ArcGIS® 9

Editing GIS Features Tutorial

DATA CREDITS

Graphical Editing Map: Wilson, North Carolina

Universal Data Editor Map, Editing in data view and layout view map: Greeley, Colorado

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Map Topology Tutorial Data: U.S. Geological Survey National Elevation Dataset Shaded Relief Image Service, published on the Geography Network

Topological Data Loading Tutorial Data: U.S. Geological Survey in cooperation with U.S. Environmental Protection Agency and Utah AGRC and REDCON

Creating and Editing Annotation Tutorial Data: U.S. Geological Survey National Elevation Dataset Shaded Relief Image Service, published on the Geography Network

Creating and Editing Annotation Tutorial Data: U.S. Geological Survey in cooperation with U.S. Environmental Protection Agency, National Hydrography Dataset

Creating and Editing Annotation Tutorial Data: National Atlas of the United States and the United States Geological Survey, Geographic Data Technology, Inc. (GDT), ESRI

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Editing GIS Features Tutorial

ArcMap has the tools you need to create and edit your spatial data. With ArcMap you can create and edit features in shapefiles or a geodatabase. ArcView licensed seats of ArcMap allow you to create a temporary map topology so you can simultaneously edit features that share geometry across multiple feature classes. With ArcEditor or ArcInfo licensed seats of ArcMap, you also have access to advanced editing tools, geometric network editing, and geodatabase topology editing and management.

The easiest way to learn how to edit in ArcMap is to complete the exercises in this tutorial. Most of these tutorials can be completed with ArcView seats of ArcMap—the exceptions are the geodatabase topology exercises.

Exercises 1 and 2 introduce the edit sketch, sketch tools, and edit tasks and show you how to use them to create new features quickly and easily.

Exercise 3 walks you through the process of converting features on a paper map directly into your database using a digitizing tablet.

Exercise 4 teaches you how to move, rotate, scale, extend, trim, and modify the vertices of existing features.

Exercise 5 shows you how to create and maintain the shared boundaries between features and layers with a map topology.

Exercise 6 demonstrates how you can integrate layers from CAD drawings into your database.

Exercise 7 shows you how to clean up existing data and create new features that share boundaries between features and layers with a geodatabase topology.

Exercise 8 shows you how to use the Spatial Adjustment tool to transform, rubbersheet, and edgematch your data.

Exercise 9 teaches you how to use the Attribute Transfer tool to transfer the attributes from one feature to another.

Exercise 10 teaches you how to convert labels to annotation in a geodatabase, place unplaced annotation features, and edit annotation features.

Each of these exercises takes between 15 and 20 minutes to complete. You have the option of working through the entire tutorial or completing each exercise, one at a time.

Exercise 1: Creating polygon features

The editing tools in ArcMap make it easy to create new features. You use edit tasks, the edit sketch, sketch tools, and snapping to create new features in ArcMap.

In this exercise, you will digitize a new polygon feature into a shapefile layer that outlines a land use study region. The study area polygon that you create needs to snap to an index grid layer that subdivides the entire geographic region. You will begin by starting ArcMap and loading a map document that contains the shapefile layer and a geodatabase that contains the index grid for the region.

Starting ArcMap and beginning editing

Before you can complete the tasks in this tutorial, you must start ArcMap and load the tutorial data.

1. Double-click a shortcut installed on your desktop or use the Programs list in your Start menu to start ArcMap.

2. Click the Open button on the Standard toolbar. Navigate to the CreatingNewFeatures.mxd map document in the Editor directory where you installed the tutorial data (C:\ArcGIS\ArcTutor is the default location). Click the map and click Open.
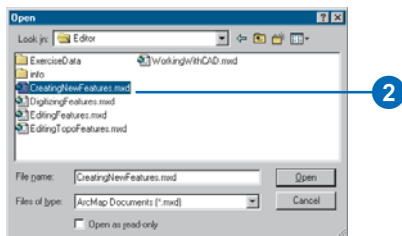

3. Click the Editor Toolbar button on the Standard toolbar to add the Editor toolbar to ArcMap.

4. Click the Editor menu and click Start Editing.

If you only have one workspace in your map, you can start editing the map layers at this point. In this exercise, two workspaces are loaded in the map, so you will need to choose the workspace you want to edit.

5. Click the Editor folder workspace to start editing the studyarea.shp shapefile. Click OK. You will edit the geodatabase in the next exercise.
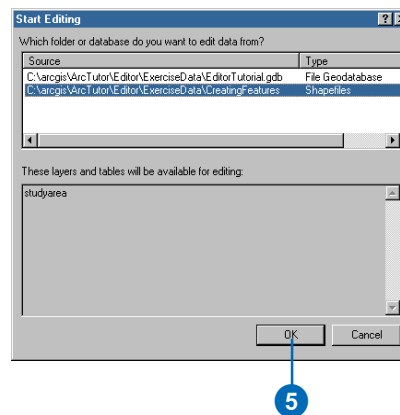
Creating a new polygon feature

This exercise focuses on creating a new study area polygon that encompasses a parcel CAD drawing. The extent of the study area is defined by the index grid lines located in an existing database. The index grid represents logical divisions within the data.

To create the new polygon, you must do heads-up digitizing against the index grid and snap the vertices of your new polygon to the vertices of the grid lines.
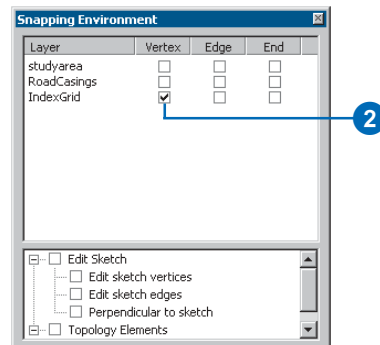
Setting the snapping environment

Before you start editing the study area shapefile, you need to set your snapping environment so each point you add snaps to the vertices of features in the index grid.

1. Click the Editor menu and click Snapping to display the Snapping Environment dialog box.
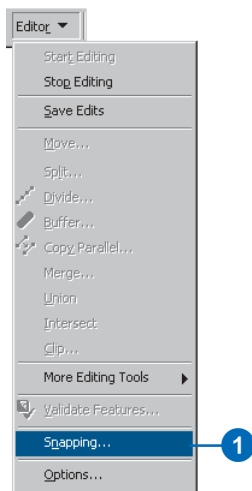
2. Check the Vertex check box next to the IndexGrid layer to snap the sketch vertices to the vertices of the index grid. Close the Snapping Environment dialog box.
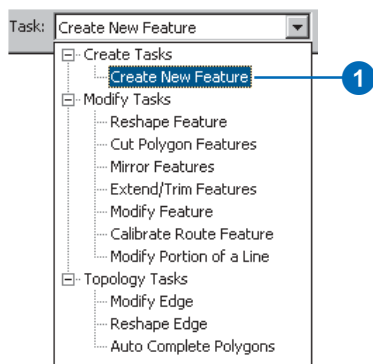

With the snapping environment set, you can create a new study area polygon. Make sure you snap each point to the thick index grid lines shown below.

Setting the current task

Before you start digitizing a new feature, you must set the current editing task to Create New Feature.

1. Click the Task drop-down arrow and click Create New Feature.


To create a new feature, you also need a target layer. The target layer determines the type of feature you will create and in which layer it will be stored. Since there is only one shapefile in the folder that you started to edit, the target layer is set to the study area shapefile by default.
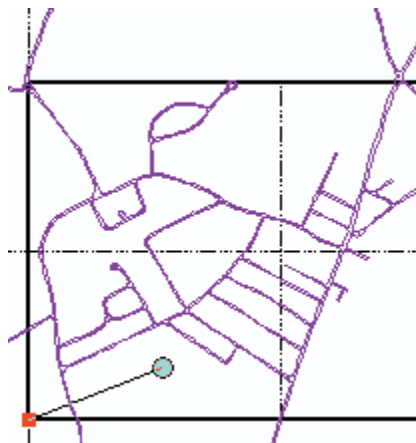
Using the Sketch tool

To create a new feature using the Create New Feature task, you must first create an edit sketch. An edit sketch is a shape that you draw by digitizing vertices using the sketch construction tools located on the tool palette.

Several tools can add vertices to the sketch. You will use the Sketch tool to add the study area polygon.

1. Click the tool palette drop-down arrow and click the Sketch tool.
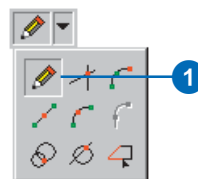

2. Click to add the first vertex of the sketch to the lower left corner of the thick index grid lines. The vertex should snap in place.


3. Click to add the remaining vertices, snapping each vertex to a corner in the index grid. Create vertices counterclockwise until you return to the point located directly above the first vertex that you placed.

Finishing the sketch

1. Press the F2 key or right-click and click Finish Sketch.

   This action adds the final sketch segment and creates the new feature.
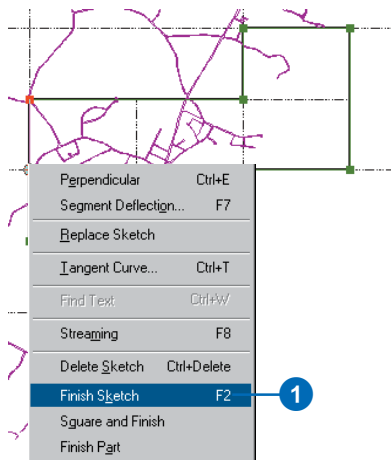
Your new study area polygon is now created. If you snapped each sketch vertex properly, the new polygon should look like the shaded polygon below.
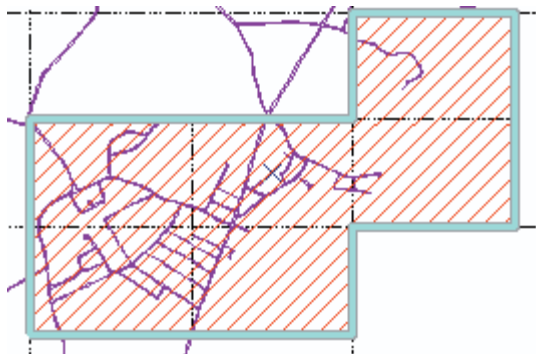

Adding attributes

The new feature you created does not contain any attribute information. Because other polygon features are present in this shapefile, distinguish your new polygon from the others by adding descriptive information about it.

You can add descriptive information for a selected feature using the Attributes dialog box.

1. Click the Attributes button on the Editor toolbar to add a description attribute to the new study area polygon.
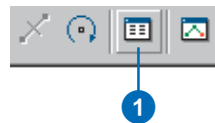

2. Click the layer field for the selected feature and type "StudyArea" as a description of the feature.
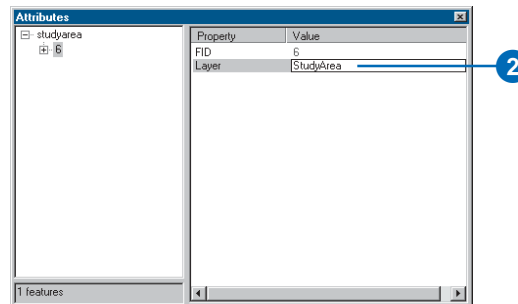
Saving your edits

After you have created the new study area polygon, you can choose to save or discard your edits by stopping the edit session.

1. Click the Editor menu and click Stop Editing.

2. Click Yes to save the new study area polygon into the study area shapefile you were editing or No to discard your edits.
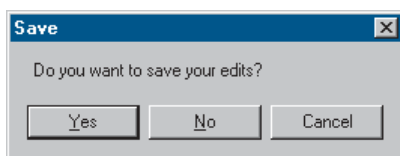
In this exercise you learned how to quickly and accurately create a new polygon feature. You used the Sketch tool to digitize a polygon shape while snapping each vertex to an existing vertex in another layer.

There are several other ways you can construct new features in your GIS database. The next exercise will show you some of the more advanced methods of constructing vertices in the edit sketch.

Exercise 2: Creating line features

In this exercise, you will update your database with a new road casing line.

In building the line feature, you will learn how to use some of the more advanced construction methods offered with the Sketch tool context menu.

Editing the geodatabase

Because the road feature class exists inside a different workspace than the study area shapefile, you need to start editing the database before you can create the new line.

1. Click the Editor menu and click Start Editing. Choose the file geodatabase as the workspace you want to edit and click OK.
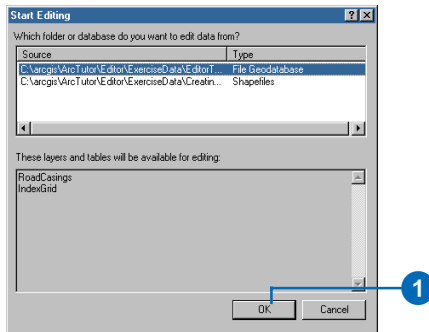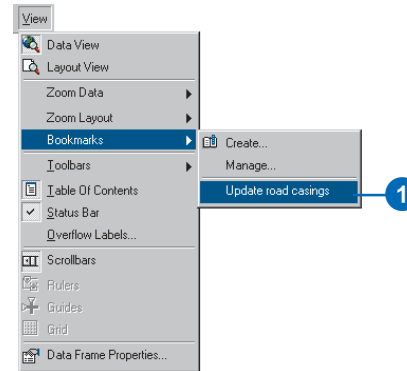

Locating the update area

Spatial bookmarks are named extents that can be saved in map documents. Creating a bookmark for areas you visit frequently will save you time.

You will now zoom to a spatial bookmark created for this exercise.

1. Click the View menu, point to Bookmarks, then click Update road casings to set the current view to the edit area of this exercise.


When the display refreshes, note that the top line of this road casing is missing from the layer. You must update the road casing by adding the missing line.
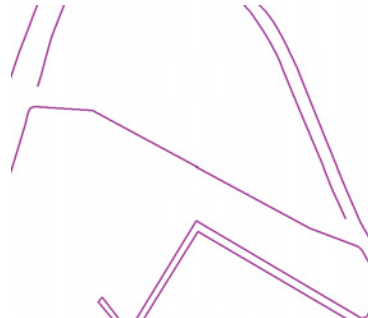
Setting the snapping environment

The endpoints of the road casing feature need to snap to adjacent casings to ensure that the new feature is connected to the existing casing features. Snapping to the end of road casing lines will help you do this.

1. Click the Editor menu and click Snapping. Check the End option for the RoadCasings layer to set snapping to the endpoint of casing features. Uncheck any other boxes that may still be checked and close the dialog box.
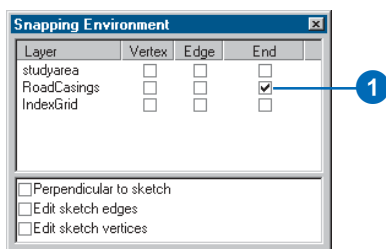
Digitizing

After setting the snapping environment, make sure the target layer is set to the RoadCasings layer. Now you can start digitizing.

1. Click the tool palette drop-down arrow and click the Sketch tool.
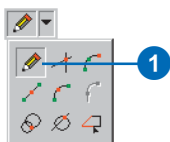
2. Move the pointer to the broken section of the road casing in the top left corner of the canvas. Once the

pointer is inside the snapping tolerance, the snapping location (blue dot) will jump to the vertex. Click the left mouse button to add the first vertex.
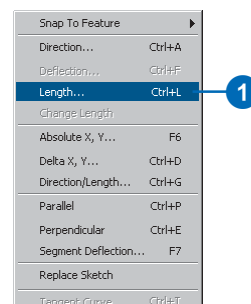

Beginning construction

With the first vertex of the new road casing properly placed, you can construct the casing line feature. Your new feature will be connected to that casing.

Setting length and angle measurements

Before creating the second vertex, you must first set the length of the line.

1. Right-click the map and click Length.

2. Type a value of 15 map units and press Enter.

If you move the pointer now, notice that you can't stretch the line further than your length measurement. This is called a constraint.

You must also set an angle constraint to create the second vertex.

3. Press Ctrl+A and type a value of 260 degrees. Press Enter.

Creating a curve tangent to the last segment

You will add a curve that is tangent to the last segment you added to the sketch. The curve will form the corner of the road casing.

1. Right-click and click Tangent Curve to enter the curve information required to place the next vertex.

2. Click the first drop-down arrow and click Chord. Type "20" to set the chord length. Click the second drop-down arrow and click Delta Angle. Type "90" in the second text box for the angle measurement. Click Left to indicate that the new curve will be tangent to the left of the previous segment. Press Enter to create the curve.
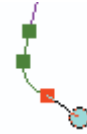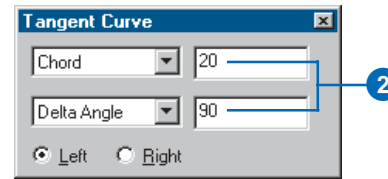
Creating a vertex relative to the last vertex

Often, construction points are calculated relative to the last point recorded. Using the Delta X, Y sketch constructor, you can add relative vertices.

1. Press Ctrl+D. Type "88" for the x-value and "-9" for the y-value. Press Enter to add the point.

Creating a vertex parallel to an existing line

You can define the angle measurement for points added to the sketch in several ways. You can set an absolute value as you did in the first step of this exercise, or you can use the angles of existing features. Quite often, road casings are constructed using the angles of road centerlines. Since you already have one road casing, you can use its angle in constructing the next segment.

1. Right-click the lower road casing line. Click Parallel. Press Ctrl+L, type a value of 415, then press Enter.
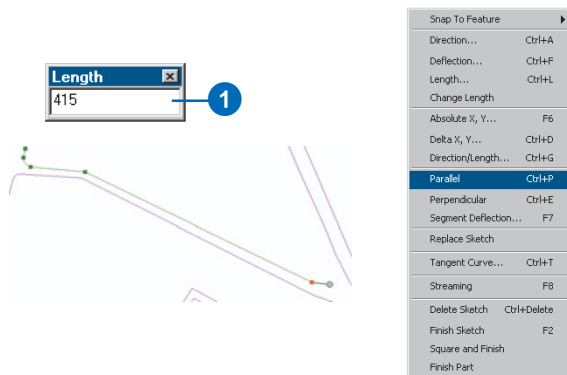
Creating a new vertex using absolute coordinates

Exact x and y coordinate information is often available for the construction of vertices. Add the next vertex by typing exact coordinates using the Absolute X, Y constructor.

1. Right-click the map and click Absolute X, Y. Type "1227820.6" in the x field, press the Tab key, and type "181460.6" in the y field. Press Enter to add the point.
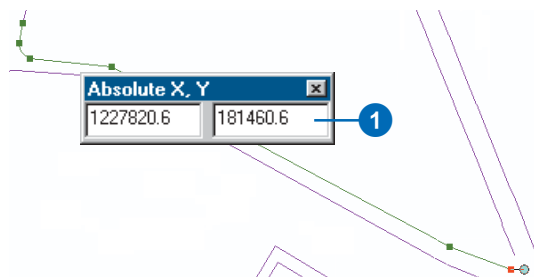
Creating a tangent curve

One final tangent curve needs to be added to the sketch before you can connect it to the existing casing and add the feature.

1. Right-click and click Tangent Curve. Type a chord length of 12 and a delta angle of 120, then press Enter to create the final curve segment.
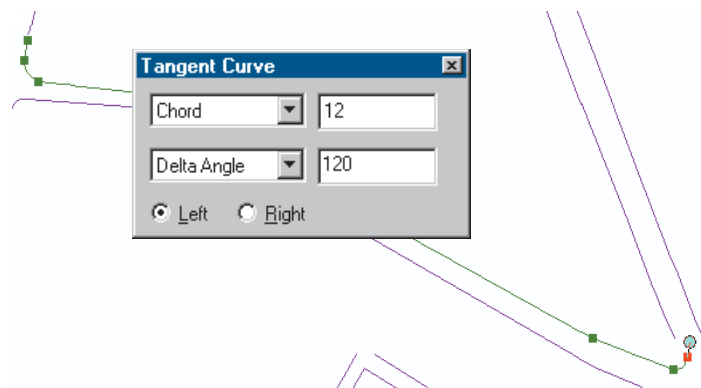
Finishing the sketch

To finish the sketch and create the feature so it is connected to the existing casing, you need to snap the last point of the sketch to the endpoint of the existing road casing.

1. Move the pointer to the endpoint of the existing road casing until it snaps. Double-click to add the last point and create the feature.
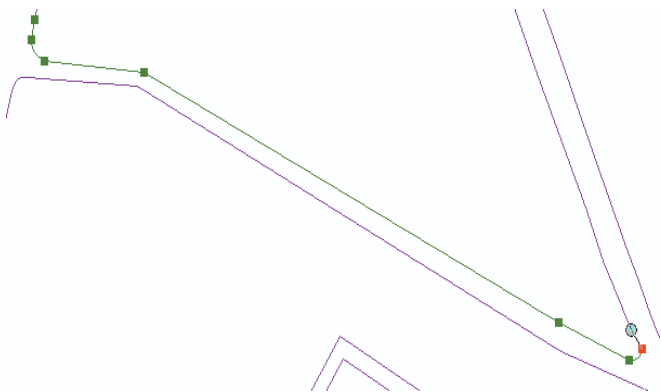
With construction now complete, you can continue to search the layer to find additional broken lines and connect them together, experimenting with these and other sketch tools and construction techniques. You can save your edits and the map document if you want.

The next exercise will show you how you can use the construction methods demonstrated in this exercise to capture features from a paper map directly into your GIS layers using a digitizing tablet.

Exercise 3: Using a digitizing tablet

The first exercise in this chapter showed you how to heads-up digitize features by snapping to an existing vector source. However, often that source information is in paper form. ArcMap lets you trace over the features you are interested in capturing using a digitizing tablet connected to your computer. By digitizing data using a tablet, you can get features from almost any paper map into your GIS database.

Setting up your digitizing tablet

Before you can start digitizing, you must set up your tablet and prepare the map from which you want to digitize features. To use a digitizing tablet with ArcMap, it must have WinTab™-compliant digitizer driver software. To find out if a WinTab-compliant driver is available for your digitizer, see the documentation that came with the tablet or contact the manufacturer.

After installing the driver software, use the WinTab manager setup program to configure the buttons on your digitizer puck. One puck button should be configured to perform a left mouse click to digitize point features and vertices; another button should be configured to perform a left double-click to finish digitizing line or polygon features. You may also want to configure a button to perform a right-click so you can access context menus.

If you installed ArcMap before installing your digitizer, the Digitizer tab may not appear in the Editing Options dialog box. To add the tab, you must register the ArcMap digitizer.dll file. To learn how to register digitizer.dll and to find more information on digitizing, see the ArcGIS Desktop Help.

Preparing the map

You will now print the paper map from which you want to digitize and attach it to your tablet.

1. Print the DigitizingFeatures.tif image located in the Editor tutorial directory where you installed the tutorial data. The default installation path is C:\ArcGIS\ArcTutor\Editor\ExerciseData\Digitizing.

2. Attach the paper map to your digitizing tablet using masking tape, drafting tape, or a special residue-free putty. Drafting tape looks like masking tape, but leaves less residue when it's removed.

3. Start ArcMap if you haven't already done so.

4. Open the DigitizingFeatures.mxd map document so you can register the paper map to your map document.

## Registering your map for the first time

You must always register your paper map before you can begin digitizing from it. This involves establishing control points to register the paper map to the geographic space of your GIS data. If your map has a grid or a set of known ground points, you can use these as your control points. If not, choose four to 10 distinctive locations and mark them on your map with a pencil. Give each location a unique number and write down its actual ground coordinates. Control points can also be saved to and loaded from x,y coordinates stored in a comma-delimited text file.

In this exercise, the control points and their ground coordinates are identified for you on the paper map.

1. Click Editor and click Start Editing.
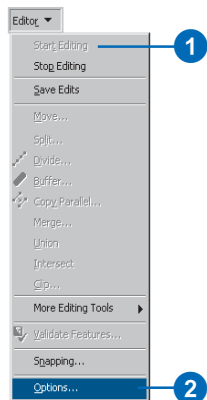
2. Click Editor and click Options.

3. Click the Digitizer tab. You will create and store control points here. The control points you add will be saved with the map document.
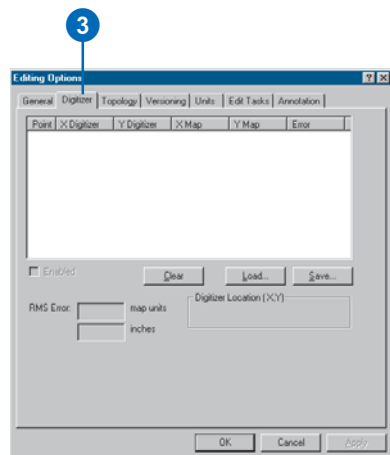
4. In the upper left corner of your paper map, locate the point marked Control Pt.1 and click it using the digitizer puck.

   A record appears in the X Digitizer and Y Digitizer columns for the control point you digitized.

5. Working clockwise, click each of the three other control points on your paper map.

6. Type the actual ground x,y coordinates for the first point (labeled X = 711907 and Y = 943420 on the paper map) in the X Map and Y Map fields.
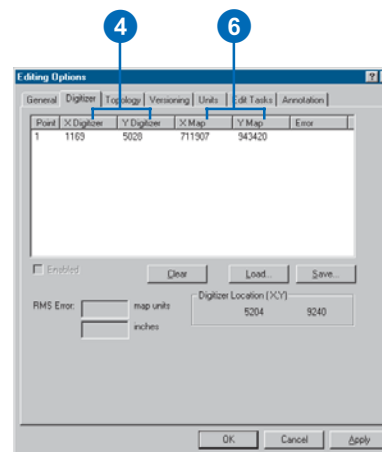
6. Continue typing the actual ground coordinates for the other points in the X Map and Y Map fields.

   An error in map units is displayed for each control point.

7. After you have digitized all the control points and typed their actual ground coordinates, the total root mean square (RMS) error is calculated and displayed in map and digitizer units. Your X and Y Digitizer and error values may be different from the ones in this example.
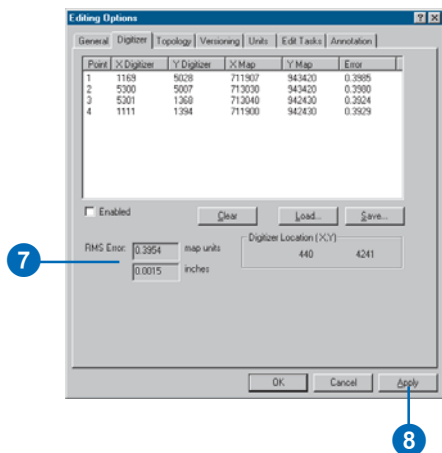
To maintain highly accurate data, your RMS error should be less than 0.004 digitizer units (often inches) or the equivalent scaled distance in map units—the ground units in which the coordinates are stored. The map units for this dataset are meters. You can see what the map units are and set the onscreen display units by clicking View, Data Frame Properties, then the General tab of the Data Frame Properties dialog box.

You can redigitize control points by selecting the point you want to replace from the list, then clicking your paper map to capture a new control point. Redigitizing points with large error values can help reduce the total RMS error.

8. Click Apply to accept the registration after you have reached an acceptable RMS error.

Digitizing modes

You need to enable digitizing mode once you have registered your map. Enabling digitizing mode maps the location of the puck on the tablet to a specific location on the screen.

1. Check the Enabled box on the Digitizer tab of the Editing Options dialog box to enable digitizing mode.

2. Click OK.
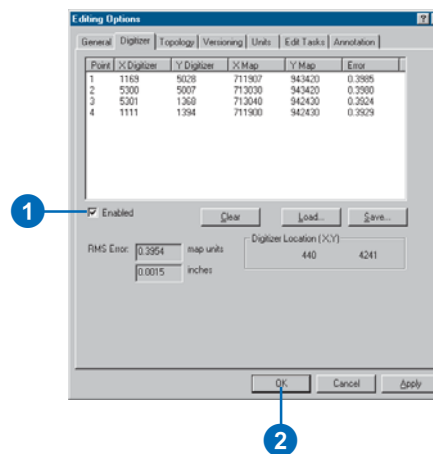
Digitizing new features

You are now ready to begin digitizing new features. You will add new lot lines representing a new parcel subdivision into an existing shapefile of lot lines.
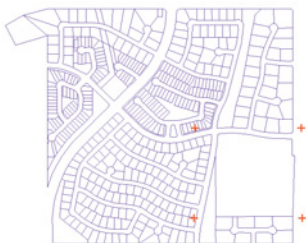
To get a better view of the area you'll digitize in, you'll zoom to a spatial bookmark that has been defined for you.

1. Click View, point to Bookmarks, and click Paper Map.
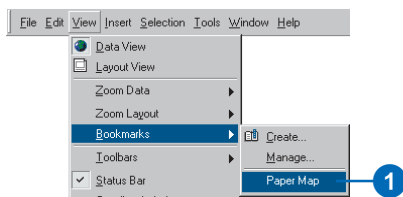
The map zooms to the area of your paper map.
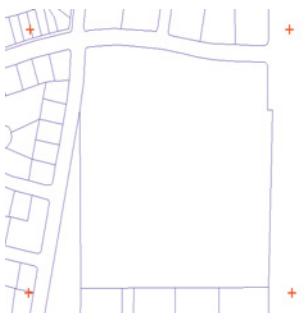
Setting the current task and target layer

Creating new features using a digitizer puck is identical to creating new features using the mouse. You must set the current task and target layer before you start digitizing.

1. Click the Task drop-down arrow and click Create New Feature.
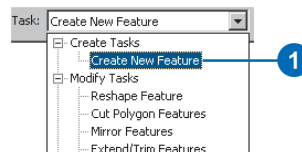
2. Click the Target layer drop-down arrow and click Lotlines to set the target layer.
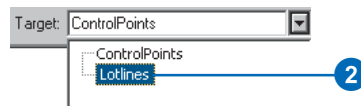
Creating new features

There are two ways to digitize features: point mode digitizing and stream mode digitizing (streaming). You can toggle between point and stream mode by pressing the F8 key or by right-clicking with the Sketch tool active and clicking Streaming from the menu. Point and stream mode digitizing are available either when you're using a digitizing tablet or when you're digitizing onscreen with your mouse.

Point mode is the default and most common method of digitizing features that are on paper maps. In point mode, you convert a feature on a paper map by digitizing a series

of points, or vertices. ArcMap then connects the vertices to create a digital feature. You generally use point mode when precise digitizing is required—for example, when digitizing a perfectly straight line.

Stream mode digitizing provides a quick and easy way to capture features on a paper map when you don't require as much precision or when you're digitizing smooth, curved lines—for example, rivers, streams, and contour lines. With stream mode, you create the first vertex of the feature and trace over the rest of the feature with the digitizer puck. When you're finished tracing, you use the puck to complete the feature.

As you stream, ArcMap automatically adds vertices at an interval you specify; this interval, expressed in current map units, is called the stream tolerance. You can change the stream tolerance at any time, even while you're in the process of digitizing a feature.

Digitizing in point mode

1. Click Editor and click Snapping.
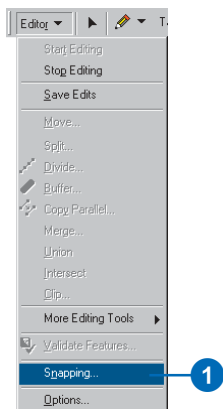
2. Check the Edge box for the Lotlines layer so the features you digitize snap to existing edges. Close the Snapping Environment dialog box.
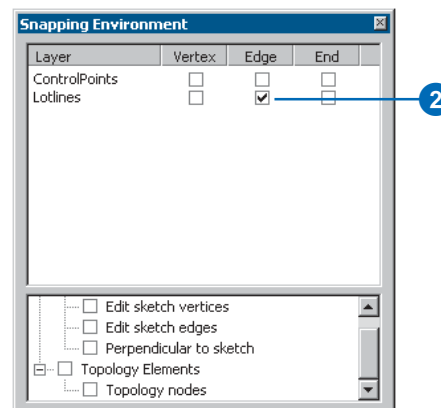
3. Click the Sketch tool.

The lines you are going to digitize now are the exterior boundary lot lines. These lines are drawn in blue.
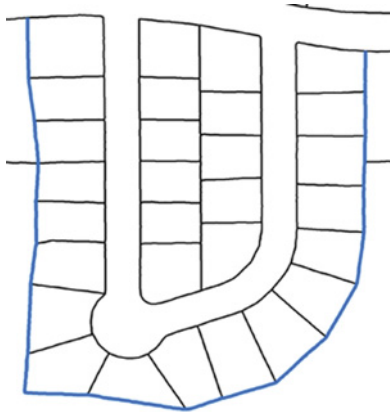
4. Using the puck, click the upper leftmost point of the exterior boundary lot line to start digitizing. You'll notice that the pointer snaps to the edges of the lot lines.
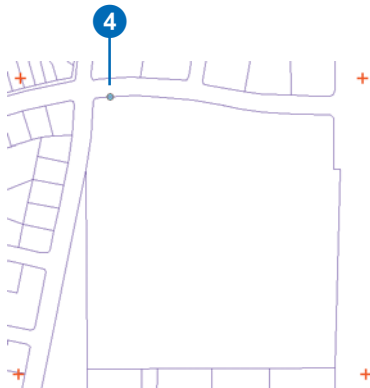
For straight segments, you should add a vertex where lot lines intersect. In curved segments, you should click more points to make sure their shapes are defined.

5. When you're done with your sketch, finish it by clicking the button on your puck that you configured as a double-click.

Digitizing in stream mode

When tracing line or polygon features, you may want to add vertices as you move the mouse rather than clicking each time you want to add a vertex. Stream mode digitizing lets you do this.

Before starting to digitize in stream mode, you need to set a stream tolerance—the interval at which the sketch adds vertices along the feature you are digitizing. The default tolerance value is 0 map units, so if you don't enter a tolerance value, you may find vertices that overlap each other.

You will also specify the group tolerance—the number of streaming vertices you want to group together. The number you set tells ArcMap how many vertices to delete when you click the Undo button. For example, if you set this number to 20 and click the Undo button while you're digitizing a feature, ArcMap deletes the last 20 digitized vertices from your feature.

You are now going to digitize the frontage lot lines—the lines drawn in red—that define the road leading into the new subdivision. You will digitize these lot lines as two features, one for the outer line and one for the inner line.

