

# Linear Referencing in ArcGIS™

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#### **DATA CREDITS**

Highways and streets map—Maryland Department of Transportation State Highway Administration, Baltimore, Maryland

Transit map—Parsons Brinckerhoff Quade & Douglas, Inc., Los Angeles, California

Railways map—Parsons Brinckerhoff Quade & Douglas, Inc., Los Angeles, California

Oil and gas exploration map—TGS-NOPEC Geophysical Company, Houston, Texas

Pipelines map—M.J. Harden Associates, Inc., Kansas City, Missouri

Water resources map—Center for Research in Water Resources, University of Texas at Austin

Hatching map 1—New York State Department of Transportation, Albany, New York

Hatching map 2—TGS-NOPEC Geophysical Company, Houston, Texas

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# Quick-start tutorial

# 2

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- **Exercise 2: Creating and calibrating route data**
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- **Exercise 5: Editing routes**

ArcGIS has the tools you need for linear referencing applications. The easiest way to start learning about linear referencing is to complete the exercises in this tutorial. Before you start, however, it is assumed you know the fundamentals of ArcToolbox™, ArcCatalog™, and ArcMap™ software. For more information, see *Using ArcToolbox*, *Using ArcCatalog*, *Using ArcMap*, and *Editing in ArcMap*.

For this tutorial, imagine that you work in the GIS department of a highway authority responsible for the maintenance and safety of your region's highways. In the exercises to follow, you will perform some of the linear referencing tasks typical to such a person. Specifically, you will use ArcToolbox to create and recalibrate route data. Next, you will learn how to display and query your newly created route data in ArcMap. After that, you will discover how easy it is to display and query your route event data in ArcMap. Lastly, you will learn how to edit your route data in ArcMap.

To complete many of the exercises in this tutorial, you will need to have an ArcInfo™ license. Feel free, however, to read through the exercises to familiarize yourself with the linear referencing functionality in ArcGIS.

Work on this tutorial at your own pace. The exercises build on one another, so it is assumed that you will complete them in order. This tutorial includes five exercises, each of which takes five to 30 minutes to complete.

The study area for this tutorial is Pitt County, North Carolina. The data was compiled from various sources and has been modified to suit the needs of the exercises. The reliability and suitability of the information, therefore, cannot be guaranteed.



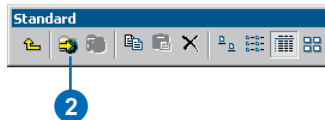
## Exercise 1: Organizing your data in ArcCatalog

The exercises in this chapter use the tutorial data distributed with ArcGIS. The default install location of the data is C:\arcgis\ArcTutor\LinearReferencing. Some of the following exercises require that you change the data. You will, therefore, need to have write access to the data. If you do not want to change the data at the default location or you do not have write access, you will need to copy the LinearReferencing folder to a new location before you start the exercises.

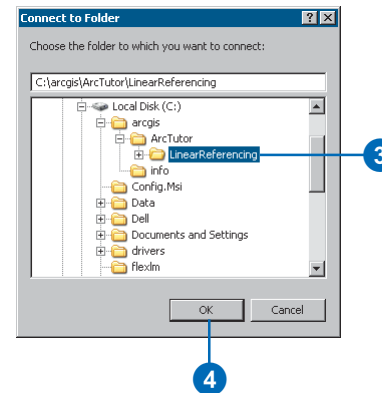
### Connecting to the data

In ArcCatalog, folder connections let you access directories on local disks or shared folders on the network. Further, database connections allow you to access the contents of a database.

1. Start ArcCatalog by either double-clicking a shortcut installed on your desktop or using the Programs list in your Start menu.
2. Click the Connect To Folder button on the Standard toolbar.



3. Navigate to the LinearReferencing folder on the local drive where you installed the tutorial data.
4. Click OK.



The new folder connection is now listed in the Catalog tree. You will now be able to access all of the data needed for the remaining exercises in this tutorial via the new connection.

## Exercise 2: Creating and calibrating route data

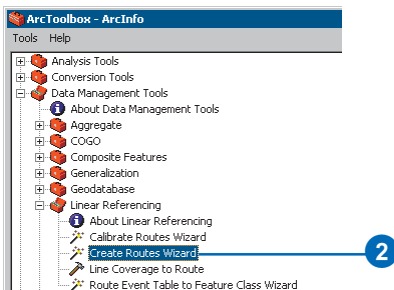
The first thing you will need for any linear referencing project is accurate route data. In this exercise, you will first create a route feature class by merging input line features that share a common route identifier. This is done with the Create Routes Wizard, which is in ArcToolbox.

Next, you will recalibrate the newly created route feature class using a point feature class that stores route and measure information as attributes. This is done with the Calibrate Routes Wizard, which is also in ArcToolbox.

### Creating route data

The Create Routes Wizard is used to specify the input line feature class, the route identifier field, the method used to set the route measures, and the output feature class. Note that the input feature classes can be any supported format. This includes coverage, shapefile, personal and enterprise geodatabase, and *computer-aided design (CAD)* data.

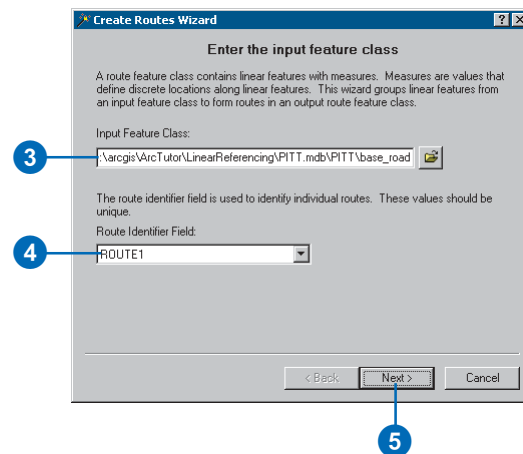
1. Start ArcToolbox by either double-clicking a shortcut installed on your desktop or using the Programs list in your Start menu.
2. Double-click the Create Routes Wizard in ArcToolbox in the Linear Referencing toolset of Data Management Tools.



There are several ways to set the input feature class. You can drag a line feature class from the ArcCatalog tree and drop it onto the text box, click the Browse button to open the ArcCatalog minibrowser and navigate to the feature class, or simply type the full pathname to the feature class in the text box.

The tutorial instructions will simply ask you to type names and paths into the appropriate text boxes. Feel free, however, to use any of the available techniques.

3. Type “C:\arcgis\ArcTutor\LinearReferencing\PITT.mdb\PITT\base\_roads” for the Input Feature Class.
4. Click the Route Identifier Field dropdown arrow and click ROUTE1. The values in the route identifier field uniquely identify each route.
5. Click Next.

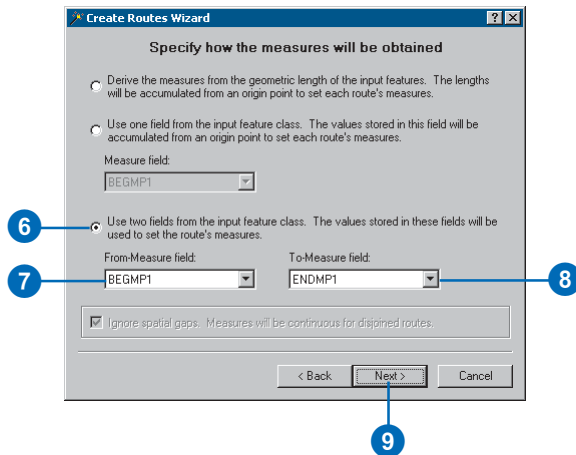


This panel asks you to specify how the route measures will be obtained. There are three choices:

- The geometric lengths of the input features are used to accumulate the measures.
- A value stored in a measure field is used to accumulate the measures.
- The values stored in from- and to-measure fields are used to set the measures.

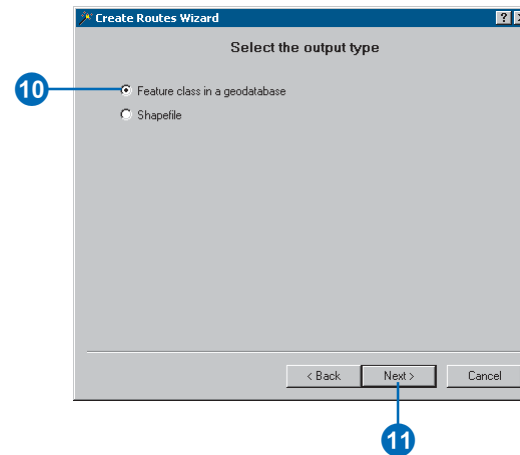
You will use the third method.

6. Click Use two fields from the input feature class.
7. Click the From-Measure field dropdown arrow and click BEGMP1.
8. Click the To-Measure field dropdown arrow and click ENDMP1.
9. Click Next.



The output routes can be written to a shapefile or a geodatabase feature class. You will be writing to a new feature class in the same feature dataset as the input feature class.

