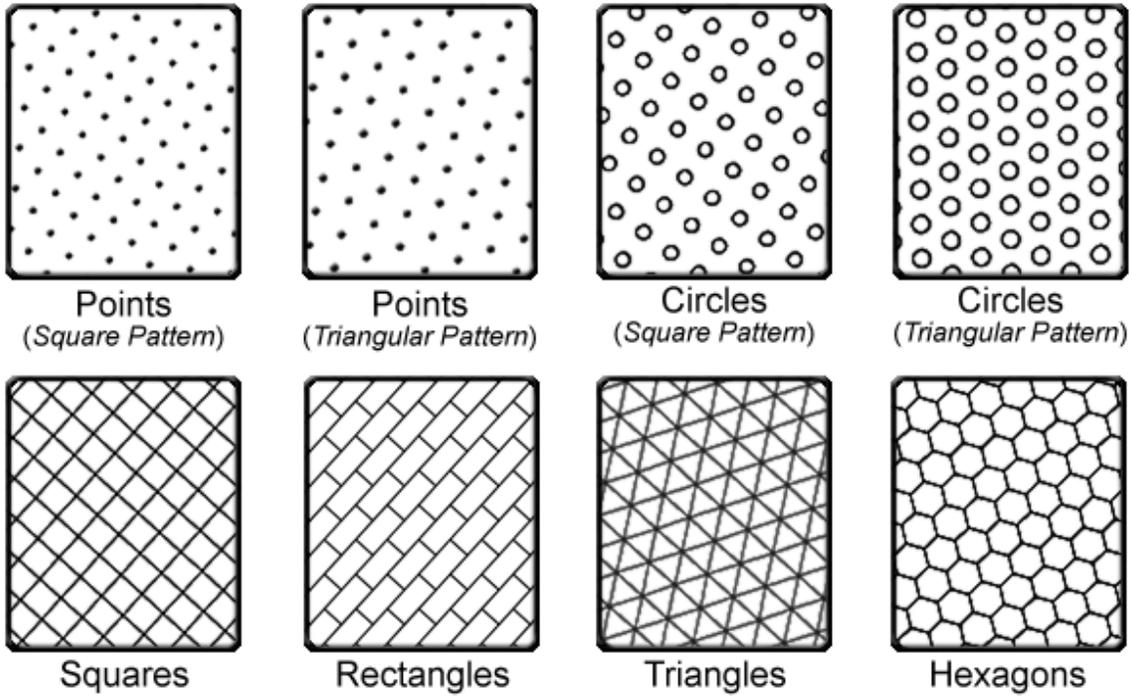
Within the Extent of the Display:

This option will use cover the entire visible region within your map display.

Choose the Shape Type to Create

You have seven options for shape type and arrangement. Points and circles may be generated in either a square or triangular pattern. Squares, triangles and hexagons will completely cover the region of interest. All options can be oriented in any direction.





Set Shape Parameters:

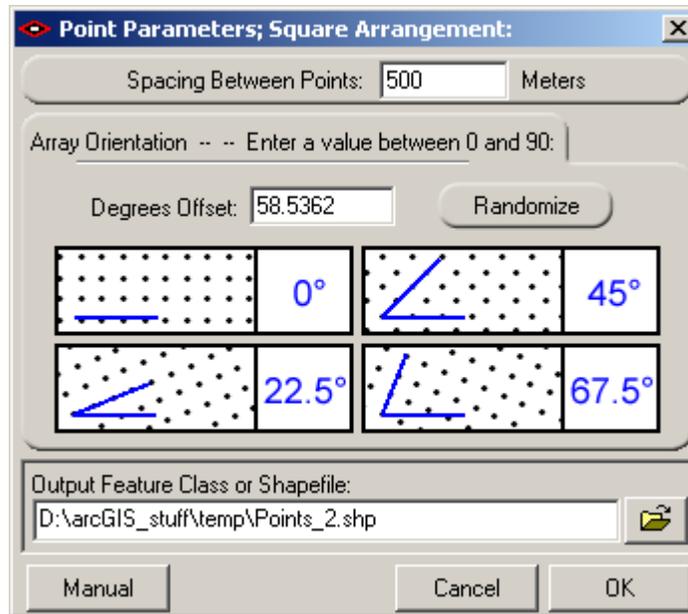
All options have several parameters relating to size, spacing and orientation of shapes. The directions and size values are based on your map spatial reference (i.e. projection and datum). If your map has no projection set, then the direction and size values will be based on the first layer in the map.

