

ArcGIS® 9

Building Geodatabases Tutorial



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Building Geodatabases Tutorial

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It is easy to create a *geodatabase* and add *behavior* to it, and it requires no programming when you use the data management tools in ArcCatalog—the application for browsing, storing, organizing, and distributing data. When querying and editing the geodatabase in ArcMap—the application for editing, analyzing, and creating maps from your data—you can easily take advantage of the data and behavior in your geodatabase without any customization.

This tutorial lets you explore the capabilities of the geodatabase using an ArcEditor or ArcInfo licensed seat of ArcCatalog and ArcMap. You can complete this tutorial at your own pace without the need for additional assistance. This tutorial includes nine exercises. Each exercise takes between 10 and 20 minutes to complete.

In the first eight exercises of this tutorial, you will use ArcCatalog to create a geodatabase that models a water utility network. You will add behavior to the geodatabase by creating *subtypes*, *validation rules*, *relationships*, and a *geometric network*. You can use ArcMap to take advantage of the behavior by editing some of the existing *features* in the geodatabase and adding some additional features.

The study area for the first eight exercises is a portion of a hypothetical city. A geodatabase that contains most of the data, a *coverage* representing water laterals, and an INFO™ table representing parcel owner data are provided with the software. You will import the coverage and INFO table into the geodatabase, then modify its properties to give it behavior.

In the last exercise, you will take coverages and import selected feature classes into a new geodatabase. The study area for the last exercise is a portion of a drainage basin in Utah.

The datasets for the first eight exercises were created by ESRI using a database schema similar to that of the city of Montgomery, Alabama. The data is wholly fictitious and has nothing to do with the actual city of Montgomery. This information may be updated, corrected, or otherwise modified without notification.

The data for the last exercise on loading coverage data into a geodatabase topology is from the National Hydrography Dataset, published by the USGS in cooperation with the EPA, Utah AGRC, and REDCON. The watershed coverage, basin_utm, was fabricated for this exercise. This information may be updated, corrected, or otherwise modified without notification.

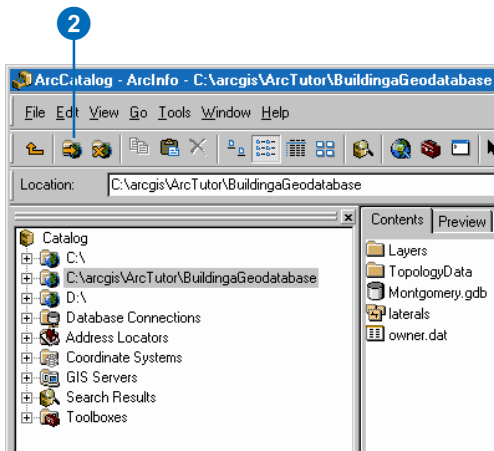
Exercise 1: Organizing your data in ArcCatalog

Before you begin the tutorial, you must find and organize the data that you will need. This can be done using ArcCatalog.

Connecting to data

In ArcCatalog, data is accessed through folder connections. When you look in a folder connection, you can quickly see the folders and data sources it contains. You will now begin organizing your data by creating a folder connection to it.

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 and navigate to the BuildingaGeodatabase folder on the local drive where you installed the tutorial data. The default installation path is C:\arcgis\ArcTutor\BuildingaGeodatabase. Click OK to establish a folder connection.



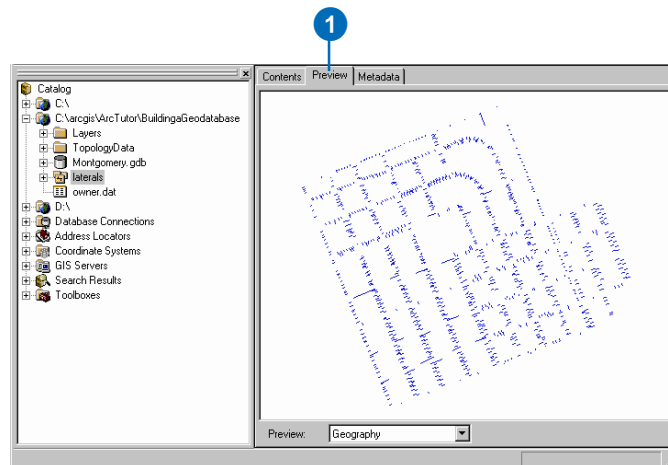
Your new folder connection—

C:\arcgis\ArcTutor\BuildingaGeodatabase—is now listed in the Catalog tree. You will now be able to access all the data needed for the tutorial through that connection.

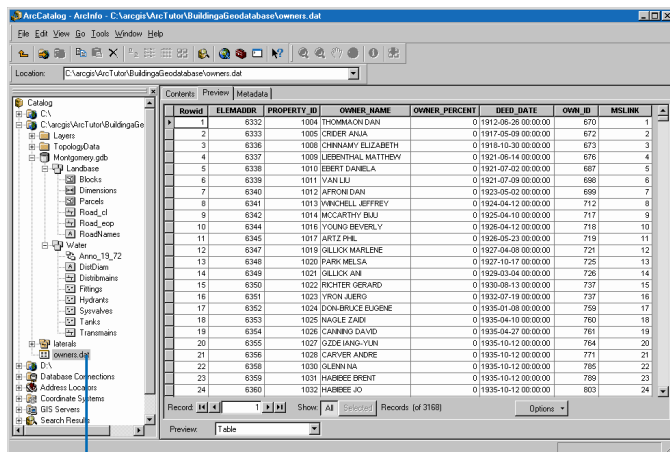
Exploring your data

Before you begin modifying the geodatabase, explore the datasets provided for the tutorial.

1. Click the plus sign next to the C:\arcgis\ArcTutor\BuildingaGeodatabase folder connection to see the datasets contained in the folder. Click the Preview tab and click the laterals coverage to see its geometry.



- Click the plus sign next to the Montgomery geodatabase and double-click each *feature dataset* to see the *feature classes* and *relationship classes* it contains. Click each feature class to preview its geometry.
- Click the owners.dat INFO *table*. Notice how the Preview type automatically changes to Table and displays the table's records. This table contains the owner information for the Parcels feature class in the Montgomery geodatabase. In the next part of this exercise, you will import this table into the geodatabase and create relationships between the parcels and their owners.



You will perform most of the tasks for modifying the Montgomery geodatabase schema with ArcCatalog. Later, you will use ArcMap to create *annotation* and edit the geodatabase.