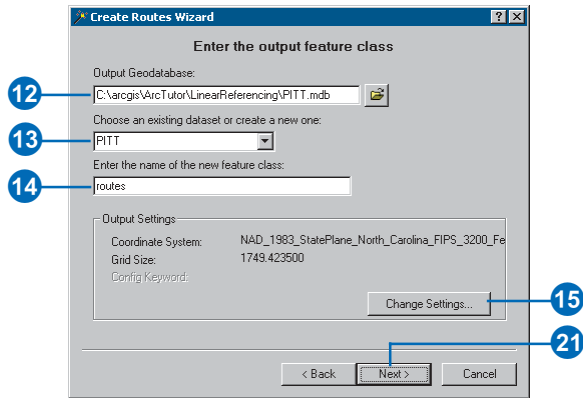
10. Click Feature class in a geodatabase.
11. Click Next.



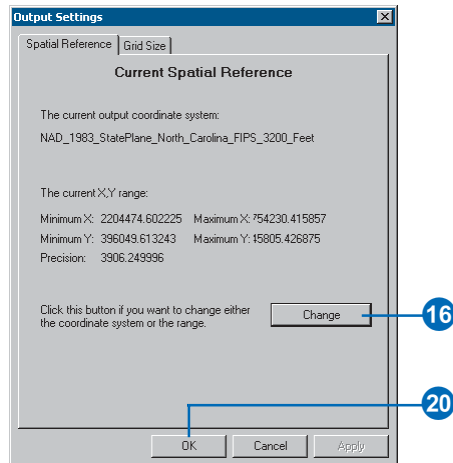
If your input features have a defined projection, the Create Routes Wizard will preserve this projection. You can choose to change the projection information for the output, in which case the features will automatically be projected. Note that you cannot change the projection if you are writing to an existing feature dataset.

Whenever writing routes to a geodatabase, you should always set the m domain. A default m domain will be calculated for you, but this might not accurately reflect your needs.

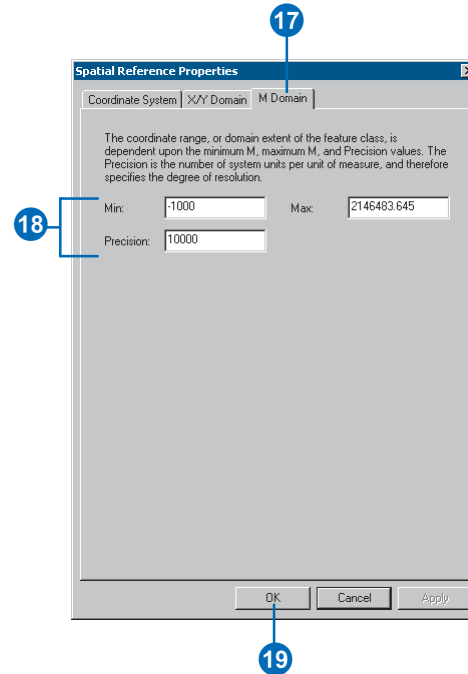
12. Type “C:\arcgis\ArcTutor\LinearReferencing\PITT.mdb” for the Output Geodatabase.
13. Click the dataset dropdown arrow and click the PITT dataset.
14. Type “routes” for the name of the new feature class.
15. Click Change Settings.



16. Click Change.



17. Click the M Domain tab.
18. Type “-1000” for the Min and “10000” for the Precision. These settings will ensure that your route measures will be accurate to four decimal places.

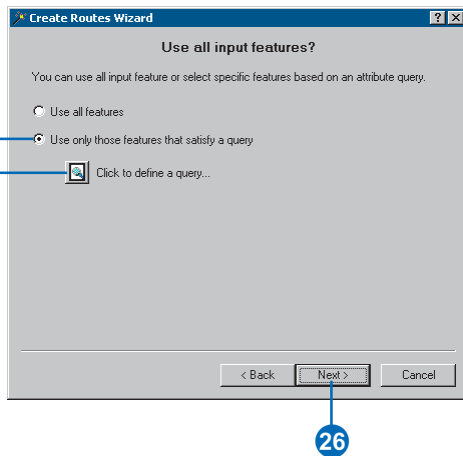


19. Click OK.
20. Click OK on the Output Settings dialog box.  
At this point, you will have returned to the Enter the output feature class panel.
21. Click Next on the Create Routes Wizard.

Not all features from the input feature class have route and measure information. These features represent roads that are not currently maintained by the highway authority and do not need to be included in the output route feature class. You will exclude these features from the route creation process by specifying a query.

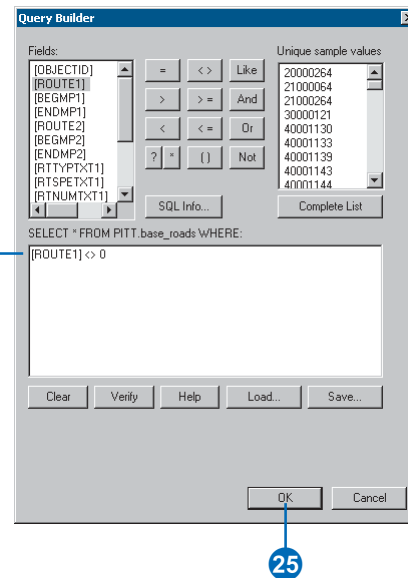
22. Click Use only those features that satisfy a query.

23. Click the Click to define a query button.



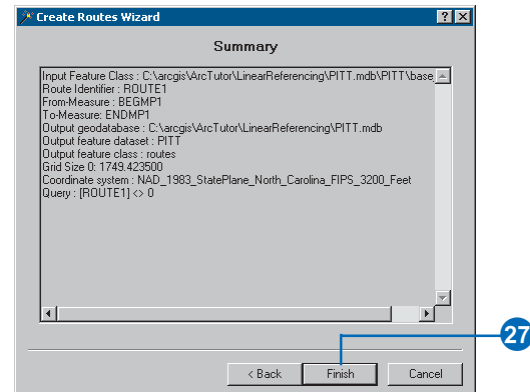
24. Type "[ROUTE1] <> 0" in the text box.

25. Click OK.



26. Click Next on the Create Routes Wizard.

27. Review your settings and click Finish.





## Calibrating route data

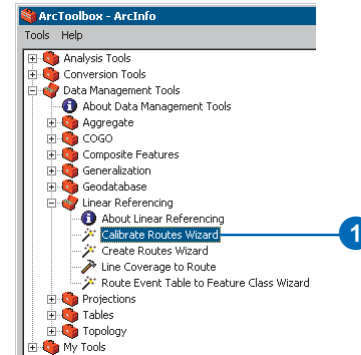
Imagine that at some point in the future, the highway authority's road maintenance crew acquired a distance measuring instrument (DMI) so that they could accurately record mileage information along the highways. For a sample set of highways, the crew went out and captured mileage information approximately every 1/10 of a mile. The results of this effort were stored as points in a shapefile, where the route and mileage information was stored as attributes.

In the next section of this tutorial, you will use the Calibrate Routes Wizard to adjust the measures of the routes you just created to match those of the points in the shapefile. The result will be written to a new feature class.

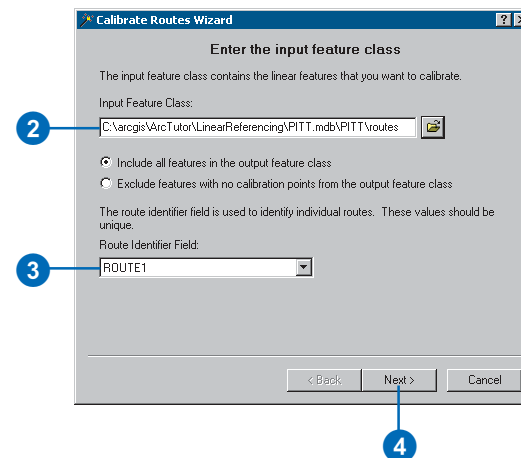
The Calibrate Routes Wizard is used to specify the input route feature class, the route identifier field, the input point feature class, the measure field, the methods used to set the route measures, and the output feature class. Note that the input route feature classes can be any supported format. This includes coverage, shapefile, personal and enterprise geodatabase, and CAD data.

Note that in addition to being able to adjust the measures of existing routes, the Calibrate Routes Wizard can also be used to create new routes by merging unmeasured input line features using a common route identifier and setting the measure information using the point attributes. To mimic the acquisition of more accurate data over time, however, the process was split into two separate tasks for this exercise.

1. Double-click the Calibrate Routes Wizard in ArcToolbox in the Linear Referencing toolset of Data Management Tools.



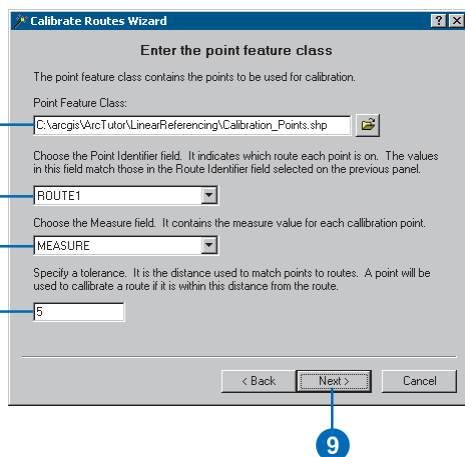
2. Type "C:\arcgis\ArcTutor\LinearReferencing\PITT.mdb\PITT\routes" for the Input Feature Class.
3. The values in the route identifier field uniquely identify each route. Click the Route Identifier Field dropdown arrow and click ROUTE1.
4. Click Next.