Polygon feature classes will include an *Area* field, and point feature classes will include *X-* and *Y-coordinate* fields.

Generating Points in a Square Pattern:

This option generates an array of points lined up in rows and columns, and oriented in any direction you choose. If you found the 4 closest points to some random location within the array, those 4 closest points would form a square.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with perfectly vertical and horizontal rows and columns. An offset value of either 0° or 90° will produce vertical and horizontal rows and columns, and you can enter any value within this range.

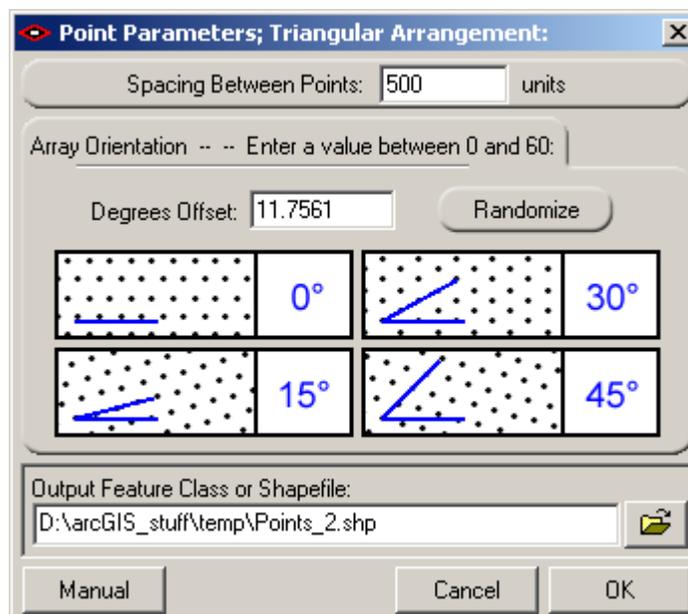


TIP: If you wish to use values of 0°, 22.5°, 45° or 67.5°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 90°, simply click the “Randomize” button.

Generating Points in a Triangular Pattern:

This option generates an array of points lined up in 3 general directions and oriented in any direction you choose. If you found the 3 closest points to some random location within the array, those 3 closest points would form an equilateral triangle.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array with one perfectly horizontal orientation. An offset value of either 0° or 60° will produce an array with one horizontal row of points, and you can enter any value within this range.