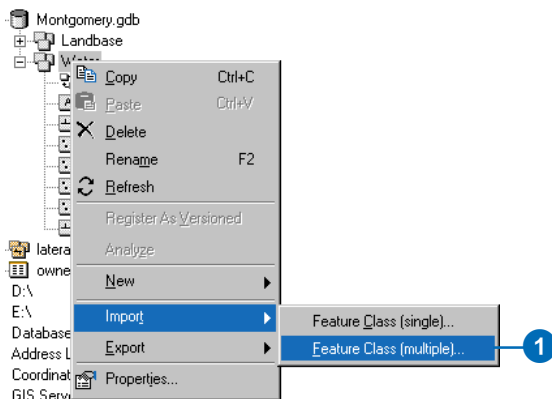
Now that you have found and organized your data in ArcCatalog, you are ready to start the first task in the tutorial—importing data into the geodatabase.

Exercise 2: Importing data into your geodatabase

Before you can start adding behavior to your data, you must get it into a geodatabase. You will import two datasets into the Montgomery geodatabase—laterals and owner.dat. The laterals coverage contains water laterals for the Montgomery water dataset, and the owner.dat INFO table contains owner information for the parcel features already in the geodatabase.

Importing the coverage

1. In ArcCatalog, right-click the Water feature dataset in the Montgomery geodatabase, point to Import, and click Feature Class (multiple).

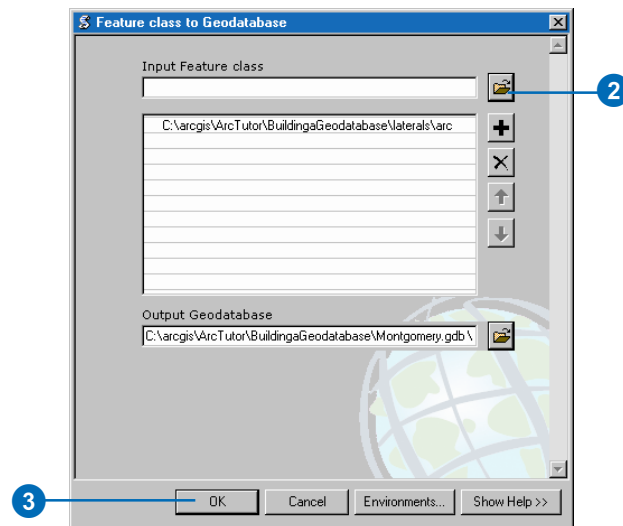


You will use the Import Feature Class tool to import the arcs in the laterals coverage into the Water feature dataset.

This tool is used to specify your input coverage, input feature class, and output feature class. Because you opened this tool by right-clicking a feature dataset, the output geodatabase, Montgomery, and feature dataset, Water, are already filled in for you.

There are several ways to set the input and output datasets. You can also drag a dataset or datasets from the ArcCatalog tree or Contents tab and drop them on the text box. Alternatively, you can click the Browse button to open the ArcCatalog minibrowser and navigate to your dataset or type the full pathname to the dataset in the text box.

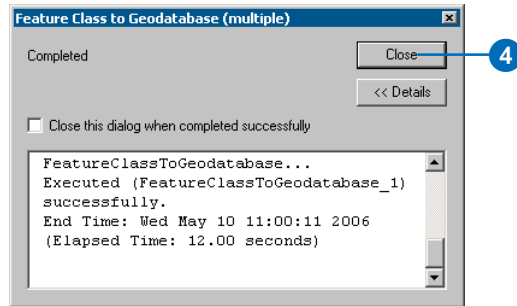
2. Click the Browse button, navigate to the arc feature class in the laterals coverage, and click Add.
3. Click OK.



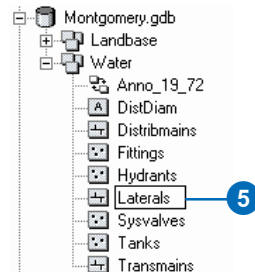
A message appears showing the progress of your data import operation. When the tool is finished, the message indicates that all the features have been imported.

The laterals_arc feature class is now in the Water feature dataset.

4. Click Close.

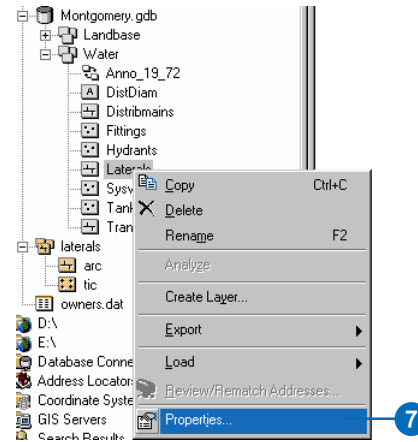


5. In the ArcCatalog tree, navigate to and click the laterals_arc feature class. Press the F2 key, and type “Laterals” to rename the feature class.



6. Click the Preview tab to see the features.

7. Right-click Laterals and click Properties.

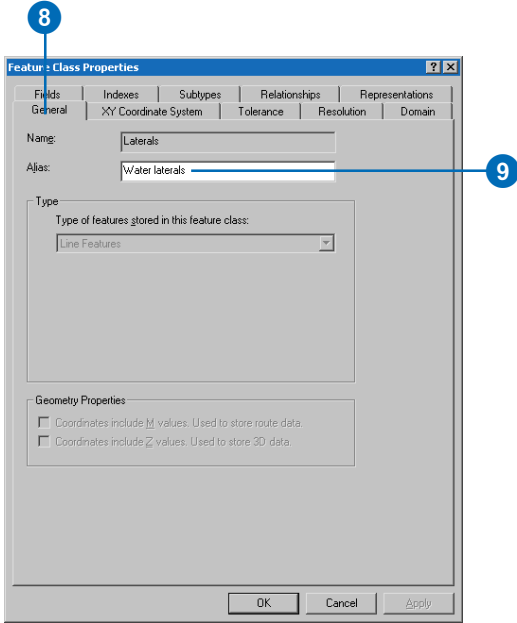


The names of feature classes and tables in a geodatabase are the same as the names of the physical tables in the relational database management system (RDBMS) in which they are stored. When you store data in an RDBMS, the names for tables and fields are often unclear, and you need a detailed data dictionary to keep track of what data each table stores and what each field in those tables represents.

