
What's New in ArcGIS 9 Desktop

May 2004

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Highlights

■ **Completely new environment for geoprocessing, modeling, and scripting.** A new dockable ArcToolbox window with a comprehensive set of geoprocessing tools is available in all applications for all types of data. An integrated model builder lets you link geoprocessing operations together and build models interactively. ArcGIS 9 features a new command interface via the new dockable Command Line window. All geoprocessing functionality can be scripted using third party scripting languages. Toolboxes can be stored in folders and geodatabases.

■ **New and improved tools for labeling maps and creating and editing annotation.** New Labeling and Annotation toolbars are available in ArcMap. The new Label Manager lets you specify label properties without visiting layer properties dialog boxes individually. Annotation can now be stored in multiple annotation classes inside an annotation feature class, each with its own set of properties. This makes it easy to create different sets of annotation for the same features. ArcMap also features new tools for converting coverage and computer aided design (CAD) annotation to geodatabase annotation.

■ **Raster data can now be completely managed through ArcCatalog and is fully integrated into the geodatabase.** Various improvements include new tools for building and working with raster catalogs in geodatabases, which now appear in ArcCatalog with their own icons and a special contents browser combining table and geographic views. There are new raster rendering options. Raster datasets and catalogs can now be stored in personal geodatabases. Raster data, such as digital photos of buildings, can be stored as raster attributes in geodatabase feature classes and standalone tables.

■ **Usability, performance, and quality improvements in ArcMap.** It's now easier and faster to manipulate layers and data frames in the Table Of Contents. Among the many fixes, ArcMap starts up more quickly. It is also quicker to launch the Add Data dialog box. New export options have been added. The Print and Page Setup dialog boxes have been completely redesigned. ArcMap now supports layer-based masking via the Advanced Drawing Options dialog box.

■ **Geodatabase scalability.** There are many improvements to the performance and scalability of the geodatabase in a multiuser work flow. All multiuser geodatabase users will benefit from these performance gains.

■ **Geodatabase open data exchange using XML.** You can export all or any part of a geodatabase, such as individual feature datasets, feature classes, and tables, to an XML file. Another user can then import the XML file into a geodatabase. Disconnected edits can also be transferred and checked in using XML. This makes geodatabases completely open and interoperable because the XML specification will be published by ESRI.

■ **GPS toolbar is now standard in ArcMap.** Before 9.0, the global positioning system (GPS) toolbar was a separate free download.

■ **Composite address locators can now be defined for geocoding.** A composite address locator references several other address locators and chains them together to provide "fall back" geocoding across, for example, reference data for different areas or at different scales.

Extensions

- **New Maplex for ArcGIS extension.** Create high-quality cartographic label placement.
- **ArcGIS 3D Analyst extension.** A completely new ArcGlobe application lets you make stunning 3D visualizations. Enhanced 3D symbology and texture support lets you create realistic displays and animations. Hundreds of great looking 3D symbols, objects, and textures are included. 3D graphics and text in ArcScene are now supported.
- **ArcGIS Publisher extension and ArcReader.** New options for publishers include data packaging and time-out. New customization options give developers access to the controls behind ArcReader so they can be embedded in customized solutions on the desktop. ArcReader is now also supported on Sun Solaris.
- **ArcGIS Spatial Analyst extension.** More than 100 new functions are exposed in the user interface, which is fully integrated with the new geoprocessing framework. The file size limit for ESRI GRIDs has been removed, and other improvements have been made.
- **StreetMap extension.** New route finding capabilities have been added. The ArcGIS StreetMap USA dataset has been enhanced.
- **New desktop and server deployment opportunities.** At 9.0, two new products are available separately: ArcGIS Engine for creating and deploying custom applications based on core ArcGIS functionality and ArcGIS Server for deploying server-based ArcGIS services and applications via Intranets and the Internet.

Welcome to ArcGIS 9

ArcGIS 9 is the next major release of ArcGIS. This release builds on previous releases and adds important new capabilities. ESRI has also worked hard to improve quality and performance in a number of areas. This document guides you through the key features of ArcGIS 9.

Getting more information

■ Look for the new **ESRI Software Documentation Library CD** that comes with the release. This CD provides the complete range of ArcGIS books in portable document format (PDF).

■ Use the **ArcGIS Desktop Help**. You can access this from the Windows Start menu or by clicking Help > ArcGIS Desktop Help in any of the ArcGIS applications. ESRI has worked hard to improve the content and indexing of the Help System.

■ Obtain detailed **context-sensitive help** about tools, commands, and dialog boxes as you use the software.

- To get help on a command in a pulldown menu or a button in a toolbar, click the What's This tool  on the Standard toolbar, then click the item.
- To get help on a command in a context menu (that is, a menu launched by right-clicking something), highlight the command and press **Shift + F1**.
- To get help on a control in a dialog box, click the ? control at the top of the dialog box, then click the control.
- Some dialog boxes have a Help or About button that displays a topic giving you quick information and tips.
- To get help on a window, such as the Table Of Contents or the Identify Results window, first click inside the window, then press **Shift + F1**.
- To get help on a control in a geoprocessing dialog box, start from the new ArcToolbox window, click the control, then click the Show Help button to expand the Help panel. When the Help panel is expanded, you can click the Help button on the top of the panel to display the desktop help topic for the tool.

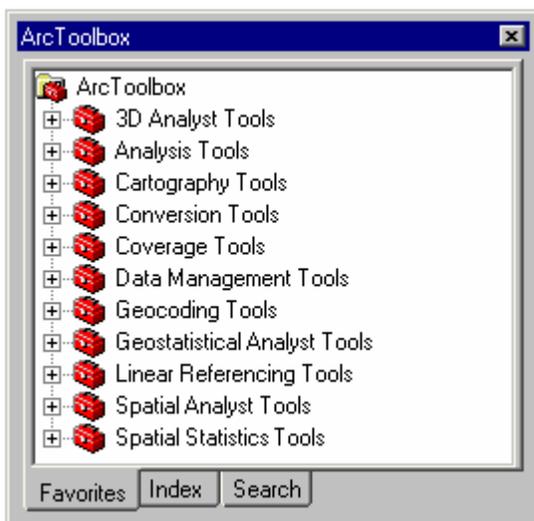
Geoprocessing

ArcGIS 9 presents a comprehensive set of geoprocessing tools that work with all the supported data formats, including geodatabase features. It also offers a completely new framework for working with these tools that enables you to use them individually, combine them together in a visual modeling environment, write scripts in standard scripting languages, and run the tools as commands in a command line window. With this new geoprocessing environment, ArcGIS 9 completes the transition of ESRI's GIS tools to the desktop that began with the introduction of ArcGIS 8. ArcGIS 8.x provided a new framework for managing, sharing, and mapping and editing data, along with a comprehensive new data model: the geodatabase. Now ArcGIS 9 completes the picture with a powerful new environment for putting that data to work.

New ArcToolbox window

- In ArcGIS 8.x, ArcToolbox was a standalone application. At 9.0, ArcToolbox is now a dockable window integrated into all the ArcGIS Desktop applications. For example, when you run tools from the ArcToolbox window inside ArcMap, you can use the current map's layers as inputs, and the outputs can be added directly into the map as new layers.
- The geoprocessing framework is common to all the ArcGIS Desktop applications and is included with each of the ArcGIS products: ArcView, ArcEditor, and ArcInfo. The number of geoprocessing tools you'll see in your ArcToolbox window depends on which product and extensions you are using.
- **ArcView** and **ArcEditor** have the standard map-based analysis tools commonly associated with project work.
- **ArcInfo** is the primary platform for advanced GIS analysis and modeling and, therefore, provides the complete set of geoprocessing tools (approximately 200). If you install ArcInfo Workstation, these tools include the Coverage Tools toolbox, which contains the complete set of ArcInfo Workstation analysis, conversion, and data management tools for use with coverage data.
- More than 200 additional tools are provided by the **ArcGIS extensions**, such as ArcGIS 3D Analyst and ArcGIS Spatial Analyst.

Here's what you will see in the ArcToolbox window if you're an ArcInfo user and you've installed ArcInfo Workstation and all the ArcGIS extensions released with 9.0:



- When you look inside a toolbox, you'll notice that the tools it contains are usually organized into toolsets.



Here's what you'll see in a toolbox:



Toolset: A container for organizing the contents of a toolbox.



Tool: Runs an underlying function in the geoprocessing framework.

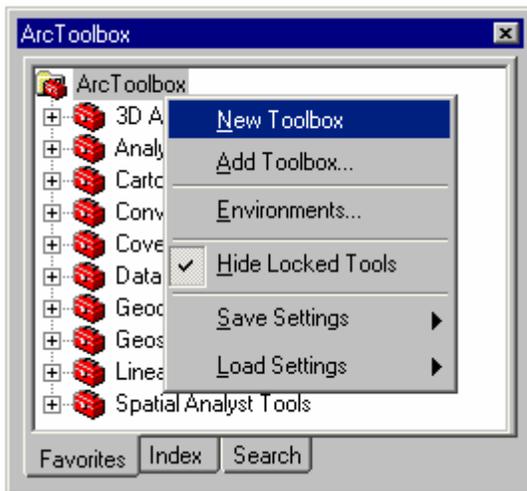


Script: Can be written in any Common Object Model (COM)-compliant scripting language, such as Python, Jscript, or VBScript. An ArcInfo Workstation ARC Macro Language (AML) script can also be added to a toolbox as a script.

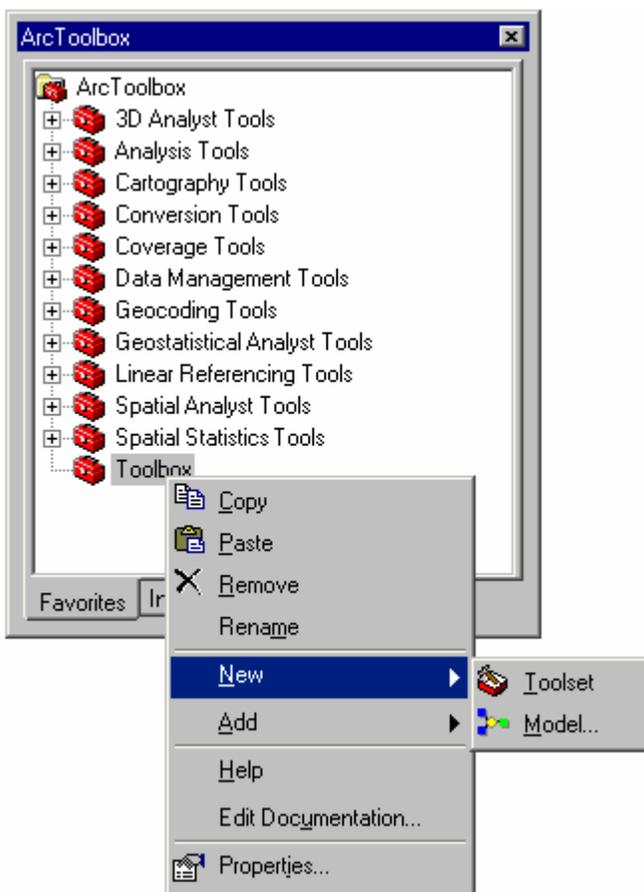


Model: You can view and edit these in the new integrated ModelBuilder window.

■ You can reorganize and save the contents of the ArcToolbox window in any way you like. You can create your own toolboxes, too. To add a new, empty toolbox to the ArcToolbox window, right-click the ArcToolbox entry at the top of the tree and click New Toolbox.



Once you've created a new, empty toolbox, you can add existing tools and scripts to it and create models in it. For example, to create a new model in the new, empty toolbox you've just added, right-click the toolbox to get its context menu and click the Model command in the New pull-right menu.

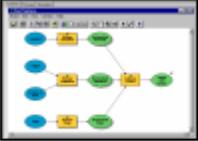


■ Toolboxes you create can be stored as .tbx files in folders or stored directly in geodatabases. This makes it easy to manage, distribute, and share custom tools, models, and scripts. For example, all the tools created by a GIS department for use with a particular enterprise geodatabase can be stored in that geodatabase and accessed and updated centrally. It is easy to package models and scripts that you make as tools for others to use. When a user double-clicks on a model you've created, they'll see a dialog box prompting them for the inputs, the user only needs to see the visual model or the actual script if they want to. In fact, several of the standard conversion tools provided in 9.0 are actually models or scripts that run underlying functions, which means you can easily inspect them to see how they work.

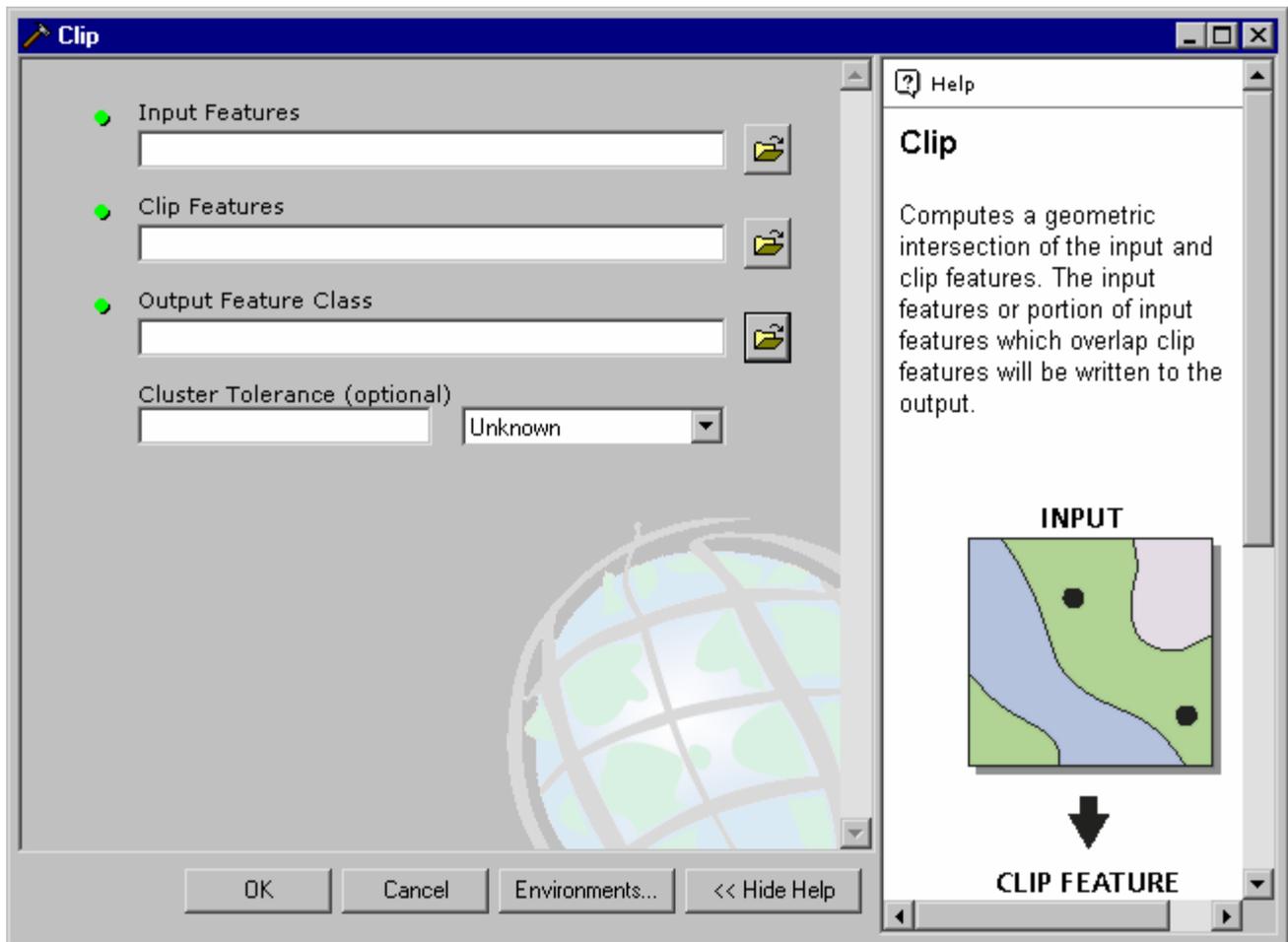
■ An integrated Documentation Editor makes it easy to create documentation and metadata for models, scripts, and toolboxes you create. Documentation you create for models and scripts can be accessed via the Help panel of the dialog box that appears when they are launched or by right-clicking them in ArcToolbox and clicking Help. Documentation for toolboxes can be accessed by right-clicking them in ArcToolbox and clicking Help. Metadata for the contents of toolboxes can be accessed via the Metadata tab in ArcCatalog.

Using the geoprocessing framework

■ There are five ways to perform geoprocessing at 9.0, summarized in this table:

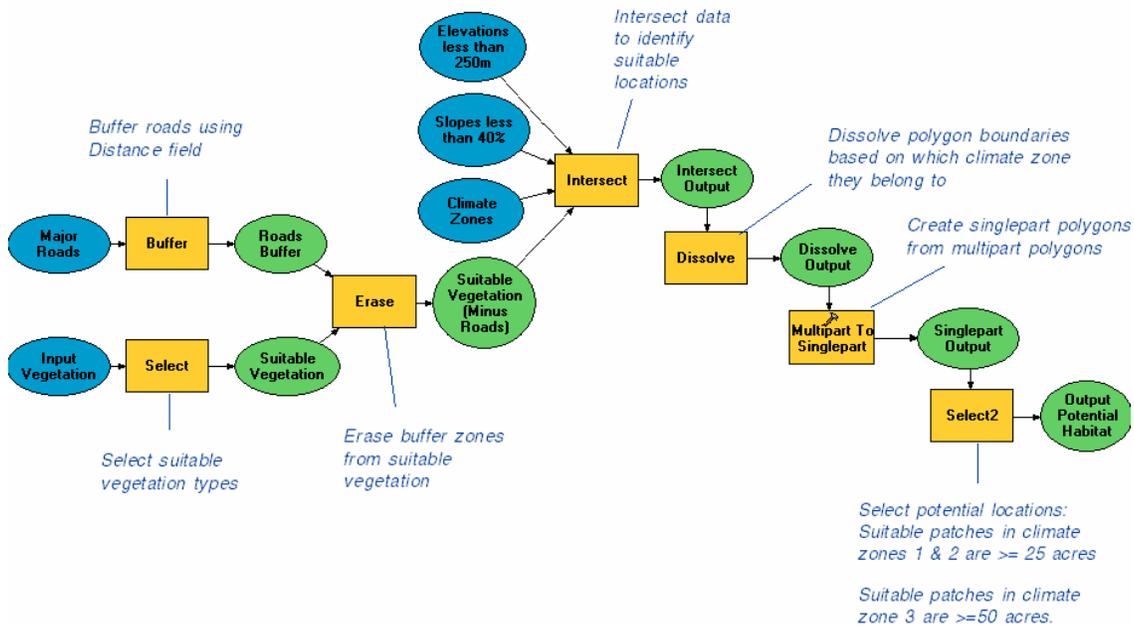
Method	Description	Use To
Tool dialog box 	<p>A form in which input data and other necessary parameters are defined. Fully embedded context-sensitive help is provided.</p>	<ul style="list-style-type: none"> - Run any geoprocessing tool from inside any application. - Get familiar with a tool and its parameters.
Model 	<p>An interactive visual model that links processes, data, and parameters together. Models are created and edited in the integrated ModelBuilder window.</p>	<ul style="list-style-type: none"> - Build models, work flows, and processes without scripting or programming. - Document or present a process. - Explore alternative scenarios. - Present methodology and work flow to others.
Command Line 	<p>The dockable Command Line window offers usage popups for commands, autocompletion, and so forth.</p>	<ul style="list-style-type: none"> - Run tools quickly without launching their dialog boxes. - Advanced users can take advantage of useful shortcuts. - This window is already familiar to long-term ArcInfo users.
Script 	<p>File written using a standard scripting language such as Python, Jscript, or VBScript.</p>	<ul style="list-style-type: none"> - Automate repetitive tasks. - Fully control processes based on any conditions, states, time delays, and so forth. - Scripts bring the traditional working environment for advanced geographic information systems (GIS) users to bear on the full range of ArcGIS Desktop functionality.
ArcObjects 	<p>Geoprocessing objects can be accessed in the ArcGIS development environment to create custom tools and applications using COM compliant languages such as Visual Basic 6, Visual Basic .NET, C++, and C#.</p>	<ul style="list-style-type: none"> - Incorporate tools into new and existing applications. - Create custom dynamic link libraries (DLLs) that incorporate geoprocessing tools. - Create custom toolbox functions (DLL, EXE, or OLE Control Extension (OCX).

■ Geoprocessing tools can be launched directly by double-clicking the tool in the ArcToolbox window. This will open the **tool dialog box** so you can specify the necessary inputs and execute the tool.

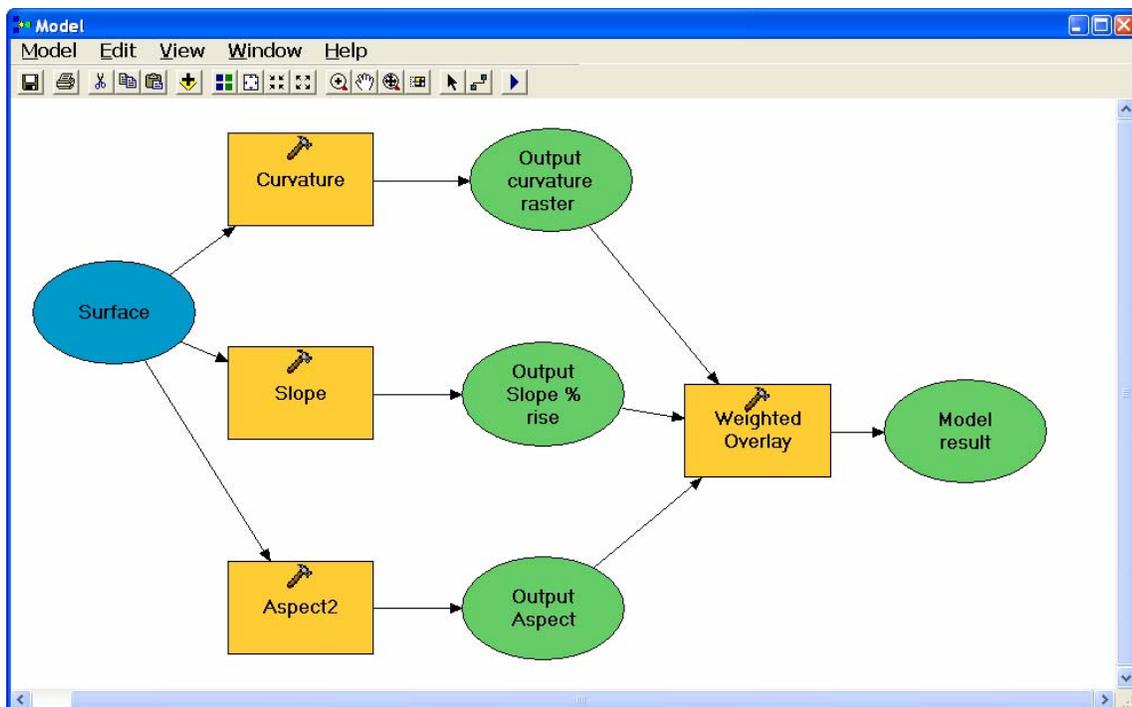


■ You can also create **models** that will execute a sequence of geoprocessing functions. For example, an output data source that is projected in one function becomes the input for an overlay function, and so on.

Gnatcatcher Habitat Suitability



Models are viewed and edited using the integrated ModelBuilder window. The ModelBuilder window lets you drag and drop tools and data into the model diagram to build processes that can be connected into a logical flow. You can run a model from within the ModelBuilder window and inspect the flow of control. Models can also include scripts and other models as steps. You can save models in toolboxes and use them as tools or distribute them to other users. A model can also be exported from the ModelBuilder window as a script, so you can build a process as a model, export it as a script, then add additional automation or advanced flow of control.

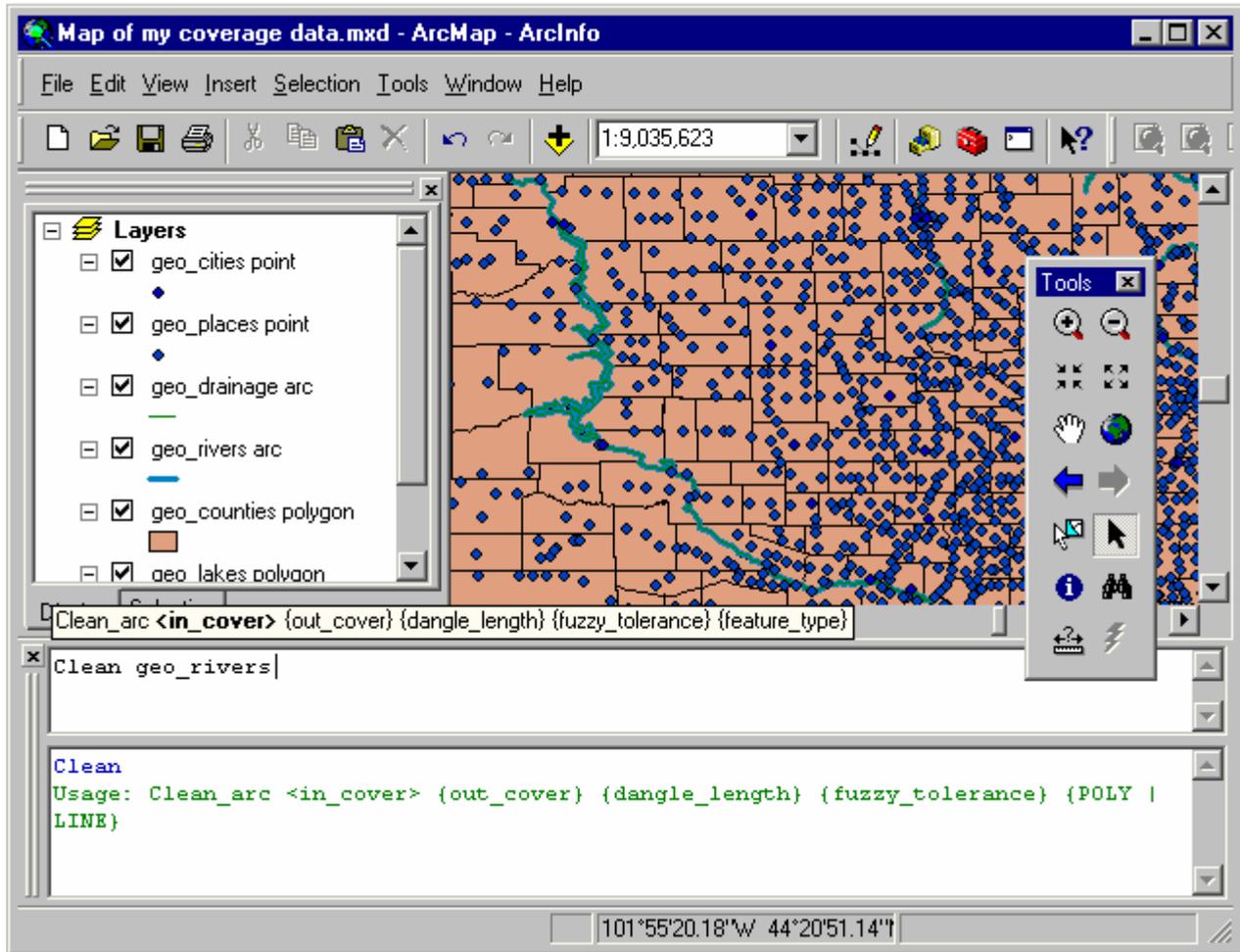


■ Geoprocessing tools can also be used within **scripts** to allow the automation of repetitive processes or complex flow of control. Scripts have traditionally been the staple working environment of long-term ArcInfo users. At 9.0 scripts are back. Scripts can include calls to geoprocessing tools, models, and other scripts. Scripts are easy to author in the COM-compliant scripting environment of your choice, such as Python, VBScript, and JScript. After a script is authored, it can be exposed to users as a standard tool and embedded in other models or scripts like any other tool. The script shown below is written in Python:

```
# -----  
# batch_buffer.py  
# Created on: Fri May 02 2003 04:55:13 PM  
# (generated by ArcGIS/ModelBuilder)  
# -----  
  
# Import system modules  
import sys, string, os, win32com.client  
  
# Create the Geoprocessor object  
gp = win32com.client.Dispatch("esriGeoprocessing.GpDispatch.1")  
  
# Set the workspace  
gp.workspace = "C:/DATA/Roads/workspace.mdb"  
  
# List all the feature classes in the workspace  
fcs = gp.listfeatureclasses()  
  
# Loop through the list of feature classes  
fcs.Reset()  
fc = fcs.Next()  
while fc != "":  
    # Set the outputname for each output to be the same as the input plus "buff"  
    out_feature_class = gp.workspace + "\\\" + gp.validatetablename(fc + "buff" , gp.workspace)  
  
    # Buffer each input feature class in the list  
    gp.Buffer_analysis(fc, out_feature_class, 10)  
  
    # Repeat with the next feature class  
    fc = fcs.Next()
```

Support for existing ArcInfo Workstation AML scripts via ArcToolbox has been improved at 9.0. Any AML command text can be added as a script in a toolbox at 9.0, not just those that execute Arc commands, as in ArcToolbox 8.3. The only stipulation is that the AML start in the Arc module. The AML can then go to ArcEdit, ArcPlot, ArcGrid, and so forth. Also, in ArcToolbox 8.3, the dialog box for running a script based on AML was limited to one input field for all arguments. At 9.0, you can define individual parameters for scripts based on AML, as you can for any other tool, script, or model you create. You can specify the parameter types and the system will validate input values against these. You can also add coded value or range domains to a parameter. The script based on AML you've created can then be used like any other geoprocessing tool: you can run it as a stand alone tool from the ArcToolbox window, add it into a model as a processing step, then run it from the geoprocessing Command Line window or call it from another script.

■ The geoprocessing environment includes a dockable Command Line window. This window provides an easy way to run any tool, model, or script. This command line makes repetitive tasks quick and easy, similar to command-line executions in ArcInfo Workstation. Messages are shown in the lower part of the window to document the progress of tools run in any session. Tools can be reexecuted by interacting with the window. Like the ArcToolbox window, the Command Line window is available in any ArcGIS Desktop application and can be docked in an application's window:

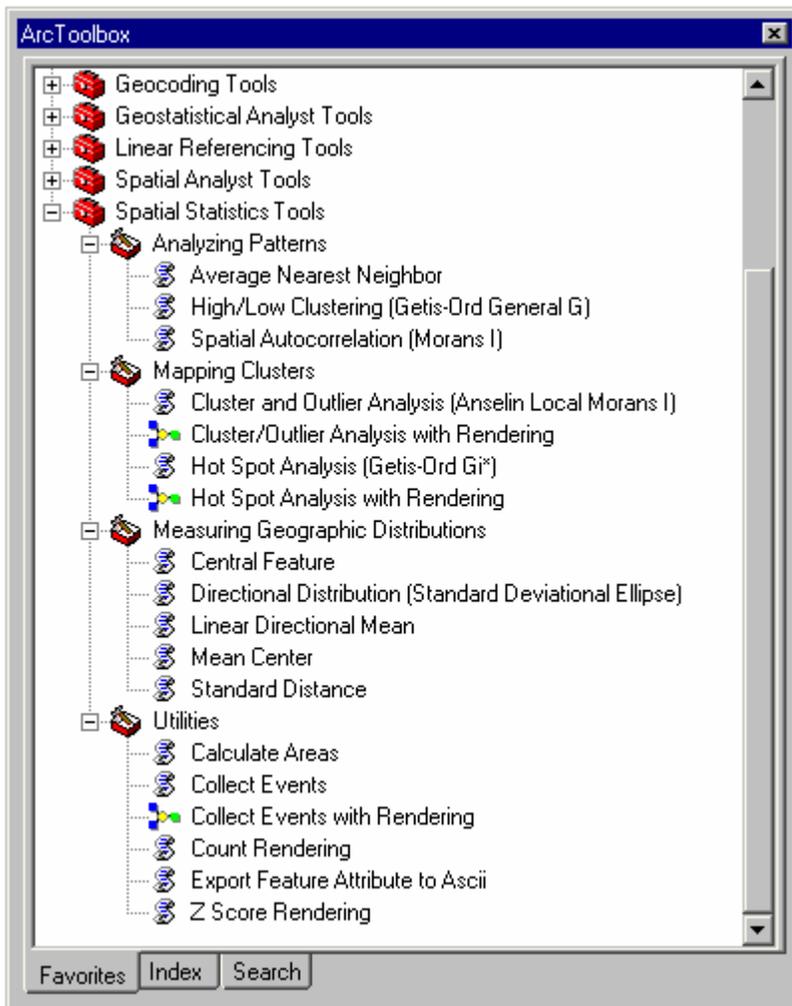


In the upper panel, type the first few letters of a command and a scrolling list containing the commands that match what you type will pop up. Once you've typed a command, its usage appears in a tip, and additional popup lists make it easy to fill in options and keywords. You can also press F1 to access the full Help topic about the command you are using.

Right-click inside the upper or lower panels in the Geoprocessing window to access a menu of additional commands.

You can use the Up and Down arrow keys on your keyboard to cycle between your recent commands. You can also recall a particular command by either right-clicking inside it on the lower panel and choosing Recall from the menu that appears, or simply double-clicking it.

■ A set of new spatial statistics tools are included with 9.0. You can find these in the Spatial Statistics Tools toolbox in the ArcToolbox window.



These tools work with all license types except for the following four tools, which require an ArcInfo license:

- Cluster/Outlier Analysis with Rendering
- Hot Spot Analysis with Rendering
- Count Renderer
- Z Score Renderer

Labeling

At 9.0 the user interface for labeling has been improved, and new core functionality has been provided. In addition, a new labeling extension is available at 9.0. The **Maplex for ArcGIS** extension allows high-quality cartographic label creation using advanced label placement and fitting techniques. Maplex uses an advanced conflict detection algorithm to automatically generate labels. There's a separate section in this document about the Maplex extension.

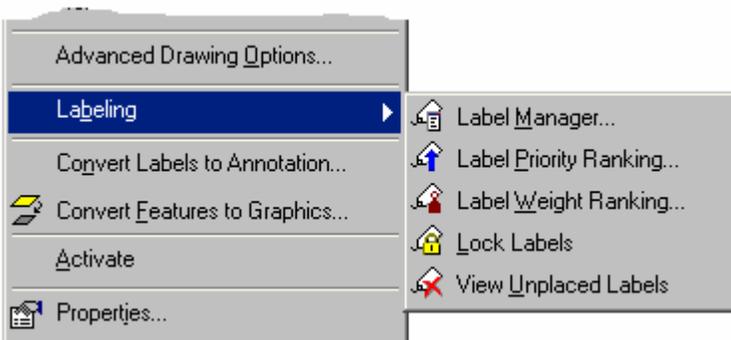
■ There's a new toolbar and some new dialog boxes for specifying and managing the labels drawn for layers. From View > Toolbars, choose the new Labeling toolbar. Here's what the Labeling toolbar looks like:



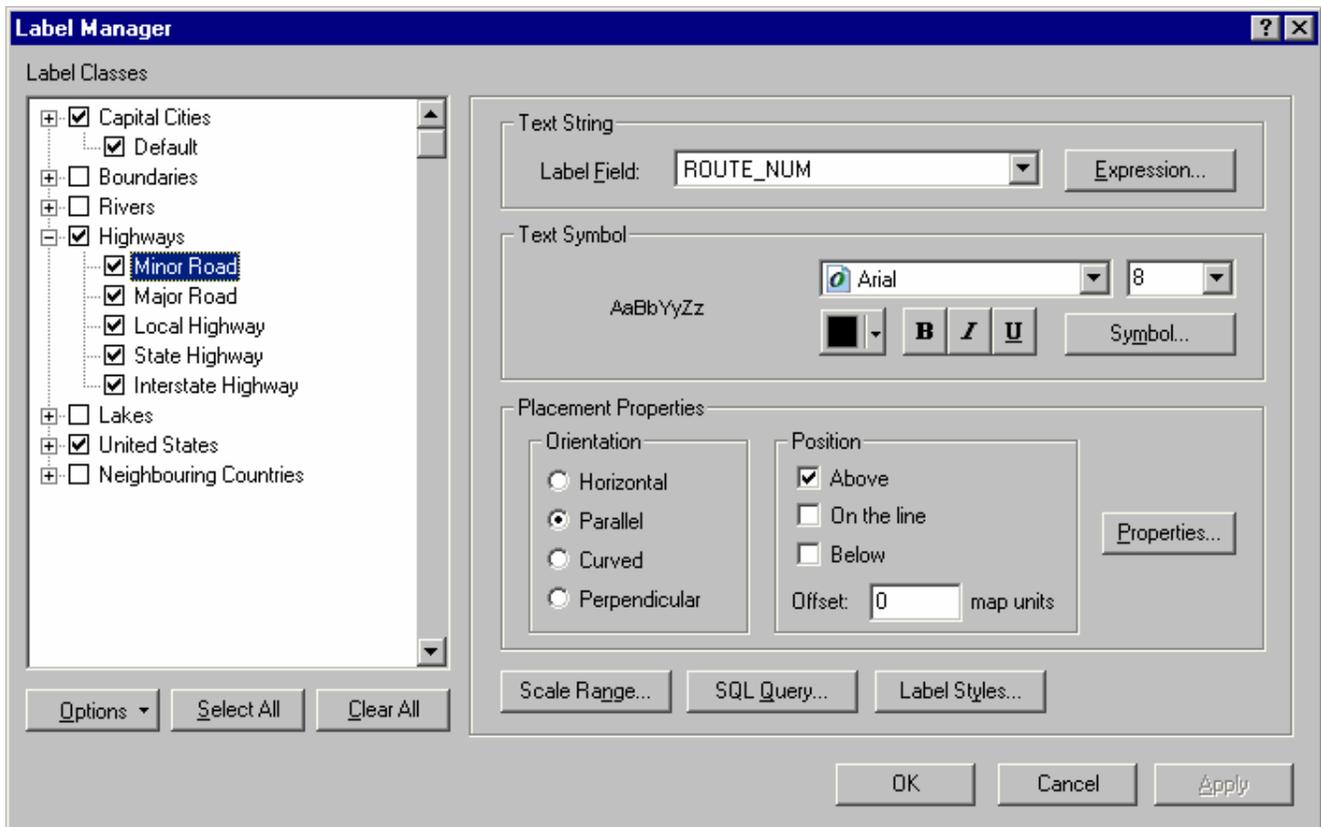
■ If you have installed the Maplex for ArcGIS extension, the Maplex commands will also appear in this new toolbar, there isn't a separate toolbar for the Maplex extension. Here's what the Labeling toolbar looks like if you have installed the Maplex extension:



■ You can also access the new labeling commands via a new Labeling pull-right menu that has been added to the context menu for a data frame.



■ The new Label Manager lets you turn labeling on and off for any label classes in the layers in the active data frame; change the properties of any label class; and create, delete, and copy or paste label classes. The Label Manager lets you specify labels for layers without repeatedly visiting their property dialog boxes. To access the Label Manager, click the Label Manager button  on the Labeling toolbar or select it from the Labeling pull-right menu.



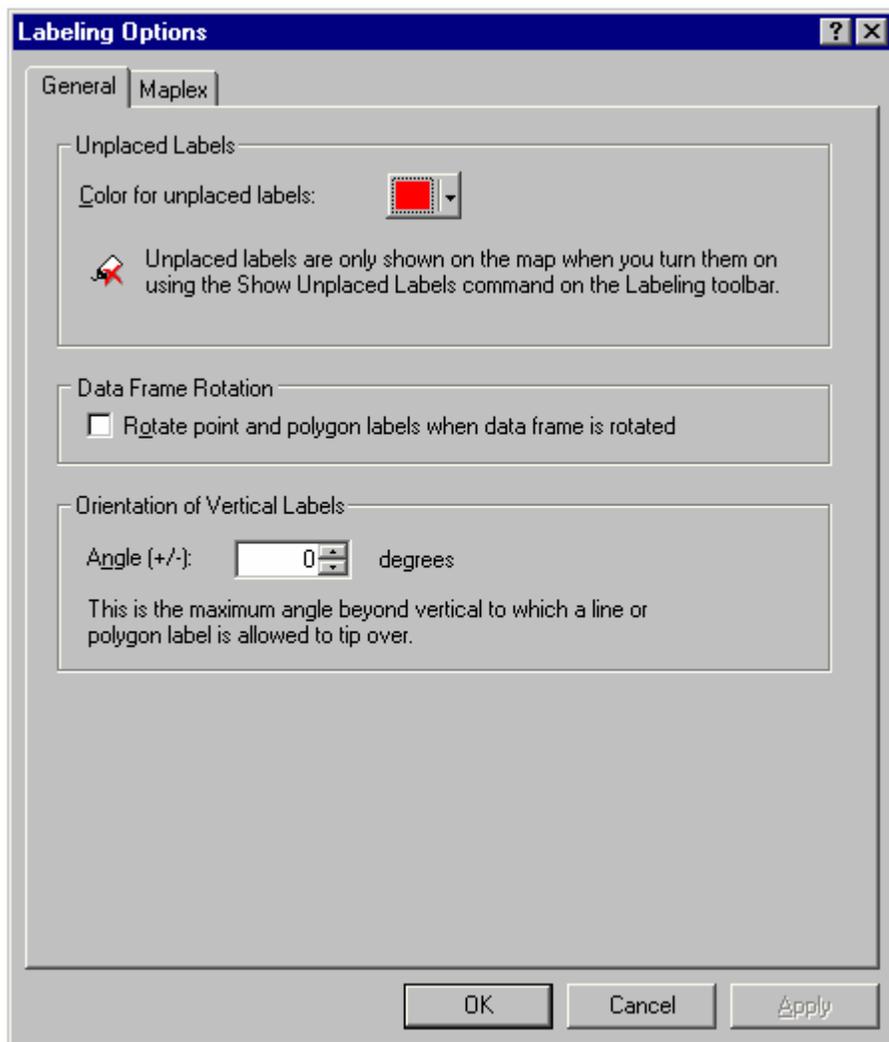
The Label Manager replaces the Labels tab in the Data frame Properties dialog box, which has been removed.

■ The Label Priority Ranking dialog box, accessed using the  button lets you rank the drawing priority of the label classes in the active frame.

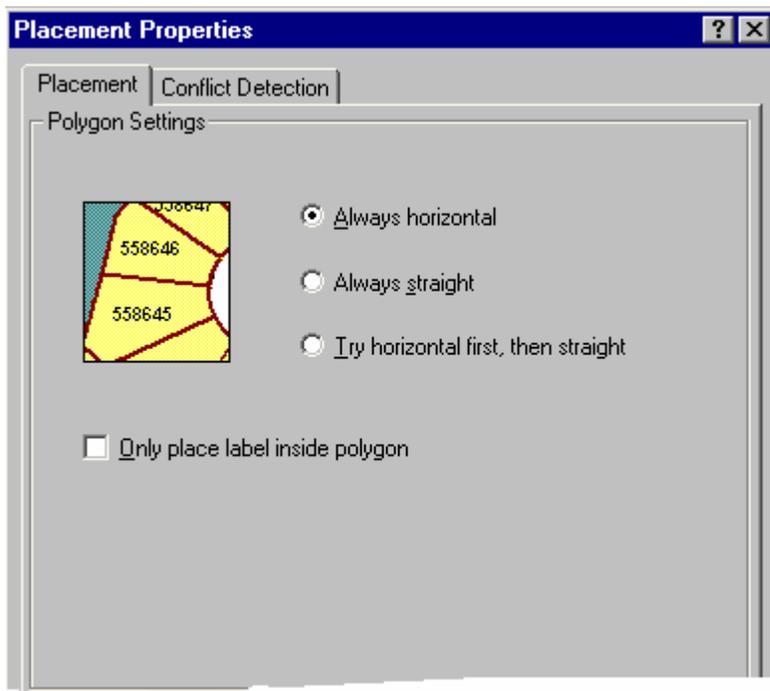
■ The Label Weight Ranking dialog box, accessed using the  button lets you control which labels will be placed when there are potential conflicts (overlaps) between features and labels.

■ Layers still have a Labels tab in their Properties dialog box, which has been enhanced to include controls for quickly specifying the main properties of the text symbol.

■ The Options command in the Labeling pulldown menu launches the new Labeling Options dialog box. This contains a General tab with options that apply to both the standard and the Maplex Label Engine. If you have installed the Maplex extension and are using the Maplex Label Engine for the active data frame, a Maplex tab will also be present in the dialog box containing options specific to Maplex.



■ In previous releases of ArcGIS, there were no placement options for labeling polygons. Version 9 adds some of the most frequently requested options for polygon label placement. Straight polygon labeling means that each label will be placed so that it follows the longest direction of the polygon being labeled. In the dialog box below, the preview on the left changes according to which radio button option you choose on the right:



■ At 9.0 a wider range of fonts is supported. The Font dropdown lists in ArcMap and all other applications in ArcGIS have been improved to better reflect the available fonts. In ArcGIS 8.x, only TrueType and TrueType-based OpenType fonts were supported, and two icons were used in the dropdown lists to indicate the font type:

-  Font is only available while printing.
-  True Type font.

At 9.0 these icons have been replaced with this new set to reflect the range of fonts that are now supported:

-  Font is not available on this machine, so type detection is impossible.
-  OpenType font (TrueType-based, Type1-based, and Type2 CFF-based)
-  TrueType font (TrueType fonts, TrueType Collection, and MultipleMaster)
-  Type 1 font
-  Raster-based font only used in the user interface (for example, in the Table Of Contents or table window)

■ If the Font dropdown list contains fonts with vertical metrics, such as those used to display Asian language text, a CJK Character Orientation check box control is shown on the Text Symbol Selector and Text Symbol Properties Editor dialog boxes. This enables users to specify that the fonts will be drawn vertically. This control is completely hidden if these types of fonts are not present.

■ Label placement options for line features have been grouped differently on the label placement properties dialog box.

■ Layer Properties dialog box Labels tab: The Label Placement Options button on this tab has been renamed as Placement Properties to match the name of the dialog box it launches.

■ Text formatting tags now work for curved annotation.

■ Several new text formatting tags and attributes have been added at 9.0:

- A scale attribute has been added to the existing FNT tag. This lets you adjust the size of the text relative to the current size. Specify a scale factor in percent (100% = regular):

```
<FNT name= "Arial" size="12">This text is Arial 12 point.<FNT scale="200">This text is Arial 24 point.</FNT></FNT>
```

- A width attribute has been added to the existing CHR tag to change the character width. Specify a width factor in percent (100% = regular):

```
<CHR width="150">My text</CHR>
```

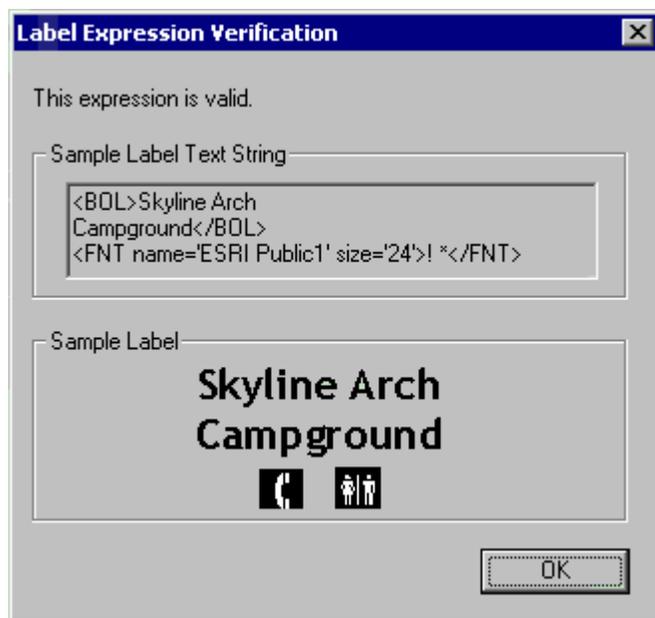
- The `_BOL`, `_ITA`, `_UND`, `_SUP`, and `_SUB` tags have been added to make text debold, deitalic, and so forth. Tags follow the rules of XML so you can't, for example, use the existing `</BOL>` tag to turn off bold for a text symbol whose base text symbol is already bold. To turn bold off, you would use the new `_BOL` tag:

```
This is bold if the base text symbol is bold<_BOL>, but this is not.</_BOL>
```

■ The dialog box launched by the Label tool , has been renamed. The original name was Labeling Options; the new name is Label Tool Options.

■ The dialog box for specifying a label expression has been renamed from Expression Properties to Label Expression. Several improvements have also been made:

- The dialog box that appears when you verify your expression has been improved to make it clearer what the actual results of your expression will be and to give you a WYSIWYG sample label that fully interprets the results of any text formatting tags in the expression:



Also, if you have defined an SQL query for your label class, the sample label the dialog box shows you now contains the values from the first feature in your feature class that matches the SQL query. In ArcGIS 8.x, the verification dialog box always used the first feature in the feature class, which was confusing when you created a label expression specifically to label values you expected to be returned by the SQL query you defined for the label class.

- There's now a Reset button that removes the current label expression and replaces it with the default label field for the layer. Click the Reset button if you want to clear or remove the current label expression. It's a quick way to start again with your expression. (If you just delete the current expression and click OK, you'll get an error because there has to be an expression in this dialog box, even if it is just the name of the default label field.)
- The Add button has been renamed Append to better reflect what it does. To define a label expression in which two fields are appended together, double-click (or drag) the first field in the list of fields to add it to the expression, then select the second field and click Append.
- Double-clicking a field in the list no longer appends it to the end of your expression. Now when you double-click a field in the list, it gets inserted at the current mouse pointer location of the expression. This makes it easier to build expressions and also better matches the behavior of the Select By Attributes dialog box.
- You can now copy values out of the Show Values subdialog box for pasting into the expression, and so forth.

Annotation

ArcGIS 9 includes a number of improvements to the functionality and user experience for creating and editing geodatabase annotation. There is a new, more flexible model for storing annotation inside a geodatabase that better suits your data modeling requirements. Also, annotation is fully integrated into the ArcMap editing user experience at ArcGIS 9. Both of these fundamental changes will increase productivity and make creating and updating annotation features easier and more intuitive.

Updating annotation feature classes to ArcGIS 9

To take advantage of these improvements, you will need to upgrade your geodatabase version to ArcGIS 9, then update each annotation feature class within the geodatabase to include a new schema required when editing annotation in ArcMap.

You can upgrade a personal geodatabase using ArcCatalog; this type of upgrade does not affect any data but makes some additions to the geodatabase system tables. For more information on how to upgrade a personal geodatabase in ArcCatalog, look in the ArcGIS Desktop Help index for "upgrading, geodatabases" to get to the 'Upgrading a geodatabase' Help topic.

The process for upgrading a multiuser geodatabase to ArcGIS 9 involves upgrading the ArcSDE software on the server. For more information on upgrading your multiuser geodatabase, see the ArcSDE installation guide for your database management system (DBMS).

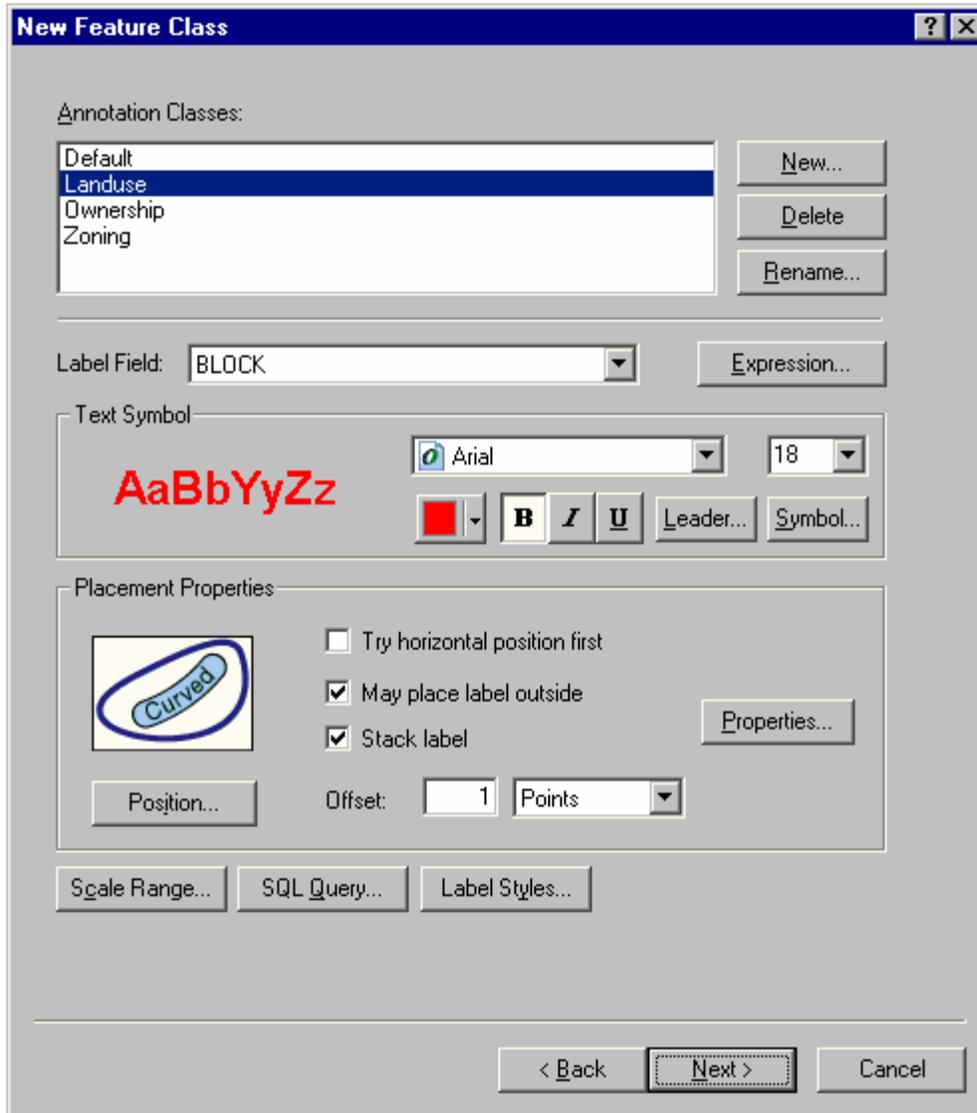
Once you have updated the geodatabase to ArcGIS 9, you can update the schema of each annotation feature class in the geodatabase to take advantage of these improvements. Before you do so, you should consider the design of annotation feature classes in your geodatabase data model and think about taking advantage of the new schema. For example, you can now create annotation classes or subtypes within an annotation feature class. This enables you to classify annotation features by theme or scale and reduce the number of feature classes within the geodatabase.