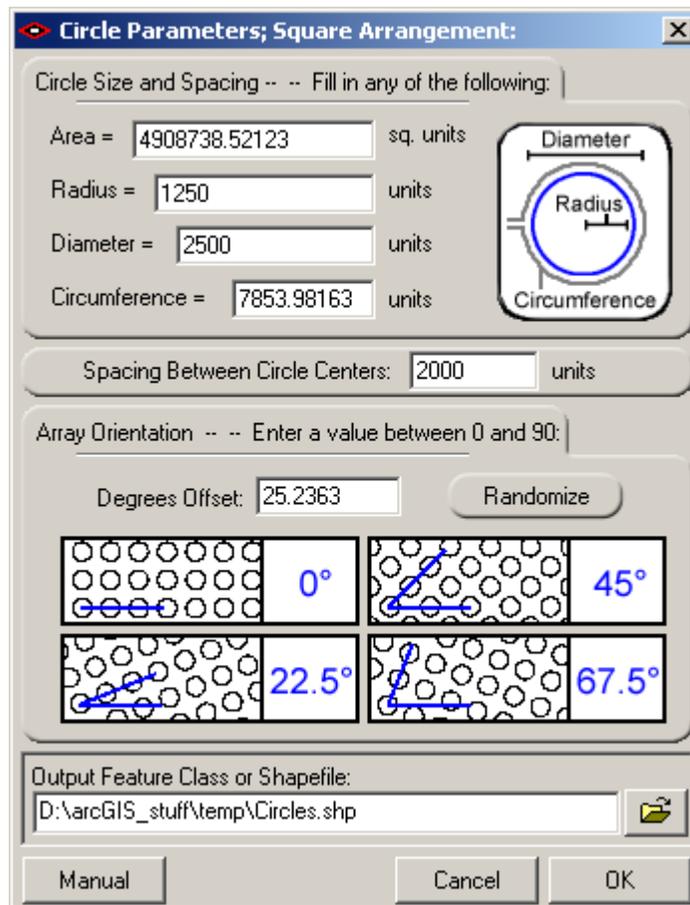
TIP: If you wish to enter values of 0°, 15°, 30° or 45°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 60°, simply click the “Randomize” button.

Generating Circles in a Square Pattern:

This option generates an array of circular polygons lined up in rows and columns, and oriented in any direction you choose. If you found the 4 circle centerpoints that are closest to some random location within the array, those 4 points would form a square. These circles may overlap and/or may fail to cover the entire region, depending on the size parameters you enter.

You must specify the size of the circles. Circle size may be defined in terms of area, radius, diameter or circumference. If you enter a value for any one of these, the other 3 will fill in automatically.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array with perfectly vertical and horizontal rows and columns. An offset value of either 0° or 90° will produce an array with vertical and horizontal circles, and you can enter any value within this range.



TIP: If you wish to enter values of 0°, 22.5°, 45° or 67.5°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 90°, simply click the “Randomize” button.

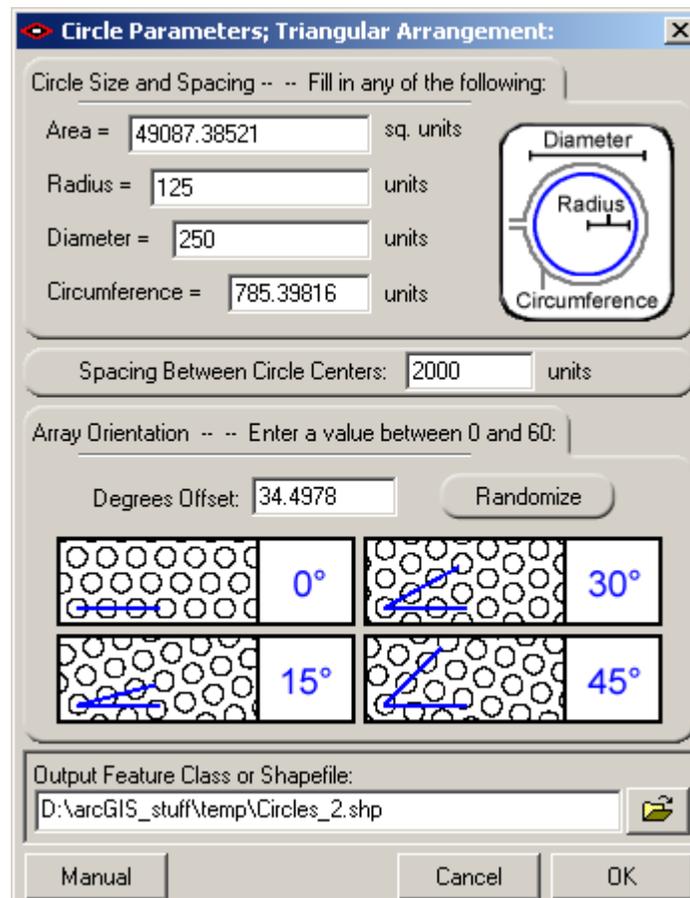
Generating Circles in a Triangular Pattern:

This option generates an array of circular polygons lined up in 3 general directions, and oriented in any direction you choose. If you found the 3 circle centerpoints closest to some random

location within the array, those 3 points would form an equilateral triangle. These circles may overlap and/or may fail to cover the entire region, depending on the size parameters you enter.