The geodatabase lets you create *aliases* for *fields*, tables, and feature classes. An alias is an alternative name to refer to those items. Unlike true names, aliases can contain special characters, such as spaces, because they don't have to adhere to the database's limitations. When you use data with aliases in ArcMap, the alias name is automatically used for feature classes, tables, and fields. However, in ArcCatalog these items are always represented by their true names.

You will now create aliases for your new feature class and its fields.

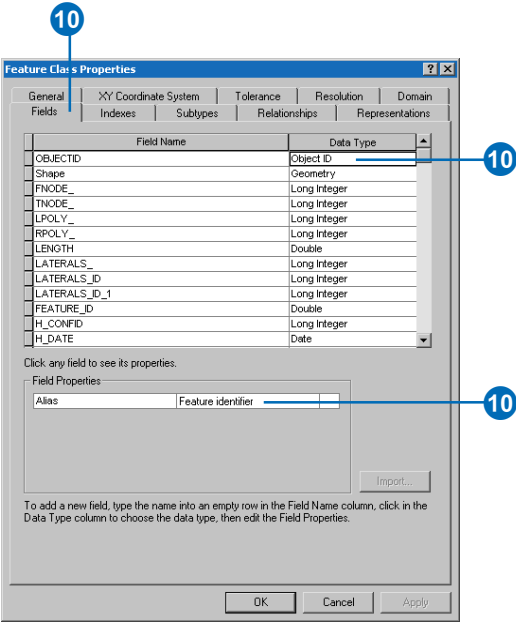
8. Click the General tab.



9. Type “Water laterals” for the alias for this feature class.

10. Click the Fields tab. Click the OBJECTID field and type “Feature identifier” for its alias.

11. Repeat step 10 for the following fields:



12. Click OK.

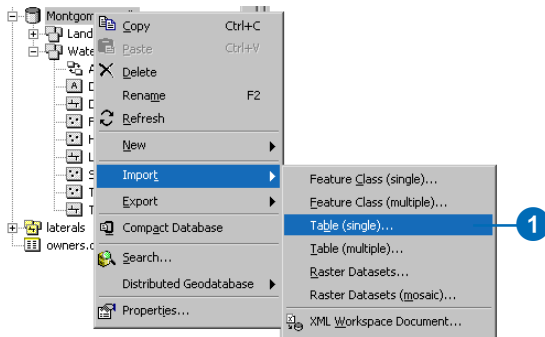
Field	Alias
Shape	Geometry field
DEPTH_BURI	Depth buried
RECORDED_L	Recorded length
FACILITY_I	Facility identifier
DATE_INSTA	Installation date
TYPECODE	Subtype code

Now that you have imported the Laterals feature class into the geodatabase and added some aliases, you are ready to import the owner.dat INFO table.

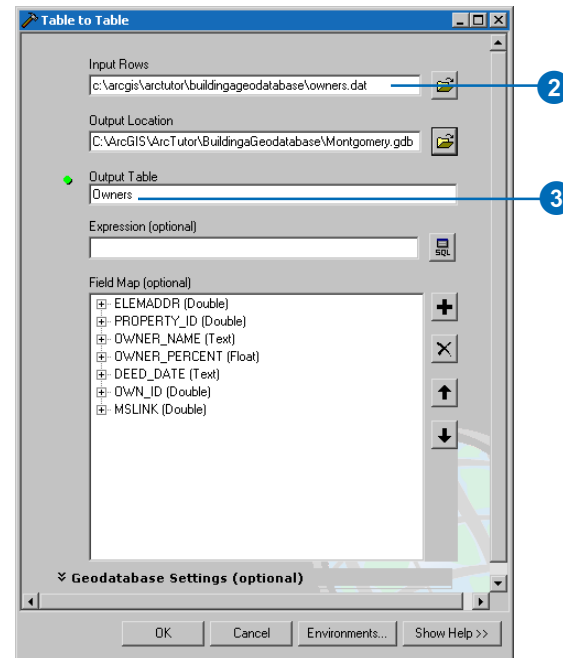
Importing the INFO table

The owner.dat INFO table contains owner information for the parcels in the Parcels feature class in the Montgomery geodatabase. To be able to create relationships between the parcels and their owners, the owner information must be imported into the Montgomery geodatabase. You will use the Table (multiple) import tool to import the owner.dat INFO table into the Montgomery geodatabase. You will then create aliases for the table.

1. Right-click the Montgomery geodatabase, point to Import, then click Table (multiple).

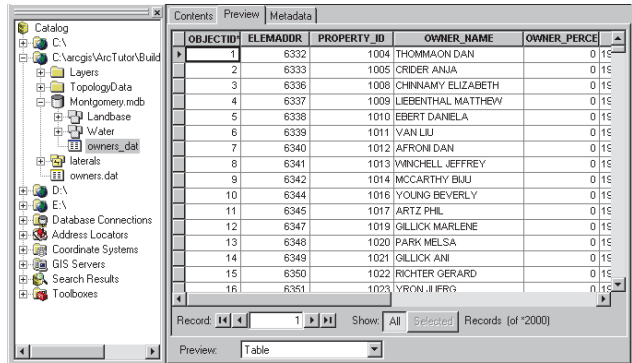


2. Drag and drop the owners.dat INFO table from the Catalog tree to the Input Table box.



3. Type "Owners" in the Output Table text box, then click OK. A message informs you of the progress of the operation. When it finishes, click Close.

- In the ArcCatalog tree, click the Owners table in the Montgomery geodatabase. Click the Preview tab to see its rows.



- Right-click the Owners table and click Properties to see the table's properties.
- Type "Parcel owners" for the alias for this table.
- Click the Fields tab and type the following field aliases:
- Click OK.

The data in the laterals coverage and owners.dat INFO table is now in the Montgomery geodatabase. Now you can take advantage of the geodatabase by applying behavior to your data. You will begin this task by creating subtypes and *attribute domains*.

Field	Alias
OBJECTID	Object identifier
OWNER_NAME	Owner name
OWNER_PERCENT	Percentage ownership
DEED_DATE	Date of deed

Exercise 3: Creating subtypes and attribute domains

One of the advantages of storing your data in a geodatabase is that you can define rules about how the data can be edited. You will define these rules by creating a new attribute domain for lateral diameters; creating subtypes for the Laterals feature class; and associating the new domain, existing domains, and default values with fields for each subtype.