5. Type “C:\arcgis\ArcTutor\LinearReferencing\Calibration\_Points.shp” for the Point Feature Class.
6. Click the Point Identifier Field dropdown arrow and click ROUTE1.
7. Click the Measure dropdown arrow and click MEASURE.

A tolerance can be specified to limit how far a calibration point can be from its route. Points outside the tolerance will not be used by the calibration process. The tolerance is expressed in the same units as the route feature class’s coordinate system.

8. Type “5” for the tolerance. This is more than enough for the data that is being used here.
9. Click Next.

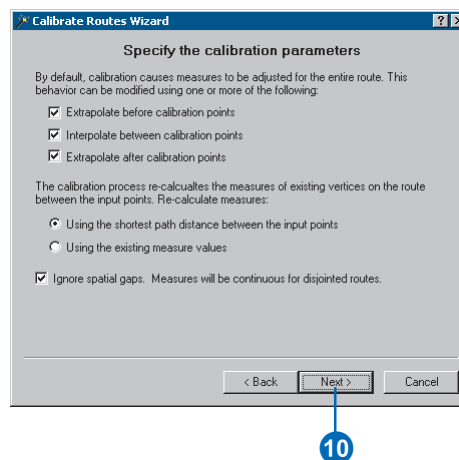


If your point features have a projection that differs from the route features, the Calibrate Routes Wizard will project the points to match the routes before the calibration process starts.

Either whole or partial routes can be calibrated. You can choose to interpolate between the input points, extrapolate before the input points, extrapolate after the input points, or use any combination of these three methods.

Note that the Extrapolate before calibration points, Interpolate between calibration points, and Extrapolate after calibration points check boxes are checked by default.

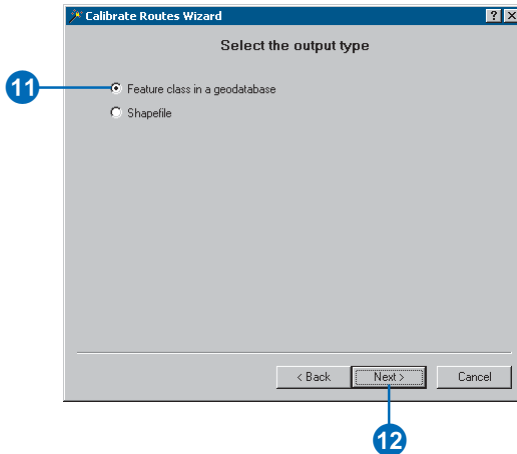
10. Click Next.



The output routes can be written to a shapefile or a geodatabase feature class. You will be writing a new feature class in the same feature dataset as the input routes.

11. Click Feature class in a geodatabase.

12. Click Next.

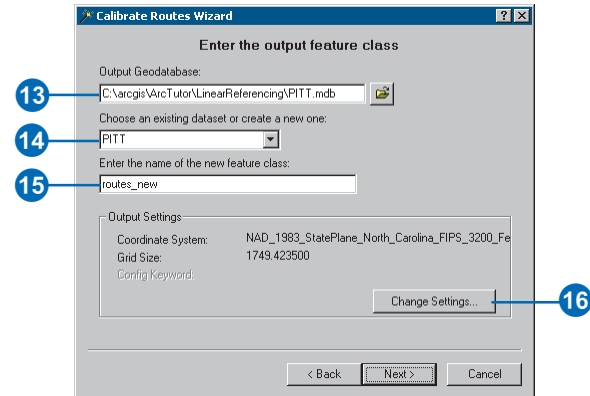


13. Type “C:\arcgis\ArcTutor\LinearReferencing\ PITT.mdb” for the Output Geodatabase.

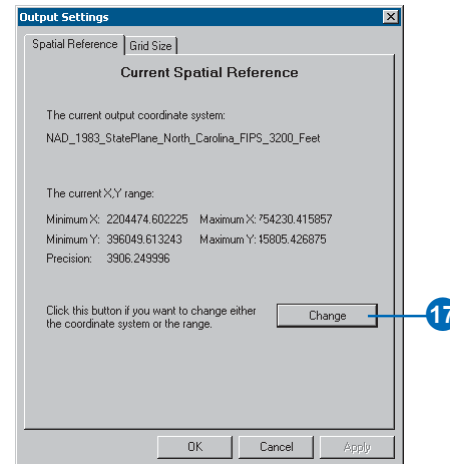
14. Click the dataset dropdown arrow and click the PITT dataset.

15. Type “routes\_new” for the name of the new feature class.

16. Click Change Settings.



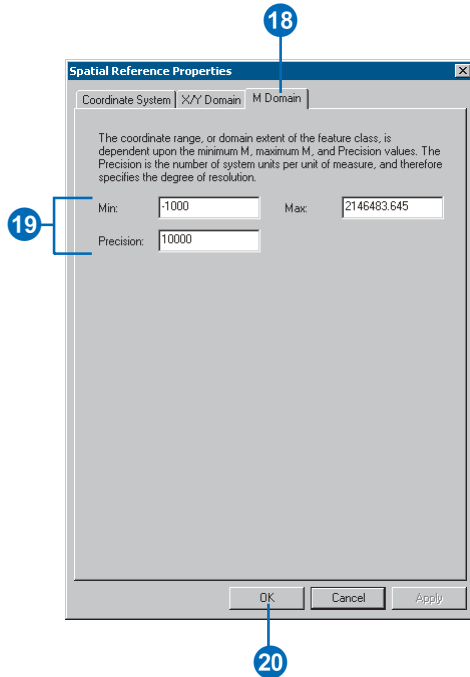
17. Click Change.



Note that whenever you create a feature class in a geodatabase, you should always check to make sure that the spatial domains are correct. In this tutorial, you will only check the m domain.

18. Click the M Domain tab.

19. Type “-1000” for the Min and “10000” for the Precision.  
These settings will ensure that your route measures will be accurate to four decimal places.



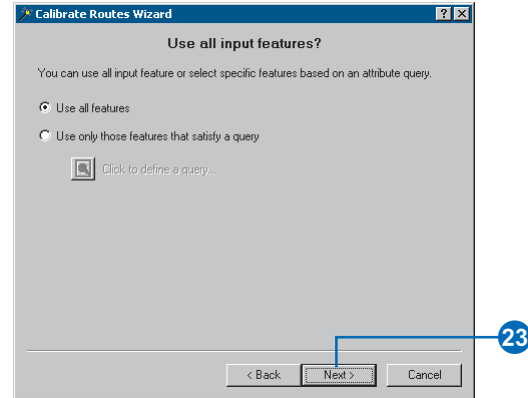
20. Click OK.

21. Click OK.

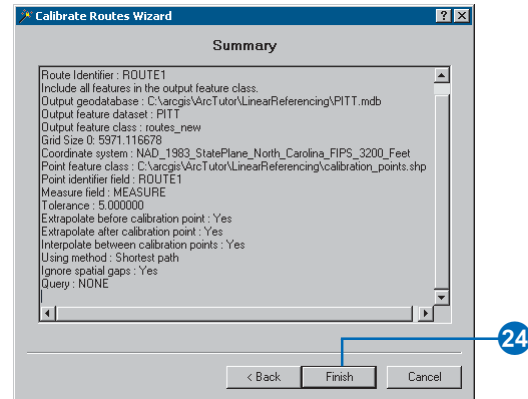
At this point, you will have returned to the Enter the output feature class panel.

22. Click Next.

23. Click Next.



24. Review your settings and click Finish.



In this exercise, you learned how to create a route feature class by merging input line features that shared a common identifier and how to adjust the route measures using measure information stored in a point shapefile. For more information on creating and calibrating route data, see Chapter 4, ‘Creating route data’.

## Exercise 3: Displaying and querying routes

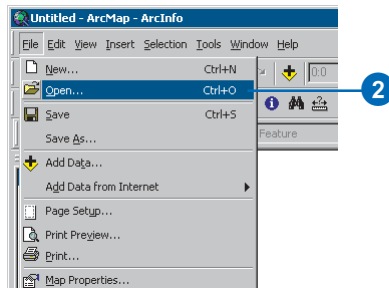
In this exercise, you will add the route data you created in Exercise 2 to an existing map document and symbolize it. You will then

- Set the route identifier field.
- Add the Identify Route Locations tool to a toolbar.
- Identify route locations.
- Find route locations.
- Display route measure anomalies.

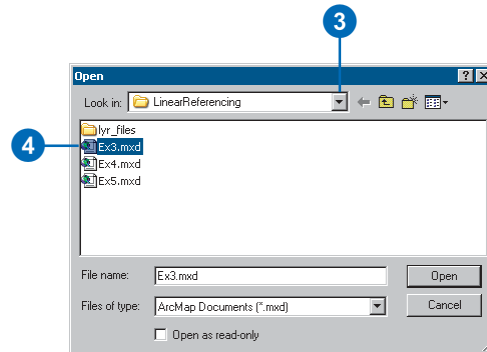
### Opening an existing map document

Before you can complete this exercise, you must start ArcMap.