You must specify the size of the circles. Circle size may be defined in terms of area, radius, diameter or circumference. If you enter a value for any one of these, the other 3 will fill automatically.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array with one perfectly horizontal orientation. An offset value of either 0° or 60° will produce an array with one horizontal row of circles, and you can enter any value within this range.



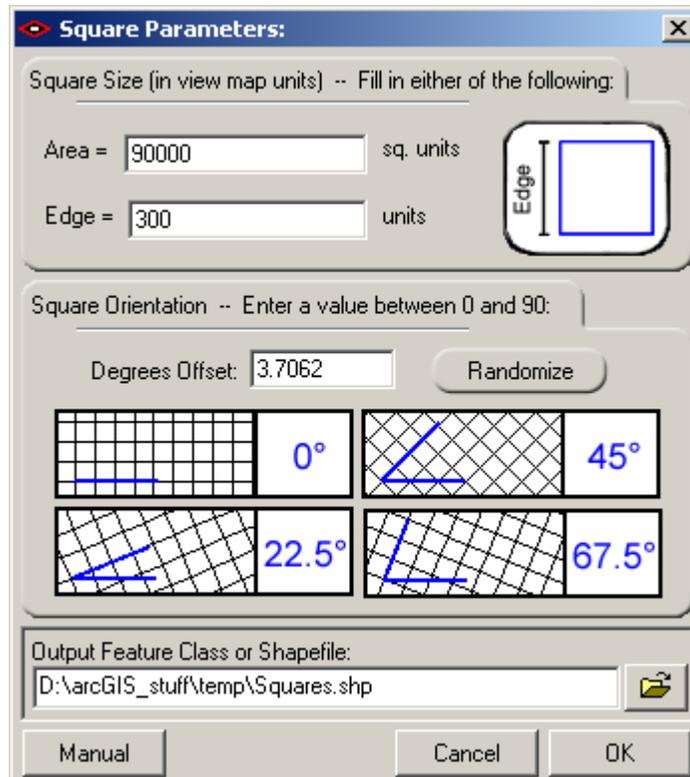
TIP: If you wish to enter values of 0°, 15°, 30° or 45°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 60°, simply click the “Randomize” button.

Generating Squares:

This option generates an array of adjacent square polygons, arranged so that they line up in rows and columns and cover the entire region of interest, and are oriented in any direction you choose.

You must specify the size of the squares. Square size may be defined in terms of area or edge length. If you enter a value for either of these, the other value will fill automatically.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array with perfectly vertical and horizontal rows and columns. An offset value of either 0° or 90° will produce an array with vertical and horizontal squares, and you can enter any value within this range.