To update the schema of your annotation feature classes, use the Update Annotation Feature Class tool found in ArcToolbox. You can find this tool in the Data Management Tools > Feature Class toolset. This will update the schema of the feature class and, optionally, each annotation feature within the feature class. The schema update will add additional fields to the feature class (Bold, Italic, Text, and so forth) and also ensure that there is a symbol within the symbol collection; without a symbol in the symbol collection, you cannot use the improvements for constructing annotation features.

If you decide that you would like to take advantage of annotation subtypes, you can merge annotation feature classes together and create subtypes. To do so, use the Append Annotation Feature Classes tool found in ArcToolbox in the Data Management Tools > Feature Class toolset. This tool will merge annotation features from multiple classes into one annotation feature class and create the appropriate subtypes. If you use this tool within ArcMap, you can select features of a given scale or theme and append only those into the new feature class.

Storing annotation

■ The annotation in a geodatabase annotation feature class can now be stored in multiple **annotation classes** inside that feature class. Each annotation class has its own set of labeling properties, including expression, text symbology, and placement properties. This enhancement prevents you from having to define multiple annotation feature classes when you want to create different sets of annotation for the same features. You can create annotation classes in the New Feature Class wizard when you create an annotation feature class. If you are creating feature-linked annotation, you can specify the placement properties for the annotation in each annotation class.



You can also create annotation classes using the Convert Labels To Annotation command in ArcMap (in the context menu for a layer). If you have defined label classes for your layer, each of these label classes becomes an annotation class in the annotation that is created.

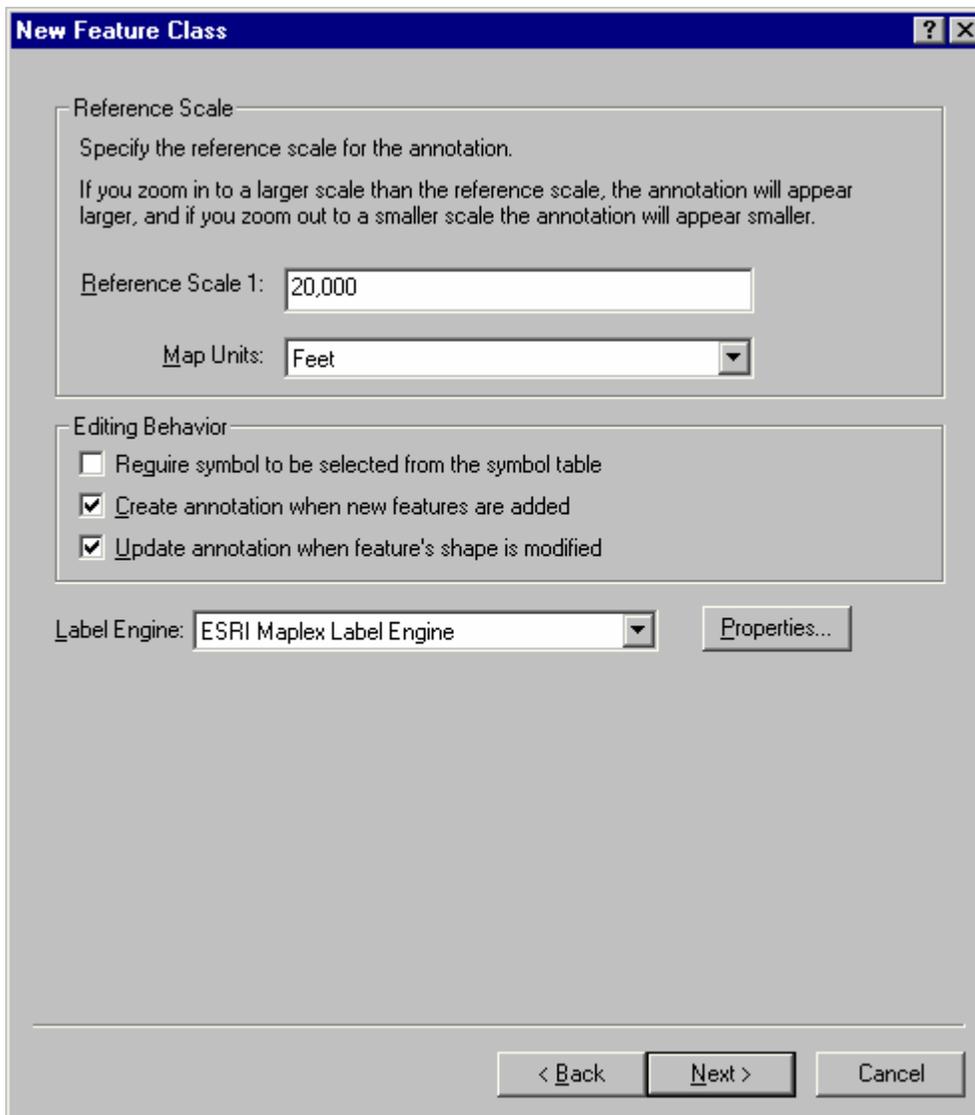
Annotation classes can be created and modified after you have created the annotation feature class by going to the new Annotation Classes tab in the Feature Class Properties dialog box for an annotation feature class in ArcCatalog.

When you add a layer based on an annotation feature class to a map, the different classes of annotation it contains are shown as entries underneath that layer in the Table Of Contents.



■ When you create a new annotation feature class, the panels for specifying the annotation options have changed to accommodate new functionality.

For example, when you create feature-linked annotation, you can now specify the **label engine** that will be used to generate the annotation placement. In the example shown below, the Maplex Label Engine in the **Maplex for ArcGIS** extension has been chosen to generate the annotation placement. The Maplex for ArcGIS extension is a new extension introduced at 9.0 that provides high quality cartographic label creation using advanced label placement and fitting techniques.



Tip: You can view and edit an annotation feature class that uses Maplex label placement whether or not you have the Maplex extension. In the case of editing standard annotation (annotation that is not feature linked) there's no difference. In the case of editing feature-linked annotation, ArcMap will automatically use the standard label engine when it needs to place new annotation if a Maplex license is not available.

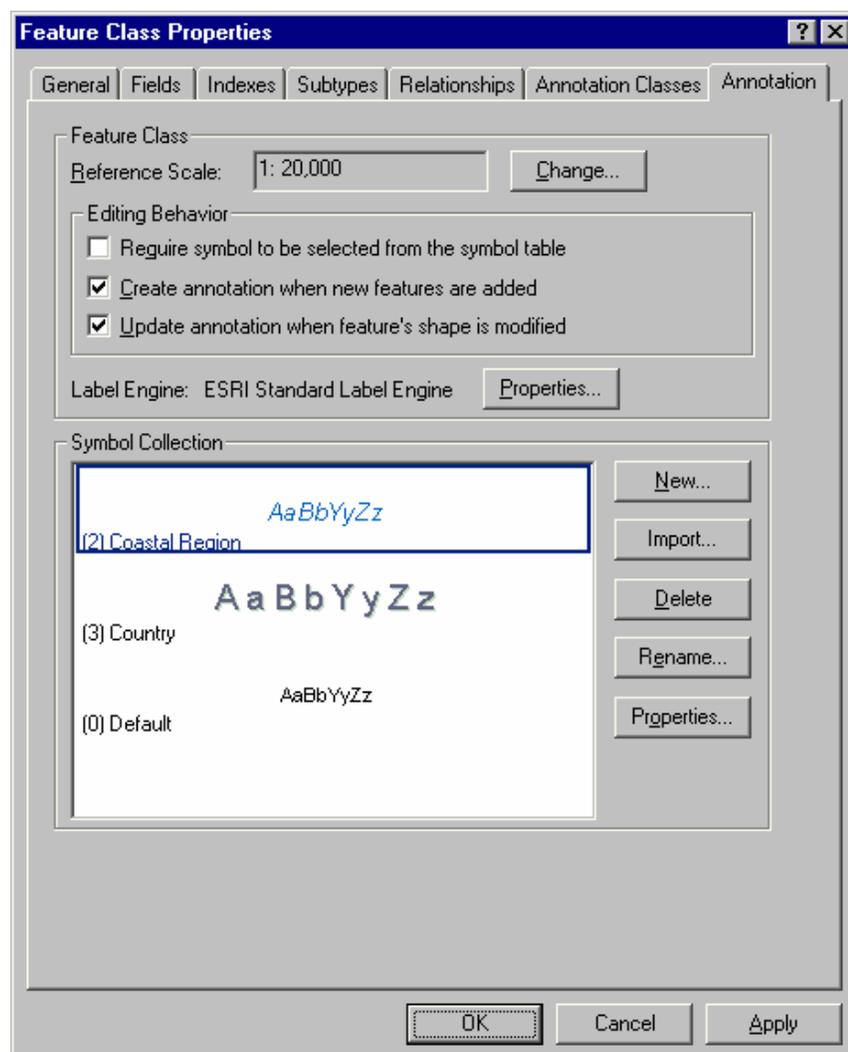
If you want to create an annotation feature class using Maplex label placement or edit a feature-linked annotation feature class using Maplex to place new annotation, you will need to have the Maplex extension.

■ Annotation text symbol properties are now shown in the attribute table for a layer based on an annotation feature class, including Label, FontName, FontSize, Bold, Italic, and so on. These fields support querying and are editable. You will also see these fields in ArcCatalog. The example below doesn't show all the fields:

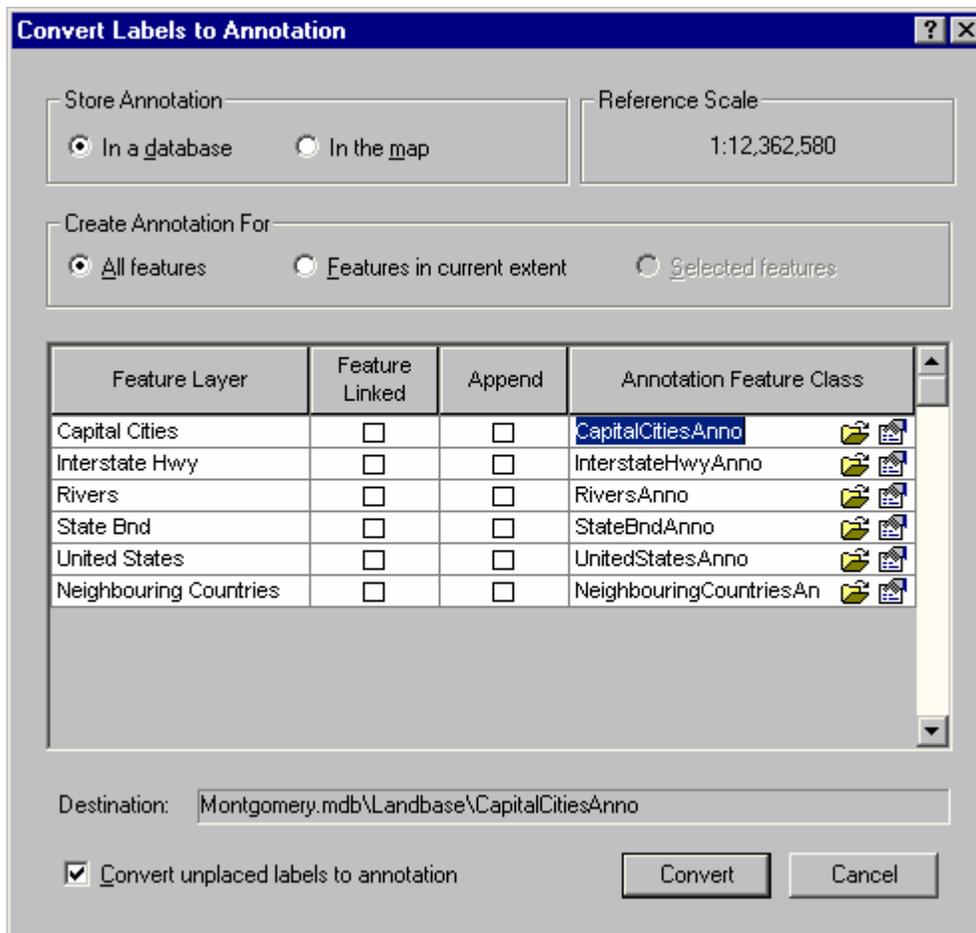
SHAPE*	FeatureID*	ZOrder	AnnotationClassID	Element	SymbolID	Label	FontName	FontSize	Bold
Polygon	3557	<Null>	Default	Blob	0	Juneau	Arial	8	No
Polygon	3555	<Null>	Default	Blob	0	College	Arial	8	No
Polygon	3554	<Null>	Default	Blob	0	Anchorage	Arial	8	No
Polygon	3553	<Null>	Default	Blob	0	Sheridan	Arial	8	No
Polygon	3552	<Null>	Default	Blob	0	Rock	Arial	8	No
Polygon	3551	<Null>	Default	Blob	0	Laramie	Arial	8	No

■ Multipart annotation is now supported in ArcGIS Desktop. This was previously only supported in ArcInfo Workstation. With multipart annotation, each part of the annotation can be adjusted individually, providing better options for placing text.

- Symbols for annotation features are now stored in the geodatabase. Annotation symbols are specified on the Annotation tab in the Feature Class Properties dialog box for an annotation feature class in ArcCatalog.



■ The Convert Labels To Annotation dialog box in ArcMap has been overhauled at 9.0. When you choose to convert labels to annotation feature classes (the default), the list in the dialog box lets you control the destination and properties of the annotation that will be created. Edit the output feature class names in the Annotation Feature Class column. Click the Browse button  in the Annotation Feature Class column to specify the destination geodatabase for the annotation. Click the Properties button  to specify properties for the annotation class that will be created, including specification of a configuration keyword when storing data in ArcSDE.



■ If you save an annotation layer as a layer (.lyr) file, you'll notice that the icon used for annotation layer files has been updated so they use the same 'A' graphic in their icon as the annotation feature class.



Layer file referencing an annotation feature class

Existing annotation layer files continue to use the old pencil icon. If you want these files to use the new A icon, you have to re-create them.

■ There are new tools for converting coverage and CAD annotation to geodatabase annotation. You can find these in the To Geodatabase toolset in the Conversion Tools toolbox in ArcToolbox.

■ There is a Append Annotation Feature Classes tool that combines two or more annotation feature classes into a single annotation feature class. You can find it in the Feature Class toolset in the Data Management Tools toolbox in ArcToolbox.

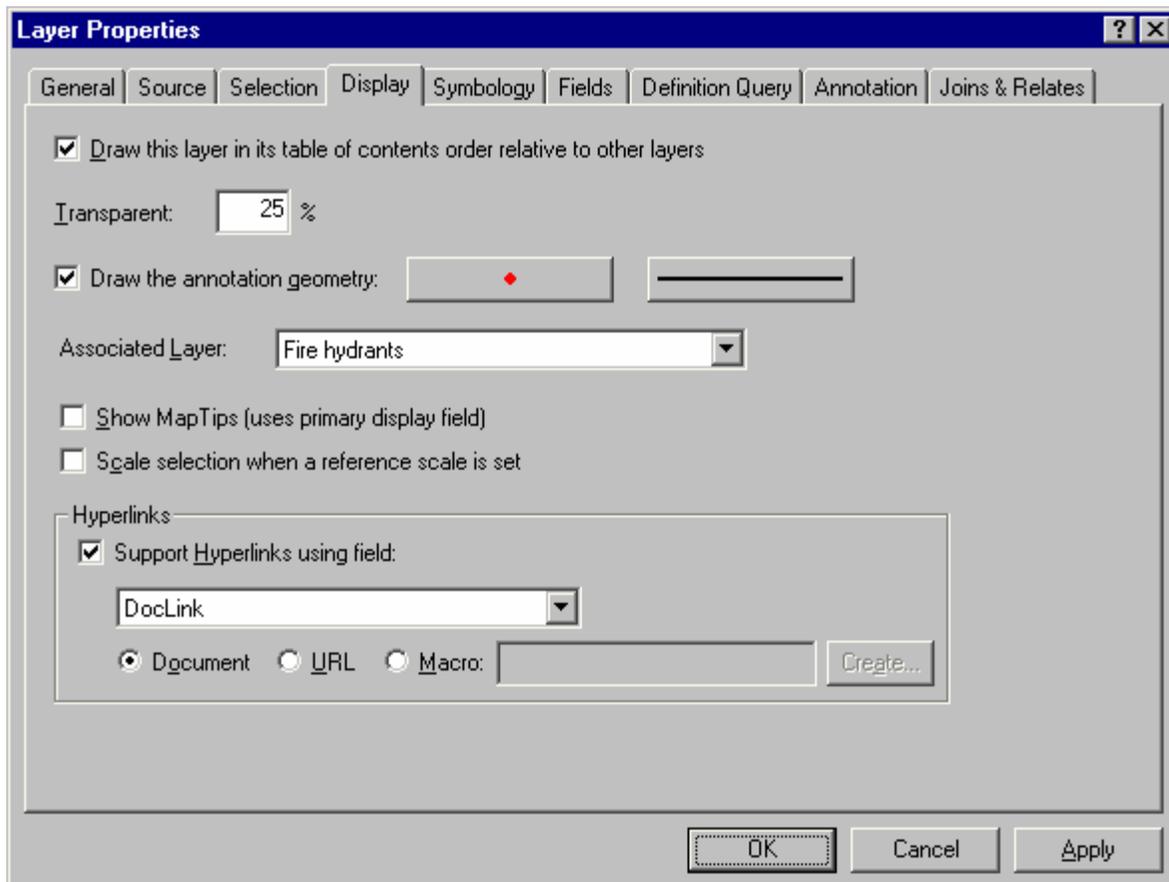
Displaying annotation

■ When you add a layer based on an annotation feature class to a map, the different classes of annotation it contains are shown as entries underneath that layer in the Table Of Contents.

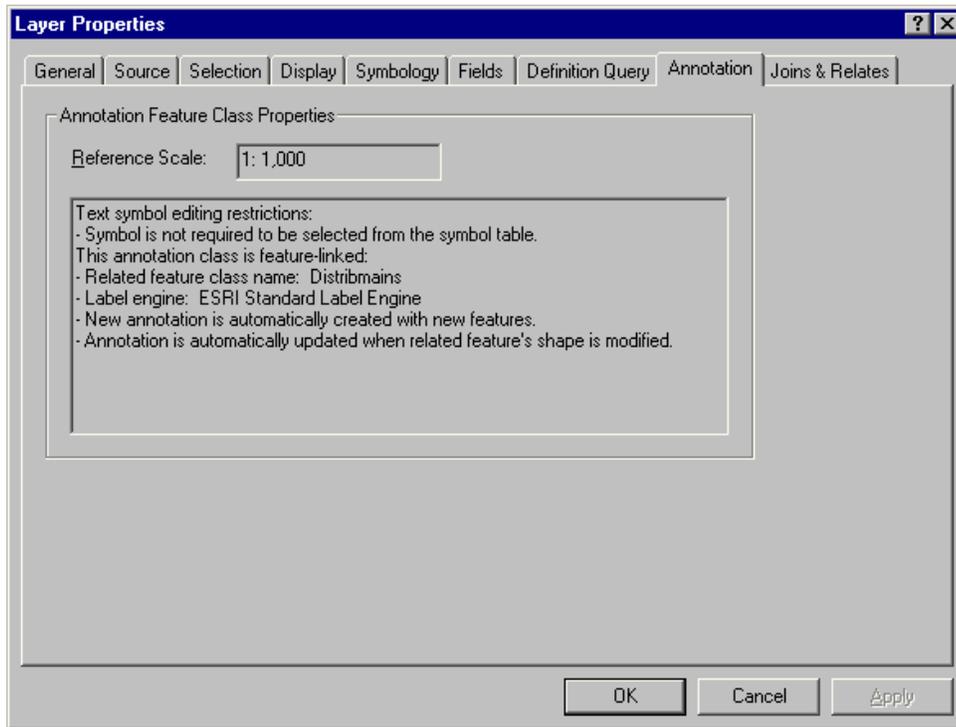


■ By default, annotation layers now respect their drawing order in the Table Of Contents, just like any other layer. You change this behavior on the new Display tab in the Layer Properties dialog box for an annotation layer (see below).

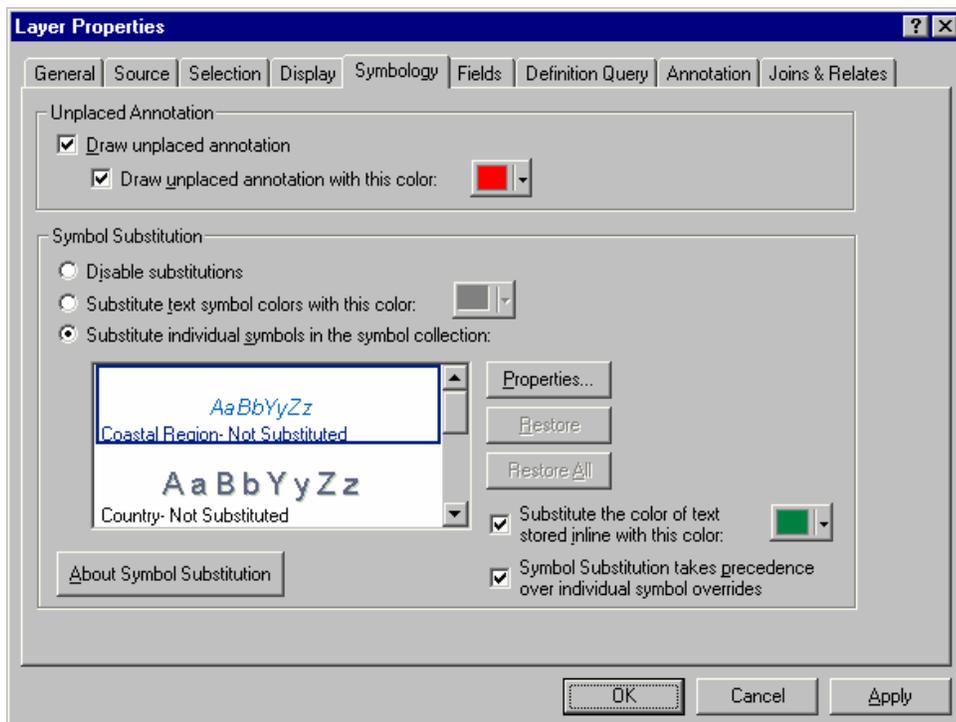
■ A new Display tab has been added to the Layer Properties dialog box for a layer representing an annotation feature class. With this tab you can specify transparency, set up MapTips, and create hyperlinks for annotation. You can also specify the layer to which the current annotation layer is associated. Specifying an associated layer links the visibility of these layers in the map. When the associated layer is turned on or off in the Table Of Contents, the annotation layer will also turn on or off.



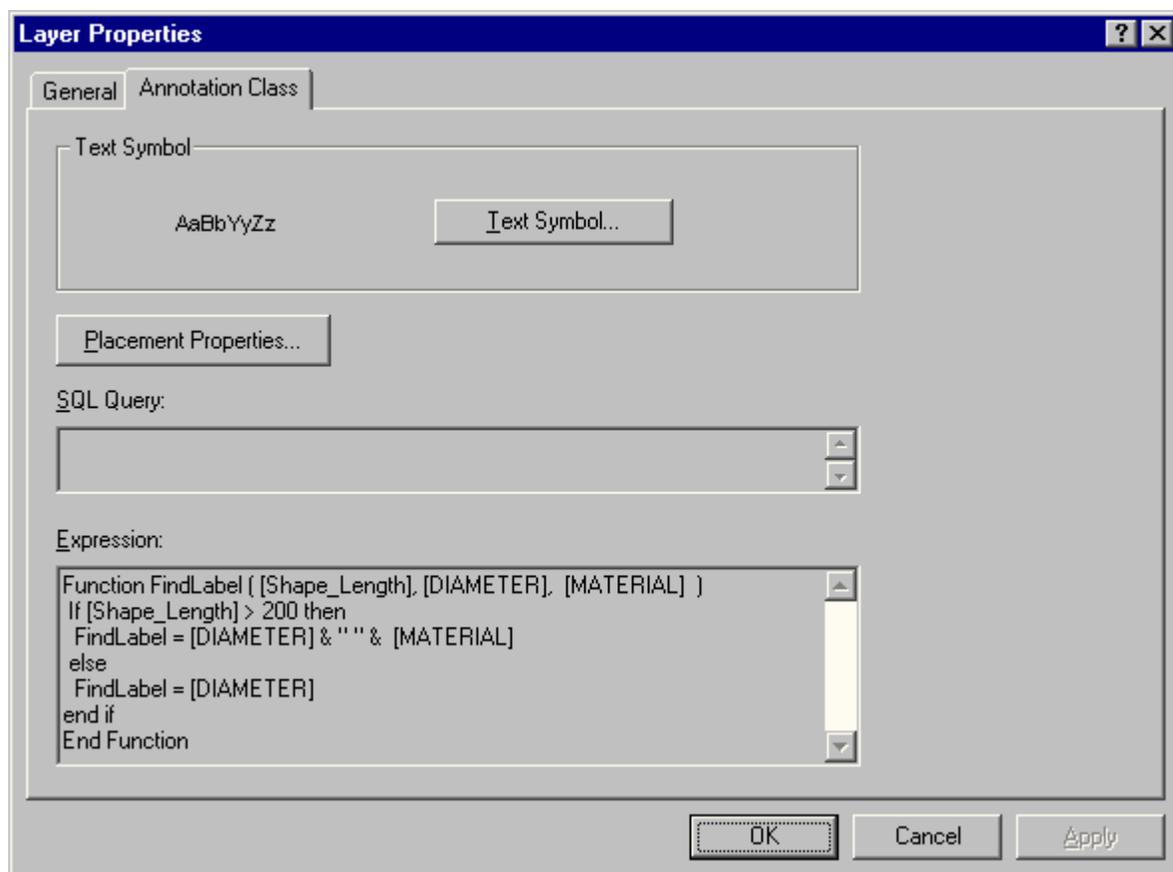
- The Labels tab in the Layer Properties dialog box for a layer representing an annotation feature class has been replaced with a new Annotation tab.



- A new Symbology tab has been added to the Layer Properties dialog box for a layer representing an annotation feature class. This new tab lets you specify symbology that will override the symbology defined for the annotation feature class, without having to change the annotation feature stored in the geodatabase. For example, if the symbology of text is defined in the geodatabase as black, you can temporarily override this and make it red.

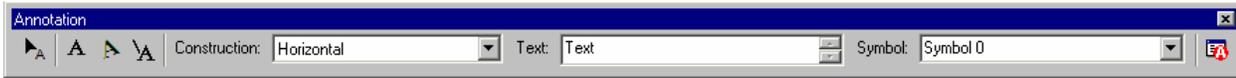


■ The Layer Properties dialog box for an annotation class listed under an annotation layer lets you review but not change the text symbol properties used to draw it. If the annotation layer is feature-linked, you can also review but not change the placement properties, SQL query, and the expression used to generate new feature-linked annotation for the annotation class from the feature class to which the annotation layer is linked.



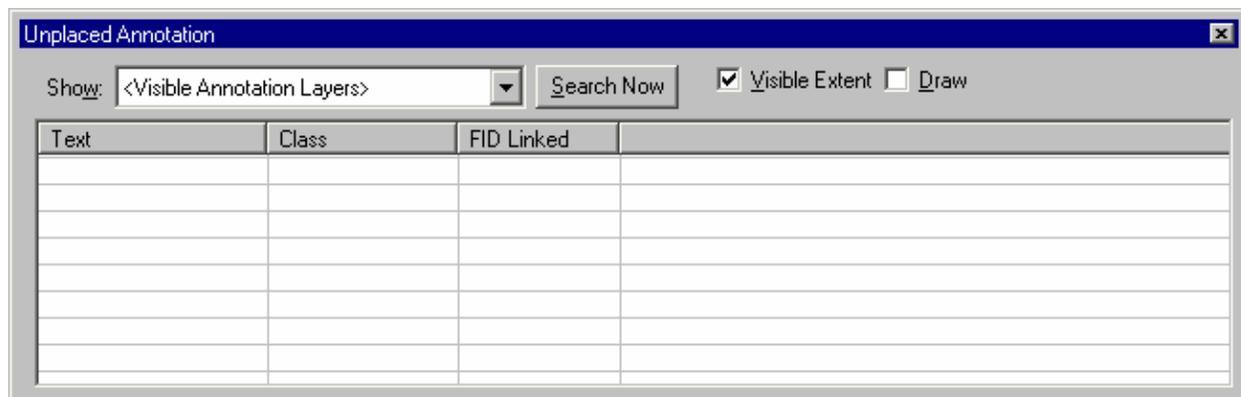
Editing annotation

- There is a new user interface for editing annotation, presented in a new Annotation toolbar.

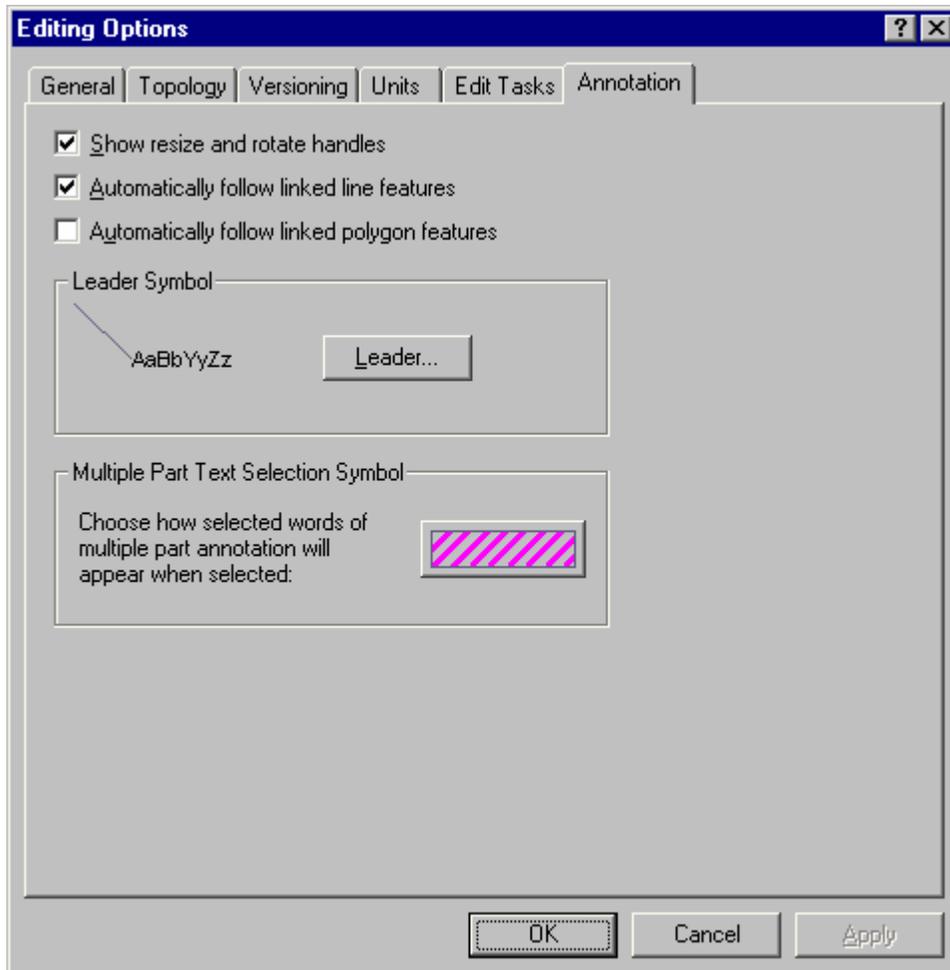


The Edit Annotation tool  has been moved out of the Advanced Editing toolbar and into this new Annotation toolbar. The tools on the new toolbar include:

-  Edit Annotation tool for working with existing annotation.
-  Construction tools for creating horizontal annotation, angled annotation, and annotation using a leader line.
- The **Construction** dropdown list lets you specify the construction method for the newly placed annotation. The available choices are Horizontal, Straight, Curved, Leader Line, and Follow Feature.
- You can type a **text** string to be used when creating new annotation, then use the construction tools to place annotation on your map. Multiline, stacked text is supported. When entering stacked text, hold Ctrl and press Enter to move the cursor to the next line.
- You can choose a **symbol** to use when creating new annotation text. Symbols for annotation features are now stored in the geodatabase. This dropdown list shows all the available symbols defined for this annotation layer. Hovering over a symbol in the dropdown list will list its basic properties, including font, font size, vertical alignment, and horizontal alignment. To add new symbols to this list, use ArcCatalog to open the feature class properties for the annotation feature class, then look in the new Annotation Class tab.
- An Unplaced Annotation button  opens a new dockable window that lets you find, list, and fix unplaced annotation. In the Unplaced Annotation window, use the Show dropdown list to choose an annotation feature class or a particular annotation class in that feature class. You can further refine the search criteria by checking the Visible Extent option. This option will constrain the search to errors that are within your current display extent.



- There's a new Annotation tab in the Editor > Editing Options dialog box for use when editing annotation.



- Two new commands have been added to the context menu for the Edit Annotation tool. These enable you to convert annotation between being composed of multiple parts (e.g., multiple words) or a single part.

- Convert To Multiple Parts
- Convert To Single Part

- A new command called Find Text has been added into the context menu for the Sketch tool . This command picks up annotation text from the first selectable and visible feature found under the cursor position on the map. You can use this to quickly annotate features with feature-linked annotation. The keyboard shortcut for this tool is **Ctrl + W**.

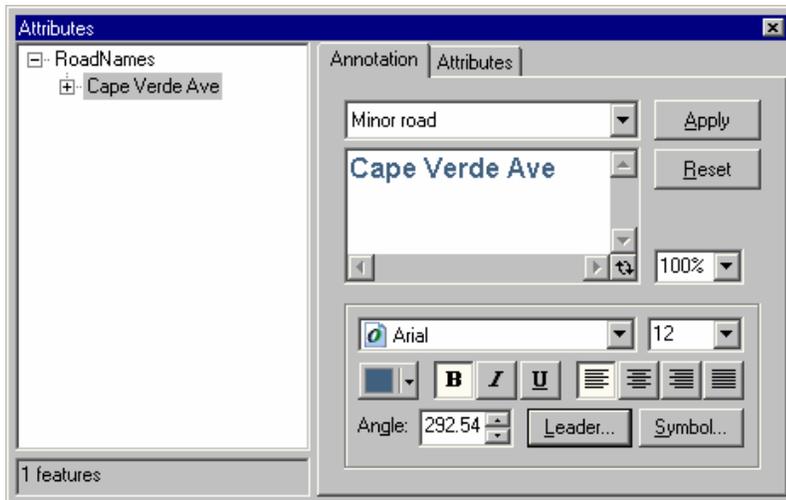
- New keyboard shortcuts make annotation editing faster and easier. These include:

- E** Cycle between the Edit, Edit Annotation, and Sketch tools.
- A** Activate the Current Text control on the toolbar (Sketch tool).
- F** Toggle follow feature functionality for the currently selected annotation (Edit Annotation tool).
- S** Activate the Current Symbol control on the toolbar (Sketch tool).
- L** Flip annotation while using the Follow Feature construction method (Edit Annotation and Sketch tools).

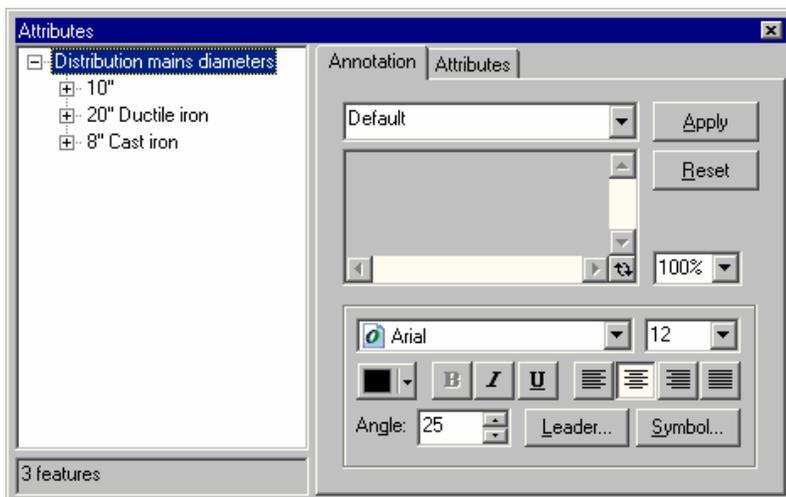
- O Open the Options dialog box for the Follow Feature construction method (Edit Annotation and Sketch tools).
- P Switch between perpendicular and parallel options while using follow feature functionality (Edit Annotation and Sketch tools).

■ The Overflow Labels command in the View menu has been renamed Overflow Annotation. When you launch this window, you can now press **Shift + F1** while it is active to get help for it.

■ When you edit annotation, the Attributes window , opened from the Editor toolbar, has a new look. The window is smaller, the most common controls are easily available, WYSIWYG editing is available for editing annotation text with most ArcGIS formatting tags, and you can choose a symbol from the annotation symbol list.



There is also added support in this window for editing multiple selected annotation features. In the example below, three annotation features are selected on the map. When the layer name is selected in the tree on the left of the window, changes to any of the annotation attributes shown on the right will be applied to all three currently selected annotation features. When an individual annotation feature is selected in the list on the left, changes that you make will be applied only to that one feature.



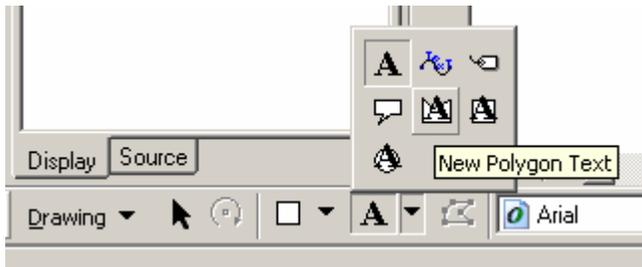
NOTE: Even though the Attributes window doesn't have a ? control in its title bar, you can get context-sensitive help on any control by highlighting the control with the mouse or by pressing the Tab key, then pressing **SHIFT + F1**. This way of getting context help works with almost any floating window in ArcMap that does not have a ? control.

■ Three new text drawing tools have been added to the ArcMap Draw toolbar that let you draw a paragraph text annotation—that is, a graphic element containing text formatted like a paragraph. The text flows within the graphic shape. The resulting element has text properties, graphics properties, and some new properties for setting columns and margins to control how the text is positioned inside the graphic. These new properties are presented in the Columns And Margins tab you'll find in the Properties dialog box for one of these new graphic elements.

 New Polygon Text tool

 New Rectangle Text tool

 New Circle Text tool



To resize graphics created with these tools, select the graphic and use the handles to scale it, or click the Edit Vertices command .

These tools can be used to create graphic elements as well as annotation stored in the map document or a geodatabase. These tools give the same dimension feedback in the ArcMap status bar and have the same options for specifying their dimensions via the keyboard that the Circle, Rectangle, and Polygon tools have been given at 9.0.

■ New curved leader lines: Two new curved leader lines are available for callouts. Click the Line Callout option when specifying the text symbol background for a text symbol drawn with the Callout tool to see these two new options.



■ The New Annotation Target command in the Draw pulldown menu can no longer be used to create an annotation feature class in a geodatabase. This command and the dialog box it launches have been renamed as 'New Annotation Group' to reflect this change. With this simplification, there are now two basic ways to create an annotation feature class in a geodatabase: create a new, empty annotation feature class in ArcCatalog, or use the Convert Labels To Annotation command to create an annotation feature class from a layer's labels.

■ A new option has been added to the Follow Feature Options dialog box (Edit Annotation tool context menu) to use the placement properties defined in the annotation class when working with feature-linked annotation.

■ Two new commands have been added to the Advanced Edit Tools category in the Tools > Customize dialog box in ArcMap. These give you additional ways to access two of the annotation construction types added at 9.0.

- Construct Curved Annotation
- Construct Annotation Following Feature

Raster data

At ArcGIS 9, raster data can now be completely managed through ArcCatalog and the underlying ArcObjects components and is fully integrated into the geodatabase. This results in many improvements in the way that rasters are stored, managed, and displayed in ArcGIS. With ArcGIS 9, terabytes of raster data (for example, air photos, scanned maps, and satellite images) can be stored in a central enterprise geodatabase and accessed by multiple users simultaneously. Rasters can be mosaicked into a single raster dataset or managed as a series of tiles in a raster catalog. A new user interface for raster catalogs makes them easier to work with. Version 9.0 also provides the ability to associate raster data, such as digital photos, and so forth, with geodatabase features by storing the rasters as attributes in fields of type raster. Fields of type raster can also be defined in standalone tables in geodatabases.

The new geoprocessing framework at 9.0 contains a full set of tools for working with raster data. Using the framework, these new tools can be combined in models and scripts to automate your raster management tasks. In ArcToolbox, look in the Data Management Tools toolbox for the Raster toolset. Look in the Conversion Tools toolbox for the From Raster and To Raster toolsets.

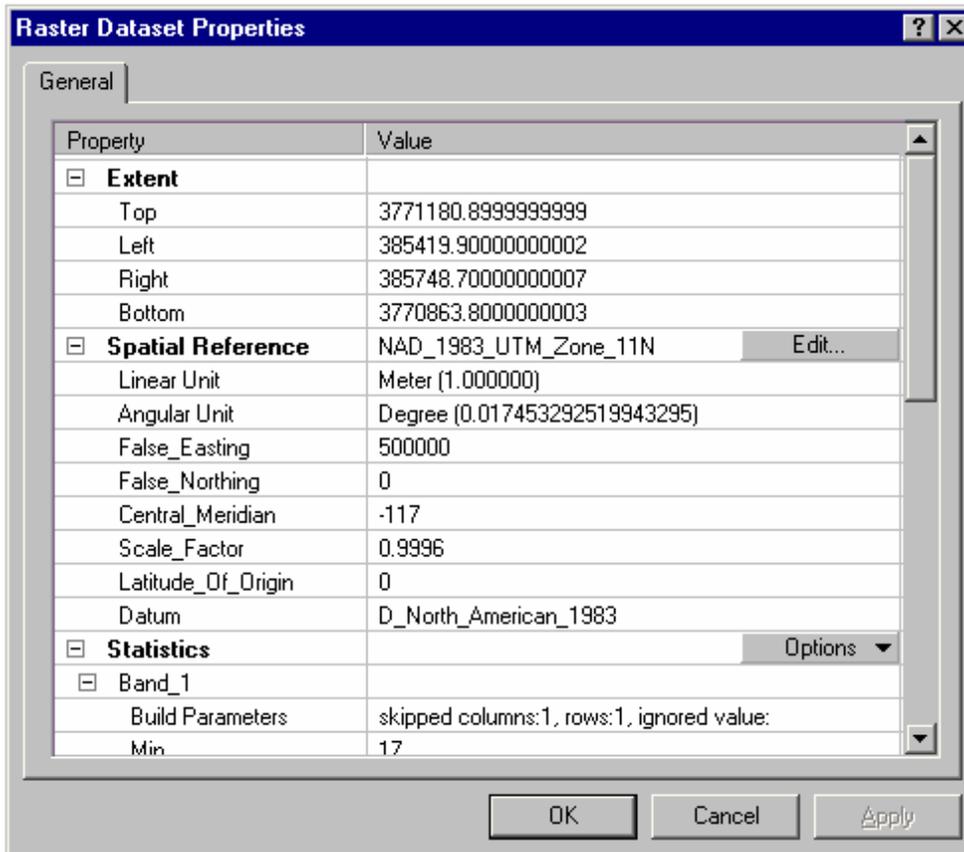
Raster datasets

- Raster datasets can now be added to personal geodatabases as well as enterprise (ArcSDE) geodatabases.
- Raster datasets added to a **personal geodatabase** are **managed** by the personal geodatabase rather than actually being stored inside the geodatabase, as they are with ArcSDE geodatabases. The personal geodatabase automatically stores raster data locally as .img files in a folder named after, and located in the same folder as, the personal geodatabase. For example, if your personal geodatabase is called Canada, the folder containing the raster data that it manages will be called Canada.idb. This folder is managed directly by the geodatabase and does not appear in ArcCatalog.
- ArcGIS 9 introduces partial pyramid building for raster datasets stored in ArcSDE geodatabases, a major performance improvement from previous versions. Instead of rebuilding pyramids for the entire extent of the raster dataset, only the area affected by the data being loaded into the raster dataset (mosaic) needs to have its pyramids rebuilt. This facilitates easy raster dataset mosaicking because now even large raster datasets in ArcSDE geodatabases can be updated easily.
- You can now perform mosaicking when you import a raster into a geodatabase. In ArcCatalog, right-click a geodatabase and look in the Import pull-right menu for the Raster Datasets (Mosaic) command.
- Versioning and geodatabase raster data at 9.0: Raster data cannot be versioned at 9.0, but this is functionality that ESRI hopes to implement in the future.

NOTE: Because fields of type raster (see the 'Raster fields' topic later in this section) are stored in geodatabase feature classes and tables and those entities themselves can be versioned, the raster data in this scenario does become a shallow version. The raster data of the parent version remains present as long as children versions of the data do not post any deletions or changes back to the parent. Addition of raster data does not affect the parent version unless posting occurs.

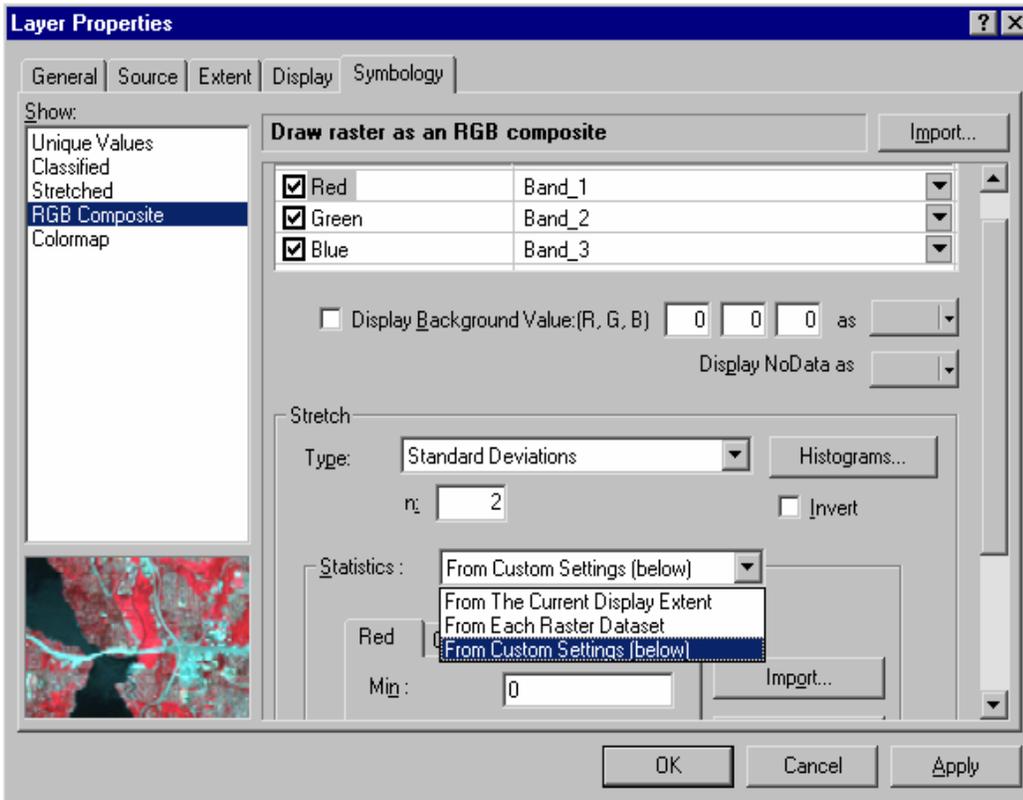
- The ESRI GRID raster format is now able to hold more than 2.1 GB of data. At 9.0, there is no limit to the amount of pixel data that can be stored using an ESRI GRID. For large imagery, however, the use of the enterprise (ArcSDE) geodatabase is recommended, as large files and folders are difficult to manage and slow to process.
- There is now no limit to the number of ESRI GRIDs that can be added to a single ArcMap, ArcScene, or ArcGlobe document. The limitation of 49 GRIDs in a single document has been removed at 9.0.

■ The Raster Dataset Properties dialog box in ArcCatalog now features a tree control that makes it easy to quickly browse through the various properties of a raster. The tree also gives access to options like building statistics.

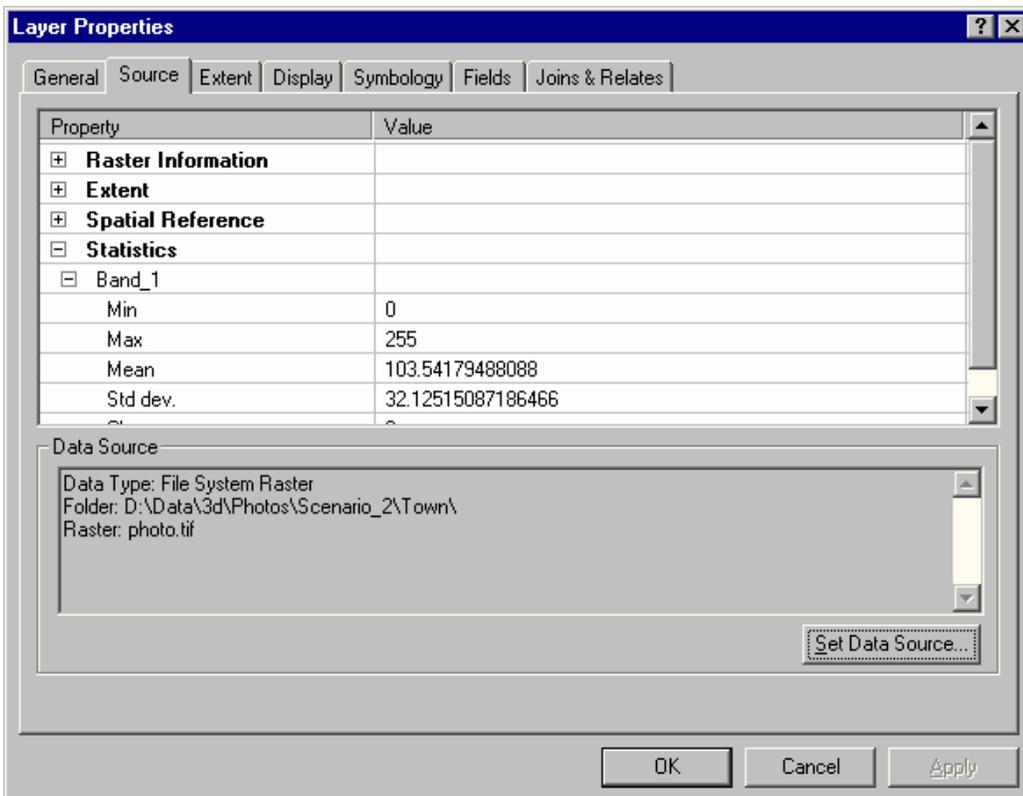


■ Additional rendering functionality is now available for drawing raster datasets. The Symbology tab in the properties dialog box for a layer based on a raster dataset has been enhanced as follows:

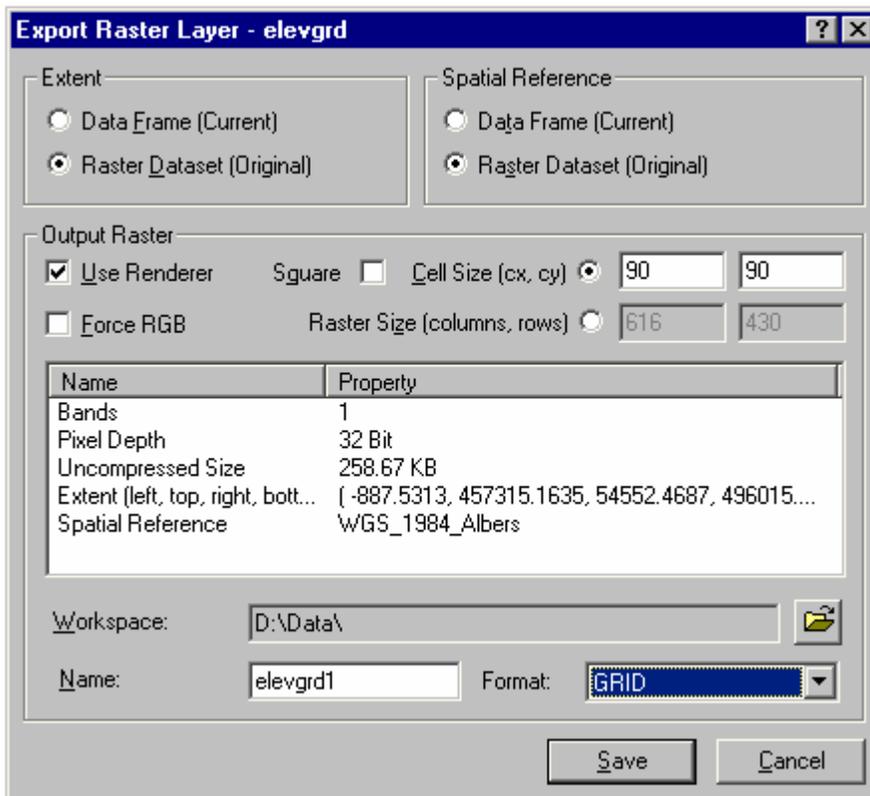
- Better management of how image stretch rendering is applied based on the statistics from the whole image, the visible portion of the image (per display raster stretching), or user-defined statistics.
- A colormap renderer is now included to display raster datasets with built in colormaps.
- A new Import button adds the ability to import raster symbology properties from a layer (.lyr) file. A limitation at 9.0 is that the Import button only imports the renderer settings, it doesn't change or set the renderer type. So, for example, if you import symbology from a raster layer that used the Stretch renderer, you have to already be in the Stretch renderer panel in the Symbology tab to import all the settings for this renderer correctly.
- The ability to choose background values as an RGB composite value has been added.