Attribute domains are rules that describe the legal values of a field type. Multiple feature classes and tables can share attribute domains stored in the database. However, not all the objects in a feature class or table need to share the same attribute domains.

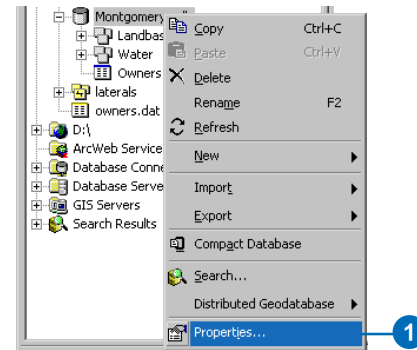
For example, in a water network, suppose that only hydrant water laterals can have a pressure between 40 and 100 psi, while service water laterals can have a pressure between 50 and 75 psi. You would use an attribute domain to enforce this restriction. To implement this kind of validation rule, you do not have to create separate feature classes for hydrant and service water laterals, but you would want to distinguish these types of water laterals from each other to establish a separate set of domains and default values. You can do this using subtypes.

To learn more about subtypes and attribute domains, see the topics on subtypes and attribute domains in the ArcGIS Desktop Help.

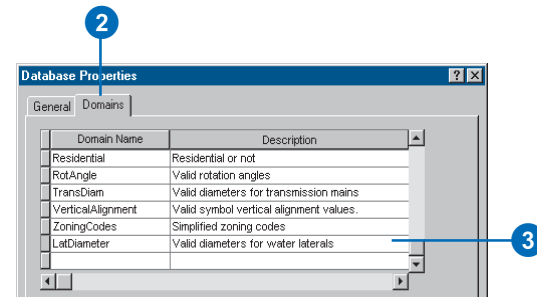
Creating an attribute domain

You will use ArcCatalog to create a new coded value attribute domain. This new domain will describe a set of valid pipe diameters for your new Laterals feature class.

1. Right-click the Montgomery geodatabase and click Properties.



2. Click the Domains tab.



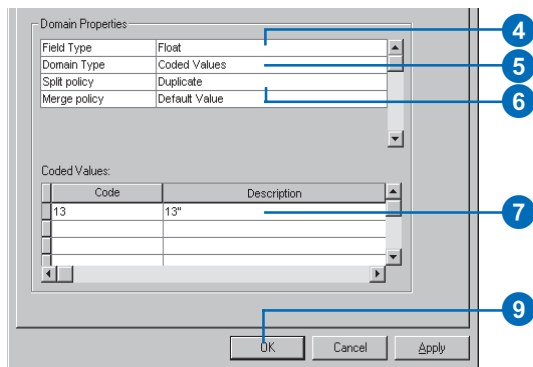
3. Click the first empty field under Domain Name and type “LatDiameter” for the name of the new domain. In the Description field, type “Valid diameters for water laterals” for the domain’s description.

You will now specify the properties of the domain. These properties include the type of field this domain can be associated with, the type of domain it is—range or coded value, the split and merge policies, and the valid values for the domain.

A range domain describes a valid range of numeric values, and a coded value domain describes a set of valid values. In this case, you will create a new coded value domain.

All domains also have split and merge policies. When a feature is split or merged, ArcGIS looks to these policies to determine the values of the resulting feature or features for a particular attribute.

- Click the Field Type to view a dropdown list and click Float for the field type for this domain.



- Click the Domain Type to view a dropdown list and click Coded Values for the domain type.
- Click the *Split policy* to view a dropdown list and click Duplicate for the split policy for the domain. The *Merge policy* will default to Default Value.

You'll type the valid values, or codes, for the coded value domain, and for each code you will provide a user-friendly description. As you will see later in the tutorial, ArcMap uses the user-friendly description, not the code, for values of fields that have coded value domains associated with them.

- Click the first empty field under Code and type "13" for the code; then click the Description field beside it and type "13" for the code's description.
- Add the following coded values to the list:

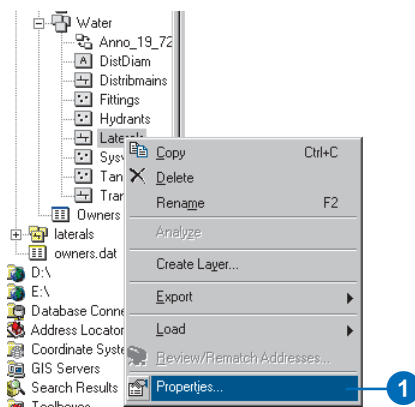
Code	Description
10	10"
8	8"
6	6"
4	4"
3	3"
2.25	2 1/4"
2	2"
1.5	1 1/2"
1.25	1 1/4"
1	1"
0.75	3/4"
-9	Unknown

- Click OK to add the domain to the geodatabase.

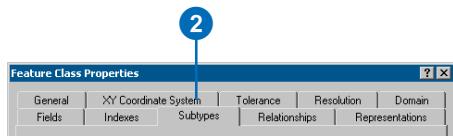
Creating subtypes and associating default values and domains

Now you will create subtypes for the Laterals feature class and associate default values and domains with the fields for each subtype. By creating subtypes, not all the water lateral features need to have the same domains, default values, and as you will see later in the tutorial, connectivity rules.

1. Right-click the Laterals feature class and click Properties.

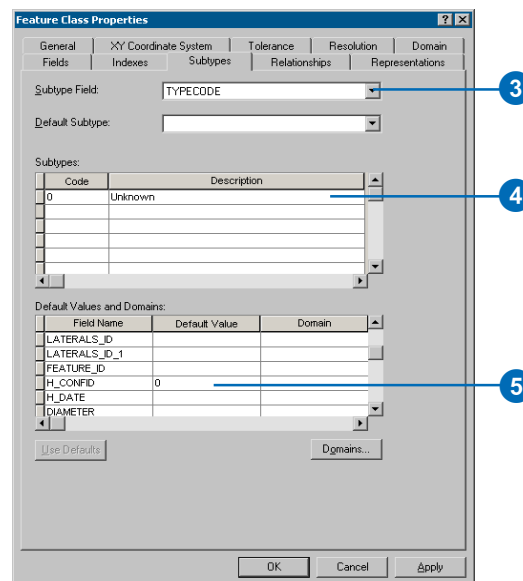


2. Click the Subtypes tab.



You will now specify the subtype field for the Laterals feature class. The subtype field contains the values that identify to which subtype a particular feature belongs.