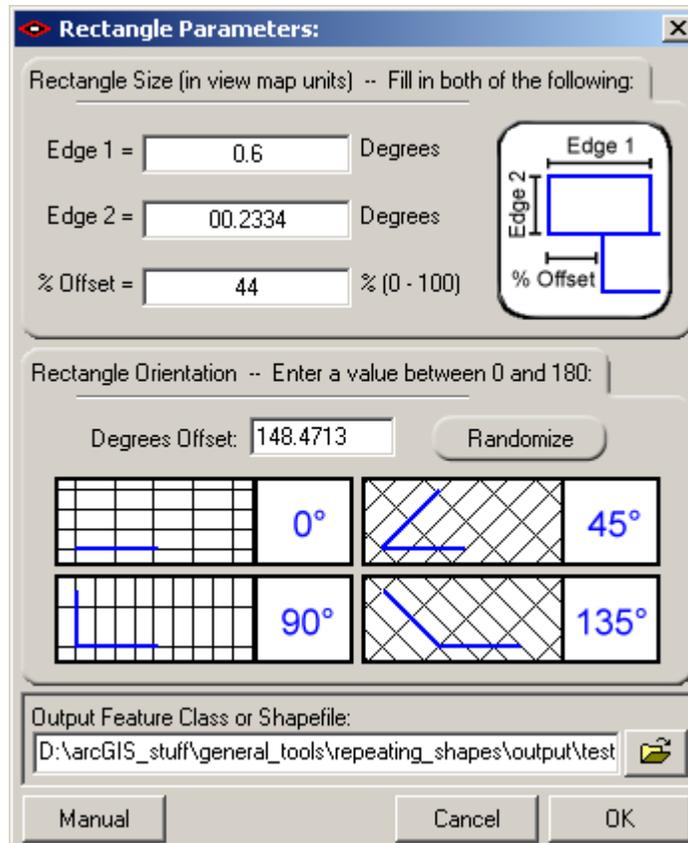


TIP: If you wish to enter values of 0°, 22.5°, 45° or 67.5°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 90°, simply click the “Randomize” button.

Generating Rectangles:

This option generates an array of adjacent rectangular polygons, with an option to offset adjacent rows by a specified percentage of the rectangle edge length. An offset percentage of either 0% or 100% will produce an array of rectangles arranged in both rows and columns. Any other value will cause each consecutive row of rectangles to be shifted by the specified percentage of the specified Edge 1 Length value. The final array of rectangles will cover the entire region of interest and will be oriented in any direction you choose.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array with perfectly horizontal rows. An offset value of either 0° or 180° will produce an array with horizontal rows of rectangles, and you can enter any value within this range.



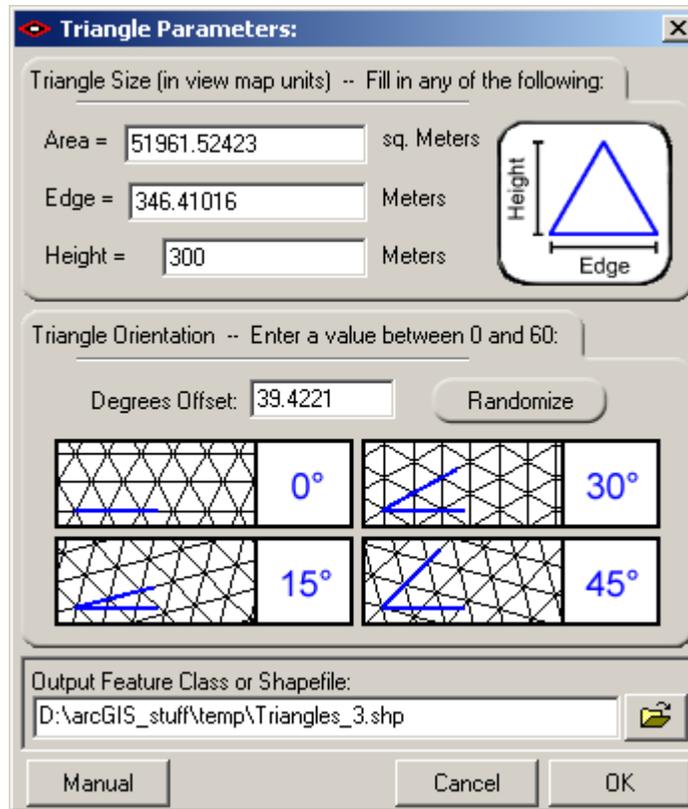
TIP: If you wish to enter values of 0°, 45°, 90° or 135°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 180°, simply click the “Randomize” button.

Generating Triangles:

This option generates an array of equilateral triangular polygons arranged so that they cover the entire region of interest, and are oriented in any direction you choose.