■ The Source tab in the Layer Properties dialog box for a layer based on a raster dataset has changed to include part of the same tree control used in the Raster Dataset Properties dialog box in ArcCatalog.



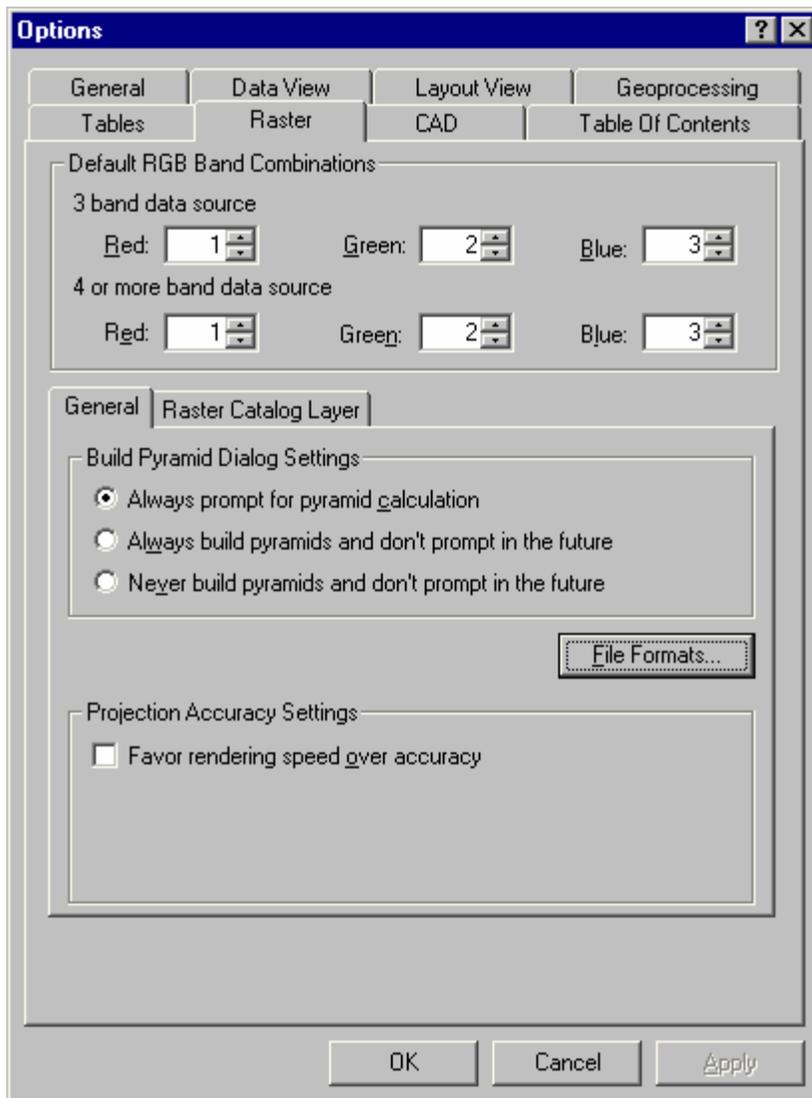
■ You can now export raster data from a layer based on a raster dataset in ArcMap using the new Export Data command you'll find in the layer's context menu. You can either use the extent of the raster dataset represented by the layer or the current extent displayed in the data frame. You also have the option of exporting the data using the layer's current raster symbology.



■ Several new raster dataset formats are supported at 9.0 (read-only); these include:

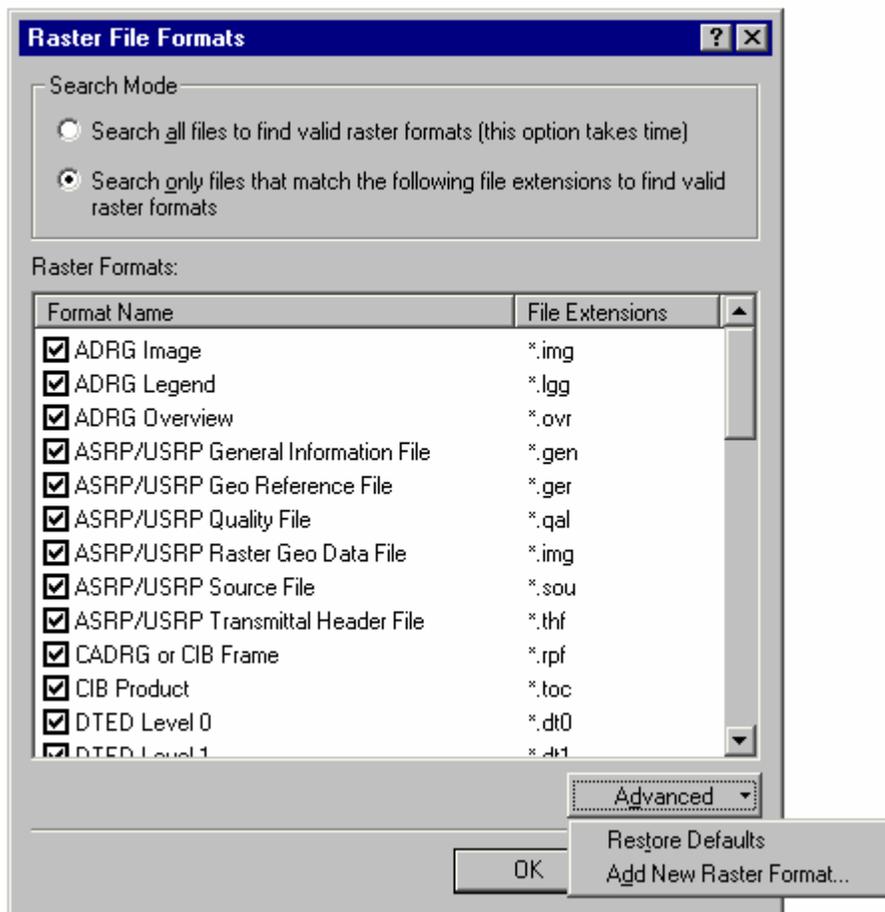
- JPEG2000 (for example, GeoJP2 from MSI)
- Integraph's CIT/COT
- DIGEST ASRP/USRP
- MrSID (generations 2 and 3). Note that the export command Raster To MrSID outputs in MrSID generation 2 format.

■ The Raster tab in the Options dialog box, which may be accessed from the Tools pulldown menu in all ArcGIS Desktop applications, has been enhanced to provide additional settings via two subtabs:



See the next few points for more information about the main options presented in this tab.

■ The handling of raster file formats has been improved so that file formats are now specified in their own dialog box launched from the General subtab on the Raster tab in the Tools > Options dialog box. The Advanced menu button gives you the option of defining a new raster format by specifying a .dll. Note that a .dll that requires additional helper .dlls may not be added using this option.



■ The reprojection of raster data has been improved at 9.0. By default, the software will automatically choose the most appropriate method of reprojecting your raster data, therefore ensuring that it is drawn in the display as accurately as possible. This same functionality is also present when reprojecting your raster data to a new output and loading raster data into a geodatabase using a different projection.

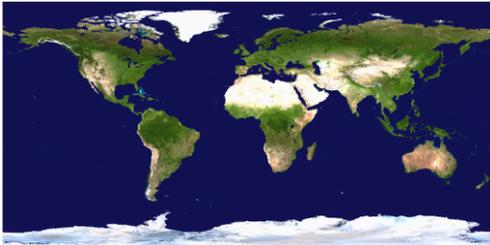
ArcGIS provides two internal methods of displaying raster data projected on the fly: a simple algorithm and a more robust algorithm. The simple algorithm is based on a single polynomial transformation and is fast, but it may not meet certain accuracy needs if the raster data covers large area, is located at high latitudes, or is being transformed between certain complicated projections. The more robust algorithm is a piecewise polynomial transformation, where the data is transformed block by block, therefore guaranteeing high accuracy. By default, ArcGIS will automatically switch to use the simple raster transformation method if it can achieve the same accuracy as the more robust raster transformation method. ArcGIS does this because highly accurate raster transformation methods require more processing time.

To enable you to control this when rasters are drawn, a 'Favor rendering speed over accuracy' check box has been placed on the Tools > Options dialog box on the Raster tab's General subtab. This box is unchecked by default. To ensure that raster data is drawn as accurately as possible, leave the box unchecked. The heavily optimized raster reprojection algorithm will take a few seconds longer to finish, but the result will be accurate.

Check the Favor rendering speed over accuracy check box to increase the display speed of raster data that is projected on the fly. When the box is checked, ArcGIS will always use the simple raster reprojection algorithm,

ensuring that raster data is rendered as quickly as possible. Note that certain inaccuracies may occur, as this will not allow ArcGIS to automatically switch into the more robust algorithm. Only check the box when accuracy is not a high priority.

To best illustrate this advance in raster reprojection technology, a 1-kilometer resolution National Aeronautics and Space Administration (NASA) worldwide image is shown below (imagery courtesy of NASA). ArcMap shows this raster in its native geographic coordinate system (GCS_WGS_84).



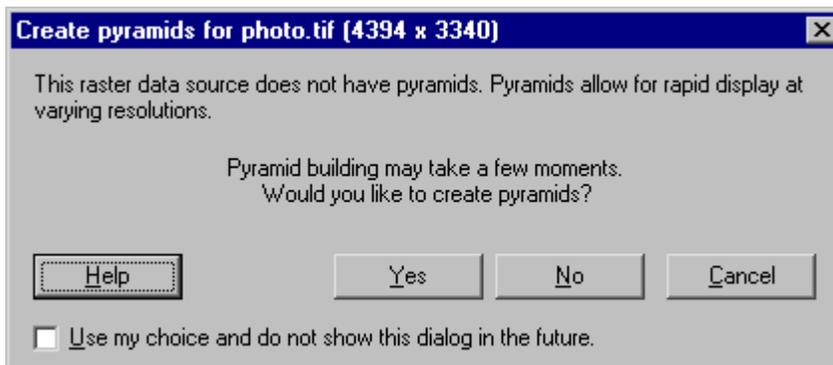
A simple change to the map display's coordinate system changes the appearance of the raster data significantly, but quickly and efficiently. Below, the same data is reprojected into Sinusoidal.



Additionally, raster reprojection clipping has been implemented, as shown below in a UTM Zone 11 projected coordinate system.



- The dialog box that prompts you about building pyramids when you add them into ArcMap, and so forth, has been improved. You can now click Cancel to cancel the addition of the data and do nothing.



- In ArcGIS 8.x, when you attempted to display the Properties dialog box of a raster layer that had many unique values, a message pops up if there are more than 2,048 unique values. The message tells you that because of the excessive number of unique values, the Symbology tab will not have a Unique Values renderer, and the Fields tab and Joins and Relates tab will not be present in the Layer Properties dialog box. At 9.0 the behavior of rasters with many unique values is still the same, but the popup message is no longer displayed.
- The New > Raster Dataset command on a geodatabase in ArcCatalog now launches the Create Raster Dataset tool from the 9.0 geoprocessing framework.
- The Load Data, Build Pyramids, and Calculate Statistics commands on a raster dataset in ArcCatalog now launch the tools for performing those operations from the 9.0 geoprocessing framework.

Raster catalogs

■ The handling of raster catalogs has been revamped in 9.0. Raster catalogs can now be created in personal geodatabases and ArcSDE geodatabases as geodatabase objects appearing with their own icons in ArcCatalog.



Raster catalog in geodatabase

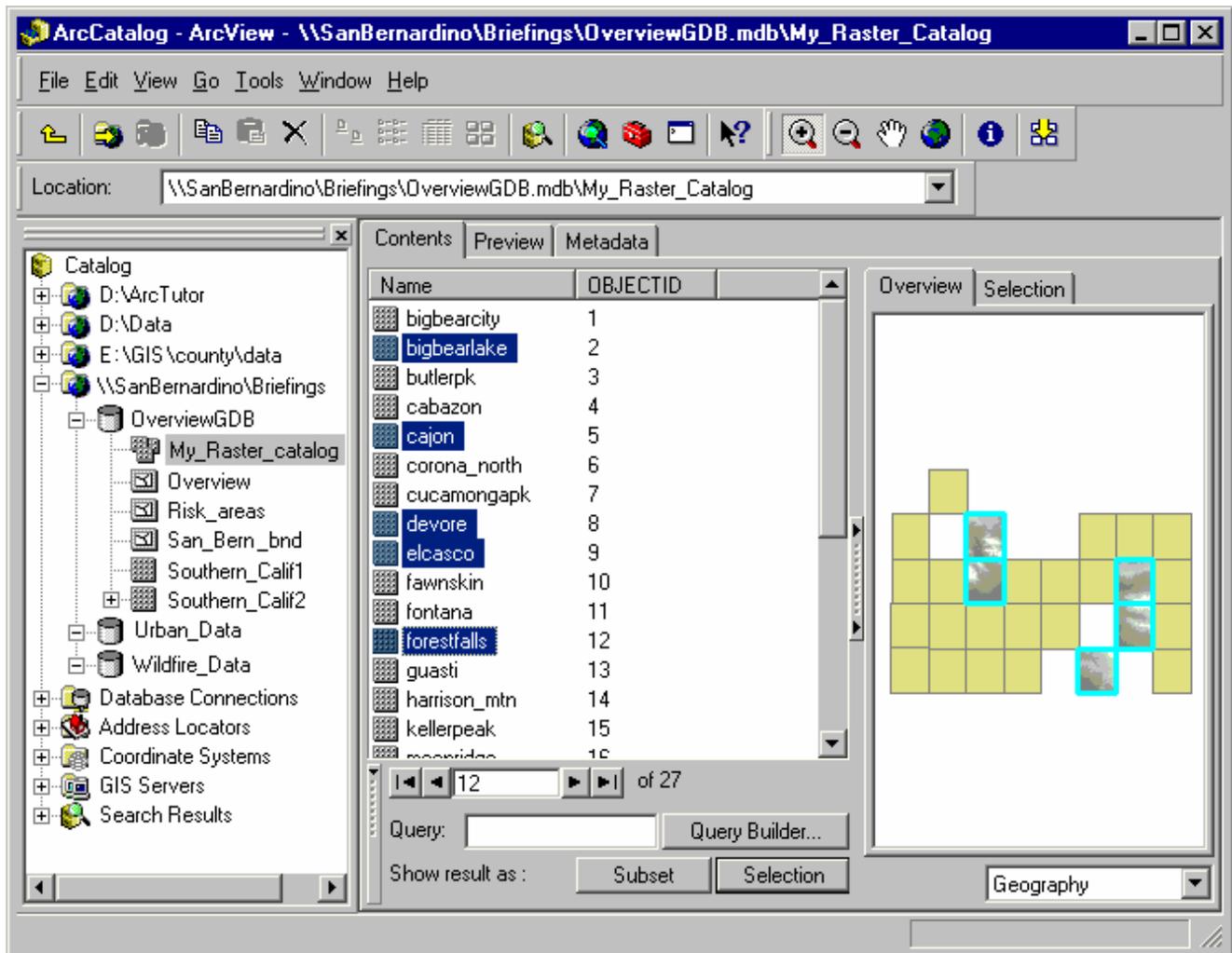
You can create a new raster catalog by right-clicking a geodatabase in ArcCatalog and choosing the New > Raster Catalog command.

The footprints of each raster in a raster catalog are stored as polygon features with attribute information, making it possible to perform spatial queries and selections for data management, corridor analysis, display, and so forth.

■ When you create a new raster catalog in a **personal geodatabase**, the raster catalog's data isn't actually stored inside the geodatabase like it is if you create it in an ArcSDE geodatabase. Instead, when you create a raster catalog in a personal geodatabase you choose whether the data will be **managed** or **unmanaged** by the personal geodatabase. You make this choice when you create a new raster catalog in ArcCatalog by setting the Raster Management Type option in the Create Raster Catalog tool.

- If the raster catalog's data is **managed** by the personal geodatabase, the rasters in the catalog will be automatically stored locally as .img files in a folder named after and located in the same folder as the personal geodatabase. This folder is managed directly by the geodatabase and does not appear in ArcCatalog.
- If the raster catalog's data is **unmanaged** by the personal geodatabase, the rasters in the catalog will be automatically referenced from the geodatabase to their disk location, linked by their pathname. This facilitates quick catalog creation and easy prototyping of managed solutions. Raster catalogs containing unmanaged rasters are similar to traditional image catalogs where the raster is managed by the user and not the database.

■ New tools are provided for browsing and managing these new raster catalogs. When you select a raster catalog in ArcCatalog and view its contents in the Contents tab, an expandable geography preview panel is available to the right of the contents listing, letting you view one or more of the rasters. An expandable query panel is also available at the bottom of the contents lists for selecting and previewing specific sets of rasters in the raster catalog. These tools facilitate management, display, and query of large raster catalogs.



If you are using the details view in the Contents tab, you can also right-click the column headings to display additional detail column fields, such as the Shape_Area of each raster.

To manage raster datasets in a raster catalog, select them in the contents view, then right-click to get a menu of commands, including Copy, Delete, Export, Build Pyramids, and so forth.

To load raster datasets into a raster catalog, right-click the raster catalog in ArcCatalog and click Load Data.

ArcGIS 8.3 raster catalogs and file-based (.dbf, .txt, and INFO) raster catalogs can still be used, but they do not have any of the new geodatabase raster catalog functionality and are not shown with the new icons.

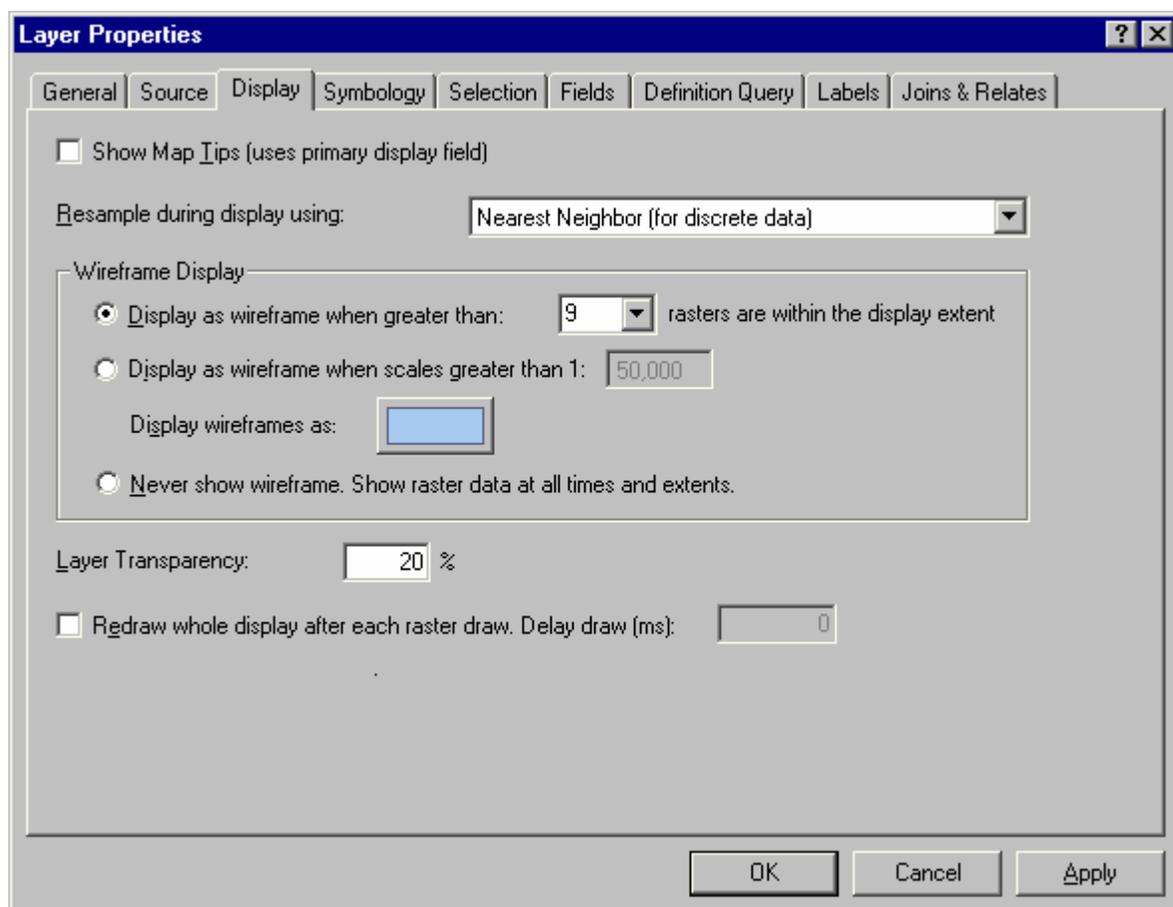
■ Raster Catalogs can now store rasters of varying type (three bands, black and white, colormap, and so on) within a single raster catalog. Rasters within a raster catalog no longer have to be of the same type. A heterogeneous raster catalog can be rendered using different renderers for its members. Note that heterogeneous raster catalogs are not ideal for all applications and are not recommended if you are aiming for optimum performance. They tend to be slower to draw, and the stretching on the images tends to be harder to

control. This multiple type functionality is available, though, because it can be useful in particular situations. In general, rasters of different type should be mosaicked together into single rasters.

Since raster catalogs at 9.0 no longer have to be of the same type, you can specify **multiple renderers** when you use the Symbology tab in a raster catalog Layer Properties dialog box. The most appropriate renderer is automatically applied to the appropriate raster in the raster catalog. The Symbology tab lists the renderers that are available for the contents of the raster catalog. You can edit this list of renderers to add or remove various renderers. Only the renderers in the list can be used in rendering. In the available renderers list, you'll see an asterisk next to each of the renderers that are currently active and are applied to one or more raster dataset members of the raster catalog. As multiple renderers can be used for raster catalog layers, raster catalog layers don't show their symbology in the Table Of Contents.

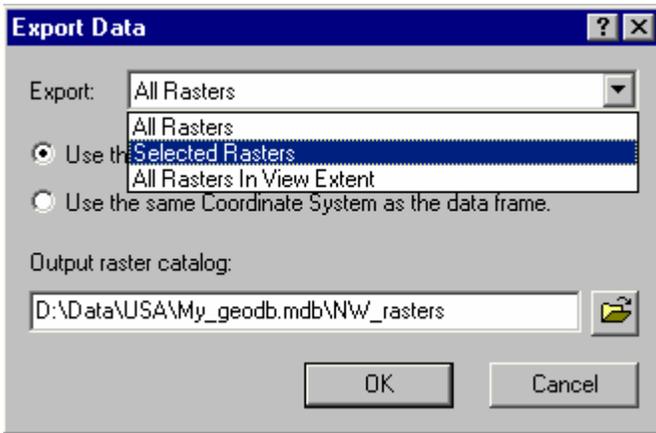
■ Rendering of raster catalogs has been vastly improved. Raster catalogs have the same new rendering capabilities as raster datasets (see the 'Raster datasets' section above for more about improved raster rendering in 9.0).

In a raster catalog Layer Properties dialog box, the Display tab lets you specify various options for viewing the contents of the raster catalog either as rendered rasters or just as a wire frame showing the footprint polygons.



■ As the footprints of the rasters in raster catalogs are polygon features, these raster footprints can be easily displayed and queried. You can open the attribute table of a raster catalog layer and work with these footprint polygons like any other features.

This also makes it easy to perform subsetting of raster catalogs. In ArcMap, you can right-click a raster catalog layer and choose Export Data. The Export Data dialog box lets you create a new raster catalog from some or all of the rasters:



Raster fields

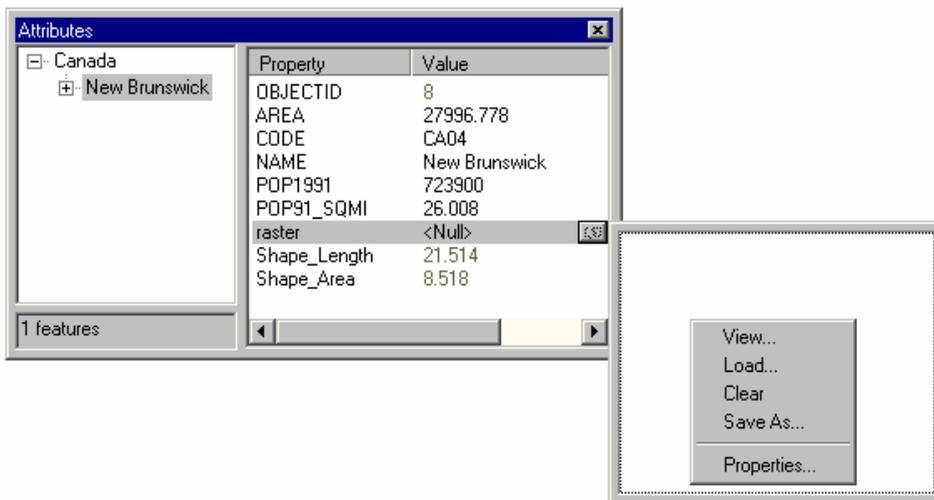
■ The attribute tables of geodatabase feature classes and standalone tables in personal geodatabases and ArcSDE geodatabases can now contain fields of type **raster**. A raster type field can contain any supported image, picture or raster dataset, such as a digital photo of a feature, a scanned floor plan, and so forth. Raster fields are defined in ArcCatalog when you create a feature class or table in a geodatabase or add fields to it after it has been created. They are not supported for shapefiles, dBASE tables, coverages, or INFO files. Only one raster field can be defined for a particular feature class or standalone table. If more than one raster field is needed, a related table can be used instead.

■ When you define a new raster field in a feature class or standalone table in a **personal geodatabase**, the raster field's data isn't actually stored inside the geodatabase like it is if you define it in an ArcSDE geodatabase. Instead, when you define a raster field in a personal geodatabase, you choose whether the data will be **managed** or **not managed** by the personal geodatabase. You make this choice by setting the Managed By GDB property on the raster field to either Yes or No when you define it.

- If the raster field's data is **managed** by the personal geodatabase, the rasters in the field will be automatically stored locally as .img files in a folder named after, and located in the same folder as, the personal geodatabase. This folder is managed directly by the geodatabase and does not appear in ArcCatalog.

- If the raster field's data is **not managed** by the personal geodatabase, the rasters in the field will be automatically referenced from the geodatabase to their disk location, linked by their pathname.

■ Once you've defined a raster field, you can add data into it in an edit session in ArcMap. In ArcMap, start editing in the normal way. Select the feature to which you want to add a raster, click the Attributes button  in the Editor toolbar to open the Attribute Inspector window, then click the > button next to the raster field. In the empty popup window that appears, right-click and choose the Load command. This will open a dialog box that lets you choose the raster to load. This is also how you replace an existing raster with a different one. To delete a raster, choose the Clear command.



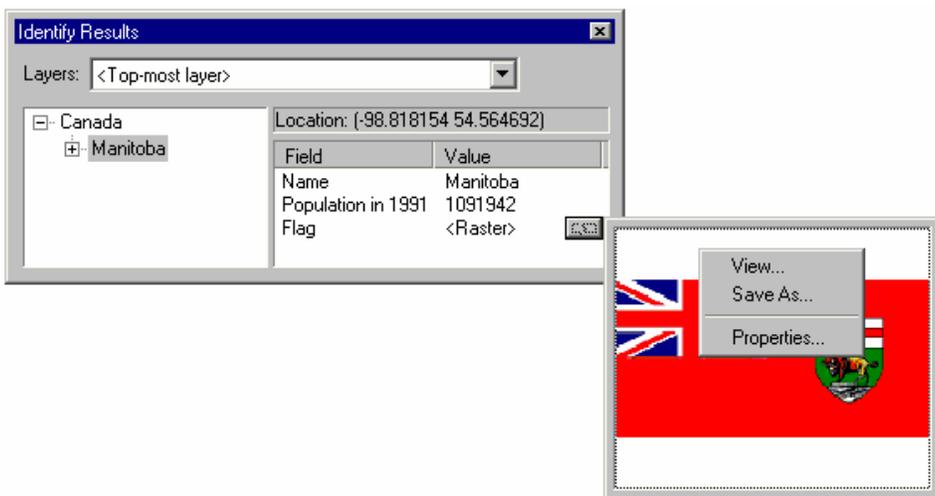
■ When you identify a feature containing a raster field in any ArcGIS Desktop application or ArcReader, you'll see a small button next to the raster field if a picture exists for the record.



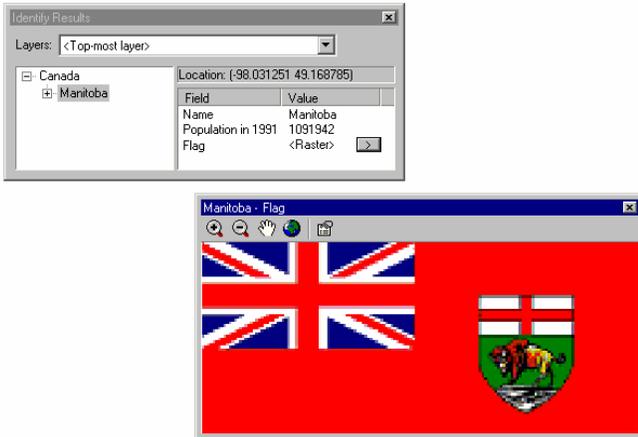
Click that button to see the raster in a small popup window.



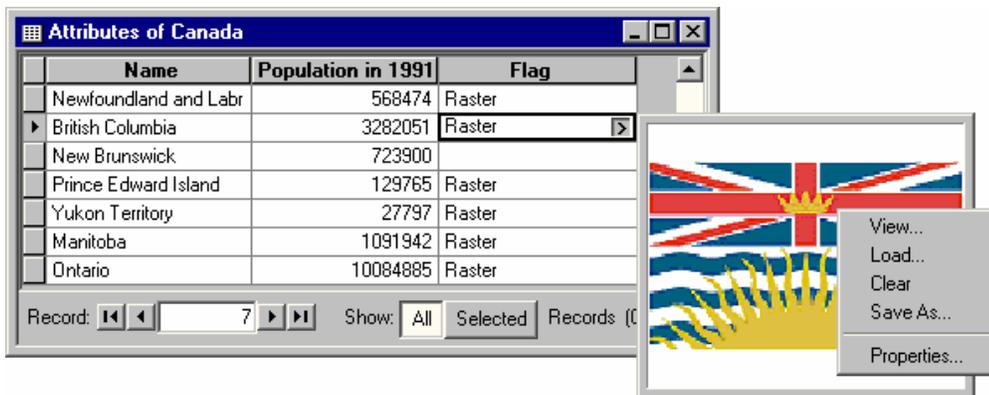
Right-click in the popup window to see more options.



Click the View command (or left-click in the popup window) to view the raster in a floating resizable window.



■ You can also view the content of raster fields in the Table window in ArcMap, ArcScene, and ArcGlobe. In the Table window, first click inside the raster field to make the > button appear, then click that button to view the raster. In the Table window, records for raster fields that contain pictures are shown with the value Raster. A record with an empty value for a raster field indicates that a raster has not yet been loaded into the field for that record. In the example below, the attribute table has been opened during an edit session in ArcMap, so the Load and Clear buttons in the context menu for the popup window are enabled.



Other ArcMap changes

Quick ArcMap 9 tips

- When you add layers into ArcMap, they are now automatically selected in the Table Of Contents. This lets you find them easily and immediately perform operations on all of them by right-clicking or using one of the shortcuts listed below. If you have added multiple layers, but just want to work with one of them, click the layer you want to work with to deselect the others.
- You can now drag or copy and paste multiple layers in the Table Of Contents.
- You can now drag or copy and paste multiple layers between two ArcMap sessions.
- You can now drag or copy and paste data frames between two ArcMap sessions.
- To quickly duplicate one or more layers in a data frame:
 - Hold down **Ctrl** and drag them into the Table Of Contents.
- To quickly activate a different data frame:
 - Hold down **Alt** and click its name in the Table Of Contents.
- To move one or more layer(s) instead of copying them when you drag them between data frames or ArcMap sessions:
 - Hold down **Ctrl** while you drag.
- To rename the selected item in the Table Of Contents:
 - Press **F2**.
- To expand or collapse all items at one level in the Table Of Contents hierarchy:
 - Hold down the **Ctrl** key and click the + or - control next to any item at that level. If any items are currently selected, click the + or - control next to any selected item to expand or collapse them.
- To expand or collapse an item in the Table Of Contents while you are dragging data:
 - Point to the + or - control next to the item and wait.
- To add data directly into a group layer:
 - Right-click the group layer and click the Add Data command.
- To give the Table Of Contents keyboard focus so you can use the keyboard to navigate and interact with it:
 - Click anywhere inside the Table Of Contents or press **F3**.
- To return keyboard focus to the map so key strokes are sent to the map instead of the Table Of Contents:
 - Click anywhere on the map or press **Esc**.
- To turn on or off the currently selected layers in the Table Of Contents:
 - Hold down the **Ctrl** key and click the check box next to any of them or press the **spacebar**.
- To open the properties of the selected item in the Table Of Contents:
 - Press **Enter**.
- To drop one or more layers so they come immediately after a group layer (without having to collapse the group layer):
 - Drag the layer or layers after the group layer and move the pointer to the left before you drop the layer or layers. A little vertical line at the left of the horizontal drop bar indicates into which level in the hierarchy the layer or layers will be dropped.

- To get a Help topic about the Table Of Contents shortcuts, give it keyboard focus, then press **Shift + F1**.

Geoprocessing in ArcMap at 9.0

■ The new geoprocessing framework introduced at 9.0 is fully integrated into ArcMap. Geoprocessing tools can be run from inside ArcMap, either by launching them directly from the new ArcToolbox window or by entering them as commands in the new Command Line window. Layers and tables in your current map can be used as inputs to geoprocessing, and outputs can be automatically added to the map as layers. You can combine tools in models and scripts and run these inside ArcMap. See the 'Geoprocessing' section of this document for more about the new framework.

TIP: The information in this section is aimed at ArcMap users but is also useful for ArcScene users looking for a quick overview of how to perform geoprocessing. The information also applies to the new ArcGlobe application (ArcScene and ArcGlobe come with the ArcGIS 3D Analyst extension).

■ The ArcGIS 8.x **Buffer Wizard**  has been removed from the Tools pulldown menu in ArcMap.

The Buffer wizard is still available in the Tools category in the Tools > Customize dialog box. If you want to use this wizard, you can add it to any ArcMap toolbar or pulldown menu from that dialog box. One reason you may still continue to use the 8.x Buffer Wizard is that it allows you to buffer graphics drawn on the map.

Where to find the 8.x Buffer Wizard operations in the ArcToolbox window at 9.0:

- Buffer at a specified distance or based on distances taken from a field:
 - Analysis Tools toolbox > Proximity > **Buffer**
- Buffer creating multiple rings:
 - Analysis Tools toolbox > Proximity > **Multiple Ring Buffer**

NOTE: In the Buffer tool, the Side Type option is restricted to FULL and the End Type option is restricted to ROUND if you are using an ArcView or ArcEditor license. Setting the Side Type to LEFT or RIGHT and the End Type to FLAT are only possible if you are using ArcInfo.

■ The ArcGIS 8.x **Geoprocessing Wizard**  has been removed from ArcMap. It is no longer provided in the product.

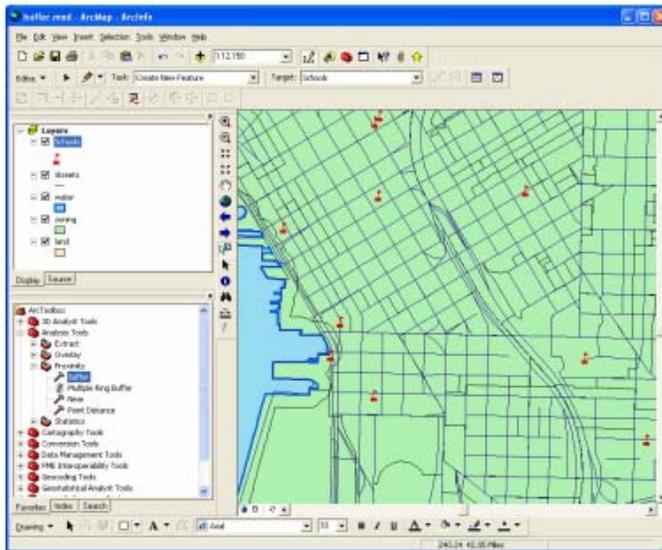
Where to find the 8.x Geoprocessing Wizard operations in the ArcToolbox window at 9.0:

- Dissolve:
 - Data Management Tools toolbox > Generalization > **Dissolve**
- Merge:
 - Data Management Tools toolbox > General > **Append**
- Clip:
 - Analysis Tools toolbox > Extract > **Clip**
- Intersect:
 - Analysis Tools toolbox > Overlay > **Intersect**
- Union:
 - Analysis Tools toolbox > Overlay > **Union**

NOTE: In the Union and Intersect tools, only two inputs are allowed if you are using an ArcView or ArcEditor license. The ability to union or intersect more than two inputs is only available if you are using an ArcInfo license.

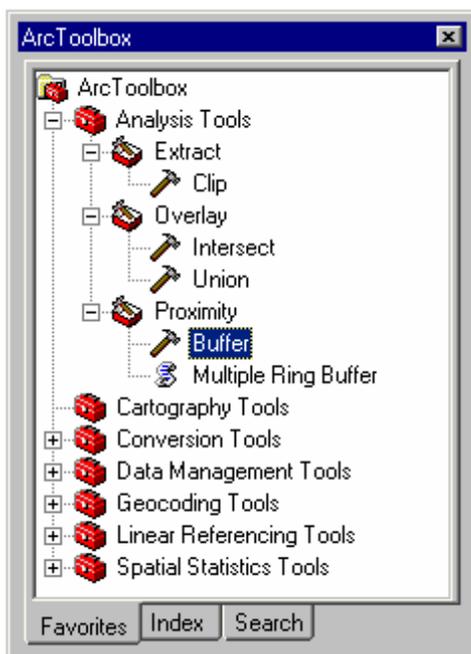
■ Quick overview of how to perform geoprocessing in ArcMap at 9.0

1. In ArcMap, open the ArcToolbox window by clicking the Show/Hide ArcToolbox Window button  on the Standard toolbar. When you open the ArcToolbox window from inside ArcMap, any tools you launch from the window are able to access the layers and tables in your current map document and to add their output back into the map for immediate display. You can run the tools from inside ArcCatalog too, but the tools won't be able to access the contents of your map, only data sources in ArcCatalog. The ArcToolbox window is a dockable window; the first time you open it after installing ArcGIS 9, it will dock vertically into your ArcMap window. A convenient location for the window is docked underneath the Table Of Contents window. You can just drag and drop it to that location:



TIP: To undock the ArcToolbox window, click the bar at the top of it. Once undocked, the window will normally try to dock when you move it over the ArcMap window. To prevent a dockable window from docking, hold down the **Ctrl** key while you move it.

2. In the ArcToolbox window, double-click the tool you want to use.



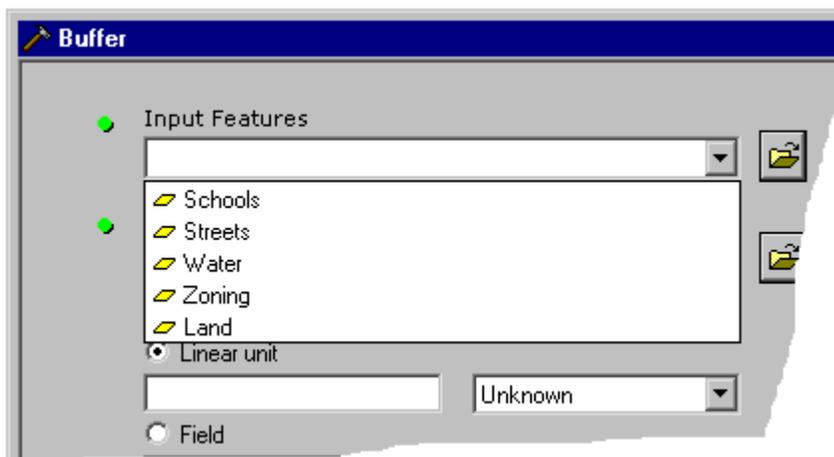
TIP: The screenshot above shows what you'll see in the Analysis Tools toolbox if you are an ArcView user. By default, core ArcGIS tools that you are not currently licensed to use are hidden in the ArcToolbox window. To see tools that you are not licensed to use, right-click the ArcToolbox entry at the top of the tree and uncheck the Hide Locked Tools command. All the tools providing operations found in the Buffer and Geoprocessing wizards at ArcGIS 8.x are available in ArcToolbox 9 for all product licenses (ArcView, ArcEditor, and ArcInfo).

3. If you want to perform the operation on a subset of the features in a particular layer, you can make the selection before or after launching the tool. The new geoprocessing tool dialog boxes are nonmodal, which means that you can continue to work on your map while a tool is open. Unlike the ArcGIS 8.x wizards, you can adjust your feature selection after you launch one of the new geoprocessing tools. The tool dialog boxes look at what features are selected at the time you execute the operation (for example, when you press OK on a tool dialog box), not when you launch the tool dialog box.

When launched from inside ArcMap, the geoprocessing tools always respect the currently selected set of features. There's no option inside the geoprocessing tool dialog boxes to choose between using all the features in a layer or just the currently selected set. If a set of selected features exists for a feature layer you use as an input to a geoprocessing tool, that set of features will be used in the operation. If no set of selected features exists, all the features in the layer will be used.

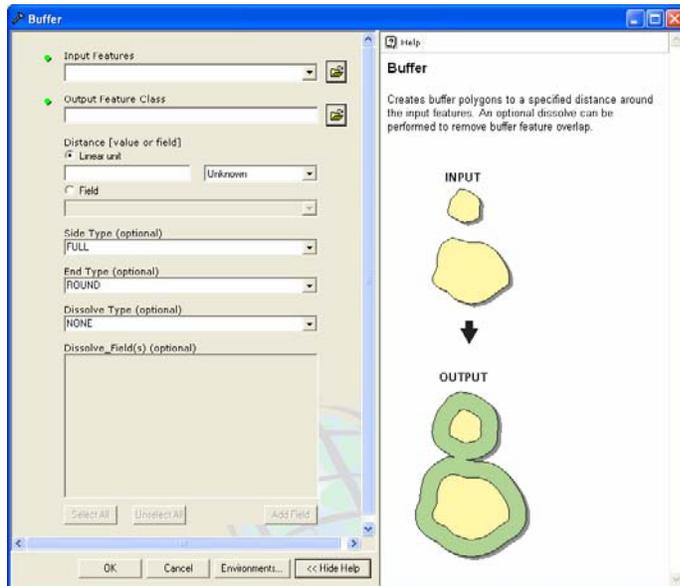
TIP: At 9.0, the set of selected features for a layer can contain no features. For example, if you use the Selection > Select By Attributes dialog box and your query expression results in 0 features being selected in a layer, this establishes a selection set containing 0 features on that layer, and 0 features will be used by the next geoprocessing operation you perform on the layer. See the 'Selection' topic in this section for more information about changes to the feature selection logic at 9.0.

4. In the dialog box that appears for the tool you chose, specify the input data and other parameters. To specify a layer in your map as an input, click the dropdown list to choose one of the layers from your active data frame.



To fill in input fields, you can also drag layers from the Table Of Contents in ArcMap, click the Browse button and locate any dataset using the Catalog Browser, or type or paste layer names or pathnames to datasets.

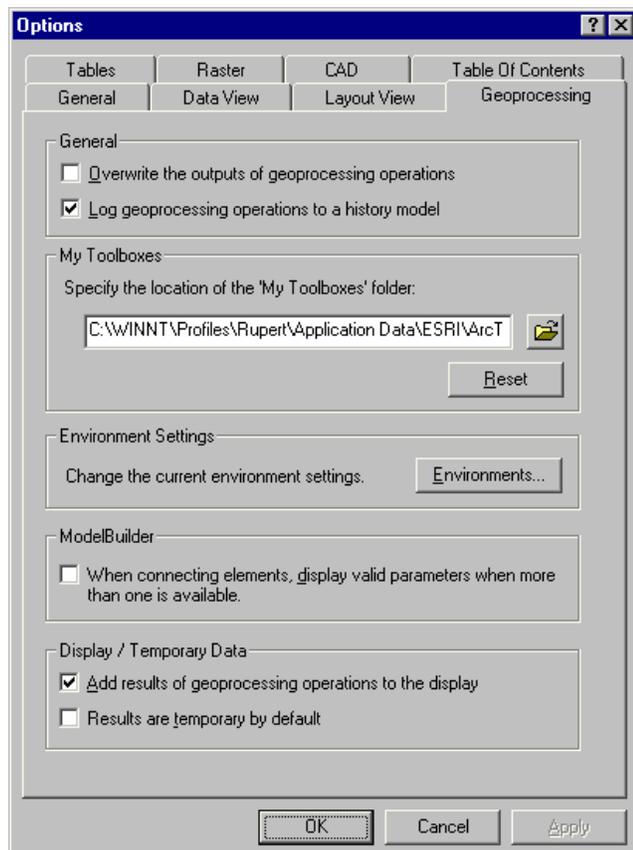
TIP: Click the Show Help button in the tool dialog box to display the Help panel. This panel gives you an overview of the tool. To get help on individual controls in the dialog box, simply click them. Help about the control you clicked will appear in the Help panel. Click the Help button at the top of the panel to launch the topic about this tool in the ArcGIS Desktop Help system.



5. While the operation is processing, a progress dialog box appears. Once it has finished, a layer representing the output data will appear in the Table Of Contents.

More geoprocessing tips for ArcMap users

■ You can control various aspects of how geoprocessing works by choosing the Options command from the ArcMap Tools pulldown menu and going to the new **Geoprocessing** tab. Settings you make in this tab apply to all the ArcGIS Desktop applications (the Display and Temporary Data options don't apply to ArcCatalog).

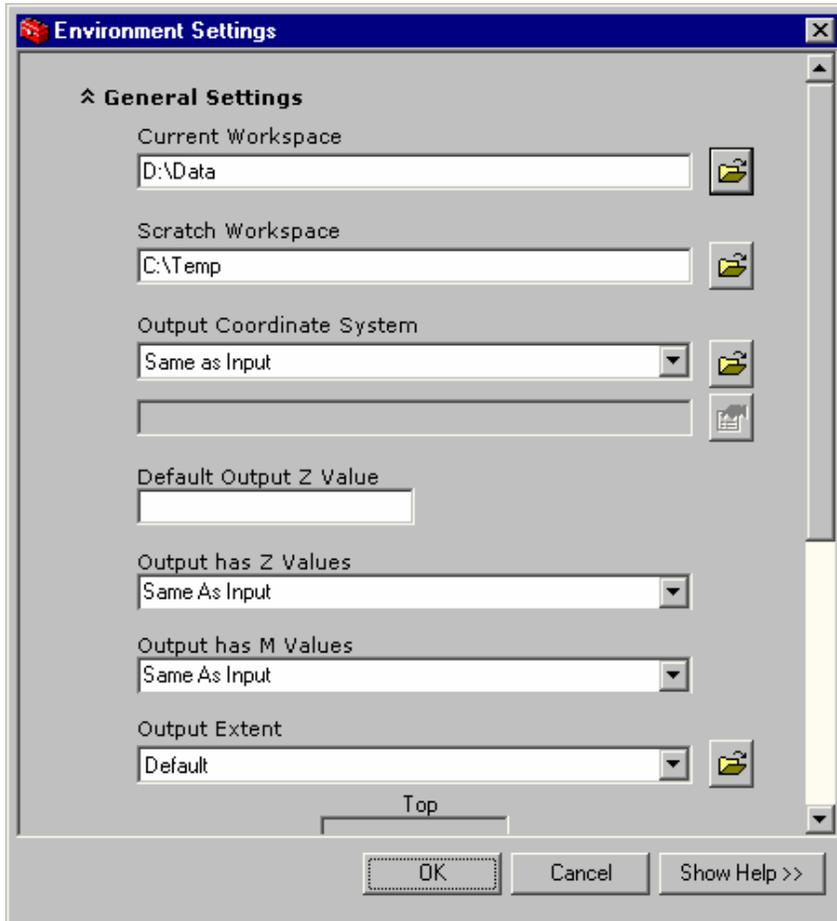


If you want geoprocessing operations to overwrite existing outputs with the same name, check that option at the top of the Geoprocessing tab. When this is checked, geoprocessing operations don't prompt you if an output already exists; they automatically overwrite the output.

The Results are temporary by default option at the bottom of the tab makes it easier to clean up unwanted output data, such as data representing intermediate steps in geoprocessing operations you perform. When this option is checked, a layer added into your map by a geoprocessing operation will be considered temporary by ArcMap. If you remove this layer from your map's Table Of Contents, ArcMap will automatically delete the data on disk that this layer represents when you close the map document or exit ArcMap. When you save your map document, any temporary layers remaining in the Table Of Contents automatically become permanent. If you close the application without saving the document, the data for temporary layers remaining in the Table Of Contents is automatically deleted.

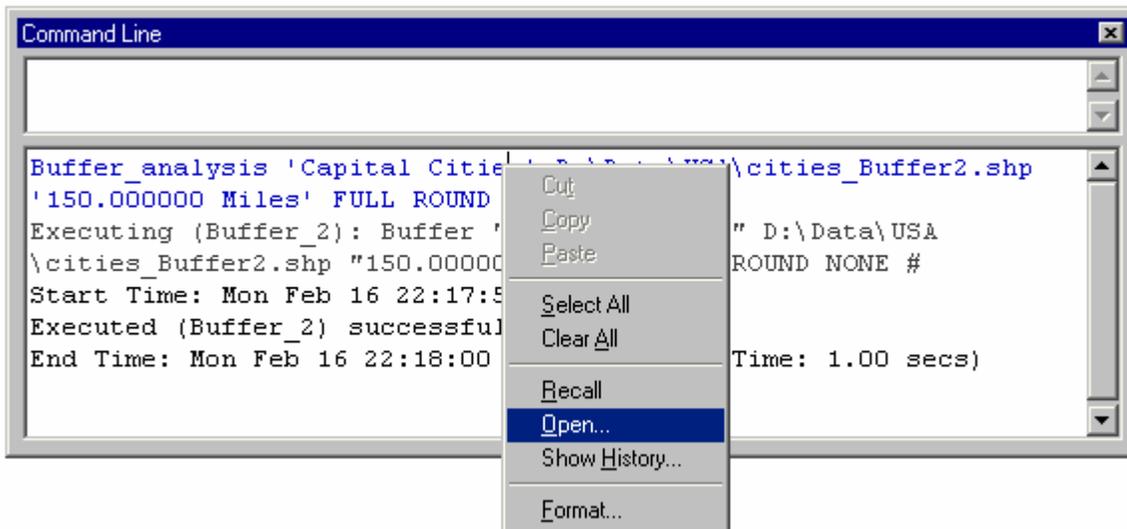
NOTE: At the time of writing, the temporary layer functionality is not working in ArcGlobe.