Start here to digitize the first line.

Start here to digitize the second line.
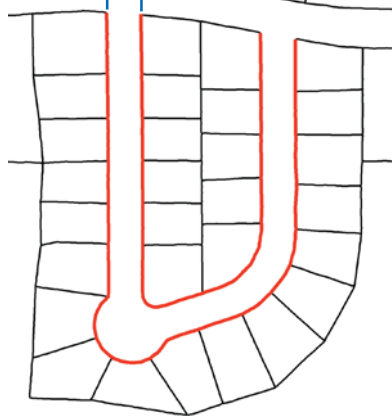
1. Click Editor and click Options.
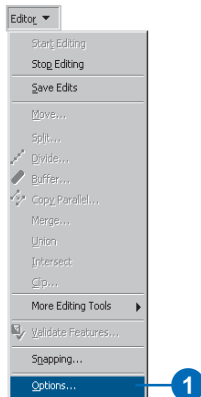
2. Click the General tab.
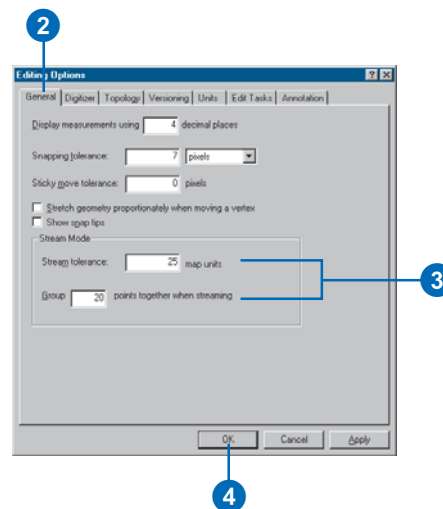
3. Type a stream tolerance value of 25 map units and set the group tolerance to 20.

4. Click OK.

5. Click the Sketch tool.

6. Snap the pointer to the upper leftmost point of the outer frontage lot line, but don't click yet.
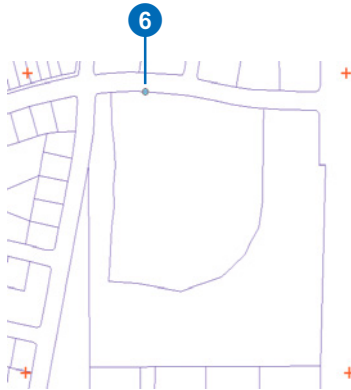
7. Press F8 to start digitizing in stream mode.

8. Click to start the sketch.

9. Carefully trace along the boundary of the lots until you reach the last lot in the upper right. Notice that vertices are added at consistent intervals that are 25 map units apart. Although you're working in stream mode, you can still click when you want to add a point by hand.

If you make a mistake while streaming, you can click the Undo button to remove the last 20 vertices. You'll need to press F8 to suspend streaming while you're choosing interface elements, and press F8 again when you want to return to stream mode digitizing.

Undo will delete 20 vertices—the number set in the group tolerance—at a time.

10. Snap the last vertex of your line to the existing lot line and finish the sketch by clicking the button on your puck that you configured as a double-click.

Now you are going to digitize the second red line, the inner frontage lot line.

11. Snap the pointer to the existing lot line and click to start digitizing the inner frontage line. You should still be in streaming mode, but if you find yourself in point mode, press F8 to switch to streaming.
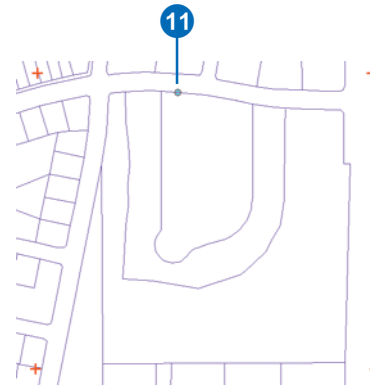
12. Carefully trace along the boundary of the lots until you reach the last lot in the upper rightmost point of the inner frontage line.

13. Snap the pointer to the existing lot line and press F8 to stop digitizing in stream mode.

14. Finish the sketch by clicking the button on your puck that you configured as a double-click.

With the exterior boundary lines and the outer and inner frontage lot lines digitized, use point mode to digitize the remaining line features that define the lots.

Once you've digitized all the new lot lines, your map should look like this:

Disabling the puck

After you're finished digitizing, you should disable the digitizer puck.

1. Click Editor and click Options.

2. Click the Digitizer tab and uncheck Enabled to disable the digitizer.
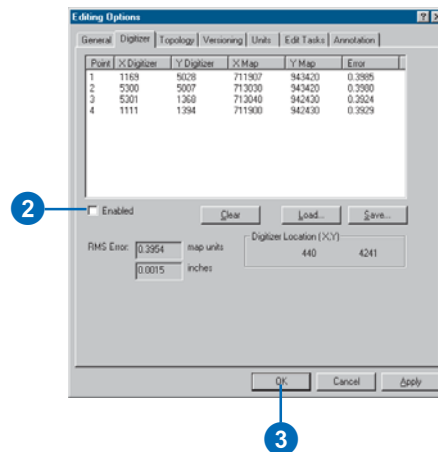
3. Click OK.

Finishing your digitizing session

Once you have finished tracing lot lines and have disabled the digitizer puck, you can stop editing and complete the exercise by saving your edits.

1. Click Editor and click Stop Editing.
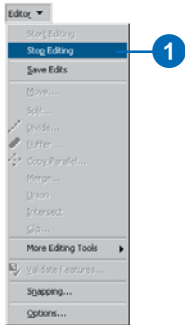
2. Click Yes to save your edits.
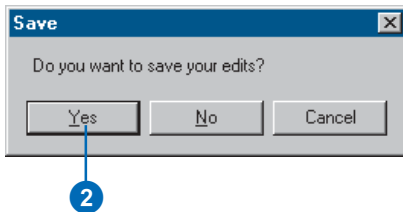
In this exercise you learned how to create new features in your GIS database by digitizing shapes directly from a digitizing tablet. The next exercise will show you how to copy shapes from existing vector sources—CAD drawing layers—and paste them into your GIS database.

If you need to find out if ArcMap supports your digitizing tablet, consult the ESRI Web site at *www.esri.com* for the most recent information.

Exercise 4: Editing features

In the first three exercises, you learned how to create new features in ArcMap. In this exercise, you'll learn how to copy and paste, move, rotate, scale, and extend existing features.

Opening the exercise document and starting an edit session

1. Start ArcMap.

2. Click the Open button on the Standard toolbar. Navigate to the EditingFeatures.mxd map document located in the Editor directory where you installed the tutorial data (C:\ArcGIS\ArcTutor is the default location).

3. Click the Editor menu and click Start Editing.
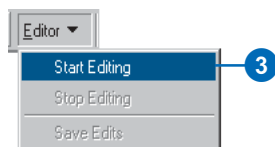
Copying and pasting features

When creating vector features of the same type as existing ones, it is more efficient to copy their shapes than to digitize over the top of them. You can copy the shapes of any vector feature that you can select in ArcMap. In this step, you will select buildings from a CAD drawing and paste them into a geodatabase layer of buildings.

1. Click the Edit tool on the Editor toolbar and drag a box around all the new building features to select them.
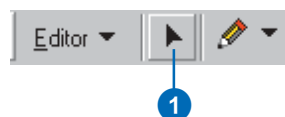
The selected CAD features should be highlighted as shown below.

2. Click the Copy button on the Standard toolbar to copy the selected features to the clipboard.

3. Set the Buildings layer as the target layer so you can paste the copied features into it.
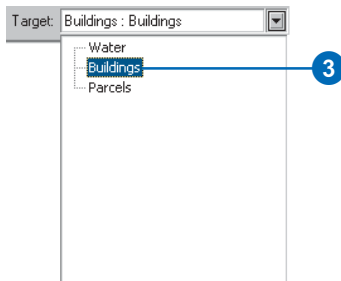
4. Click Paste to copy the selected building features into the target layer. The progress bar will update as each feature is copied into the target layer.

It is important to note that only the shapes are copied from the CAD file into the geodatabase. If you need to paste the attributes as well, you must use the object loader. Exercise 6 of this chapter shows you how to do this.

Rotating features

Now that you've copied the building features into the Buildings layer of your geodatabase, you need to orient the features to fit the parcel subdivision into which you'll move them.

1. To avoid selecting features from the CAD layer—called New Buildings—uncheck it in the table of contents to hide its features.
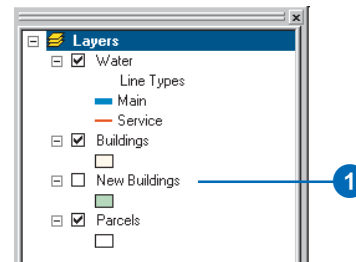
2. Click the Rotate tool on the Editor toolbar.
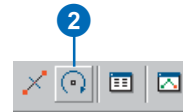
3. Press the A key, type "180", and press Enter to rotate the selected building features 180 degrees.

The selected features are now oriented 180 degrees from their previous location.
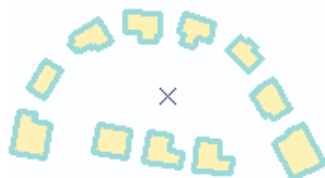
Moving features

Now that the buildings are oriented properly, you are ready to move and scale them so that they fit inside the subdivision located near the bottom center of the map.
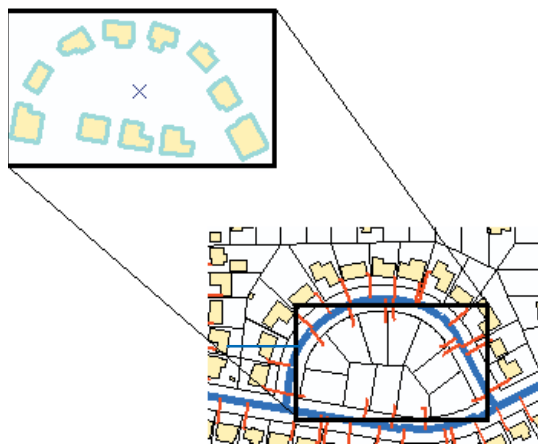
You can ensure the proper relocation of the building features by snapping the lower left selected building feature to the endpoint of the lower left water service line, shown in red.

1. With the buildings selected, click the Editor menu and click Snapping.
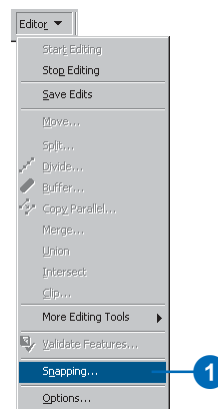
2. Check the End option for the Water layer and the Vertex option for the Buildings layer so you can snap the corner of a building feature to the endpoint of a waterline. Close the dialog box.
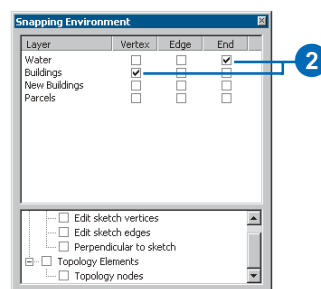
3. Click the Edit tool so you can move the selection anchor for selected features.

The selection anchor is a small x located at the center of selected features. It is the point on the feature or group of features that will be snapped when you move them.

4. Hold down the Ctrl key and move the pointer over the selection anchor. When the pointer icon changes, click and drag the selection anchor until it snaps to the corner of the lower left building.

5. Drag the selected buildings until they snap to the endpoint of the waterline.

Notice that some of the buildings are too large to fit inside the parcels. You must scale these features to make them fit.

Scaling features

When data is created using a coordinate system different from that of your database, you may need to adjust the projection and scale of the data to fit the projection and scale of your database. Often, simply moving, rotating, and scaling those features are sufficient.

Because scaling is not a common operation, the Scale tool is not located on the Editor toolbar. You must, therefore, add it to the toolbar before you can use it.

1. Click the Tools menu and click Customize.
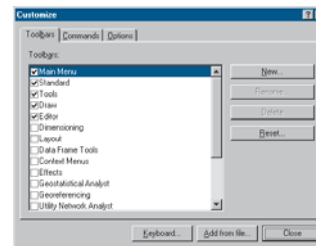
2. Click the Commands tab and click Editor in the Categories list. The Editor category contains many editing tools, regardless of their location.
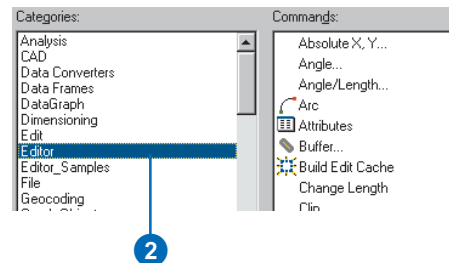
3. Scroll down the list of commands on the right until you find the Scale tool. Drag and drop the tool next to the Rotate tool on the Editor toolbar. Click Close on the Customize dialog box.

4. Before scaling the selected features, you may want to zoom in so that your scaling is more accurate. Click the Selection menu and click Zoom To Selected Features.
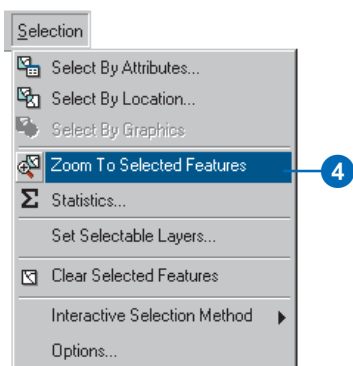
5. Click the Scale tool and drag the selected building features to scale them. Shrink the features until they fit inside the parcel subdivisions. Use the waterlines as a guide. Scale features until the lower right building matches the endpoint of the waterline.
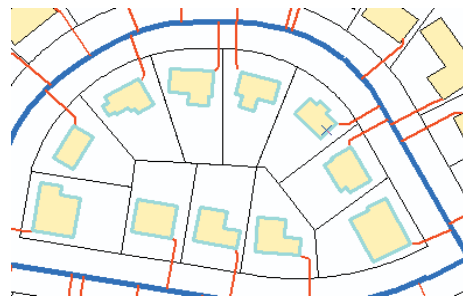
Extending and trimming waterlines using the Extend/Trim Features task

Now that you have scaled the building features to fit inside the parcel subdivision, you need to extend the waterlines so that they snap to the side of each building. You can extend and trim waterlines using the Extend/Trim Features task.

1. To get a better view of the waterline that you need to extend, you can zoom in to the Extend Water Line bookmark. Click the View menu, point to Bookmarks, and click Extend Water Line.

2. Click the Task drop-down arrow and click Extend/Trim Features to set the edit task.
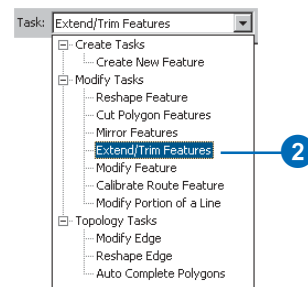
3. The Extend/Trim edit task will extend selected polyline features to the sketch you digitize. Click the Edit tool and click the waterline feature that you need to extend.

4. Click the Sketch tool and snap the first sketch point to the upper right corner of the building feature to which you want to extend the water line feature.
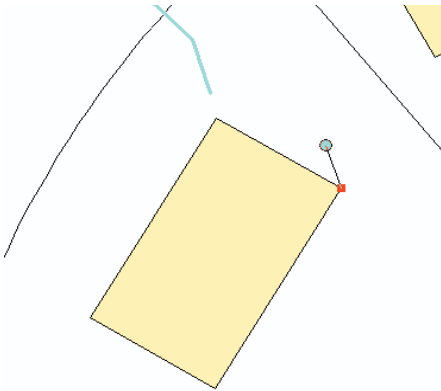
5. Move the pointer until it snaps to the upper left building corner and double-click to finish the sketch. The waterline will then extend until it intersects the line that you have digitized. Since the line is identical to the side of the building, the end of the waterline should snap to the building.
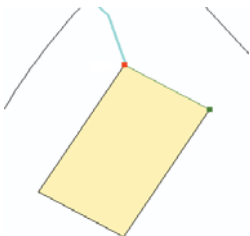
You can also use the Extend/Trim Features task to cut a waterline feature if it extends too far into the building.

6. To get a better view of the waterlines, you must zoom to the bookmarked extent called Trim Water Line, which was created for you. Click the View menu, point to Bookmarks, and click Trim Water Line.
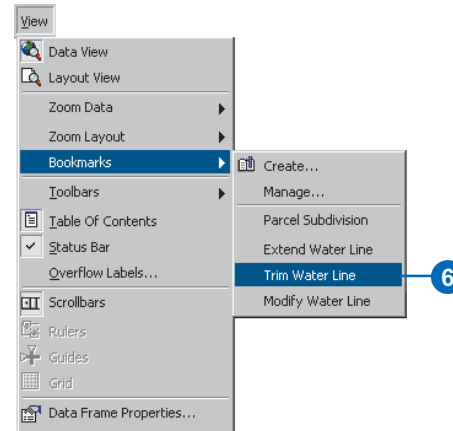
7. Click the Edit tool and click to select the waterline that extends into the building and needs to be trimmed.
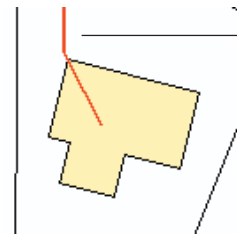
8. If you changed the current task, make sure you change it back to Extend/Trim Features, then click the Sketch tool to start digitizing.

9. Snap the first sketch point to the lower left corner of the building feature.
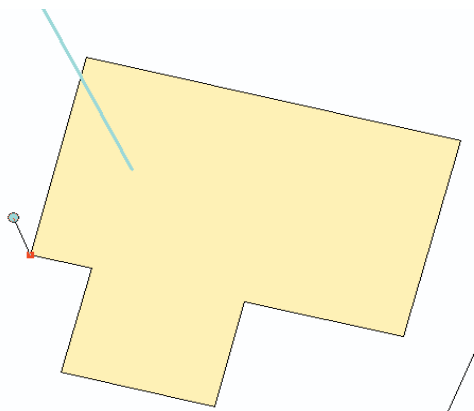
10. Move the pointer to the upper left corner of the building. Double-click to snap the last point of the sketch to the building corner and trim the waterline feature.
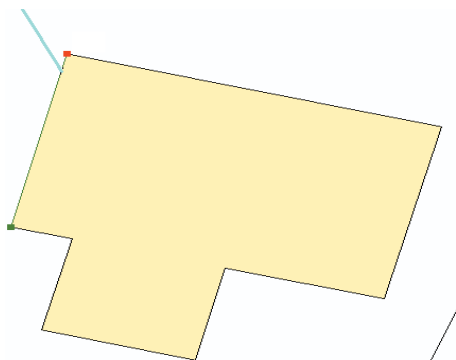
Extending and trimming waterlines using the Modify Features task

The Extend/Trim Features task lets you extend and trim selected waterlines using a sketch that the features either cross or extend to. However, that is not the only method for extending or trimming waterlines. You can move, insert, or remove vertices of the waterline by making its shape the edit sketch. You can do this using the Modify Features task.

1. To get a better view of the waterlines, you need to zoom to the bookmarked extent called Modify Water Line. Click the View menu, point to Bookmarks, and click Modify Water Line.
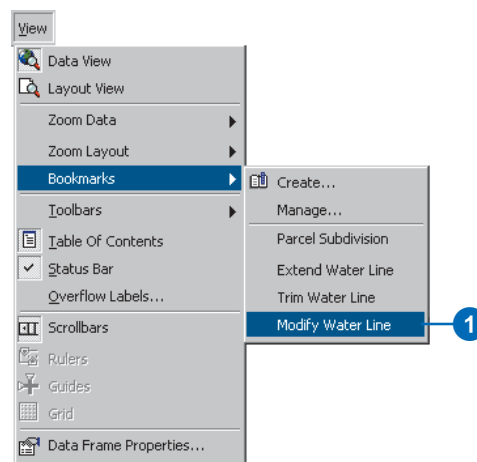
2. Click the Edit tool and click to select the waterline feature that needs to be extended.

3. Click the Task drop-down arrow and click Modify Feature to display the vertices of the waterline.
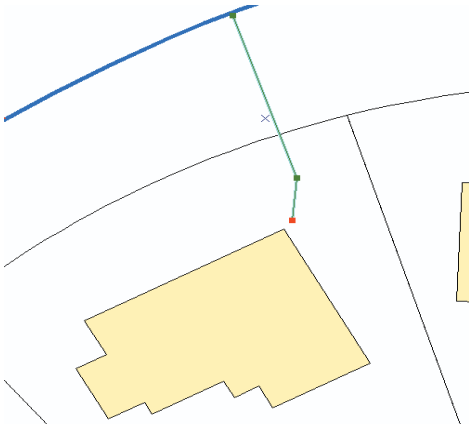
4. Click the Edit tool and move the pointer over the red vertex at the end of the waterline. Drag the vertex until it snaps to the building corner.
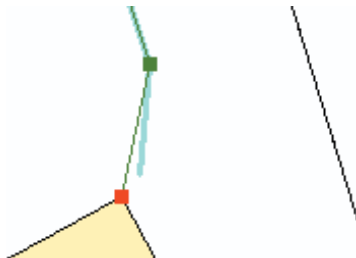
5. Move the pointer over the red vertex, right-click, then click Finish Sketch to finish modifying the waterline.
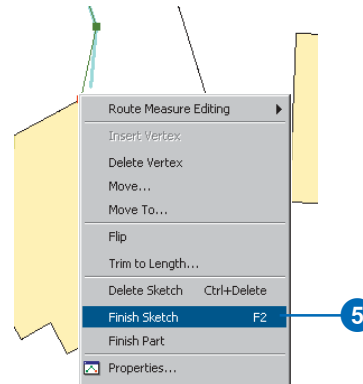
You can follow the same steps to trim line features using the Modify Features task. You can use the Trim command to reduce the length of the sketch by an exact distance as well.

With modifications to these waterlines completed, continue modifying the rest of the waterlines that don't connect to building features and experiment with other methods of modifying shapes.

Exercise 5: Editing adjacent features with a map topology

Many vector datasets contain features that share geometry. Features can share edges—for example, line segments—or nodes, the points at the ends of segments. For example, watershed polygons might have common edges along ridgelines, and lake polygons might share their shoreline edges with land cover polygons. Three watersheds might share a single node at a mountain peak, and three river-reach features might share a node at a confluence. You can simultaneously edit shared edges and nodes with the Topology Edit tool when you create a map topology.

Opening the exercise document

In this exercise you will update multiple watershed features in two feature classes using the Topology Edit tool.

1. Start ArcMap.
2. Click the Open button on the Standard toolbar. Navigate to the MapTopology.mxd map document located in the Editor directory where you installed the tutorial data. (C:\ArcGIS\ArcTutor is the default location.) Click the map and click Open.

This map contains two feature classes. Hydro_region contains polygon features representing three large hydrologic regions in the southwestern United States. Note that part of the Great Basin regional watershed has been omitted from the tutorial dataset. Hydro_units contains polygon features representing smaller watersheds within these regions. You can see the features in the Hydro_units feature class because the Hydro_region features are partly transparent.

The regional data was derived by dissolving the smaller hydrologic units, so the boundaries of the features in Hydro_regions are already coincident with the boundaries of the smaller watersheds. In this exercise, you will create a map topology to allow you to edit the vertices that make up a shared edge and move a node that defines the intersection of multiple features.

3. Click Editor and click Start Editing.

   If the Topology toolbar is not on the map, you will add it.

4. Click Editor, point to More Editing Tools, and click Topology.
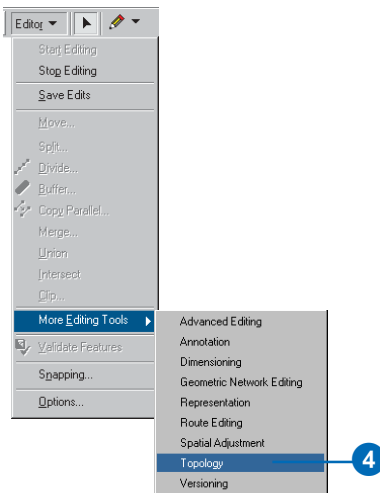
The Topology toolbar contains tools for working with topologically related features. Some features are related by a topology stored in a geodatabase. With an ArcInfo or ArcEditor license, you can use the topology editing tools on this toolbar to edit such geodatabase topologies.

You may still need to edit features that share geometry when you are working with shapefiles or features in a geodatabase that do not have a topology defined for them. You can use the tools on this toolbar to create a temporary topological relationship between coincident parts of features—a map topology—then edit the shared parts of

features. ArcView licensed seats of ArcMap can edit map topologies but not geodatabase topologies. ArcEditor and ArcInfo licensed seats of ArcMap can edit both types of topology.

Creating a map topology for an area

Before you create the map topology, you'll zoom in to the area that you want to edit. Zooming in to an area reduces the number of features that the map topology analyzes when building the topology cache.

1. Click View, point to Bookmarks, and click 3 Region Divide.
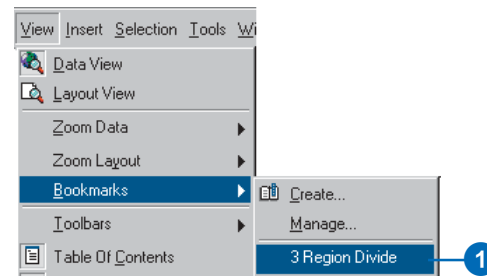
The map zooms to the bookmarked area. Now you can see labels for the smaller watersheds.
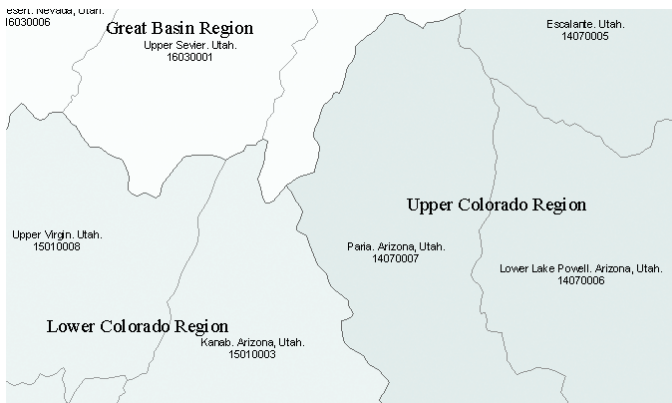
2. Click the Map Topology button.

The Map Topology dialog box appears. You can select the feature classes that will participate in the topology and choose a cluster tolerance. The cluster tolerance defines how close together parts of features must be before they are considered to be coincident.

3. Click Select All.
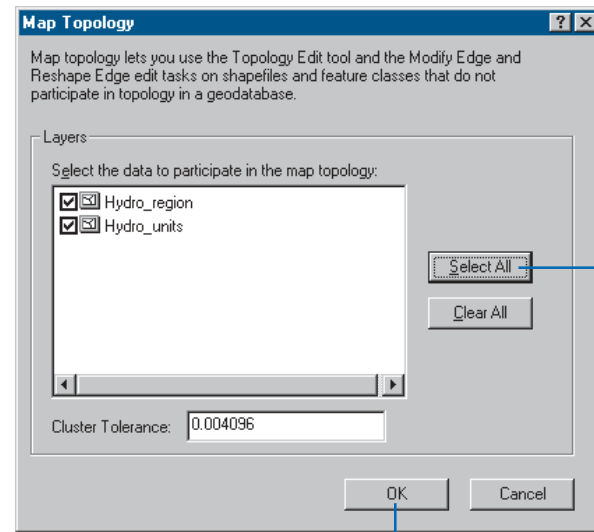
You want all of the features on the map from both feature classes to participate in the map topology.

The default cluster tolerance is the minimum possible cluster tolerance and is given in coordinate system units. In this case, the dataset is in the Universal Transverse Mercator coordinate system, and the units are meters. You will accept the default cluster tolerance.

4. Click OK.

Now you will start editing the map topology using the Topology Edit tool.

5. Click the Topology Edit tool.

6. Click the edge that is shared by the East Fork Sevier. Utah, polygon (#16030002) and Kanab. Arizona, Utah, polygon (#15010003).
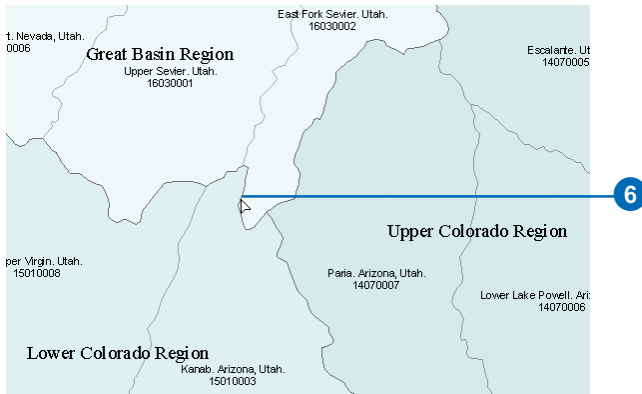
The edge is selected and changes color.

If you have set ArcMap to show unselected topology nodes, then open circles will also appear around the intersections of the lines that make up the polygon edges. These are unselected nodes in the map topology.

This edge is also shared by the larger regional polygons. To check this you'll use the Show Shared Features tool.

7. Click the Show Shared Features button.
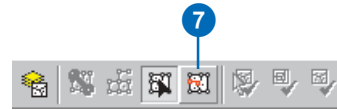
The Shared Features dialog box appears.
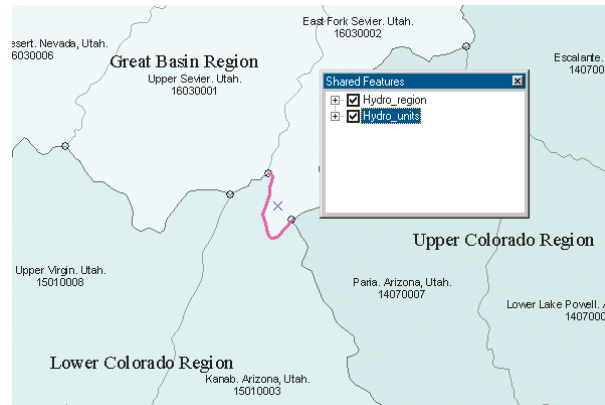
You can use this dialog box to investigate which features share a given topology edge or node. You can also use this dialog box to control whether or not edits that you make to a given topology element will be shared by certain features.

The names of both feature classes in the map topology, Hydro_region and Hydro_units, are listed with check marks in this dialog box. The checks mean that the selected topology element is shared by features in these feature classes. Next, you'll see which features share this edge.

8. Double-click Hydro_units.
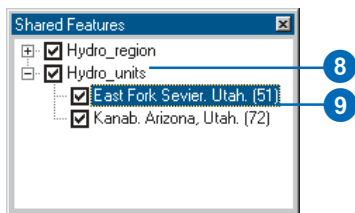
The plus sign changes to a minus, and two more branches expand below Hydro_units. Each of these represents a hydrologic unit feature that shares this edge.

9. Click East Fork Sevier. Utah. (51).

Feature number 51 in the Hydro_units feature class, the East Fork Sevier hydrologic unit, flashes on the map.

10. Double-click Hydro_region and click Great Basin Region (1).
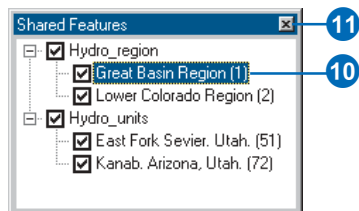
Feature number 1 in the Hydro_region feature class, the Great Basin region, flashes on the map.

11. Close the Shared Features dialog box.

Editing a shared edge in a map topology

Now that you've seen that the features you need to update share this edge, you'll update the boundary of the watersheds to better fit the terrain.

1. Check Hillshaded_terrain.sid to turn on the image in the ArcMap table of contents.
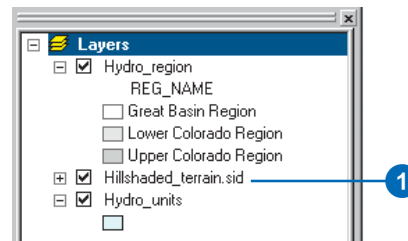
This is a small area of hillshaded terrain extracted from the National Elevation Dataset Shaded Relief Image Service, published by the U.S. Geological Survey. You can add the original image to ArcMap from the Geography Network[SM].
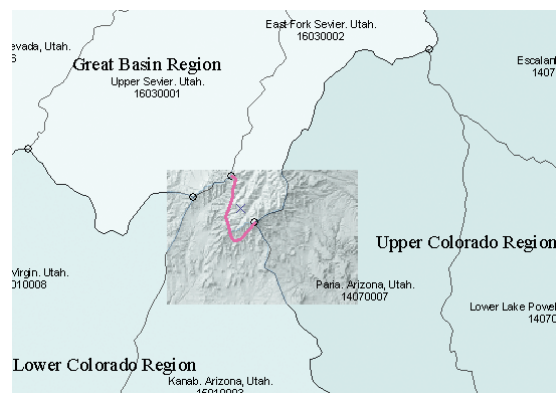
You will use this image, and the guidelines that have been added to it, to update your watershed data.

2. Press and hold down the Z key.

   The pointer becomes the Zoom In tool.

3. While pressing the Z key, click and drag a box around the selected edge.
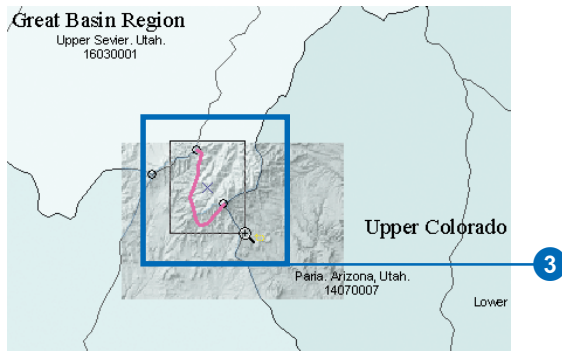
The watershed data that you have is derived from the medium resolution National Hydrography Dataset, published by the United States Geological Survey and the United States Environmental Protection Agency. This data was compiled at a scale of 1:100,000. The National Elevation Dataset hillshade is derived from 1:24,000-scale digital elevation model data. You will use the higher resolution hillshade data to improve the watershed boundaries.