3. Click the Subtype Field dropdown arrow and click TYPECODE.



You will now add subtype codes and their descriptions. When you add a new subtype, you will assign default values and domains to some of its fields.

4. Click the Description field next to subtype code 0 and type "Unknown" for its description.
5. Click the Default Value field next to H_CONFID and type "0" for its default value. Do the same for DEPTH_BURI and RECORDED_L. For the WNM_TYPE and PWTYPE fields, type "WUNKNOWN" as the default values.

6. Click the Default Value field next to DIAMETER and type “8” for the default value. Click the Domain dropdown list and click LatDiameter to set it as this field’s attribute domain for the Unknown subtype.

Feature Class Properties

General | XY Coordinate System | Tolerance | Resolution | Domain
Fields | Indexes | Subtypes | Relationships | Representations

Subtype Field: TYPECODE

Default Subtype:

Subtypes:

Code	Description
0	Unknown

Default Values and Domains:

Field Name	Default Value	Domain
H_DATE		
DIAMETER	8	LatDiameter
DEPTH_BURI	0	
RECORDED_L	0	DistDiam
FACILITY_I		TransDiam
PW_ID		

Use Defaults Domains...

OK Cancel Apply

7. Repeat step 6 for the MATERIAL field, typing “DI” for the default value. Click Material in the Domain dropdown list.
8. Add the following subtypes and set the default values and domains the same as for the Unknown subtype, except for the WNM_TYPE and PWTYPE field default values.

Code	Description
1	Hydrant laterals
WNM_TYPE, PWTYPE	default value = WHYDLIN
2	Fire laterals
WNM_TYPE, PWTYPE	default value = WFIRELIN
3	Service laterals
WNM_TYPE, PWTYPE	default value = WSERVICE

Feature Class Properties

General | XY Coordinate System | Tolerance | Resolution | Domain
Fields | Indexes | Subtypes | Relationships | Representations

Subtype Field: TYPECODE

Default Subtype: Service laterals

Subtypes:

Code	Description
0	Unknown
1	Hydrant laterals
2	Fire laterals
3	Service laterals

Default Values and Domains:

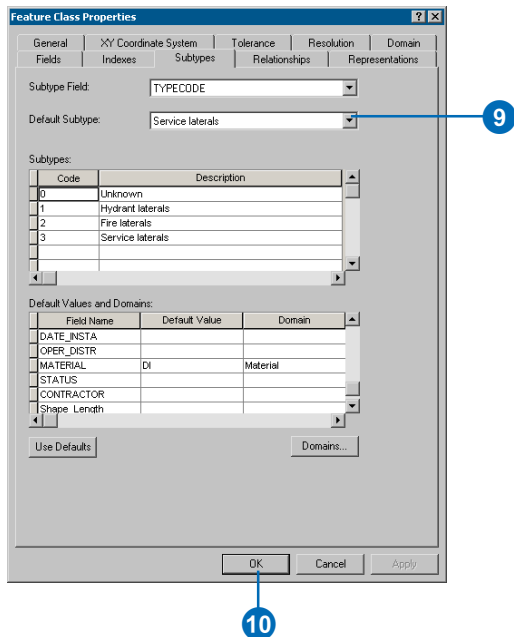
Field Name	Default Value	Domain
DATE_INSTA		
OPER_DIST		
MATERIAL	DI	Material
STATUS		
CONTRACTOR		
Shape Length		

Use Defaults Domains...

OK Cancel Apply

When adding new features to a feature class with subtypes in the ArcMap editing environment, if you don't specify a particular subtype, the new feature will be assigned the default subtype. Once you have added all the subtypes for this feature class, you can set the default subtype from those you entered.

9. Click the Default Subtype dropdown arrow and click Service laterals to set it as the default subtype.



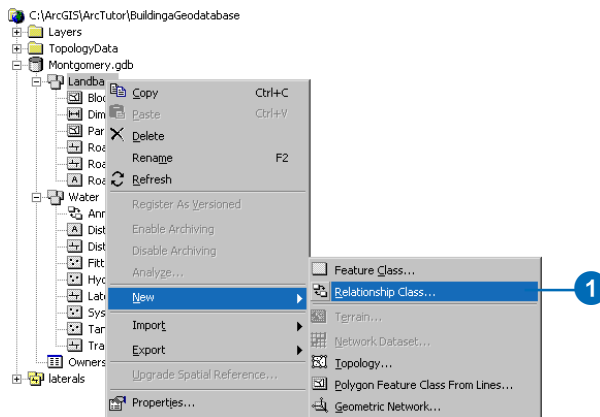
10. Click OK.

You have now added behavior to the geodatabase by adding domains and creating subtypes. Now you will add some additional behavior to the geodatabase by creating relationships.

Exercise 4: Creating relationships between objects

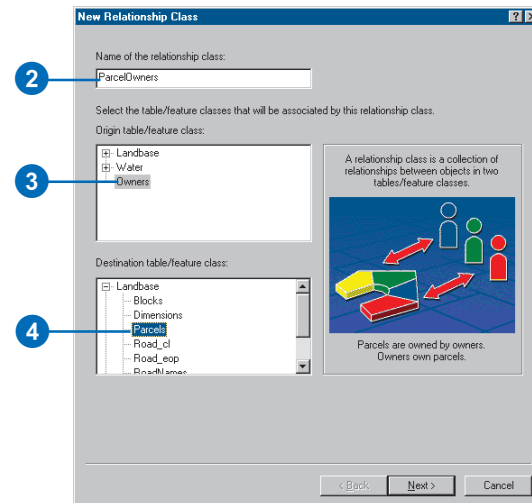
In Exercise 2, you imported an INFO table containing owner objects into the Montgomery geodatabase. The geodatabase already has a feature class called Parcels that contains parcel objects. You will now create a *relationship class* between the parcels and the owners so that when you use the data in ArcMap you can easily find out which owners own which parcels.

1. Right-click the Landbase feature dataset, point to New, then click Relationship Class.



The New Relationship Class wizard opens. The first panel of the wizard is used to specify the name, origin, and destination feature class or table for the new relationship class.

2. Type “ParcelOwners” as the name of this relationship class.
3. Click Owners for the origin table.



4. Double-click Landbase and click Parcels for the destination feature class. Click Next.

The next panel is used to specify the type of relationship class you are creating. You are creating a simple relationship class since owners and parcels can exist in the database independently of each other. You can, therefore, accept the default type—simple relationship class.