■ In Tools > Options > Geoprocessing, press the **Environments** button to launch a dialog box that lets you specify additional settings for your geoprocessing work. For example, the Current Workspace setting in the Environment Settings dialog box lets you specify a folder or geodatabase that will serve as the default location for inputs and outputs you specify in geoprocessing tools, which saves you having to specify a pathname if you type in the name of an input or output.



You can also launch the Environments dialog box from the context menu obtained by right-clicking the ArcToolbox entry at the top of the ArcToolbox window tree. These settings apply to the current map document you are using and get saved into that document. To temporarily override your current environment settings for a particular operation you run from a tool dialog box, press the Environments button on the tool dialog box and modify the settings in the dialog box that appears.

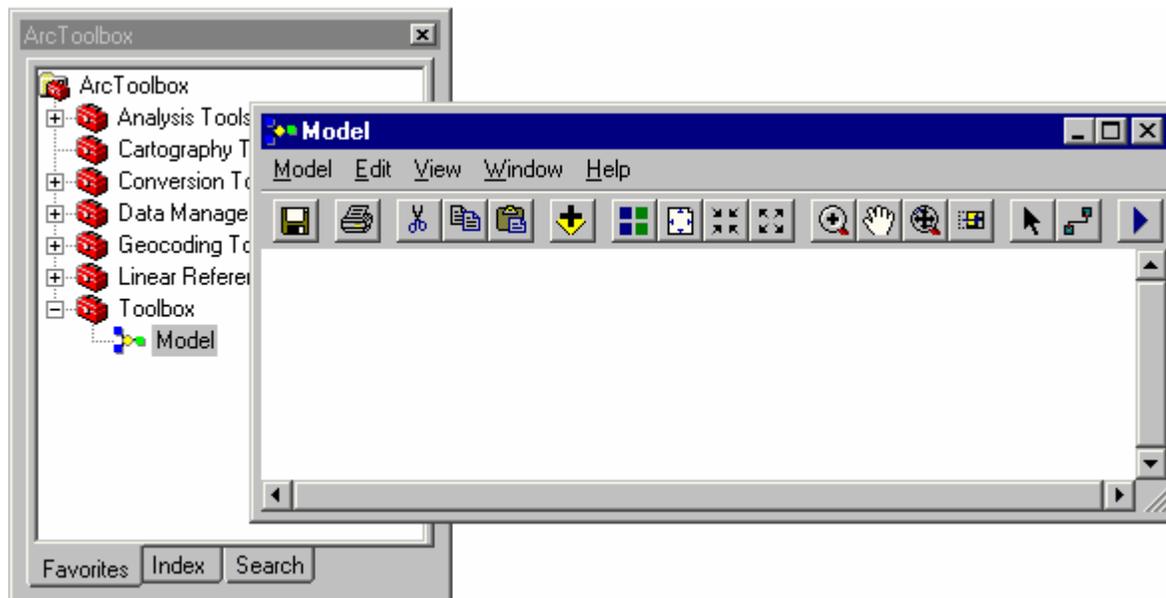
■ To make it easy to reexecute operations you perform, open the Command Line window before you run the geoprocessing tools. You can open this dockable window by clicking the Show/Hide Command Line Window button  on the Standard toolbar. When you run one of the geoprocessing tools from the ArcToolbox window, the underlying command executed by the tool will appear in blue in the message area in the Command Line window. Right-click the command to access a context menu.



Choose **Open** from the menu to reopen the tool dialog box for the operation you just performed.

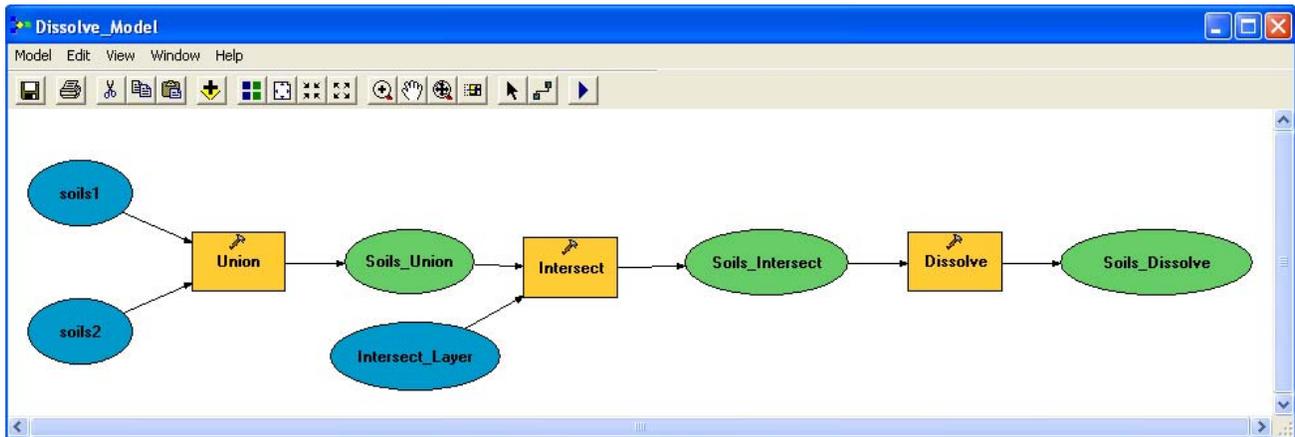
Choose **Recall** from the menu to put the command into the top part of the window so you can make any adjustments to the options used, then press **Enter** to execute it.

■ You can combine geoprocessing operations in models and scripts to automate repetitive tasks or create analytical models. To create a **model**, first create a new, empty toolbox in the ArcToolbox window to contain the model. Right-click the ArcToolbox entry at the top of the tree and choose the New Toolbox command. Then right-click the new toolbox that appears and choose the New Model command. An empty ModelBuilder window will appear.



You can now drag layers from the Table Of Contents and tools from the ArcToolbox window into the ModelBuilder window to build your model. In the ModelBuilder window, use the Add Connection tool  to connect layers and tools. Double-click tools to launch their dialog boxes so you can enter values for their parameters. To run a model, click the Run button .

For example, the following model takes two soil layers and performs a Union to create an output layer. An Intersect is then performed on the output layer to create a new layer, Soils_Intersect. The Dissolve operation is then run on the output from the Intersect operation to create the final layer, Soils_Dissolve.



■ When you create a new toolbox in the ArcToolbox window in ArcMap, that toolbox will belong to the map document you are currently working with. When you create a new map document or open a different one, the toolbox you created will not appear in the ArcToolbox window.

To add a toolbox you have already created in another map document into the ArcToolbox window, right-click the ArcToolbox entry at the top of the tree and click the Add Toolbox command. You'll be prompted to browse to the toolbox you want to add. The default location for new toolboxes you've already added into the ArcToolbox window is your My Toolboxes folder. You can find this folder in ArcCatalog inside the Toolboxes folder at the top level of the ArcCatalog tree. The physical location on disk for your My Toolboxes folder is specified in the Tools > Options dialog box Geoprocessing tab.

Changes you make to the contents of the ArcToolbox window are part of your **geoprocessing settings**. Your geoprocessing settings are:

- The current choice of toolboxes in the ArcToolbox window and how they are expanded or contracted.
- The current settings in the Environment Settings dialog box. These settings are accessed by right-clicking the top of the ArcToolbox window and clicking the Environments command or by pressing the Environments button in the Tools > Options dialog box.
- The current variables defined in the Variable Manager. These variables are accessed by right-clicking inside the panel at the top of the Command Line window and choosing the Variables command.

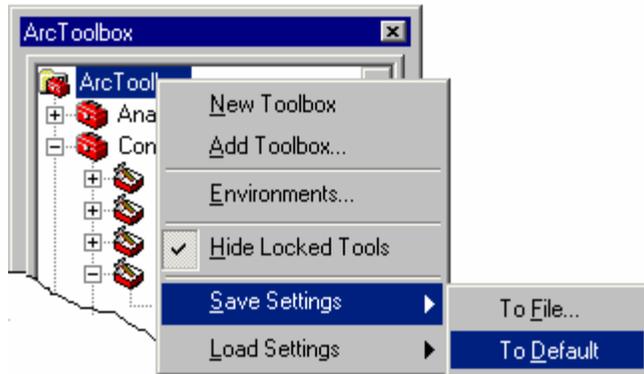
If you are using **ArcMap**, **ArcScene**, or **ArcGlobe**, the geoprocessing settings you apply to the current document are saved into that document. In this way, all the settings you set to perform geoprocessing on the data shown in a particular map are stored in that map. If you are using **ArcCatalog**, settings you make apply to ArcCatalog.

TIP: If you create a map template (.mxt) with ArcMap, your current geoprocessing settings are saved into the template and will be used by any new map document created using that template. In this way you can create different map templates with different settings according to your needs.

Whenever you create a new ArcMap, ArcScene, or ArcGlobe document, your **default geoprocessing settings** are used for the document unless you are creating a new map in ArcMap using a map template that contains geoprocessing settings. Your default settings are also used by ArcCatalog.

Your default geoprocessing settings are set in one of two ways:

- Whenever you quit ArcCatalog, your current geoprocessing settings in ArcCatalog automatically become the default.
- You can set the defaults manually by right-clicking the ArcToolbox entry at the top of the ArcToolbox window and clicking Save Settings > To Default. This command enables you to make your current geoprocessing settings the default from whatever application you are in.



If you change your default geoprocessing settings, you'll find that your changes are not reflected in documents you have already created. To load your latest default geoprocessing settings into existing documents, right-click the top entry in the ArcToolbox window and click Load Settings > From Default command. For example, if you've customized the ArcToolbox window in ArcCatalog and you'd like this customization to appear in an existing map, use that command to load the default geoprocessing settings.

TIP: Use Save Settings > To File and Load Settings > From File to save and restore geoprocessing settings using an **XML file** without affecting your default settings. The commands make it easy to transfer your geoprocessing settings between, for example, different ArcMap documents or ArcCatalog and an existing ArcMap document. Using an XML file is also useful if you want to copy or distribute geoprocessing settings between machines or between users.

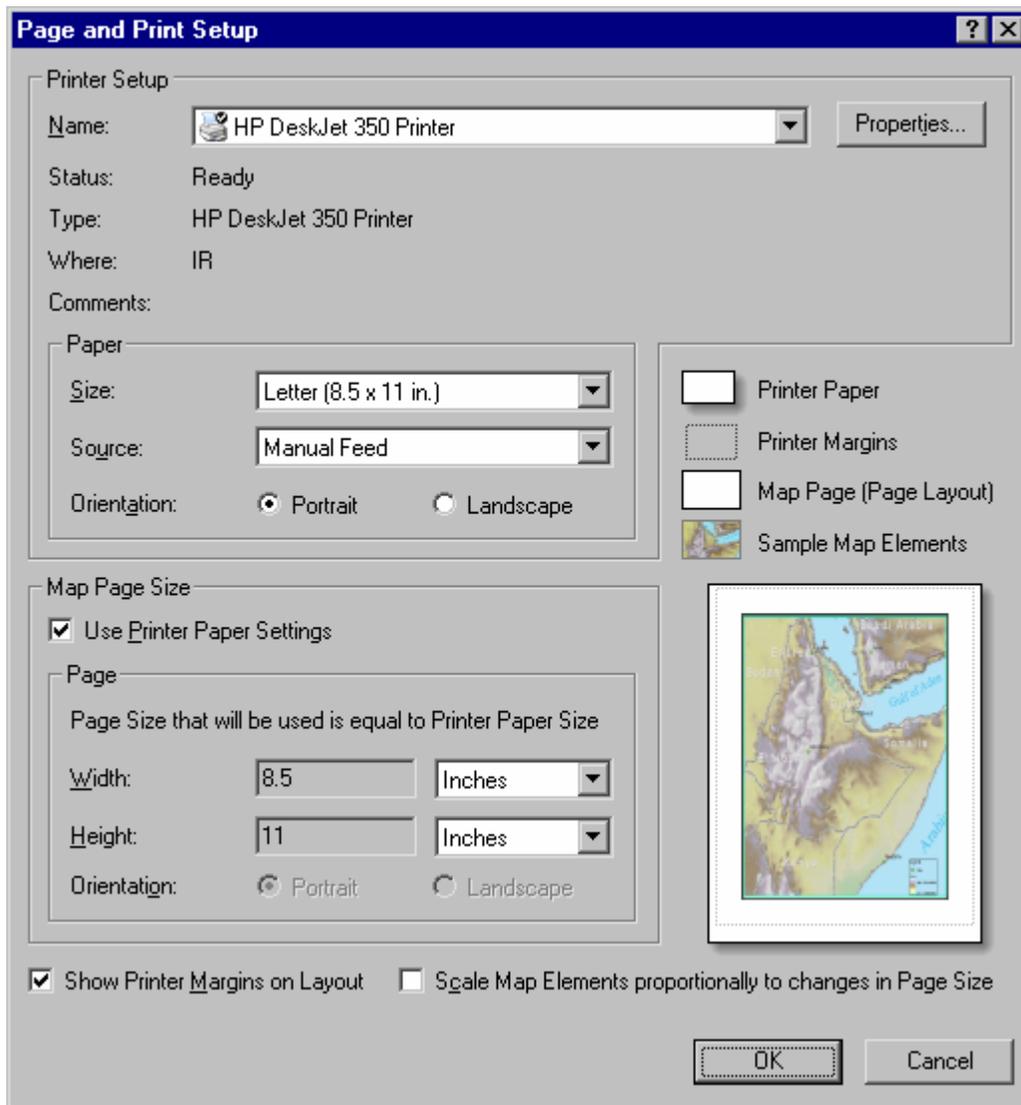
■ A good way to familiarize yourself with how **scripts** work in the geoprocessing framework is to create a model and export it as a script by choosing Export To Script in the Model pulldown menu. Also, you may notice that some of the tools in the ArcToolbox window actually run scripts, such as the Multiple Ring Buffer tool in the Analysis Tools > Proximity toolset. To view the script for a tool based on a script, right-click the tool in the ArcToolbox window and click Edit. The script will appear in a window.

A screenshot of a PythonWin window titled 'PythonWin - [MultiRingBuffer.py (read-only)]'. The window displays the following script content:

```
##  
## Tool Name: Multi-ring Buffer  
## Source Name: Multiringbuffer.py  
## Version: ArcGIS 9.0  
## Author: Environmental Systems Research Institute Inc.  
## Required Arguments: An input feature class or Feature layer  
##                      An output feature class  
##                      A set of distances (multiple set of double values)  
## Optional Arguments: The name of the field to contain the distance values,  
##                      "distance" is the default name  
##                      Option to have the output dissolved. "All" is the default,  
##                      which will dissolve all overlapping polygons. "None" will  
##                      will maintain all overlaps.  
## Description: Creates a set of buffers for each of input features...
```

Printing maps

■ The File > Page Setup command has been renamed as Page and Print Setup. The dialog box launched by this command has also been renamed; it is now the Page and Print Setup dialog box, and it has been improved for easier use. The Page and Print Setup dialog box includes a page layout preview that makes it much easier to ensure that the map will fit on the selected printer page. Also, the printer properties have been moved from the Print dialog box to the Page and Print Setup dialog box, and the Print Engine dropdown list has been moved to the Print dialog box. This makes setting up the page more intuitive and easier to create custom printer page sizes. The Output Image Quality setting has been moved out of the Page and Print Setup dialog box and onto both the Print and Export dialog boxes to improve ease of use.



In this dialog box, the Same As Printer option has been renamed as Use Printer Paper Settings. When a map document is saved with the Use Printer Paper Settings check box checked, then opened on a computer that is not connected to the same printer, ArcMap will automatically turn off the Use Printer Paper Settings option so the map document will open properly.

Also, the Scale Map Elements option is now off by default. This makes it easier to share maps with others and move maps to other machines because, if the printer referenced by the Use Printer Paper Settings option is not available, the map will not be scaled by default.

■ The File > Print dialog box has been improved in coordination with the new Page and Print Setup dialog box. You now only need to make your Printer Engine and Output Image Quality selections at print time. There is also a print layout preview so you can ensure that the map will fit on the printer page. Printer properties have been moved to the Printer and Page Setup dialog box, which makes creating customer printer page sizes easier.

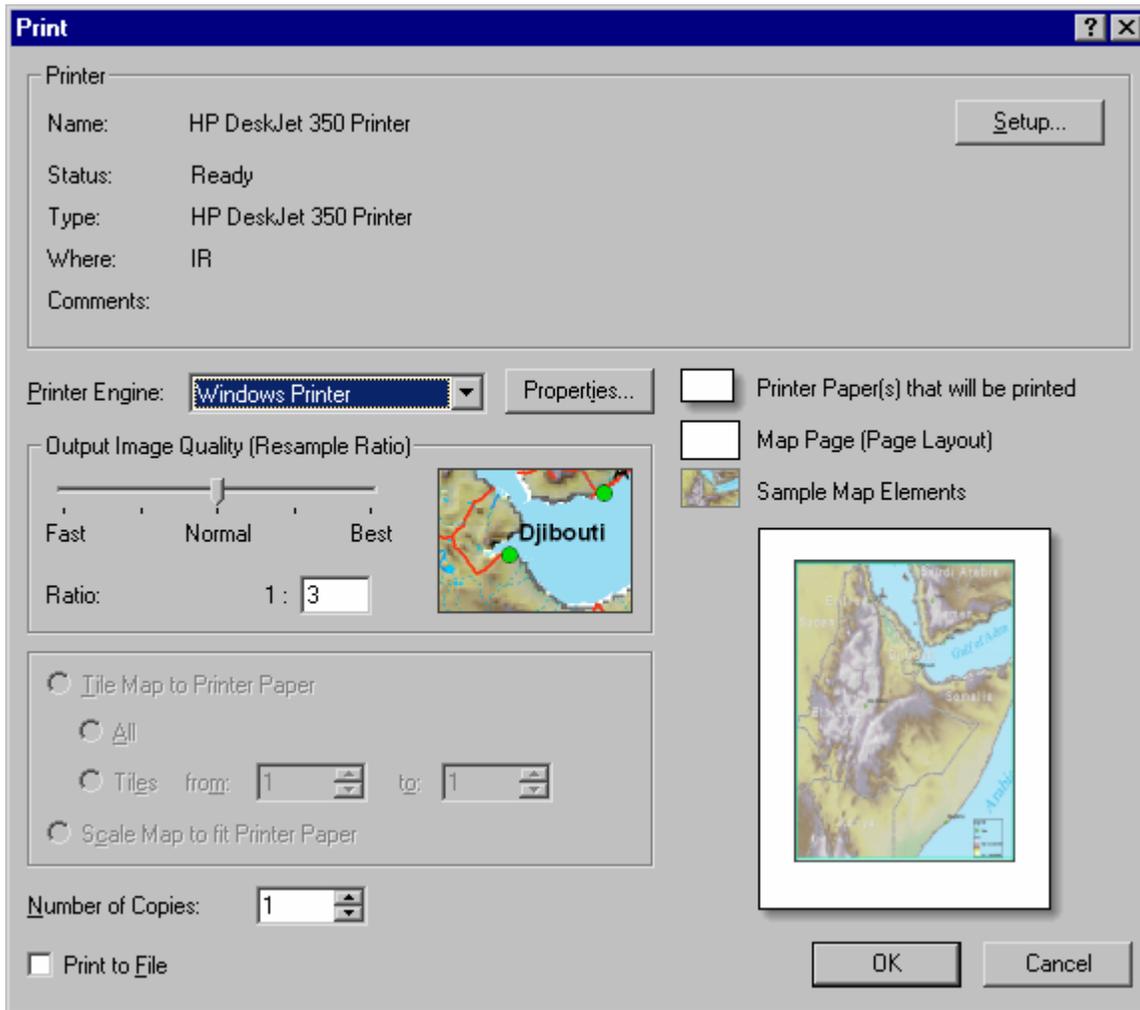
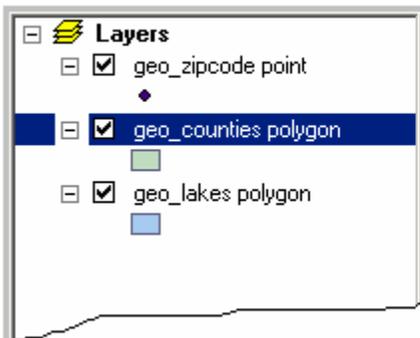


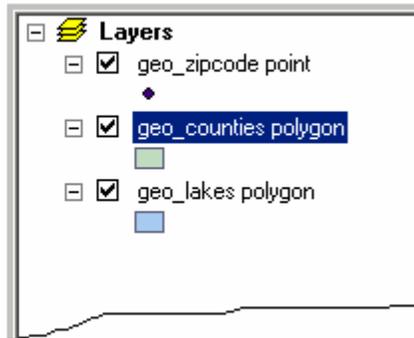
Table Of Contents

- The pulldown menu command for hiding and displaying the Table Of Contents  has been moved into the Window menu. In this way, the core ArcMap commands that show and hide the dockable windows (such as the Table Of Contents and the ArcToolbox and Geoprocessing windows) are in the same menu.
- To get help on the various keyboard shortcuts for working with the Table Of Contents that have been added in 9.0, click inside the Table Of Contents to give it keyboard focus; then press **Shift + F1**.
- The highlight used in the Table Of Contents to show the selected item or items has been improved so it no longer extends across the whole window.

8.x



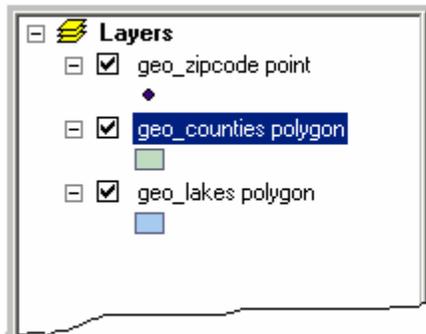
9.0



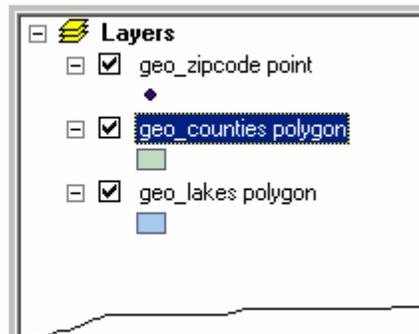
NOTE: To view the context menu for an item in the Table Of Contents, you can still right-click the item's name or anywhere to the right of the item's name.

- You can now tell when the Table Of Contents has keyboard focus; you'll see a dotted line around the highlighted area when it has keyboard focus. When the Table Of Contents has keyboard focus, you can use the new keyboard shortcuts (described below) to work with it.

Without keyboard focus:

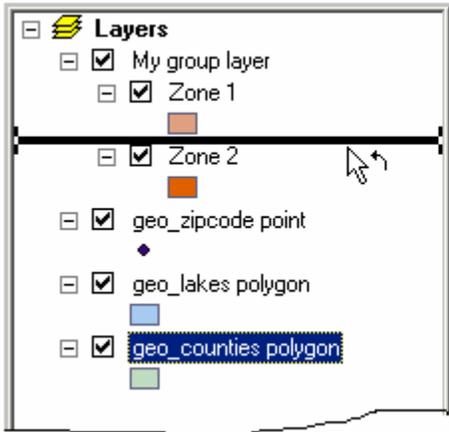


With keyboard focus:

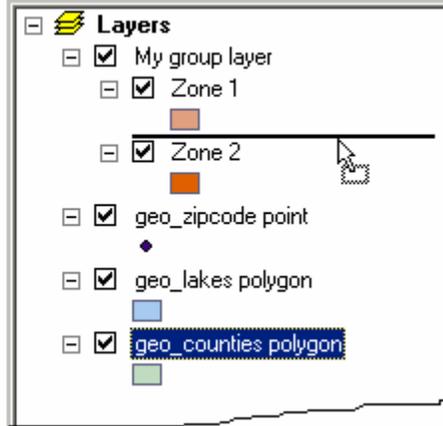


■ The horizontal insertion bar that appears when you are dragging layers over the Table Of Contents has been made smaller and more sensitive in 9.0. The bar now indents to reflect the position in the layer hierarchy at which the insertion will occur. For example, as you can see in the graphic below on the right, the insertion bar is indented in 9.0 to show that the current drop location is in a group layer. In addition, ESRI has standardized the drag-and-drop cursor.

8.x

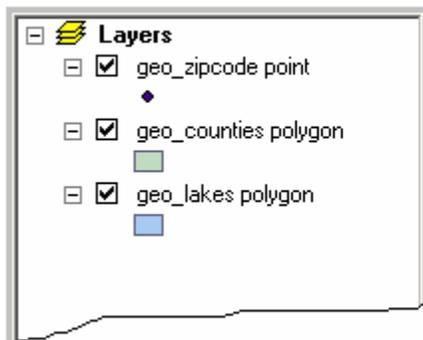


9.0

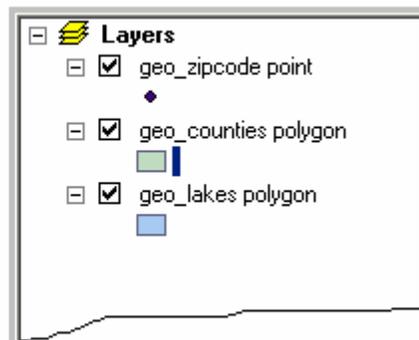


■ In 8.x, if you selected a symbol in the Table Of Contents that had no label (either by clicking it or using the up and down arrows on the keyboard), there was no indication that the symbol was selected. This made it hard to use the up and down arrows to navigate through the Table Of Contents, because you were always losing your place. In 9.0, this has been fixed so that when a symbol with no label is selected, a small area highlights (see below). When this area is highlighted, you can now press **F2** if you want to specify a label for the symbol.

8.x



9.0



■ The Selection tab now appears in the ArcMap Table Of Contents by default. In ArcMap 8.x, this tab was turned off by default. The Selection tab lists all the feature layers in your active data frame and lets you choose which of these layers will be selectable when you use the interactive selection tools. The Selection tab is more convenient than using the Set Selectable Layers dialog box, accessed from the Selection pulldown menu. In addition, layers are listed in **bold** in this tab if they currently have a selection set, and the number of features in this set is also shown.

TIP: In the Selection tab, hold down **Ctrl** and click any check box to make all the layers selectable or not selectable. For more help on using the Selection tab, click inside the tab to give it keyboard focus, then press **Shift + F1**.

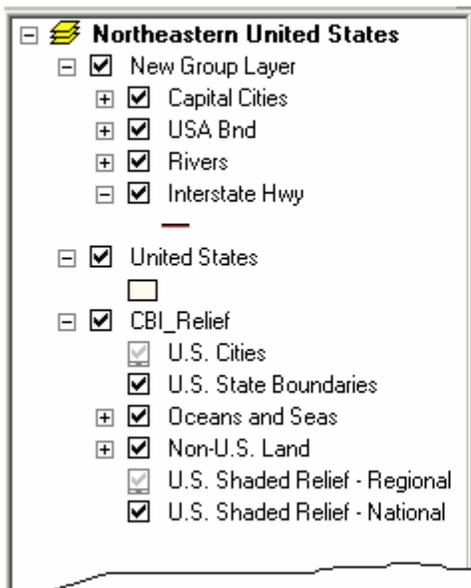
NOTE: If you have been using the 9.0 Prerelease, you may not see the Selection tab in the ArcMap Table Of Contents by default. The 9.0 Prerelease installed a registry setting that controlled whether this tab appears or not, and in the Prerelease, this was set to off by default. Installing the final ArcGIS 9 won't change this registry setting if it already exists. To turn the Selection tab on, go to the Table Of Contents tab in the Tools > Options dialog box.

■ In the Tools > Options dialog box, the TOC tab has been renamed as the Table Of Contents tab. When you use the options at the top of this tab to choose which tabs will appear in the ArcMap Table Of Contents, your choice of tabs is now saved for the application (for example, in the Windows registry) instead of being stored in the map document. In this way, your choice of Table Of Contents tabs will always be the same no matter which map document you are working with.

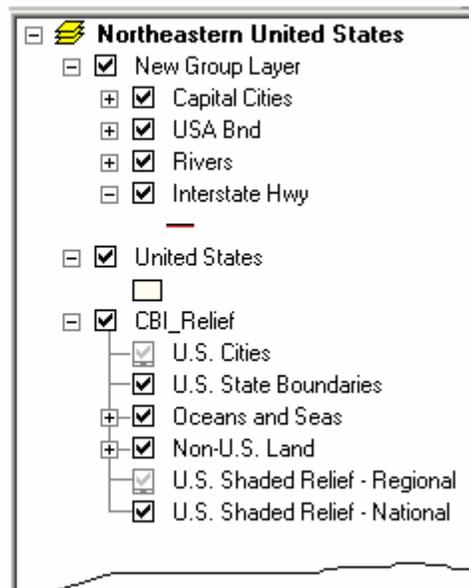
■ In 8.x, there was no distinction in the Table Of Contents between group layers and layers such as ArcIMS Image Service layers or survey layers, and so forth, which can be expanded to view the individual sublayers that they contain. Unlike the layers belonging to a group layer, the sublayers don't have the full range of layer properties and cannot be dragged out of the layer they belong to; they are sublayers rather than independent layers.

To make this distinction clearer in the Table Of Contents, at 9.0 you'll see tree lines when you expand a layer that contains sublayers. The tree lines indicate that these sublayers belong together and cannot be broken apart or used separately from the layer to which they belong. The graphic below shows how the same Table Of Contents containing a group layer and an ArcIMS Image Service layer (CBI_Relief from the Geography Network) looks in 9.0 compared with 8.x.

8.x



9.0



■ New keyboard shortcuts have been added for working with the Table Of Contents. You can use these when the Table Of Contents has keyboard focus. If these shortcuts don't seem to be working, click inside the Table Of Contents to make sure it has keyboard focus.

- **Enter** or **F12** opens the currently selected entry's property dialog box.
- **F2** renames the selected entry.
- The **Spacebar** turns drawing of the selected layer or layers on or off.

- **Shift + F10** or the **Application key**  on the Microsoft Natural Keyboard (or any other compatible keyboard) opens the context menu for the selected entry.
- **F11** activates the currently selected data frame. You can also hold down **Alt** when you click a data frame's name to activate it.
- The **Left** and **Right arrows** or the + and - keys expand and contract the selected entry.
- When the tabs at the bottom of the Table Of Contents have keyboard focus, the **Left** and **Right arrows** switch between them.
- **F3** returns keyboard focus to the Table Of Contents from the map. This enables you to continue working in the Table Of Contents with the keyboard if an operation you performed put the keyboard focus onto the map. Clicking in the Table Of Contents also gives it keyboard focus. A new command, Focus Table Of Contents, has also been provided that can be put into a pulldown menu or toolbar to return keyboard focus to the Table Of Contents. You can add this into your ArcMap user interface in the normal way, through the Tools > Customize dialog box. It is in the View category.
- **Esc** returns keyboard focus to the map from the Table Of Contents. Clicking the map also gives it keyboard focus.
- **Shift + F1** displays a Help topic describing these shortcuts.

■ It is now easier to expand and collapse multiple entries in the Table Of Contents. Hold down the **Ctrl** key when you click the expansion control next to a data frame or a layer to expand or collapse all of the entries at that level in the Table Of Contents hierarchy. For example, if you hold down the **Ctrl** key and click the expansion control next to a data frame, all the data frames listed in the Table Of Contents will be expanded or collapsed. If any of the entries are selected, and you hold down the **Ctrl** key and click the expansion control next to a selected entry, only the selected entries will be expanded or collapsed.

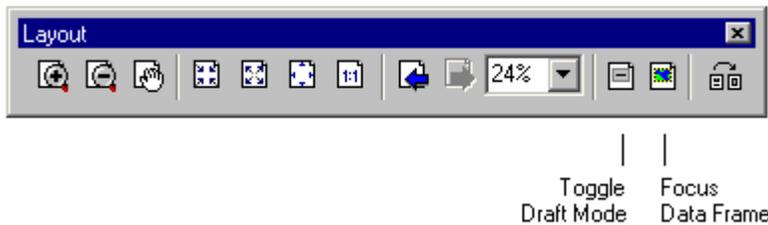
■ When you are dragging layers over the Table Of Contents, you can now expand and collapse any entry by pointing to its expansion control with the drop cursor.

■ Undo and redo support for actions performed in the Table Of Contents has been improved.

■ The Table Of Contents has been enhanced so it doesn't flicker or redraw as much as it did in 8.x.

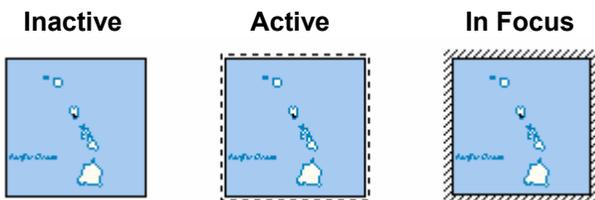
Map documents

- The File > Page Setup and File > Print dialog boxes have been completely redesigned to clarify and streamline the process of setting up a map for printing. The Page Setup dialog box and command has been renamed as Page And Print Setup to reflect the new design.
- The first time you open or save a file after installing ArcMap on Windows XP or Windows 2000, the Windows file browser dialog box that appears now defaults to looking into the My Documents folder.
- Two new commands have been added to the Layout toolbar.



Toggle Draft Mode —Toggles all the map elements, such as data frames, legends, and pictures in your map between normal drawing mode and **draft mode**. In ArcMap 8.x, draft mode was called fast drawing mode, and the only way to enable it was to check a box in Frame tab of the map element's Properties dialog box. You can still do that, but this new command makes it easy to put all the frames into draft mode at once. In draft mode, the contents of the elements are not drawn. Instead, their frames are shown as light blue boxes labeled with the name of the element. Using draft mode makes it quicker to lay out your map because you don't have to wait while the contents of frames, especially data frames, are drawn.

Focus Data frame —Puts the active data frame into **focus**, making it the target for graphics and text you draw on top of it while you are in layout view. The ability to put a data frame into focus has always been available in ArcMap (by double-clicking a data frame in the layout). ESRI has added this command to make it more obvious that this ability exists. The Focus Data Frame command lets you work with graphics and text drawn on a data frame, as though you were in data view, while remaining in layout view. This command is also available in the context menu that appears when you right-click a data frame on the page layout. When a data frame is in focus, a thick line will appear around it, compared to the thin dashed line you see around the active data frame.



The Focus Data frame button remains highlighted while the data frame is in focus. This provides an additional indication that the data frame is in focus, which is useful, for example, in a situation where you are zoomed in on your layout and, therefore, can't see the edge of the data frame.

To take a data frame out of focus, either click the layout outside the data frame or click the Focus Data frame button again.

- The Legend Wizard now defaults to include just those layers that are currently turned on in your data frame. A Remove All button (<<) has also been added to the wizard and the property dialog box.

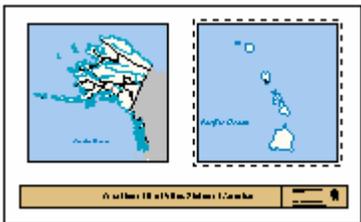
- When you create a new map document, the Save thumbnail image with map setting in the File > Map Properties dialog box no longer defaults to being on. It is now off by default for new maps you create. This avoids the performance overhead of having to wait for the thumbnail to be regenerated whenever you save a map. If you want your map document to be saved with a thumbnail, turn this setting on. This setting is stored in

the current map document, and this change has no effect on maps you have already created in 8.x; your existing maps will use the setting for this option that was current when you last saved the map. To prevent your existing maps from saving thumbnails, open each map and uncheck this option in the Map Properties dialog box.

■ A new command, Pause Drawing , has been added to the Pan/Zoom category in the Tools > Customize dialog box. This lets you temporarily suspend all drawing in ArcMap. You can add this command to any ArcMap pulldown menu or toolbar, or you can use the Keyboard button in the Tools > Customize dialog box to assign a keyboard shortcut to it. While drawing is suspended, you can continue to work with the program, but the display is not redrawn. This is useful if you want to make a number of changes to your map, for example, changing the symbology for a number of layers, without having the map redraw. Once you have made your changes, you can then choose this command again to turn drawing back on. This command works in both the data and layout views.

■ The contents of the View > Toolbar pull-right menu are now sorted alphabetically to make it easier to find toolbars. The exception is the Main menu bar, which is always shown at the top of the list.

■ In the Tools > Options > Layout view tab, a check box option, called Show dashed line around active data frame, has been added to let you control whether the indication will be drawn showing you which data frame is currently active when your map contains more than one data frame. By default, when your layout contains more than one data frame, one of the data frames is shown with a dashed line around it to indicate that it is the **active** data frame.

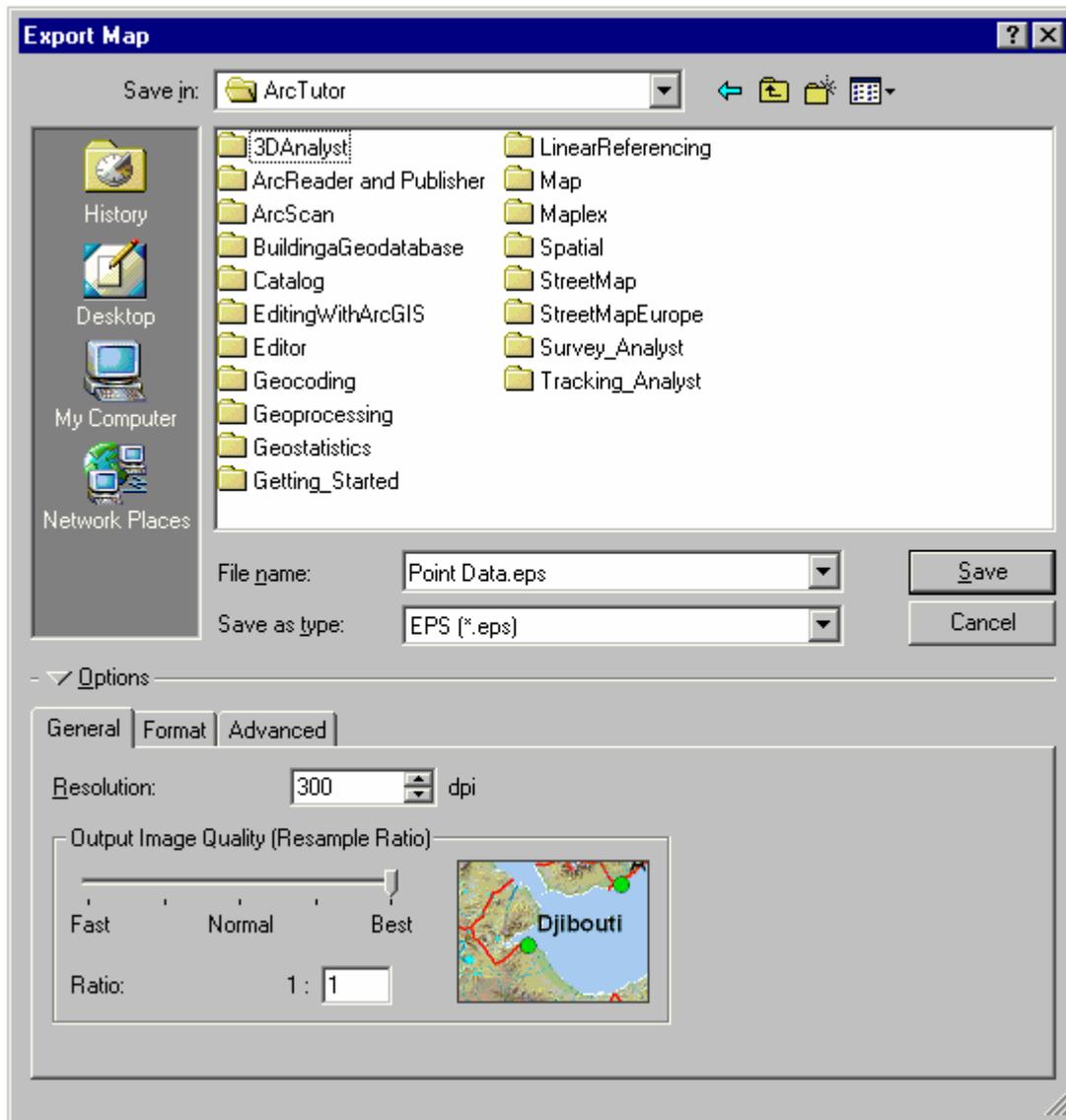


The active data frame is the one to which commands that you use, such as Add Data, Full Extent, Select By Attributes, and Zoom To Selected Features, will be applied when you are working in layout view. This active data frame indication is not part of your map layout and does not appear on your map when you print it out. However, you may want to hide this indication, for example, if you want to view your map exactly as it will appear when printed. If you turn off the active data frame indication, you can still see which data frame is active by looking in the Table Of Contents: the active data frame's name is always shown in bold.

■ In the Tools > Options dialog box, the Application tab has been renamed as the General tab, and the tab called TOC has been renamed as Table Of Contents. This dialog box now remembers the last tab you were using instead of defaulting to either the data or layout view tabs.

■ Your choice of which tabs appear in the Table Of Contents is no longer stored in the map document. Your choice of tabs and their order, which is set in the Tools > Options dialog box, is now stored at the application level and does not vary based on which map document you are using.

■ The File > Export Map dialog box has been improved to add an expandable Options panel. This makes it much easier to browse and set the options for a particular output format. Several new graphic export options and formats have been added, as well as an overall improvement of all the graphic exports.



New **raster** map export formats include:

- PNG
- GIF (license may be required by user)

When you export a map to a raster format, you can now:

- See the exact size in pixels of the image you are about to export.
- Write out a world file for any raster format.
- Pick from various compression choices and color depths for all raster formats.
- Specify transparent color for PNG and GIF formats.
- Specify a one-bit mask or threshold export.

Output image size is no longer limited for raster formats.

Scalable Vector Graphics (SVG) in compressed and non-compressed forms has been added as a **vector** map export format.

Layering is now retained in Adobe Illustrator (AI), PDF, and SVG exports so that graphical objects are conveniently grouped and named.

Also, font mapping is no longer required because the information is read from the font file. Fonts are converted to appropriate formats for embedding in exported files when required.

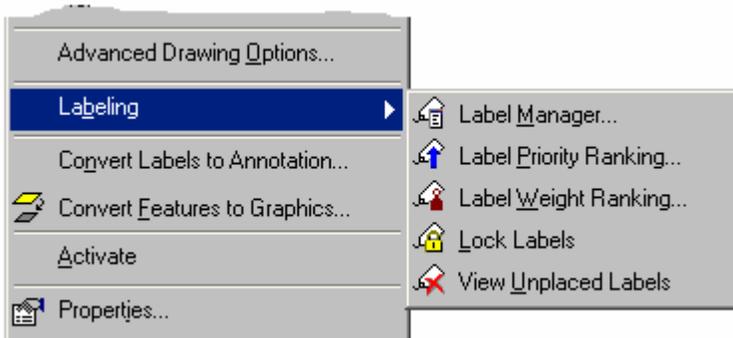
In ArcMap 8.x, font embedding worked in a simple way: either the character outlines (also known as Type3 fonts) were embedded or a polygon representation of the text string was exported. In 9.0, fonts are now directly embedded as Type1, Type42, TrueType, or Type2CFF, depending on the source fonts and the requirements of the destination file format.

Computer Graphics Metafile (CGM) format was removed from the ArcMap Export Map functionality due to problems associated with this format, which prevented any improvement, and the lack of user demand for continuing to have this export format in ArcMap.

■ **Draw toolbar:** Three new commands have been added into the Distribute pull-right menu in the Drawing pulldown menu. These are Fit To Margins, Fit Width To Margins, and Fit Height To Margins. These commands work in layout view and let you automatically size the currently selected map elements or graphics to fit them to the margins of your map layout. The commands use the printer margins if the Use Printer Paper Settings option is checked for the Map Page Size in the File > Page and Print Setup dialog box. Otherwise, the commands use the edge of the page.

Data frames

■ Data frame Properties dialog box: The Labels tab has been removed. Its functionality is now provided by the Label Manager dialog box, along with separate Label Priority Ranking and Label Weight Ranking dialog boxes. You can access these dialog boxes via the new Labeling pull-right menu in the context menu for a data frame:



or via the new Labeling toolbar:



■ In 8.3, the **edit cache** can be used to improve the performance of editing, drawing, and selecting geodatabase features during an edit session, especially those stored in an ArcSDE geodatabase. In 9.0, the edit cache has been renamed as the **map cache** and moved into the core ArcMap user interface because it now operates on geodatabase features either inside or outside an edit session. The map cache has no impact on the performance of other data types.

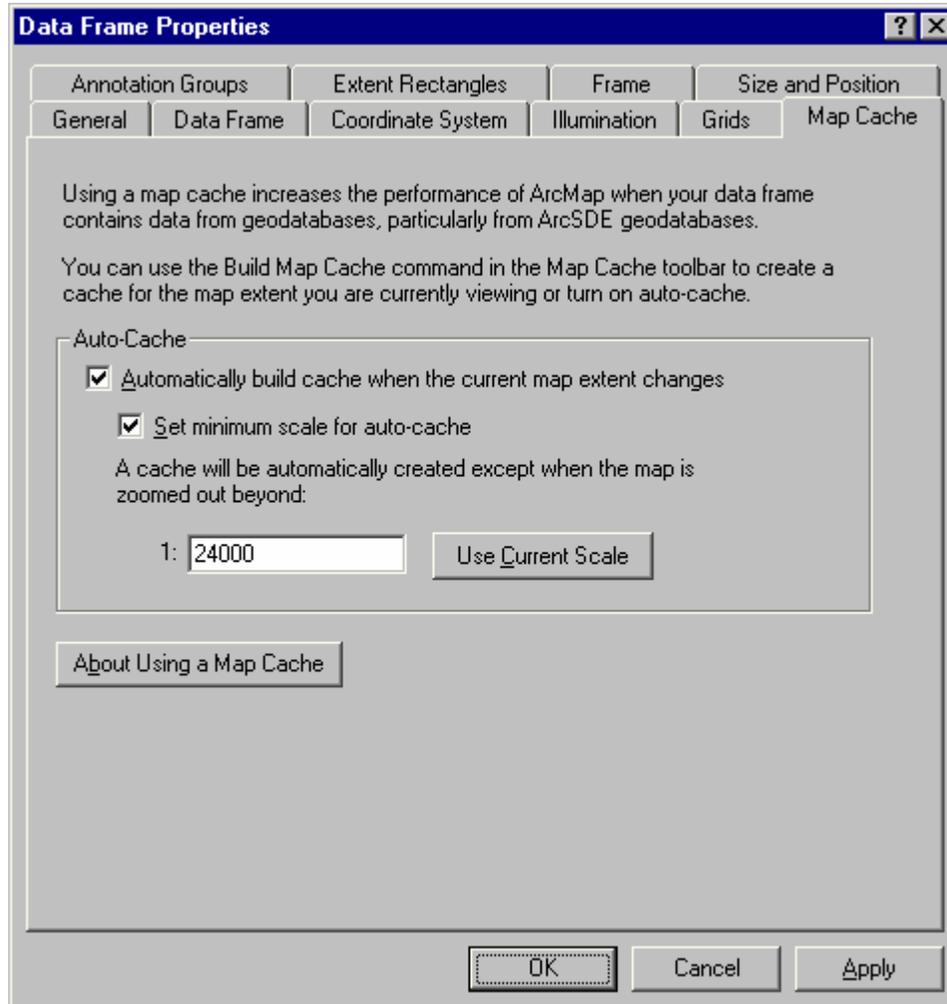
In an enterprise environment, using the map cache can significantly improve the overall performance of the ArcGIS system by reducing the number of queries to the geodatabase, the number of features retrieved from the geodatabase, and the overall network traffic. Since retrieving features from the computer's memory is a fast operation, using the map cache will often result in performance improvements in ArcMap for editing, feature rendering, and labeling.

- The new Map Cache toolbar (in 8.3 this toolbar was called the Edit Cache toolbar) lets you build and manage the map cache.



A new command called Empty Map Cache  has been added to the toolbar. When you empty the map cache, features will be retrieved directly from the geodatabase instead of the memory on your machine.

- There is also a new Map Cache tab in the Data frame Properties dialog box.

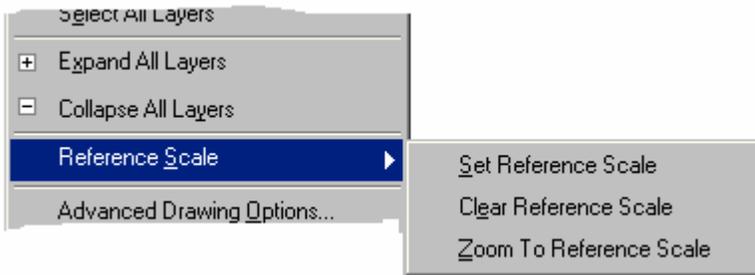


The terminology on the new Map Cache tab and toolbar has been clarified from what was used in the Edit Cache tab in the Editor Options dialog box in ArcGIS 8.x. It now refers to setting the minimum scale for auto-cache, with the cache being automatically created except when the map is zoomed out beyond the minimum scale.

- Data frame Properties dialog box Data frame tab: If you use the fixed extent option for a data frame, you now have the option of specifying the coordinates of the extent in degrees instead of map units. An Advanced button has been added next to the coordinates to give you additional options for specifying the fixed extent coordinates.

- Data frame Properties dialog box Extent Rectangles tab: Extent rectangles now default to having a red frame.

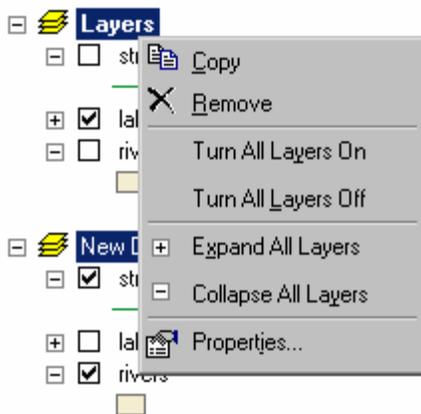
■ The three reference scale commands in the context menu for a data frame have been moved into a pull-right menu called Reference Scale to help make this context menu shorter:



■ You can now drag data frames up and down in the Table Of Contents. Hold down the **Ctrl** key when you drop the data frame or data frames to copy rather than move. Moving data frames in the Table Of Contents lets you change the order in which they are listed but no longer has an effect on the order in which they are drawn on the map. This fixes the issue in 8.x where new data frames you added at the bottom of the Table Of Contents unexpectedly appeared at the top of the Table Of Contents the next time you opened the map. You can still control the drawing order of data frames on the page by using the Bring To Front and Send To Back commands in the Drawing pulldown menu when you are in layout view.

■ The Copy command in the data frame's context menu in the Table Of Contents is no longer disabled when you are in data view.

■ When multiple data frames are selected in the Table Of Contents, you can now right-click one of them to access a menu that lets you perform operations, such as copy, remove, and turn all layers on or off, on all of the selected data frames at once.



■ You can now drag or copy and paste data frames between ArcMap sessions—for example, between different map documents. Dragging data frames between ArcMap sessions copies the entries being dropped. Hold down the **Ctrl** key when you drop the data frames if you want to move them rather than copy them.

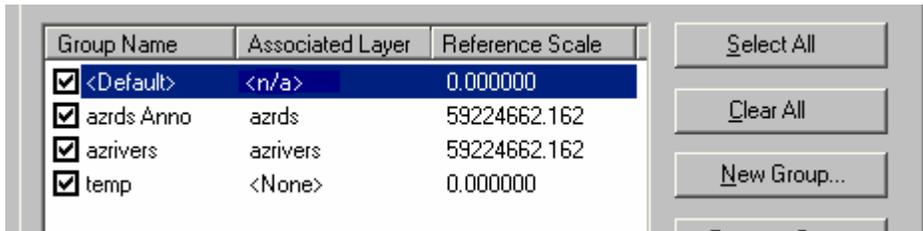
■ Two new keyboard shortcuts speed up activating data frames from the Table Of Contents.

- **F11** activates the currently selected data frame. You can also hold down the **Alt** key and click a data frame's name to activate it.

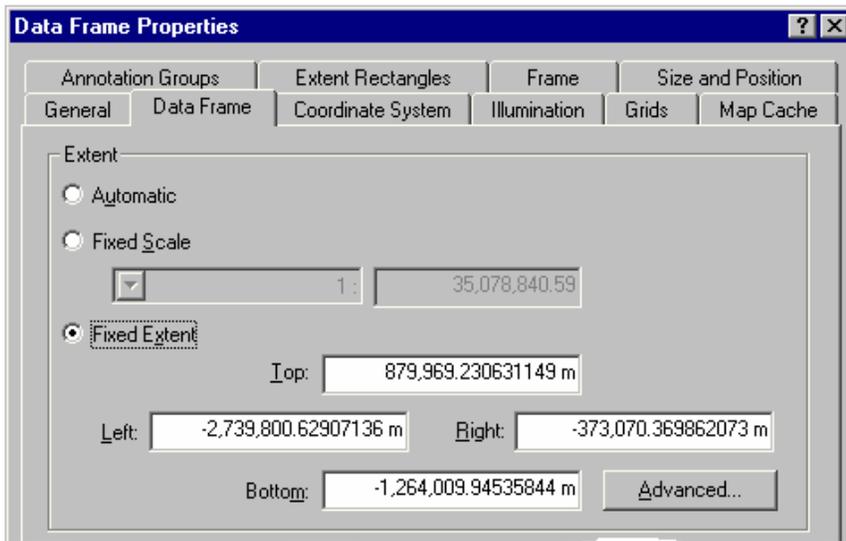
■ In 8.x, if you right-clicked an inactive data frame in the Table Of Contents and chose certain commands, such as Properties, Copy, and Advanced Drawing Options, they operated on the active data frame instead. This has been fixed in 9.0.