4. Double-click the edge to see the vertices that define the shape of the edge.
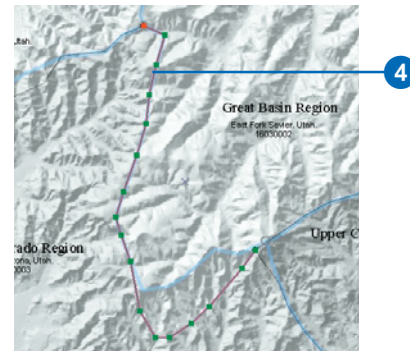
Now you can see the vertices (in green) that define the shape of this edge.
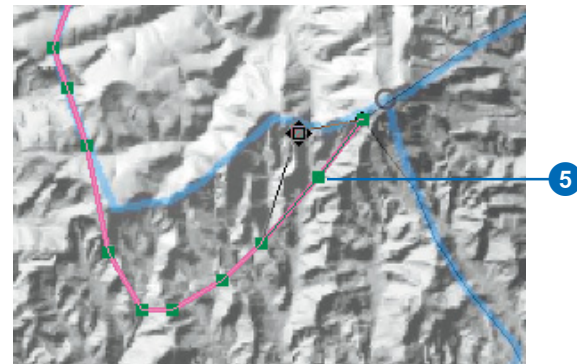
5. Move the pointer over the second vertex from the eastern end of the edge. When the pointer changes to a box with four arrows, click the vertex, drag it northwest, then drop it on the blue guideline.

You could continue reshaping this edge vertex by vertex, but there is a faster way to update it.

6. Click and drag a box across part of the selected edge.
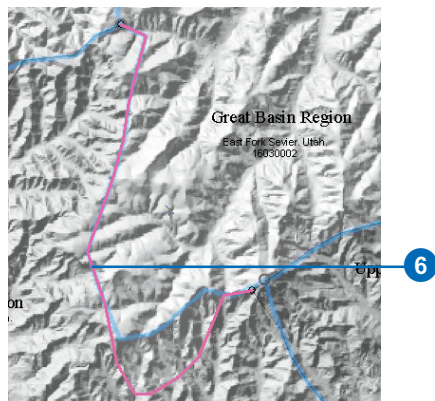
This reselects the edge and refreshes the change you made to it.

Reshape a shared edge in a map topology

Now you'll use an edit sketch to reshape the shared edge. You'll need to set the edit task to Reshape Edge and turn on snapping to the watershed edges.

1. Click the Task drop-down list and click the Reshape Edge topology task.
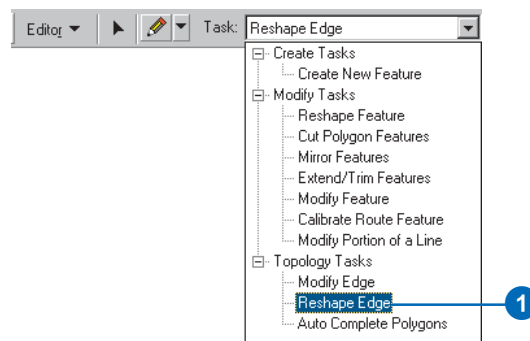
2. Click the Sketch tool on the Editor toolbar.

3. Click Editor and click Snapping.
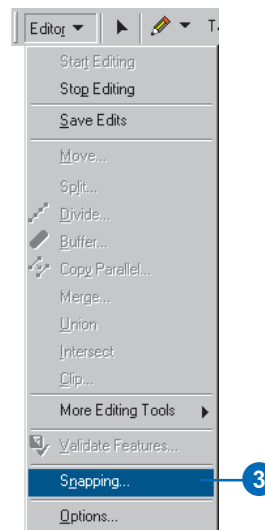
4. Check the box to snap to edges in the Hydro_region feature class, then close the Snapping Environment dialog box.
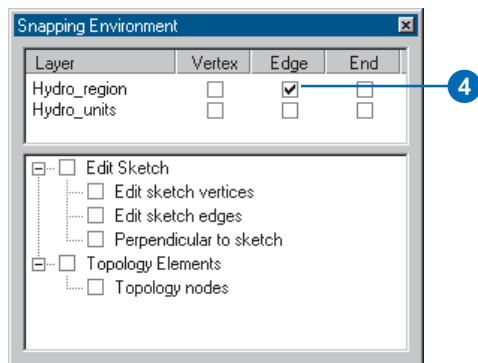
5. Move the pointer over the edge where the selected topology edge and the blue guideline begin to diverge.
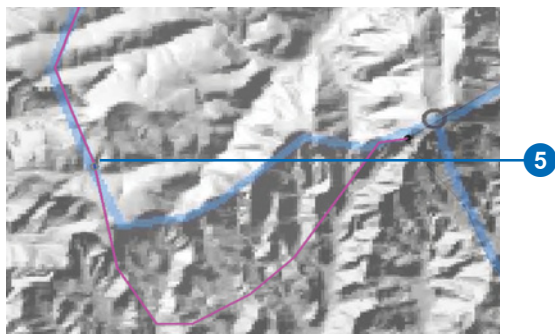
6. Click the edge to begin an edit sketch.
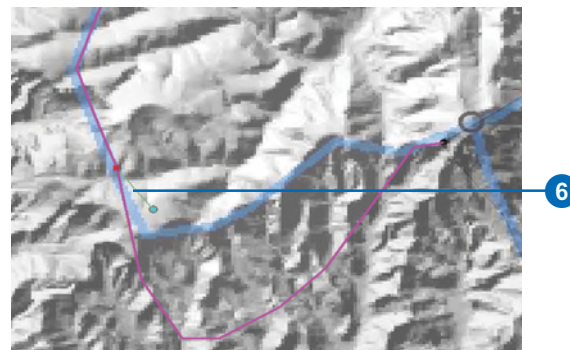
7. Continue adding vertices along the guide line.

8. Make sure that the last vertex you add to the sketch snaps to the edge near the vertex you moved.
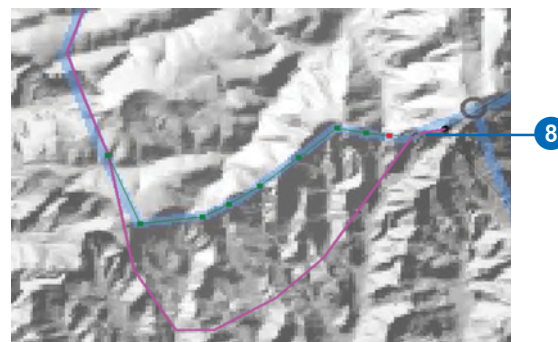
9. Press F2 or right-click and click Finish Sketch.

The change that you made with the edit sketch is applied to the shared edge.
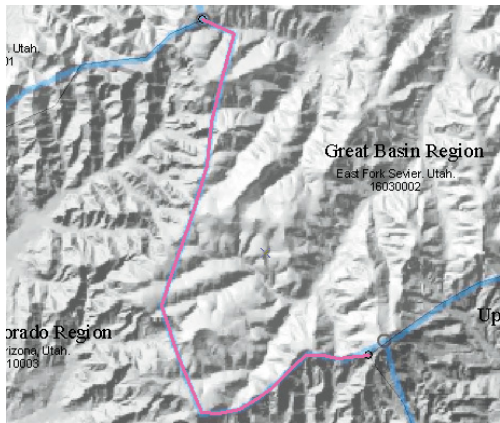
Move a shared node in a map topology

Now that you've adjusted the edge shared by the watershed boundaries, another problem with the existing data needs to be fixed. The node at the east end of the edge is the point where the Great Basin, Upper Colorado, and Lower Colorado Region watersheds come together. You'll move this shared node by a specified number of meters.

1. Click the Topology Edit tool.

2. Click once on the map, off of the edge, to deselect it.

3. Press and hold down the N key.

   This temporarily limits the selectable topology elements to nodes.

4. Click and drag a box around the node while holding down the N key.
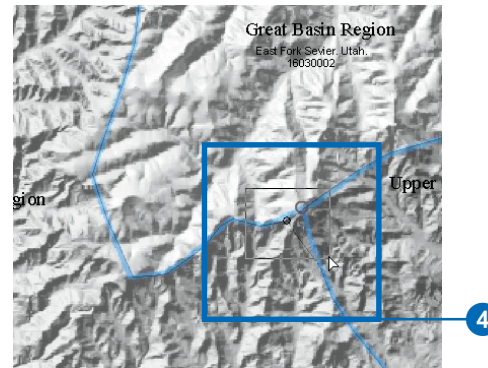
The node is selected. Now you'll move it to the correct location.

5. Right-click and click Move.
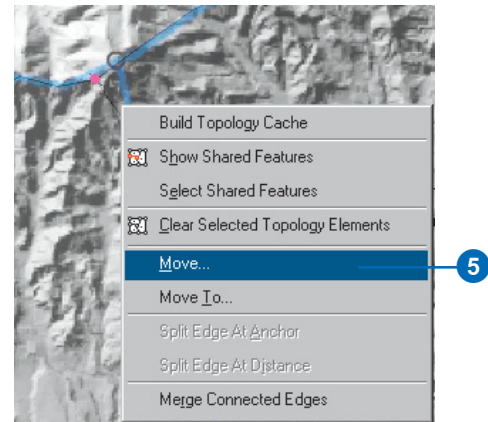
You will move this node 460 meters in the x direction (east) and 410 m in the y direction (north).

6. Type "460" and "410" in the x and y boxes, respectively, then press Enter.

The node is moved to the new location, and all the features that share it in the map topology are updated.

You can also move the node by clicking and dragging it, as you move the vertex of the topology edge.

7. Click Editor and click Stop Editing.
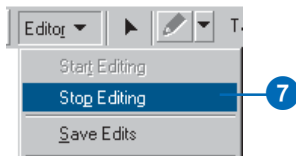
8. Click Yes if you want to save your edits.

In this exercise you learned how to create a map topology and how to use the Topology Edit tool to edit multiple features that share edges and nodes. The map topology allowed you to maintain the common boundary between the features while simultaneously editing four, then six features in two different feature classes. The Topology Edit tool and the topology editing tasks can also be used to edit the edges and nodes in a geodatabase topology.

Exercise 6: Importing CAD features

ArcMap lets you seamlessly integrate computer-aided design drawings into your work. It allows you to display and query CAD datasets without first having to convert the drawing files to an ESRI format.

The ability to work with CAD drawings in ArcMap is particularly useful if your organization has existing CAD data resources that you need to use immediately in your work.

Not only can you perform basic query and analysis functions using ArcMap tools, you can also snap directly to CAD features or entities when you update your database.

This exercise will show you how to import CAD features directly into your edit session; this will allow you to easily integrate CAD features into your work.

Opening the Exercise document

1. Start ArcMap.
2. Click the Open button on the Standard toolbar. Navigate to the WorkingWithCAD.mxd map document located in the Editor directory where you installed the tutorial data. (C:\ArcGIS\ArcTutor is the default location.)

3. Zoom to the area of the map identified by the red hatched polygon.
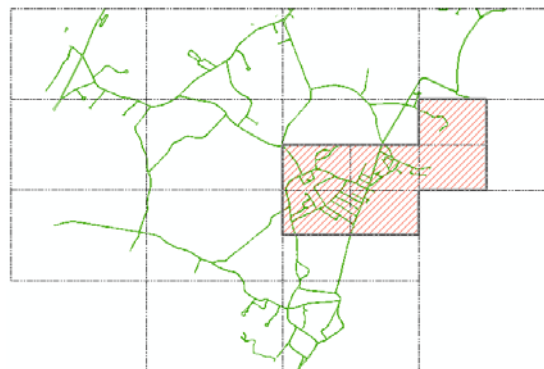
Using the Load Objects wizard

You can import CAD entities directly from CAD feature classes using the Load Objects wizard. However, you'll need to add the Load Objects wizard into ArcMap first.

1. Click the Tools menu and click Customize. Click the Commands tab.
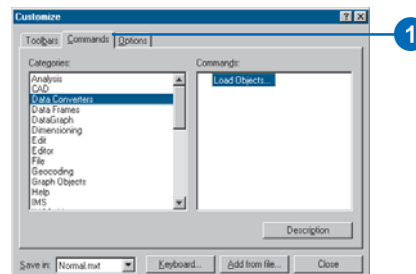
2. Click the Data Converters category from the Categories list and drag and drop the Load Objects command onto the Editor menu. Close the Customize dialog box.
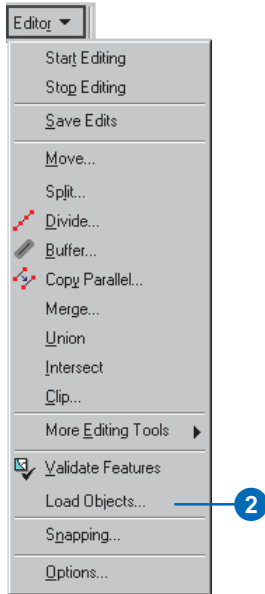
3. Click Editor and click Start Editing. Set the Target layer to the LotLines layer. This is the layer into which you will load the parcel lines.
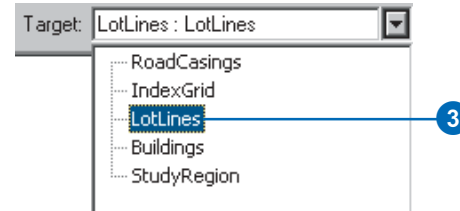
Loading CAD features

With the target layer set to the lot lines feature class, you are ready to load features directly from the CAD drawing.

CAD drawings are represented in two ways: CAD drawing files and CAD drawing datasets. CAD drawing datasets contain feature classes organized by point, line, or polygon shape types.

Each CAD feature in a CAD feature class contains a Layer field; it lets you identify the CAD drawing layer from which each feature is derived. In this exercise, you'll extract the features belonging to the lot line layer of the polyline feature class into your empty lot line geodatabase feature class.

1. Click Editor and click Load Objects.

2. Click the Browse button, located to the right of the Input data list. Navigate to where you installed the ArcTutor sample data (C:\ArcGIS\ArcTutor by default), then navigate to the Editor\ExerciseData\EditingCAD directory.
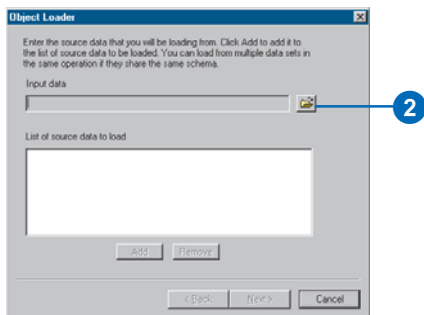
3. Double-click the Parcels.dwg drawing dataset. Click the Polyline feature class and click the Open button.

4. Click the Add button to add the CAD feature class—listed in the Input data list—to the list of source data to load.

5. Click Next.
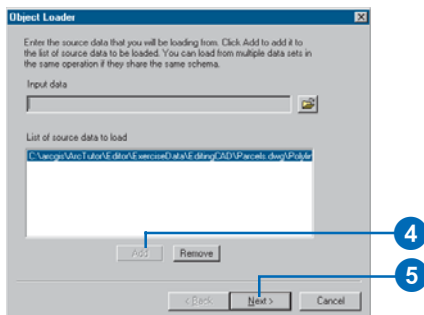
Matching input and target fields

The next step in the wizard lets you match the fields of the CAD feature class with the fields in your target layer.

1. Accept the default field mappings for this exercise. Click Next.
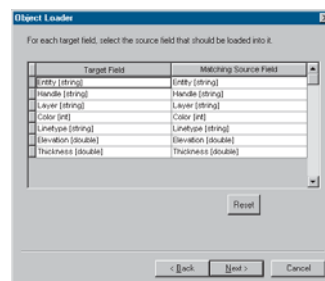
Defining a query

Since all CAD layers are combined into a single feature class containing a Layer attribute value, you will define an attribute query so that only features with a layer name = 'LOT-L' will be loaded into the target layer.

1. Click the option to load only features that satisfy the query.

2. Click Query Builder to define the query.
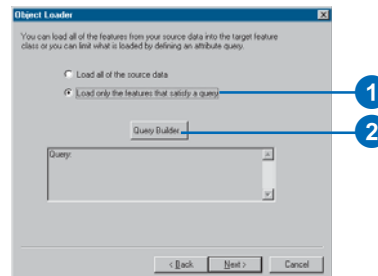
3. Double-click Layer in the Fields list. This adds the string to the where clause for the query.

4. Click the equal (=) sign.
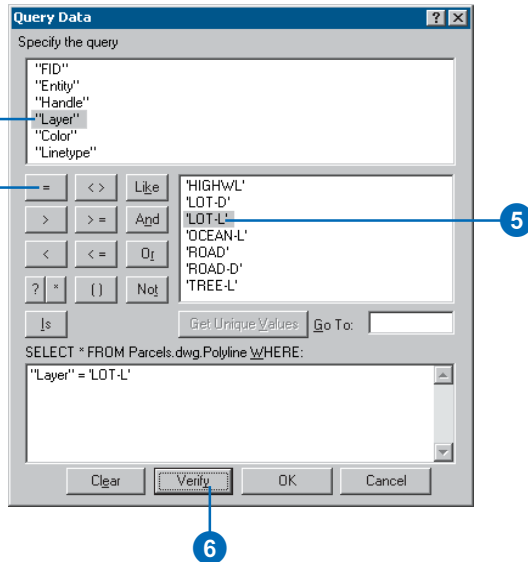
5. Click Get Unique Values to display all unique attribute values for the Layer field. Double-click LOT-L from the list to complete the query.

   After completing the steps above, your query should read: "Layer" = 'LOT-L'. You can alter the query by typing directly into the where clause box.

6. Click Verify to ensure that you have created a valid SQL where clause.

7. Click OK. Make sure that you have a valid query expression before applying the query to the wizard.

8. Click Next on the Object Loader dialog box.

Snapping and validation

Next, the Object Loader will ask if you want to apply any snapping agents that you have set in the Snapping Environment dialog box to features as they are loaded into the map and whether you want to validate each feature that is added.

If you're concerned about the connectivity between features that you import and existing features in your database, you may want to apply snapping. However, you should be aware that features will move within the current snapping tolerance. If the source CAD data was constructed using coordinate geometry, applying snapping may reduce the accuracy of the original data.

1. Click Next (do not apply snapping).
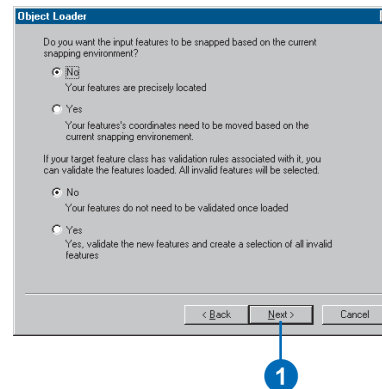
Completing the wizard and loading features

The final dialog box provides a summary of the options that you chose through each step of the wizard. You can examine each of your steps and click Back if you made any mistakes.

1. Click Finish.

   A progress indicator will appear.
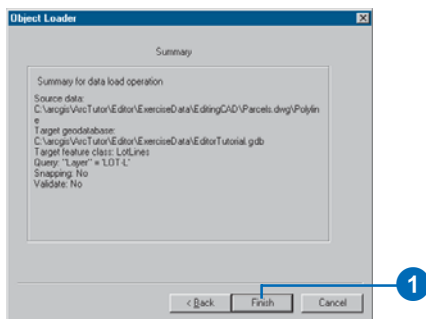
Once the wizard has finished loading features, you may need to refresh the display to see the new lot lines.
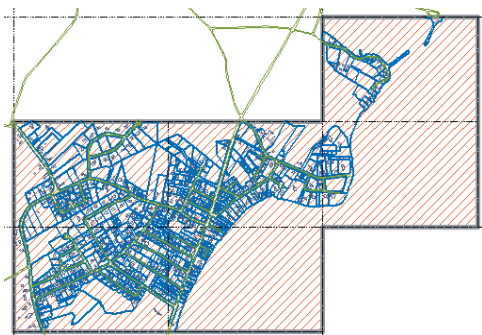
Saving your edits

Now that you have successfully loaded CAD data into your edit session, you can stop editing and save your edits.

1. Click Editor and click Stop Editing.
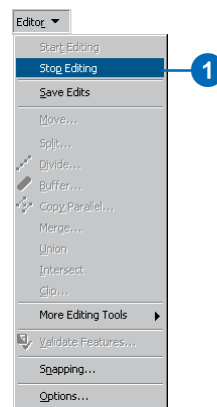
2. Click Yes to save your edits. You'll use this data in the next exercise.
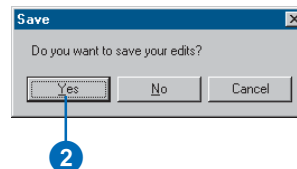
In this exercise, you learned how to load CAD features directly into your GIS database. You were able to import features by their shape type and by their CAD layer name using the Load Objects wizard. But you don't have to import CAD data to use it. You can also snap directly to CAD features or simply display and query their attributes.

Exercise 7: Using geodatabase topology to clean up your data

The CAD lot lines data that you loaded in the previous exercise needs some quality checking, editing, and other processing for you to have useful parcel polygon features for your geodatabase.

You will create a simple geodatabase topology rule to help you find digitizing errors in the lot line data, then use the topology and editing tools to fix these errors. Once the problems, mostly lines that do not close to form polygons, are fixed, you will create a new polygon feature class from the lot lines. You'll add the polygons to the topology, then use the topology to identify and resolve other errors in the data.

If you have not loaded the lot lines, a duplicate of this feature dataset with the lot lines already loaded may be found where the tutorial data is installed at: C:\ArcGIS\ArcTutor\Editor\ExerciseData\ TopologyEdits\TopologyTutorial.gdb.

You must close ArcMap before building the topology to release the lock on the database.

1. Close ArcMap. You do not need to save changes to the map.

Navigating to the study area dataset

1. Start ArcCatalog.

2. Click the Connect to Folder button.

3. Navigate to the ExerciseData folder. The default location for this folder is C:\ArcGIS\ArcTutor\Editor.
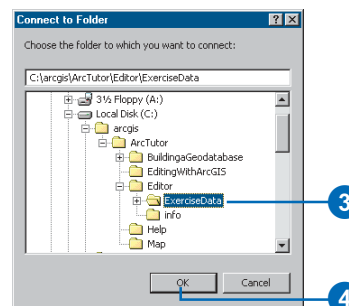
4. Click OK.

5. Double-click the folder connection.

6. Double-click the EditorTutorial geodatabase.
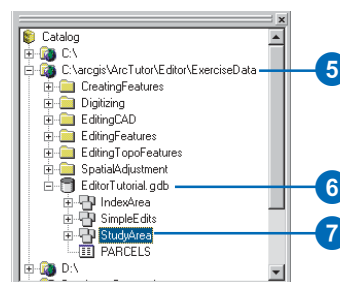
7. Click StudyArea.

This is the feature dataset into which you loaded the CAD lot lines in the previous exercise.

Creating a geodatabase topology

Now you'll create a geodatabase topology to help you find errors in the LotLines data. The topology will be simple, involving one feature class and one topology rule.

1. Right-click the StudyArea dataset, point to New, and click Topology.
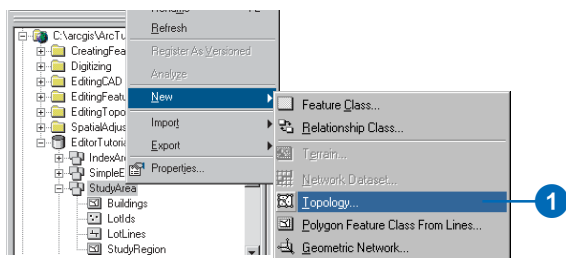
2. Click Next.
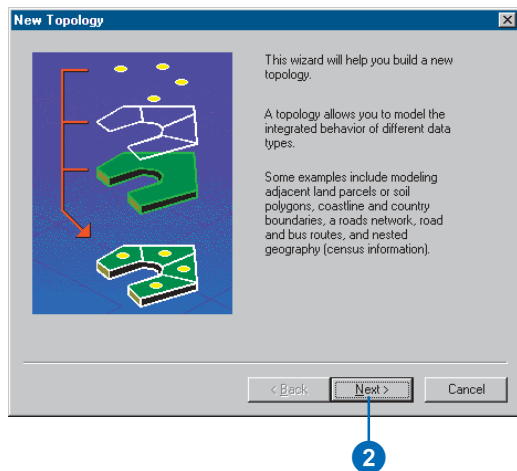
On the next panel of the wizard, you can set the cluster tolerance. The cluster tolerance is the minimum distance that separate parts of features can be from each other. Vertices and edges of features that fall within the cluster tolerance are snapped together.

By default, the wizard gives the smallest possible cluster tolerance, which is determined by the precision of the spatial reference of the dataset. The precision of a dataset defines how many system units can be stored per unit of linear measure and controls how precisely coordinates are stored in the dataset.

3. Click Next.
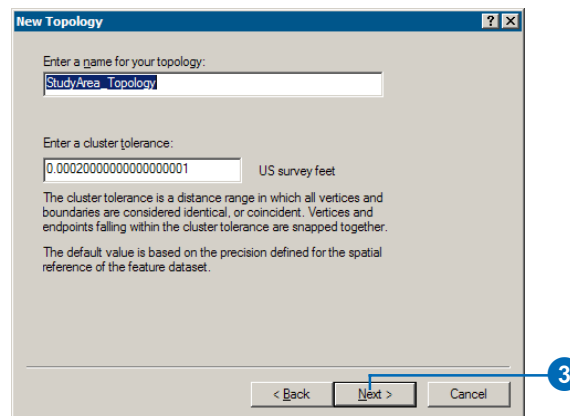
Now you can choose which feature classes in the dataset to include in the topology.

4. Check LotLines.
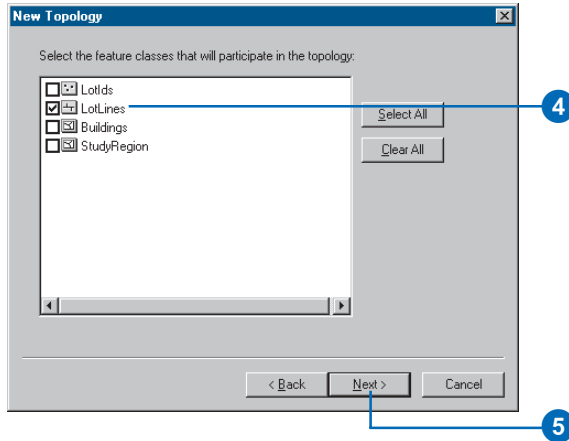
5. Click Next.

When you have more than one feature class in a topology, you can give them different ranks. When vertices or edges of features fall within the cluster tolerance of each other, the feature class ranks control which is moved to the other's location. Feature classes of a lower rank will be snapped to feature classes of a higher rank. The highest rank is 1; the lowest is 50. Parts of features of the same rank that fall within the cluster tolerance are geometrically averaged.

6. Click Next.
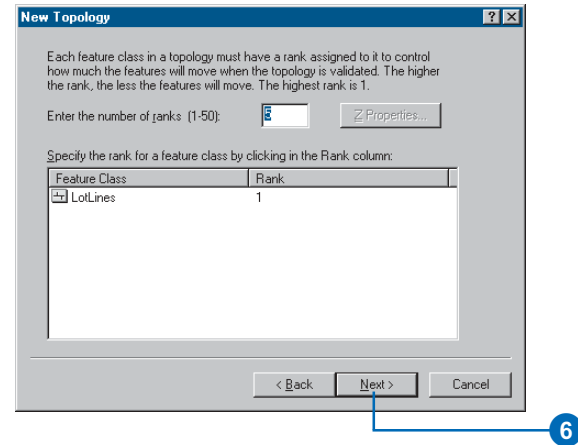
When you build a topology, you can pick the rules that will govern the allowable spatial relationships between features.

7. Click Add Rule.
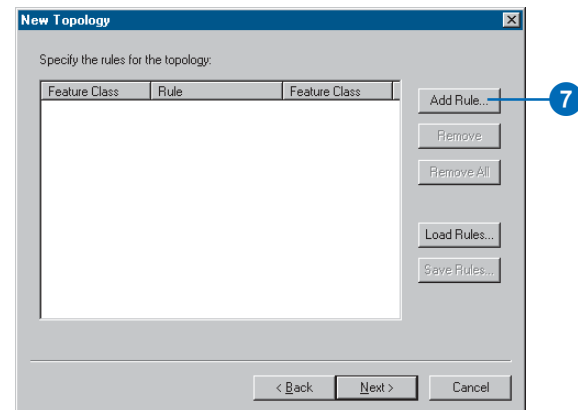
8. Click the Rule drop-down list and click Must Not Have Dangles.
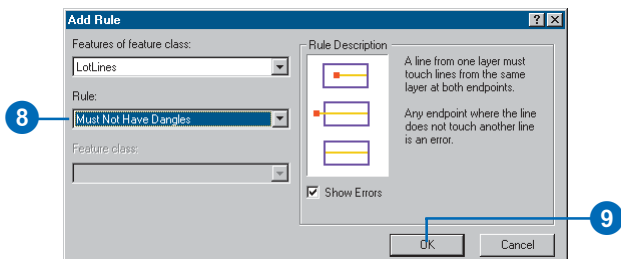
Dangles are the endpoints of lines that are not snapped to other lines in the feature class. You will want to find the dangles in the LotLines feature class because they represent places where the imported CAD line work will not produce closed polygons.

9. Click OK.

The rule is added to the list of topology rules.

10. Click Next.
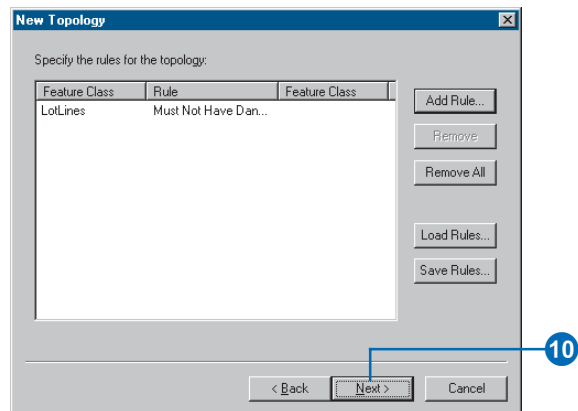
11. Click Finish.
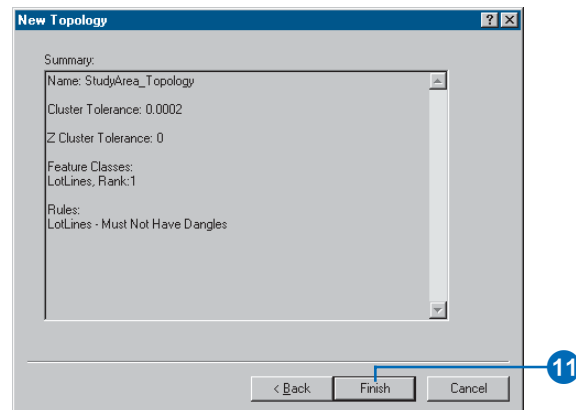
You get a message that the topology is being built, then another asking whether you want to validate the topology now.

12. Click Yes.
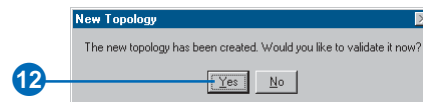
You get a message that the topology is being validated, and the new topology appears in the StudyArea dataset.

Adding the topology to the map

Now you'll use the topology to help you find the dangle errors in the LotLines data. It is important to clean up this data before you create polygon features because only one lot polygon will be created if a line dividing two lots does not completely separate them.

1. Click the Launch ArcMap button to start a new map.
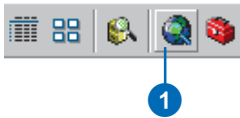
2. If the Startup dialog box appears, click the button to start a new empty map.
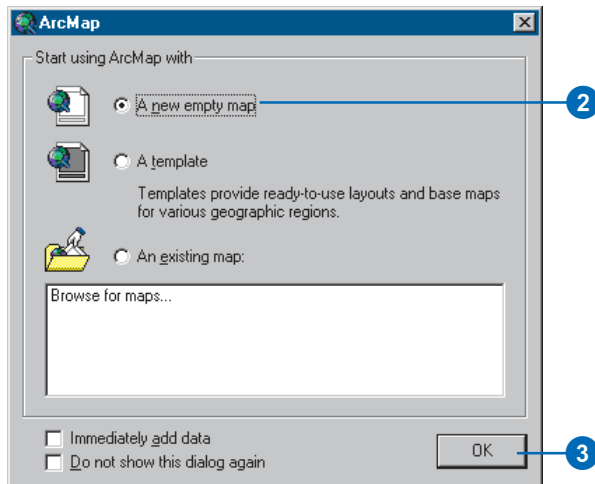
3. Click OK.

4. Resize the ArcMap and ArcCatalog windows so that you can see both.

5. Click StudyArea_Topology and drag it onto the map.
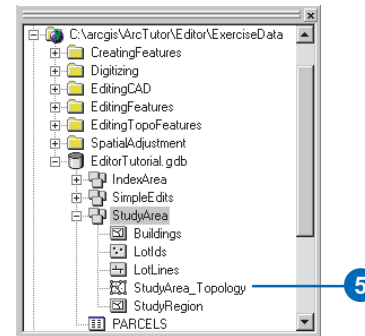
6. Click Yes when you are asked whether to add all the layers that participate in the topology.
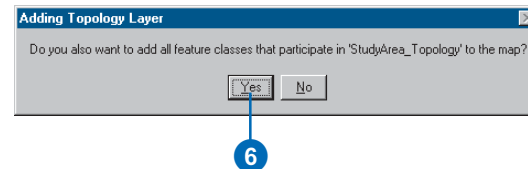
The topology layer and the LotLines features are added to the map.
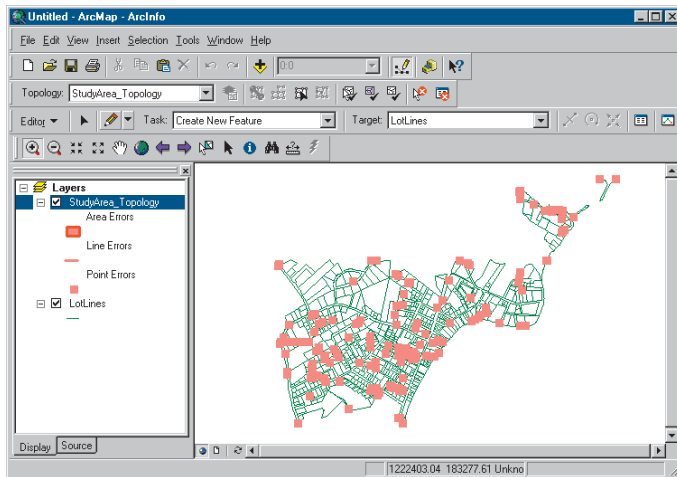
The Topology layer shows all of the topology errors. Notice that in the ArcMap table of contents, the topology layer can show Area, Line, and Point errors. This topology only has one feature class and one rule, so all of the topology errors relate to that rule. The topology rule specifies that LotLines must not have dangles. The error geometry for dangles is a point, located at the dangling end of a line feature. All of the red error features on the map are dangles.