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



3. Click the Look in dropdown arrow in the Open dialog box and navigate to the folder where you installed the data for this tutorial.
4. Double-click Ex3.mxd. ArcMap opens the map.



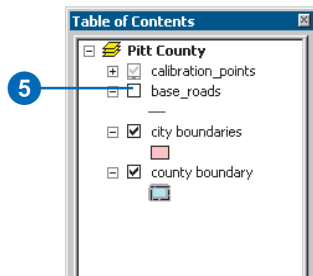
This map contains the following layers in a data frame called Pitt County:

calibration_points	The points used in Exercise 2 to recalibrate the route measures
base_roads	All of the roads in Pitt County
city boundaries	The boundaries of the cities in Pitt County
county boundary	Pitt County boundary



The map currently displays the city boundaries and county boundary layers. Their check boxes are checked in the table of contents. The calibration\_points layer is checked, but scale suppression has been set. It will only be visible when you zoom in to a scale beyond 1:25,000.

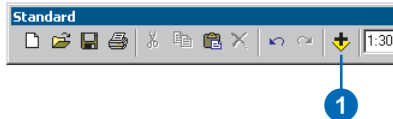
- Click the check box for the base\_roads layer in the table of contents.



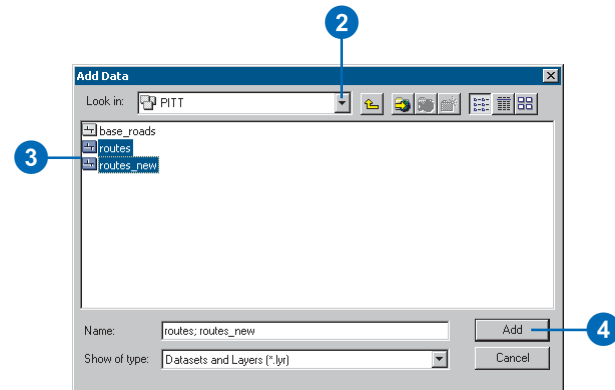
You will now see all of the roads in Pitt County. This includes roads not maintained by the highway authority. The roads maintained by the highway authority were written to the routes feature class.

## Adding route data to your map

- Click the Add Data button on the ArcMap Standard toolbar.



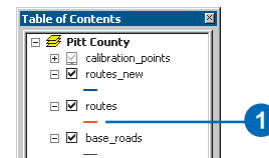
- Click the Look in dropdown arrow and navigate to where you installed tutorial data. Double-click Pitt.mdb and double-click the Pitt feature dataset.
- With the Ctrl key pressed down, select both the routes and routes\_new feature classes.
- Click Add. You will see two new layers in the table of contents.



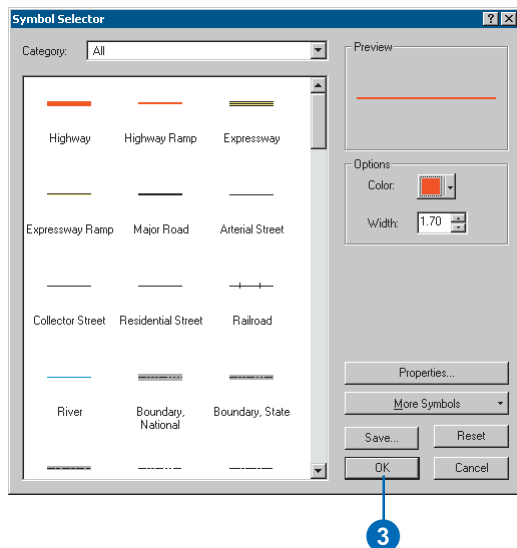
## Changing the display symbol

The colors and symbols ArcMap chose to display for the routes layer might make it difficult to see where the route features are located. It is easy to change the colors and symbols used to display features in ArcMap.

- Click the line symbol in the table of contents for the routes layer to display the Symbol Selector dialog box.



2. Scroll down until you find a symbol you like and click it.
3. Click OK. Your routes layer will be displayed with the symbol you chose.



4. Repeat steps 1 through 3 for the routes\_new layer.

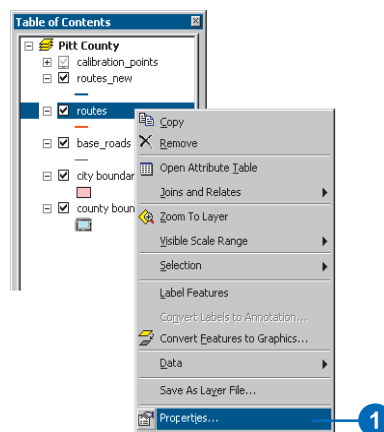
You can also open the Symbol Selector dialog box by right-clicking the layer in the table of contents, clicking Properties, and clicking the Symbology tab. To simply change the color of a symbol, right-click the symbol in the table of contents to display the color palette. For more information on changing display symbols, see *Using ArcMap*.

## Setting the Route Identifier field

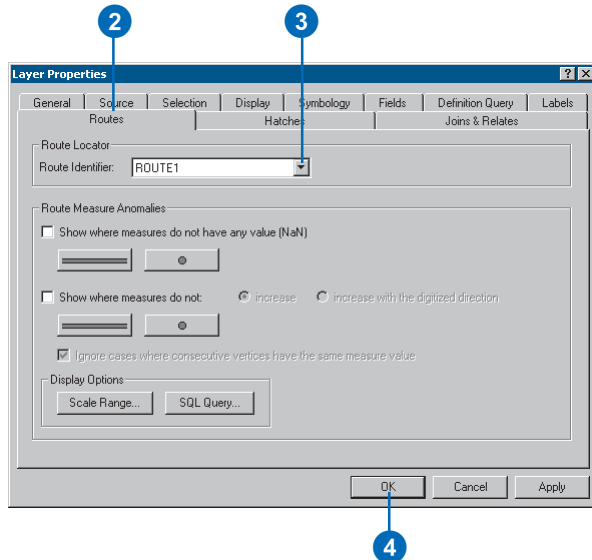
ArcMap knows whenever route data has been added to a map and exposes some additional layer properties. One of these properties is the Route Identifier field. This field uniquely identifies each route.

Setting the Route Identifier field is not required. Doing so, however, reduces the number of steps required to use many of the ArcMap Linear Referencing dialog boxes, wizards, and tools.

1. Right-click the routes layer in the table of contents and click Properties.



- Click the Routes tab.
- Click the Route Identifier dropdown arrow and click ROUTE1.
- Click OK.



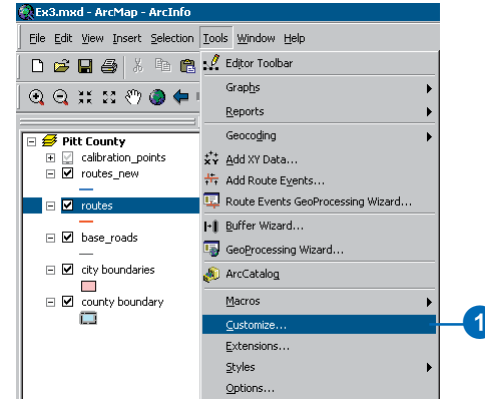
- Repeat steps 1 through 4 for the routes\_new layer.

## Adding the Identify Route Locations tool

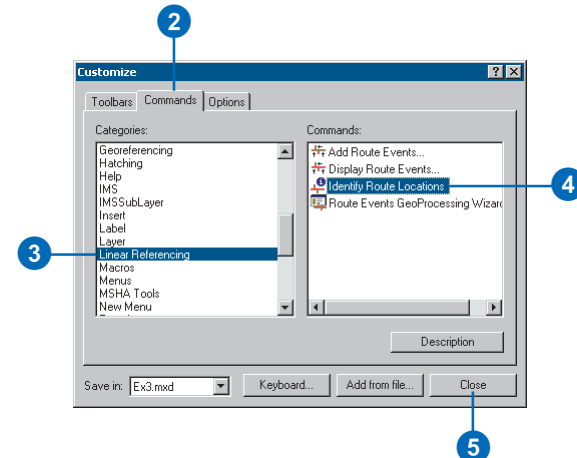
ArcMap gives you the ability to point to a route in a map and find the route identifier and measure value at that location. In this part of the exercise, you will use the Identify Route Locations tool to inspect the measures on the routes you created in Exercise 2.

The Identify Route Locations tool does not appear on any toolbar by default. You will have to add it to one.

- Click Customize from the ArcMap Tools menu.



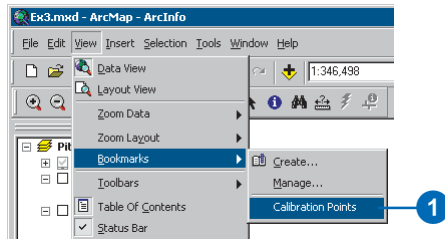
- Click the Commands tab.
- Click Linear Referencing in the Categories list.
- Drag the Identify Route Locations tool to the toolbar of your choice (e.g., the Tools toolbar).
- Click Close.