■ In 8.x, if you copied and pasted a data frame while you were in data view, it was pasted into the map as a graphic. This has now been fixed so that when you paste a data frame, it always gets pasted into the map as a data frame, no matter which view you are in.

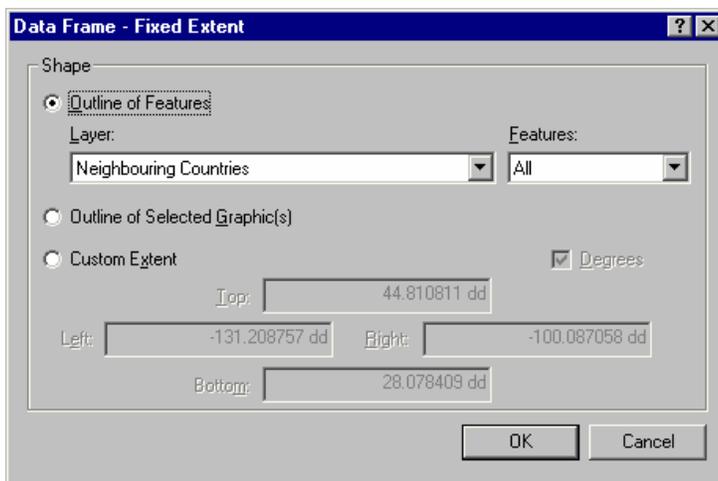
■ Data frame Properties dialog box Annotation Groups tab: The buttons to the right of the annotation groups list have been standardized to add the Select All and Clear All buttons. You can also use the keyboard shortcut for selecting and clearing all the entries in a checkable list hold down the **Ctrl** key and click any check box in the list. You can also double-click a grid in the list to see its properties.



■ Data frame Properties dialog box Data frame tab: An Advanced button has been added under the Extent option to access additional options for setting a fixed extent.



Clicking Advanced displays the following dialog box:



You can set your data frame extent to the extent of all features or just the visible or selected ones in a layer, to the extent of graphics inside the data frame, or to a custom extent specified in display units or decimal degrees. This gives you greater flexibility over determining a map extent. For example, you could set the extent to fit a particular set of features; this way, even if you change the map scale, the features would still fit the frame. Or you could draw a rectangle graphic that fits your data view and set the fixed extent to use the graphic; then both the data and the layout views would show the same extent. These are just a couple of examples of the flexibility provided by the advanced options.

These options are the same as the options for data frame clipping, but they work slightly differently in that for setting the extent, the minimum-bounding rectangle of the chosen option is used.

Another advantage of the advanced options is that you can set the display units to a different unit from your map units, then set the fixed extent by the display units. For example, meters are commonly used as map units, but you might find it easier to set your extent in kilometers or miles.

Layers

■ Layer Properties dialog box Source tab: The Source details information now includes the actual name of the coordinate system in which the layer's data is stored and the linear units, if known:

8.3:

Projection: Transverse_Mercator
False_Easting: 500000.00000000
False_Northing: 0.00000000
Central_Meridian: -111.00000000
Scale_Factor: 0.99960000
Latitude_Of_Origin: 0.00000000

9.0: (new items shown in bold):

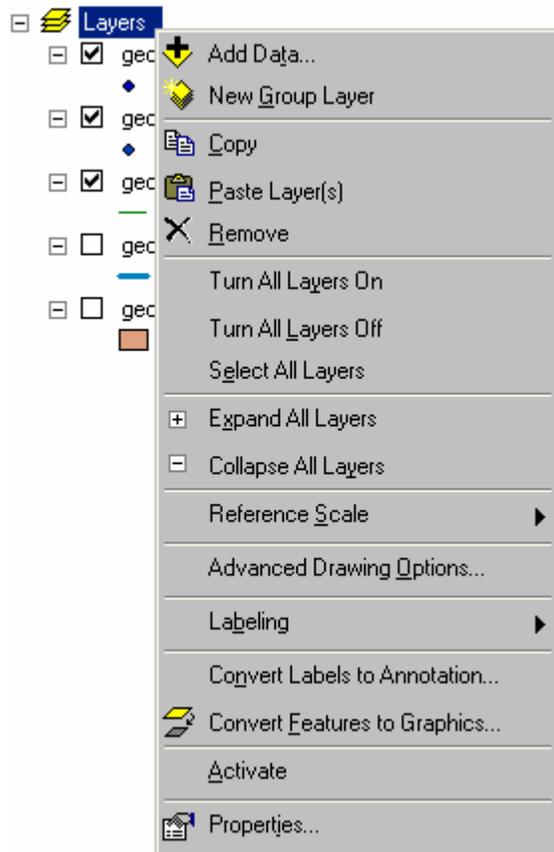
Projected Coordinate System: NAD_1927_UTM_Zone_12N
Projection: Transverse_Mercator
False_Easting: 500000.00000000
False_Northing: 0.00000000
Central_Meridian: -111.00000000
Scale_Factor: 0.99960000
Latitude_Of_Origin: 0.00000000
Linear Unit: Meter (1.000000)

■ You can now copy and paste or drag multiple layers in the Table Of Contents.

■ New commands have been added into the context menu for a data frame to make it easier and faster to work with layers.

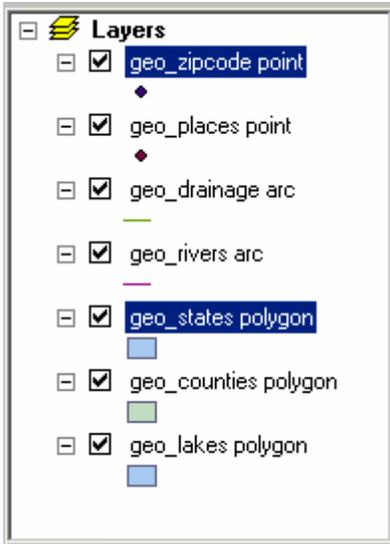
- Turn All Layers On/Turn All Layers Off: Checks or unchecks all the layers in the data frame. This option was available in 8.x but only as a keyboard shortcut; it is still available as a keyboard shortcut (hold down the **Ctrl** key and click any check box).
- Select All Layers: Selects all the layers in the data frame. This makes it easy to quickly select all the layers and perform an operation on them, such as right-clicking and clicking Remove to remove all the layers.

- Expand All Layers/Collapse All Layers: Shows or hides the legends for all the layers in the data frame. A keyboard shortcut for this action has also been added. To expand or collapse all the layers in a data frame, hold down the **Ctrl** key and click the expansion box next to any of the layers.



- When you drag one or more layers inside the same data frame, you can now hold down the **Ctrl** key when you drop them if you want to copy the layers instead of moving them. This makes it easy to quickly duplicate layers.
- Dragging layers between different data frames in the same map now copies the layers instead of moving them. This makes it easier to duplicate layers, such as layers providing backgrounds, between data frames and later modify them. Hold down the **Ctrl** key when you drop the layers if you want to move them instead.
- Layers can now be dragged and dropped between different ArcMap sessions (for example, between different map documents). Dragging between ArcMap sessions copies the entries being dropped. Hold down the **Ctrl** key when you drop the layers if you want to move them rather than just copy them.
- When multiple layers are selected in the Table Of Contents:
 - You can turn them all on or off with one click. Hold down the **Ctrl** key and click the check box next to any of the selected layers. If only one layer or no layers at all are selected, holding down the **Ctrl** key and clicking any check box will turn all the layers on or off, just as it does in 8.x.
 - You can expand or collapse them all with one click. Hold down the **Ctrl** key and click the expansion box next to any of selected layers. If only one layer or no layers at all are selected, holding down the **Ctrl** key and clicking any expansion box will expand or collapse all the layers.

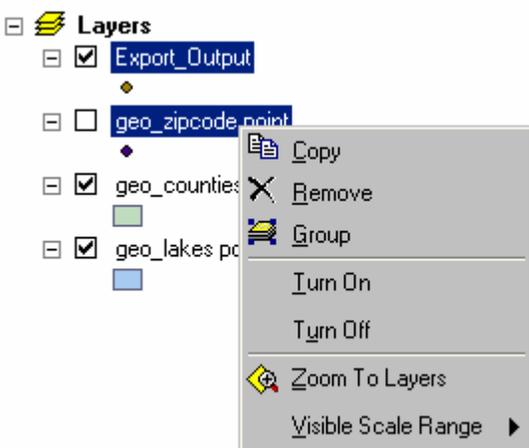
■ When you add layers, they are automatically selected in the Table Of Contents so you can see where they are positioned. In the example below, `geo_zipcode point` and `geo_states polygon` have been added to the map. This also enables you to immediately perform operations on the newly added layers without having to reselect them. For example, you can right-click any of the selected layers and choose any command, such as Remove, Group, or Zoom To Layers, or hold down the **Ctrl** key and click the expansion control next to any of the layers to expand or collapse them all.



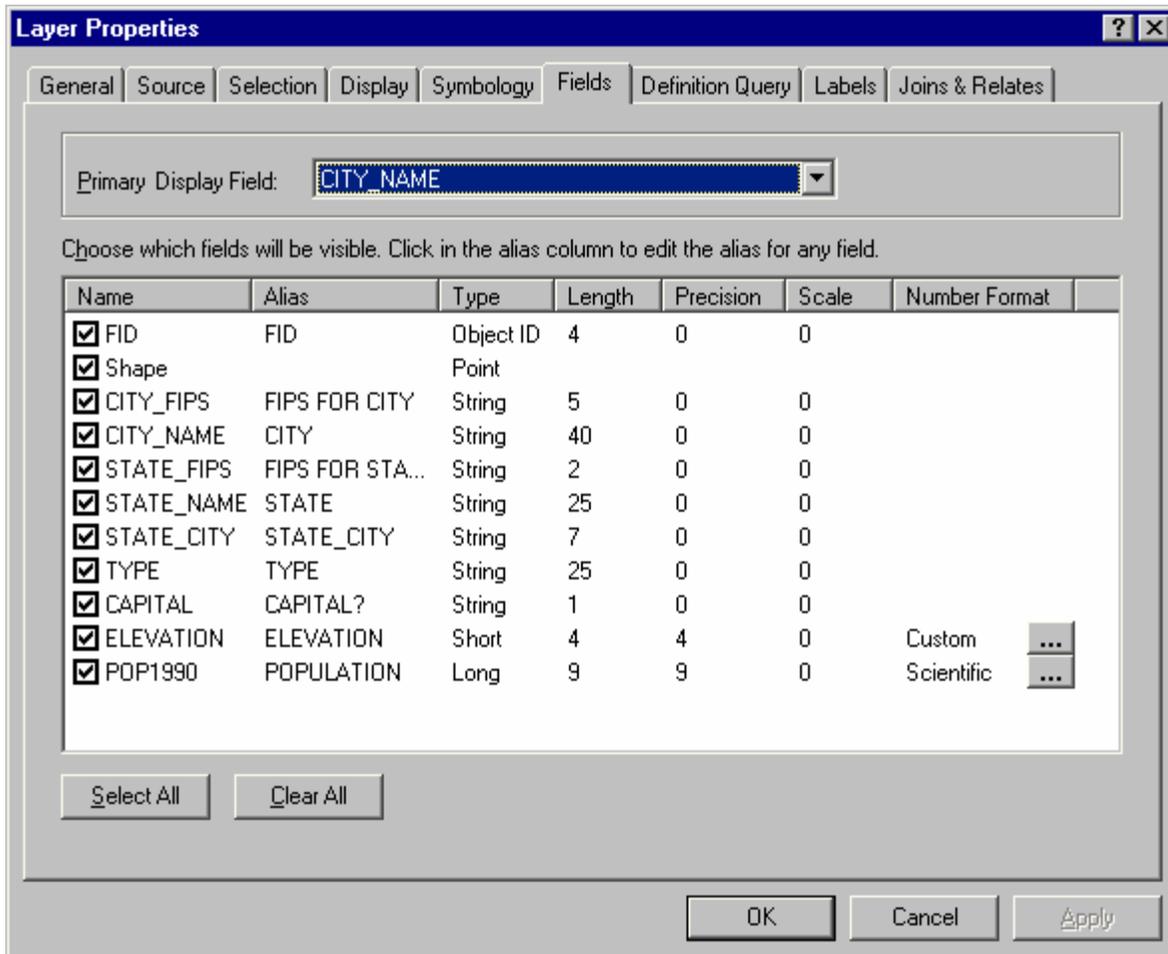
■ In 8.x, the context menu that appeared when you right-clicked a group layer is the same as the one that appeared when you selected multiple layers and right-clicked. At 9.0, these are now two separate context menus.

■ New commands have been added into the context menu when you select two or more layers and right-click. These include:

- Turn On/Turn Off: Checks or unchecks all the selected layers.
- Zoom To Layers: Zooms the geographic extent encompassing the extents of all the selected layers.



■ Layer Properties dialog box Fields tab: The user interface for specifying the field properties of a layer or a table has been improved to make it faster and easier.

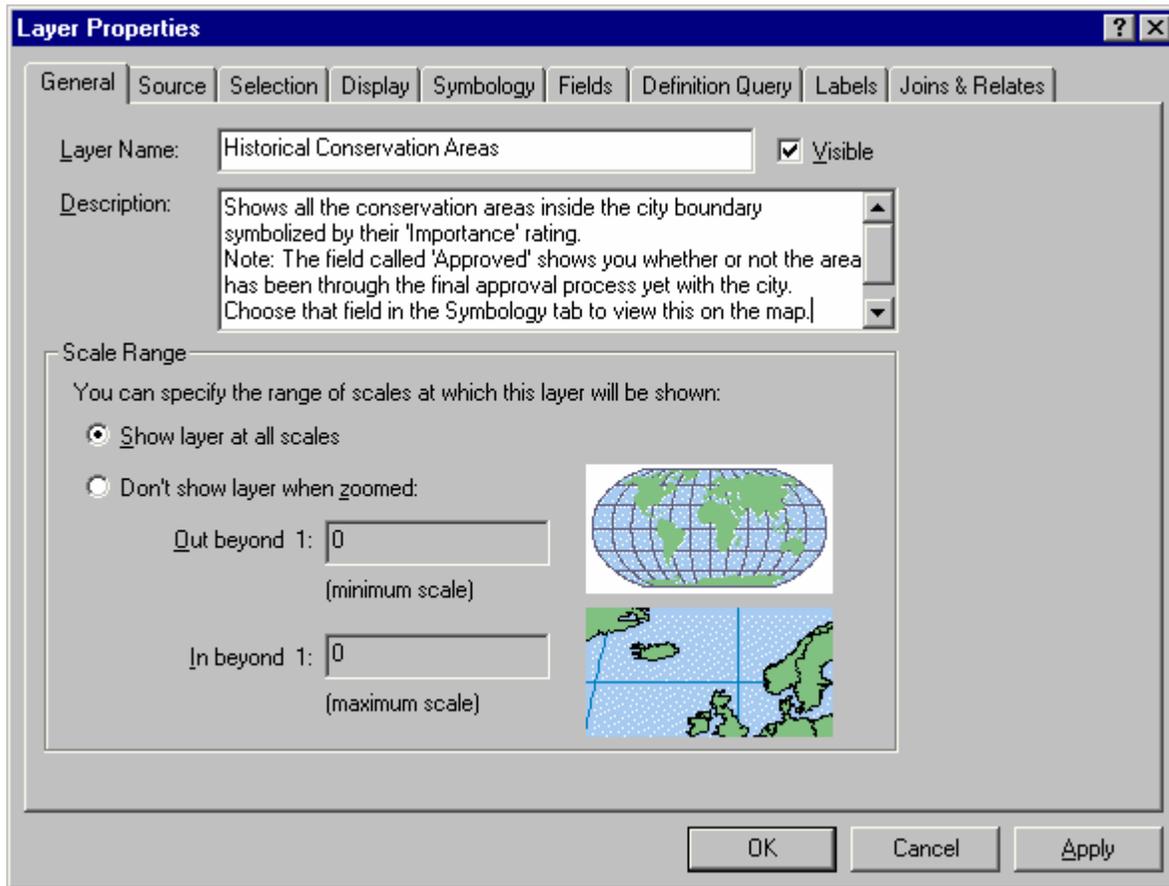


To hide or show fields, click their check box. Click Select All or Clear All to hide or show all the fields.

To specify an alias for a field, type into the Alias column.

To set the number format for a numeric field, click the button in the Number Format column.

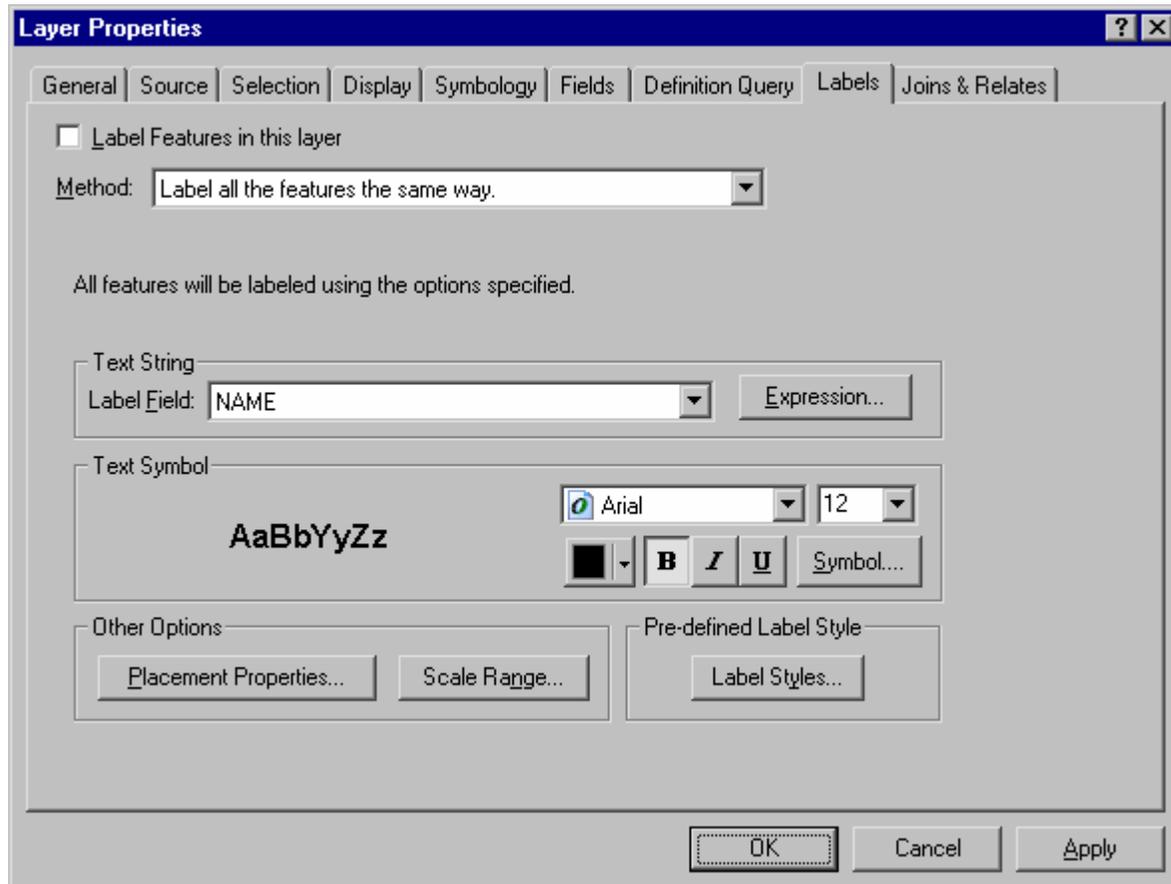
■ Layer Properties dialog box General tab: A description field has been added to the General tab for all layer types. This enables you to store comment or description text as a layer property. This has been implemented for most layer types, but not all.



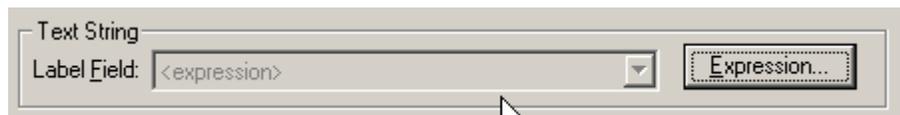
■ Layer Properties dialog box General tab: When you use the Don't show layer when zoomed option, the scale values you enter no longer disappear if you change your mind and use the Show layer at all scales option. This lets you, for example, temporarily turn off scale-dependent drawing for a layer, then turn it back on later without having to retype the scale values you originally entered. This has been implemented for most layer types, but not all.

■ The Layer Properties dialog box Labels tab has several enhancements.

- Controls have been added to the Labels tab to let you quickly specify the font, size, color, and so forth, of the text symbol. In 8.3, you had to press the Symbol button to specify these.



- When a layer is getting its labels from an expression instead of a single label field, you'll now see the text <expression> in the label field. This makes it clearer that an expression is being used.



■ At 9.0, **symbol-level** advanced drawing functionality has been improved, and symbol-level properties can now be defined at the layer and group layer levels, rather than at the data frame level as in 8.3. In this way, these properties are saved with the layers when you create layer files and so forth. Symbol-level drawing enables you to take advantage of ArcMap software's ability to join and merge multilayered symbols, such as those used for cased road and street symbology. You can now define symbol levels via commands added to the Advanced menu buttons on the Layer Properties dialog box Symbology tab for feature layers. You can also now turn **symbol-level drawing** on and off for a layer by using the new Use Symbol Levels command that has been added into the context menu for a feature layer. See the 'Symbology' section in this document for more information about what's new in symbol-level drawing.

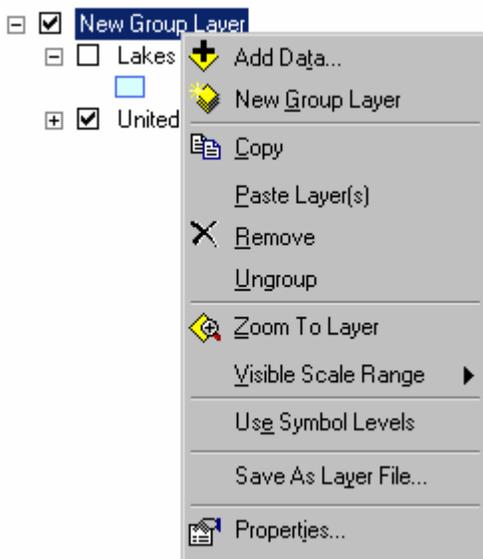
■ The size and shape of layer properties dialog boxes have been standardized so that they are all now roughly the same. This change is most noticeable with the group layer properties dialog box and the ArcIMS Image Service layer properties dialog box, which now are now sized and shaped more like the standard feature layer properties dialog box. The property dialog box for some layer types may still be larger than usual because one or more of their tabs need to be larger in order to accommodate all their controls.

Group layers

■ It is now easy to create group layers that contain other group layers. This was possible in 8.x but required that you use layer files to do it. There are several ways now to create nested group layers.

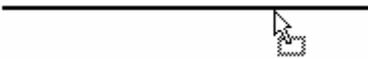
- You can drag any group layer into any other group layer.
- You can select any layers in the Table Of Contents (including group layers), right-click, and click Group. The Group command is now always enabled, regardless of what type of layers you selected. You can also select layers that are already in a group layer, right-click, then click Group to create a nested group layer.
- You can right-click a group layer, click New Group Layer, and drag layers into the new, empty group layer that is created.

■ Add Data, New Group Layer, Paste Layer(s), and Ungroup commands have been added to the group layer context menu, so it is much easier to rapidly assemble group layers and break them apart.

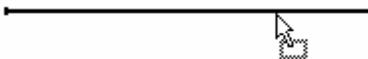


■ When you drag layers to the end of an expanded group layer, you can choose whether the layers get dropped into or after the group layer.

Normally, when you are dragging layers over the Table Of Contents, the insertion bar looks like this:



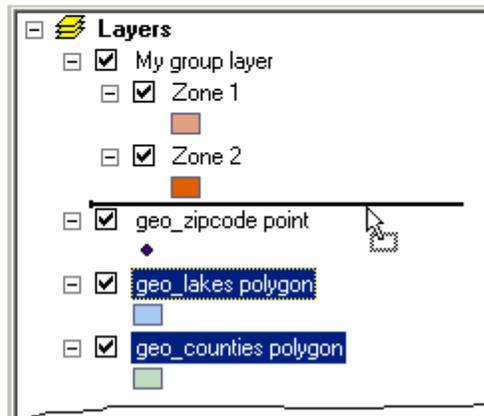
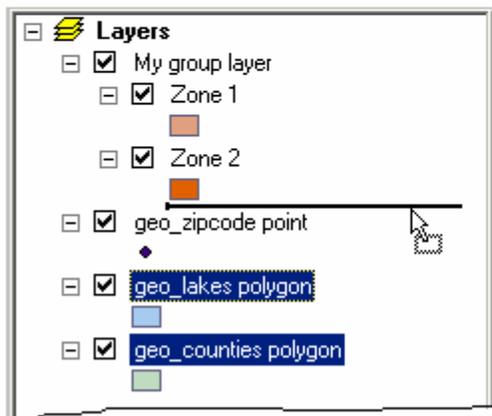
When the insertion bar is at the end of a group layer, you'll see a small indicator drawn at the left end of the bar:



This indicates that you have a choice about where the layers you are dragging will be dropped. They can either be dropped into or after the group layer. When you see the indicator on the insertion bar, you can move the pointer either left or right to make your choice. The insertion bar will extend to the left as you drag the pointer to the left, and the indicator at the end of the bar shows you where the layers will be dropped in the hierarchy.

1. Drag layers up so the insertion bar is underneath the expanded group layer. If you want to drop the layers into the group layer, position the insertion bar so that it is indented to the right.

2. If you want to drop the layers after the group layer, instead of into it, move the cursor to the left. The insertion bar will extend to the left to show that the layers will be dropped after the group layer.

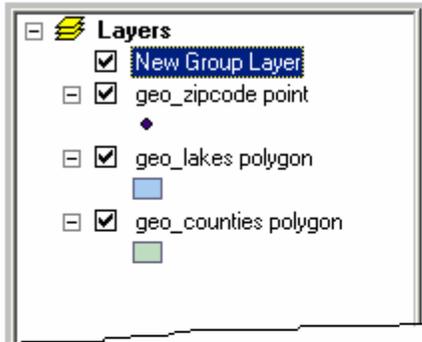


■ In the Group Layer Properties dialog box Group tab, you can now double-click any layer in the list to access its properties.

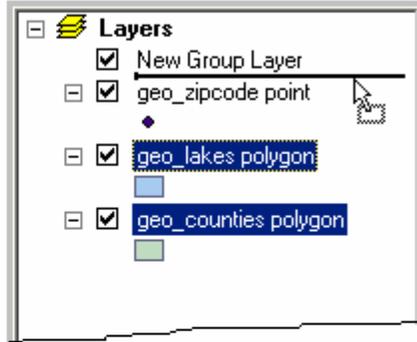
■ At 9.0, **symbol-level** advanced drawing functionality has been improved, and symbol-level properties can now be defined at the layer and group layer levels, rather than at the data frame level as in 8.3. In this way, these properties are saved with the layers when you create layer files and so forth. You can now define symbol levels for a group layer via the new Symbol Levels button that has been added to the Groups tab in the Group Layer Properties dialog box. Any of the feature layers in the group layer can participate in the symbol-level drawing, including those in nested group layers inside the group layer. See the 'Symbology' section in this document for more information about what's new in symbol-level drawing.

■ You can now drag layers into a new, empty group layer. When you drag layers underneath an empty group layer, you can choose whether the layers get dropped after or into the group layer. When you see the insertion bar underneath the new group layer, you can move the pointer either left or right to make the choice.

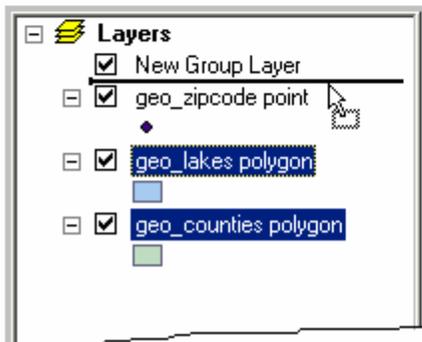
1. Right-click the data frame and choose New Group Layer



2. Drag layers up so the insertion bar is underneath the new group layer. If you want to drop the layers into the group layer, position the insertion bar so that it is indented to the right.



3. If you want to drop the layers after the new group layer, instead of into it, move the cursor to the left. The insertion bar will extend to the left to show that the layers will be dropped after the group layer.



Selection

■ The Selection tab now appears in the ArcMap Table Of Contents by default. In ArcMap 8.x, this tab was turned off by default. The Selection tab lists all the feature layers in your active data frame and lets you choose which of these layers will be selectable when you use the interactive selection tools. The Selection tab is more convenient than using the Set Selectable Layers dialog box accessed from the Selection pulldown menu. In addition, layers are listed in **bold** in this tab if they currently have a selection set, and the number of features in this set is also shown. Using this tab can help you understand the change to the selection logic at 9.0 (see below).

TIP: In the Selection tab, hold down the **Ctrl** key and click any check box to make all the layers selectable or not selectable. For more help on using the Selection tab, click inside the tab to give it keyboard focus, then press **F1** or **Shift + F1**.

Remember that you can choose which tabs appear in the Table Of Contents and the order in which they appear by going to the Tools > Options dialog box and looking in the Table Of Contents tab. In 9.0, your choice of tabs in the Table Of Contents is saved for the application (in the Windows registry) instead of being stored in the map document you are currently working on, as it was in 8.x. In this way, your choice of tabs will always be the same in ArcMap, no matter which map document you are working with.

■ The feature selection logic in ArcMap has changed at 9.0 to differentiate between the state in which a layer currently has **0 features selected** versus when it currently has **no set of selected features**.

In ArcMap 8.x, these two states were not differentiated. A layer that had 0 features currently selected was not considered to have a set of selected features. The new geoprocessing framework at 9.0 makes this differentiation. Within a geoprocessing model or script, there's an important difference between steps that result in 0 features being selected versus there being no set of selected features. This determines whether 0 features or all features will be used in the next step. Therefore, ArcMap has been updated so that the selection logic is consistent with the geoprocessing framework. Performing a selection on a layer now always results in a selection set, even if that set contains 0 features.

For example, suppose you use the Select By Attribute dialog box and specify an expression that results in 0 features in a layer being selected.

- In 8.x, the layer had **no selection set** and all the layer's features were available for the next geoprocessing operation you performed.
- In 9.0, there is a **selection set containing 0 features**, and the next geoprocessing operation you perform will operate on 0 features, unless you first clear the selected set. So if you select wells with particular attributes, then buffer the wells that are selected, no wells will be buffered if no wells met your selection criteria, which is what you'd expect. In geoprocessing at 9.0, operations you perform on layers inside ArcMap always operate on the currently selected set of features, unless no selection has been performed, in which case they operate on all the features in the layer.

A good way to understand this change is to look in the Selection tab in the ArcMap Table Of Contents.

- In 8.x, layers listed in the Selection tab turned bold and showed you their number of selected features when they had **one or more features** selected.
- In 9.0, layers listed in the Selection tab turn bold and show you their number of selected features when they have a selection set, that is, when they have **0 or more features** selected.

If a layer has a selection set and you want a geoprocessing operation to use all the features in that layer, simply clear the selected set of features first. As in 8.x, there are two ways to clear the selected set of features. You may:

- Use the Clear Selected Features command . Choose this command from the Selection pulldown menu to clear the selection sets for all layers. Choose this command by right-clicking a layer in the Table Of Contents to clear only the selection set for that layer.
- Click the map (or drag a box) with the Select Features tool  without selecting a feature. This will clear the selection sets for all layers. In other words, if you click on the map to deselect the currently selected feature or features, this clears the selected features. In ArcMap, the Edit tool  works this way, too.

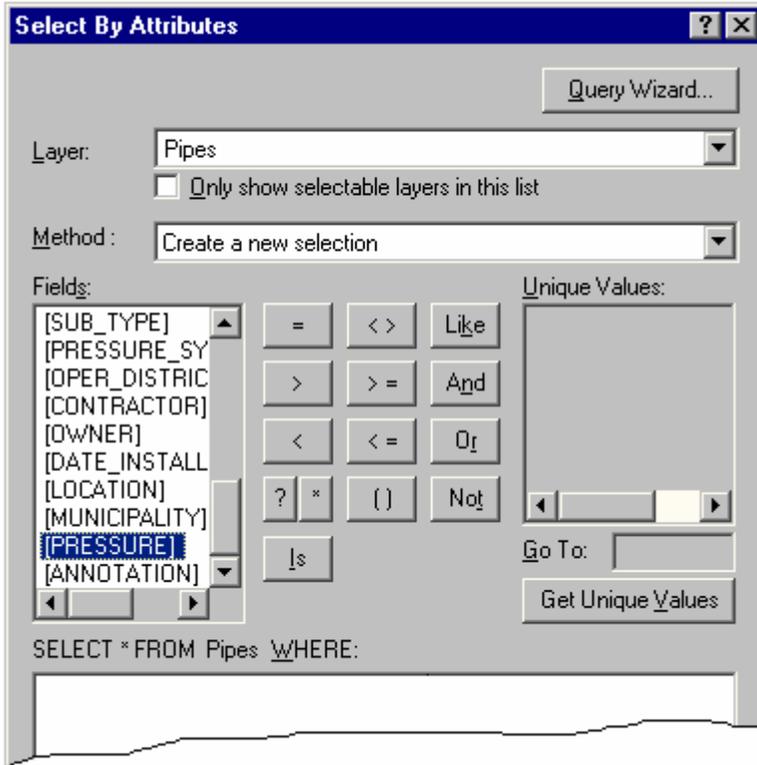
NOTE: If a layer currently has all of its features selected, and you choose Switch Selection, this does not clear the selected set. The layer will still have a selected set, but the number of features in it will be 0.

NOTE: This change to the feature selection logic also applies to the 3D Analyst extension's ArcScene and ArcGlobe applications.

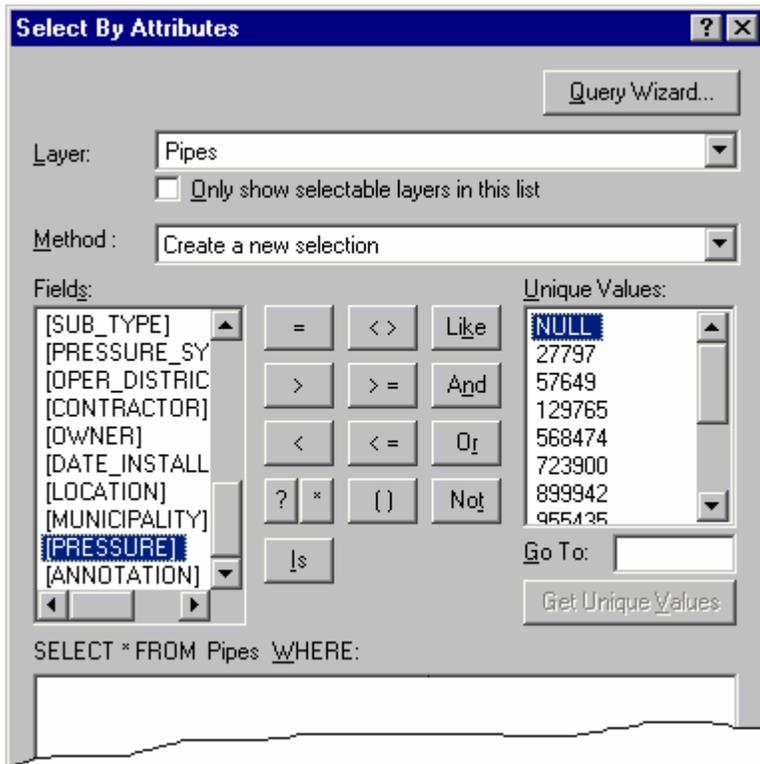
■ A check box has been added to the Selection > Select By Attributes and Selection > Select By Location dialog boxes that enables you to restrict the list of layers from which you choose to select features to layers that are currently set as **selectable**. When this box is checked, the list will only contain layers that are currently set as selectable. You can set layers as selectable using the Selection tab in the Table Of Contents or by choosing the Set Selectable Layers command from the Selection pulldown menu.

By default, all the feature layers in a data frame are selectable, so checking this new check box has no effect on the length of the list of layers if you have not yet turned off some of the layers in the Set Selectable Layers dialog box or Selection tab for this data frame.

■ Selection > Select By Attributes: The Unique Values list is no longer populated automatically when you select a field in the Fields list or Query wizard, accessed from the Select By Attributes dialog box. This was done to improve performance, especially when working with large datasets, and because in most cases the list was only partially populated when the datasets contained more than a few hundred features. In 9.0, when you select a field from the Fields list, the Unique Values list remains empty until you press the Get Unique Values button. In this way, you can choose whether or not you want to wait for a list of unique values to be obtained.



A Reading Unique Values dialog box will appear when you click Get Unique Values if the process needs more than a few seconds to complete. When the Unique Values list is fully populated, the Get Unique Values button will become unavailable to indicate that the list is complete.



If you cancel the process before it is finished, you'll see a partial list of unique values, and the Get Unique Values button will remain enabled to indicate that the list is incomplete.

■ Selection > Select By Attributes dialog box: A Go To text box has been added underneath the Unique Values list that enables you to rapidly move through this list. Type the first letter or number of the value, with or without quotes. As soon as you start typing, ArcMap will try to go to the first value in the list matching what you typed.

■ Selection > Select By Attributes dialog box: If you are working with a field that supports null values, it is now easy to build a query to select records that have or do not have null values. Null values are supported by fields in geodatabases and date fields in shapefiles, dBASE tables, coverages, and INFO tables. When you select one of these fields in the Query Builder, you'll now see a NULL entry at the top of the Unique Values list if there is a null value in the values displayed by that list. If there are no null values in the list, you won't see a NULL entry at the top. You can double-click the NULL entry to add it into your query like any other value and use the IS operator to select null values. As you can see from the graphic above, a button for the IS operator has also been added to the Query Builder. The following query selects all the null values for a field in a geodatabase:

```
[POP1991] IS NULL
```

This query selects all the values in the same field that are not null:

```
[POP1991] IS NOT NULL
```

■ Selection > Select By Attributes: The dialog box now automatically determines the correct format for querying date fields based on the type of data you are querying. The format for date queries varies according to the data type. In 8.3 you always had to compose expressions for querying date fields manually. Most of the time in 9.0, you will only need to click the date field, the operator, and a value in the Unique Values list to have the proper

syntax generated automatically. For more information about date fields, look up "SQL reference" in the Desktop Help index and, in that help topic, click the Date link.

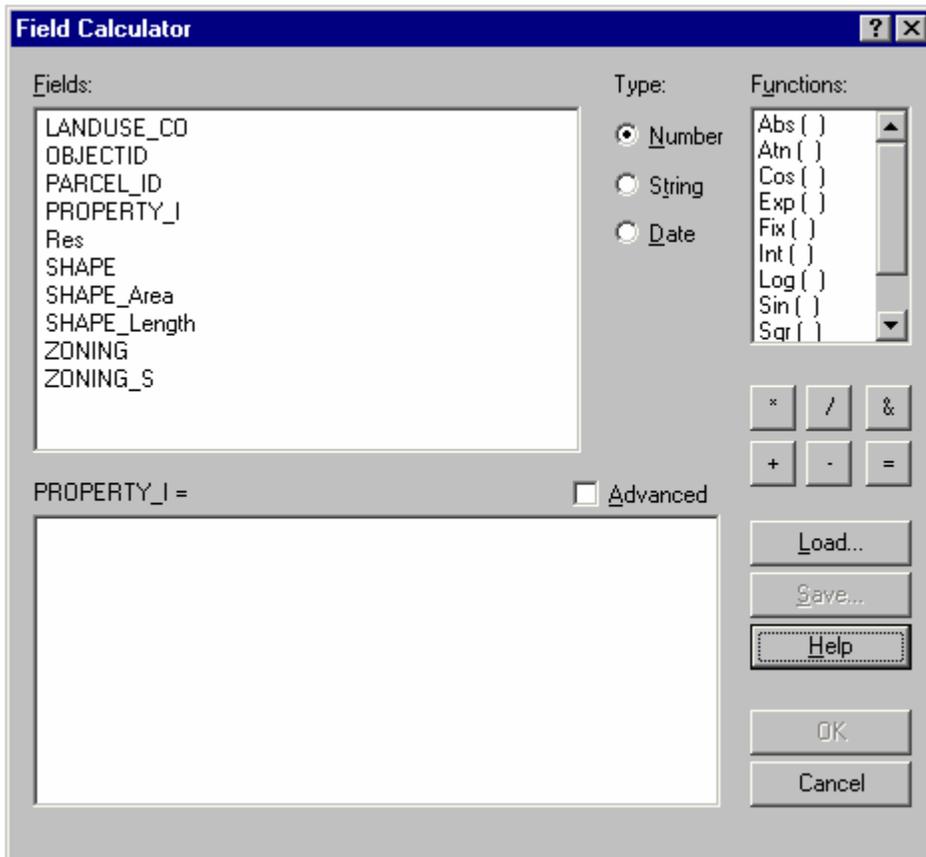
■ Selection > Select By Attributes dialog box: The SQL Info button has been removed from the dialog box.

■ The Desktop Help for creating SQL queries has been improved. There's a new SQL reference topic containing an expandable list of SQL operators and functions. Choose ArcGIS Desktop Help from the Help pulldown menu in any of the Desktop applications; in the Desktop Help Index, look for "SQL reference".

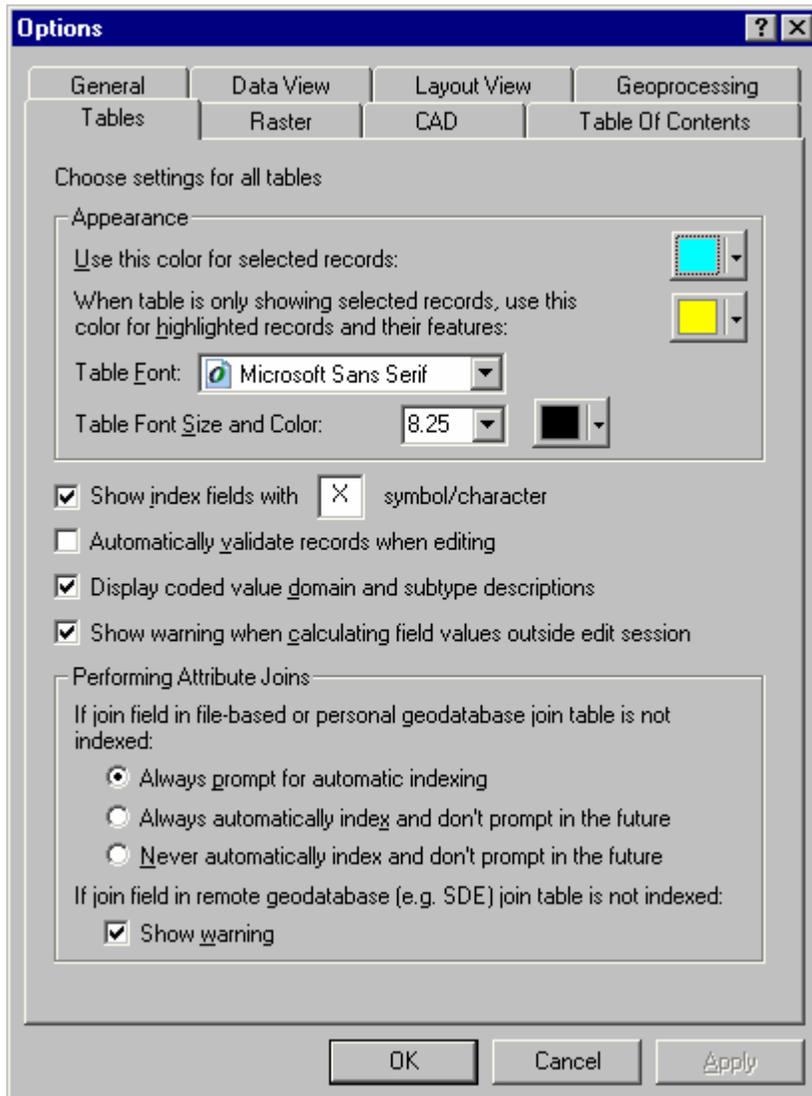
NOTE: Most of the changes to the Selection > Select By Attributes dialog box described in this section also apply to other instances of the Query Builder dialog box that you find throughout ArcGIS.

Tables

■ The Field Calculator dialog box has been made larger to accommodate longer and wider field lists. A Help button has also been added. It includes some commonly used examples to calculate fields based on area, length, perimeter, and so forth.



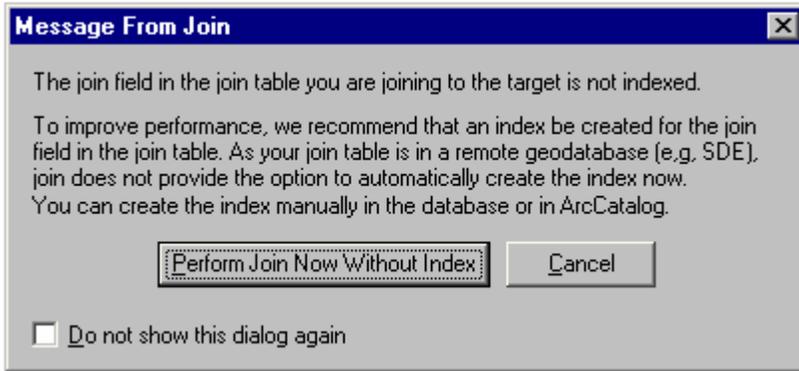
■ You can now suppress the message that appears when you attempt to calculate field values outside an edit session. To suppress the message, click the Options command from the Tools pulldown menu in any Desktop application and uncheck the Show warning when calculating field values outside edit session option.



■ New automatic indexing option for join: When you perform a join and the join table to which you are joining the target is a file-based table or a table in a personal geodatabase, ArcGIS will check to see if the join field you chose in this join table is indexed. If it is not indexed, you'll see the following message prompting if you'd like to have ArcGIS automatically index the join field:



When you perform a join and the join table to which you are joining the target is in an ArcSDE geodatabase, ArcGIS will check to see if the join field you choose in this join table is indexed. If it is not indexed, it will display the following message advising you of this:



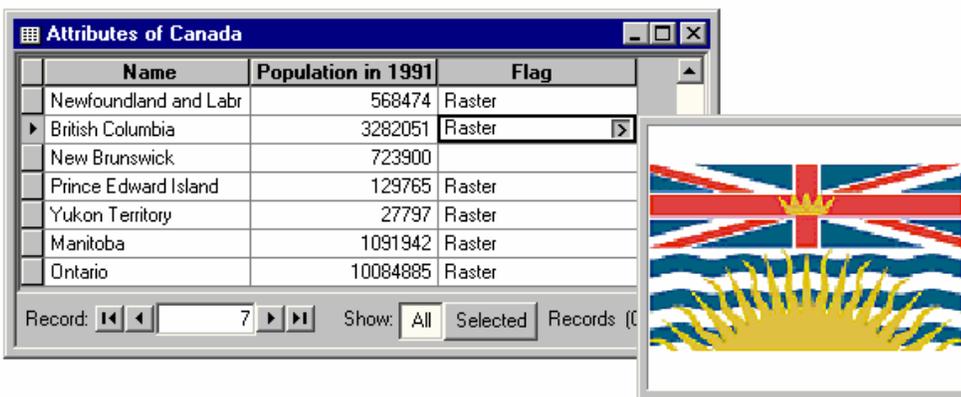
Automatic indexing is not supported for ArcSDE geodatabases, but you or your database administrator could index the field manually in the database or in ArcCatalog to improve performance.

Controls have been added to the Tools > Options dialog box Table tab, allowing you to control whether automatic indexing occurs and suppress the ArcSDE warning message.

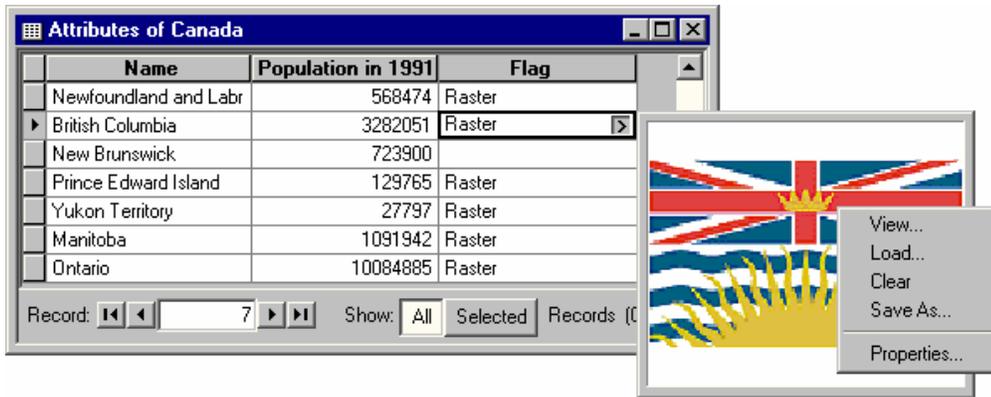
- The Open Table For Selected Features command that was available via the Tools > Customize dialog box in 8.x has been removed. This command no longer worked correctly. The ability to choose what mode the table window uses when it opens is planned for a future release.

- The attribute tables of geodatabase feature classes and standalone tables in geodatabases can now contain fields of **raster** type. A raster type field can contain any supported image or raster file, such as a photo of a feature. You can view the content of raster fields in the Table window, in the Identify Results window when you identify a feature, or in the Attribute Inspector window launched from the Editing toolbar.

In the Table window, records for raster fields that contain pictures are shown with the value Raster. A record with an empty value for a raster field indicates that a raster has not yet been loaded into the field for that record. Click a value in a raster field to make a small > button appear next to it, then click that button to view the picture in a popup window.



Right-click inside the picture popup or the value in the table to see a menu of additional options:



The Load and Clear options in the menu are only enabled if you are currently editing the layer that contains the raster field.

Choose the View command (or left-click in the popup window) to view the raster in a floating resizable window:



For more about raster fields, see the 'Raster data' section of this document.

Identify tool

■ In response to customer suggestions, the Identify tool in ArcMap has been changed so that when you select the tool in the Tools toolbar, the Identify Results window immediately appears. This enables you to select from which layer or layers you want to identify before you click the map to identify a feature. This makes Identify more convenient if you don't want to simply use the default <Topmost Layer> setting. It also enables you to position the window conveniently onscreen so it doesn't cover up the area you are looking at on the map. The Identify tool in ArcCatalog doesn't open the window when it is selected because you normally only work with one layer in the ArcCatalog Preview window. At 9.0, the Identify tool in the ArcScene and ArcGlobe applications in ArcGIS 3D Analyst also doesn't open the window when it is selected.

■ The View > Identify Results command has been removed. Now that the Identify window automatically opens as soon as you select the Identify tool, there's no need for the separate command that enabled you to open the window before using the tool.

■ In the Identify Results window, <Top-most Layer> is still the default option in the Layers dropdown list. At 9.0, this option has been moved to the top of the list to make it more obvious that it is the default.

■ Identify Results window in ArcMap and all desktop applications: In the Identify Results window, you can now click field values for fields containing strings that are full URLs or full pathnames to documents to launch the URL or document to which they point. When you have identified a feature, point at the value for any field shown in the Identify Results window that contains a URL or pathname. The pointer will change to the hand pointer to indicate that the value is "hot". If the application cannot resolve the path to a document, the cursor won't change, and you'll get a "file not found" message if you click the value.

URLs included as values must start with either <http://> or <https://>. Paths must start with a disk drive or be a full Uniform Naming Convention (UNC) pathname. That's how the Identify window recognizes these values as being links.

This enables you to include launch URLs and documents from fields in the Identify window without defining a hyperlink field in the layer's properties. You can have as many fields as you like containing URLs or pathnames to documents, and you can mix URLs and pathnames in the same field. The logic for recognizing these clickable URLs/paths is built into the Identify window, so there's no layer or document properties to set. These links will work in any of the ArcGIS Desktop applications that have an Identify tool, even if those applications don't support field-based hyperlinks (for example, ArcCatalog and ArcScene). They are also supported in the ArcReader 9.0 Identify window if you publish your map document to a published map file (.pmf) using the ArcGIS Publisher extension. As these links are defined purely in the attribute table and don't require any accompanying layer file or map document, they are especially convenient; anyone who accesses the data will immediately be able to use the links via the Identify window of any ArcGIS Desktop application.