Finding topology errors

The next step to make this data useful is to identify the topology errors that are present. Lot lines that have a dangle, where one end of the line is not connected to another lot line, are errors that you need to find to clean up this data so you can create lot polygons. Some dangles need to be extended to close a polygon; others overshoot the line that they should snap to and need to be trimmed. You will find some of these errors now.

1. Click Editor and click Start Editing.
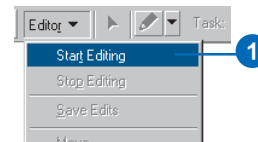
2. Click the Zoom In tool.

3. Click and drag a box around the three red error features located near the middle of the map, to the right of and above the north–south and east–west trending series of errors.
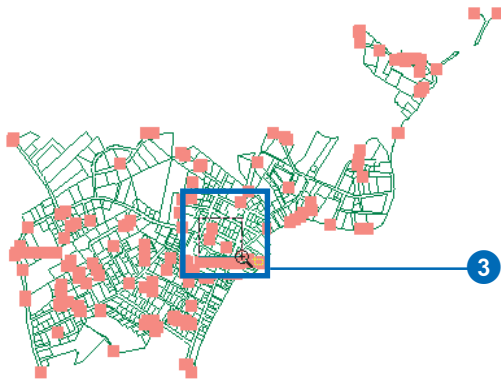
Now you can see three of the errors.
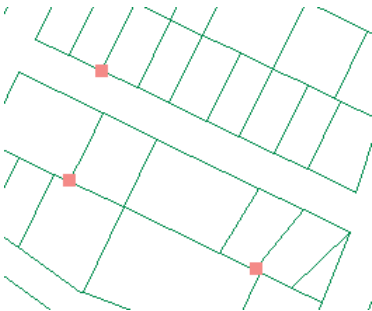
You will use tools on the Topology toolbar to find out more about these errors and to correct them. If the Topology toolbar is visible, skip the next step in which you add the toolbar.

4. Click Editor, point to More Editing Tools, and click Topology.
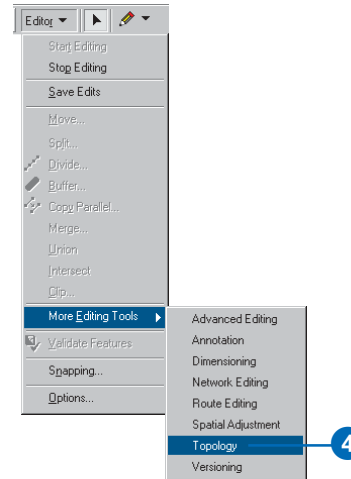
5. Click the Error Inspector button on the Topology toolbar.

The Error Inspector allows you to manage and interact with all of the topology errors on your map.

6. Check the Errors and Visible Extent only check boxes.
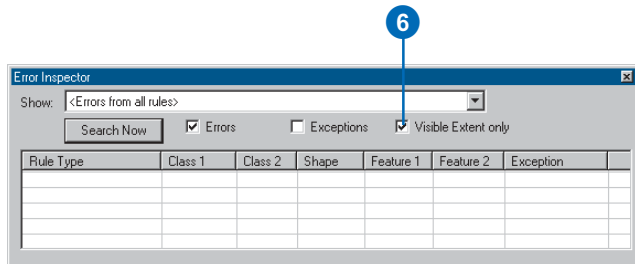
7. Click Search Now.
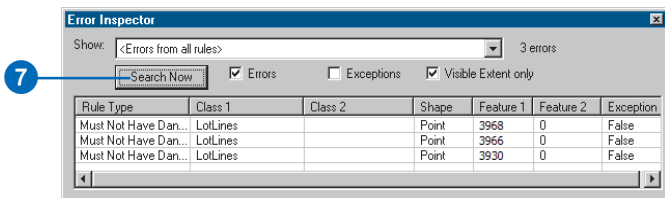
You may see additional errors if the map display changed shape when you added the Error Inspector.

Correcting an overshoot error

All the errors on the map are violations of the Must Not Have Dangles rule. However, there are several different problems that can cause this type of error. A dangle error can be caused by a line that extends too far beyond the line it is supposed to touch or by a line that doesn't extend quite far enough. These are called overshoots and undershoots, respectively.

Dangles can also occur where features have been digitized from adjacent map sheets. These lines sometimes need to be snapped together so they connect to form a continuous line. Other dangle errors occur at the edge of map sheets, where a line is cut off on the original source data.

You will now correct one of the errors on this map.

1. Click in the Feature 1 column until the northernmost feature on the map flashes and turns black to show that it's selected. (You may see different Feature 1 values.)
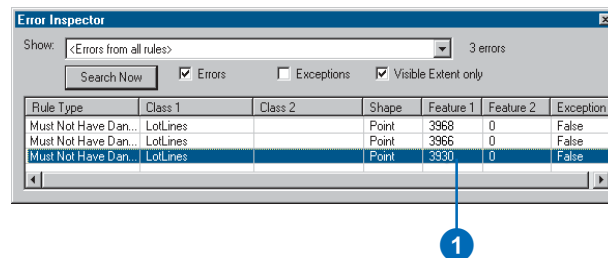
2. Click and drag a small box around the error to zoom to the error.
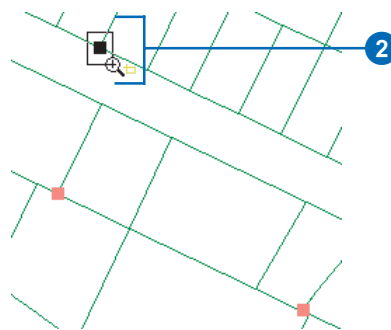
3. Zoom in again, if necessary, until you can see where the lot line with the error crosses the other lot line.
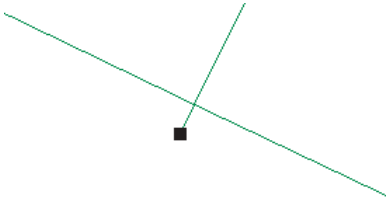
This is an overshoot error, a type of error that is often found in line work imported from CAD programs or digitized without using snapping to control the connectivity of the line features.

4. Right-click the error in the Error Inspector and click Trim.
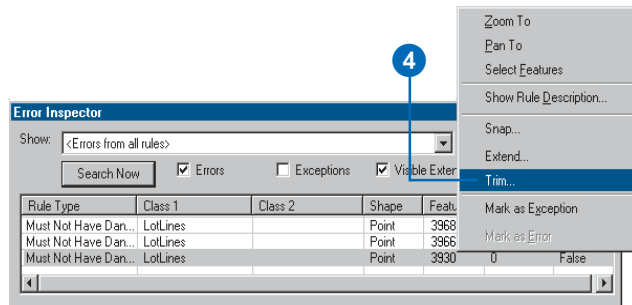
5. Type "3" in the Maximum Distance box and press Enter.
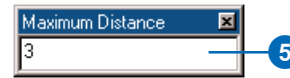
The dangling segment is trimmed back to where the lines intersect, and the error disappears.
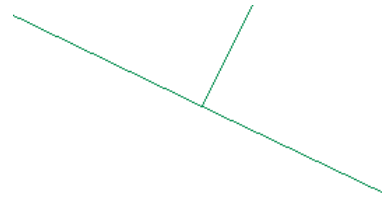
The Error Inspector context menu provided a list of potential fixes for this error. You trimmed the line feature to fix this error. You also could have marked the error as an exception or snapped or extended the line until it reached another feature.

Correcting an undershoot error

Now you'll correct another type of dangle error.

1. Click the Go Back to Previous Extent button until you can see the two remaining errors in this area of the data.
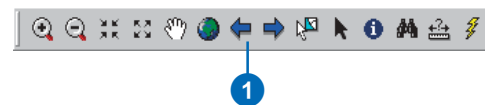
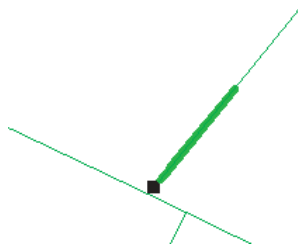2. Click the Zoom In tool and drag a box to zoom in to the westernmost of the two remaining errors.
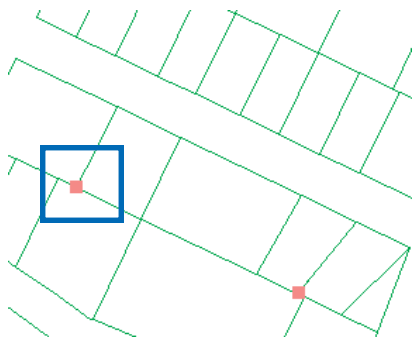
3. Zoom in again, if necessary, until you can see where the lot line with the error fails to connect to the other lot line.
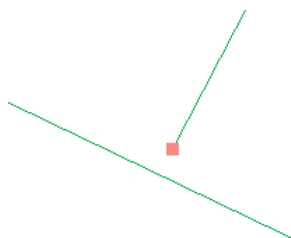
This is an undershoot error, another type of error that is often found in line work imported from CAD programs or digitized without using snapping to control the connectivity of the line features. The end of this line fell short by a little more than half a meter. You'll fix this error by extending the undershoot until it meets the line to which it should have been snapped.

4. Click the Fix Topology Error tool.

The Fix Topology Error tool lets you interactively select and apply predefined fixes to topology errors on the map.

5. Click and drag a box around the error.
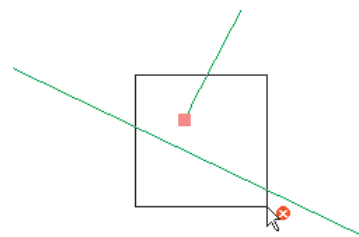
6. Right-click the map and click Extend.
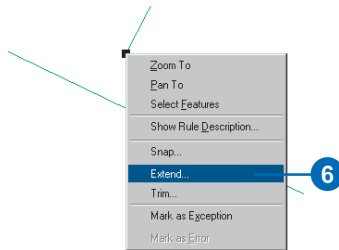
7. Type "3" in the Maximum Distance box and press Enter.
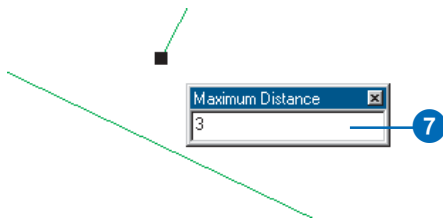
You've corrected the undershoot by extending the line with the dangle to the other line.
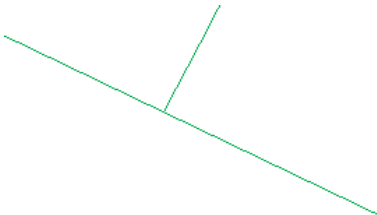
If the distance to the next line had been greater than the three-meter maximum distance you specified, the line would not have been extended.

Correcting a double-digitized line

Sometimes a given line or part of a line is digitized twice in the course of creating the data. This may happen with CAD drawings or with lines digitized on a digitizing tablet.

1. Click the Go Back to Previous Extent button until you can see the one remaining error in this area of the data.
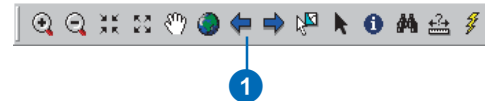
2. Click the Zoom In tool and drag a box to zoom in to the remaining error.
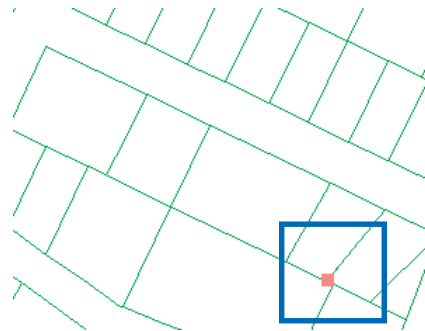
3. In the Error Inspector, click Search Now.
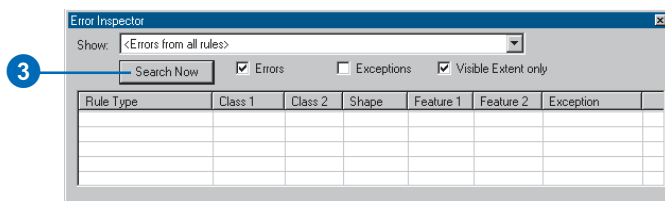
4. Click the numeric value in the Feature 1 column.
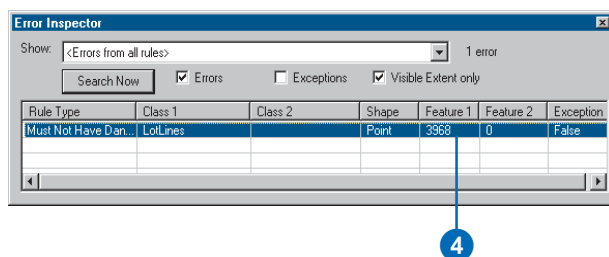
The line feature with the dangle flashes. Notice that the whole lot line did not flash.

5. Click and drag a box to zoom closer to the dangle error.
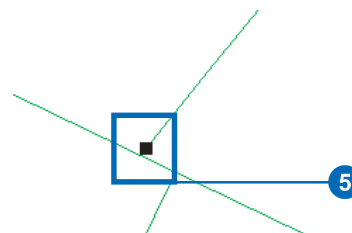
If necessary, zoom in again until you can see that there are two nearly parallel lot lines, one of which has the dangle.

You'll correct this error by deleting the extra line.
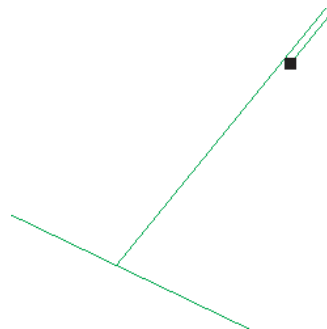
6. Right-click the numeric value in the Feature 1 column and click Select Features, then press the Delete key.
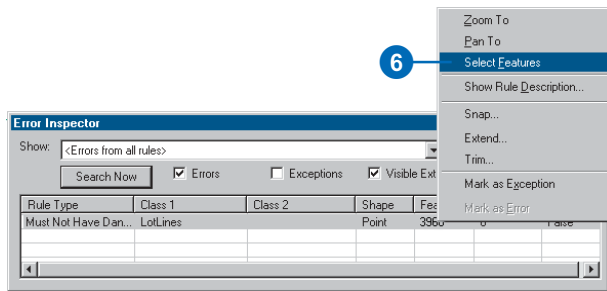
The extra line is deleted.

7. Click the Go Back to Previous Extent button until you can see the area in which you've been working.
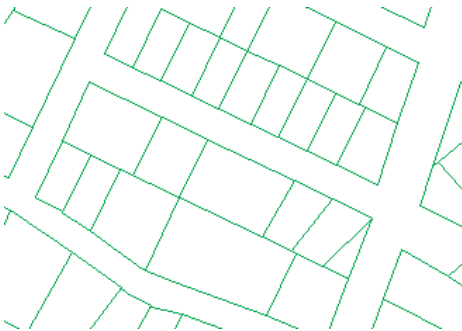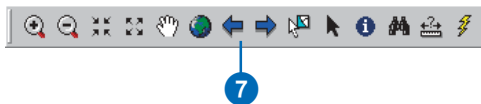
You've fixed three errors that resulted from violations of the Must Not Have Dangles rule. In each case, the error was corrected by editing the geometry of a lot line feature by trimming, extending, or deleting the feature.

Topology errors are useful for tracking where there are problems with your data, but correcting the error requires you to correct the data—you can't edit the Topology error feature layer directly.

Reviewing the areas you've edited

When you edit features in a topology, the topology tracks where changes have been made. These places are called dirty areas because a topology rule could potentially have been violated by the edits, but the error, if it exists, cannot be found until the dirty area is validated again. When you validate the topology again, it just checks the dirty areas.

You can see the areas that have been edited by showing the dirty areas in the topology layer.

1. Click StudyArea_Topology in the ArcMap table of contents so only it is selected. Right-click it and click Properties.
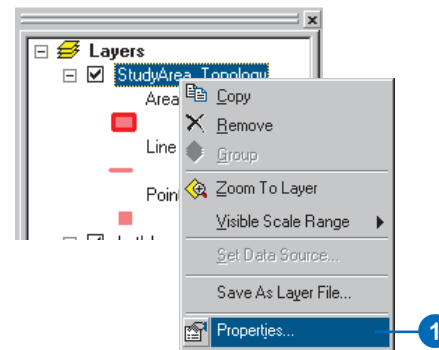
2. Click the Symbology tab.

3. Check Dirty Areas.

4. Click OK.
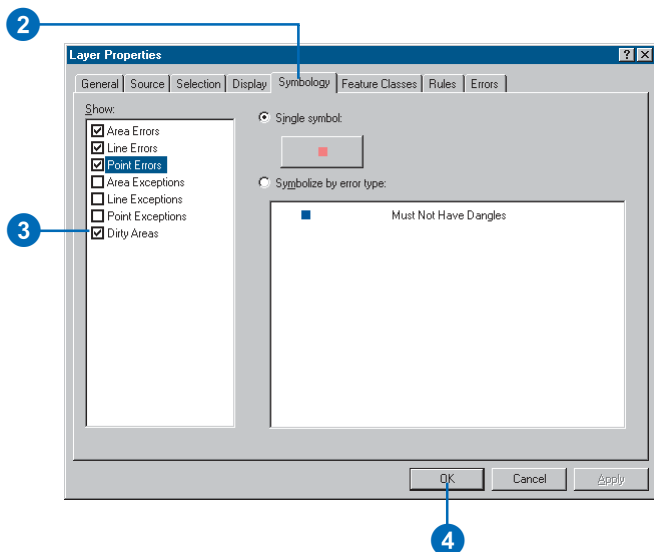
Now you can see the dirty areas on the map. The dirty areas cover the features that you edited. Dirty areas optimize the validation process, as only these must be checked for errors.
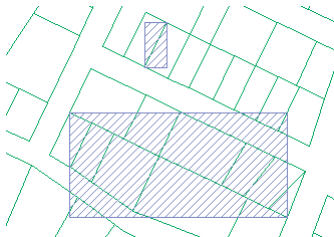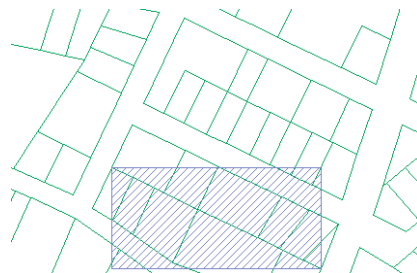

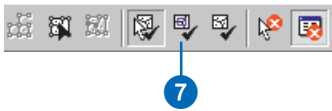5. Click the Validate Topology in Specified Area tool.
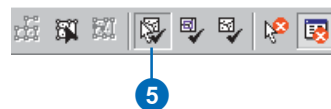
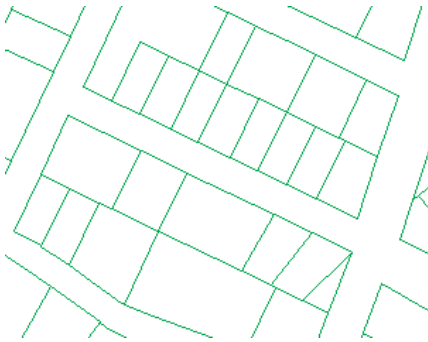6. Click and drag a box around the northern dirty area.
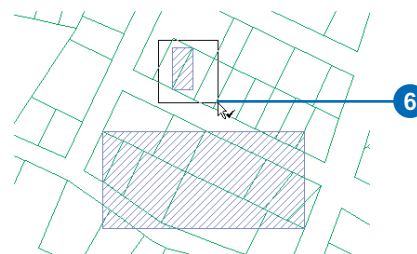
The dirty area is removed, and no errors are found in the area you validated.
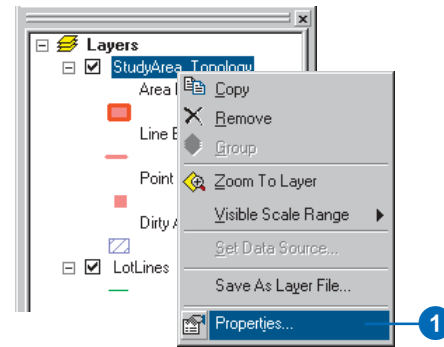
7. Click the Validate Topology in Current Extent button.

The topology is validated for the other areas you edited, and the dirty area is removed.

Creating a report of the status of the data

Next you'll generate a report summarizing the number of topology errors remaining in the data.

1. Right-click the topology in the ArcMap table of contents and click Properties.

2. Click the Errors tab.
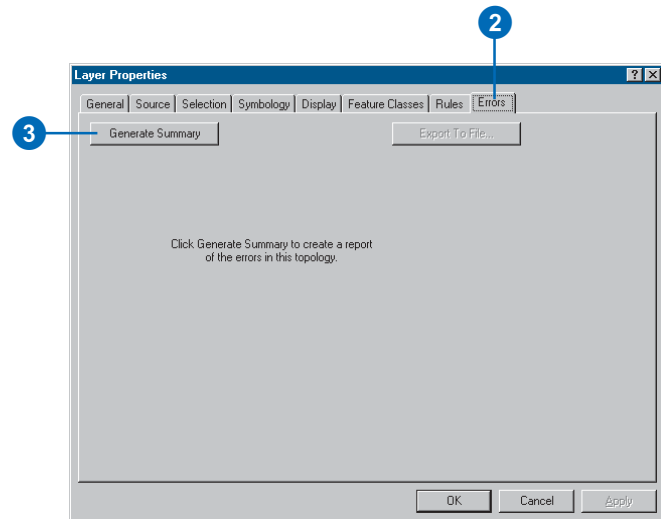
3. Click Generate Summary.

   The summary shows the number of topology errors and exceptions; you may have a different number of errors. You can save this report to a text file to document the status of the data, but you do not need to for this exercise.

4. Click OK.
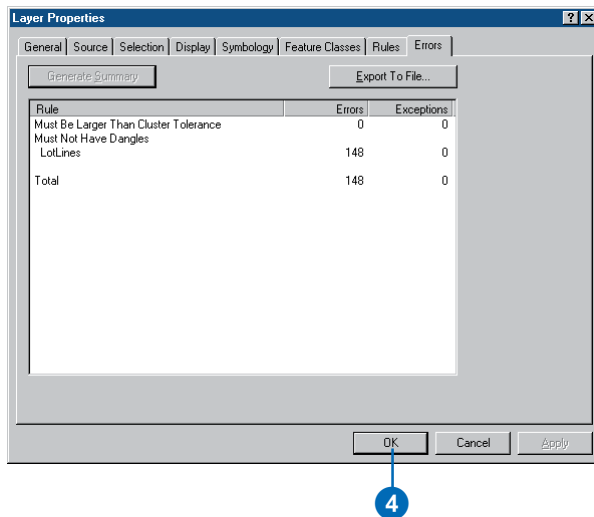
Fixing multiple errors at once

Many errors, like the double-digitized line, need to be fixed one at a time by deleting, modifying, or moving individual features. Some errors must be fixed by creating new features. However, sometimes a feature class contains a number of errors, such as the overshoots and undershoots, that are simple to fix. When this is the case, you can select multiple errors at once with the Fix Topology Error tool

and apply the same fix to all of them. If you prefer, you can individually check each error using the Error Inspector. This is a workflow and quality assurance decision that your organization should make before you begin applying topology fixes to multiple errors.

Before applying a fix to multiple errors, it's a good idea to look at your data and evaluate whether the fixes are appropriate. You would not want to trim lines with dangles that actually needed to be snapped to another line, or extend a line that actually needed to be trimmed.

In this case, if you extend dangling lines that are within three meters of another line, you're not likely to cause problems with your data, since the parcels and rights-of-way are larger than three meters.

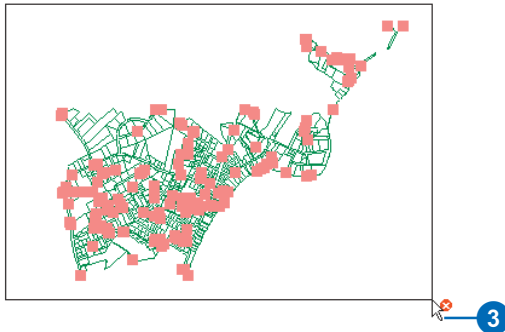Now you'll use this method to clean up several errors at one time.

1. Click the Full Extent button.
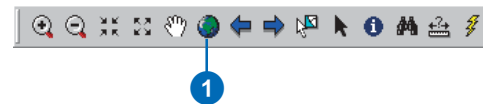
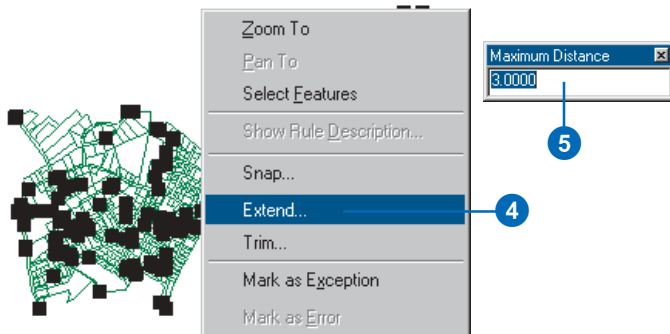2. Click the Fix Topology Error tool.

3. Click and drag a box around all the errors on the map.


This selects all of the errors. Now you'll fix the undershoots.

4. Right-click the map and click Extend.

5. The Maximum Distance you set when you fixed the other undershoot is fine, so press Enter.

The process may take a few seconds while all of the features with dangles are checked to see if there is a feature within three meters to which they can be extended.

The undershoots are fixed, and a number of dirty areas appear on the map. Each dirty area marks the bounding box of a feature that was edited by the extend error fix.
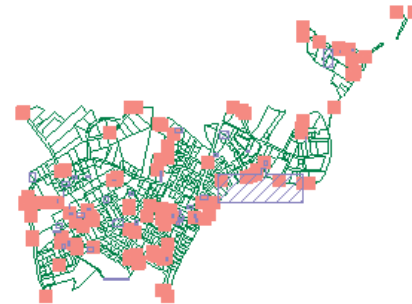
6. Click Search Now on the Error Inspector. (If you closed the Error Inspector dialog box, you can open it again from the Topology toolbar.)
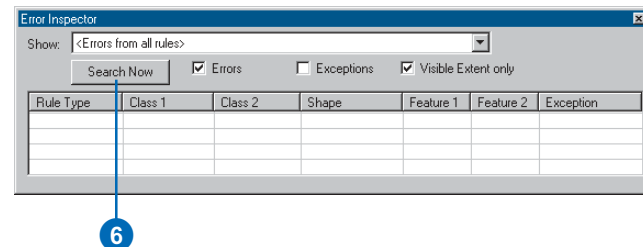
The number of topology errors is displayed to the right of the Show drop-down menu; you may have a different number of errors remaining. You will notice that many have been fixed. You could continue fixing topology errors to clean up this data, but you'll skip ahead in the process now to see some other ways to clean up data with topology.

The number of errors still remaining
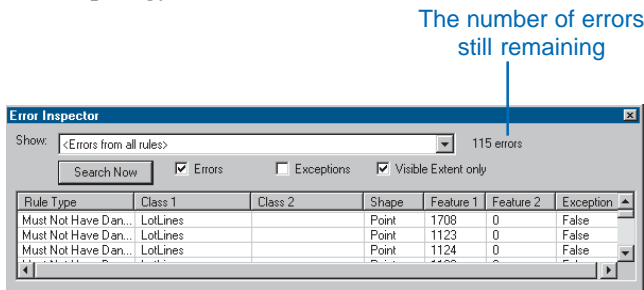
7. Click the Editor menu and click Stop Editing.
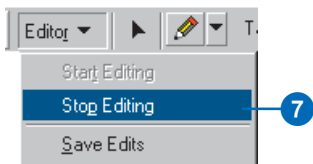
8. Click Yes to save your edits.
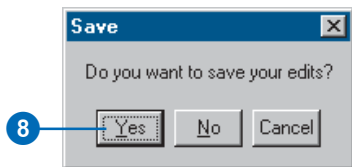
9. Close ArcMap.

Creating a new polygon feature class

Now you'll create a new feature class of lot polygons from the lot lines feature class that you've been working on and from a point feature class that will supply the attributes of the new lot features.

1. Right-click the StudyArea dataset in ArcCatalog, point to New and click Polygon Feature Class From Lines.
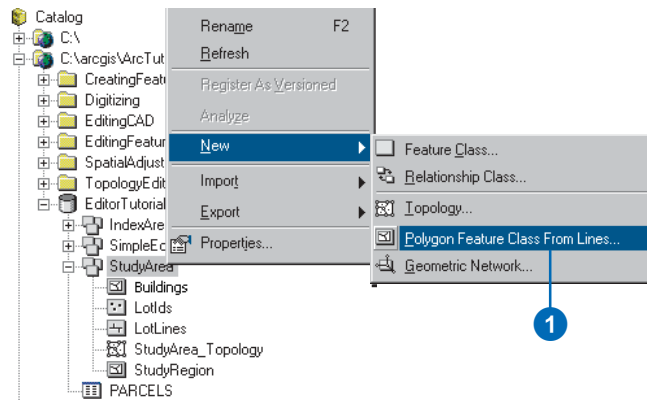
2. Type "Lots" as the new feature class's name.
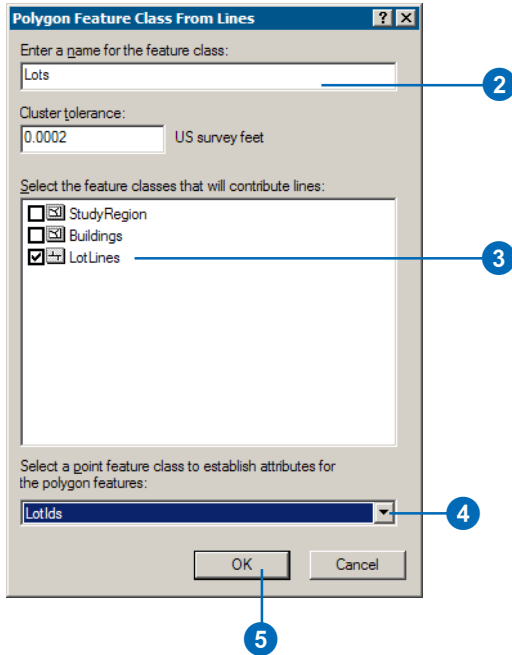
3. Check LotLines.

4. Click the point feature class drop-down list and click LotIds.

5. Click OK.

The new Lots polygon feature class is added to the StudyArea dataset. Next, you will include the Lots and LotIds feature classes in the topology so you can add rules to help you continue to clean up the data.
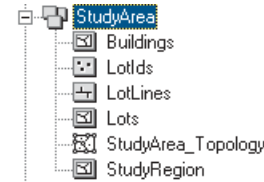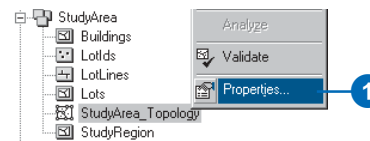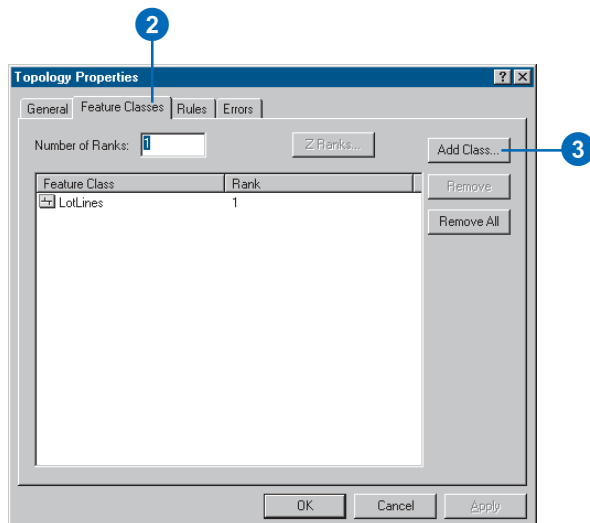

Adding feature classes to the topology

Before you can add topology rules for feature classes, you need to add the feature classes to the topology.

It is important to note that you are using this topology for the purpose of improving the polygon feature class you created from line work and points. You do not need to have the line or point feature classes to model the Lots—some organizations might decide to keep the LotLine feature class to provide easy annotation of lot boundary lengths, while others might not. Likewise, the Lots Parcel_ID attribute is now stored in the polygon feature class—you're using the LotIds feature class to quality check the data you've created. You might decide not to keep the LotIds feature class when you've finished checking the data.
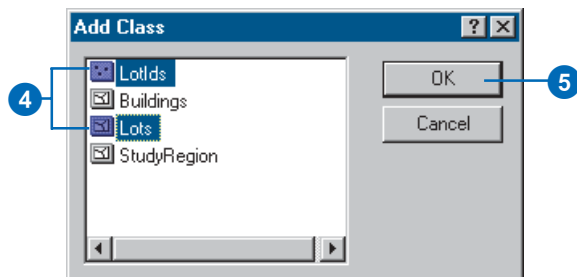
1. Right-click StudyArea_Topology and click Properties.