You must specify the size of the triangles. Triangle size may be defined in terms of area, edge length or height. If you enter a value for any one of these, the other 2 will fill automatically.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array in which one edge of the triangles is perfectly horizontal. An offset value of either 0° or 60° will produce an array with one horizontal edge on the triangles, and you can enter any value within this range.



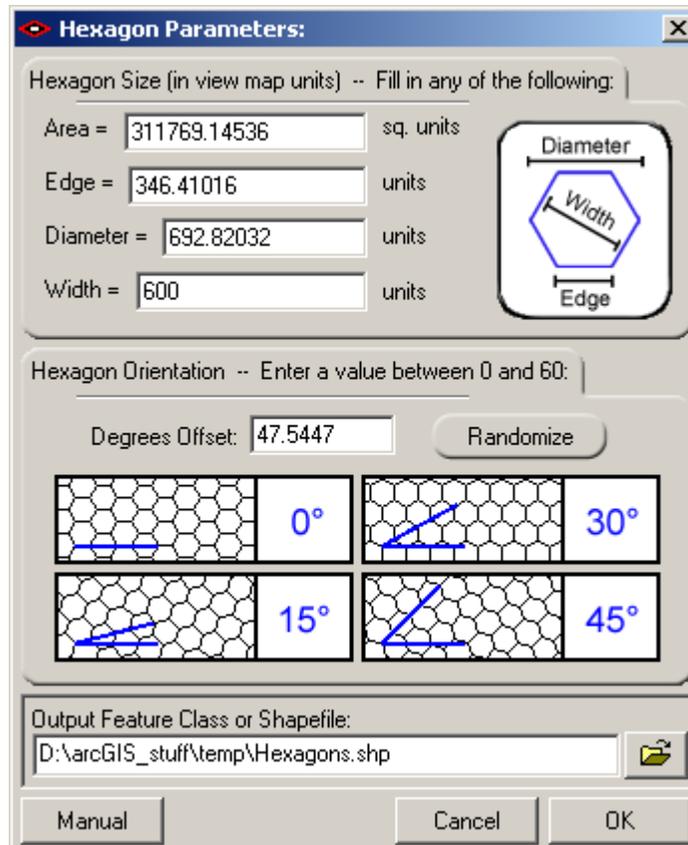
TIP: If you wish to enter values of 0°, 15°, 30° or 45°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 60°, simply click the “Randomize” button.

Generating Hexagons:

This option generates an array of hexagonal polygons arranged so that they cover the entire region of interest, and are oriented in any direction you choose.

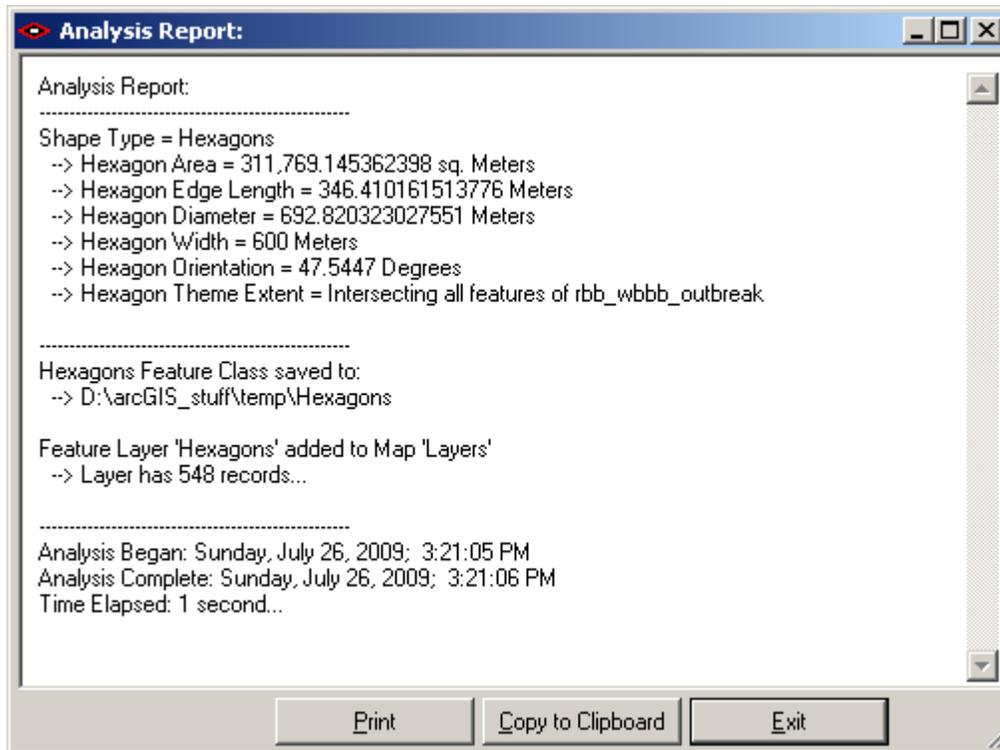
You must specify the size of the hexagons. Hexagon size may be defined in terms of area, edge length, width or diameter. If you enter a value for any one of these, the other 3 will fill automatically.