NOTE: These new links accessed via the Identify window will not support the hyperlink base property in the File > Map Properties dialog box. They have to be complete URLs or paths. This is for robustness and because not all ArcGIS Desktop applications support the hyperlink base property. The values of a field-based hyperlink (for example, a hyperlink specified in the Layer Properties dialog box Display tab and normally accessed using the Hyperlink tool) will only be clickable in the Identify window if they contain complete URLs or paths; they are not supported in the Identify window if they use the hyperlink base property.

■ At 9.0 the attribute tables of geodatabase feature classes and standalone tables in geodatabases can now contain fields of **raster** type. A raster type field can contain any supported image or raster file, such as a photo of a feature. When you identify a feature containing a raster field, you'll see a small > button next to the raster field if a picture exists for the record.

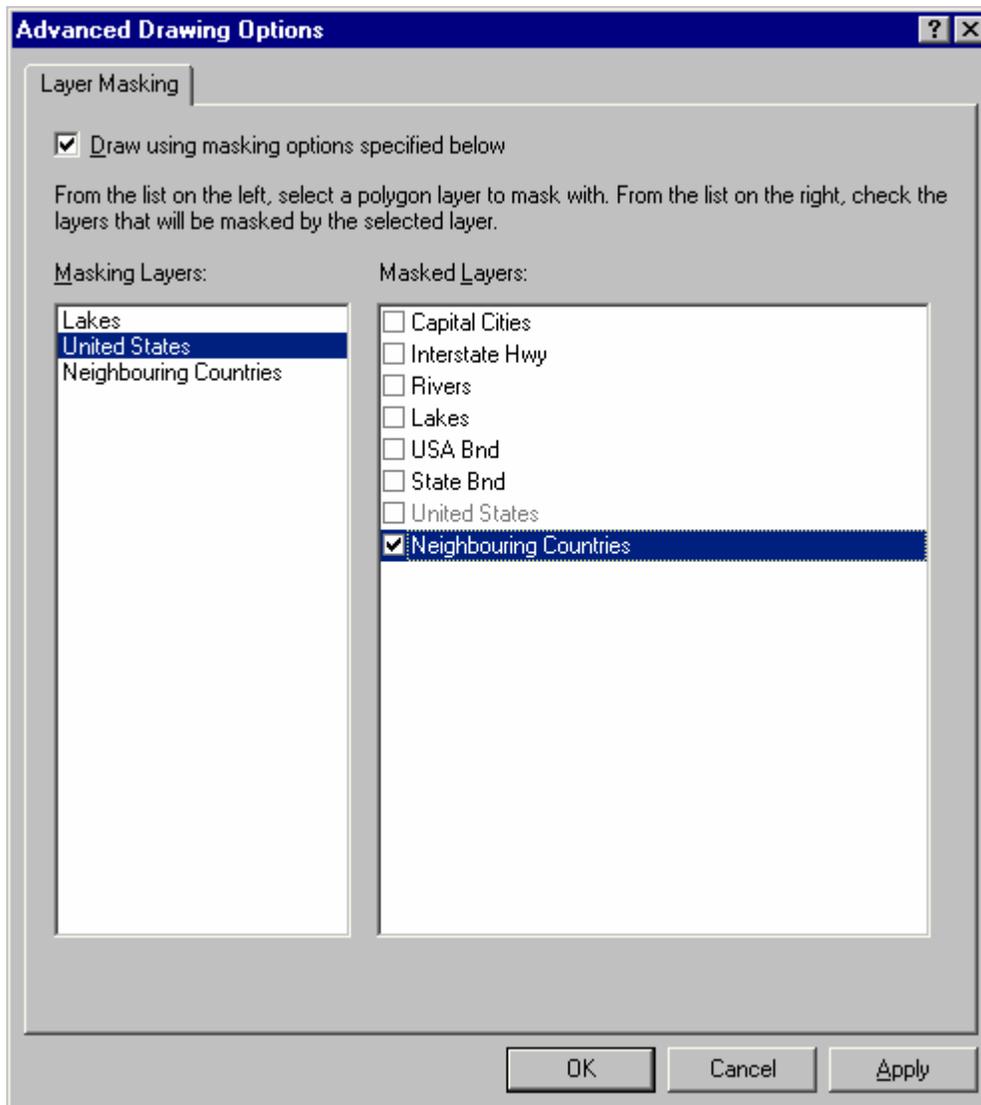
Click that button to see the raster in a small popup window.



Right-click the popup window to see more options. Click View or left-click in the popup window to view the raster in a floating, resizable window.

Symbology

■ The Advanced Drawing Options dialog box has a new Layer Masking tab that lets you specify that the features in one or more layers be masked by the features in one or more polygon layers in your map. To specify masking, first check the box at the top of the tab. All of the polygon layers in your current data frame are listed on the left side of the tab. From this list, choose which polygon layer or layers you want to use to perform masking. Then in the list on the right, check which layers you want to be masked by the chosen polygon layers. As with all checkable lists in ArcMap, hold down the **Ctrl** key and click any box in the list to toggle all the entries on or off. If the layer that you would like to mask is not in the list on the right, it does not support masking. Layers that don't support masking include annotation layers and the layers inside group layers.



■ How you work with **symbol-level drawing** has changed in 9.0. In 8.3, symbol-level drawing is a property of the data frame. In 9.0 it is a property of the layers for which it is defined. This means that the symbol-level drawing specification for a layer is saved with the layer if you save it to disk as a layer (.lyr) file. The drawing will travel with the layer when you copy and paste or drag it inside the same map document or between two map documents.

You can still define a symbol-level drawing that includes symbols from multiple layers. Symbol-level drawing is also now a property of group layers. Put all the layers whose symbols you want to include in the symbol-level drawing specification into a group layer, then define the symbol-level properties for this group layer.

- If you open a map created with **ArcMap 8.x** when you are in ArcMap 9, you can still use the 8.x data frame-based symbol-level drawing functionality via the Symbol Drawing tab in the Advanced Drawing Options dialog box. To get to this dialog box, you still right-click a data frame and choose the Advanced Drawing Options command. When you open this dialog box, you'll see a new button at the top of the Symbol Drawing tab that enables you to upgrade your map document to use the new layer-based symbol-level drawing functionality. It is recommended that you upgrade your map documents to use this new functionality.
- If you create a new map in ArcMap 9, it will automatically use the new layer-based symbol-level drawing functionality. If you look in the Advanced Drawing Options dialog box, you will no longer see a Symbol Drawing tab.
- To access the new Symbol Levels dialog box for a feature layer, open the layer's Properties dialog box, click the Symbology tab, click the Advanced menu button, and choose the Symbol Levels command.

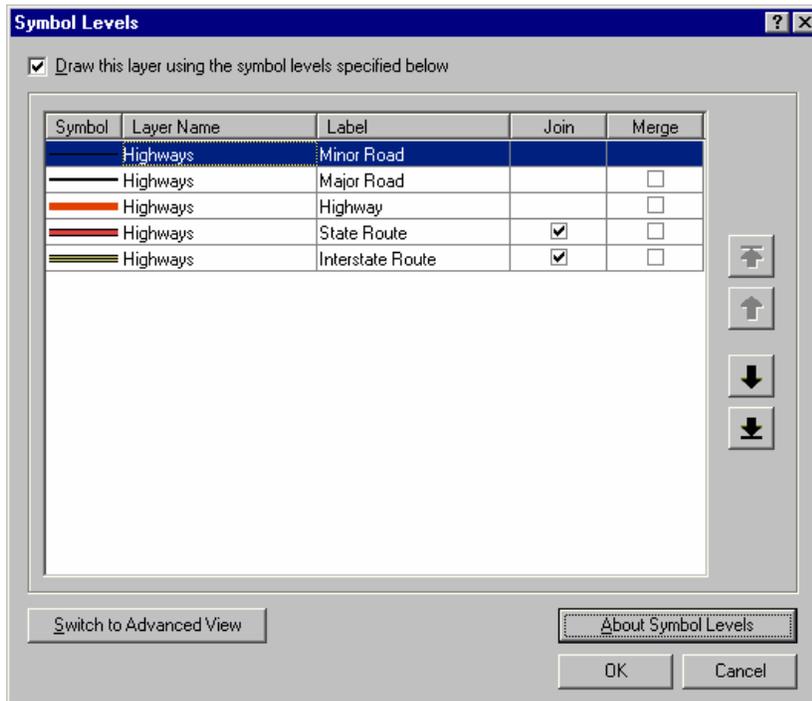
To access the new Symbol Levels dialog box for a group layer, open the group layer's Properties dialog box, go to the Group tab, and click the Symbol Levels button.

To toggle symbol-level drawing on and off for any layer or group layer, right-click the layer and choose the Use Symbol Levels command.

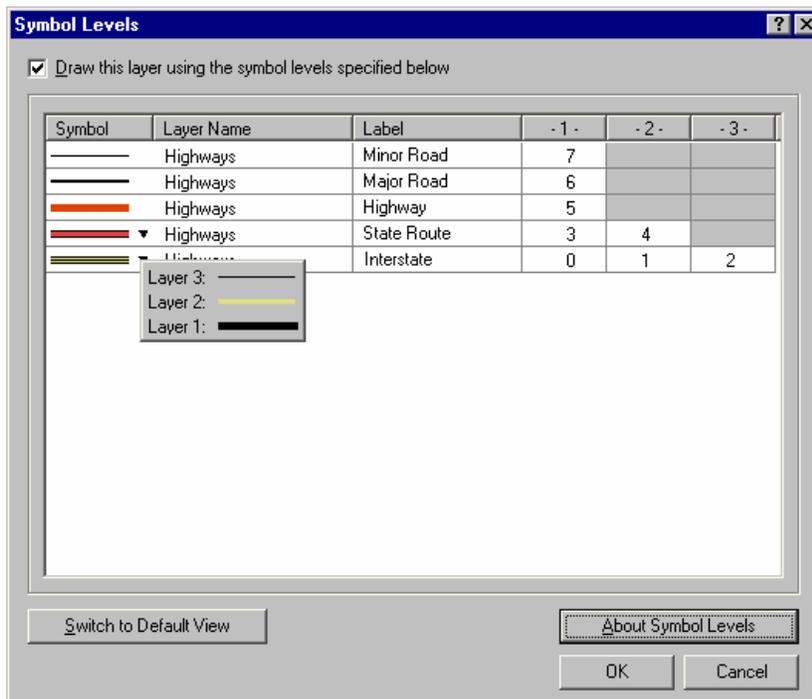
If any of these commands are disabled, you are using a map document that was created in 8.x in which the symbol-level drawing functionality is still tied to the data frame. To enable the commands, right-click the data frame, click Advanced Drawing Options click the Symbol Drawing tab, and click the Upgrade button.

TIP: If you'll be using the Symbol Levels dialog box frequently, there's a Set Symbol Levels command you can add to the context menu for feature layers and group layers that lets you launch that dialog box without having to launch the layer's Properties dialog box first. Click Tools > Customize and look in the Layer category to find the Set Symbol Levels command.

- The new Symbol Levels dialog box looks like the old Symbol Drawing tab in the Advanced Drawing Options dialog box. The new dialog box is more compact, and you can move multiple symbol levels up and down at once using the Up and Down arrows or by dragging.

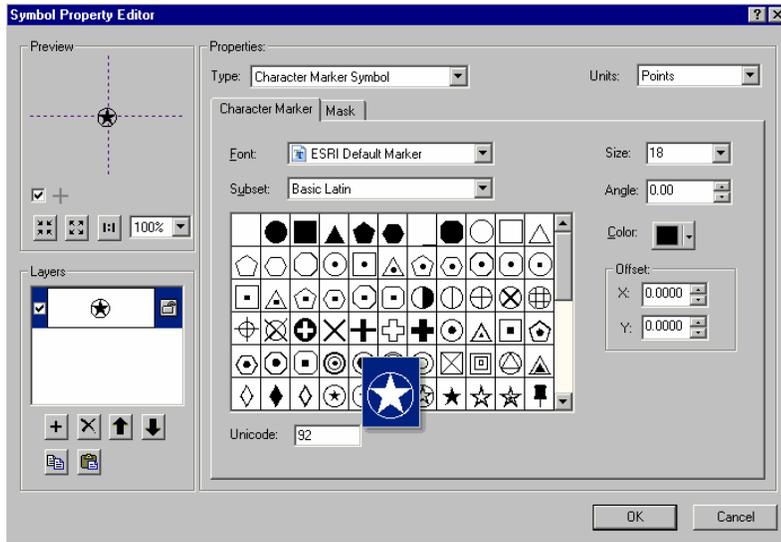


In the dialog box there is also a new **Advanced View**, which gives you more control over the drawing order of symbol levels. Advanced View breaks each symbol into its component layers, and you can enter numeric values to specify where each symbol layer will be positioned in the draw order. This position is referred to as its symbol level. More combinations are possible in the Advanced View than in the Default View.



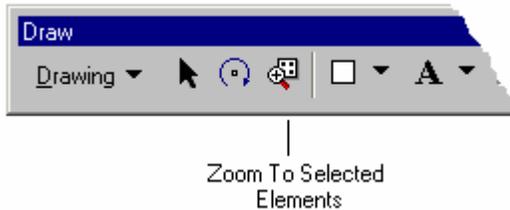
■ In the Symbol Property Editor dialog box, the buttons for manipulating the preview and the list of symbol layers have been improved and standardized to make them better match the same buttons found elsewhere in ArcMap.

■ It is now much easier and quicker to choose fonts and glyphs when editing the properties of character marker symbols and North arrows. All the glyphs in the selected font and subset are listed in a scrolling list, and you can click on any glyph to see an enlargement. Here's what the character marker panel looks like now in the Symbol Property Editor.

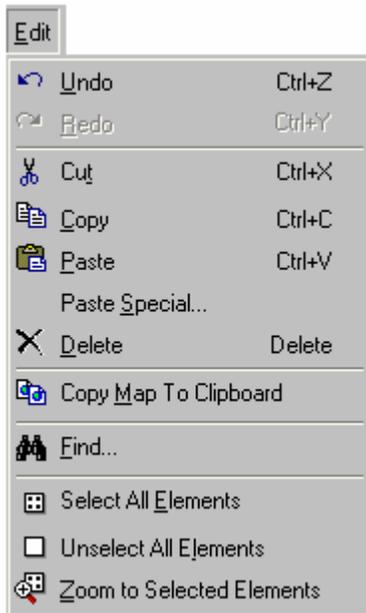


Elements

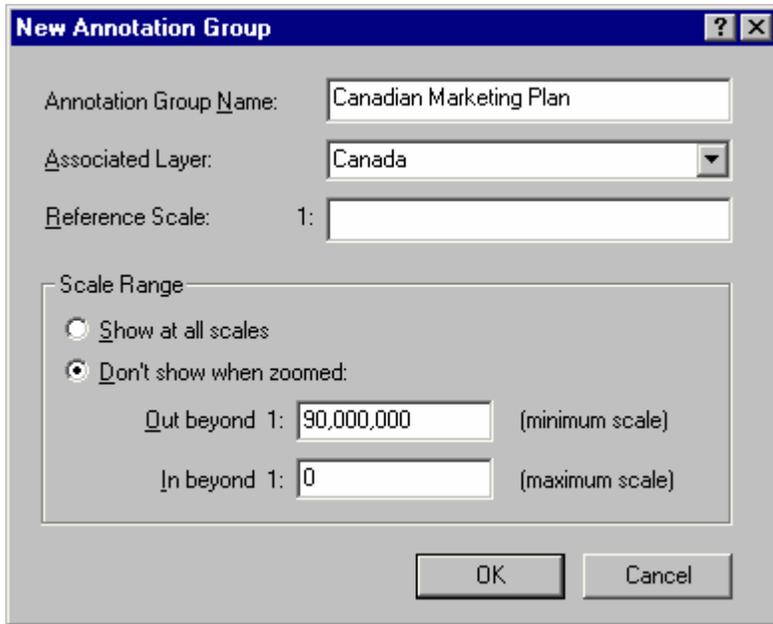
- A new option called Unselect All Elements  has been added to the Edit pulldown menu. This option unselects all selected text elements and graphic elements if you are in data view and all selected text elements, graphic elements, and map elements if you are in layout view. This command has the same effect as simply clicking any location on the map where there's no element. In some situations where you are zoomed in close on the map, there may be no such location you can click because one of the selected elements fills the ArcMap window. In those situations, this command lets you unselect all the elements without having to zoom out.
- The Zoom To Selected Elements command has been added to the Draw toolbar.



This command zooms to the currently selected graphics, text, or map elements in both the data and layout views. It is disabled if none of those items is currently selected. It has also been added to the Edit pulldown menu. In this way, the Edit pulldown menu now contains a group of commands for working with the selected elements on your map. A matching icon has been added to the existing Select All Elements command .



■ The New Annotation Target command in the Draw pulldown menu and the dialog box it launches have been renamed as New Annotation Group because at 9.0 this command can no longer be used to create annotation feature classes in geodatabases. The dialog box has also been enhanced so that you can now specify all the properties for the annotation group you create without having to visit the Annotation Groups tab in the Data frame Properties dialog box. You can associate your new annotation group with a layer and also set a scale range at which the annotation group will be drawn.



As in 8.x, when an annotation group is associated with a layer, it will be automatically turned on or off when the layer with which it is associated is turned on or off. With the changes at 9.0, it is now much easier to create an annotation group associated with a layer. Simply choose the New Annotation Group command, type a name for your new annotation group, choose which layer you want to associate it with, press OK, and start adding text and graphics elements to your map using any of the tools on the Drawing toolbar. The elements you draw are automatically added to your new annotation group. You can choose a different annotation target using the Active Annotation Target command in the Draw menu.

■ When you draw rectangles, polygons, and circles, their area is now shown in the status bar along with other dimensions. When you draw a line, the length is shown. If you are drawing the graphics in data view or on top of a focused data frame in layout view, the dimensions are shown in the data frame's **display units**. If you are drawing them in Layout view, they are shown in the **layout's page units**. In addition, you can enter coordinates and dimensions using keyboard shortcuts as described below.

Rectangle tool:

- The area, height, and width are shown as you draw the rectangle.
- Press **C** on your keyboard to type the coordinates of a corner point. This can be either the start or end point of the rectangle.

Polygon tool:

- The area and perimeter are shown as you draw the polygon.
- Press **C** on your keyboard to type the coordinates of the next vertex.
- Press **E** on your keyboard to type the coordinates of the last vertex. Press **E** then press **Enter** to use the current location as the last vertex.

Circle tool:

- The area, circumference, and radius are shown as you draw the circle.
- A line representing the radius appears inside the circle as you draw it.
- Press **C** on your keyboard to type the coordinates of either the start (center) or the endpoint of the radius.
- Press **A** on your keyboard to type the area of the circle after the start point has been specified.
- Press **R** on your keyboard to type the radius of the circle after the start point has been specified.

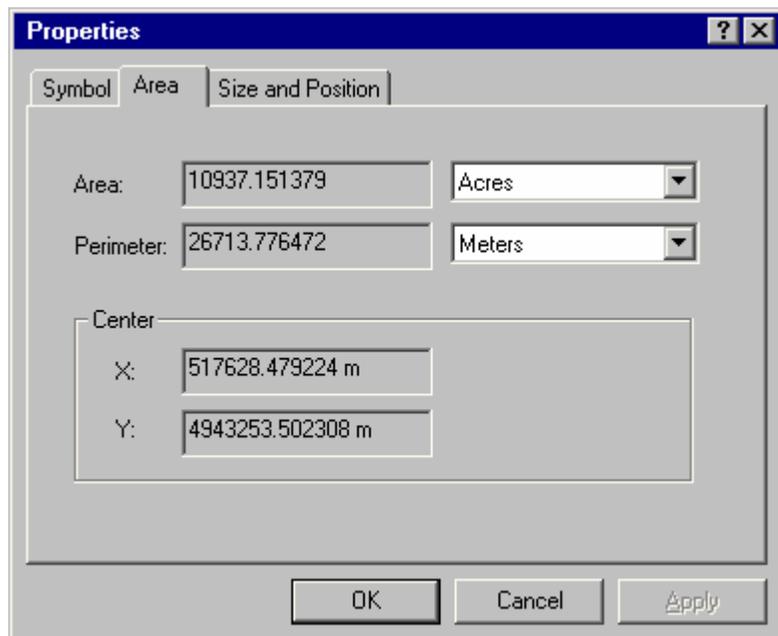
Line tool:

- The total length is shown as you draw the line.
- Press **C** on your keyboard to type the coordinates of a vertex.
- Press **E** on your keyboard to type the coordinates of the last vertex. Press **E** then press **Enter** to use the current location as the last vertex.

Edit Vertices tool:

- When you edit the vertices of a polygon, its area and perimeter are shown in the status bar.
- When you edit the vertices of a line, its total length is shown in the status bar.

In addition, if you right-click a rectangle, polygon, or circle and choose Properties, you'll see a new Area tab in its Properties dialog box. This shows you the area and perimeter of the graphic as well as the coordinates of its center point. You can choose what units the area and perimeter are displayed in on this tab by using the dropdown lists of units.

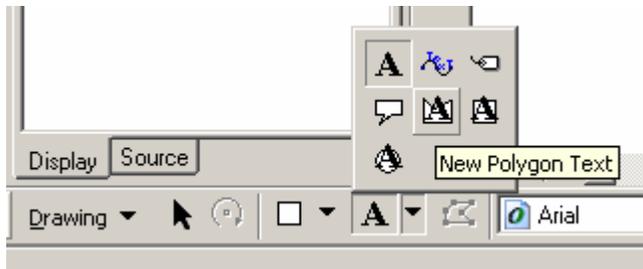


■ Three new text drawing tools have been added into the Draw toolbar that let you draw a graphic element containing text formatted like a paragraph. The text flows within the graphic shape. The resulting element has text and graphics properties as well as some new properties for setting columns and margins to control how the text is positioned inside the graphic. These new properties are presented in the Columns And Margins tab, which you'll find in the Properties dialog box for one of these new graphic elements.

 New Polygon Text tool

 New Rectangle Text tool

 New Circle Text tool



To resize graphics created with these tools, select the graphic and use the handles to scale it or click the Edit Vertices button .

These tools can be used to create graphic elements, annotation stored in the map document, and annotation stored in a geodatabase. These tools give the same dimension feedback in the ArcMap status bar and have the same options for specifying their dimensions via the keyboard that the Circle, Rectangle, and Polygon tools have been given at 9.0.

■ A Create Text From Graphic Elements command  has been added into the Page Layout category in the ArcMap Tools > Customize dialog box, from where you can add it to any menu or toolbar. This command creates a text element with the same geometry as the selected graphics element or elements. Any new element created from this command has the same properties, such as columns and margins, as a text element created with one of the three new text drawing tools    added to the Draw toolbar at 9.0. This new command is useful when you want to create text elements based on graphic elements you have already drawn on your map.

■ New curved leader lines: Two new curved leader lines are available for callouts. Choose the Line Callout option when specifying the text symbol background for a text symbol drawn with the Callout tool to see these new leader lines.



Editing

■ The edit cache has been renamed as **map cache** and moved into the core ArcMap user interface because it now operates both inside and outside an edit session. Defining a map cache improves performance when you draw, edit, or select geodatabase features, particularly those stored in an ArcSDE geodatabase.

- The Edit Cache toolbar has been renamed as the Map Cache toolbar, and all the commands it contains have also been renamed.
- A new Empty Map Cache command  has been added to the toolbar. When you empty the map cache, features will be retrieved directly from the geodatabase instead of the memory on your machine.
- The Show Map Cache command  has been enhanced to indicate the status of the map cache. Like the 8.x edit cache, the map cache only takes effect when your current display extent (for example, the geographic extent you are currently viewing) is completely within the extent of the map cache. When your current display extent is completely within the extent of the map cache, the Show Map Cache command turns green to show you that the map cache will be used.



When your current display extent is not completely within the extent of the map cache, the Show Map Cache command turns red to show you that the map cache will not be used.



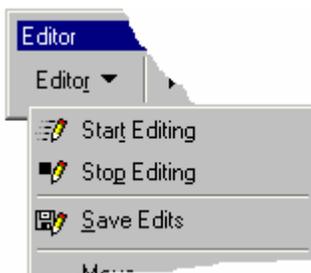
As in 8.x, the Show Map Cache command is disabled if your current display extent is entirely outside the extent of the map cache:



- The Edit Cache tab in the Editor > Options dialog box has been moved to the Data frame Properties dialog box and renamed as the Map Cache tab.

(See the 'Data frames' section above for more about map cache.)

■ Icons have been added to the Start Editing, Stop Editing, and Save Edits commands in the Editor pulldown menu on the Editor toolbar. This makes it easier if you want to customize ArcMap by moving these commands out of the pulldown menu and onto a toolbar to make them more readily accessible.



■ The Disconnected Editing toolbar is still in the user interface but has been removed from the Editor > More Editing Tools pull-right menu.

■ There is a new user interface for editing annotation, including a new Annotation toolbar and a new look for the Attributes window launched from the Editor toolbar when you edit annotation. See the 'Annotation' section of this document for more information.

Internet data

■ When you add a layer based on an ArcIMS Image Service layer to your map, the layer's entry in the Table Of Contents is no longer expanded by default. ArcIMS Image Service layers often have a large number of sublayers. This enhancement avoids the issue of adding an ArcIMS Image Service layer into your map and causing a huge entry to immediately appear in your Table Of Contents. Now once you've added the layer, you can click the + sign next to it if you want to expand it to see a listing of its sublayers.

■ Working with ArcIMS Image Service layers: The problem of ArcIMS Image Service layers not showing up as layers in the Source tab of the ArcMap Table Of Contents has been solved. In 8.3 the sublayers appeared in the Source tab but not the layers themselves.

■ Working with ArcIMS Image Service layers: The problem of expanding or collapsing the sublayers in a layer based on an ArcIMS Image Service not being saved when you saved your map document or when you saved the layer as a layer file has been solved.

■ Working with ArcIMS Image Service layers: When you expand an ArcIMS Image Service layer in ArcMap's Table Of Contents, you'll notice tree lines between the layer and its sublayers. These tree lines indicate that these sublayers belong together and cannot be broken apart or used separately from the layer to which they belong. These lines have been added at 9.0 to help differentiate these types of layers from group layers.

■ Working with ArcIMS Image Service layers: Two new commands, Expand All Sub-Layers and Collapse All Sub-Layers, have been added to the context menu for ArcIMS Image Service layers to make it easier for you to manipulate the often large number of sublayers that these layers can contain. The keyboard shortcut for these commands is to hold down the **Ctrl** key and right-click the + or - control next to any of the sublayers. To expand or contract the currently selected (highlighted) sublayers, hold down the **Ctrl** key and right-click the + or - control next to any selected sublayer.

■ Working with ArcIMS Image Service layers: ArcIMS Image Services are defined on the ArcIMS server by the publisher either using the map renderer and ArcXML built into ArcIMS or the ArcMap Server extension to ArcIMS that was introduced at ArcIMS 4. These two different types of ArcIMS Image Services behave the same way when they are added as layers into ArcMap, but there are a few minor differences. At 9.0, ArcMap now correctly reflects these differences in its user interface. For example, in the Layer Properties dialog box Layers tab for an ArcIMS Image Service layer that is rendered by the ArcMap server, the controls for reordering the sublayers in the service are now disabled, because this type of ArcIMS Image Service does not support that functionality.

At 9.0 the data type information in the Layer Properties dialog box Source tab for an ArcIMS Image Service layer now reflects whether or not the service is being rendered on the server using the ArcMap server extension. If it is, the data type is listed as ArcIMS ArcMap Image Service or ArcMap Image Service. If it is not, the data type is listed as ArcIMS Image Service.

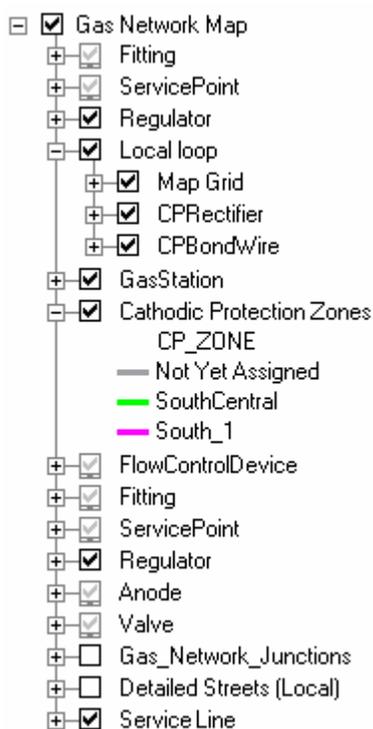
■ Working with ArcIMS Image Service layers: In the Layer Properties dialog box Advanced tab for an ArcIMS Image Service layer, the transparency options are now unavailable if the service you are working with does not support transparency. The ArcIMS Administrator has the option to exclude certain image types from being created by their service. When image types that support transparency (GIF and PNG) are excluded, the transparency options for the ArcIMS Image Service layer will be disabled. If no image type has been excluded by the ArcIMS Administrator, then the transparency functionality will be enabled, and ArcMap will request a PNG output.

■ At 9.0, ArcGIS Desktop adds support for services being served using ArcGIS Server, which is a new server product in the ArcGIS 9 family purchased separately from ArcGIS Desktop. You can connect to an ArcGIS server either locally or via the Internet. See the 'ArcCatalog' section of this document for more about how you connect to ArcGIS servers. You can add map services from ArcGIS servers into your maps. When you add an ArcGIS map service into ArcMap, you'll see an **ArcGIS map service layer** appear in your Table Of Contents. It represents the contents of a map that is being served from an ArcGIS server. If you have already worked with ArcIMS Image Service layers in ArcMap, this new layer type will seem familiar because they are similar. You

can add them into ArcMap in the same way and they look and work similar when they are in ArcMap. The main differences between how these layers work in ArcMap are:

- You can't change the drawing order of the sublayers in an ArcGIS map service layer. You can change the drawing order of the sublayers in an ArcIMS Image Service layer by using the Up and Down arrows in the Layer Properties dialog box Layers tab.
- You can't select the features in an ArcGIS map service layer using the ArcMap selection tools and commands. So for example, if you look in the Set Selectable Layers dialog box or the Select By Attributes dialog box, you won't see these sublayers listed. You can use the Identify tool and the Find command to query the sublayers inside an ArcGIS map service layer.
- You can't open the attribute table for the data in an ArcGIS map service layer.
- The sublayers inside an ArcGIS map service layer may have been grouped into a hierarchy by the author of the service. These groups simply reflect group layers in the map document used to create the map service. These groupings make it easier to work with ArcGIS map services that contain a large number of sublayers.

When you expand an ArcGIS map service layer in the Table Of Contents you'll immediately notice tree lines linking together the sublayers it contains. For example, the graphic below shows an ArcGIS map service layer called Gas Network Map. It contains a number of sublayers, some of which are grouped under the heading Local loop.



The tree lines show you that, like the sublayers inside an ArcIMS Image Service layer, the sublayers inside an ArcGIS map service layer belong to that layer and can't be moved out of it.

Like the sublayers contained in an ArcIMS Image Service layer, the sublayers contained in an ArcGIS map service layer don't provide all the functionality that ordinary layers have. If you right-click one of these sublayers, you'll notice that the menu that appears only has a few commands. You can use the Identify tool and the Find command to query the sublayers inside an ArcGIS map service layer. When you look in the Identify window or the Find dialog box, you'll see these sublayers listed in the usual way (if they represent data that can be queried in those dialog boxes).

Why don't ArcGIS map services support attribute tables and feature selection? An ArcGIS map service is designed to be literally a map service. It is intended to enable you to access a map that someone has published, embed it into your own map as a layer, and perform basic Find and Identify queries. It's not designed to be a whole collection of feature classes that you can work with. At 9.0, there is currently no equivalent in ArcGIS Server to the ArcIMS feature service. In future releases of ArcGIS Server, there will be new services that allow you to work directly with data that is being published on an ArcGIS Server so you'll be able to decide exactly how you want to serve your data, either as a map service with restricted data query capabilities or as data services, which will enable end users to work with the data directly as data sources in ArcGIS.

To emphasize the similarity between ArcIMS Image Service layers and ArcGIS map service layers, ArcCatalog uses the same icon for layer files created to store either type of layer.



Internet map service layer (based either on an ArcIMS Image Service or an ArcGIS map service)

Linear referencing

■ The new geoprocessing framework introduced at 9.0 contains a set of tools for performing linear referencing. In the new ArcToolbox window, look in the Linear Referencing Tools toolbox (available with an ArcInfo license only).

At 9.0, the ArcGIS 8.x **Route Events Geoprocessing wizard**  (available with an ArcInfo license only) has been removed from the ArcMap Tools pulldown menu. You can still find this wizard in the Linear Referencing category in the Tools > Customize dialog box. If you still want to use this wizard, you can add it to any ArcMap toolbar or pulldown menu from that dialog box.

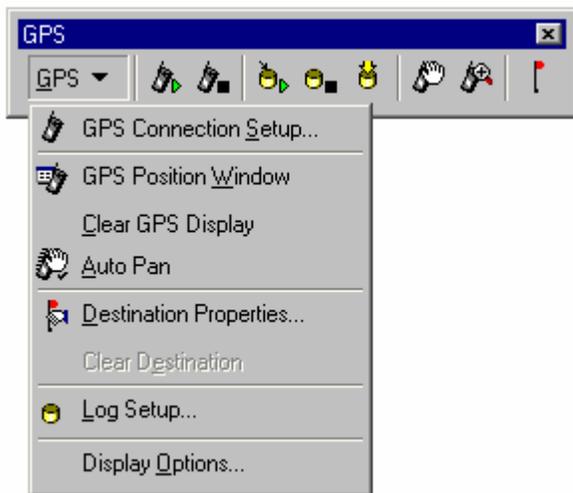
NOTE: No development has been carried out on this wizard since 8.3, and no further development is planned.

Here is where to look to find the operations performed by this wizard in the ArcToolbox window at 9.x:

- Intersect:
 - Linear Referencing Tools toolbox > **Overlay Route Events**
- Union:
 - Linear Referencing Tools toolbox > **Overlay Route Events**
- Dissolve:
 - Linear Referencing Tools toolbox > **Dissolve Route Events**
- Transform:
 - Linear Referencing Tools toolbox > **Transform Route Events**
- Locate point features:
 - Linear Referencing Tools toolbox > **Locate Features Along Routes**
- Locate polygon features:
 - Linear Referencing Tools toolbox > **Locate Features Along Routes**

GPS support

- The GPS toolbar is now standard in ArcMap. Before 9.0, the GPS toolbar was a separate, free download.



Miscellaneous

■ ArcMap performance has been improved in a number of areas, notably the time it takes to start the application, launch the Add Data dialog box, redraw the map after changes have been made in the Table Of Contents, and draw legends.

Other areas where there is an improvement in performance include the time it takes to launch the Tools > Customize dialog box, update the Table Of Contents, and select large numbers of graphics.

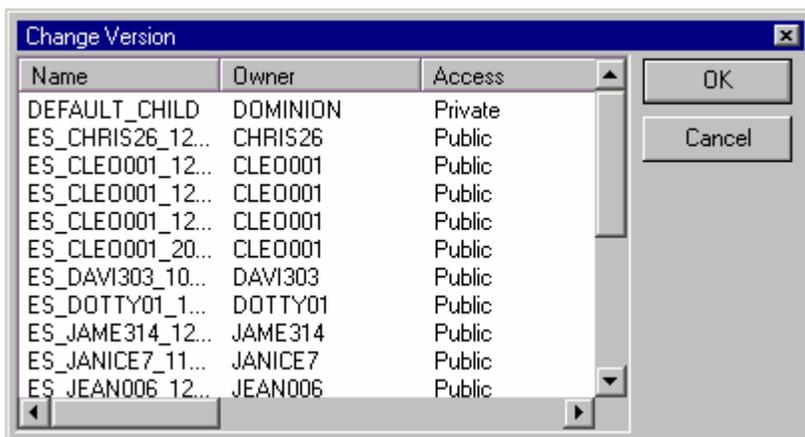
The logic ArcMap uses to determine whether or not the map needs to be drawn in response to changes or additions made to its contents has also been improved. The problem has not been eliminated entirely at this release, but the number of unnecessary redraws you may experience has been cut down.

■ A renewed effort has been made to identify and track down random crashes and other error issues within ArcMap. Progress was made in addressing the issues that have been reported in this area.

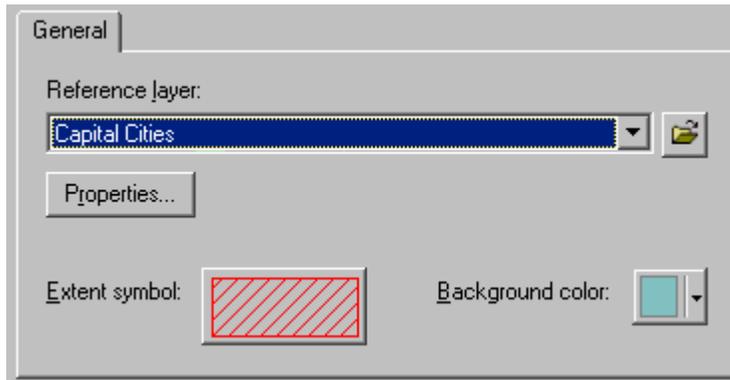
■ The problem where long context menus, such as the context menu for a data frame in the Table Of Contents or the context menu for the Sketch tool, sometimes appeared with a scroll control, forcing you to scroll up and down through the menu to access all the commands, has been fixed. Long context menus now only scroll if they won't completely fit on the screen you are using. Normally, this will not happen unless you are using ArcGIS on a device with a particularly small screen or unless you customize the context menus to add a large number of additional commands.

■ The Edit > Paste command (and the Paste button on the Standard toolbar) now lets you paste layers you have copied. Right-clicking a data frame and choosing the Paste Layer command, which has been renamed as Paste Layer(s) at 9.0, still works too.

■ Working with versioned data: You can now sort columns in the Versions Manager. The Change Version dialog box has changed and now allows you to sort the list by any of its three headings: Name, Owner, or Access.



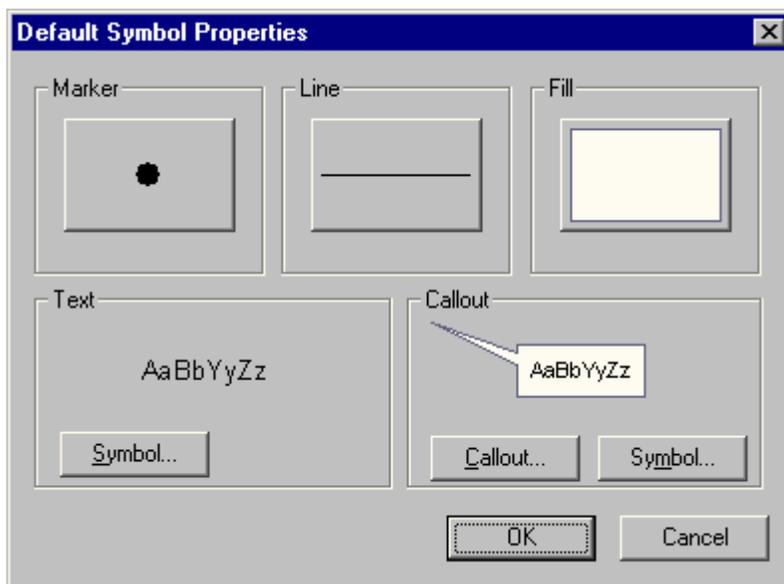
■ Overview window Properties dialog box. You can now specify a background color for the Overview window. The option to browse for a reference layer has been removed from the dropdown list and standardized as a button to the right of the dropdown list.



■ Several new commands have been added to the Help pulldown menu for ArcMap and all the ArcGIS Desktop applications. These commands give you immediate access to ESRI support and training resources on the Web, including the ESRI Support Center, ArcObjects Online, and the Virtual Campus.

■ If you have used the English language version of ArcGIS Desktop 8.x on a platform running a non-English language version of Microsoft Windows, you may have seen some dialog boxes in which some user interface text is partially truncated. This is due to the wider system font that gets used for English text in Microsoft Foundation Class-based dialog boxes on certain platforms, such as the Korean version of Windows NT 4. More than 50 text truncation problems have been fixed at 9.0.

■ The Default Symbol Properties dialog box has been improved. Separate buttons have been added for launching the Text Symbol Selector dialog box for the default text symbol and the text symbol used in the default callout. You can now also specify the default properties for the callout itself.

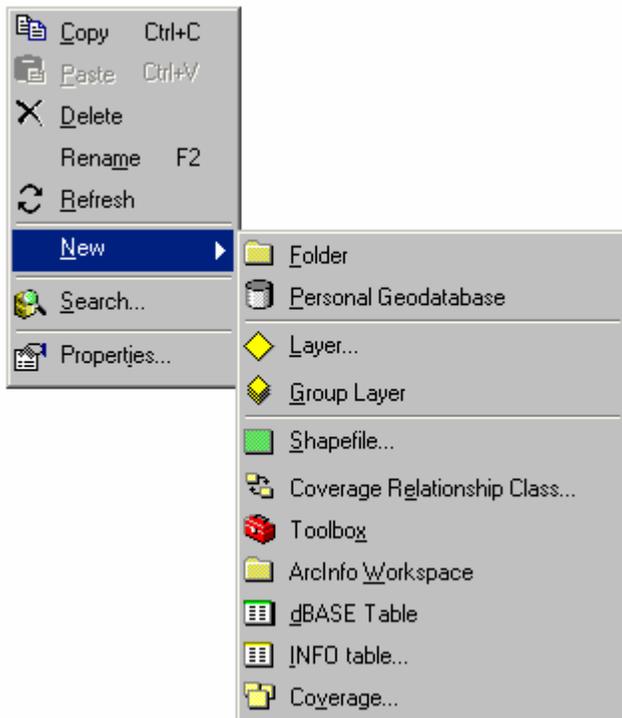


Other ArcCatalog changes

General

■ The performance of ArcCatalog has been improved in a number of areas, notably the time it takes to start the application.

■ Icons have been added to the New pull-right menus accessed when you right-click items in ArcCatalog or use the File pulldown menu to help you differentiate between the various things you can create. For example, this is what you see if you are an ArcInfo user and you've right-clicked a folder in ArcCatalog:



■ The command for showing and hiding the Catalog Tree window has been moved out of the View pulldown menu and into the Window pulldown menu so that all the commands for controlling ArcCatalog's windows are in the same place. It is also no longer a checkable command. Instead, it has been given an icon so it can easily be added onto the Standard toolbar if you want a rapid way to toggle the Catalog Tree window on and off.

■ When you right-click a map document (.mxd file) in ArcCatalog, you'll see a new Set Data Source(s) command. This launches a dialog box that makes it easy to update or repair some or all of the references to file-based data sources in the map. By default, this dialog box creates a copy of the .mxd file.

This command is also present if you right-click a published map file, although it is disabled if the publisher of the .pmf chose not to provide full access to its contents in ArcGIS applications when it was published.

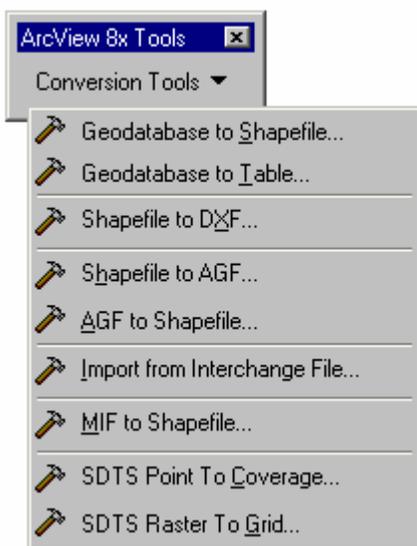
The Set Data Source command cannot be used to update or repair references to data in ArcSDE geodatabases.

■ The dialog box you see if you right-click a map document and choose Properties has been standardized so it now matches the one you see in ArcMap if you choose File > Map Properties. It has everything except for the data source options for setting relative or absolute paths. Data source options can only be set within ArcMap.

Data conversion tools

■ At 9.0, new conversion tools are provided in ArcCatalog that make full use of the new geoprocessing framework. You'll see these tools in ArcCatalog in the Import and Export pull-right menus of the context menu that appears when you right-click data. Tools are provided for importing and exporting one or more items. These tools can also be launched from the new dockable ArcToolbox window that's available in each of the ArcGIS Desktop applications. Like any tools in the new framework, the new conversion tools can be launched individually, run at the command line, used in scripts, or added to models. This makes it easy to combine the tools with other functions and create complete conversion work flows.

■ A new ArcView 8x Tools toolbar has been added to ArcCatalog. To enable this toolbar, go to View > Toolbars. This toolbar provides easy access to some of the ArcGIS 8.x conversion tools commonly used by ArcView users. While this toolbar is available for all license types, its name reflects the fact that it is particularly aimed at ArcView users.



- Geodatabase to Shapefile and Geodatabase to Table Commands are provided for convenience for those users who want to use the 8.x commands for these operations. ESRI recommends that you use the new conversion tools provided at 9.0 instead of these commands. Access the new conversion tools by right-clicking data in ArcCatalog or via the new ArcToolbox window.
- The Shapefile to DXF command is provided because it is available for all license types. You can also access this command by right-clicking a shapefile in ArcCatalog. If you are using ArcInfo, ESRI recommends that you use the Export to CAD tool instead of this command. You can find the Export to CAD tool in the ArcToolbox window or by right-clicking any feature data in ArcCatalog. The Export to CAD tool supports converting to DXF and other formats. The tool is not available if you are using ArcView or ArcEditor.
- The Shapefile to AGF, AGF to Shapefile, and MIF to Shapefile commands are provided because no equivalent tools exists in the ArcToolbox window at 9.0 for these operations.
- The Import from Interchange File command for importing export .e00 files and the Spatial Data Transfer Standard (SDTS) conversion commands are provided because they are available for all license types. The ArcInfo versions of these commands are available in the ArcToolbox window at 9.0 in the Coverage Tools toolbox, but they require an ArcInfo license, and the Coverage Tools toolbox is only present if you have installed ArcInfo Workstation.

You can launch these commands without having to first select the appropriate data in ArcCatalog. However, if you do select the data in ArcCatalog first, this data is automatically used to populate the input field or fields on the dialog boxes.

NOTE: The commands on this toolbar are from ArcGIS 8.x, and no development has been carried out on them for 9.0. These commands do not participate in the new geoprocessing framework.

■ Many of the ArcGIS 8.x tools and wizards for performing data conversion are still available at 9.0. Some of these are presented in the new ArcView 8x Tools toolbar described above. To see the full set of ArcGIS 8.x conversion tools still available at 9.0 in ArcCatalog, click Tools > Customize and click the Commands tab in the dialog box that appears. You'll find the 8.x tools and wizards in these categories:

- ArcGIS 8x Conversion Tools
- ArcGIS 8x GeoDB Conversion Tools

You can drag these ArcGIS 8.x tools into any ArcCatalog toolbar, pulldown menu, or the context menu for the appropriate input data type. If you add ArcGIS 8.x tools into toolbars or pulldown menus, some of them will only become enabled when data of the appropriate input type is selected in the ArcCatalog Contents tab.

These 8.x conversion commands are provided for the convenience of those users who want to use them. However, ESRI recommends that you use the new conversion tools provided at 9.0 instead of these commands. Access the new conversion tools by right-clicking data in ArcCatalog or via the new ArcToolbox window.

NOTE: The commands in these categories are from ArcGIS 8.x, and no development has been carried out on them for 9.0. They are provided on an as-is basis. These commands do not participate in the new geoprocessing framework.

Internet data

- The Internet Servers folder in ArcCatalog has been renamed as the GIS Servers folder.



The new GIS Servers folder contains connections to two types of servers:

- **ArcIMS servers:** Apart from the one icon used for these servers, these connections are unchanged at 9.0.
- **ArcGIS servers:** These are connections to servers created using the ArcGIS Server product, which is a new server product in the ArcGIS 9 family, purchased separately from ArcGIS Desktop. You can connect to an ArcGIS server either locally or via the Internet. If you have the correct permissions, you can add new services to an ArcGIS server you connect to locally. ArcCatalog provides tools for administering ArcGIS servers and their contents.



Connection to ArcIMS server



Connection to ArcGIS server over Internet



Connection to ArcGIS server over local area network (LAN).

In this example, connections have been made to three ArcIMS servers, a local ArcGIS server, and an ArcGIS server on the Internet:



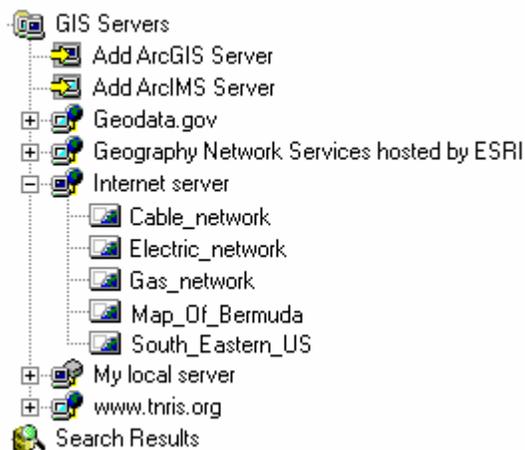
- In 8.3, a connection to the Geography Network ArcIMS server at <http://www.geographynetwork.com> was automatically installed by ArcGIS. At 9.0, this connection is still automatically installed but, as you can see in the graphic above, it's been renamed Geography Network Services hosted by ESRI. The connection still points to <http://www.geographynetwork.com>. This new name better reflects the fact that when you look at the services available on this server, you don't see everything that's available in the Geography Network. It only contains the services in the Geography Network that are hosted by ESRI on that particular ArcIMS server. There are hundreds of additional services on the Geography Network that are not hosted by ESRI. To access these, use the Add Data From Geography Network command in the ArcMap File menu.

■ When you look inside an ArcGIS server, you'll see the services it contains, the same way that you see the services that an ArcIMS server contains when you look inside it. The services you'll find inside an ArcGIS server at 9.0 are map services and geocoding services.

 Map service

 Geocoding service

In this example, you can see that this ArcGIS server contains five map services:



An ArcGIS map service is created by the person or organization publishing it using an ArcMap map document. All the layers in that map document will be in the ArcGIS map service but with this difference: when users of the ArcGIS Server create a map service using an ArcMap document that contains multiple data frames, they choose which one of the data frames they want the service to primarily display when it is accessed via ArcCatalog. So each ArcGIS map service accessed via ArcCatalog will display the contents of one data frame. Custom applications based on ArcGIS map services can access all the data frames in the map service, not just the primary one.

■ There's a new Proxy Server tab in the Tools > Options dialog box in ArcCatalog. The proxy server you specify will be used when you access services from any ArcGIS or ArcIMS server in any ArcGIS application.

Metadata

- The problem of attribute information being scrambled after converting data to a different format or dropping attributes in the middle of a table has been fixed.
- Editing metadata in ArcSDE is now associated with data editing privileges in ArcSDE. You no longer need to be the owner of the data to edit its metadata.
- The Search dialog box in ArcCatalog can now be used to search ISO metadata documents using all search criteria except dates.
- Improvements have been made to the ArcIMS Metadata Service for better scalability and performance.
- Additional sample applications have been added to the ArcGIS Developer Kit and support site, including an exporter for generating templates and a custom page for entering data quality information with the ISO metadata editor.
- Regarding support for metadata standards in ArcGIS 9, ISO 19115 has been finalized. Now a new standard, ISO 19139, is in development. ISO 19139 is the implementation specification for ISO 19115. It will define how ISO metadata should be stored in XML format; the new XML is much different than the format ESRI currently uses. ISO 19139 is also pulling together several different technical committee 211 standards, including spatial referencing, feature cataloging, data quality, geography markup language (GML), and Part 2 of 19115, which adds remote sensing information. Groups that require ISO metadata support are requiring support for ISO 19139 rather than 19115. ESRI is already working on supporting ISO 19139 for the next release after 9.0. Because of this change in tack, no pages have been added to the ISO 19115 version of the metadata wizard for 9.0. When ESRI supports ISO 19139, translators will be provided to let people migrate from their current Federal Geographic Data Committee (FGDC) and ISO metadata to the new standard.
- The Gazetteer Loader command from ArcIMS 4.0.1 is now provided with ArcCatalog to make it more readily available. To add this command into the ArcCatalog user interface, go to the Tools > Customize dialog box and drag the command out of the Gazetteer category. This command lets you populate a gazetteer in an ArcIMS metadata service with records, enabling you to customize your gazetteer by adding places that are not included by default or trimming it down so it only contains places inside the area of interest covered by your metadata service.

Geodatabases

Scalability

■ Many improvements have been made at ArcGIS 9 to the performance and scalability of the geodatabase in a multiuser work flow. Queries have been optimized and overusage of CPU and bandwidth has been eliminated. All multiuser geodatabase users will benefit from these performance gains.

Open geodatabase data exchange via XML

■ You can export all or any part of a geodatabase, such as individual feature datasets, feature classes, and tables, to an export file in XML format. The file can include all of the data or just the schema. You can then send or transfer the file to another user who can import the data into their geodatabase. Disconnected edits can also be transferred and checked in using the export file.