2. Click the Feature Classes tab.

3. Click Add Class.

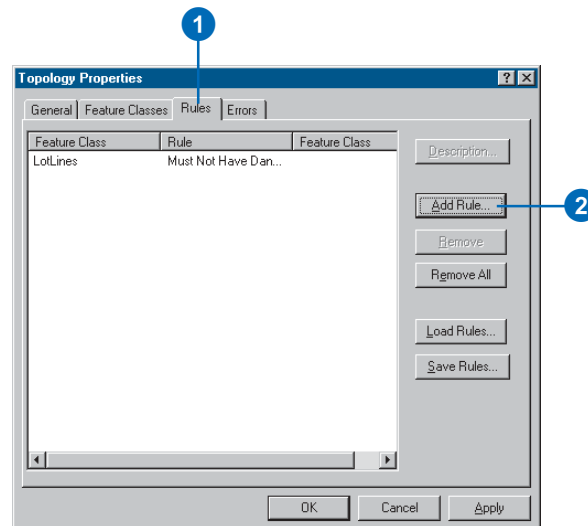4. Click LotIds, press and hold down the Ctrl key, and click Lots.

5. Click OK.

Now that you've added these two feature classes to the topology, you can include them in topology rules.
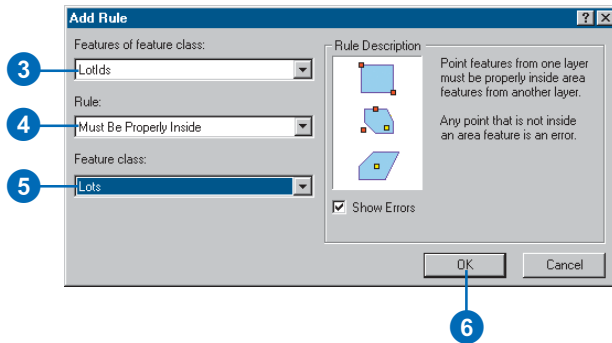
Adding rules to the topology

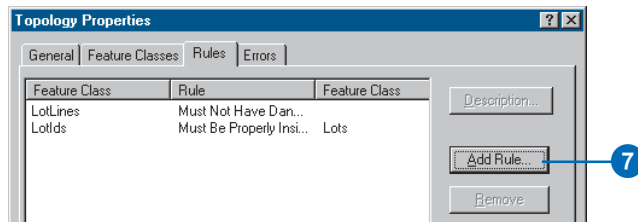1. Click the Rules tab.

2. Click Add Rule.

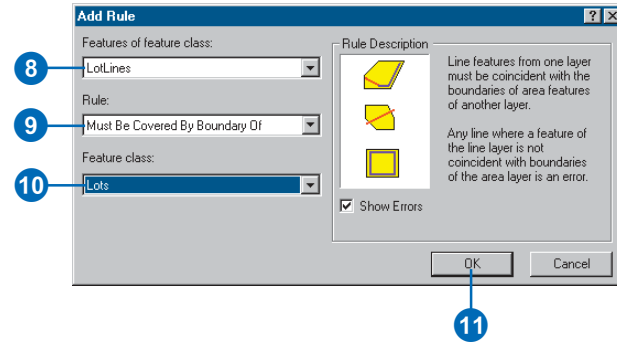3. Click the Features of feature class drop-down arrow and click LotIds.

4. Click the Rule drop-down arrow and click Must be Properly Inside.

5. Click the Feature class drop-down arrow and click Lots.

6. Click OK.

This rule will be useful for finding places where lot polygons were not formed due to breaks in the line work.
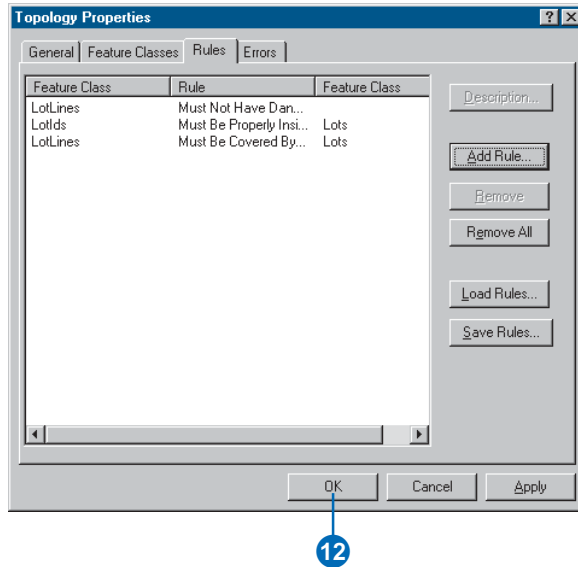
7. Click Add Rule.

8. Click the Features of feature class drop-down arrow and click LotLines.

9. Click the Rule drop-down arrow and click Must be Covered By Boundary Of.

10. Click the Feature class drop-down arrow and click Lots.

11. Click OK.

This rule will be useful for finding polygons that were not completely split due to gaps in the line work.

12. Click OK.

13. Right-click StudyArea_Topology and click Validate.
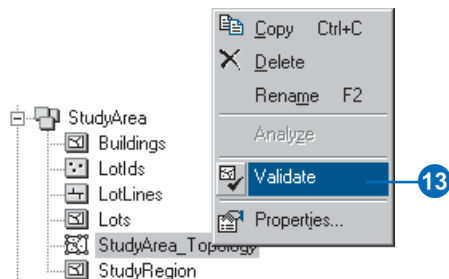
You've added two more feature classes to the topology and added topology rules to control their spatial relationships.
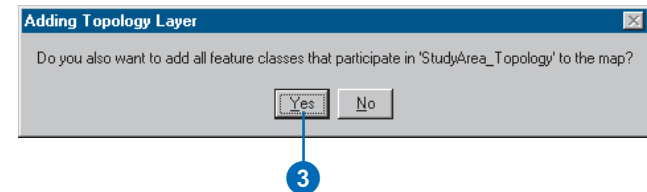
Adding the new topology to ArcMap

Now you'll examine the revised topology in ArcMap and continue cleaning up your data.

1. Start ArcMap.

2. Click and drag the topology from ArcCatalog onto ArcMap.
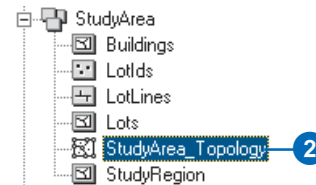
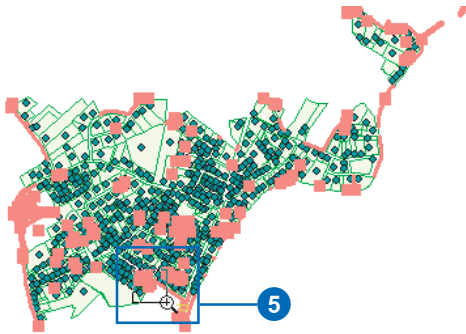3. Click Yes to add all the feature classes that participate in the topology to the map.

The topology and the feature classes that participate in it are added to the map.

4. Click the Zoom In tool.

5. Click and drag a box around the central part of the south edge of the data.

Now there are line and point errors visible on the map.

The red lines represent a new type of error feature—line errors. These show violations of the Must Be Covered

By Boundary Of rule. There are two types of point errors now, violations of the Must Not Have Dangles rule, which you're already familiar with, and violations of the Must Be Properly Inside rule.

Changing a point error symbol

Since there is now more than one type of point error, you will change the symbology of the Topology layer to make it clearer which errors are which.
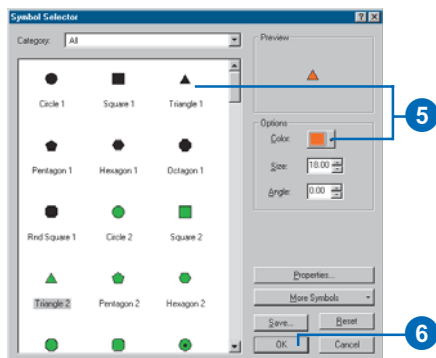
1. Click StudyArea_Topology in the ArcMap table of contents so only it is selected. Right-click it and click Properties.
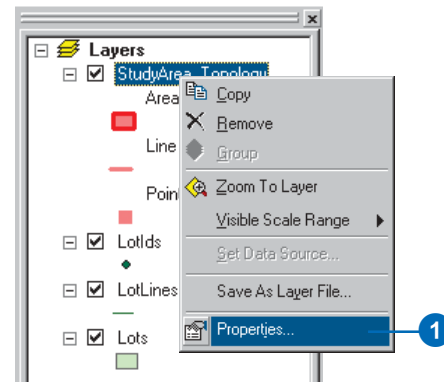
2. Click the Symbology tab.

3. Click Point Errors.

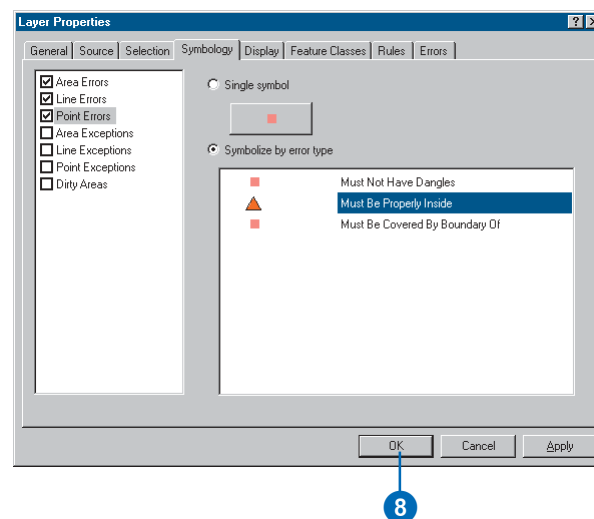4. Click the square symbol for Must Be Properly Inside errors.
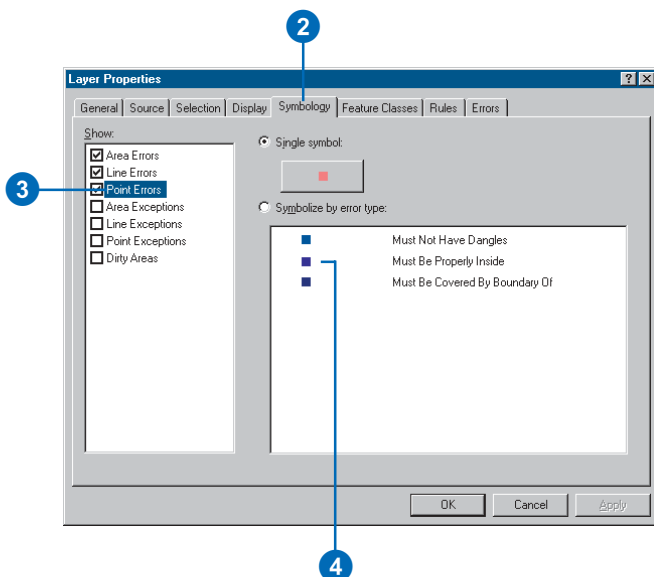
5. Click a triangle symbol and set the color to red.

6. Click OK.

7. Right-click each of the square symbols for the other two errors and set their colors to Medium Coral Light.
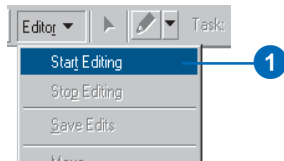

8. Click OK.

The triangle marks the LotID point for a lot that was not created when you created polygons from lines. The red square to the east of the triangle is actually a pair of dangles where the lot lines were not snapped together. The two lot lines are marked as errors because they are not covered by a lot polygon boundary.
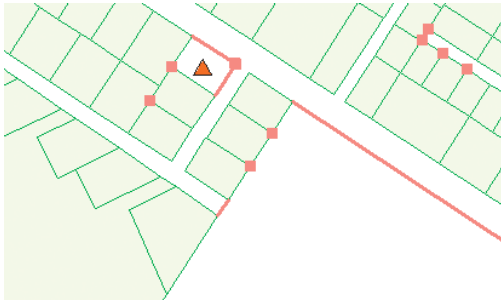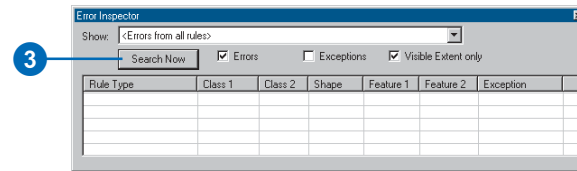

1. Click Editor and click Start Editing.
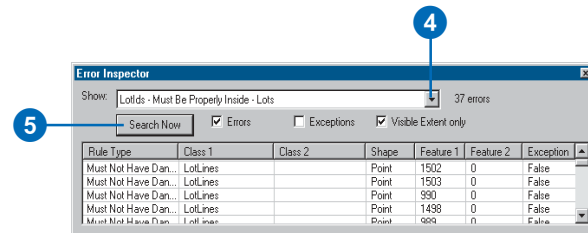

2. Click the Error Inspector button.

3. Click Search Now.

The visible extent of your map will determine how many errors you see.

4. Click the Show drop-down list and click LotIds - Must Be Properly Inside - Lots.

5. Click Search Now.

Now you can see the one violation of this rule visible in this part of the data. You can use the Error Inspector to sort through the various types of topology errors in your map.

6. Uncheck Visible Extent only.
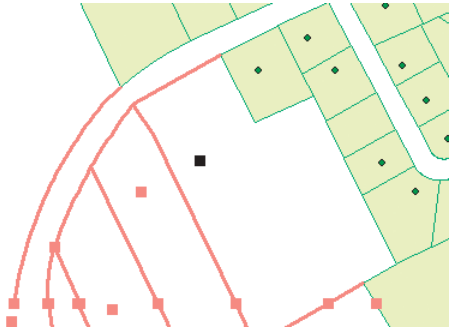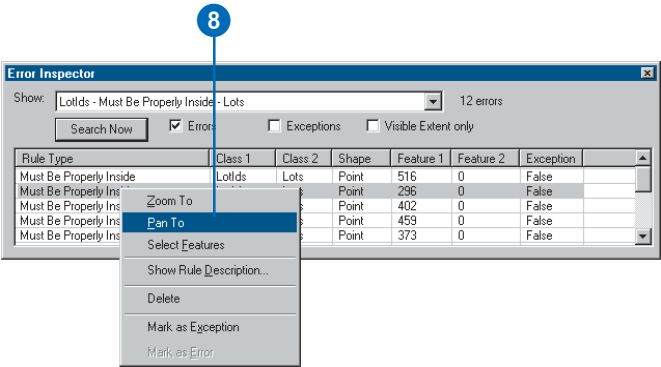
7. Click Search Now.
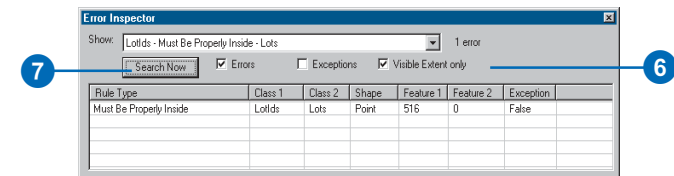
There are several violations of this rule in the topology. After you fix this error, you could use the Error Inspector to systematically find the other LotIDs that are not within Lot polygons, although for this exercise you will not.
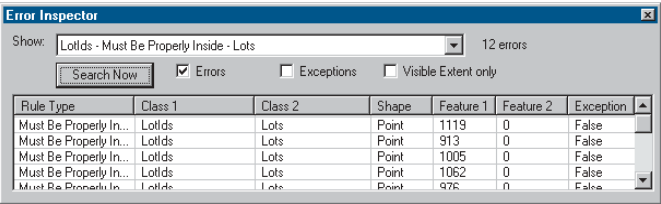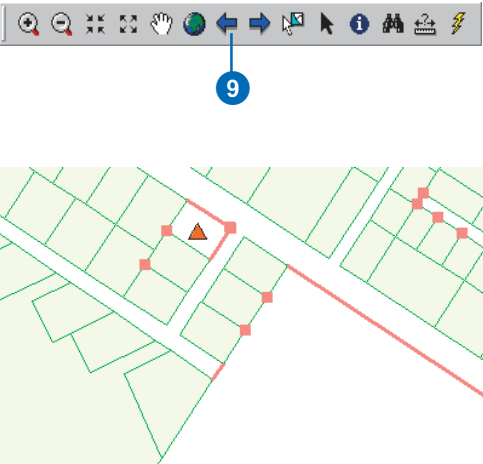

8. Right-click a feature in the Error Inspector table and click Pan To.

   The map pans to the error you selected.

Now you'll go back to the error you were just looking at and fix it.

9. Click the Go Back to Previous Extent button.

Creating a new polygon

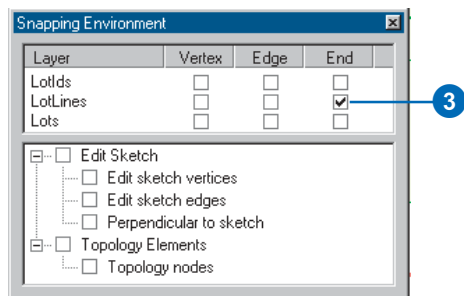Now you will create the new lot and fix these topology errors.

1. Click the Target drop-down arrow on the Editor toolbar and click Lots.
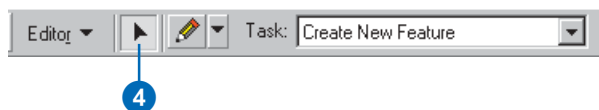

2. Press Alt+R and press N.

   The key combination Alt+R opens the Editor menu, and N opens the Snapping Environment dialog box.
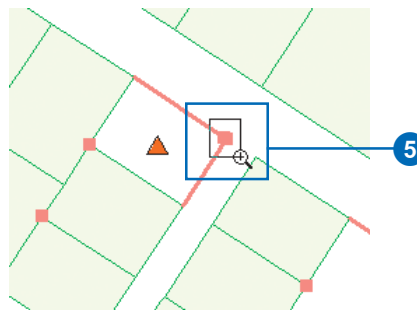
3. Check the End box for LotLines and close the dialog box.
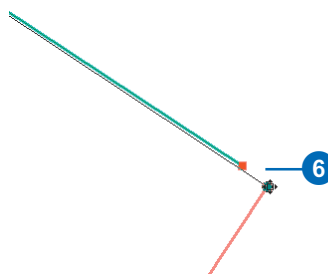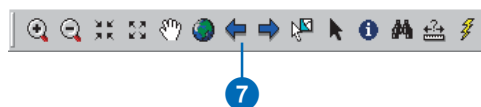

4. Click the Edit tool.

5. Hold down the Z key and drag a box around the place where the lot lines should intersect.

6. Double-click the northern lot line, move the pointer over its eastern end until the pointer changes to a box with four arrows, click the end, and drag it east until it snaps to the other lot line.
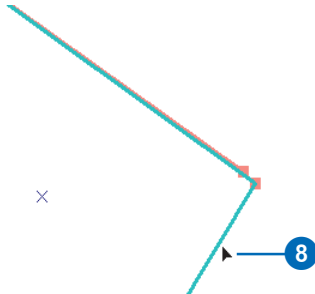

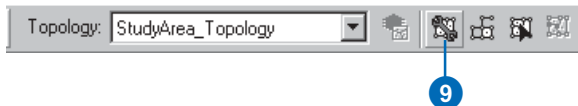7. Click the Go Back to Previous Extent button.

You should be able to see the lot lines and the lot polygons that adjoin this lot to the south and west. Now the new polygon can be constructed.

8. Hold down the Shift key and click the eastern lot line.

Both northern and eastern lot lines should now be selected.

9. Click the Construct Features tool.

10. Click the option to create new polygons considering existing features.
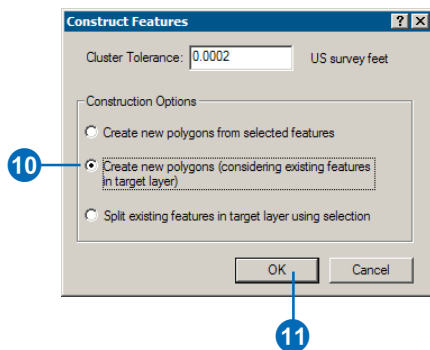
11. Click OK.

The new Lot polygon feature is created from the selected lines and from the existing Lot polygon boundaries.
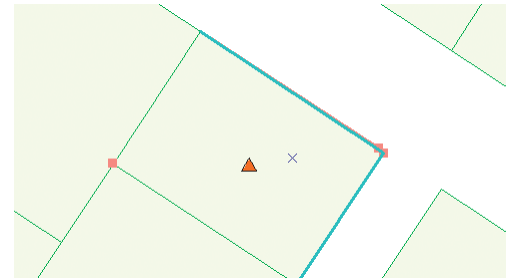
12. Click the Validate Topology in Current Extent button.

The new polygon covers the LotID point, the polygon boundary covers the lot lines, and you fixed the dangle errors by snapping them together, so when you validated the topology in the area, all of those errors went away.

It is important to note that the new polygon has a <null> value for its Parcel_ID attribute. The other parcels, which you created in ArcCatalog, derived their Parcel_ID attribute values from the LotID point feature class. There are several ways that you could add this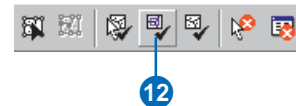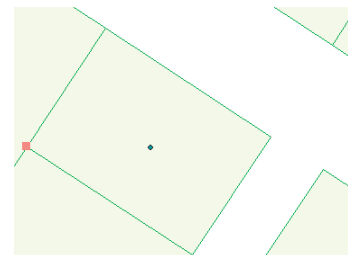 information to the new parcel. You could edit the parcel's attributes and type in its Lot_ID value. You could select the LotID point feature and the Lot polygon, open the Attributes dialog box, and copy and paste the Parcel_ID value from one to the other. You could even use the Attribute Transfer tool on the Spatial Adjustment toolbar to transfer the attributes from the point to the polygon.

For this exercise you'll skip updating the new polygon feature's attributes and move on to edit another Lot polygon.

Splitting a polygon

Because there were some undershoot dangle errors with gaps larger than three meters, there are some lots that were not completely enclosed. Where the gap opened onto an adjacent lot, and the two lots' other boundaries were closed, a single large lot was created. In this step you'll split up one such lot.

1. Click the Full Extent button.
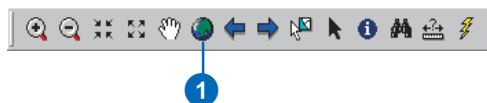
2. Hold down the Z key and drag a box around the lots on the south side of the eastern part of the study area.
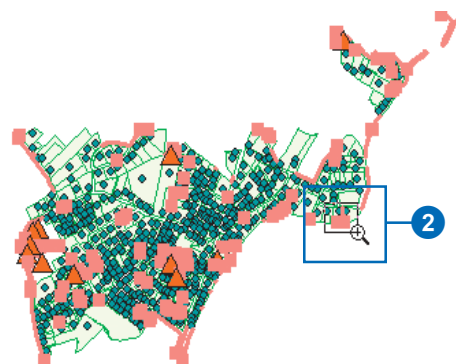
3. Click one of the lots that are on either side of the Must Be Covered By Boundary Of line error.

The lots are incorrectly represented by a single feature. The error at the south end of the line error is an undershoot dangle error. You'll use a new method to fix this error using a tool on the Advanced Editing toolbar.

4. Click Editor, point to More Editing Tools, and click Advanced Editing.

The Advanced Editing toolbar appears.
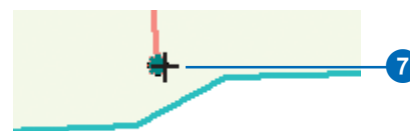
5. Click the Extend tool.

The Extend tool works differently from the Extend topology error fix. Rather than specifying a distance, you select a feature to which the tool will extend a line. After a feature is selected, you click the line feature that you want to extend. Since the parcel is currently selected, all you have to do is click the dangling lot line. You'll zoom in a little closer to see the gap.

6. Press and hold down the Z key and drag a box around the line near the south edge of the parcel.
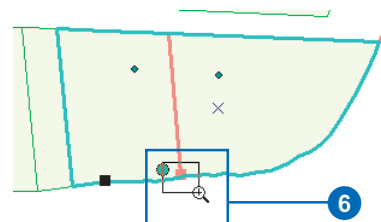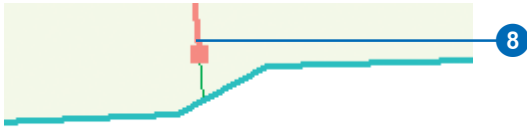

7. Move the pointer over the dangling end of the line.

When the pointer gets close to the endpoint, the blue circle snaps to it. Although you can click anywhere on the line that you want to extend, the Extend tool obeys the current snapping environment. Since you set up snapping to endpoints of LotLines earlier, the Extend tool snaps to them.

8. Click the line.

The line is extended to the nearest selected feature—in this case, the edge of the Lot polygon.

9. Click the Go Back to Previous Extent button.
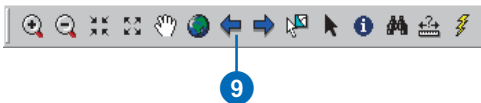
10. Click the Edit tool, then click an empty space somewhere on the map to deselect all features.

11. Uncheck all layers but LotLines on the Selection tab of the table of contents. This will make it easier to select only the line feature. Click the line that you just extended, and make sure it is the only feature that is selected.

12. Click the Construct Features tool.
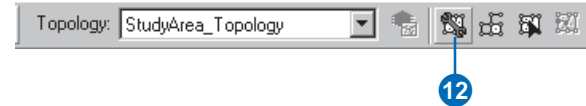
13. Click the option to split existing features in the target layer using selection.
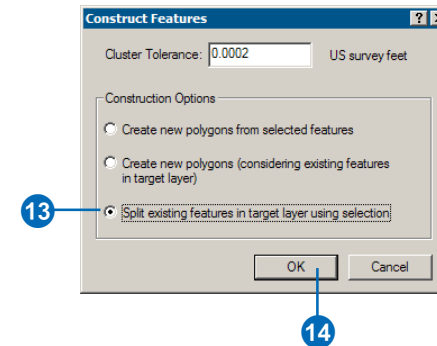
14. Click OK.

The newly extended line feature splits the existing parcel into two features.

15. Click the Validate Topology in Current Extent button.

The topology is validated and the line error and dangle are removed.

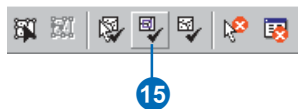You will need to check the attributes of both of these lots against the attributes of the LotIds points and update one or both of them to make sure they have the right PARCEL_ID numbers. The new lot feature has a <null> PARCEL_ID, and there is a 50 percent chance that the wrong parcel inherited the value from the original large parcel.

There are many more errors in the data, although as you saw in this and the previous examples, more than one error may be related to a given problem. Almost all of the errors follow from the underlying problem of the original CAD data, incompletely snapped line work and unclosed polygons. Spending more time editing the dangle errors would have taken care of most of the errors that were revealed by adding the new rules.

Some of the errors, like the small dangling line and the lot line not covered by a parcel boundary visible here, may not need to be corrected at all. If your organization needs only to model lots, the LotLine and LotIDs feature classes could be removed from the topology and deleted once you've finished developing the polygon features from them. On the other hand, you might want to keep the lot lines for cartographic reasons or to simplify annotating the dimensions of lots. If this is the case, you would need to continue cleaning up the lot lines. An additional step would be to use the Planarize Lines tool to split all of the lot lines at intersections—something that was not done with the original CAD data. The two errors visible above are actually on the same feature. Planarizing the lines would split this feature into several features, each tracing a single lot boundary.

Whether or not you retain the LotLines and LotIds feature classes, you would probably want to add at least one more rule to assist in the day-to-day management of the lot feature class. One such rule would be a Must Not Overlap rule, so when you digitize new lots they cannot overlap each other. This should not be a problem for the lots you've just created, but it is a rule that one would typically enforce on landownership polygons.

In this exercise, you created a geodatabase topology with simple rules to help you clean up data. You learned how to use the Error Inspector to find errors of a particular type and how to use some of the many editing tools to fix errors in your data.

Exercise 8: Using the Spatial Adjustment tool

The Spatial Adjustment tool allows you to transform, rubbersheet, and edgematch your data within an edit session.

Spatial adjustments are based on displacement links. These are special graphical elements that represent the source and destination locations for an adjustment.

This exercise will show you how to perform each of the spatial adjustments.

Starting ArcMap and beginning editing

Before you can complete the tasks in this tutorial, you must start ArcMap and load the tutorial data.

1. Double-click a shortcut installed on your desktop or use the Programs list in your Start menu to start ArcMap.

2. Click the Open button on the Standard toolbar. Navigate to the Transform.mxd map document in the Editor directory where you installed the tutorial data. (C:\ArcGIS\ArcTutor is the default location.)
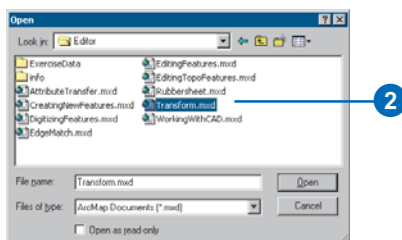
3. If the Editor toolbar isn't displayed in ArcMap, click the Editor Toolbar button on the Standard toolbar to add it.
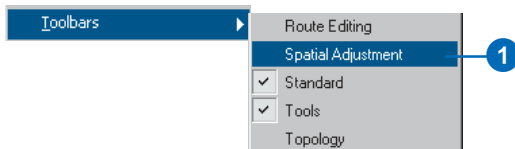

4. Click Editor and click Start Editing.
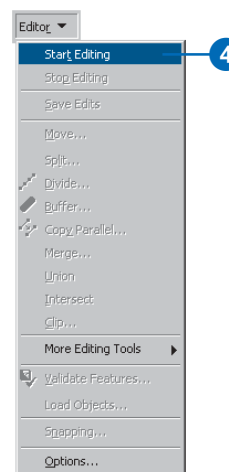
Adding the Spatial Adjustment toolbar

1. Click the View menu, point to Toolbars, and click Spatial Adjustment to add the Spatial Adjustment toolbar to ArcMap.
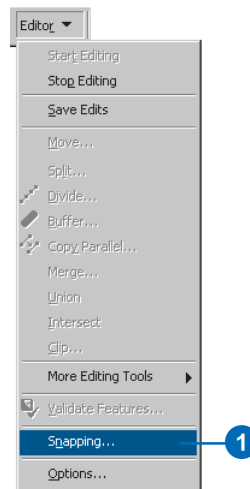

The Spatial Adjustment toolbar appears.

Setting the snapping environment

Before you start adding links, you should set your snapping environment so each link you add snaps to the vertices or endpoints of features.

1. Click the Editor menu and click Snapping to display the Snapping Environment dialog box.

2. Check the Vertex check box next to the NewParcels and SimpleParcels layers to snap the displacement links to the vertices of these features. Close the dialog box.
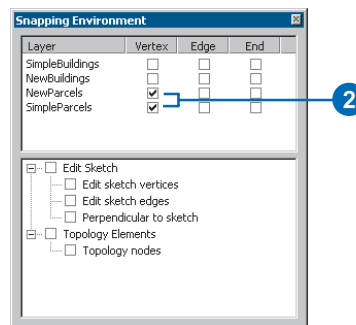
Applying a transformation

A transformation is used to convert the coordinates of a layer from one location to another. This involves the scaling, shifting, and rotation of features based on displacement links defined by the user. Transformations are applied uniformly to all features in a feature class and are often used to convert data created in digitizer units into real-world units represented on a map.

This exercise will show you how to apply a transformation based on displacement links that you will create. This transformation will move, scale, and rotate two feature classes containing parcel and building features into alignment with another set of parcel and building feature classes. You might use this technique to adjust data that was digitized or imported into a temporary feature class in preparation for copying and pasting the features into your database. You will also learn how to specify which features to adjust, preview the adjustment, and view a link table.

Specifying the features to adjust

The Spatial Adjustment tool allows you to adjust a selected set of features or all the features in a layer. This setting is available in the Choose Input For Adjustment dialog box. The default is to adjust a selected set of features.

1. Click the Spatial Adjustment menu and click Set Adjust Data to display the Choose Input For Adjustment window.
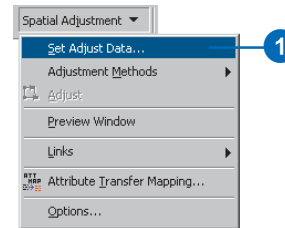

2. Click All features in these layers.
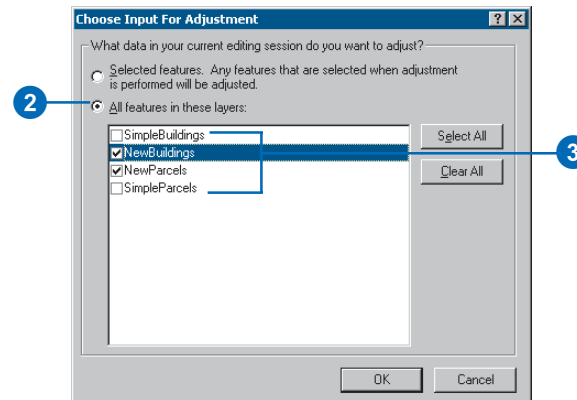
3. Uncheck the SimpleBuildings and SimpleParcels layers, keep the NewBuildings and NewParcels layers checked, and click OK.

Selecting an adjustment method

Now that you have determined which features will be adjusted, the next step is to choose an adjustment method. The Spatial Adjustment tool supports several adjustment methods. In this exercise, you will perform a Similarity Transformation.

1. Click the Spatial Adjustment menu, point to Adjustment Methods, and click Transformation - Similarity to set the adjustment method.
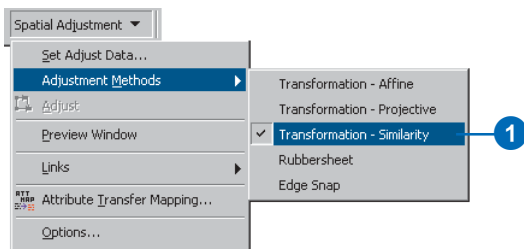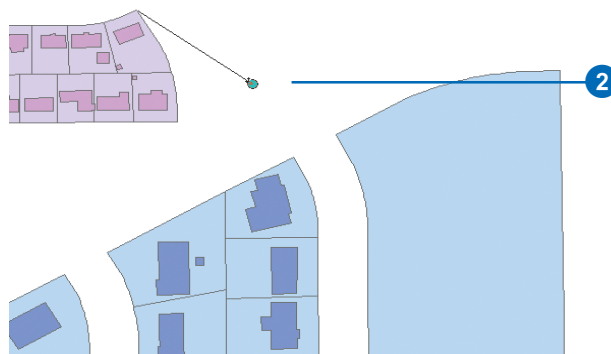

Adding displacement links

Displacement links define the source and destination coordinates for an adjustment. Displacement links can be created manually or loaded from a link file. In this exercise, you will create your own displacement links from the exterior corners of the NewParcels layer to the corresponding locations in the SimpleParcels layer.