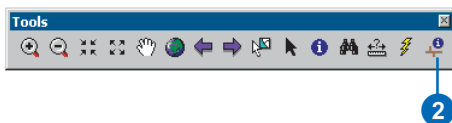
## Identifying route locations

In ArcMap, a bookmark is a saved map location. A bookmark containing some of the calibration points used in Exercise 2 to recalibrate the routes has been created for you.

1. Point to Bookmarks from the ArcMap View menu and click Calibration Points.

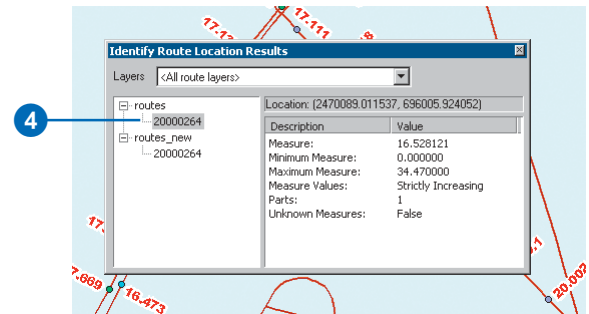


When ArcMap moves to the saved location, the calibration points appear with labels that represent the measure values for each point. The reason they appear when the bookmark has been used is because scale suppression was set on the layer. For more information on scale suppression, see *Using ArcMap*.



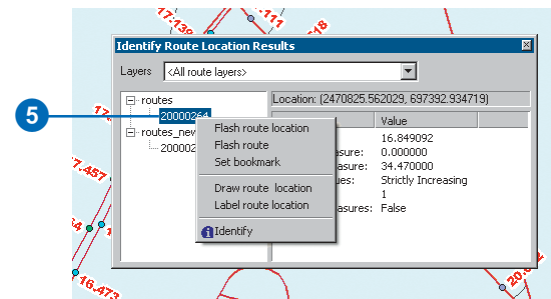
2. Click the Identify Route Locations button.
3. Move the mouse pointer over one of the calibration points and click. Route locations from both the routes and routes\_new layers will be identified.

4. Click the route node for each of the route layers.

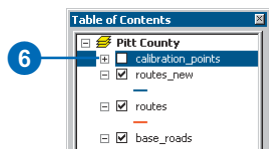


The numeric value listed for each of these nodes corresponds to the value stored in the Route Identifier field, which you set in a previous section of this exercise. Note that the measure value for the two routes differs. Note further that the measure value for the routes\_new layer corresponds closely to the measure value of the calibration point you clicked (the closer you are to a calibration point, the closer the measure will be).

5. Right-click the route node for one of the layers and explore the context choices available to you.



- Uncheck the check box for the calibration\_points layer in the table of contents to make it not visible. It will not be used any further in this exercise.

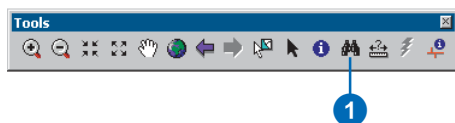


- Close the Identify Route Location Results window.

## Finding route locations

In many linear referencing applications, you will discover that you will often need to find a location along a route. For example, you may need to find where an accident occurred along a highway. On a paper map, it is hard to find a route location. This is because route measures are typically not shown. In ArcMap, finding a route location is made easy.

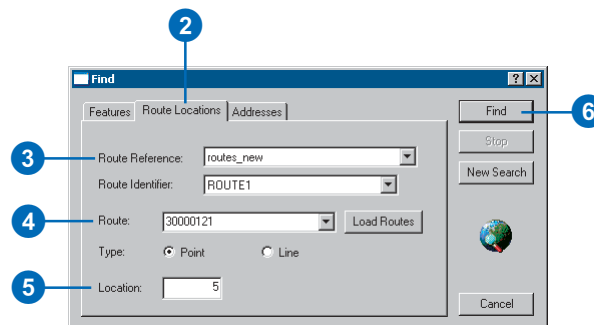
- Click the Find button on the ArcMap Tools toolbar.



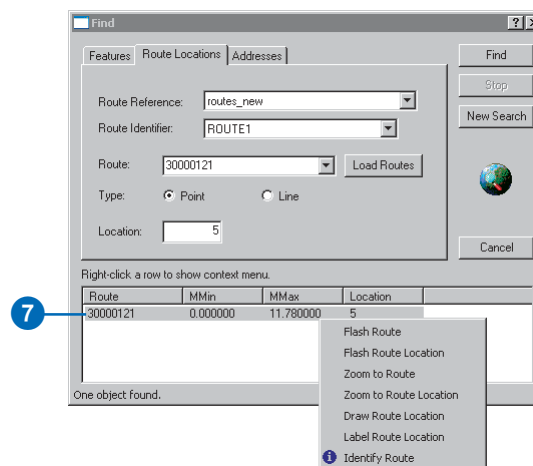
- Click the Route Locations tab.
- Click the Route Reference dropdown arrow and click routes\_new.

Notice that the field listed in the Route Identifier dropdown arrow corresponds to the Route Identifier field you set previously in this exercise.

- Type “30000121” in the Route text box.
- Type “5” in the Location text box.
- Click Find.



- Right-click the route location that was found and explore the context choices available to you.



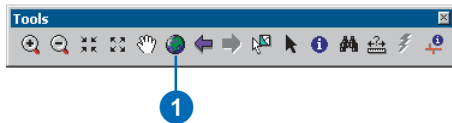
- Close the Find dialog box.



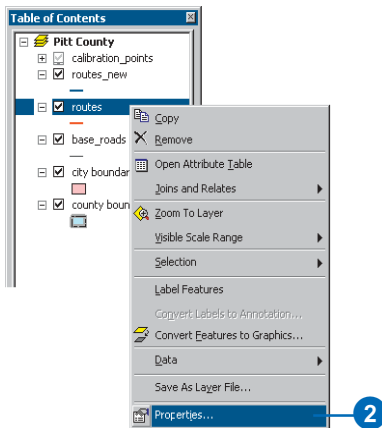
## Displaying route measure anomalies

In most linear referencing applications, route measure values are expected to follow a set of rules. For example, you might expect that route measures always increase over the course of a route. ArcMap has the ability to show you where route measures do not adhere to the behavior you expect. These are known as *route measure anomalies*.

1. Click the Full Extent button on the ArcMap Tools toolbar.

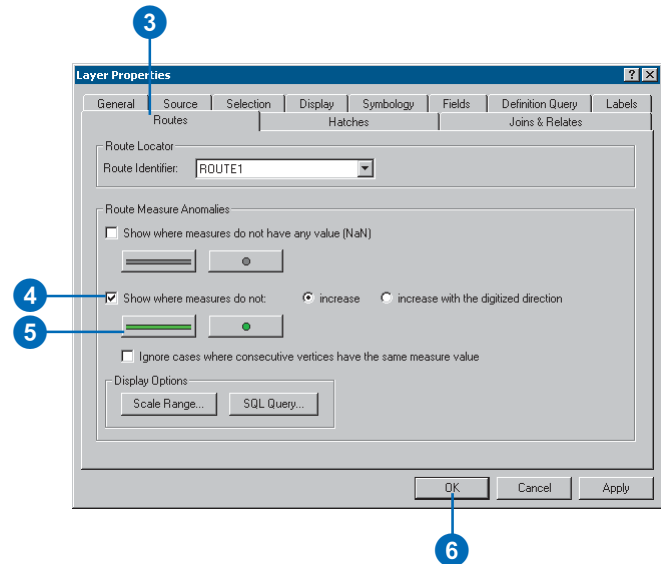


2. Right-click the routes layer in the table of contents and click Properties.



3. Click the Routes tab.
4. Check Show where measures do not increase.

5. Click the Line Symbol button and select a line symbol you like. Do the same for the marker symbol.
6. Click OK.



Remember that the routes feature class was created from the base\_roads feature class in Exercise 2. There are a few digitizing errors and a few attribute errors that caused the measure anomalies to exist in the routes feature class. Route measure anomalies can be fixed with ArcMap route editing tools. For more information on route editing tools, see Chapter 6, 'Editing routes'.

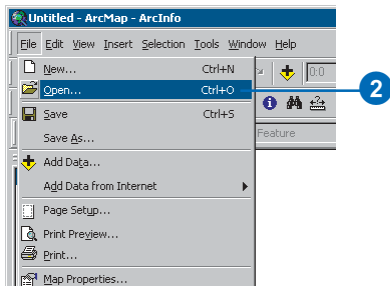
## Exercise 4: Displaying and querying route events

In this exercise, you will create a new event table that represents where injury accidents occurred along sections of poor-quality pavement. To do this, you will first use the Add Route Events dialog box to display the accident location and pavement quality event data on your map. You will then use the Select By Attributes dialog box to select the injury accidents and poor-quality pavement locations. Finally, you will use the Route Events GeoProcessing Wizard to create a new event table whose records represent where injury accidents occurred along poor-quality pavement.