5. Click Next.

You must now specify the path labels and the message notification direction. The forward path label describes the relationship as it is navigated from the origin class to the destination class—in this case, from Owners to Parcels. The backward path label describes the

relationship when navigated in the other direction—from Parcels to Owners.

The message notification direction describes how messages are passed between related objects. Message notification is not required for this relationship class, so accept the default of None.

6. Type “owns” for the forward path label and type “is owned by” for the backward path label. Click Next.

New Relationship Class

Specify a label for the relationship as it is traversed from the origin table/feature class to the destination table/feature class.

owns

Specify a label for the relationship as it is traversed from the destination table/feature class to the origin table/feature class.

is owned by

Which direction will messages be propagated between the objects related by this relationship class?

☐ Forward (origin to destination)

☐ Backward (destination to origin)

☐ Both

☒ None (no messages propagated)

< Back Next > Cancel

You will now specify the cardinality of the relationship. The cardinality describes the possible number of objects in the destination feature class or table that can be related to an object in the origin feature class or table.

7. Click 1–M (one-to-many) to specify that one owner may own many parcels. Click Next.

You must now specify whether your new relationship class will have attributes. In this example, the ParcelOwners relationship class does not require attributes, which is the default.

8. Click Next.

The next step is to specify the primary key in the origin table (Owners) and the embedded foreign key field in the destination feature class (Parcels). Owners and Parcels that have the same value in these fields will be related to each other.

9. Click the first dropdown arrow and click PROPERTY_ID for the origin table primary key.

New Relationship Class

Select the primary key in the origin table/feature class [generally, this will be the object identifier field]. If this is a 1 - M (one to many) relationship, you will also need to select the foreign key in the destination table/feature class.

Select the primary key field in the origin table/feature class:

PROPERTY_ID

Select the foreign key field in the destination table/feature class that refers to the primary key field in the origin table/feature class:

PROPERTY_I

< Back Next > Cancel

10. Click the second dropdown arrow and click PROPERTY_I for the embedded foreign key in the destination feature class.

11. Click Next. A summary page appears. Once you have reviewed the summary, click Finish.

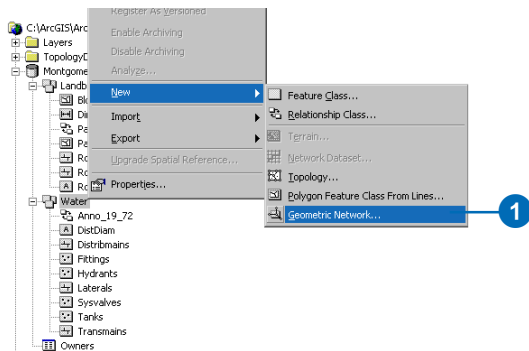
You have now added a second kind of behavior to the geodatabase—relationships. Next you will continue to add behavior to the geodatabase by creating a geometric network and defining connectivity rules.

Exercise 5: Building a geometric network

Feature classes stored in the same feature dataset can participate in a geometric network. Geometric networks model network systems such as water networks. You will build a geometric network from the feature classes in the Water feature dataset in the Montgomery geodatabase. You will then create connectivity rules to define which features can connect to each other in the network.

Creating the water network

1. Right-click the Water dataset, point to New, then click Geometric Network.



The Build Geometric Network Wizard opens. You can use this wizard to either build a geometric network from existing feature classes or to create an empty geometric network. In this case, you will be building a network from the existing feature classes in the Water feature dataset.

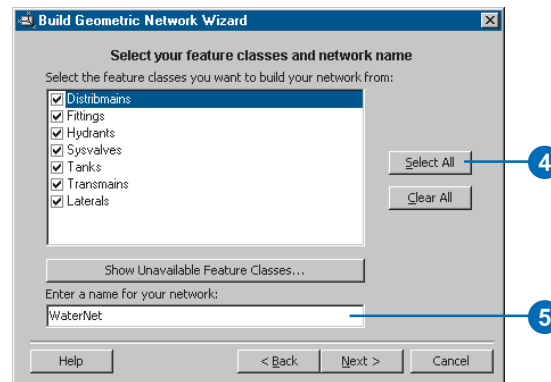
2. Click Next.

The second panel is used to specify whether to build a network from existing feature classes or to create an empty one. You want the default—Build a geometric network from existing features.

3. Click Next.

You must now select which feature classes in the feature dataset will participate in the geometric network and what the name of the network will be.

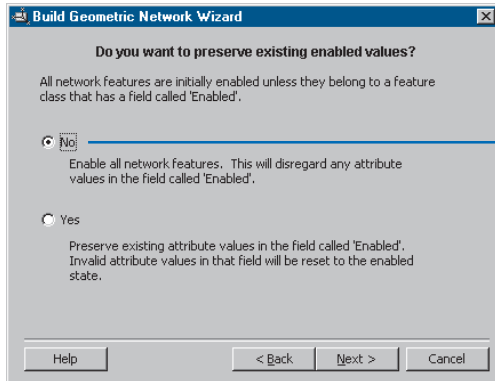
4. Click Select All.



5. Type “WaterNet” for the name of the geometric network. Click Next.

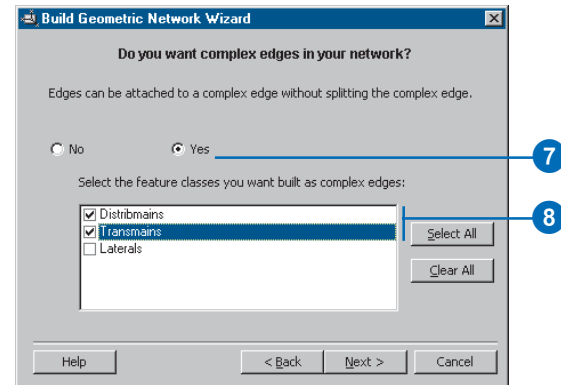
The option to exclude features with certain attributes makes it easier to manage the state of parts of the network if you need to drop the network and rebuild it after you've been working with it for a while.