1. Click the New Displacement Link tool on the Spatial Adjustment toolbar.
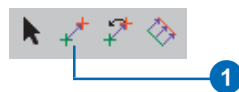
2. With the New Displacement tool active, snap to a from-point in the source layer and snap to a to-point in the target layer.

3. Continue to create additional links as shown below. For this exercise, you should have a total of four displacement links when you are finished.
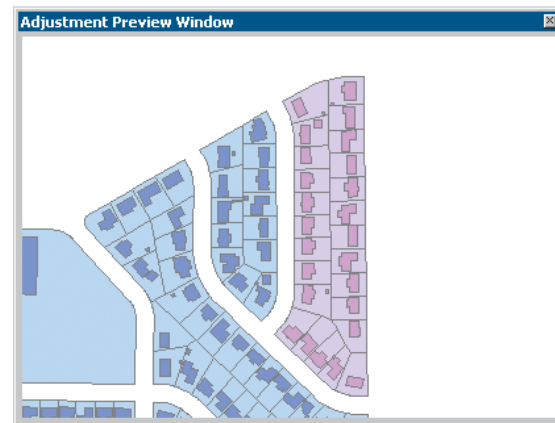

Examining the adjustment

The Spatial Adjustment tool includes a tool to preview an adjustment prior to actually performing the adjustment. This tool is called the Preview Window. If the results of the adjustment are not adequate, you can modify the links to improve the accuracy of the adjustment.

1. Click the Spatial Adjustment menu and click Preview Window.
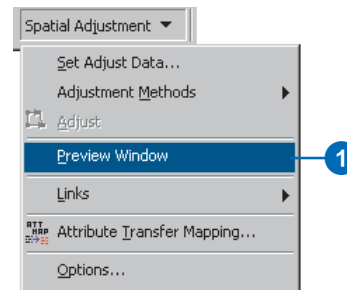
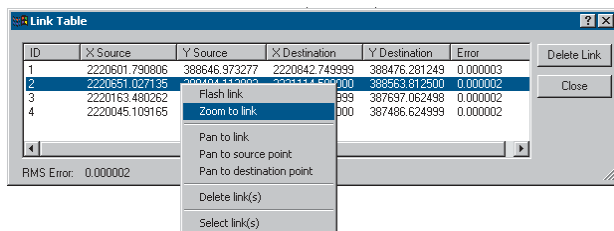The Adjustment Preview Window appears.

In addition to the visual preview of the adjustment, you can also examine the results of the adjustment by viewing the Link Table. The Link Table provides information about link coordinates, link IDs, and RMS errors.

2. Click the View Link Table button on the Spatial Adjustment toolbar.

The Link Table dialog box appears.

Right-clicking a link record opens the Link Table's context menu. You can edit link coordinates, flash links, zoom and pan to selected links, and delete links with these commands.
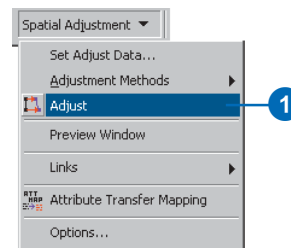

If the RMS error for this adjustment is not acceptable, you can modify the links to increase the accuracy. The Preview Window and Link Table tools are designed to help you fine-tune your adjustment.

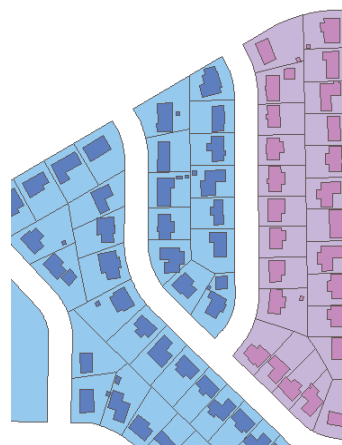## Performing the adjustment

The final step of the spatial adjustment process is to perform the adjustment.

1. Click the Spatial Adjustment menu and click Adjust.

Since the Spatial Adjustment tool operates in an edit session, you can use the Undo command to undo the adjustment.
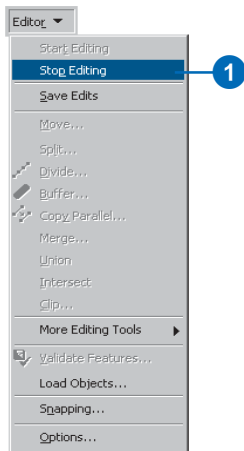
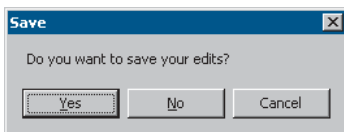The adjusted data should look like this:

Saving your edits

If you are satisfied with the results of the spatial adjustment, you can stop editing and save your edits.

1. Click Editor and click Stop Editing.

2. Click Yes to save your edits.

In this exercise, you learned how to set your data for an adjustment, create displacement links, preview the adjustment, and use the Link table to view the RMS error.

Rubbersheeting your data

Rubbersheeting is typically used to align two or more layers. This process moves the features of a layer using a piecewise transformation that preserves straight lines.

This exercise will show you how to rubbersheet data by using displacement links, multiple displacement links, and identity links. You will rubbersheet a newly imported set of street features to match an existing feature class of street features.

This tutorial assumes that ArcMap is started and the Editor and Spatial Adjustment toolbars have been added to ArcMap.

1. Close the Transform.mxd map document.

2. Click the Open button on the Standard toolbar. Navigate to the Rubbersheet.mxd map document in the Editor directory where you installed the tutorial data. (C:\ArcGIS\ArcTutor is the default location.)
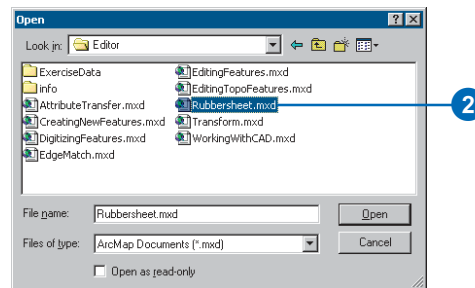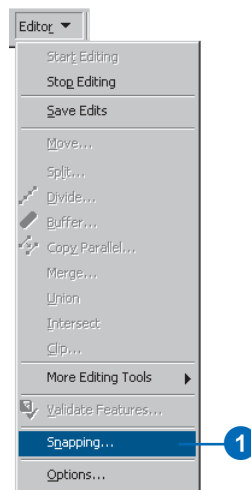
3. Click Editor and click Start Editing.
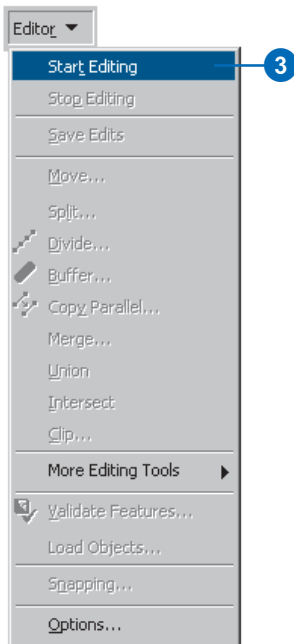
Setting the snapping environment

Before you start creating links, you should set your snapping environment so each link you add snaps to the vertices or endpoints of features.

1. Click the Editor menu and click Snapping to display the Snapping Environment dialog box.

2. Check the Vertex check box next to the ImportStreets and Streets layers to snap the displacement links to the vertices of these features. Close the dialog box.
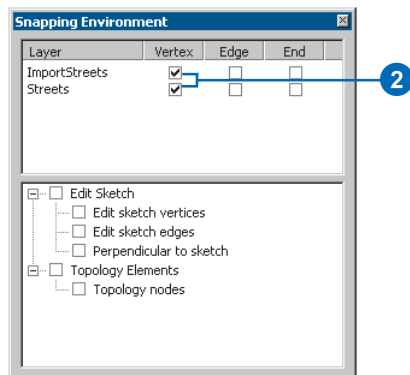

Setting data for the adjustment

The Spatial Adjustment tool allows you to adjust a selected set of features or all the features in a layer. This setting is available in the Choose Input For Adjustment dialog box. The default is to adjust selected features.

1. Click the Spatial Adjustment menu and click Set Adjust Data to display the Choose Input For Adjustment dialog box.
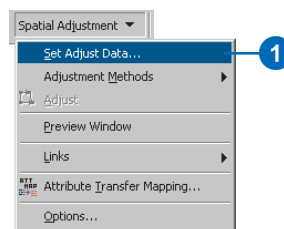

2. Click All features in these layers.
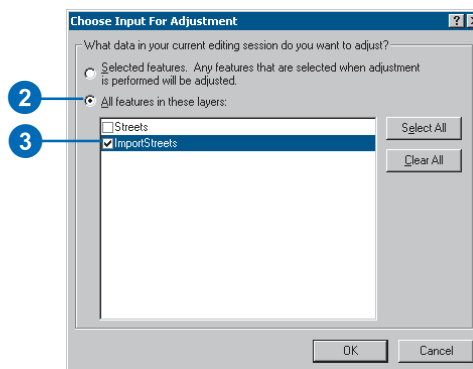
3. Uncheck the Streets layer. Keep the ImportStreets layer checked, then click OK.

Selecting an adjustment method

Now that you have determined which features will be adjusted, the next step is to choose an adjustment method. The Spatial Adjustment tool supports several adjustment methods. In this exercise, you will use Rubbersheet.
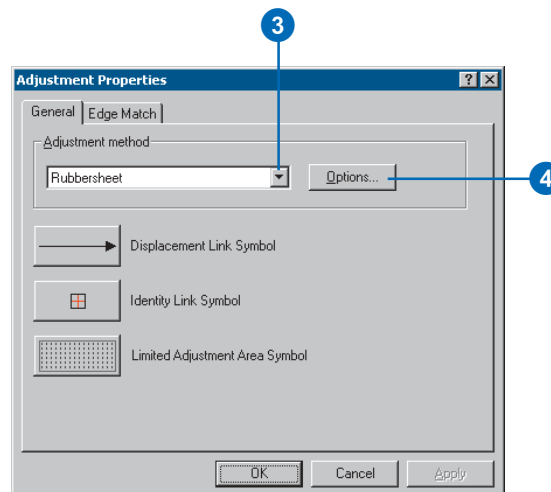
1. Click the Spatial Adjustment menu, point to Adjustment Methods, then click Rubbersheet to set the adjustment method.
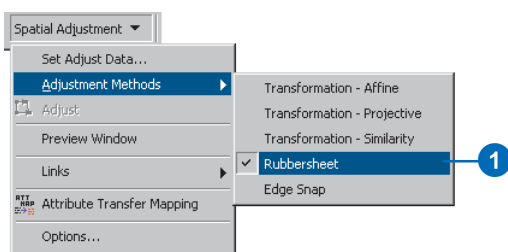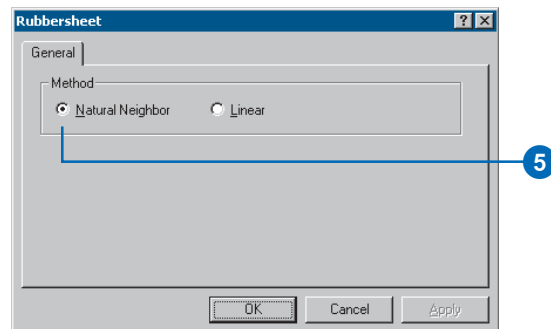

2. Click the Spatial Adjustment menu and click Options to open the Adjustment Properties dialog box.
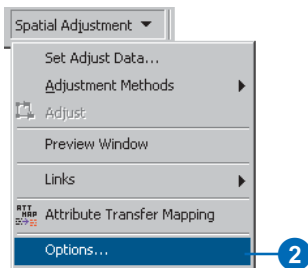
3. Click the General tab, then click Rubbersheet from the Adjustment method drop-down list.

4. Click Options to choose a rubbersheet method.

5. Click the Natural Neighbor method and click OK.

6. Click OK to close the Adjustment Properties dialog box.

Locating the adjust data

Spatial bookmarks are named extents that can be saved in map documents. Creating a bookmark for areas that you visit frequently will save you time.

You will now zoom to a spatial bookmark created for this exercise.

1. Click the View menu, point to Bookmarks, then click Import streets to set the current view to the edit area of this exercise.
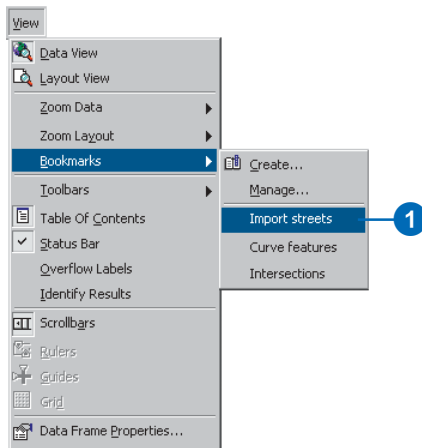
When the display refreshes, note that the ImportStreets layer is not aligned with the Streets layer. You must adjust the ImportStreets layer so it aligns with the Streets layer by using the rubbersheet adjustment method.
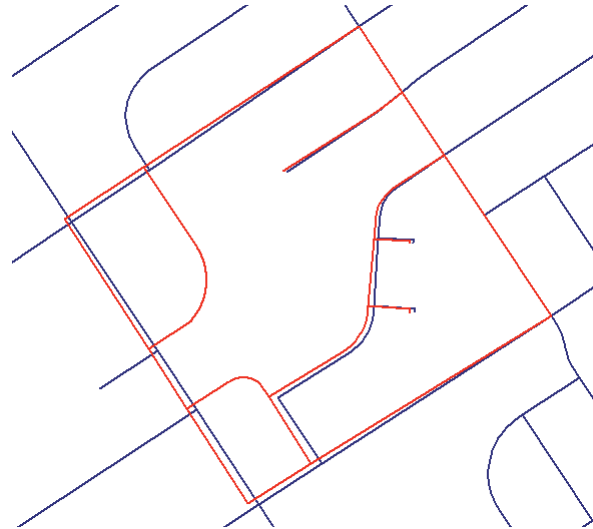
2. To get a better view of the adjustment area, you need to zoom to the bookmark called Intersections, which was created for you. Click the View menu, point to Bookmarks, then click Intersections.
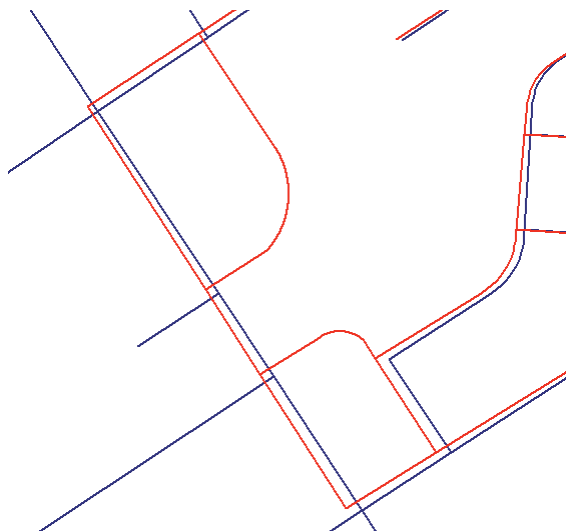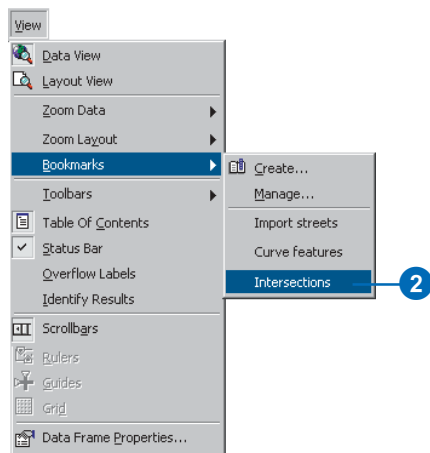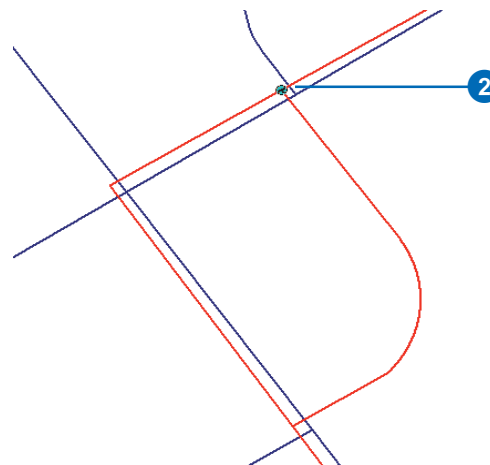

Adding displacement links

Displacement links define the source and destination coordinates for an adjustment. Displacement links can be created manually or loaded from a link file. In this exercise, you will create your own displacement links at several key intersections of the Streets and ImportStreets layers.
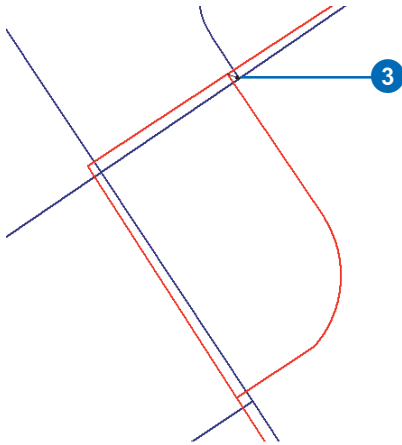
1. Click the New Displacement Link tool on the Spatial Adjustment toolbar.

2. Snap the link to the source location in the ImportStreets layer, as shown below.

3. Snap the link to the destination location in the Streets layer, as shown below.


4. Continue to create links at the perimeter intersections of the layers in a counterclockwise direction. You will create a total of six displacement links, as shown below.
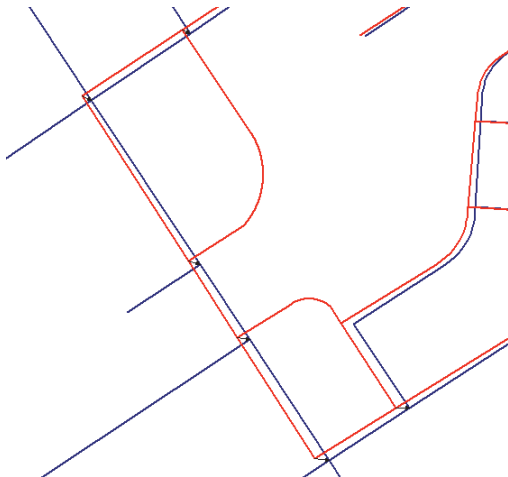
Adding multidisplacement links

The Multiple Displacement Links tool allows you to create multiple displacement links in one operation. This tool can help save time by allowing you to create more than one link at a time; it is especially useful for curved features.

1. To get a better view of the adjustment area, zoom to the bookmark called Curve features, which was created for you. Click the View menu, point to Bookmarks, and click Curve features.
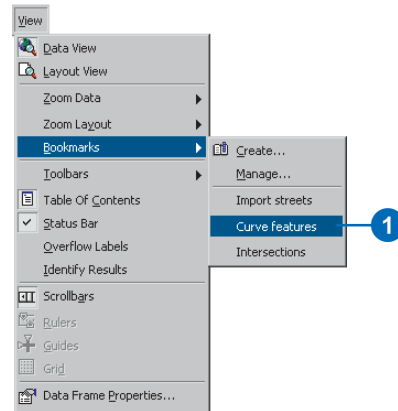
To preserve the curved road features, add multiple links at critical points.

2. Click the Multiple Displacement Links tool on the Spatial Adjustment toolbar.
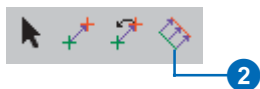
3. With the Multiple Displacement Links tool active, click the curved road feature in the ImportStreets layer.
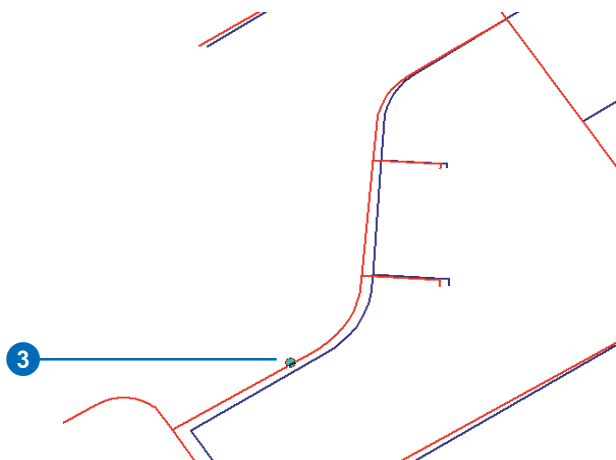
4. With the Multiple Displacement Links tool still active, click the curved road feature in the Streets layer.

5. You will be prompted to enter the number of links to create. Accept the default value (10) and press Enter.

The multiple links now appear in the map.

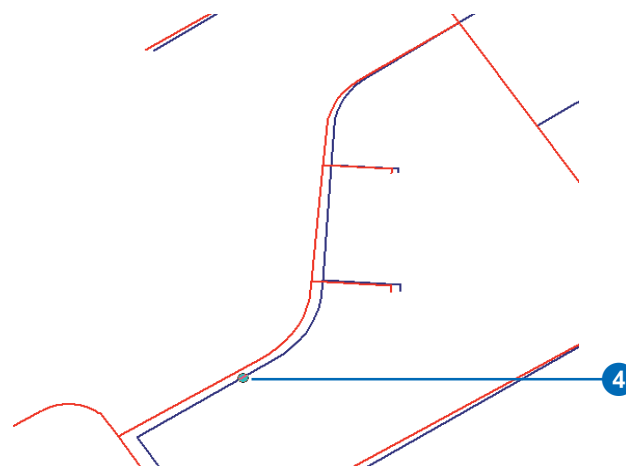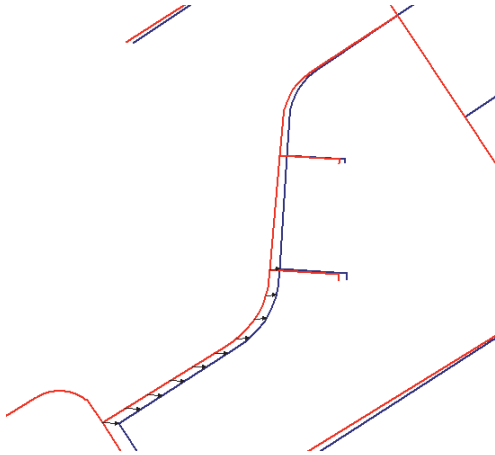6. Use the Multiple Displacement Links tool to create multiple links for the remaining curved feature.

7. Click the New Displacement Link tool on the Spatial Adjustment toolbar.

8. Add the final displacement links, as shown below:

Adding identity links

Identity links are used to anchor features at specific points to prevent their movement during an adjustment. You will now add identity links at key intersections to maintain their locations.

1. Click the New Identity Link tool on the Spatial Adjustment toolbar.

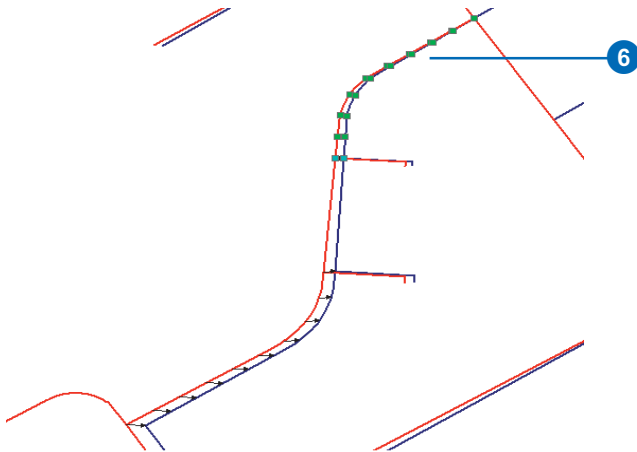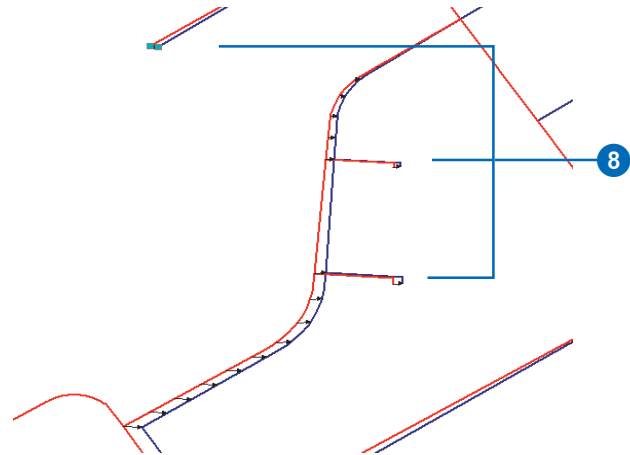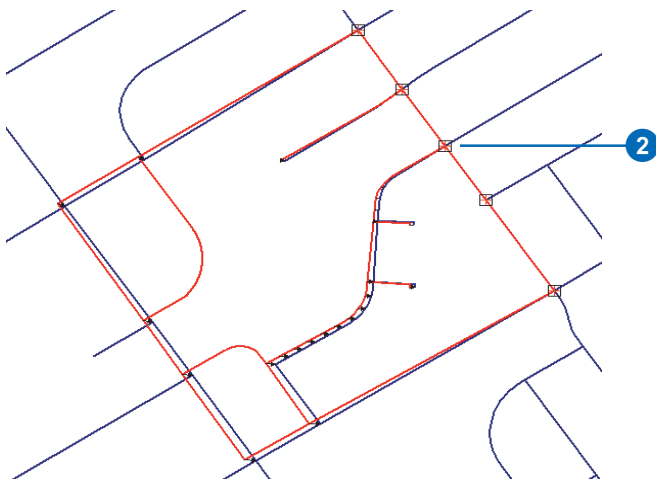2. With the New Identity Link tool active, add five identity links at the intersections shown below.

Examining the adjustment

You can examine how an adjustment will appear prior to actually performing it with the Preview Window. Use the standard ArcMap Zoom and Pan tools to change the display of the Preview Window.

1. Click the Spatial Adjustment menu and click Preview Window to examine the adjustment.
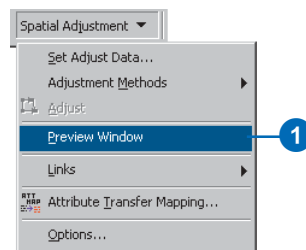
The Adjustment Preview Window appears.
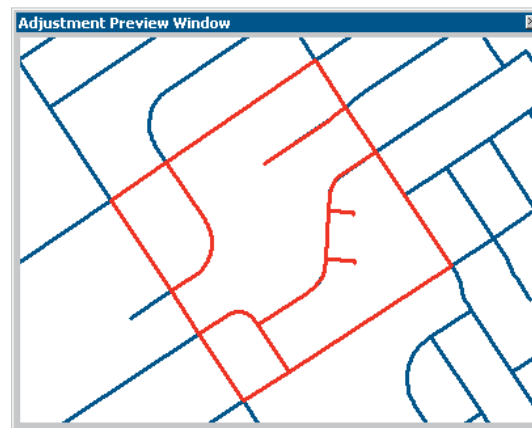
If the results are not acceptable, modify the existing links to improve the accuracy of the adjustment.

Performing the adjustment

The final step of the spatial adjustment process is to perform the adjustment.

1. Click the Spatial Adjustment menu and click Adjust.
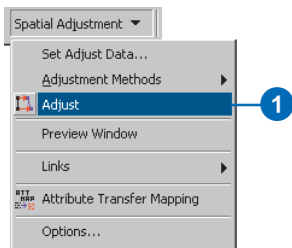
Since the Spatial Adjustment tool operates in an edit session, you can use the Undo command to undo the adjustment. Here is how the adjustment should appear:

After performing the rubbersheet adjustment, you will notice that all of the displacement links you created have turned into Identity links. The next step is to delete these links since you no longer need them.

1. Click the Select Elements tool on the Spatial Adjustment toolbar. This will allow you to select the links since they are graphic elements.

2. Click the Edit menu and click Select All Elements.
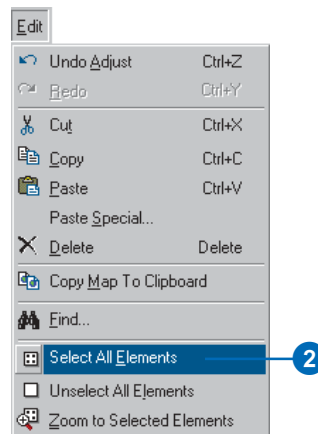
3. Press the Delete key.

Saving your edits

If you are satisfied with the results of the spatial adjustment, you can stop editing and save your edits.

1. Click the Editor menu and click Stop Editing.

2. Click Yes to save your edits.

In this exercise, you learned how to set your data for an adjustment, create displacement links, create identity links, and preview the adjustment.

Edgematching data

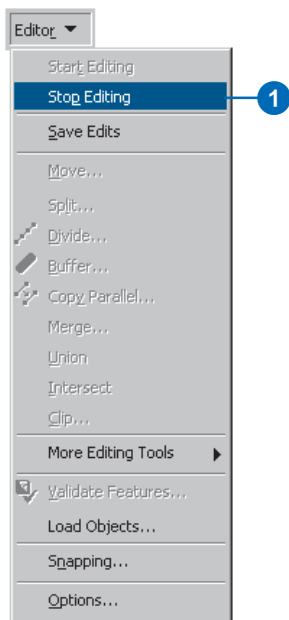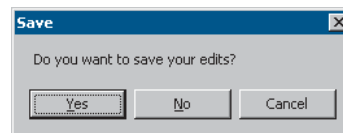Edgematching is used to align features along the edges of adjacent layers. Usually, the layer with the less accurate features is adjusted, while the other layer is used as the target layer. Edgematching relies on displacement links to define the adjustment.

In this exercise, you will edgematch two adjacent tiles of stream data by using displacement links that you will create. You will also learn how to use the Edge Match tool and set Edge Snap properties.

This tutorial assumes that ArcMap is started and the Editor and Spatial Adjustment toolbars have been added to ArcMap.

1. Close the Rubbersheet.mxd map document.

2. Click the Open button on the Standard toolbar. Navigate to the EdgeMatch.mxd map document in the Editor directory where you installed the tutorial data. (C:\ArcGIS\ArcTutor is the default location.)
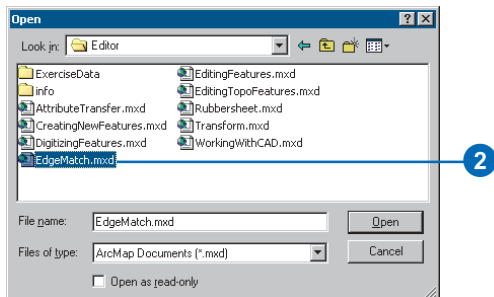
3. Click Editor and click Start Editing.
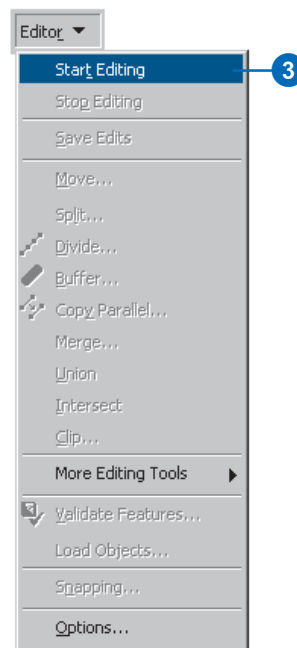
Setting the snapping environment

Before you start creating links, you should set your snapping environment so each link you add snaps to the vertices or endpoints of features.

1. Click the Editor menu and click Snapping to display the Snapping Environment dialog box.
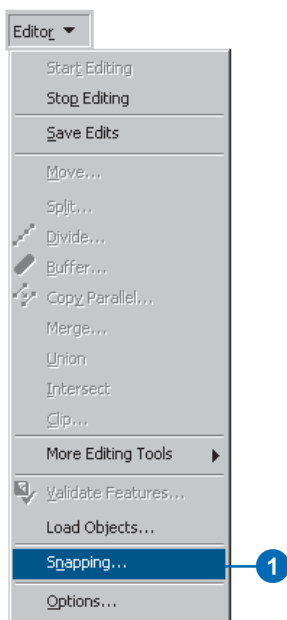
2. Check the End check boxes next to the StreamsNorth and StreamsSouth layers to snap the displacement links to the endpoints of these features. Close the dialog box.
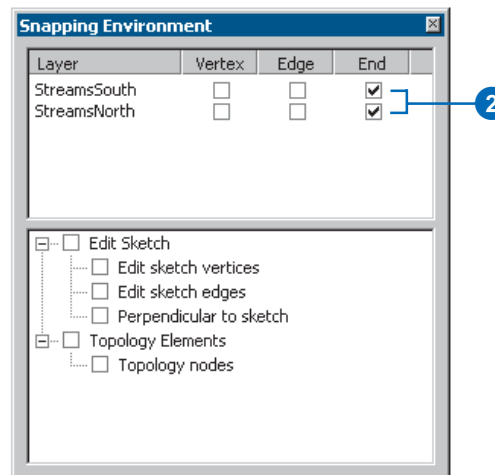
Setting data for the adjustment

The Spatial Adjustment tool allows you to adjust a selected set of features or all the features in a layer. This setting is available in the Choose Input For Adjustment dialog box. The default is to adjust a selected set of features.