The XML schema used by geodatabases is a published standard (much like shapefiles). This schema provides access to all geodatabase data types. This will allow other applications to import and export data in a geodatabase-friendly format. This XML format is not engineered as a direct read format; rather, it is a data exchange format. It is expected that other applications will import the XML file to their native formats, then export back to XML format when editing. The geodatabase exchange format will allow complete export; change only export, for example, disconnected editing; and schema only export. By providing a way to exchange geodatabase information, users can publish data models and share geodatabase datasets in a completely open and interoperable environment.

To export data from a geodatabase in ArcCatalog, right-click the geodatabase, feature dataset, feature class, or table you want to export, then from the Export pull-right menu click the XML Workspace Document command.

To import data from an export file in ArcCatalog, right-click the geodatabase you want to import to, then from the Import pull-right menu, click the XML Workspace Document command.

Geodatabase conversion tools

■ At 9.0, new tools are provided for importing to and exporting from geodatabases that make full use of the new geoprocessing framework. You'll see these tools in ArcCatalog in the Import and Export pull-right menus from the context menu that appears when you right-click a geodatabase, any type of data in a geodatabase, or any file-based data that can be converted into a geodatabase. Tools are provided for importing and exporting one item or multiple items. These tools can also be launched from the new dockable ArcToolbox window that's available in each of the ArcGIS Desktop applications. Like all of the tools in the new framework, the new conversion tools can be launched individually, run at the command line, used in scripts, or added to models. This makes it easy to combine the tools with other functions and create complete conversion work flows.

TIP: Most of the ArcGIS 8.x tools and wizards for converting to and from geodatabases are still available at 9.0. In ArcCatalog, click Tools > Customize and click the Commands tab in the dialog box that appears. You'll find the 8.x tools and wizards in the ArcGIS 8x GeoDB Conversion Tools category. You can drag any ArcGIS 8.x tool onto any ArcCatalog toolbar, pulldown menu, or the context menu for the appropriate input data type. If you add ArcGIS 8.x tools to toolbars or pulldown menus, some of them (not all) will only become enabled when data of the appropriate input type is chosen in the ArcCatalog Contents tab. Note that no new development has taken place on the ArcGIS 8.x tools available via the Tools > Customize dialog box since ArcGIS 8.3 was released; these tools are provided on an as-is basis.

New data types

■ At 9.0, **raster data** is fully integrated into the geodatabase, with improvements in how raster data is stored and managed as well as new tools for building and working with raster catalogs in geodatabases. Raster datasets and raster catalogs can also now be stored in personal geodatabases. See the 'Raster Data' section in this document for more information.

Geodatabase tools that previously only applied to feature data now also apply to raster data. For example, data in rasters and raster catalogs can be extracted using the Extract Data commands in the Disconnected Editing toolbar. Raster data can also be included in a checkout, but changes to the rasters will not be checked in.

■ You can now define **fields** of type raster. Supported for feature classes and standalone tables in personal and ArcSDE geodatabases, they enable you to store rasters, such as digital photos, in tables so they can be accessed across all ArcGIS Desktop applications via the Table window and Identify function. See the 'Raster Data' section in this document for more information.

■ Whenever you create a new table or feature class, you select a data type for each field. **GlobalID** and **GUID** are data types new to 9.0 that store registry style strings that uniquely identify a feature or table row within a geodatabase and across geodatabases. Developers can use these new data types in relationships or in any application requiring globally unique identifiers.

■ Feature classes of type **multipatch** can now be created in geodatabases. Multipatch feature classes are used primarily to represent 3D objects for use in the 3D Analyst extension. To create an empty multipatch feature class in a geodatabase, use the New Feature Class command. When you get to the panel for defining fields, click the Shape field and set the Geometry Type property of the Shape field to Multipatch. Creating new multipatch feature classes in geodatabases doesn't require the 3D Analyst extension.

Disconnected editing

■ In 9.0 you can now edit data that has been checked out to a personal geodatabase if you have an ArcView license. In 8.3 you were not able to edit a check-out personal geodatabase with an ArcView license. Note that the same rules still apply regarding what you can and can't edit in the check-out personal geodatabase with an ArcView license as in the case of a non-checkout personal geodatabase. For example, topologies can't be edited with an ArcView license, but simple feature classes can.

■ New file format for transferring disconnected edits: In 8.3, if you didn't want to check in directly from the checkout geodatabase, you exported only the changes from the checkout geodatabase to a delta database, transferred the delta database, then checked in the changes from the delta database. Instead of exporting to a delta database, you can now export changes to a smaller XML file and transfer it. The changes can then be checked in from the XML file.

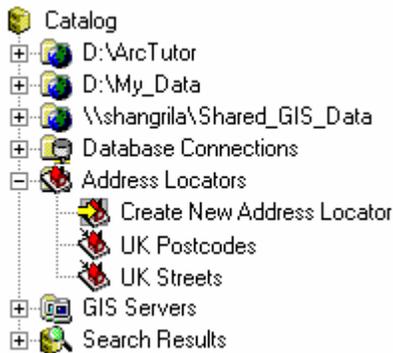
Miscellaneous

■ You can now define a cluster tolerance for z coordinates in a **topology**.

■ The documentation for specifying the x,y domain for new datasets when you use the Spatial Reference Properties dialog box has been improved. You can find this new documentation in the ArcGIS Desktop Help and the printed documentation for working with geodatabases. You can also access it directly via the About Setting the X/Y Domain button that you'll find on the X/Y Domain tab in the Spatial Reference Properties dialog box.

Geocoding

■ Geocoding services have been renamed as Address locators throughout ArcGIS. The Geocoding Services folder in the ArcCatalog tree is now the Address Locators folder.



In previous releases, the terms geocoding service and locator were used somewhat interchangeably. Locator is the term that was used for developers, and geocoding service was the term used in the user interface. This caused some confusion for people. Also, at 9.0 the ArcGIS Server product enables users to create geocoding servers that provide geocoding-based services. Renaming geocoding services to address locators in the ArcGIS user interface removes possible confusion between address locators on disk or in databases and geocoding-based services being served via ArcGIS Server.

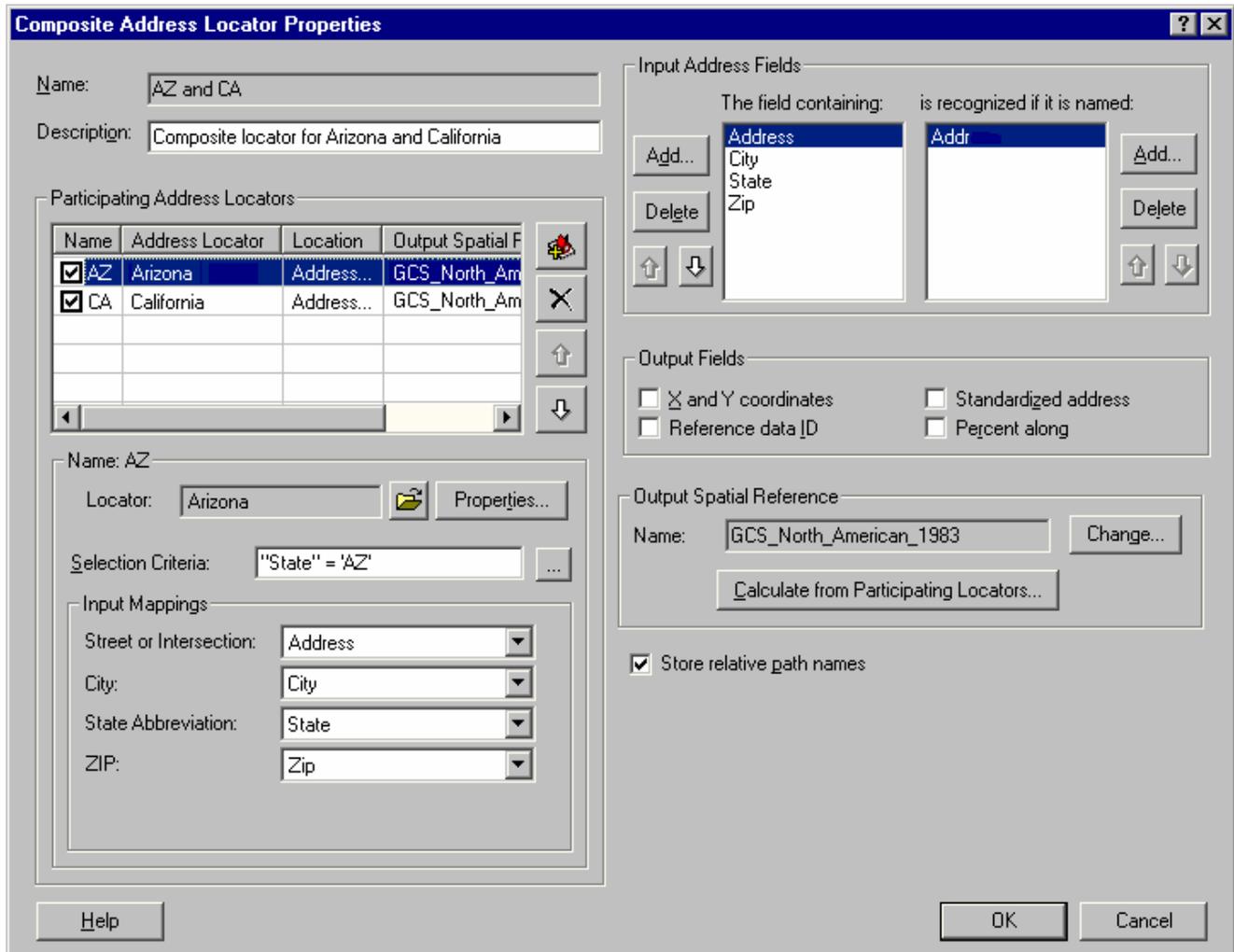
■ When you create an address locator, you now have the choice to create a **composite** address locator that references several other address locators and chains them together. With a composite address locator you can perform "one pass" geocoding using multiple address locators and their reference data. This lets you use separate address locators for different geographic areas or different levels of detail to provide custom fallback strategies to maximize the number of addresses that can be successfully geocoded.

For example, you can create a composite address locator composed of three separate locators that lets you geocode against detailed street data for a county, fall back to a generalized street network if the address is not found, and finally fall back to ZIP Codes if the address is still not found.

When you define a composite address locator, you also can define selection criteria that control when particular address locators that participate in the composite locator will be used when you geocode. For example, a composite locator can be defined so that if the Country field in an address is equal to "USA", the address will be geocoded by the StreetMap USA locator, while Canadian addresses will be sent to a different locator.

To create a composite address locator, choose the Composite locator style when you create a new address locator.

The example below shows a composite locator that comprises two address locators, one for each of two states. Selection criteria have been defined so that based on the value of the State field, the address locator for the appropriate state is used.



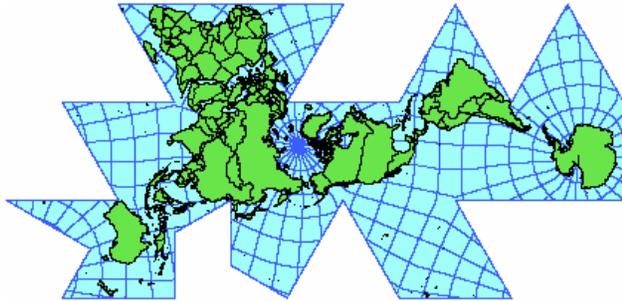
■ A new option is available in the Geocoding Settings tab of the Feature Class Properties dialog box for geodatabase feature classes created by geocoding. The Add new records in unmatched state check box lets you choose the state in which new records will be added. When this is checked, additional records added to this geodatabase feature class will be in an unmatched state. This option only applies to geodatabase feature classes that were geocoded using the Create dynamic feature class related to table option in the Geocode Addresses dialog box or the Geocode Addresses geoprocessing tool. The dynamic feature class option is only available when the address table and the geocoded feature class are in the same geodatabase. It is not available if the output is a shapefile.

Coordinate systems

In addition to the enhancements listed here, many quality and performance issues have been addressed in this part of the software.

■ Additional map projections supported:

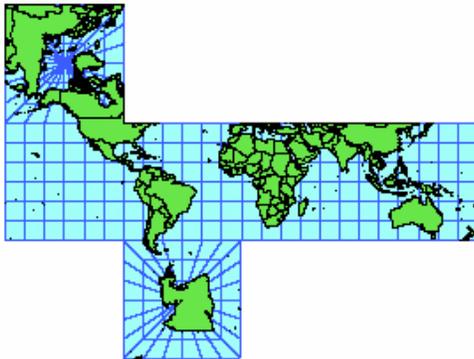
- **Fuller** projection: The final version described by Buckminster Fuller in 1954 is supported. This projection converts the globe into a 20-sided figure called an icosahedron.



- **Local Cartesian** projection: An improved version of the ArcInfo Workstation LOCAL projection is supported. Unlike the Workstation version, the ArcGIS Desktop Projection Engine adds support for a scale factor, a rotation value, and false easting and northing parameters. This is a specialized map projection that does not take into account the curvature of the earth. It's designed for large-scale mapping applications.
- **Robinson ArcInfo**: This is the same version of Robinson that's supported in ArcInfo Workstation.
- **Rectified Skew Orthomorphic (RSO)** projection: This is used for coordinate systems in Malaysia and Borneo.



- **Cube** map projection: This is a faceted projection used behind the scenes by the ArcGlobe application in the 3D Analyst extension when it prepares data for caching. The world is projected onto a six-sided figure with square sides. Although this projection is not normally used directly in mapping, it may be suitable for educational purposes.



- Support has been added for more than 250 additional geographic transformations. These include:
 - Replacement of the state-level National Transformation Version 2 (NTv2) files with the new national files for Australia.
 - NTv2 transformations files for France, the island of Grand Terre, and the area around Noumea in New Caledonia.
- New coordinate system (.prj) files:
 - More than 300 geographic coordinate system files, including ones for the Minnesota and Wisconsin county systems, planets and moons in the solar system, and many others from the European Petroleum Survey Group (EPSG) (<http://www.epsg.org/>) database.
 - Almost 1,000 projected coordinate systems, including the Minnesota and Wisconsin county systems, three-degree Gauss–Kruger zones for China and Russia, Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) grid systems, Lambert Azimuthal, and Lambert Conformal Conic systems for Europe, RSO systems for Malaysia and Borneo, Australian Integrated Survey Grid (ISG) zones, Universal Transverse Mercator (UTM) and large-scale mapping zones based on Japanese Geodetic Datum 2000 (JGD2000), several U.S. statewide zones, and state plane zones based on international feet.

Application development and deployment

ArcGIS 9 provides a complete system for GIS application development. ESRI offers developers enormous flexibility in selecting a development platform for ArcGIS. ArcObjects is at the core of these choices, offering an integrated collection of GIS software objects written in C++. Developers can choose from four development environments (Java, .NET, C++, and Component Object Model). Until now, developers have only been able to customize the ArcGIS Desktop applications. At 9.0 developers also have the ability to deploy ArcGIS solutions as independent applications on the desktop or as Web services across the Intranet or Internet.

Developers can choose from three deployment options:

- **ArcGIS Desktop:** Custom applications deployed with the desktop applications.
- **ArcGIS Engine** (separately available product, new at 9.0): ArcGIS Engine is a new developer product that provides a powerful collection of embeddable mapping and GIS components for creating and deploying custom GIS and mapping desktop applications. With ArcGIS Engine, developers can build solutions and deploy them to customers without requiring the ArcGIS Desktop applications (ArcMap, ArcCatalog) to be present on the same machine. Developers can create new applications or add dynamic mapping and GIS capabilities to existing applications. Solutions created using ArcGIS Engine can vary from simple map viewers to more sophisticated GIS applications for integrated data visualization, analysis, and management. ArcGIS Engine supports all the standard development environments, including .NET, COM, Java, and C++. The initial 9.0 release of ArcGIS Engine is available only on Microsoft Windows. More information is available at <http://www.esri.com/arcgisenine>.
- **ArcGIS Server** (separately available product, new at 9.0): ArcGIS Server is a GIS enterprise application server that provides complete GIS capabilities throughout an organization while maintaining a centrally managed database. Mapping, geocoding, spatial queries, editing, tracing, and linear referencing are all examples of applications that developers can build using ArcGIS Server. These applications can be accessed by browser-based clients, custom applications built with ArcGIS Engine, and ArcGIS Desktop. ArcGIS Server supports all common development environments (Java, .NET, C++, COM). The initial 9.0 release of ArcGIS Server is available only on Microsoft Windows. More information is available at <http://www.esri.com/arcgisserver>.

ArcGIS Server is designed primarily for enterprise information system developers and integrators who want to build server-side GIS applications in either a client/server or Web services environment. It is complementary to ESRI's two other enterprise application server products: ArcSDE, which is used to access spatial data in a commercial DBMS, and ArcIMS, which is used for high-volume Internet geopublishing.

■ There's a new ArcGIS Developer Web site for 9.0 at <http://arcgisdeveloperonline.esri.com>. A shortcut to this site is to choose the ArcGIS Developer command in the Help pulldown menu of any of the ArcGIS Desktop applications.

The ArcGIS 8.x ArcObjects Online Web site is still available at <http://arcobjectsonline.esri.com>.

Licensing

■ For the 9.0 release, the name of the License Manager has changed. Previous versions of the software use the name ESRI License Manager. ArcGIS 9 uses the name ArcGIS License Manager, which reflects the new vendor daemon used (ARCGIS). The default port number for the new ARCGIS daemon is 27004, and the license file variable is ARCGIS_LICENSE_FILE=@<host>.

■ At the 9.0 release, ArcIMS and ArcSDE software no longer use the FLEXlm License Manager. At 9.0, these products—as well as ArcGIS Engine, ArcGIS Server, and ArcView (Single Use)/ArcEditor (Single Use)—all require that you register and authorize the software for use.

■ ArcGIS 9 Desktop and ArcInfo 9 Workstation cannot use an older version of the License Manager or pre-9.0 license files. To run ArcGIS Desktop and/or ArcInfo Workstation at 9.0, you will need to upgrade your license file to a 9.0 license file. To do so, see <http://service.esri.com>. Once you have obtained your new file, you can install the 9.0 License Manager from the Desktop or Workstation CDs.

■ During the transition period, you can maintain both an 8.x and 9.0 License Manager on one machine, or you can separate them on two machines. If you want to use only one machine, then you must use your existing 8.x hardware key number to request your new 9.0 license file.

■ ESRI will systematically generate two license files that will be sent back to you.

- A 9.0 license file, which will contain all the licenses you had on maintenance (licenses you were entitled to upgrade).

- An 8.x license file, which will contain the number of licenses you did not have on maintenance (or which you chose not to upgrade). Should you upgrade all of your licenses to 9.0, this 8.x file will not be generated.

■ While your organization is in transition, you can continue to use your existing 8.x license file along with the License Manager you installed with 9.0. However, once the transition period is complete and all of your licenses on maintenance have been upgraded to 9.0 and installed, you will need to either replace your existing 8.x license file with the new 8.x license file that was sent to you or, if no 8.x file was sent, you will need to completely uninstall your 8.x ESRI License Manager.

If, for example, only some of your licenses are on maintenance:

Software Name	License Type	Total Seats	On Maintenance	Maintenance Expiration
ArcInfo	Floating	5	3	10/31/04

If you decide to upgrade all licenses (those on maintenance) to version 9.0, then ESRI will generate and send you:

- A 9.0 file with three ArcInfo 9 licenses

- An 8.x file with two ArcInfo 8.x licenses

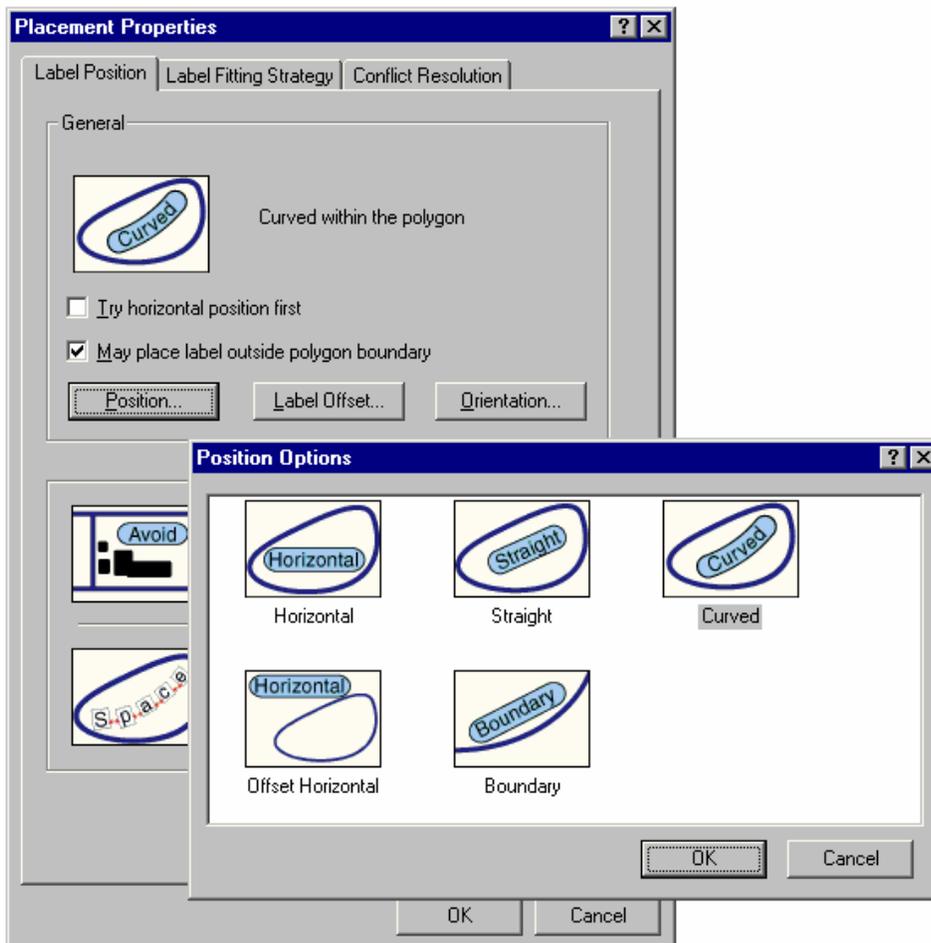
■ For more information on these topics or any other portion of the License Manager please visit the License Manager Reference Guide found in the Documentation directory on your ArcGIS 9 Desktop or ArcInfo 9 Workstation CDs.

New extension: Maplex for ArcGIS

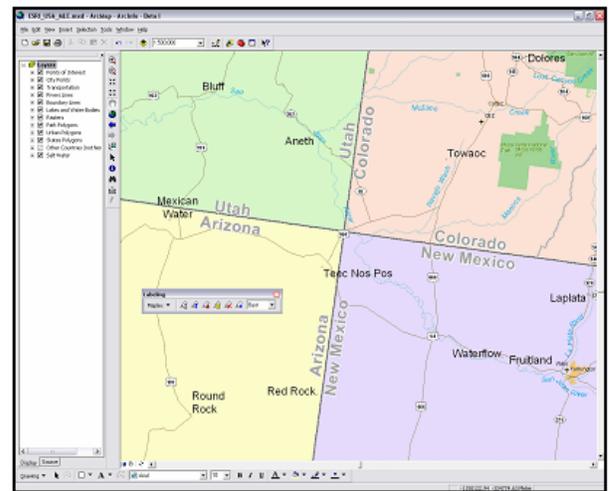
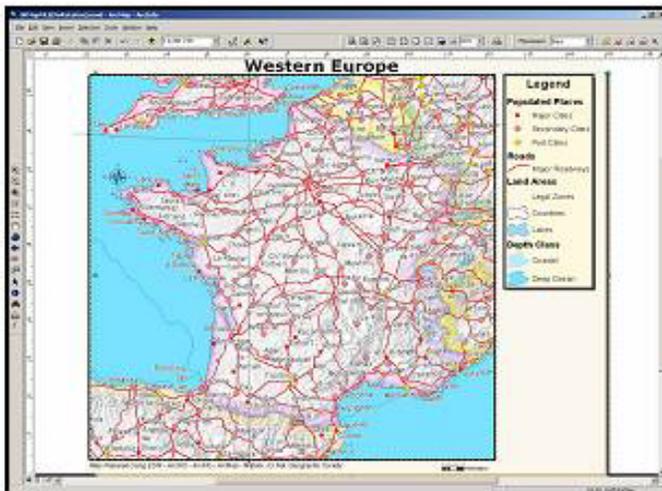
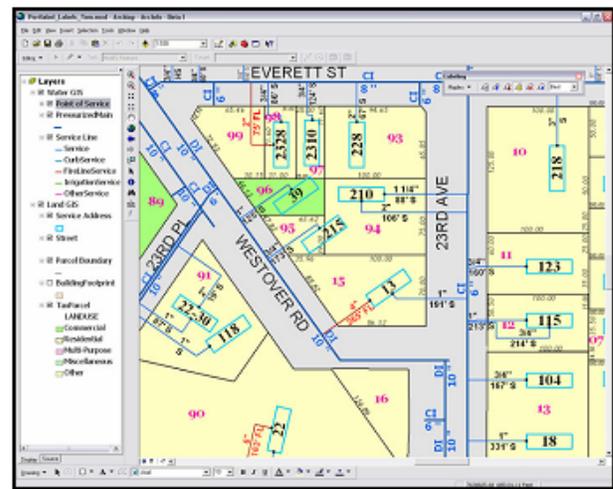
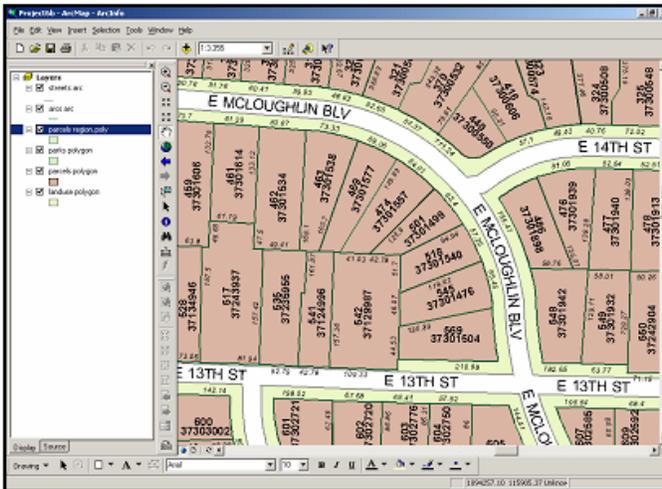
Maplex for ArcGIS allows high-quality cartographic label creation using advanced label placement and fitting techniques. Using an advanced conflict detection algorithm, Maplex can place a larger number of labels in appropriate locations. If you need to produce cartographic labeling of the highest quality, the Maplex extension will save you many hours of intensive manual labeling time. The advanced label placement capabilities provided by the extension can also be used when you create and edit annotation feature classes in geodatabases.

■ Maplex extends the standard label properties with advanced settings for placement and fitting. Some of these properties include:

- Automatic font reduction
- Automatic label stacking
- Automatic abbreviation
- Boundary placement
- Repeating labeling
- Automatic character spacing
- Control of the label overrun on features
- Setting feature weights
- Setting boundary weights
- Draft or production-quality placement



The following are some examples of labeling generated with the Maplex for ArcGIS extension:



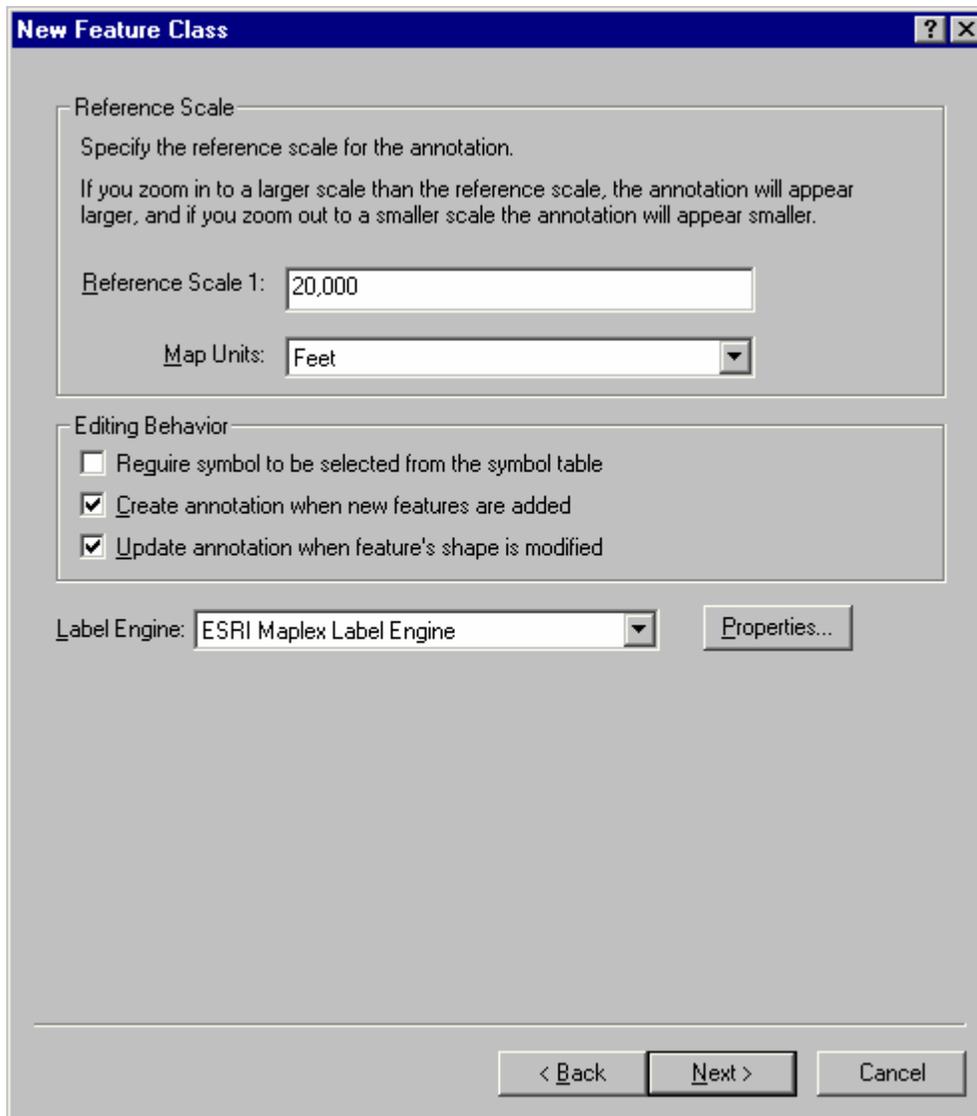
■ The Maplex for ArcGIS extension is fully integrated into the new labeling user interface in ArcMap 9. The extension uses the same Labeling toolbar and Label Manager as standard ArcMap, with the addition of new label handling options and functionality not available in the standard labeling user interface. There isn't a separate toolbar for the Maplex extension. Here's what the Labeling toolbar looks like if you have installed the Maplex extension:



TIP: You can open a map document containing Maplex labels whether or not you have the Maplex extension. If you open a map document containing Maplex labels and you don't have the Maplex for ArcGIS extension, you'll simply get a message and the standard label engine will be used instead of Maplex to label the map.

■ The Maplex for ArcGIS extension is also fully integrated into the new annotation functionality in 9.0. When you create and edit annotation, you can use Maplex to generate the annotation placement.

In the screenshot below, a feature-linked annotation feature class is being created in a geodatabase in ArcCatalog, and the Maplex label engine has been selected to generate the annotation placement.



TIP: You can view and edit an annotation feature class that uses Maplex label placement whether or not you have the Maplex extension. In the case of editing standard annotation (annotation that is not feature-linked), there's no difference. In the case of editing feature-linked annotation, ArcMap will automatically use the standard label engine when it needs to place new annotation if a Maplex license is not available.

If you want to create an annotation feature class using Maplex label placement or edit a feature-linked annotation feature class using Maplex to place new annotation, you will need to have the Maplex extension.

3D Analyst extension

At ArcGIS 9 the 3D Analyst extension presents new functionality in three major areas: 3D visualization, 3D symbology, and 3D geoprocessing. ArcGlobe is the next generation of 3D visualization. ArcGlobe allows many gigabytes of data to be seamlessly merged on the fly into a single fast visualization experience. Enhanced 3D symbology includes true 3D symbols and realistic texture support. In addition, there is a new set of 3D Analyst tools presented in the geoprocessing framework at 9.0.

ArcGlobe

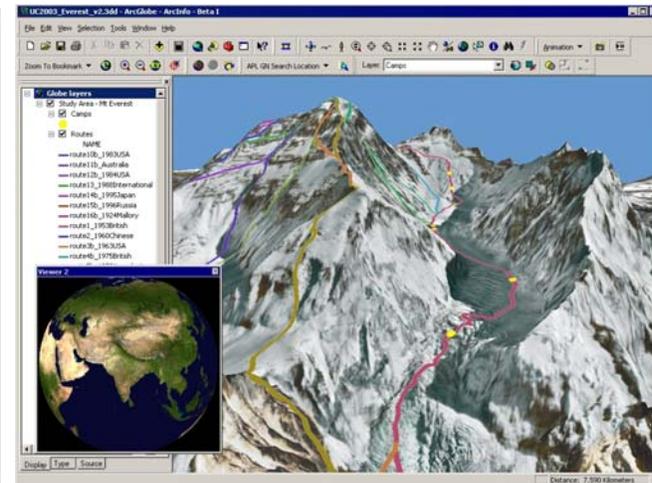
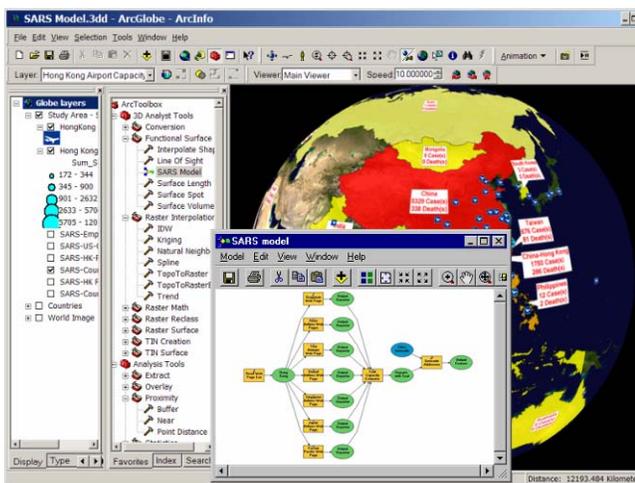
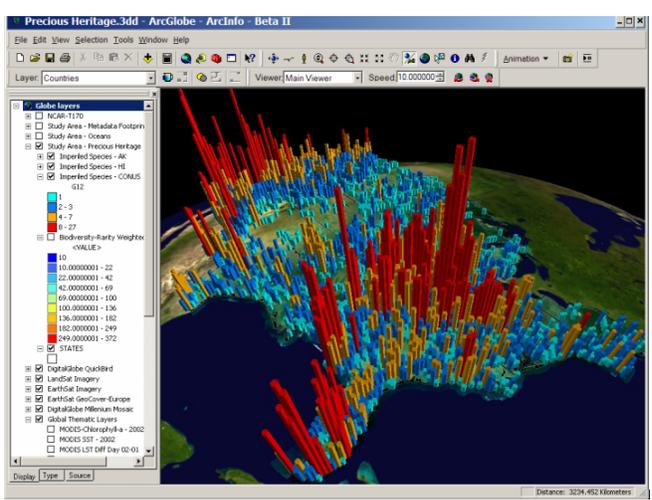
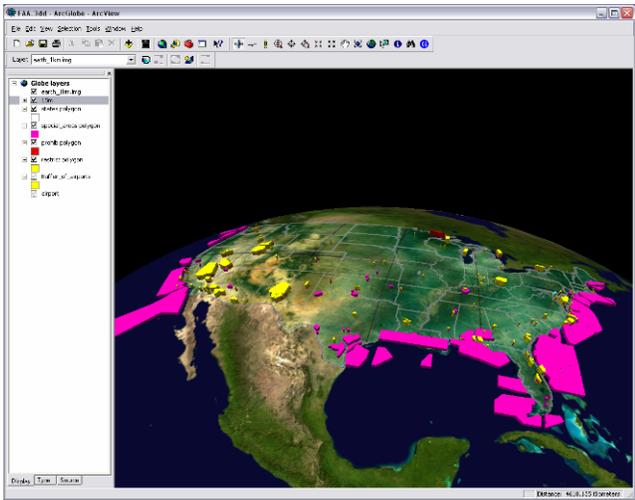
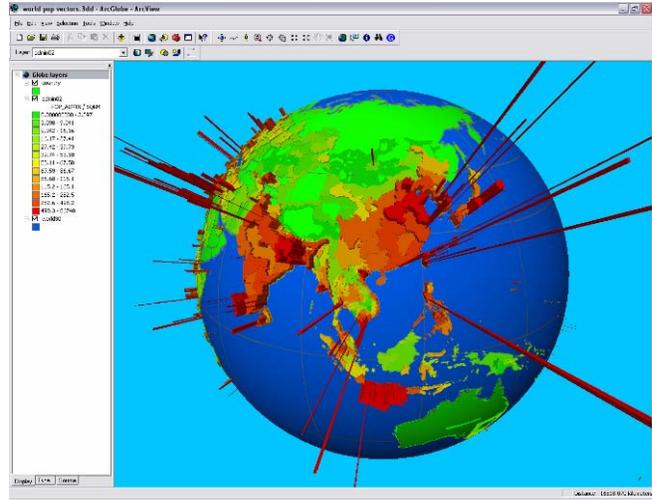
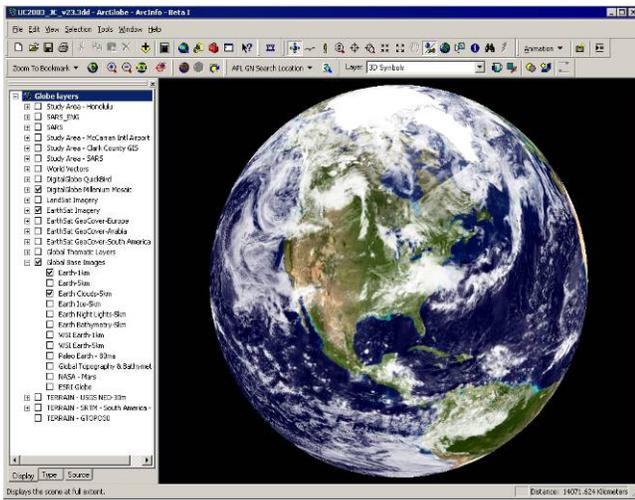
■ The 3D Analyst extension includes a completely new application called ArcGlobe. ArcGlobe provides a highly interactive 3D visualization and analysis application for working with large and varied GIS datasets. Using a special indexing structure, ArcGlobe allows users to quickly navigate gigabytes and terabytes of GIS data without preprocessing it. ArcGlobe also integrates with the new ArcToolbox framework, allowing tools, models, and scripts to be executed within this highly dynamic environment.

ArcGlobe provides the same basic functionalities as ArcMap, excluding graphics, editing, and page layout. This means users can:

- Select by attribute, by location, or interactively.
- Identify features.
- Symbolize features.
- Extrude features to 3D.
- Use 3D symbols.
- Navigate (equivalent of pan, zoom).
- Find based on an attribute.
- Find based on an address.
- Find based on a location using a global gazetteer.
- Rotate globe.
- Interactive fly or walk through mode.
- Record animation to Audio Video Interleave (AVI) or QuickTime.
- Animate the display automatically.
- Integrate raster, vector, and terrain data, including data being served on the Internet.
- Display data on the surface at a specified elevation or on a different specified surface.
- Customize the application with Visual Basic for Applications (VBA) or COM.

ArcGlobe and ArcScene, while engineered for different users, overlap in many areas of functionality. ArcScene is good for small, local projects with relatively small amounts of data. ArcScene has more interactive tools and graphic support than ArcGlobe, making it ideal for some analysis and visualization tasks. ArcGlobe focuses on using larger amounts of data, which allows the user to seamlessly integrate this data into a single globe-based document.

Examples of dramatic visualizations created with ArcGlobe. The screenshot at the bottom left shows a model created with the new geoprocessing framework with results displayed in ArcGlobe. The tight integration of modeling and 3D visualization is a new and powerful feature of the 3D Analyst extension at 9.0. (Some data shown below courtesy of DigitalGlobe and NatureServer [Natural Heritage Programs]).



3D symbols

■ 3D Analyst adds support for using 3D symbols. This allows you to represent GIS features with 3D symbology, such as using houses or cars for point features, grass or water texture fills for polygon features, and tubes or textured lines for line features. ArcScene and ArcGlobe both support these new 3D symbols. In the standard symbol selector dialog box, you can choose various 3D symbol types.

For points:

3D Character Marker: 3D symbols from TrueType fonts extruded

3D Marker: Import of OpenFlight, 3D Studio, and Virtual Reality Modeling Language (VRML) models

3D Simple Marker: Simple shapes

For lines:

3D Simple Line: Simple line shapes of tube, wall, and strip

3D Textured Line: Strip line with image texture (such as a photo of a road)

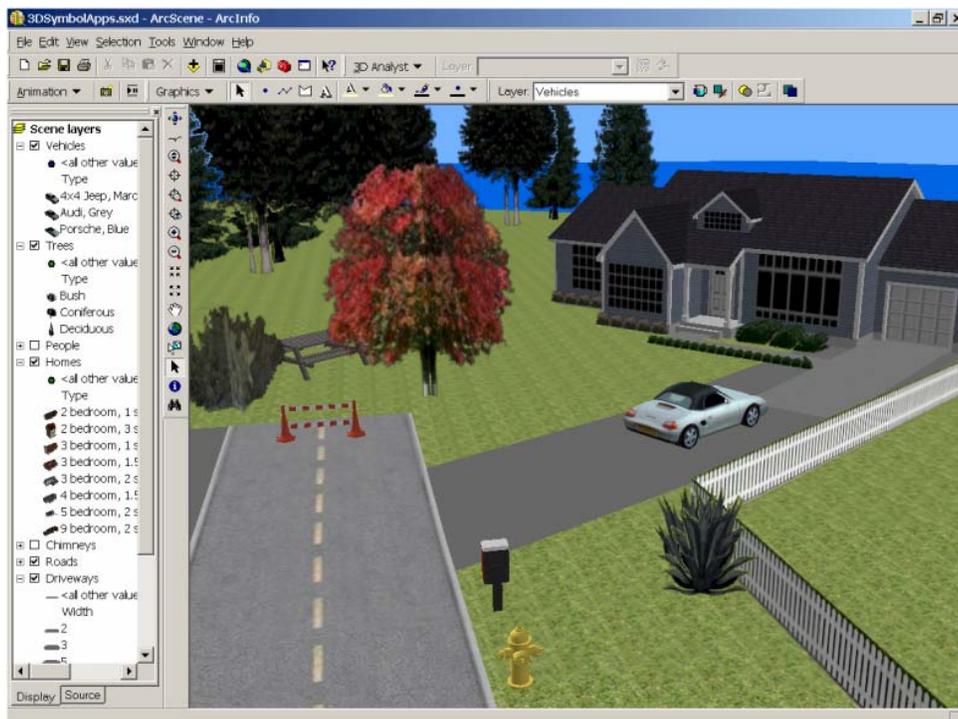
For polygons:

3D Texture Fill: Allows the user to pick an image to use as a fill pattern—for example, grass, water, pavement.

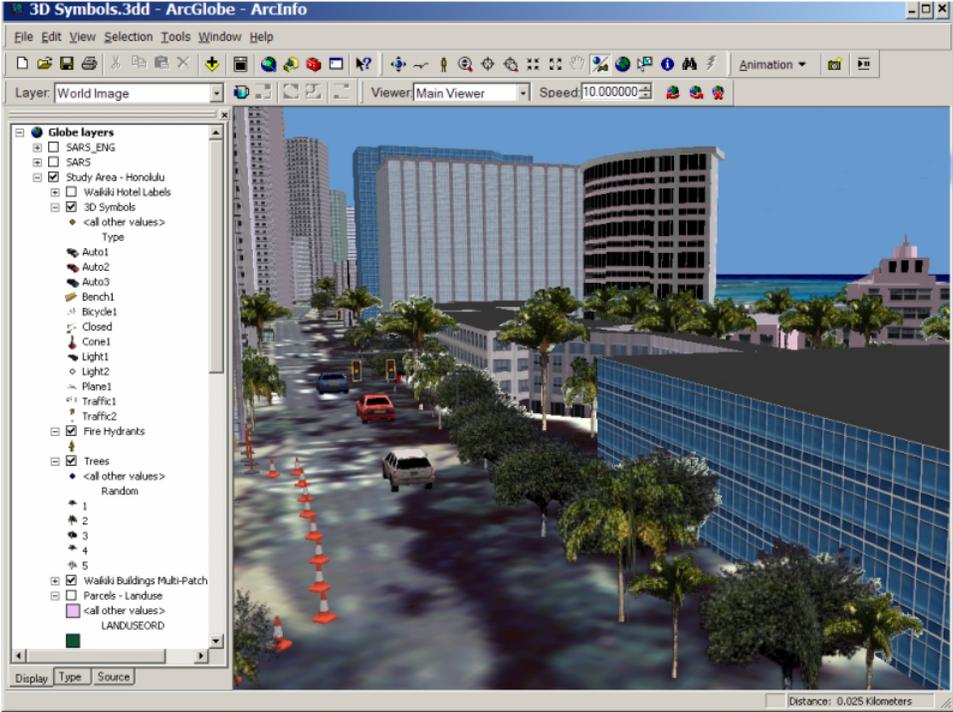
In addition, you can choose from a variety of supplied 3D styles and more than 500 quality 3D objects. These styles include:

- 3D houses
- 3D skyscrapers
- 3D industrial buildings and equipment
- 3D basic shapes
- 3D street furniture (signs, lights, benches)
- 3D trees (and shrubs)
- 3D vehicles

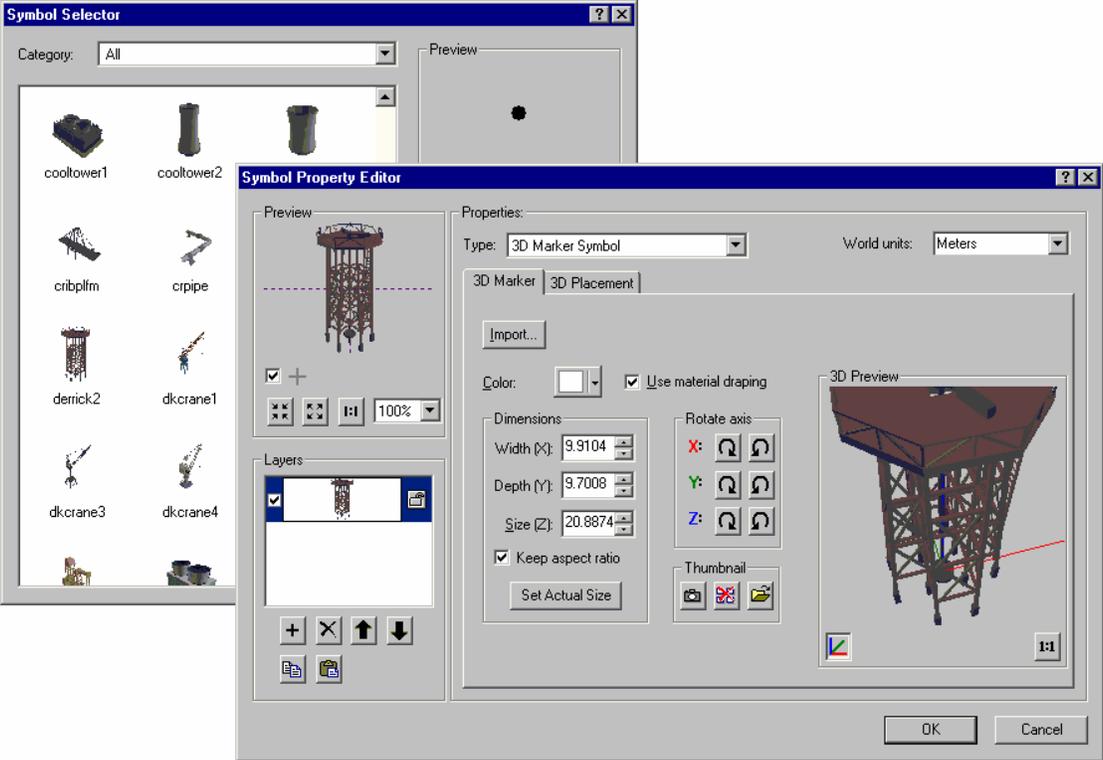
Various 3D symbols and textures used in ArcScene are illustrated below.



3D symbols, including palm trees and textures on the buildings and ocean, add realism to the ArcGlobe display below (data courtesy of the City and County of Honolulu).



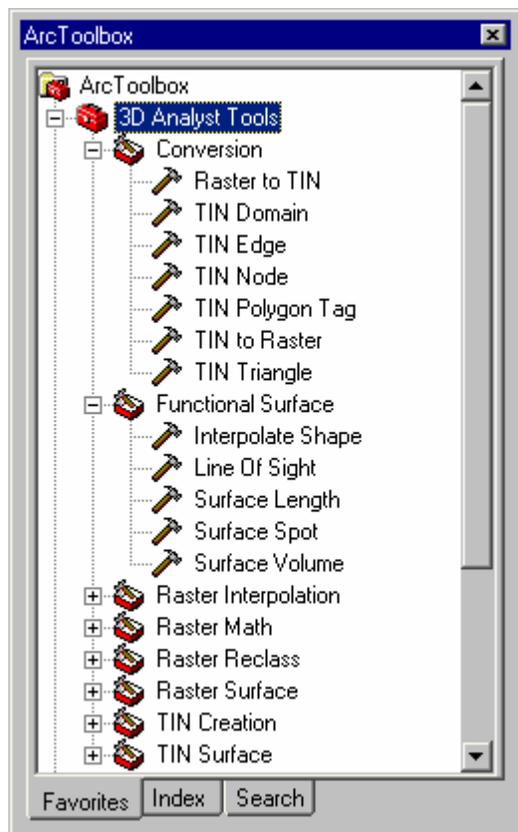
3D Symbol Property Editor



3D geoprocessing

■ While the 3D Analyst toolbar you are familiar with from ArcMap 8.x is still in the product, it is not provided in the new ArcGlobe application. However, at 9.0 there is a new suite of geoprocessing tools for working with 3D data provided in the new geoprocessing framework. Use these tools to take full advantage of modeling, scripting, and so forth, in your 3D analysis work. The new ArcToolbox window is available in ArcMap, ArcCatalog, ArcScene, and ArcGlobe. This means that for the first time you can perform your 3D analysis and data processing directly inside ArcCatalog, for example.

The screenshot below shows the toolsets you'll find in the 3D Analyst Tools toolbox at 9.0. Two of the toolsets in the tree have been expanded so you can see the tools they contain.

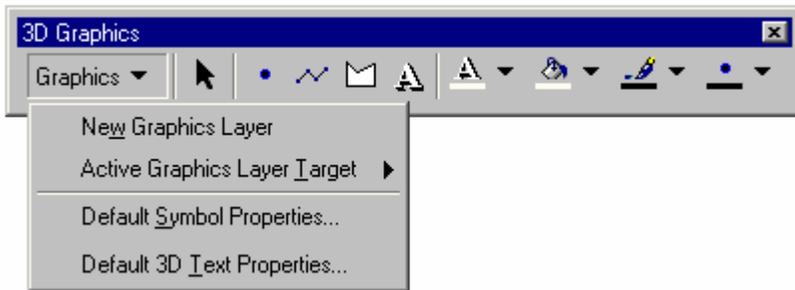


For an introduction to the geoprocessing framework and its capabilities, refer to the 'Geoprocessing' section of this document.

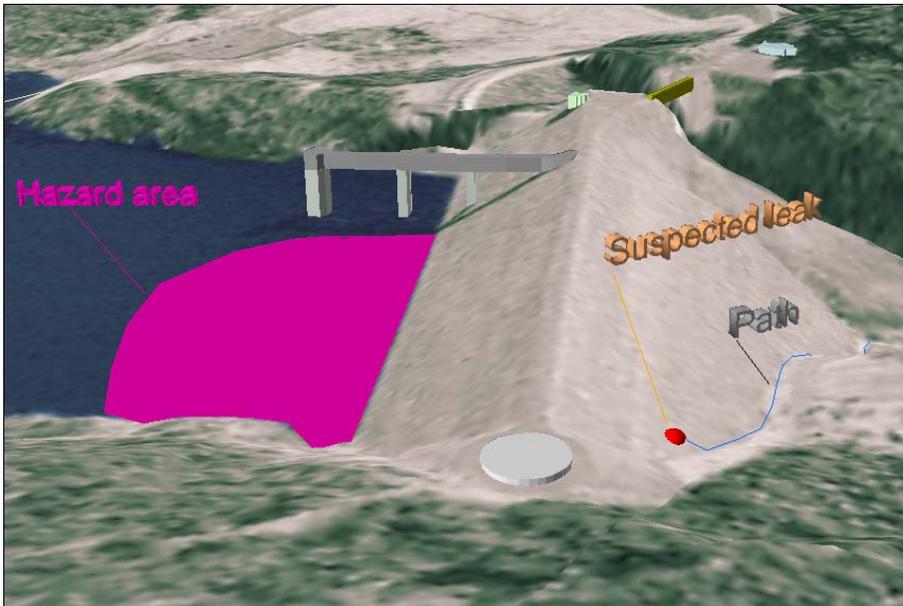
For a quick overview of how to use geoprocessing to work with layers, see the 'Geoprocessing in ArcMap at 9.0' topic in the 'Other ArcMap changes' section of this document.