You must specify the general orientation of the array. The “Degrees Offset” value in the dialog below refers to the general orientation of the array in comparison with an array in which one edge of the hexagons is perfectly horizontal. An offset value of either 0° or 60° will produce an array with one horizontal edge on the triangles, and you can enter any value within this range.



TIP: If you wish to enter values of 0°, 15°, 30° or 45°, you can automatically enter those values by clicking on the illustrations below the text box. If you wish to generate a random orientation between 0° and 60°, simply click the “Randomize” button.

As soon as the process finishes, the extension will generate a short report describing what it has done:



General Notes:

Stopping the Process: At any point during the computations you may cancel the process by clicking on the "Stop" button at the bottom right corner of the progress meter dialog. This should stop the process within approximately 1 second. This may be useful to you if you, like the author, accidentally enter a size value in "degrees" while forgetting that the view is currently projected, and therefore causing the extension to attempt to generate a new feature class with trillions of shapes.

Updates

- Version 1.5.107: July 26, 2009:
 - Added functions to save to file and personal geodatabases
 - Added functions to show progress at various points in the analysis
 - Multiple minor bug fixes, speed enhancements and modifications
 - Added buttons to dialogs to open manual
- Version 1.5.123: October 24, 2010
 - Multiple minor bug fixes, speed enhancements and modifications
 - Added ArcGIS 10 installation functions
- Version 1.5.131: November 6, 2010
 - Added function to generate rectangles.
 - Fixed a bug in which it was clearing the selection of the layer used to determine the extent for the new repeating shapes layer.
- Version 1.5.131: March 14, 2011
 - Added additional ArcGIS 10 registration instructions to manual to handle Windows 7/Vista and Windows 32-bit/64-bit issues.
- Version 1.5.138: August 4, 2011
 - Corrected an error in the Hexagon Generator code in which it the hexagons were too small if the user had specified the size according to the hexagon diameter. Specifically the code would generate hexagons with an edge size equal to half the hexagon width, rather than half the hexagon diameter.
 - Added a Tool Version label to the first dialog.

Enjoy! Please contact the author if you have problems or find bugs.

Jeff Jenness
Jenness Enterprises
3020 N. Schevene Blvd.
Flagstaff, AZ 86004
USA

jeffj@jennessent.com
<http://www.jennessent.com>
(928) 607-4638

Updates to this extension and an on-line version of this manual are available at

http://www.jennessent.com/arcgis/repeat_shapes.htm

Please visit *Jenness Enterprises* [ArcGIS Tools](#) site for more ArcGIS tools and other software by the author. We also offer [GIS consultation](#) services for both ArcGIS and ArcView 3.x to help you meet your specific data analysis and application development needs.