1. Click the Spatial Adjustment menu and click Set Adjust Data to display the Choose Input For Adjustment dialog box.
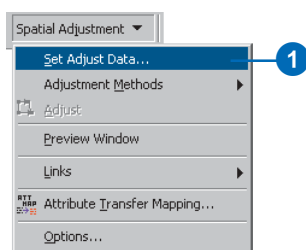

2. Click Selected features and click OK.
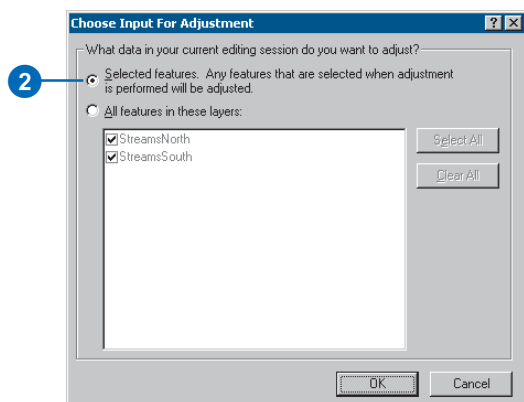
Choosing an adjustment method

Now that you have determined which features will be adjusted, the next step is to choose an adjustment method. The Spatial Adjustment tool supports several adjustment methods. In this exercise, you will use Edge Snap.

1. Click the Spatial Adjustment menu, point to Adjustment Methods, then click Edge Snap to set the adjustment method.
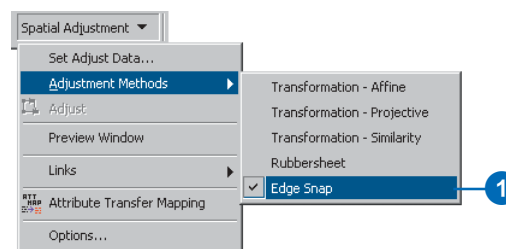
2. Click the Spatial Adjustment menu and click Options to open the Adjustment Properties dialog box.

   You will define several edgematch settings and properties in this dialog box.
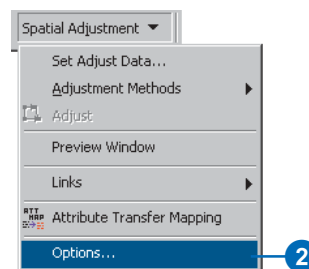
Setting the adjustment method properties

1. Click the General tab, then click the Adjustment method drop-down arrow and click Edge Snap as your adjustment method.

2. Click Options to open the Edge Snap dialog box.
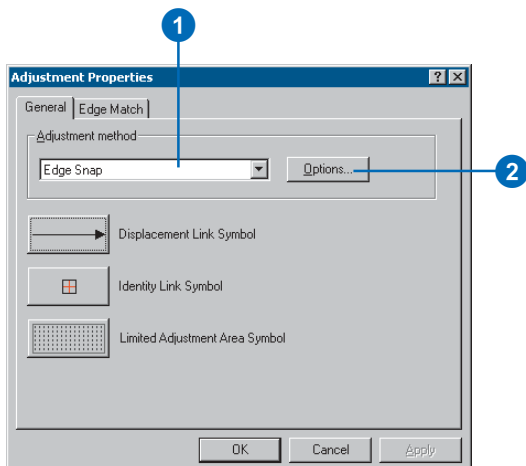
3. Click Line as the method and click OK.
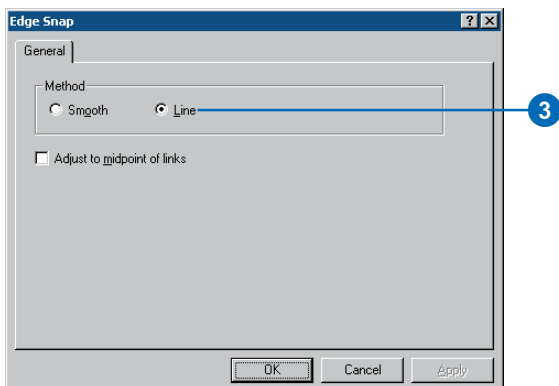
The line method only moves the endpoint of the line being adjusted. The Smooth method distributes the adjustment across the entire feature.

Setting the edgematch properties

The edgematch adjustment method requires additional adjustment methods. These properties will define the source and target layers as well as determine how the displacement links will be created when using the Edge Match tool.

1. Click the Edge Match tab of the Adjustment Properties dialog box.

2. Click the Source Layer drop-down arrow and click StreamsNorth.
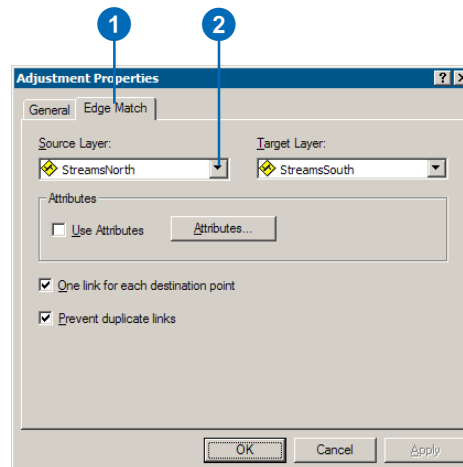
3. Click the Target Layer drop-down arrow and click StreamsSouth.

The StreamsNorth layer will be adjusted to match the target layer, StreamsSouth.
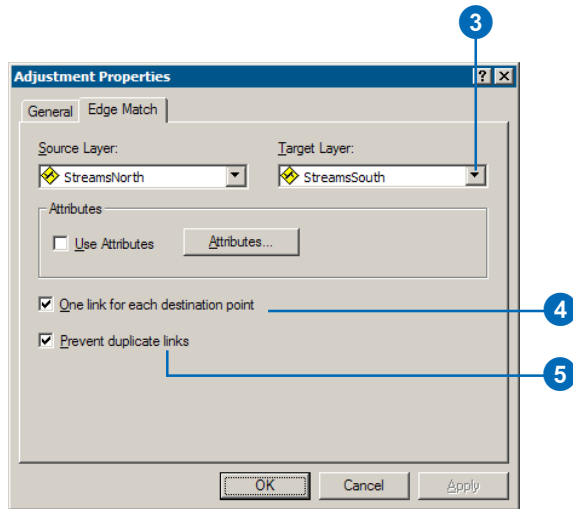
4. Check the One link for each destination point check box.

5. Click the Prevent duplicate links check box and click OK.

Locating the adjust data

You will now zoom to a spatial bookmark created for this exercise.

1. Click the View menu, point to Bookmarks, then click West streams to set the current view to the edit area of this exercise.
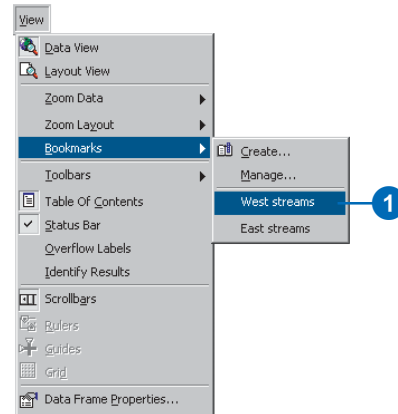
The map will display the following area:
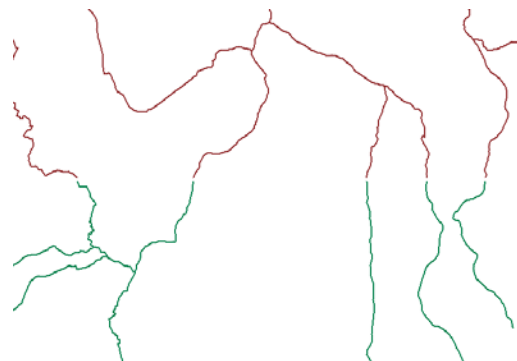
Adding displacement links

Displacement links define the source and destination coordinates for an adjustment. In this exercise, you will create multiple links using the Edge Match tool.

1. Click the Edge Match tool on the Spatial Adjustment toolbar.

2. With the Edge Match tool active, drag a box around the endpoints of the features.

   The Edge Match tool will create multiple displacement links based on the source and target features that fall inside the box.
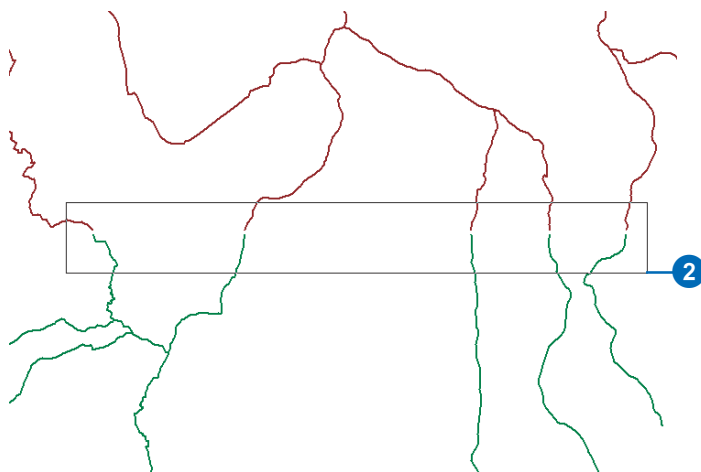
Displacement links now connect the source and target features at their endpoints.
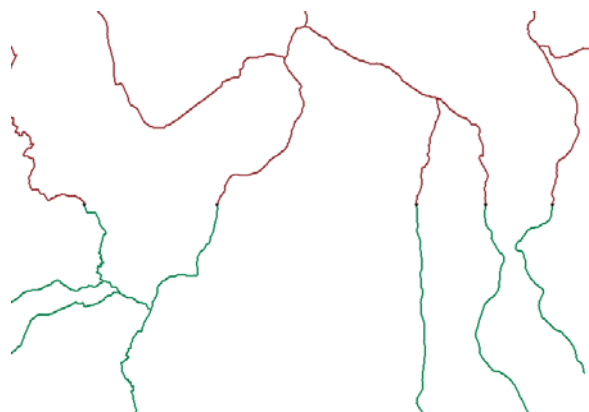
Selecting features

Since edgematching only affects the exterior regions of the layer, you must select the features you want to adjust.

1. Click the Edit tool on the Editor toolbar.
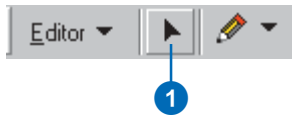
2. With the Edit tool active, drag a box around the features that are to be edgematched, as shown below.
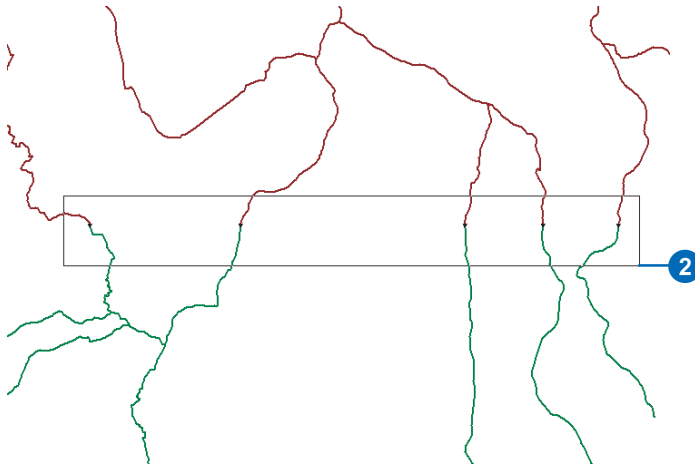
The participating features are now selected.
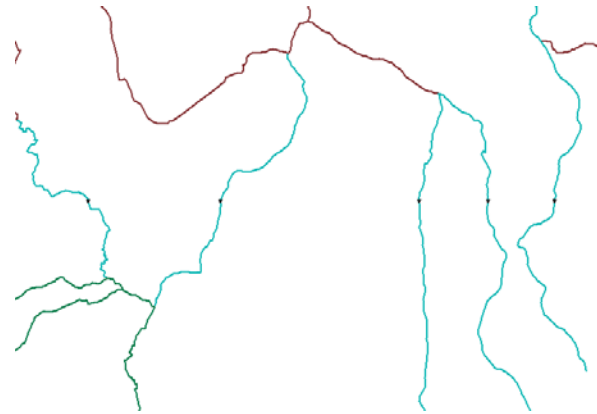
Adding additional displacement links

1. Click the View menu, point to Bookmarks, then click East streams.
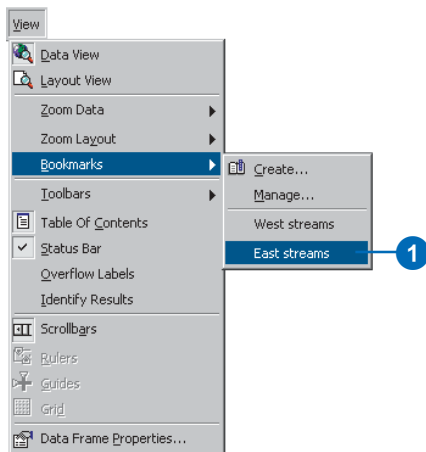
Repeat the same steps used for creating links with the Edge Match tool for the East streams portion of the data.

You will need to hold down the Shift key while you select the stream features so the features from the West side stay selected.

Examining the adjustment

You can examine how an adjustment will appear prior to actually performing it with the Preview Window. You can use the standard ArcMap Zoom and Pan tools to change the display of the Preview Window.

1. Click the Spatial Adjustment menu and click Preview Window to examine the adjustment.
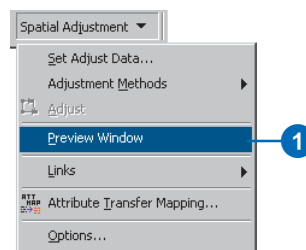
The following window appears:
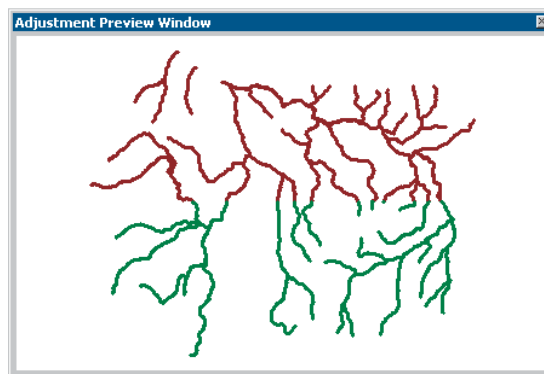
If the results are not acceptable, you can modify the existing links to improve the accuracy of the adjustment.

Performing the adjustment

The final step of the spatial adjustment process is to perform the adjustment.

1. Click the Spatial Adjustment menu and click Adjust.
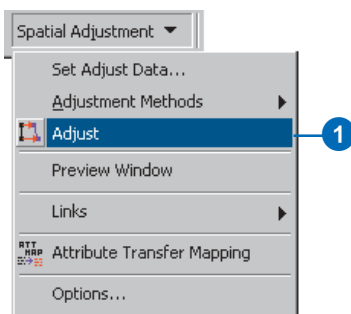
Since the Spatial Adjustment tool operates in an edit session, you can use the Undo command to undo the adjustment. Here is how the adjustment should appear:

Saving your edits

If you are satisfied with the results of the spatial adjustment, you can stop editing and save your edits.

1. Click the Editor menu and click Stop Editing.
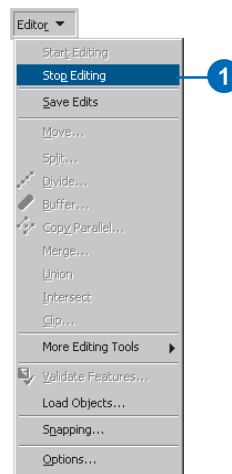
2. Click Yes to save your edits.
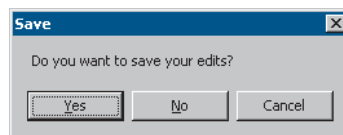
In this exercise, you learned how to set edgematch properties, use the Edge Match tool to create displacement links, and preview the adjustment.

Exercise 9: Using the Attribute Transfer tool

The Attribute Transfer tool is used to transfer attributes from features in a source layer to features in a target layer. Source and target layers and the attributes to be transferred are defined in the Attribute Transfer Mapping dialog box. The Attribute Transfer tool is then used to interactively transfer those attributes between features of the source and target layers.

In this exercise, you'll transfer the street name and type from an existing street to a new street recently added to the database.

Starting ArcMap and beginning editing

Before you can complete the tasks in this tutorial, you must start ArcMap and load the tutorial data.

1. Double-click a shortcut installed on your desktop or use the Programs list in your Start menu to start ArcMap.

2. Click the Open button on the Standard toolbar. Navigate to the AttributeTransfer.mxd map document in the Editor directory where you installed the tutorial data. (C:\ArcGIS\ArcTutor is the default location.)
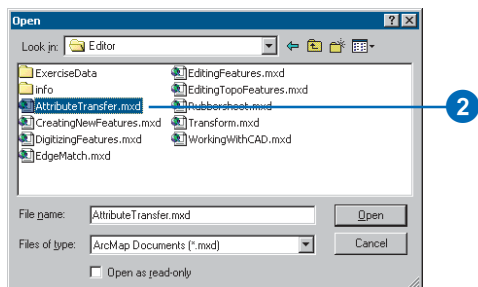
3. Click the Editor Toolbar button on the Standard toolbar to add the Editor toolbar to ArcMap.

4. Click the Editor menu and click Start Editing.
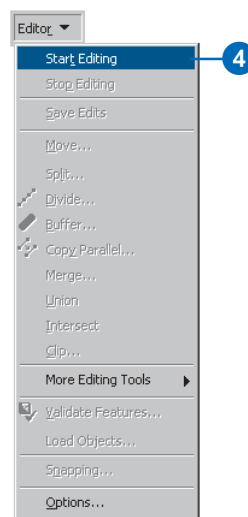
Adding the Spatial Adjustment toolbar

1. Click the View menu, point to Toolbars, then click Spatial Adjustment to add the Spatial Adjustment toolbar to ArcMap.
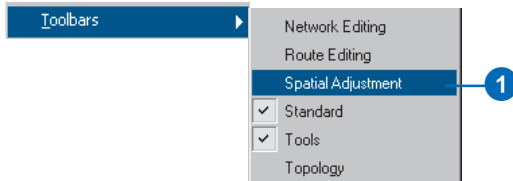
The Spatial Adjustment toolbar appears.

Setting the snapping environment

Before you transfer attributes, you should set your snapping environment for your source and target layers. This will ensure that you select the correct feature when using the Attribute Transfer tool.

1. Click the Editor menu and click Snapping to display the Snapping Environment dialog box.
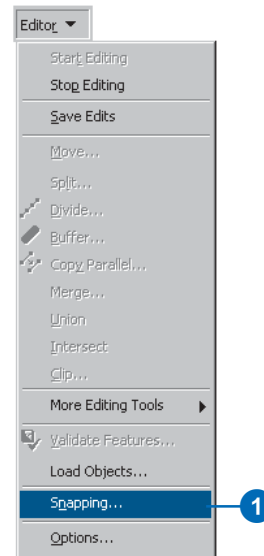
2. Check the Edge check boxes next to the Streets and NewStreets layers. Close the dialog box.
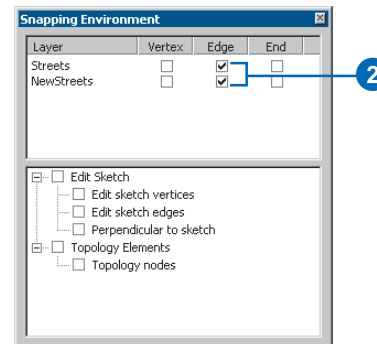
Setting the source and target layers

The first step in the Attribute Transfer process is to set the source and target layers. The Attribute Transfer Mapping dialog box allows you to define these settings.

1. Click the Spatial Adjustment menu and click Attribute Transfer Mapping.
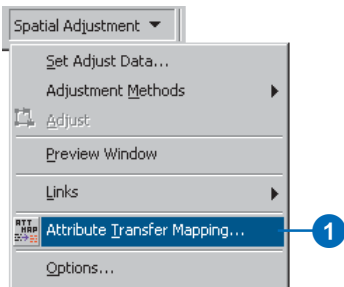
2. Click the Source Layer drop-down arrow and click the Streets layer.
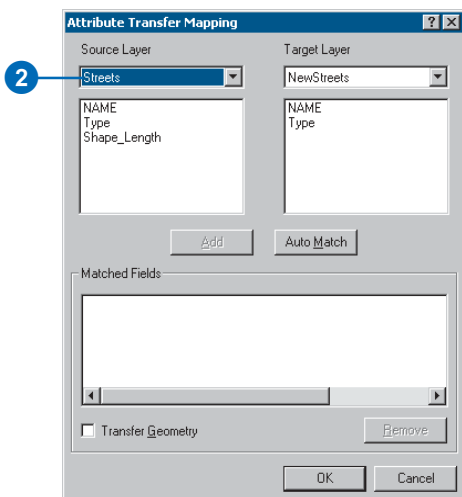
3. Click the Target Layer drop-down arrow and click the NewStreets layer.
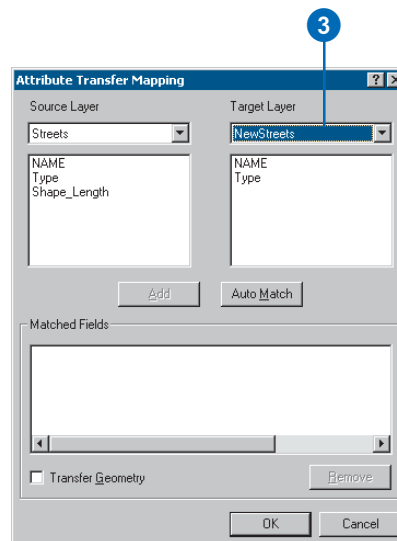
Mapping source and target fields

The next step is to specify which fields to use for the attribute transfer. You will select a field in the source layer and match it to a corresponding field in the target layer. The Attribute Transfer tool will use these matched fields to determine which data to transfer.

1. Click the NAME field in the Source Layer field list box.
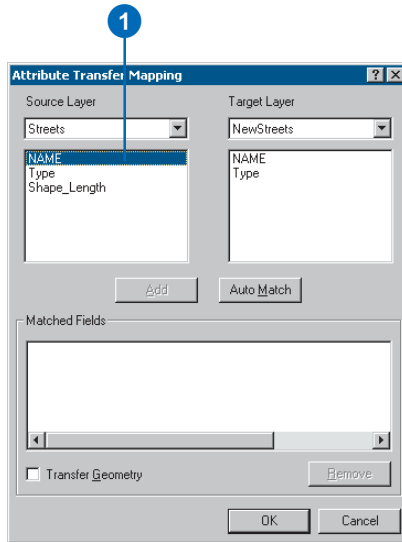
2. Click the NAME field in the Target Layer field list box.

3. Click Add.
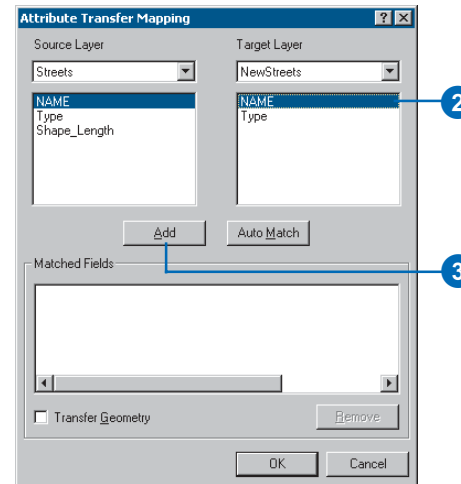
The fields are now added to the Matched Fields list box.

4. Repeat the same steps for the Type fields and click OK.
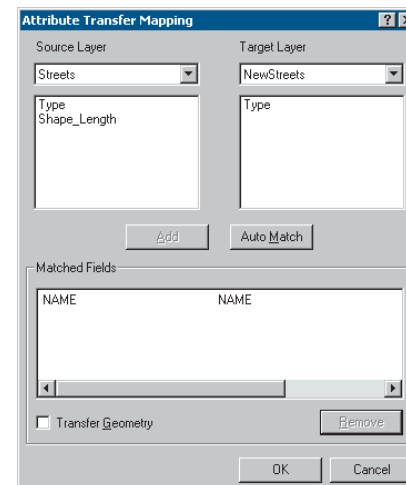
Locating the adjust data

Spatial bookmarks are named extents that can be saved in map documents. Creating a bookmark for areas that you visit frequently will save you time.

You will now zoom to a spatial bookmark created for this exercise.

1. Click the View menu, point to Bookmarks, then click New streets to set the current view to the edit area of this exercise.
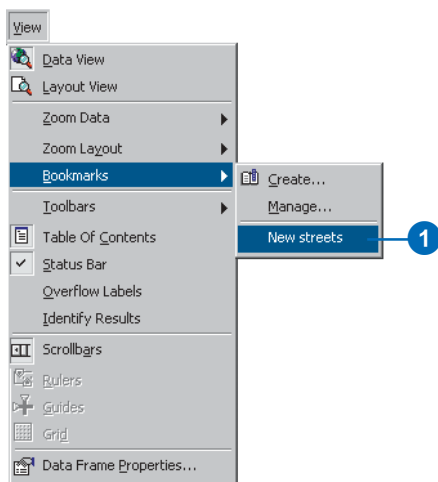
When the display refreshes, you should see the following area in your map:
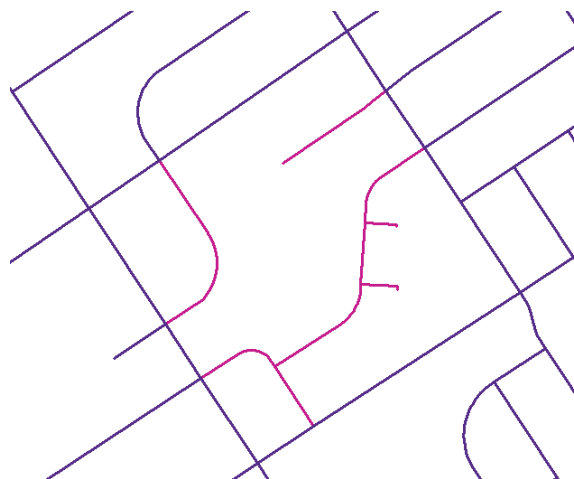
Identifying features for the attribute transfer

Prior to performing the attribute transfer, you will need to verify the attributes of the source and target features. This can be done using the Identify tool.

1. Click the Identify tool. The Identify dialog box appears.

2. Click the source feature indicated, as shown below.
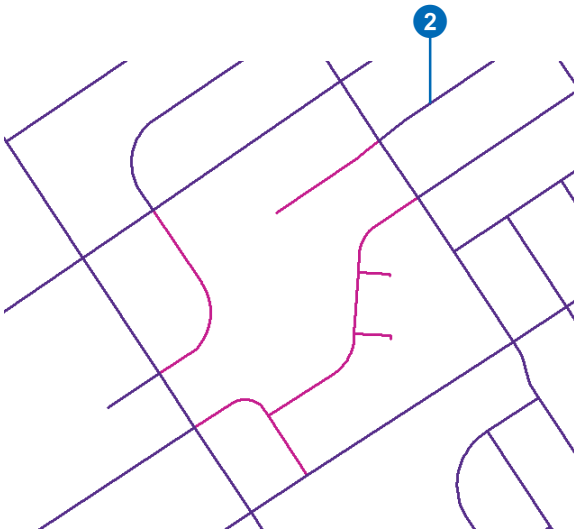
Notice the NAME and Type field attributes. These attribute values will be transferred to the target feature.
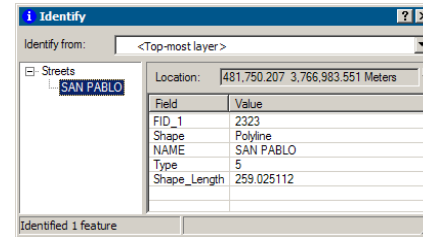
3. With the Identify tool still active, click the target feature, as shown below.
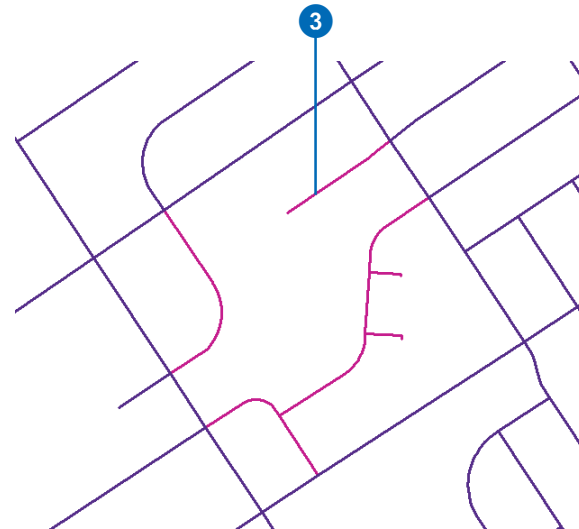
The Identify dialog box now displays information about the target feature. Notice the NAME and Type fields; attribute values for these fields will be transferred to the target layer from the Streets layer.
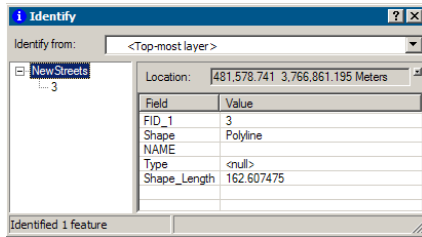
Using the Attribute Transfer tool

You will now use the Attribute Transfer tool to transfer the source feature attributes to the target feature.

1. Click the Attribute Transfer tool on the Spatial Adjustment toolbar.

2. Snap to an edge of the source feature, as shown below.
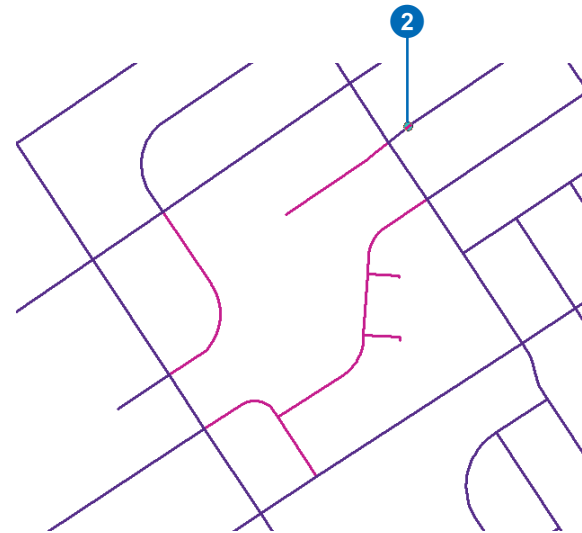
3. Drag the link toward the target feature.
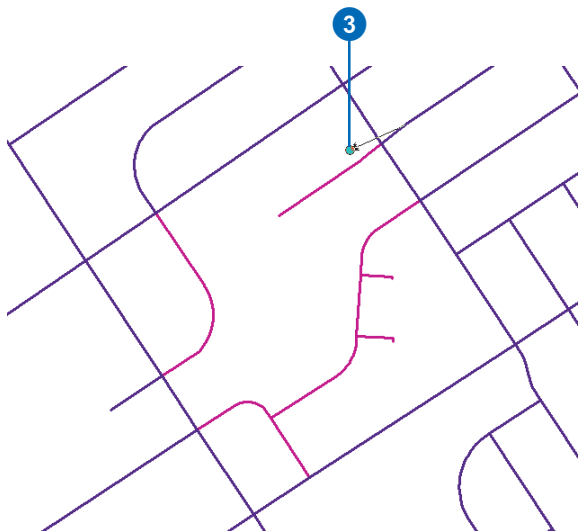
4. Snap to an edge of the target feature and click.
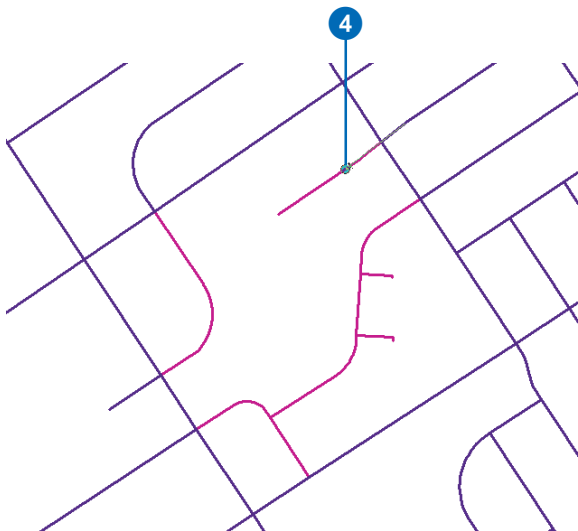
Verifying the results of the attribute transfer

Now that you have transferred the attributes from the source feature to the target feature, it is a good idea to verify that the target feature was updated with the proper information.

1. Click the Identify tool.

2. Click the target feature.
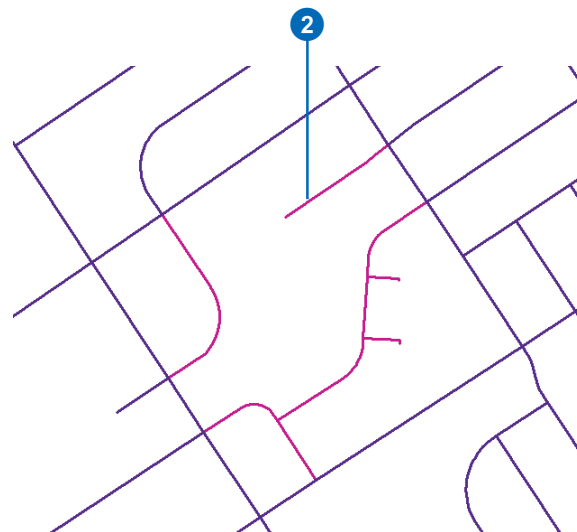
The NAME and Type fields in the target feature should reflect the new attributes:
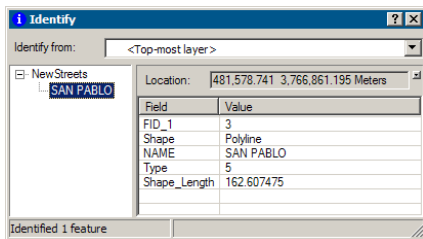
Transferring attributes to multiple features

To transfer the attributes of a source feature to multiple target features, hold down the Shift key while selecting the target features.

Saving your edits

If you are satisfied with the results of the attribute transfer, you can stop editing and save your edits.