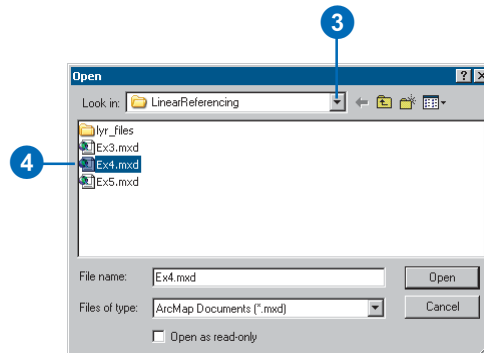
### Opening an existing map document

Before you can complete this exercise, you must start ArcMap.

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



3. Click the Look in dropdown arrow in the Open dialog box and navigate to the folder where you installed the data for this tutorial.
4. Double-click Ex4.mxd. ArcMap opens the map.



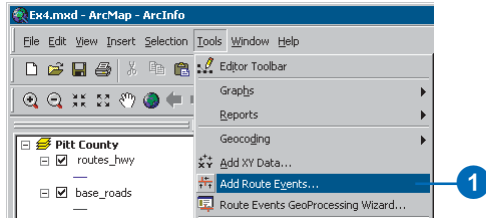
This map contains the following layers in a data frame called Pitt County:

routes_hwy	Shapefile copy of routes_new feature class you created in Exercise 2
county boundary	Pitt County boundary
accident	Point event table storing accident information
pavement	Line event table storing pavement information
base_roads	All of the roads in Pitt County

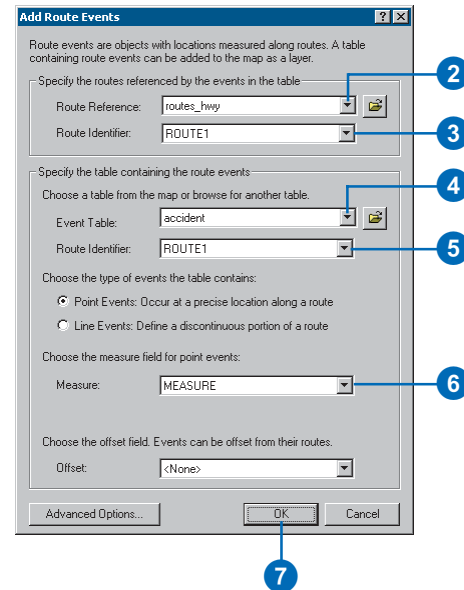
## Displaying point events on your map

The accident table is a point event table. Point events occur at a precise point location along a route. In this section of the exercise, you will display the accident event data as a layer.

1. Click Add Route Events from the ArcMap Tools menu.



2. Click the Route Reference dropdown arrow and click routes\_hwy.
3. Click the Route Identifier dropdown arrow and click ROUTE1.
4. Click the Event Table dropdown arrow and click accident.
5. Click the Route Identifier dropdown arrow and click ROUTE1.
6. Click the Measure dropdown arrow and click MEASURE.



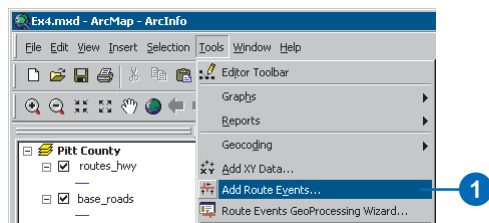
7. Click OK.

A new layer—accident Events—has been added to your map.

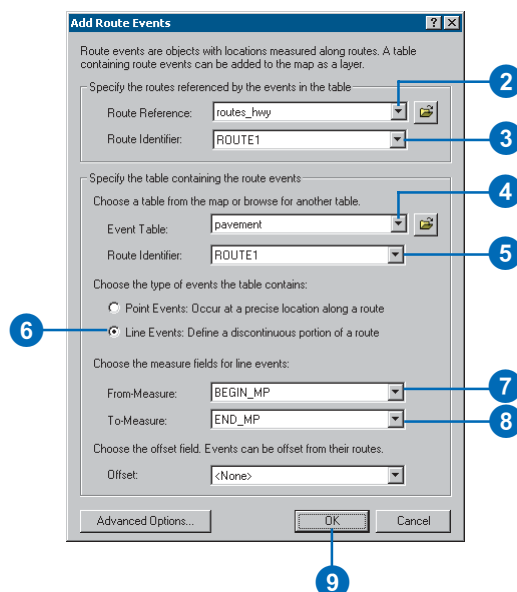
## Displaying line events on your map

The pavement table is a line event table. Line events differ from point events in that they have two measure fields that define a portion of a route. The procedure for adding line events to your map is almost the same as adding point events.

1. Click Add Route Events from the ArcMap Tools menu.



2. Click the Route Reference dropdown arrow and click routes\_hwy.
3. Click the Route Identifier dropdown arrow and click ROUTE1.
4. Click the Event Table dropdown arrow and click pavement.
5. Click the Route Identifier dropdown arrow and click ROUTE1.
6. Click Line Events.
7. Click the From-Measure dropdown arrow and click BEGIN\_MP.
8. Click the To-Measure dropdown arrow and click END\_MP.
9. Click OK.

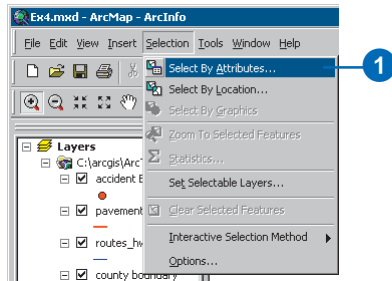


A new layer—pavement Events—has been added to your map.

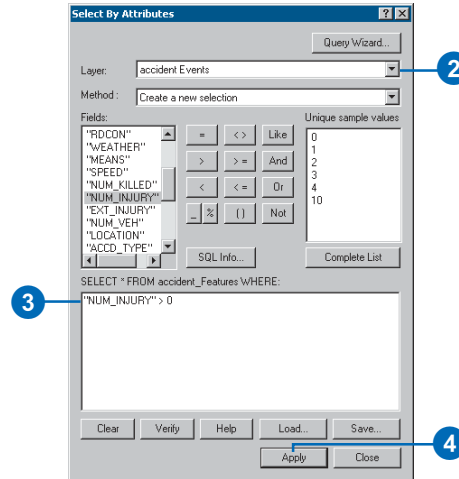
## Querying events

Layers based on an event table can be queried in many ways. They can be identified by clicking them, they can be selected by dragging a box or clicking them on the map, they can be selected by clicking them in an attribute table, and they can be selected using a Structured Query Language (SQL) expression. You will use the Select By Attributes dialog box to input SQL expressions to select the event records needed for this exercise. Specifically, you will select injury accidents and poor quality pavement.

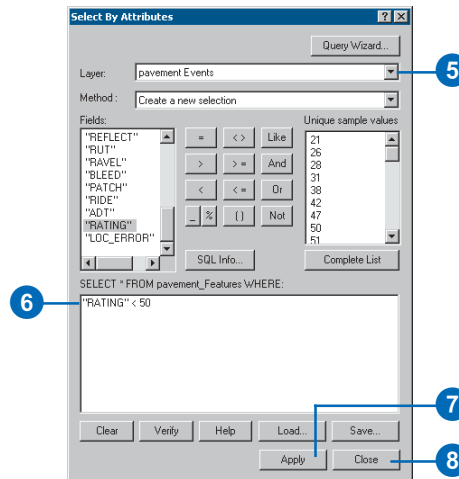
1. Click Select By Attributes from the ArcMap Selection menu.



2. Click the Layer dropdown arrow and click accident Events.
3. Type the following in the text box:  
"NUM\_INJURY" > 0
4. Click Apply.
5. Click the Layer dropdown arrow and click pavement Events.



6. Type the following in the text box: "RATING" < 50
7. Click Apply.
8. Click Close.

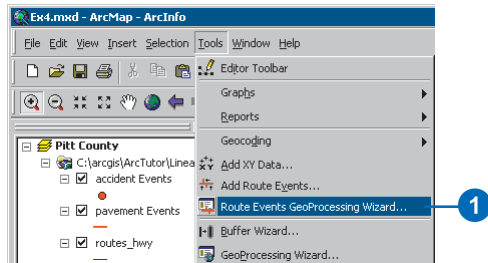




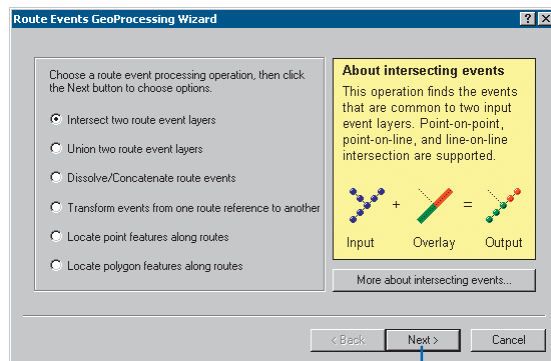
There are many events selected on your map. In the next section of this exercise, you will use the Route Events GeoProcessing Wizard to intersect the two event layers. The result will be a table that contains the injury accidents that happened on poor-quality pavement. All attributes from both inputs are maintained.