Other ArcScene changes

- At 9.0, you can now draw 3D graphics and text directly onto scenes using the new 3D Graphics toolbar.



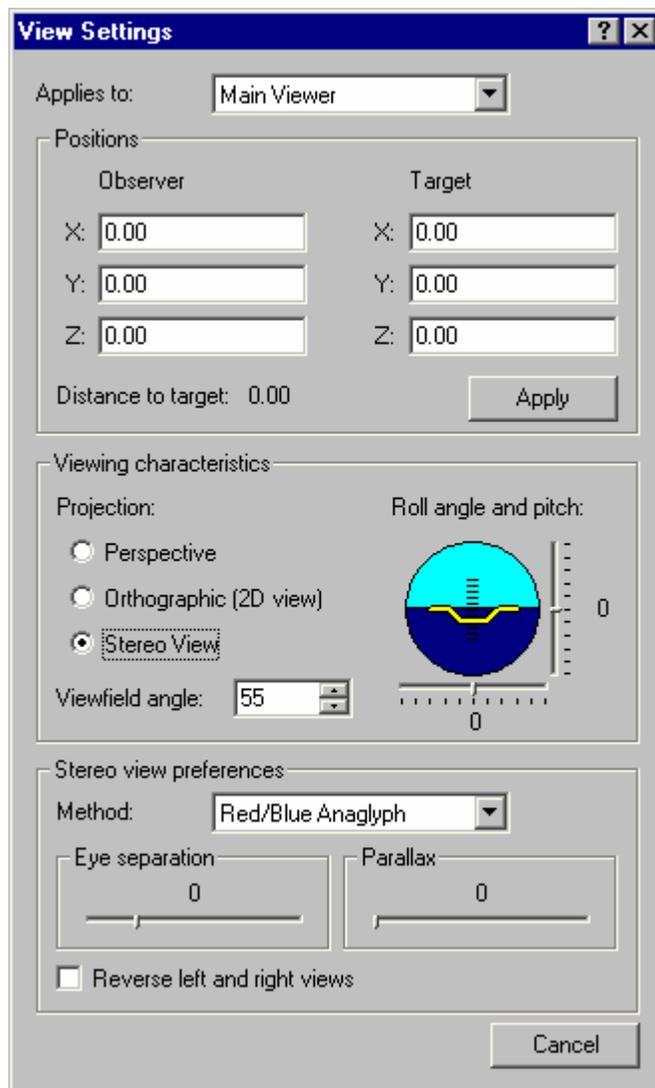
Use 3D graphics and text to enhance your scenes or 3D maps. You can draw points, lines, polygons, and 3D text to highlight parts of your scene. For example, you might define a study area by enclosing it with a line or polygon boundary or label buildings with text indicating their names.



- ArcScene has a new full-screen mode, in which the application window surrounds are hidden. Press **F11** to go into full-screen mode. Press **F11** again to leave full-screen mode. This mode is also available in ArcGlobe.
- The change made to the feature selection logic in ArcMap at 9.0 also applies to ArcScene. See the 'Selection' topic in the 'Other ArcMap changes' section of this document for more information.
- There is now no limit to the number of ESRI GRIDs that can be added to a single ArcScene document. This enhancement also applies to ArcMap and ArcGlobe. The limitation of 49 GRIDs in a single document has been removed at 9.0.

■ ArcScene now supports stereo viewing. Stereo viewing provides added depth and realism to your 3D scenes. You can view your scenes in stereo by using red and blue stereo viewing glasses, using a polarized stereo shutter for your monitor in combination with specialized glasses, or projecting the images in a scene and viewing the images with specialized glasses.

To specify stereo viewing, navigate to View > View Settings. In the View Settings dialog box, choose the new Stereo View option in the Viewing Characteristics panel.

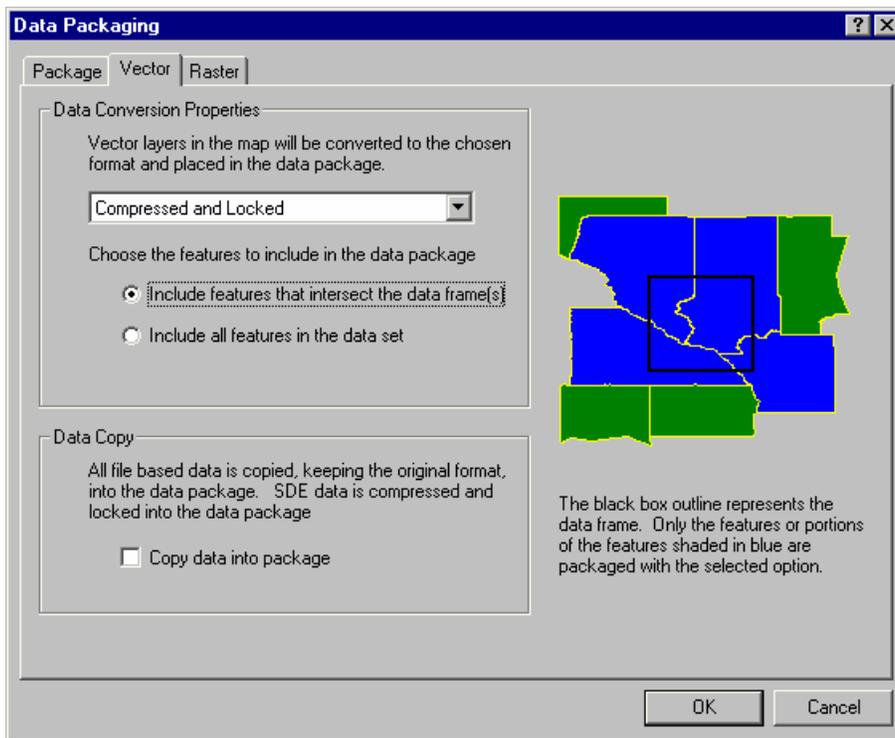


Miscellaneous

■ Feature classes of type multipatch can now be created in geodatabases. Multipatch feature classes are used primarily to represent 3D objects for use in the 3D Analyst extension. To create an empty multipatch feature class in a geodatabase, use the New Feature Class command in the usual way. When you get to the panel for defining fields, click the Shape field, then set the Geometry Type property of the Shape field to Multipatch. Creating new multipatch feature classes in geodatabases doesn't require the 3D Analyst extension.

ArcGIS Publisher extension and ArcReader

■ **Data Packaging dialog box:** Allows the data presented in a map document to be clipped and centrally packaged for distribution with the published map file. Various options are provided for handling vector and raster data sources, including the ability to compress and lock vector data.



■ **Map time out:** Allows the map author to define an optional message to warn users that the map may be out of date. The author can also choose to block access to a published map altogether after a specified date. To access this function, click Settings on the Publisher toolbar and click the Other tab in the Publisher Settings dialog box.

■ At 9.0, ArcGIS Publisher includes a programmable ArcReader control that enables developers to easily build and deploy ArcReader applications. Custom ArcReader applications can be built using the .NET and COM application programming interfaces (APIs). With this new access to the developer controls behind ArcReader, you can build your own ArcReader software-based applications and embed them in customized solutions on the desktop. This level of customization is simple and only provides the 10 or so underlying objects and functionalities provided in ArcReader. Developers do not have access to ArcObjects using this customization.

■ A new Set Data Sources command is available when you right-click a .pmf in ArcCatalog. This launches a dialog box that makes it easy to update or repair some or all of the references to file-based data sources in the file. By default, this dialog box creates a copy of the .pmf. This command is disabled if the publisher of the .pmf chose not to provide full access to its contents in ArcGIS applications when it was published. The Set Data Sources command cannot be used to update or repair references to data in ArcSDE geodatabases.

■ **The ArcReader Identify Results dialog box:** If one of the fields of the layer you identify contains URLs or paths to documents, you can launch these links by clicking a small icon you'll see next to the field value. You can also open rasters stored in raster fields this way too. Rasters that you open are displayed inside a special generic raster viewer window.

- The ArcReader Identify Results dialog box: A new option has been added to the context menu that appears when you right-click the right side of this dialog box. This option lets you choose between having the fields listed in alphabetical order or in the order in which the fields occur in the data source of the layer you have identified.
- ArcReader is now supported on Sun Solaris.

ArcGIS Spatial Analyst extension

ArcGIS 9 is a significant step forward for ArcGIS Spatial Analyst. In addition to the return of the ModelBuilder graphical modeling interface, there are more than 100 new functions exposed in the ArcGIS Spatial Analyst user interface. Many of these functions were previously only accessible through ArcObjects or Map Algebra. All of these functions are accessible in 9.0 through the geoprocessing framework, which provides access to tools in dialog boxes, the command line, ModelBuilder, and scripting.

The Spatial Analyst toolbar you are familiar with from ArcMap 8.x is still in the product, with a few improvements and bug fixes. If everything you need is in that toolbar, you don't have to switch to the Spatial Analyst tools in the new geoprocessing framework. However, if you are someone who has never had quite enough analytical tools, always wanted to combine Spatial Analyst tools with tools from other parts of the software, wanted to write batch scripts without learning Visual Basic, or wanted to create process models that you can save, share, and rerun without going through every dialog box again, then explore the new tools and user interface options available for ArcGIS Spatial Analyst.

There's a new version of ArcGIS Spatial Analyst tutorial that describes how to use the new functionality at 9.0. You can find this tutorial in .pdf on the ESRI Software Products Library CD that comes with the release. The file is Spatial_Analyst_Tutorial_90.pdf.

Integration with the geoprocessing framework

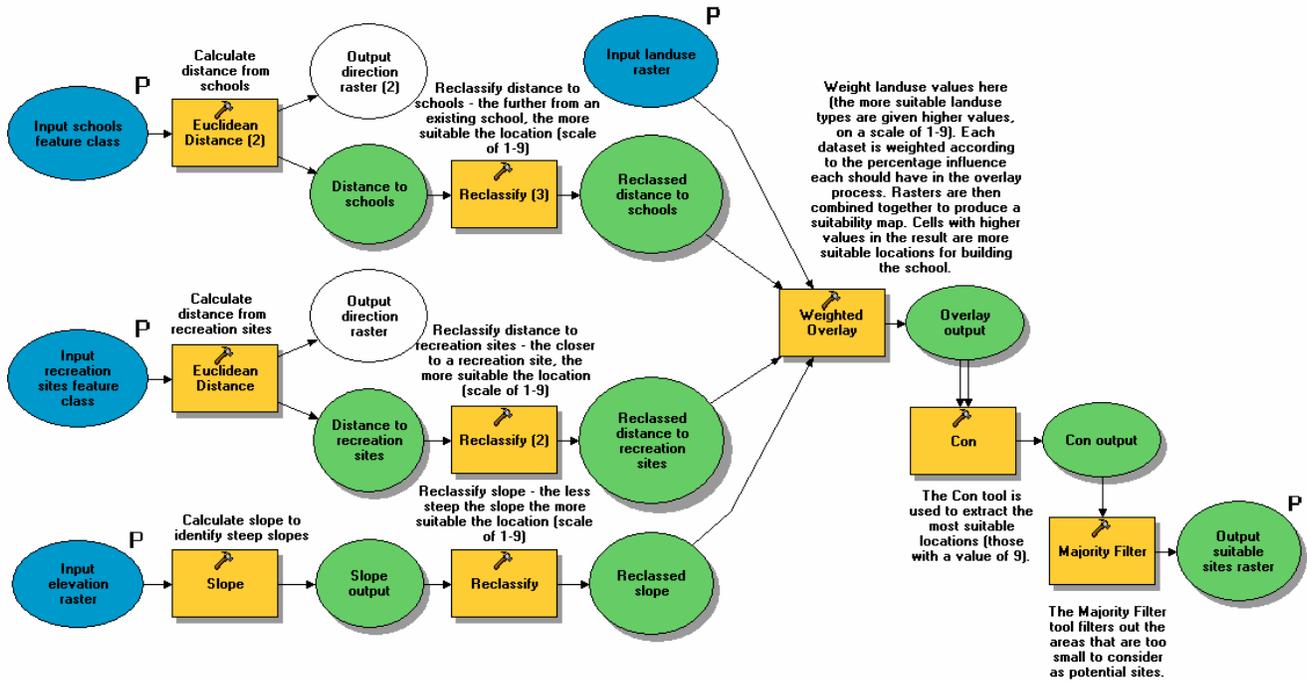
The ArcGIS Spatial Analyst extension is fully integrated into the new geoprocessing framework. For an introduction to the geoprocessing framework and its capabilities, refer to the 'Geoprocessing' section of this document. For a quick overview of how to use geoprocessing written from the point of view of working with layers, see the 'Geoprocessing in ArcMap at 9.0' topic in the 'Other ArcMap Changes' section of this document.

■ As the new ArcToolbox window at 9.0 is available in ArcCatalog as well as ArcMap, you can now perform spatial analysis inside ArcCatalog. If you also have the 3D Analyst extension, you can access the Spatial Analyst tools inside ArcScene and ArcGlobe, too.

■ ModelBuilder, which first appeared in ArcView Spatial Analyst 3, is part of the geoprocessing framework of 9.0. ModelBuilder is now a fully integrated part of the ArcGIS package containing more than 400 tools and working on every data type supported by ArcGIS. The graphical modeling environment of ModelBuilder is used to create, edit, run, and document spatial models; it is a natural paradigm for Spatial Analyst users who often wish to string many tools together as a process to solve a complex problem.

Here is a site suitability model created in ModelBuilder with the Spatial Analyst tools:

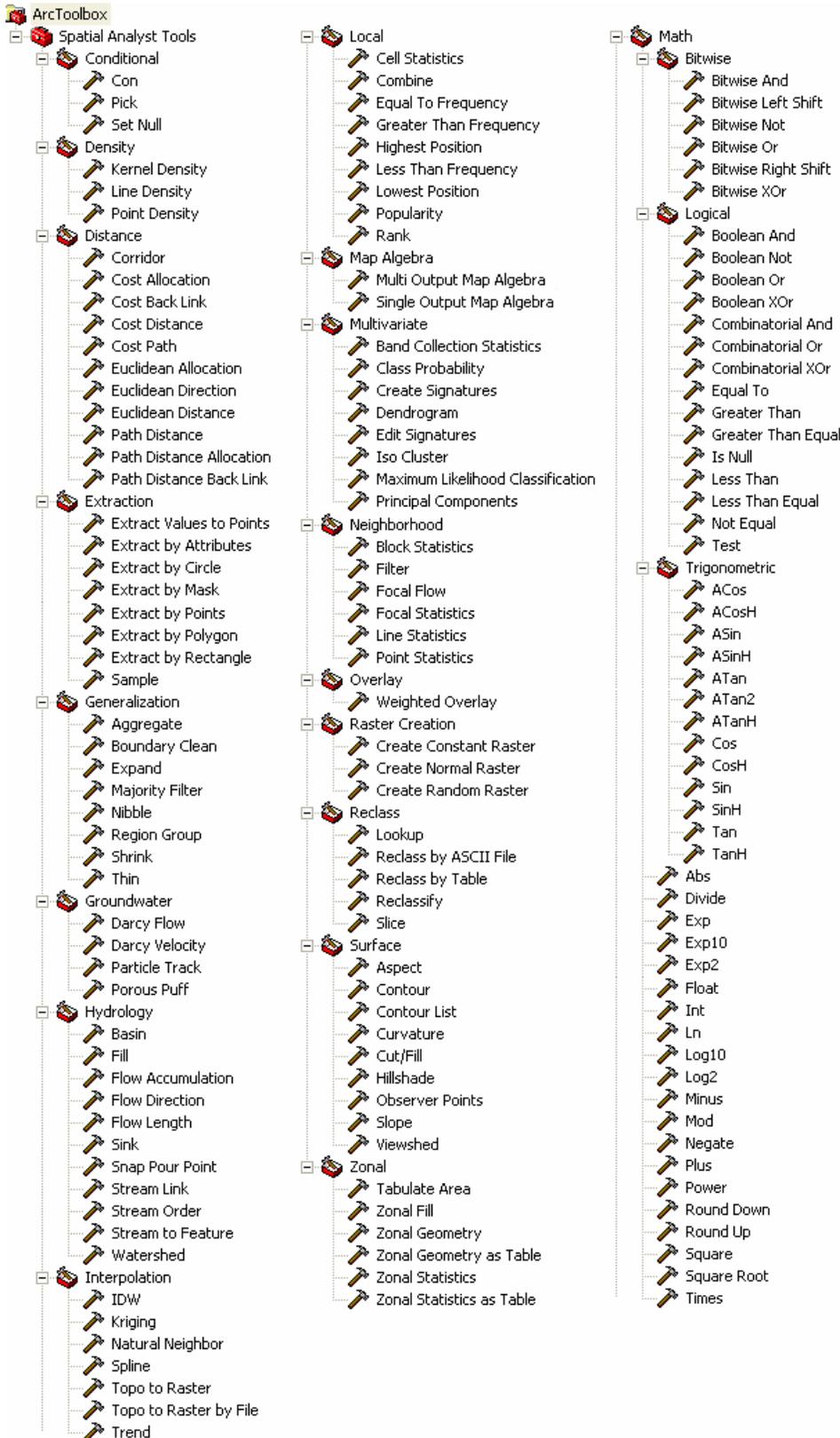
Find suitable sites for a school



■ Within the ArcToolbox folder, the Spatial Analyst tools are organized into functional groups as toolsets, as shown below.

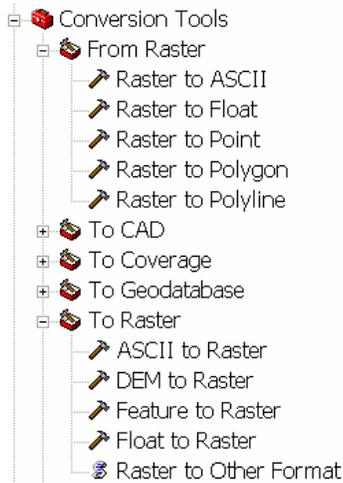
- [-] Spatial Analyst Tools
 - [+] Conditional
 - [+] Density
 - [+] Distance
 - [+] Extraction
 - [+] Generalize
 - [+] Groundwater
 - [+] Hydrology
 - [+] Interpolation
 - [+] Local
 - [+] Map Algebra
 - [+] Math
 - [+] Multivariate
 - [+] Neighborhood
 - [+] Overlay
 - [+] Raster Creation
 - [+] Reclass
 - [+] Surface
 - [+] Zonal

■ Within each toolset is a collection of tools for performing that type of analysis. All of the tools found in the ArcGIS Spatial Analyst toolbox require an ArcGIS Spatial Analyst license. Here are the tools available within each toolset:

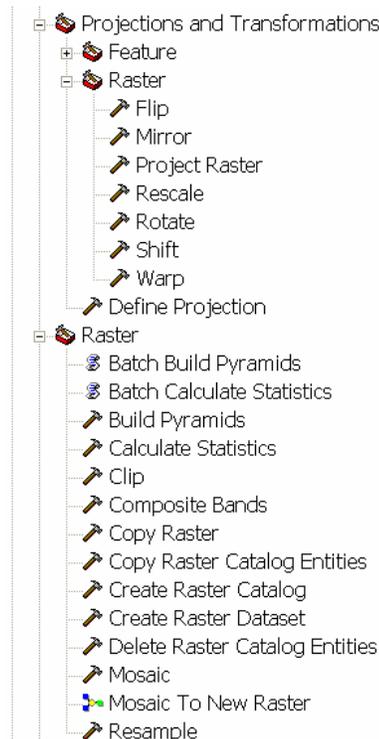


■ The data management functions, such as data conversion and import, that have been part of ArcGIS Spatial Analyst toolbar in the past are now found in other toolsets that do not require an ArcGIS Spatial Analyst license.

■ Tools for data conversion are found in the Conversion Tools toolbox.



■ Tools for general raster data management, such as geometric transformation, map projection, mosaicking, and loading raster data into a geodatabase, are in the Data Management Tools toolbox under the Raster toolset and the Projections and Transformations > Raster toolset.



New or improved functions

As you can see, there are a large number of tools available. Following are highlights of some of the most requested toolsets and tools.

■ **Hydrology**—The hydrology toolset provides tools for analyzing terrain surfaces and modeling how water will flow across them. Included are tools for calculating the direction of flow, accumulation of flow, flow length, and delineating watersheds, to name a few. Many of these functions have been available to Spatial Analyst users in the past through ArcObjects or sample tools.

■ **Groundwater**—The groundwater toolset provides tools for analyzing the movement of groundwater, particles in the water, and their dispersion. It uses simple Darcian flow principles based on two-dimensional steady state flow.

■ **Generalization**—The generalization toolset provides tools for simplifying and cleaning up raster data. These tools are often used for simplifying raster data before it is vectorized, but they are also useful to the pure raster user.

■ **Interpolation**—There are two new tools for interpolation in Spatial Analyst 9. Natural Neighbors is an interpolation technique that has been part of 3D Analyst and is useful for creating a simple surface that reflects your actual data values. It is unique in that it uses linear interpolation between observation points and will not, therefore, create artificial peaks and valleys in your data. It is great for making an initial surface to see what your data looks like before moving on to more advanced techniques. Topo To Raster is a specialized interpolation tool designed for the creation of hydrologically correct elevation surfaces for use in the hydrology tools described above. For ArcInfo Workstation users, this is an updated version of the TopoGrid command, based on ANUDEM.

■ **Distance**—In addition to the distance tools that have always been part of Spatial Analyst, the PathDistance functions from ArcGrid have been added. PathDistance is a special variation of CostDistance that allows calculation of surface distance instead of only planimetric distance. PathDistance also allows input of vertical and horizontal factors, such as slope or wind in the weighted distance calculation.

■ **Multivariate**—The multivariate tools allow you to explore relationships between many different types of attributes from multiple input rasters. ArcGIS Spatial Analyst provides tools, such as supervised and unsupervised classification, and principal component analysis.

■ **Map Algebra**—The Map Algebra toolset provides two tools for using the traditional GRID Map Algebra syntax inside the geoprocessing framework. The tools are primarily distinguished by their outputs and their use in ModelBuilder. The Single Output Map Algebra tool creates only a single raster output and can have inputs to it and the output from it connected in a model. It is also open in the type of inputs it can accept and has better syntax checking and error handling. The Multi Output Map Algebra tool can create one or many outputs, and, therefore, cannot be connected in a model. Its list of acceptable input types and syntax checking is less robust, much like the ArcGrid command line.

■ **Weighted Overlay**—The weighted overlay tool, found in the Overlay toolset, applies a common scale of values to diverse and dissimilar inputs to create an integrated analysis. It allows you to specify different weight values for datasets and classes within datasets that are combined to a single output. This tool will save numerous steps and provide a better user experience for problems such as site selection and suitability analysis.

■ **Con**—The Con tool, short for "conditional", is found in the Conditional toolset. The Con function was a cornerstone of ArcGrid and can be useful for testing conditions of input cell values and having complex control of the outputs. The Con tool is a simplified version of this, and the Map Algebra tools can provide all the power and flexibility you need.

■ **Tabulate Area**—The Tabulate Area tool, found in the Zonal toolset, calculates the cross-tabulated areas between two raster or feature datasets.

■ **Extract Values to Points**—The Extract Values to Points tool, found in the Extraction toolset, is a unique and useful raster and vector tool. It is used to overlay point data on a raster and transfer the value of the cells into a field in the attribute table of the point dataset. This is similar to the LatticeSpot command from ArcInfo Workstation but also provides the option to obtain the cell value or an interpolated value between cell centers if you are working with a continuous surface.

Removed system limits

- **2 GB file size limit removed**—The file size limit for the ESRI GRID format has been removed. There is no longer a hard-coded limit. For files near or larger than 2 GB, you will not be able to build a value attribute table (VAT) or add additional attributes to the table.
- **50 channel limit removed**—The limit on the number of inputs you can provide to a function at one time, commonly known as the channel limit, no longer exists. There is no hard-coded limit to the number of inputs you can now provide to an ArcGIS Spatial Analyst function that takes a list of inputs. This also removes the limit on the number of GRIDs you can display in ArcMap simultaneously. This also applies to ArcScene and ArcGlobe.
- **32,767 operations in a session limit removed**—The limit on the number of Spatial Analyst operations you could perform in a session no longer exists. There is now no limit.

What's different from 8.3?

■ **Environments**—The Spatial Analyst toolbar has an analysis environment accessed from the Options command on the toolbar. The geoprocessing framework at 9.0 also has a set of environment parameters. These two environments, although they have some similar parameters, are not connected. For example, setting a cell size in the Spatial Analyst toolbar > Options dialog box will not affect the cell size when running a tool from the new ArcToolbox window, and vice versa.

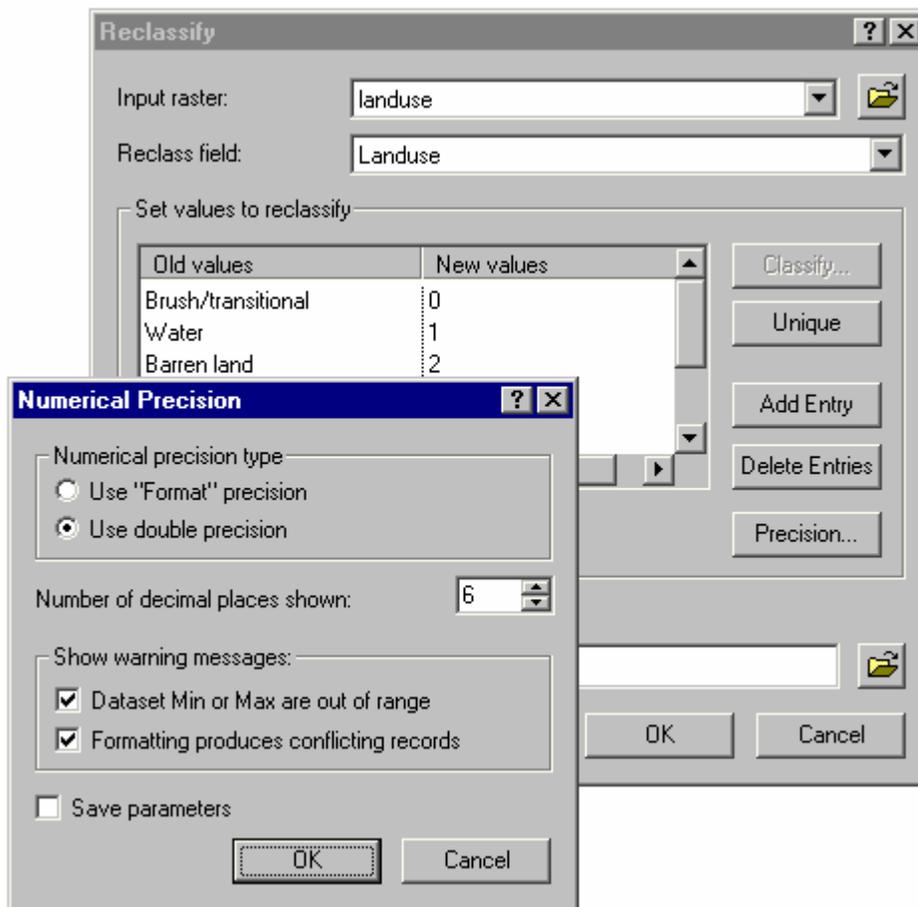
You specify the new environment settings by either navigating to the Tools > Options dialog box for the application you are using, clicking the Geoprocessing tab, and clicking the Environments button or by opening the ArcToolbox window, right-clicking the ArcToolbox entry at the top of the ArcToolbox window, and clicking the Environments command. Both of these will launch the new Environment Settings dialog box.

If you use **ArcMap**, **ArcScene**, or **ArcGlobe**, your environment settings apply to the current document you are working with and get saved into that document.

If you use **ArcCatalog**, your environment settings apply to all of the work you perform in ArcCatalog. The current environment settings in your application can be overridden by environment settings specified as overrides in the **model** properties and also by environment settings specified as overrides in the properties of any of the **processes in the model**.

In the new Environment Settings dialog box, the current workspace, default output workspace, output coordinate system, extent, and snap raster are found in the General Settings option. Cell size and mask are found in the Raster Analysis Settings option. Parameters for loading rasters into the geodatabase are found in the Raster Geodatabase Settings option.

■ **Reclassify**—A new precision option for setting numerical precision has been added to the Reclassify function. You'll see a new Precision button on the Reclassify dialog box opened from the Spatial Analyst toolbar. Click this button to open the Numerical Precision subdialog box (see illustration below). This Numerical Precision dialog box is also accessible from the Reclassify tool in the new ArcToolbox window.



Expanded ArcObjects API

There has been some reorganization and additions to the ArcObjects API for Spatial Analyst.

First, the SAExtension is no longer cocreatable; use the ExtensionManager to load and enable the ArcGIS Spatial Analyst license.

Second, the objects have been reorganized into three object libraries: GeoAnalyst (for things that are not just Spatial Analyst), SpatialAnalyst (things licensed only to Spatial Analyst), and SpatialAnalystUI (the UI components of Spatial Analyst).

Finally, there are several new objects, interfaces, and methods for Spatial Analyst.

■ **GridTableOp**—This is a new object at 9.0 that includes the methods AddField, DeleteField, and Update. It is used to add and delete fields and update the VAT of an ESRI GRID.

■ **RasterConversionOp**—This object has two new interfaces, IRasterExportOp and IRasterImportOp2. IRasterExportOp provides methods to export raster data to ASCII and floating-point binary formats with the methods ExportToASCII and ExportToFloat, respectively. IRasterImportOp2 adds the method ImportFromUSGSDem to import rasters in the United States Geological Survey (USGS) digital elevation model (DEM) format.

■ **RasterDistanceOp**—This object has a new interface, IDistanceOp2, to support the PathDistance functions explained above. The new methods in this interface are PathDistance, PathDistanceFull, PathAllocation, and PathBackLink.

■ **RasterExtractionOp**—This object has a new interface, IExtractionOp2, to accommodate the ExtractValuesToPoints methods described above.

■ **RasterInterpolationOp**—This object has a new interface, IInterpolationOp2, to accommodate the NaturalNeighbor and TopoToRasterByFile methods described above.

■ **RasterSurfaceOp**—This object has a new interface, ISurfaceOp2, to accommodate changes to the method signature for Visibility. It now accepts a user-defined refractivity coefficient.

■ **RasterTransformationOp**—This is a new object at 9.0 that includes methods for performing geometric transformations of raster data such as projection, warp, shift, resample, and so forth.

ArcGIS Engine and ArcGIS Server

Spatial Analyst functionality is available for the new ArcGIS Engine and ArcGIS Server products introduced at 9.0. Options are available for both ArcGIS Engine and ArcGIS Server, enabling the use of the ArcGIS Spatial Analyst extension's ArcObjects developer components in those products. Developers using ArcGIS Engine with this option can create custom desktop applications containing embedded Spatial Analyst functionality. Developers using ArcGIS Server with this option can deploy server-based applications, providing Spatial Analyst functionality across the enterprise or over the Internet.

Documentation

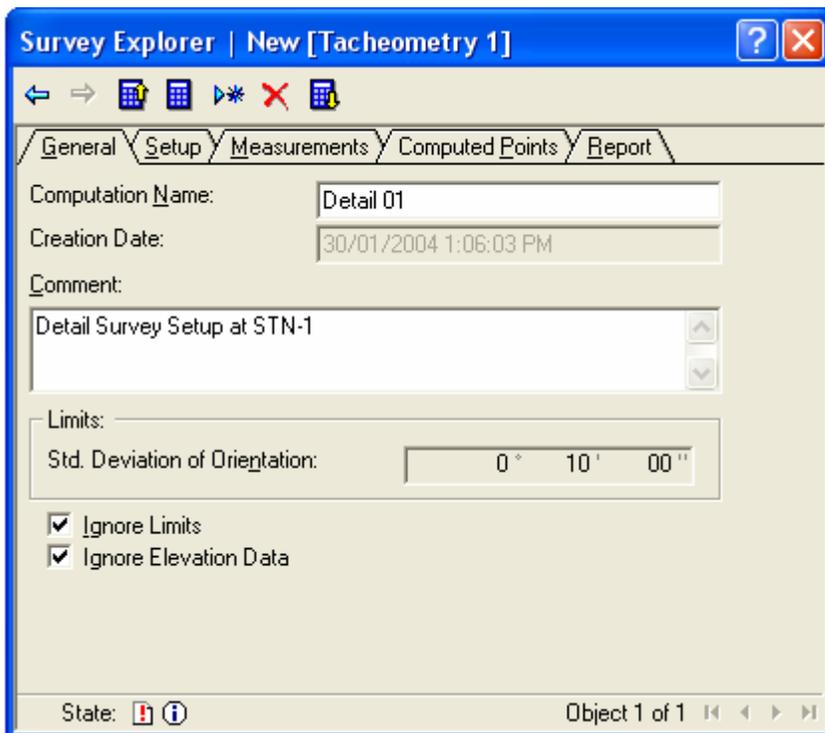
There have been extensive updates to the Spatial Analyst documentation to keep up with all the new functionality.

- As mentioned previously, there's a new version of the Spatial Analyst tutorial that describes how to use the new functionality at 9.0. You can find this tutorial in .pdf on the ESRI Software Products Library CD that comes with the release. The file is `Spatial_Analyst_Tutorial_90.pdf`.
- The conceptual information that had been scattered among many topics in the past has been reorganized, expanded, and given new graphics. It now follows the functional organization of the geoprocessing toolsets. This pattern for the conceptual information is the same for all geoprocessing toolboxes and toolsets.
- The functional reference documents for the Spatial Analyst functions that appeared in 8.2 have been expanded to cover all the analysis tools available in the Spatial Analyst toolbar as well as geoprocessing tools, geoprocessing scripting, and Map Algebra. All function help is now fully cross-referenced and has syntax examples for each use case. Now you can also launch the geoprocessing tool directly from the Help page.
- For ArcObjects developers, there is also more complete coverage of the syntax and examples for the analysis tools available in the Spatial Analyst API.

Survey Analyst extension

A number of bug fixes and performance enhancements have been made for the 9.0 release. Here are the key improvements:

- Survey datasets no longer use an oversized spatial grid, greatly improving performance during map navigation.
- The least squares adjustment now works with 2D reference points.
- Data exchange bug fixes include the following: units for imported elevations are now converted correctly, Tripod Data Systems (TDS) format system coordinates are now ignored, and Leica geo serial interface (GSI) format offsets are now imported and exported.
- Better developer support for data exchange, including a developer sample demonstrating how to create a new importer for data collector files as well as feature coding.
- Better processing feedback, such as the progress bars that indicate what is occurring during the import process, survey dataset creation, survey project creation, feature linking, and listing data in the Survey Explorer.
- The Compass Adjustment now computes the correct distance residuals.
- For the Total Positioning System (TPS) computations, there are now two options; you can choose whether or not to enforce limit checking and whether or not to compute elevation data.



ArcPress extension

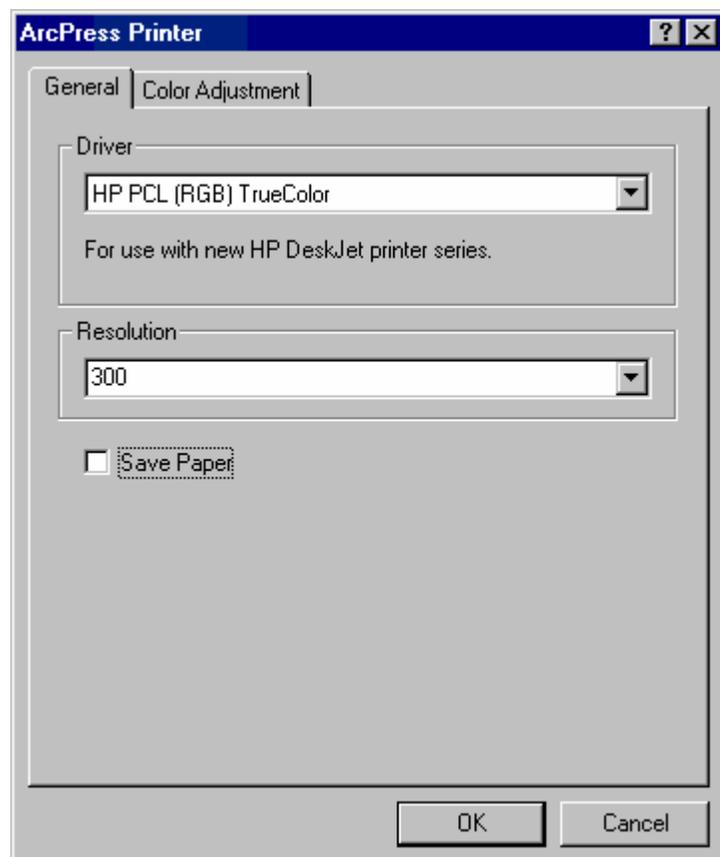
■ ArcPress for ArcGIS 9 dramatically improves the user experience, performance, and quality of the output. ArcPress has been completely reengineered for 9.0, including a metafile interpreter and rasterizer, rewritten and new printer drivers, and a new user interface.

ArcPress 9 will no longer support graphic export and instead will focus on providing a great printing solution. At 9.0 all of the graphic export formats are now supported as part of the core ArcGIS system.

The new rasterizer now interprets and processes the metafile directly, whereas the previous ArcPress rasterizer required that the metafile be converted to Encapsulated PostScript (EPS). Because this conversion is no longer a requirement and due to the more efficient and robust rasterizer engine, ArcPress throughput power has been greatly improved.

In addition, all of the ArcPress drivers have been significantly improved. ArcPress 9 now includes true halftone drivers for RTL CMYK, RTL monochrome, PCL CMYK, and PCL monochrome. Everyone's favorite driver, the RTL Device Dithered RGB (now simply called "RTL RGB"), has been tweaked to improve quality and performance. In addition, ESRI is proud to announce that ArcPress 9 includes the PCL RGB driver that supports the following printers with outstanding picture and color quality: HP DesignJet 10ps, 20ps, 50ps, 500, 800, 100, and 120.

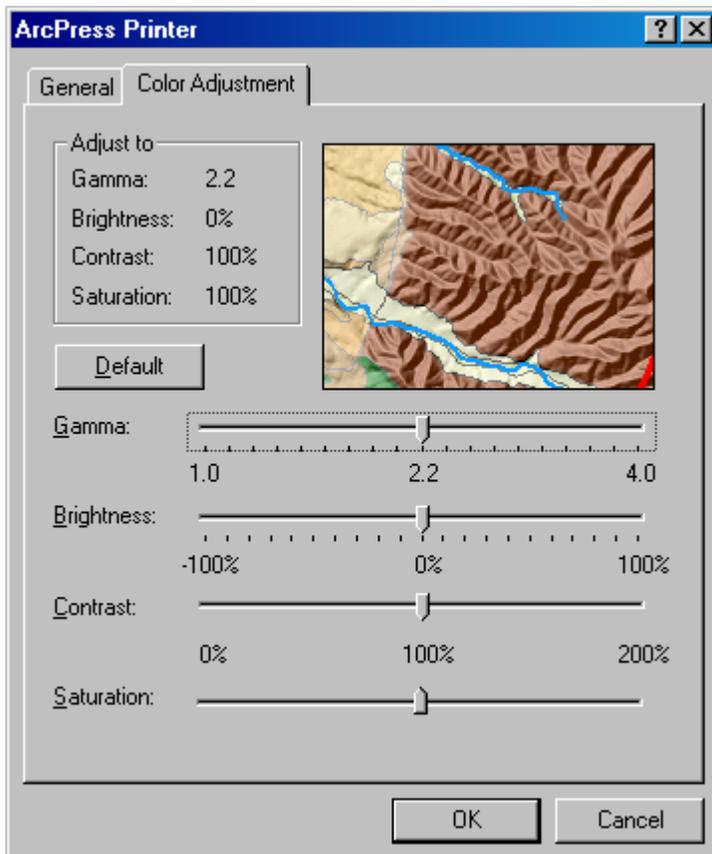
The File > Print > ArcPress Properties dialog box has been improved to support the new printer drivers and improved Color Adjustment options (for the halftone drivers). ArcPress will continue to automatically select the correct printer driver for the printer you have selected; if this cannot be determined, you will be prompted to select one or to use the Windows printer engine.



ArcPress will now only show the output resolution or resolutions supported by the printer you have selected. This will eliminate any errors in selecting an unsupported output resolution.

ArcPress 9 now includes a Save Paper option. This will force a rotation on the printout if it will fit on the printer paper. Note that if you are printing to a printer that is wider than 36 inches (for example, the HP DesignJet 5500), and it is loaded with 36-inch paper, and you select Save Paper while printing an E/AO-sized map, the map may clip when printed because there is no way to detect what the width of the paper you have loaded in the printer is.

The color adjustment options have also been improved for 9.0. They include Gamma, Brightness, Contrast, and Saturation. A preview image is included to help visualize the changes. NOTE: color adjustments affect the total map. You cannot adjust raster and vector data separately.



- Gamma: This allows you to adjust the total color by using display gamma units. The default is set to 2.2.
- Brightness: Based on the Hue–Lightness–Saturation model, brightness adds or subtracts a percentage of lightness to each pixel's color in the map.
- Contrast: Changes the contrast between 0 percent and 200 percent. This percentage of contrast is applied to each pixel of color in the entire map on output.
- Saturation: Based on the Hue–Lightness–Saturation model, saturation adds or subtracts a percentage of saturation to each pixel's color in the map.

StreetMap extension

■ At 9.0, the StreetMap USA extension has been renamed as the StreetMap extension. The extension name is now generic because it has been designed to support additional street datasets as well. As part of this change, the separate StreetMap Europe extension product has been discontinued at ArcGIS 9. Instead of having separate StreetMap extensions for different street datasets, the new model is that the single generic StreetMap extension provides the underlying support for whatever StreetMap data products become available.

At 9.0 the ArcGIS StreetMap extension includes the StreetMap USA data from ESRI. The term "StreetMap USA" now only refers to the name of the U.S. dataset created to be used with the ArcGIS StreetMap extension.

ESRI envisions that in the future, ESRI distributors and other data providers will offer their own StreetMap datasets that can plug into and be used directly by the ArcGIS Desktop products (ArcInfo, ArcEditor, and ArcView) through the ArcGIS StreetMap extension. For information on additional data options, consult your local distributor or data provider.

■ The ability to define a **composite** address locator that references multiple address locators and chains them together, which was part of the discontinued StreetMap Europe extension product, is now a generic out-of-the-box feature in the core ArcGIS 9 product. Address locator is the term used at 9.0 for what was called "geocoding services" at 8.3. With a composite address locator, you can perform one-pass geocoding using multiple address locators and their reference data. This lets you use separate address locators for different geographic areas or different levels of detail to provide custom fallback strategies to maximize the number of addresses that can be successfully geocoded.

StreetMap extension users can take advantage of composite locators. For example, the StreetMap USA address locator can be included in a composite address locator so that geocoding can be performed against StreetMap USA reference data and additional datasets in one pass.

When you define a composite address locator, you also can define selection criteria that control when particular address locators that participate in the composite locator will be used when you geocode. For example, a composite locator can be defined so that if the Country field in an address is equal to "USA", the address will be geocoded by the StreetMap USA locator, but Canadian addresses will be sent to a different locator.

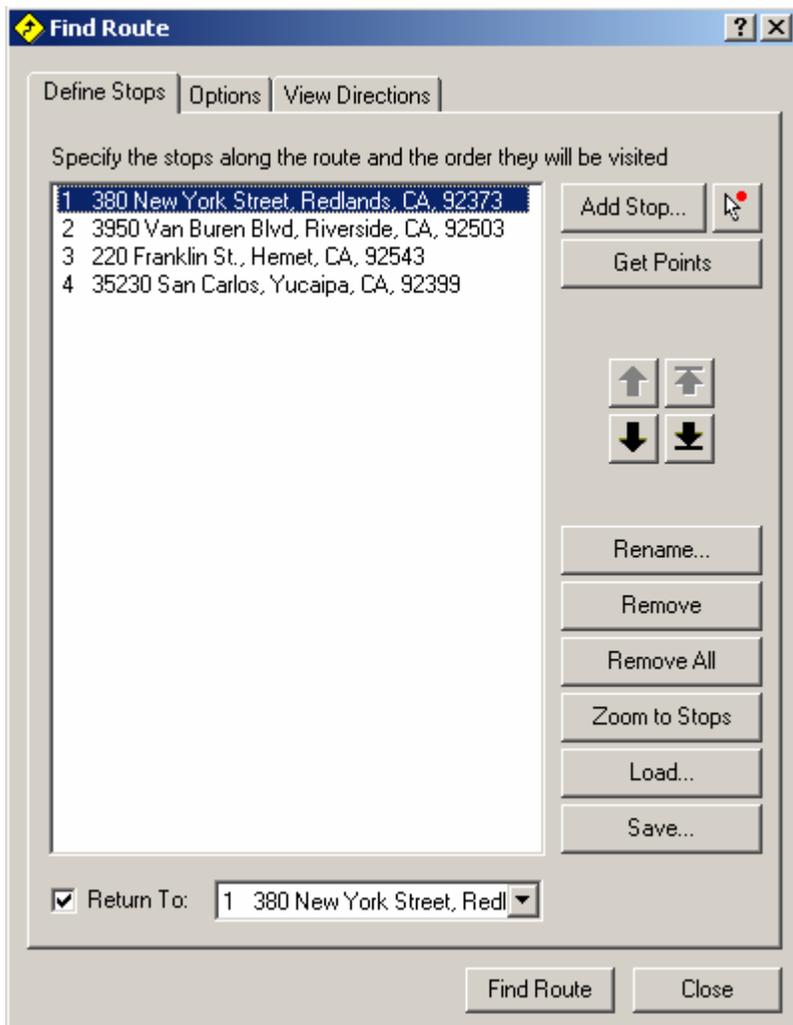
■ In 8.x you could improve the appearance of your maps by turning on the **symbol-level** advanced drawing options to take advantage of the ArcMap capability to join and merge multilayered symbols, such as those used for cased road and street symbology in the StreetMap USA group layer. At 9.0, this symbol-level drawing functionality has been improved, and symbol-level properties are now defined at the layer and group levels, rather than at the data frame level as in 8.x. This makes it much easier to use the StreetMap USA 9 group layer, both the standalone layer file and the group layer that's in the StreetMap USA map document (.mxd), because the group layer now contains predefined, ready-to-use, symbol-level properties.

In addition, at 9.0 symbol-level drawing is enabled by default for the StreetMap USA group layer; you no longer have to enable symbol-level drawing manually when working with the layer. This means that you'll now see correctly joined and merged cased line symbols out-of-the-box when you use the StreetMap USA .lyr and .mxd files.

■ At 9.0, ESRI has introduced **route finding** capabilities into StreetMap. You'll find the new Find Route command on the new StreetMap toolbar in ArcMap.



After installing ArcGIS, you can turn this toolbar on in the usual way by navigating to the View > Toolbars menu. The toolbar contains one command. The dialog box launched by this command enables you to define the stops you want the route to visit, find the best route, then add the resulting route to your map as a graphic- or shapefile-based layer. You can define stops by entering addresses, using an interactive tool, or getting existing point graphics or point features on your map.



You can choose between finding the quickest or the shortest route and whether the stops are visited in the order you define or in an optimized order determined by the program to minimize the route. This dialog box has the same look and feel as the Find Route dialog box that comes with two existing ESRI products: the ArcGIS Business Analyst extension and the ArcWeb Services for ArcGIS toolbar.

■ What's new in the StreetMap USA dataset at 9?

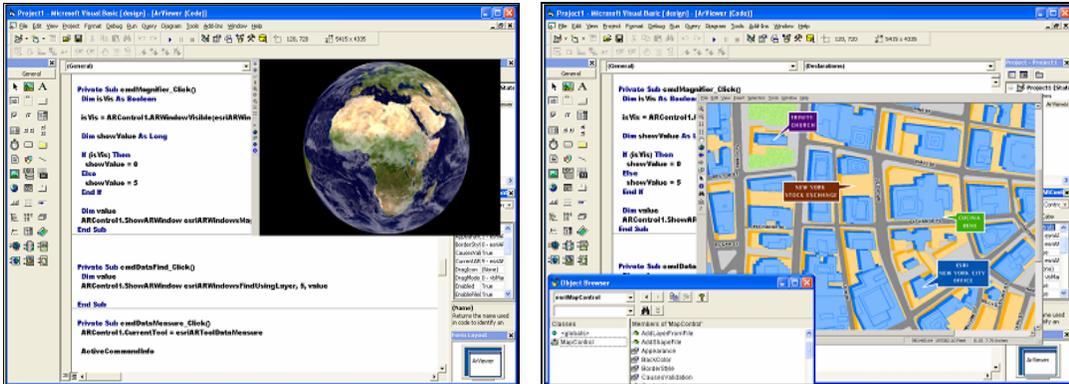
At 9.0 the data is delivered on a combined ESRI Data & Maps/StreetMap USA DVD. This contains all the StreetMap USA data as well as all the Data & Maps vector data. The StreetMap USA streets dataset was in StreetMap Feature Class/EDGE (.edg) format at 8.3. It is now in Smart Data Compression (SDC) data format. SDC feature datasets and feature classes are shown with orange icons in ArcCatalog.

Many updates were made to the values in the highway numbers field to create better highway connectivity in the streets dataset. The StreetMap USA map document has also been enhanced to include improved supporting basemap data.

Other software available separately

ArcGIS Engine

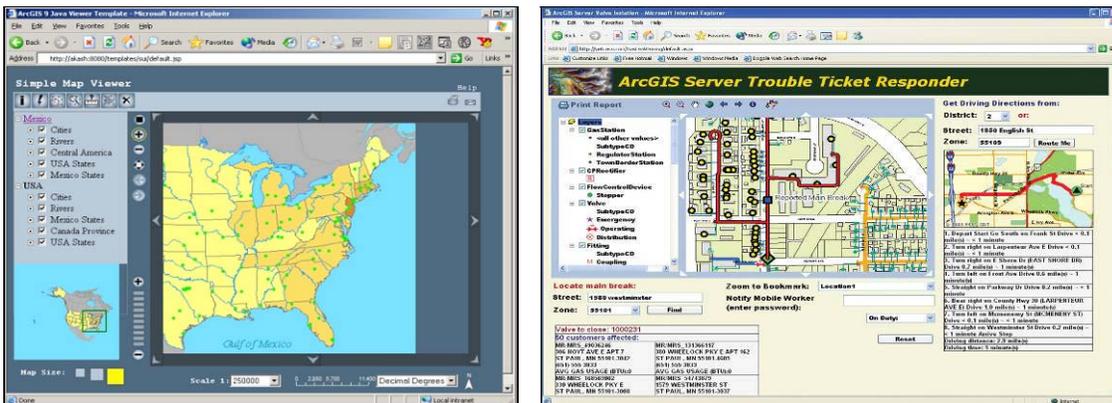
ArcGIS Engine is a powerful collection of embeddable mapping and GIS components for creating and deploying custom GIS and mapping desktop applications. The ArcObjects software components provided in the product can be called from various programming interfaces such as .NET, Java, COM, and C++. ArcGIS Engine consists of a software development kit and a redistributable run time. In addition, application functionality can be extended by using optional functionality from ArcGIS Spatial Analyst, 3D Analyst, and StreetMap products.



More information is available at <http://www.esri.com/arcgisengine>.

ArcGIS Server

ArcGIS 9 introduces a new technology for supporting enterprise geographic information system implementations. ArcGIS Server is a GIS enterprise application server for deploying server-based GIS services and applications throughout an organization or over the Internet. ArcGIS Server is the first GIS enterprise application server that implements GIS business logic and centralized GIS processing in an information technology (IT) standards-based server environment. ArcGIS Server supports key standards (Java, C++, .NET, COM, XML, SOAP, and HTTP).



More information is available at <http://www.esri.com/arcgisserver>.

Data Interoperability extension

The ArcGIS Data Interoperability extension provides read access to more than 65 spatial data formats, including GML, XML, WFS, AutoDesk DWG/DXF, MicroStation Design, MapInfo MID/MIF and TAB, Oracle and Oracle Spatial, and Intergraph GeoMedia Warehouse. The extension also provides the ability to export to more than 50 spatial data formats.

In addition, the extension provides a semantic data translation engine with specialized transformers to diagram and model custom spatial data formats. These new formats and tools are integrated with the new geoprocessing and ModelBuilder framework found in ArcGIS 9 to allow easy data format manipulation within geoprocessing work flows and models.

This is an optional extension to ArcGIS 9 that will be available to order several months after the ArcGIS 9 release.

More information is available at <http://www.esri.com/software/opengis/index.html>.

NOTE: Support for OpenGIS Web Map Services (WMS) will be released as a free download after the release of ArcGIS 9.