1. Click the Editor menu and click Stop Editing.
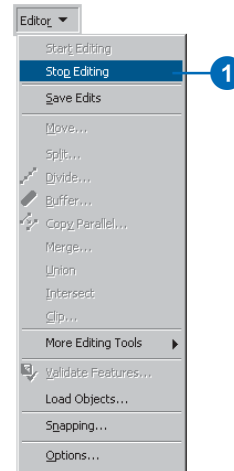
2. Click Yes to save your edits.
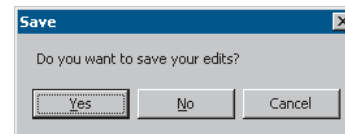
In this exercise, you learned how to transfer attributes from a source layer to a target layer.

Exercise 10: Creating and editing annotation

Annotation is a way to store text to place on your maps. With annotation, each piece of text stores its own position, text string, and display properties. Dynamic labels, based on one or more attributes of features, are the other primary option for placing text on maps. If the exact position of each piece of text is important to you, then you should store your text as annotation. ArcGIS fully supports two types of annotation: geodatabase annotation and map document annotation. ArcGIS also supports the display and conversion of other annotation types including ArcInfo coverage annotation and CAD annotation.

In this exercise, you will convert some labels into geodatabase annotation, place some unplaced annotation features, and edit some annotation features.

Opening the exercise document

1. Start ArcMap.
2. Click File and click Open. Navigate to and open the EditingAnno.mxd map document located in the Editor folder where you installed the tutorial data (C:\ArcGIS\ArcTutor is the default location).

This map shows roads and water features in Zion National Park. Each feature layer has dynamic labels, and the Streams, Major Roads, and Water Points layers have label classes based on the layers' symbology. Label classes let you create different labels for different types of features in a given layer, so, for example, intermittent streams can be given smaller labels than perennial streams.

Suppose you need to create an 8.5 x 11 inch map that shows the named streams within the park. It is more

important to get the perennial streams labeled than the intermittent ones, but your objective is to include as many stream names as possible for the park area.

Viewing unplaced labels

Some of the streams could not be labeled due to space constraints on the map. You'll add the Labeling toolbar and view the unplaced labels.

1. Click View, point to Toolbars, and click Labeling.
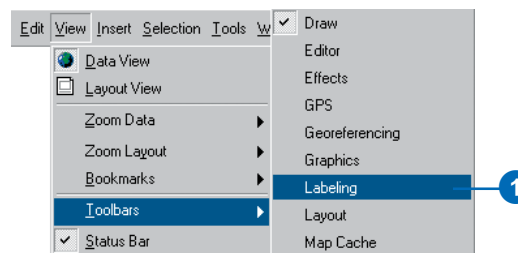
2. Click the View Unplaced Labels button.

The labels that could not be placed are displayed in red.

It might be possible to fit these labels by adjusting the size of the labels, changing the feature and label weights, or making the map larger. However, for this exercise, you will convert the labels to annotation and place or delete the unplaced annotation.

3. Click the View Unplaced Labels button again to hide the unplaced labels.

Next you'll prepare to convert the labels to annotation.

Setting a reference scale

Annotation features have a fixed position and size, so when you zoom in to the map they appear to get larger. Labels are dynamically drawn according to their layer's label properties. If the map does not have a reference scale, they are drawn at their specified font size regardless of the map scale. To make labels behave more like annotation, you can set a reference scale for the map. The labels will be drawn with their specified font size scaled relative to the reference scale. When converting labels to annotation, you should specify a reference scale. If you do not, the current map scale will be used as the reference scale for the annotation.

1. Type "170000" in the Map Scale box and press Enter.

2. In the ArcMap table of contents, right-click Layers, point to Reference Scale, and click Set Reference Scale.
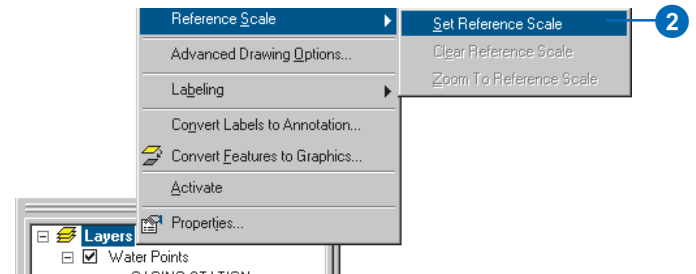
You can also view and change the reference scale for the data frame using the General tab of the Data Frame Properties dialog box.

Now if you zoom in or out, the labels will become correspondingly larger or smaller. You're ready to convert these labels to annotation.

Converting labels to annotation

Annotation can be stored in a map document or in feature classes in a geodatabase. You will convert these labels to annotation stored in a geodatabase.

1. In the ArcMap table of contents, right-click Layers and click Convert Labels to Annotation.
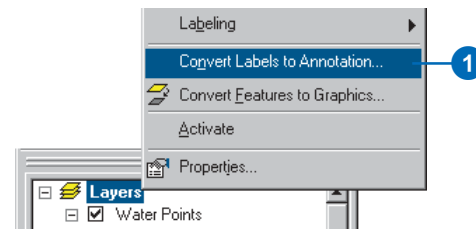
The Convert Labels to Annotation dialog box allows you to specify what kind of annotation to create from the labels, which features to create annotation for, and where the annotation will be stored.
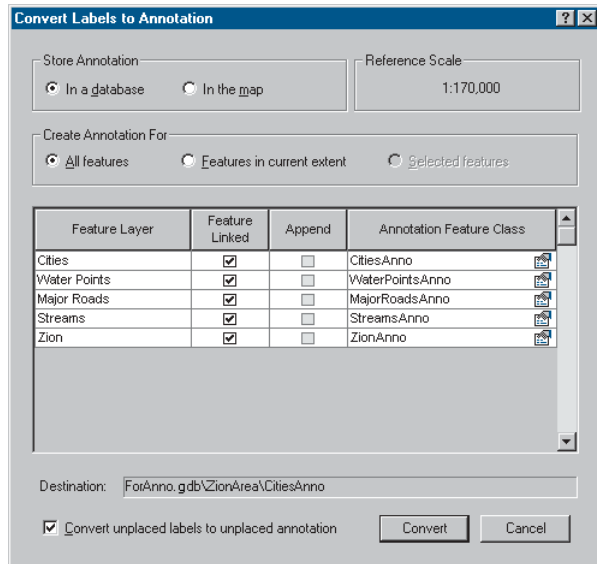
Convert Labels to Annotation dialog box with an ArcEditor or ArcInfo license of ArcMap. Annotation will be feature-linked by default.

ArcView licensed seats of ArcMap can view feature-linked annotation, but they cannot create it or edit datasets that contain it. If you have an ArcView license, the Feature Linked column of check boxes will be unavailable. In this exercise, you will create standard annotation features. Skip the next step if you have an ArcView license.

2. Uncheck the check boxes in the Feature Linked column.
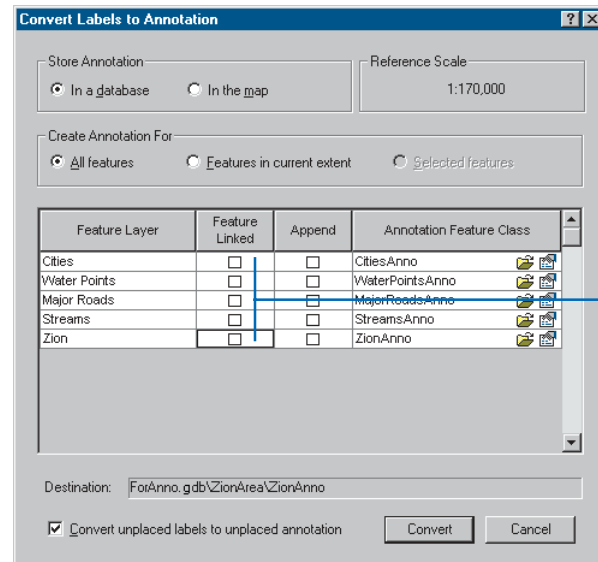
Small folder icons, the Browse buttons, appear beside the annotation feature class names as you uncheck the Feature Linked check boxes. Feature-linked annotation must be stored with the feature class that it is related to in the geodatabase. Standard annotation feature classes can be stored in other geodatabases; after unchecking the boxes, you have the option to specify a new location for your annotation. Standard annotation feature classes will be stored in the same dataset as their source feature class by default. If a feature layer on the map was based on a shapefile or coverage feature class, the Browse button would have been visible and you would need to browse to a geodatabase to store the new annotation feature class.

3. Verify that the box to Convert unplaced labels to unplaced annotation is checked.
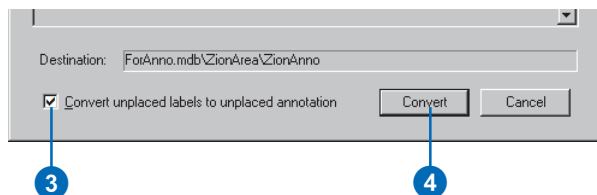
This will give you a chance to manually place the annotation for the features that could not be labeled.

4. Click Convert.

The labels are converted to annotation. The process should take less than a minute, though the speed will depend on your computer. When the annotation feature classes are created, they are added to ArcMap.
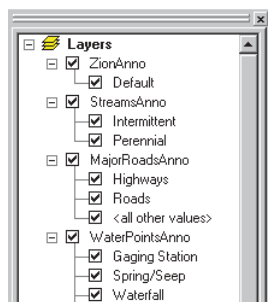
Each layer's label classes will be stored as separate annotation classes within a single annotation feature class. For example, the two label classes for streams will become two annotation classes, called Intermittent and Perennial, within the StreamsAnno annotation feature class. These annotation classes can be turned on and off independently, and they can have their own visible scale ranges.

Preparing to place unplaced annotation

Now that the labels have been created, you will add the Editor and Annotation toolbars, switch to data view in ArcMap, and start an edit session.

1. If the Annotation toolbar is not visible, click View, point to Toolbars, and click Annotation. If the Editor toolbar is not visible, add it using the same method.
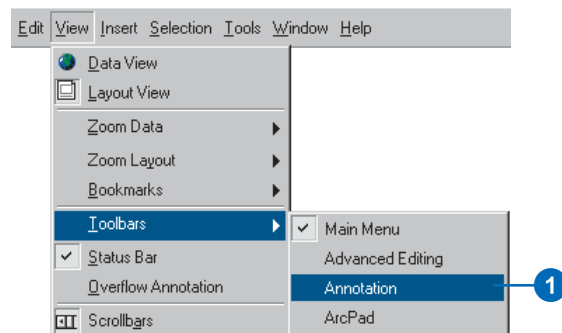
While you can edit in layout view, the display performance is better in data view.

2. Click View and click Data View.
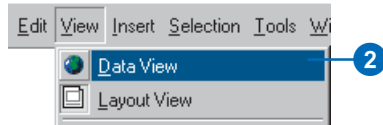
3. Click Editor and click Start Editing.

4. Click the Unplaced Annotation Window button on the Annotation toolbar.

The Unplaced Annotation Window appears. You can resize it, dock it to the ArcMap window, or leave it floating.

The Unplaced Annotation Window lets you view unplaced annotation features in a table that can show all the unplaced annotation in the annotation feature classes on your map. You can filter the table to show annotation for a specific annotation class and choose whether to show annotation for the whole extent of the data or for the current visible extent. You can sort the table alphabetically by the unplaced annotation's text content or annotation class by clicking the Text or Class column headings.

5. Check the Draw check box.
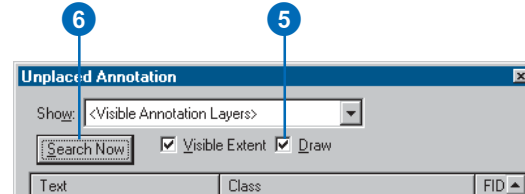
The Draw check box lets you view the unplaced annotation features on the map.

6. Click Search Now.

A number of annotation features are listed in the table. If you scroll down the table, you can see there are unplaced annotation features from several annotation classes represented.
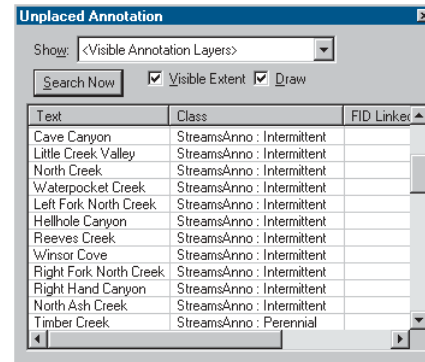
You can also see some new annotation features outlined in red on the map. You see these unplaced annotation features because the Draw check box is checked.

7. Click the Edit Annotation tool.

8. Click the map, press and hold down the Z key, and click and drag a box around the small cluster of unplaced annotation features at the east side of the park.
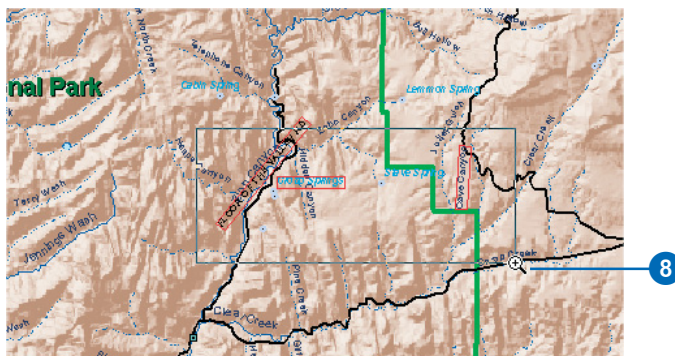
The Z key is the editing shortcut key to zoom in.

The Hillshade background layer has a visible scale range; when you zoom in closer than 1:85,000, it is no longer displayed. Setting a visible scale range is also a good idea for annotation feature classes, as they are most useful within the range of scales where they are legible. There is no need to spend time or—especially for multiuser geodatabases—network and database resources drawing annotation features when they cannot be read. You can set a visible scale range for a layer in ArcMap, or you can change the properties of the annotation feature class itself

in ArcCatalog. The second method has the advantage that the annotation feature class will always be drawn within its visible scale range when it is added to a map.

Placing an unplaced annotation feature

Now that you've zoomed in to the cluster of unplaced annotation in the east side of the park, you're ready to start placing the unplaced annotation features.

1. Click Search Now.
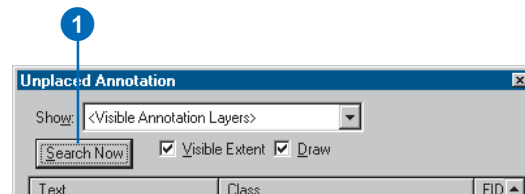
2. Right-click Cave Canyon in the Text column and click Place Annotation.
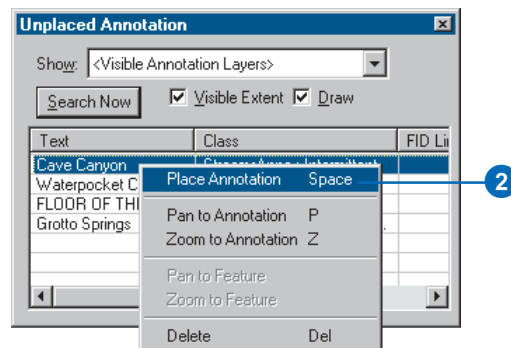
The Cave Canyon annotation feature is placed. It is selected, so it has a blue outline instead of a red outline.

The annotation feature is straight and placed parallel to a segment of the stream feature. The other stream annotation features curve to follow the streams, so you will make this newly placed annotation feature follow the stream.

Following a feature

You can make an annotation feature follow a line feature or the boundary of a polygon feature. The Follow Feature Options dialog box allows you to specify how annotation will behave when it follows a feature.

1. Right-click the Cave Canyon annotation feature, point to Follow, and click Follow Feature Options.

    The Follow Feature Options dialog box appears.
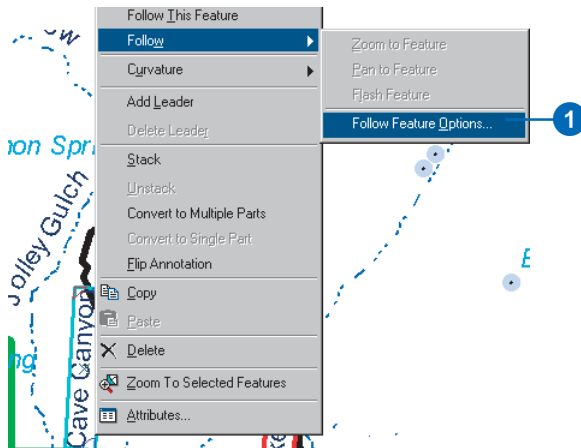
2. Click Curved.
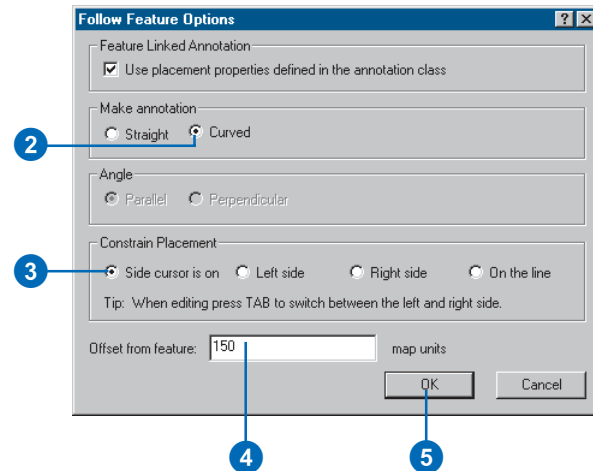
3. Click the Side cursor is on button to constrain the placement of the annotation.

4. Type "150" in the Offset from feature text box. The annotation will be offset 150 meters from the stream.

5. Click OK.

6. Move the pointer over the stream feature just east of the Cave Canyon annotation feature. With the pointer slightly to the left of the stream, right-click and click Follow This Feature.

The stream feature will flash, and the annotation feature will bend to follow the stream. If you click too near the road feature, the annotation may follow the road. While the Cave Canyon annotation feature is still selected, you can fix this by repeating the last step. The selected annotation feature will follow any line feature that you right-click and tell it to follow using the Edit Annotation tool.

7. Place the pointer over the middle of the Cave Canyon annotation feature. The pointer will change to the four-pointed Move Annotation pointer.
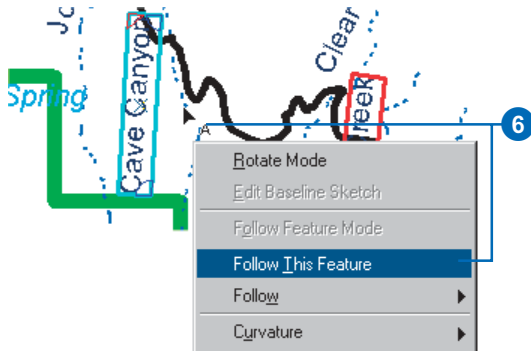

8. Click and drag the Cave Canyon annotation feature along the stream feature until it is between the park boundary and the road. It will slightly overlap each of these features. Press the L key as you drag the annotation to flip its reading direction.
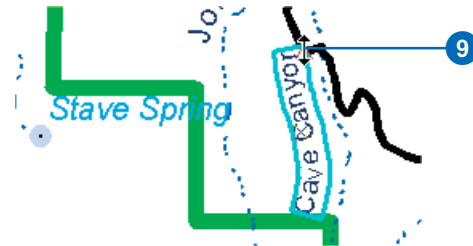
9. Place the pointer over the red triangle on the edge of the Cave Canyon annotation feature. The pointer will change to the two-pointed Resize Annotation pointer.

10. Click and drag the resize handle toward the middle of the annotation feature. The feature will shrink as you drag it. Resize the feature until it fits between the park boundary and the road.

You've placed an annotation feature, made it follow another feature, and resized it with the Edit Annotation tool. The Edit Annotation tool also allows you to make other edits to annotation features.

Stacking and rotating annotation

Now that you've placed the annotation feature from the StreamsAnno feature class, you'll place the other nearby annotation features.

1. In the Unplaced Annotation window, right-click Grotto Springs and click Pan to Annotation.
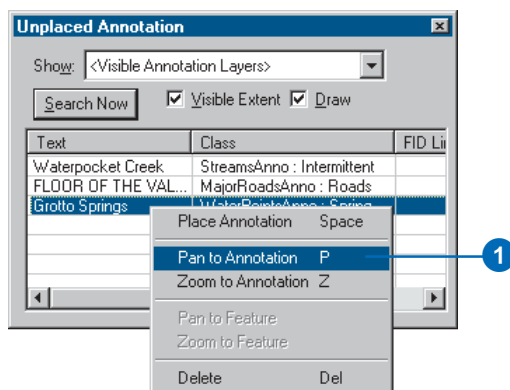
2. Press the Spacebar.

The Grotto Springs annotation feature is placed.

The Spacebar is the Unplaced Annotation window shortcut key to place a selected annotation feature.

3. Right-click the map and click Stack.
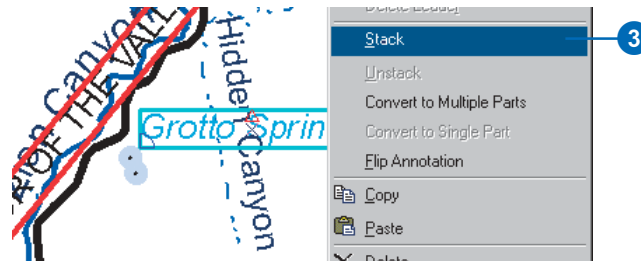
The Grotto Springs annotation feature is split at the space in the text, and the word Grotto is placed above the word Springs.

4. Move the pointer over the middle of the Grotto Springs annotation feature. The pointer will change to the four-pointed Move Annotation pointer. Click the middle of the Grotto Springs annotation feature and drag it to the southwest, so it does not cover the Hidden Canyon annotation feature.
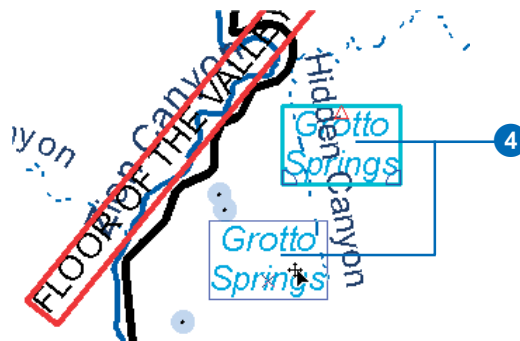
5. In the Unplaced Annotation window, click FLOOR OF THE VALLEY RD, and press the P key.

The P key is the Unplaced Annotation window shortcut key to pan to a selected annotation feature.

6. Click the map, press and hold down the X key, and click near the unplaced FLOOR OF THE VALLEY RD annotation feature.
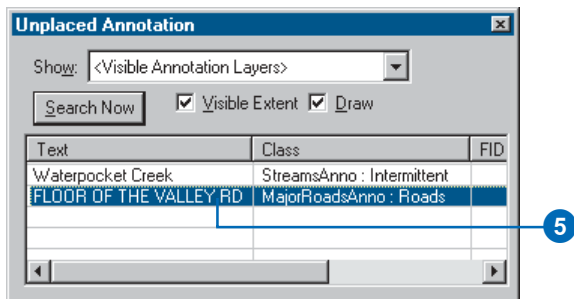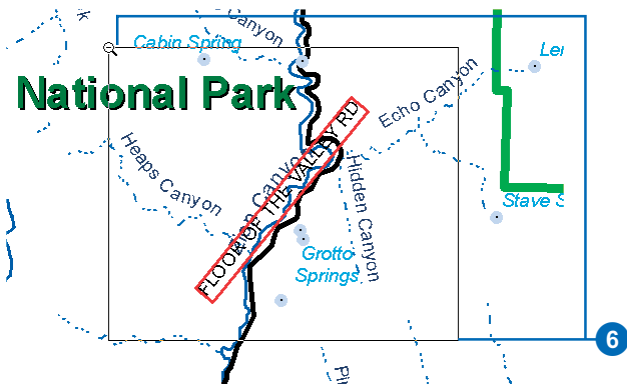

The X key is the shortcut key to zoom out.

7. Right-click FLOOR OF THE VALLEY RD and click Place Annotation.
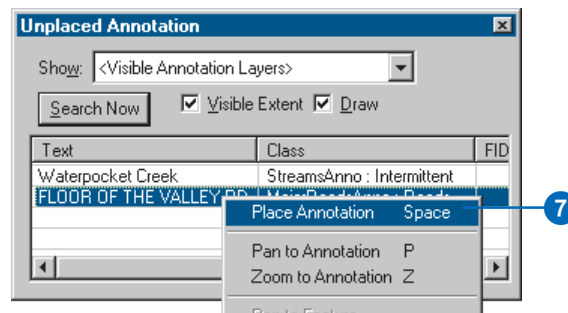
8. Click the middle of the FLOOR OF THE VALLEY RD annotation feature with the four-pointed Move Annotation pointer, and drag it to the southwest, until the south end of the annotation feature is near the intersection of Floor of the Valley Rd and the road that branches off to the east, State Highway 9.

9. Move the pointer over the blue, wedge-shaped rotate handle on the northeast corner of the FLOOR OF THE VALLEY RD annotation feature until the pointer becomes the Rotate pointer. Click the corner and drag it counter-clockwise until the annotation feature follows the general trend of the road.

10. Right-click the FLOOR OF THE VALLEY RD annotation feature and click Stack.

You've placed, moved, stacked, and rotated annotation features with the Edit Annotation tool. Next you'll create new annotation and delete annotation.
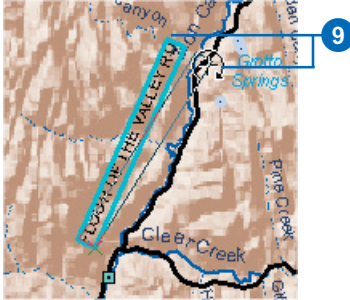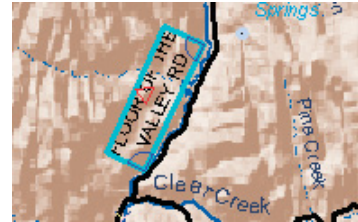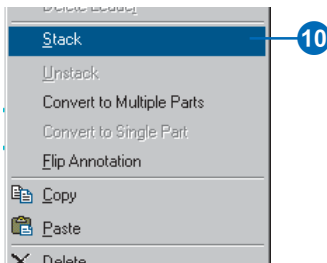
Creating and deleting annotation

Suppose you decide that the intersection of Floor of the Valley Rd and State Highway 9 is inadequately annotated. You'll create a new annotation feature for State Highway 9 and place it near the intersection.

1. On the Editor toolbar, click the Sketch tool.
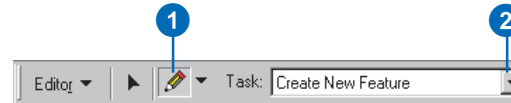
When the Edit Annotation tool is active, you can press the E key to quickly switch between Sketch, Edit, and Edit Annotation tools.

2. Verify that the Task drop-down list says Create New Feature. If necessary, click the drop-down arrow and click Create New Feature.

3. Click the Target drop-down list and point to Major_RoadsAnno. You have the option to choose an annotation class. Click the plus sign to expand Major_RoadsAnno and click Roads.

4. Verify that the symbol has switched to Roads when you made the Roads annotation class the target for your edits.

5. Press the Esc key to return focus to the Sketch tool.

When you click the drop-down lists, the Sketch tool loses focus. Pressing the Esc key returns focus to the tool so the shortcut key you use in the next step will work.
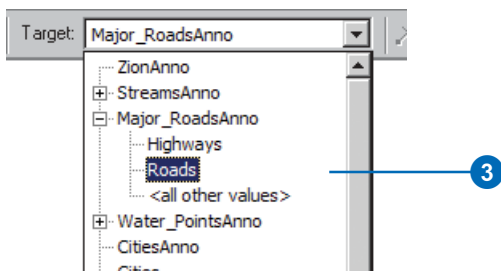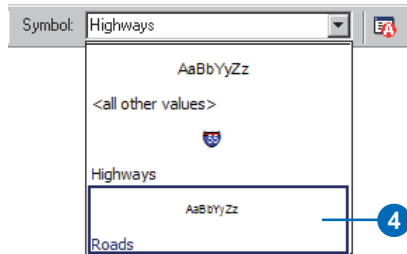
6. Move the pointer over the road feature that branches off to the east from the intersection with Floor of the Valley Rd. Press Ctrl+W.
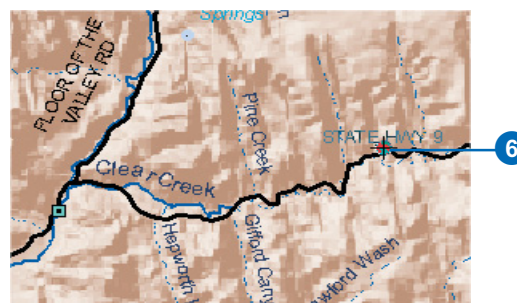
The Ctrl+W shortcut takes the label expression of the first visible and selectable feature that you are pointing at and adds it to the Text box on the Annotation toolbar. When you use Ctrl+W while editing a feature-linked annotation class, it uses the expression of the annotation class to derive the text and will only derive the text from a feature in the linked feature class.

The Text box on the Annotation toolbar should say STATE HWY 9. If it says ZION NATIONAL PARK or Clear Creek, move the pointer over the road feature and press Ctrl+W again.
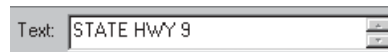
7. Click above the road to place the new annotation feature.
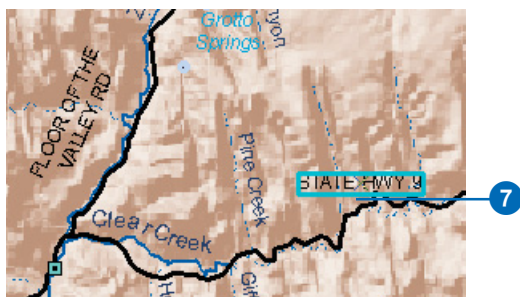
Because the construction method was Horizontal, one click placed the annotation feature.

The pointer is still in Construct feature mode, and it says STATE HWY 9. If you needed to annotate more features, you could click somewhere else on the map to add another piece of annotation with the same text, or you could move the pointer over another feature and press Ctrl+W to pick up new text from its label expression. You could also type new text directly into the Text box on the Annotation toolbar. In Construct feature mode, the A key is a shortcut that lets you set the focus to the Text box, so you can type new text without clicking in the box.

Most of the road annotation follows the road features. You'll use a different construction method to create a new annotation feature that follows the road.

8. Click the Construction drop-down list and click Follow Feature.

9. Click the road feature, then move the pointer along the road. The road should be highlighted, and the annotation feature should move along the road as you move the pointer. Click again to finish the annotation sketch.
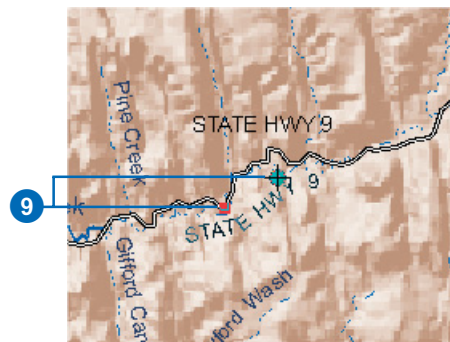
10. Press the E key to switch to the Edit tool pointer.

11. Click the horizontal STATE HWY 9 annotation feature that you created and press the Delete key.

The horizontal annotation feature is deleted.

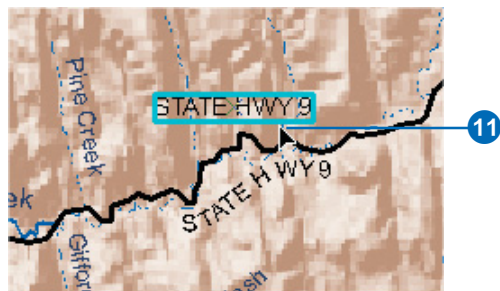You could continue to place the unplaced annotation, edit annotation, create new annotation features, and delete unwanted annotation until the map suits your needs. This annotation is stored in geodatabase annotation feature classes, each of which can be reused on other maps.

12. Click Editor and click Save Edits, then click Editor and click Stop Editing.

In this exercise, you created annotation from labels with multiple label classes, placed annotation features derived from labels that did not fit on the map, stacked and rotated annotation using the Edit Annotation tool, resized annotation features, made existing and new annotation features follow a given linear feature, and set the text string for a new annotation feature.

In the first two exercises, you learned how to use the edit sketch and sketch tools to create new features. There are a lot of additional methods for creating features that were not touched upon in these exercises.

In addition to digitizing new features using the mouse, you learned how to use a digitizer puck and tablet to capture data from paper maps. Exercise 3 showed how you can attach a paper map to your digitizing tablet, register the paper map to the coordinate space of your GIS database, and add features using the puck.

In Exercise 4, you learned how easy it is to modify the shape of existing features. You copied and pasted buildings from a CAD file into your GIS database; you also moved, rotated, and scaled the buildings to match a parcel subdivision using some of the editing tools in ArcMap. Once the buildings were properly placed, you used the Extend/Trim and Modify Feature edit tasks to connect water service lines to the side of each building.

You can edit multiple features at the same time in ArcMap and ensure that the boundaries between them are consistent. In Exercise 5, you learned how to create a map topology and use the Topology Edit tool and two basic editing tools to edit several features at once while maintaining contiguity along their shared edge.

In Exercise 6, you learned how to update your existing data with features in a CAD drawing file using the Load Objects wizard. You defined a query based on the lot line CAD layer type and loaded only those features into your target layer.

Whether importing CAD data, using a digitizer to capture features from paper, or editing the shared boundaries

between polygon features, ArcMap provides the tools you need to edit your data quickly and easily.

In Exercise 7, you learned how to use a geodatabase topology and the topology error management tools in ArcMap to clean up data and create new features.

In Exercise 8, you learned how to use the Spatial Adjustment tool to transform, rubbersheet, and edgematch data. You created displacement links to define the source and destination locations and set adjustment properties.

In Exercise 9, you learned how to use the Spatial Adjustment tool to transfer the attributes from one feature to another.

In Exercise 10, you learned how to convert labels to annotation in a geodatabase, place unplaced annotation, and edit annotation features.

To learn more about these and other topics, see the ArcGIS Desktop Help.