## Intersecting event layers

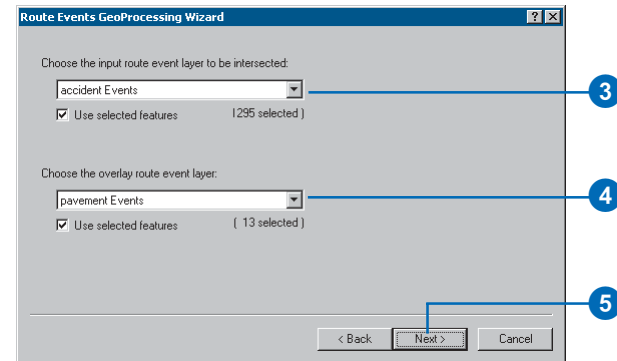
1. Click Route Events GeoProcessing Wizard from the ArcMap Tools menu.



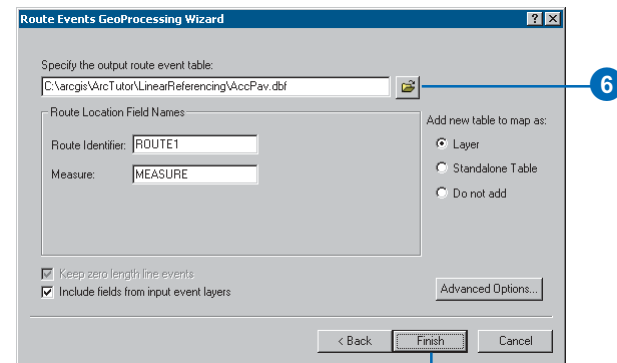
2. Intersect two route event layers is the default. Click Next.



3. Click the input route event layer dropdown arrow and click accident Events.
4. Click the overlay route event layer dropdown arrow and click pavement Events.
5. Click Next.

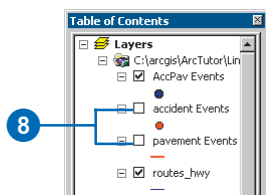


6. Type “C:\arcgis\ArcTutor\LinearReferencing\AccPav.dbf” for the output route event table.
7. Click Finish.



A new layer—AccPav Events—will be added to your map. It will be hard to see, however, because the accident and pavement event layers are still visible.

8. Turn off the accident and pavement layers by clicking their check boxes in the table of contents.



You will now see only the injury events that occurred along poor quality pavement. Each of these new events has all of the attributes from both the accident and pavement tables.

For more information on the display and query of events or the spatial analysis of events, see Chapter 5, 'Displaying and querying routes and events', and Chapter 7, 'Creating and editing event data'.

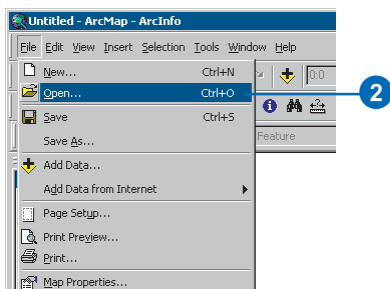
## Exercise 5: Editing routes

There are a number of tools in ArcMap that make the interactive creation and editing of route measures easy. In this exercise, you will create a new route from a selected set of linear features and set its identifier. You will then convert the measures of this newly created route from feet to miles. Lastly, you will recalibrate the route using known measure values at specific locations on your map.

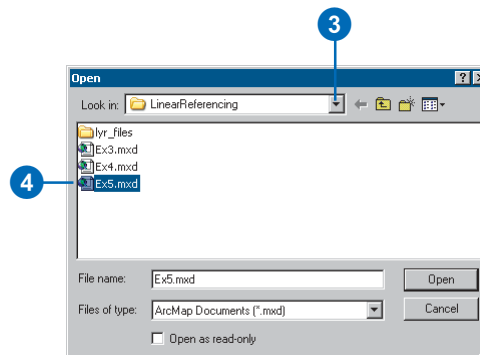
### Opening an existing map document

Before you can complete this exercise, you must start ArcMap.

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



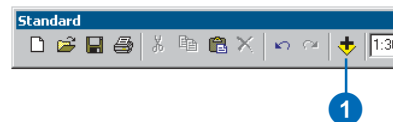
3. Click the Look in dropdown arrow in the Open dialog box and navigate to the folder where you installed the data for this tutorial.
4. Double-click Ex5.mxd. ArcMap opens the map.



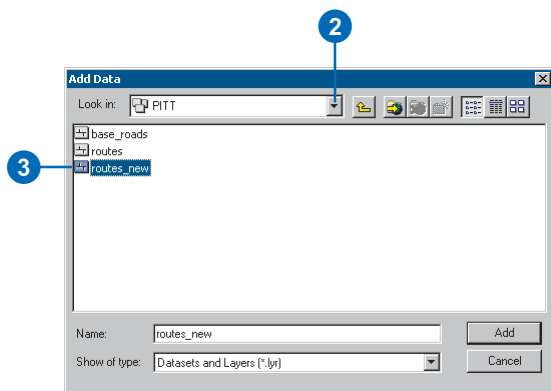
### Adding route data to your map

You will use one of the route feature classes you created in Exercise 2 to complete this exercise.

1. Click the Add Data button on the ArcMap Standard toolbar.



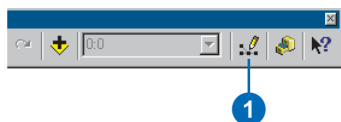
- Click the Look in dropdown arrow, navigate to where you installed tutorial data, double-click Pitt.mdb, and double-click the Pitt feature dataset.
- Double-click the routes\_new feature class. You will see a new layer in the table of contents.



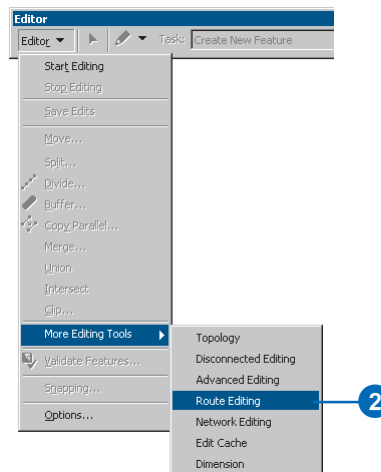
## Adding the toolbars, editing, and setting the target feature class

The toolbars necessary to complete this exercise might not be visible.

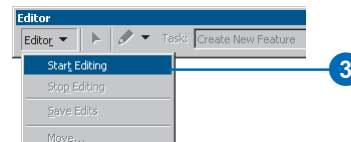
- Click the Editor Toolbar button on the ArcMap Standard toolbar to add the Editor toolbar to ArcMap.



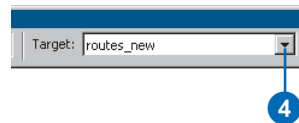
- Click the Editor menu, point to More Editing Tools, and click Route Editing.



- Click the Editor menu and click Start Editing.



- Click the Target dropdown arrow and click routes\_new.

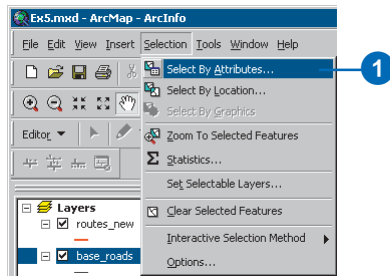


## Making a route from selected features

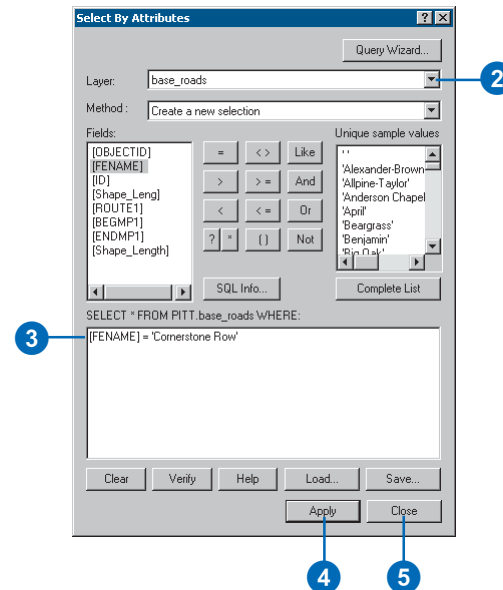
The highway authority has been informed that it will now be responsible for maintaining a road that it previously had not been maintaining. It is necessary, therefore, to select the appropriate features from the base\_roads feature class and make a route in the routes\_new feature class out of them.

The Make Route command creates a new route in the target feature class by merging a selected set of line features and setting the measure values. The selected line features do not need to be from the target feature class.

1. Click Select By Attributes from the ArcMap Selection menu.

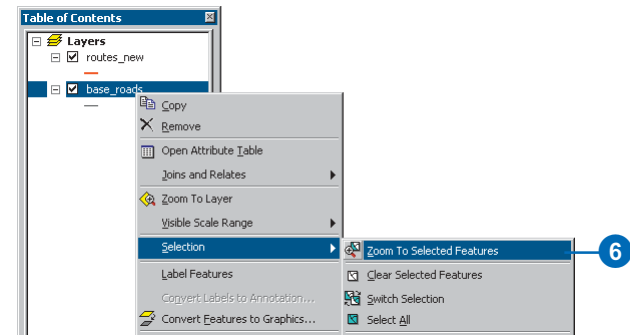


2. Click the Layer dropdown arrow and click base\_roads.
3. Type the following in the text box:  
[FENAME] = 'Cornerstone Row'
4. Click Apply.
5. Click Close.