6. Click No, so that all features will participate in the geometric network. Click Next.



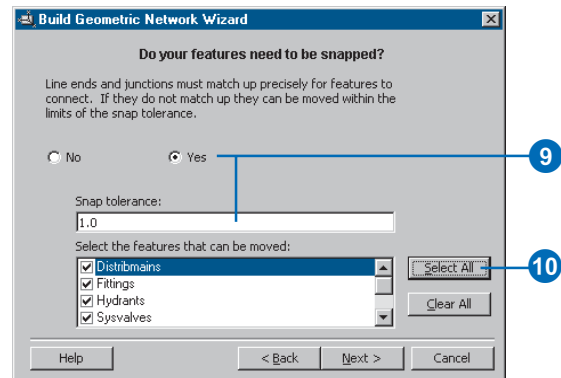
You will now specify which line feature classes will become complex edge feature classes in the geometric network. Complex edge features are not split into two features by the connection of another feature along their length; thus, they are useful for modeling water mains which may have multiple laterals connected to them. By default, all line feature classes become simple edge feature classes.

7. Click Yes to specify that some of the line feature classes will become complex edges.
8. Check Distribmains and Transmains to make the water distribution and transmission mains complex edges. Click Next.



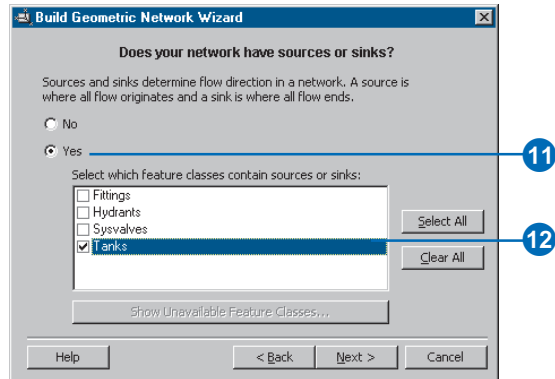
Features in a geometric network must be precisely connected to one another. The input feature classes can be adjusted to ensure connectivity by snapping. You will specify whether these features need to be adjusted to snap to one another in the network-building process.

9. Click Yes to specify that some of the features need to be adjusted. Type "1.0" for the snapping tolerance.
10. Click Select All to indicate that the features stored in each feature class can be adjusted. Click Next.



You must specify which, if any, of the junction feature classes can act as sources and sinks in the network. Sources and sinks are used to determine the flow direction in the network.

11. Click Yes to indicate that some of the junction feature classes will act as sources or sinks.



12. Check the Tanks feature class to indicate that tanks can be sources or sinks in the network. Click Next.

Now you can assign network weights. A network weight describes the cost of traversing an element in the logical network, such as the drop in pressure as water flows through a pipe. This geometric network does not require weights, which is the default.

13. Click Next. A summary page appears. Once you have reviewed the summary, click Finish.

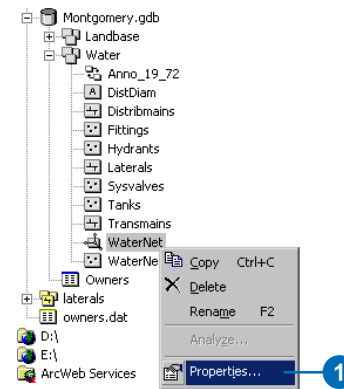
A progress indicator appears, displaying the progress for each stage of the network-building process.

Your new geometric network, WaterNet, has been created in the Montgomery geodatabase. Next, you'll establish *connectivity rules* for your water network.

Creating connectivity rules

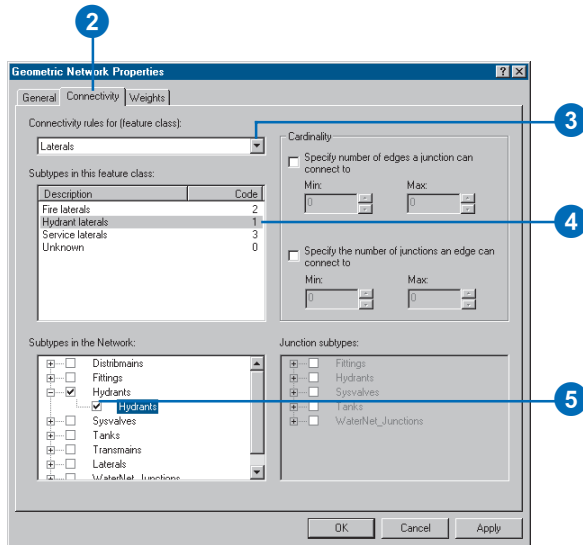
Network connectivity rules constrain the type of network features that may be connected to one another and the number of features of any particular type that can be connected to features of another type. By establishing these rules, you can maintain the integrity of the network connectivity in the database.

1. Right-click WaterNet and click Properties.



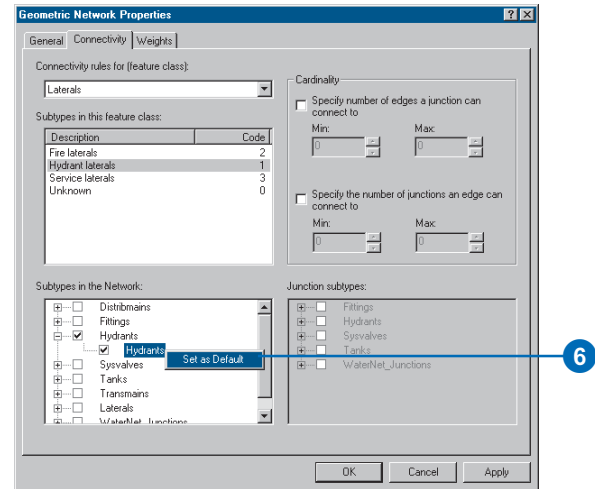
The Geometric Network Properties dialog box opens. The dialog box provides information about feature classes participating in the network and a list of the network weights. You can also add, delete, and modify connectivity rules using this dialog box.

2. Click the Connectivity tab.



This tab lets you add and modify connectivity rules for the geometric network. You will first create a new *edge-junction rule*, which states that hydrants can connect to hydrant laterals; it also indicates that when a hydrant lateral is created, a hydrant junction feature should be placed at its free end.