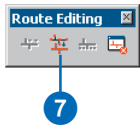


Nine features from the base\_roads feature class are now selected.

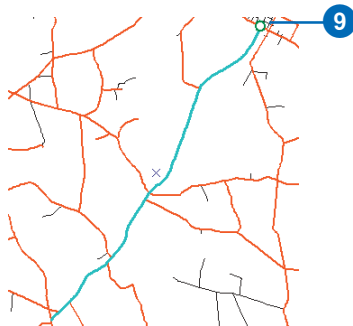
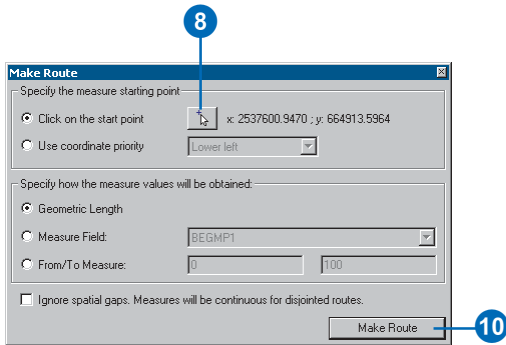
6. Right-click the base\_roads layer in the table of contents, point to Selection, and click Zoom To Selected Features.



- Click the Make Route button on the Route Editing toolbar.



- Click the Start Point button.
- Click the mouse pointer on the map near the upper-right corner of the selected set of features. This is where the output route's measures will begin.
- Click Make Route.

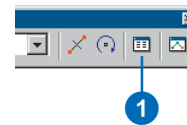


The new route will flash when it is being created. During the route creation process, the selected lines will be unselected, and the new route will be selected. This is so you can set the new route's attributes.

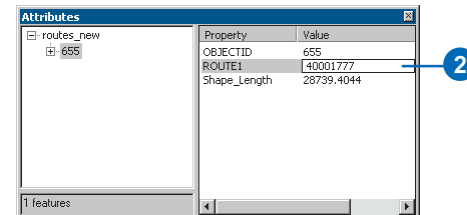
## Setting the Route Identifier

Because the newly created route is selected, you can now set the route identifier. The route identifier uniquely identifies each route.

- Click the Attributes button on the Editor toolbar.



- Click the ROUTE1 value and type "40001777".

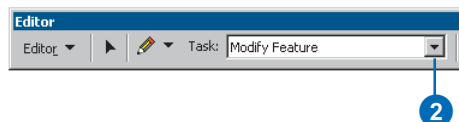


- Press Enter.
- Close the Attributes dialog box.

## Converting route measure units

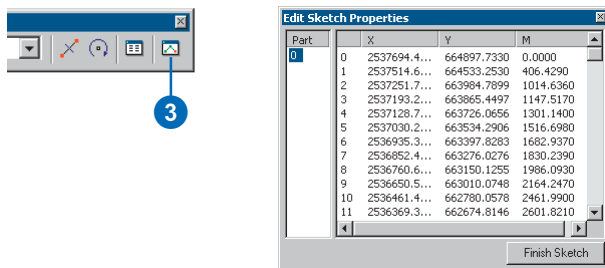
When you created the new route, you accepted the default method for setting the route measures. This method accumulates the geometric length of the input line features and uses the length as the measure. Because the coordinate system of the feature class is State Plane Feet, this means that the measures on the new route are feet. However, the measures on all other routes in the feature class are miles.

1. The newly created route should still be selected. If it is not, select it.
2. Click the Task dropdown arrow and click Modify Feature.



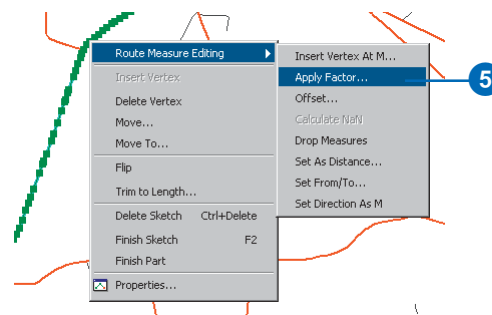
The selected feature will now be loaded into the edit sketch.

3. Click the Sketch Properties button. Note the measure values.



4. Close the Edit Sketch Properties dialog box.

5. Right-click anywhere over the edit sketch, point to Route Measure Editing, and click Apply Factor.



6. Type "0.00018939" in the Factor text box and press Enter. This converts feet to miles.



At this point, you have only made changes to the edit sketch, not the route feature.

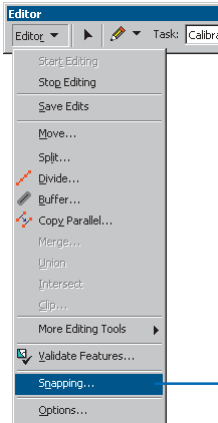
7. Press F2 to finish the edit sketch. Alternately, right-click anywhere over the edit sketch and click Finish Sketch.

Your route measures are now in miles. You can verify this by double-clicking the selected route to bring it into the edit sketch, right-clicking anywhere over the sketch, and clicking Properties. Note that this is an alternate way to perform Steps 2 and 3.

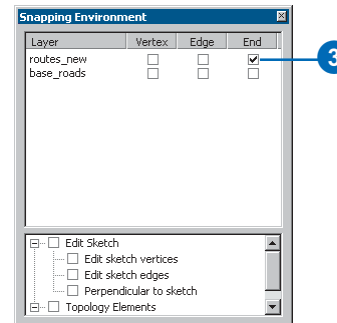
## Recalibrating a route

So far in this exercise, you have created a route and transformed its measures from feet to miles. Imagine that at some point the maintenance crew went out into the field and recorded the actual mileage for this new route. The mileage was captured every time the new route intersected with another route from the same feature class. In this section of the exercise, you will recalibrate the newly created route based on this mileage information.

1. The newly created route should still be selected. If it is not, select it.
2. Click the Editor menu and click Snapping.



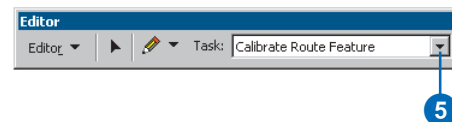
3. Check the End check box next to the routes\_new layer.



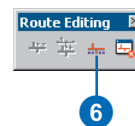
4. Close the Snapping Environment dialog box. It will not be used again in this exercise.

With the snapping environment set, you will be able to create calibration points that are snapped to the end vertex of the features in the routes\_new layer, thereby ensuring accuracy of the route measures at the calibration points. Setting the snap environment, however, is not necessary for the Calibrate Route command to work.

5. Click the Task dropdown arrow and click Calibrate Route Feature.



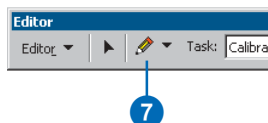
6. Click the Calibrate Route button on the Route Editing toolbar.



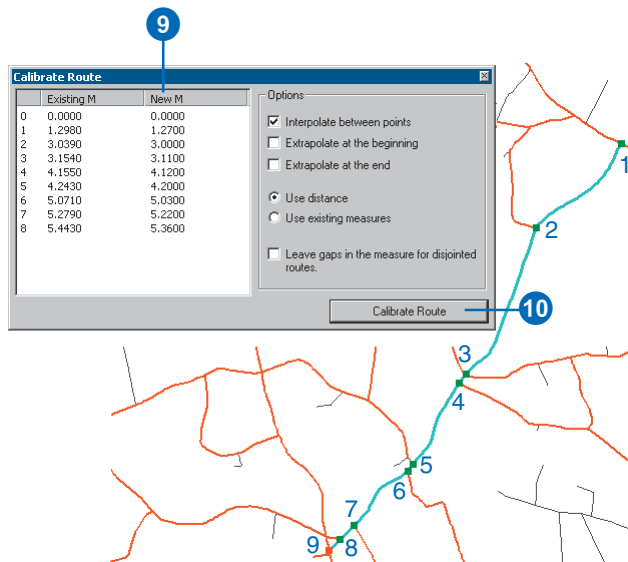


The Calibrate Route dialog box is now on the screen, but it is empty. Your next task is to digitize the calibration points.

7. With the Calibrate Route dialog box open, click the Sketch tool on the Editor toolbar.



8. Click along the route at nine different places to create the calibration points. The locations of the calibration points are indicated in the graphic below.
9. Type the New M value (see values in graphic below) for each calibration point.

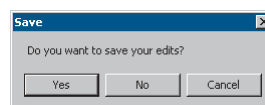


10. Click Calibrate Route.

## Saving your edits

Once you have completed the steps in this exercise, 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 your edits or No to discard your edits.



In this exercise, you first learned how to create a route from a selected set of line features. Next, you converted the route measures from feet to miles. Lastly, you learned how to recalibrate a route using calibration points you digitized on the map.

For more details about the route editing tools outlined here or for information on tools not discussed in this chapter, see Chapter 6, 'Editing routes'.