3. Click the dropdown arrow and click Laterals.
4. In the list of subtypes in the feature class, click Hydrant laterals.

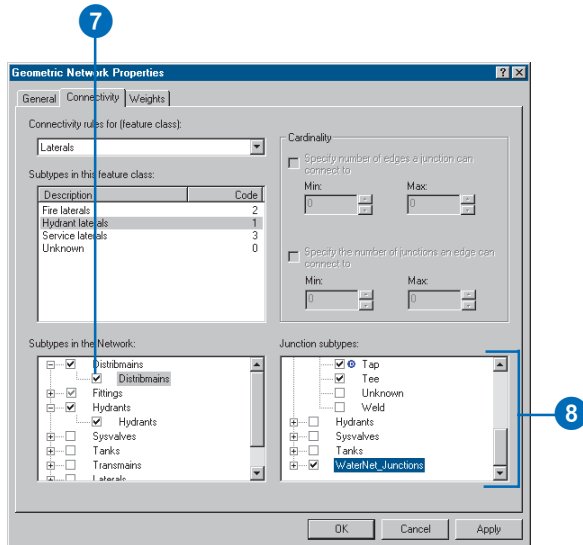


You will now click the types of junctions that hydrant laterals can connect to in the network. For simplicity, hydrant laterals can only connect to hydrants.

5. Check Hydrants in the list of subtypes in the network.
You should also specify that when you create a hydrant lateral, if an end of the lateral is not connected to another edge or junction, then a hydrant is placed at that end.
6. Click the plus sign to expand Hydrants, right-click Hydrants under it, then click Set as Default. A blue D will appear next to the hydrant subtype, indicating that it is the default junction for this edge subtype.

You will now create a new *edge-edge rule* that states that hydrant laterals can connect to distribution mains through taps, tees, and saddles. The default junction for connections between hydrant laterals and distribution mains will be taps.

7. In the network subtypes list, click the plus sign to expand Distributemains and check Distributemains under it.



Because you have checked an edge in the network subtypes list, the list of junction subtypes in the network becomes active. In this list, you can specify which junction types hydrant laterals and distribution mains can connect through.

8. In the Junction subtypes list, click the plus sign to expand Fittings and check Tap, Tee, and Saddle in that order. Notice that Tap has a blue D next to it; this means that Tap is the *default junction*. Check WaterNet_Junctions, which is the generic, or default, network junction type.
9. Click OK.

You have now added behavior to your geodatabase by defining connectivity rules. You would normally define many more connectivity rules for a network. However, for this tutorial, you only need to define the connectivity rules specified here. In the next part of the tutorial, you will create feature-linked *annotation* for your new hydrant lateral feature class.

Exercise 6: Creating annotation

In Exercise 1, you browsed through the existing feature classes in the Montgomery geodatabase. One of these feature classes contained annotation that was linked to features in the Distributables feature classes. You then imported the water laterals from a coverage into the Water feature dataset. Now you will create labels for the water laterals in ArcMap and convert them to an annotation feature class that is linked to the laterals.

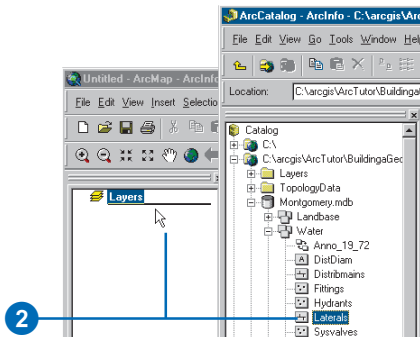
Creating labels for the lateral subtypes

You'll start ArcMap and add the Laterals feature class.

1. Click the Launch ArcMap button. Start a new, empty map document.

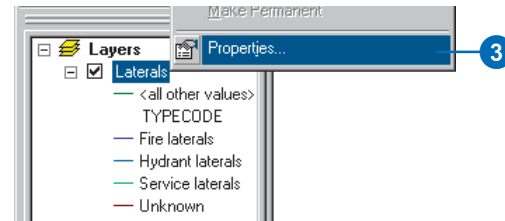


2. Click the Laterals feature class, drag it from ArcCatalog, and drop it on the ArcMap table of contents.

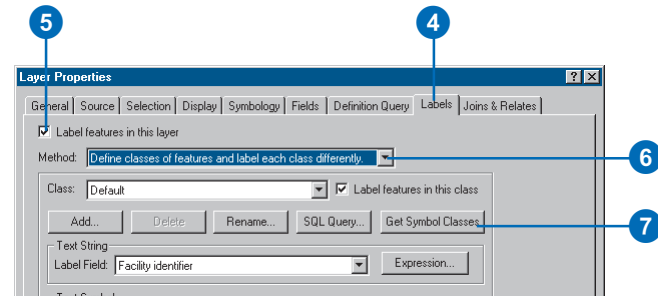


Because you created subtypes for the Laterals feature class, each subtype is automatically drawn with unique symbols. You'll create different label classes for the subtypes.

3. In ArcMap, right-click Laterals and click Properties.



4. Click the Labels tab.



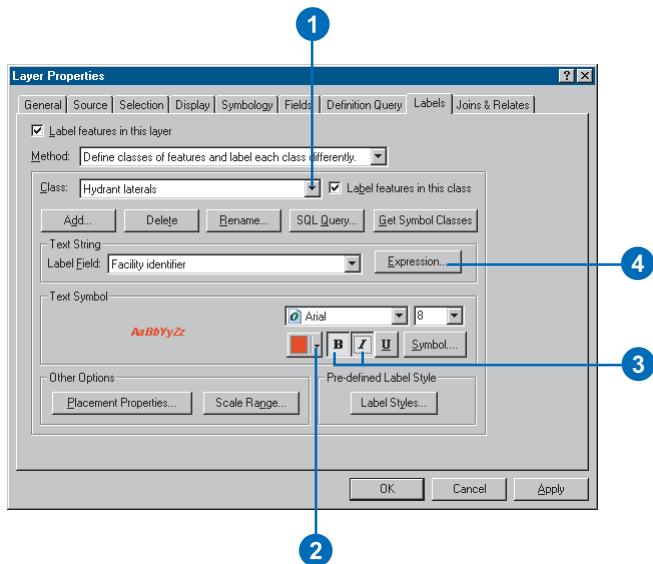
5. Check the box to Label features in this layer.
6. Click the Method dropdown list and click Define classes of features and label each class differently.
7. Click Get Symbol Classes.

Now the layer has several label classes defined—one for each subtype and one for other values.

Defining the labels for the hydrant laterals

The different subtypes of laterals have different roles in the water system. For example, service laterals bring water from the distribution mains to residences or businesses, and hydrant laterals bring water from mains to fire hydrants. You will make the labels for the hydrant laterals red to make it easy for map readers to differentiate hydrant laterals from other laterals.

1. Click the Class dropdown list and click Hydrant laterals.

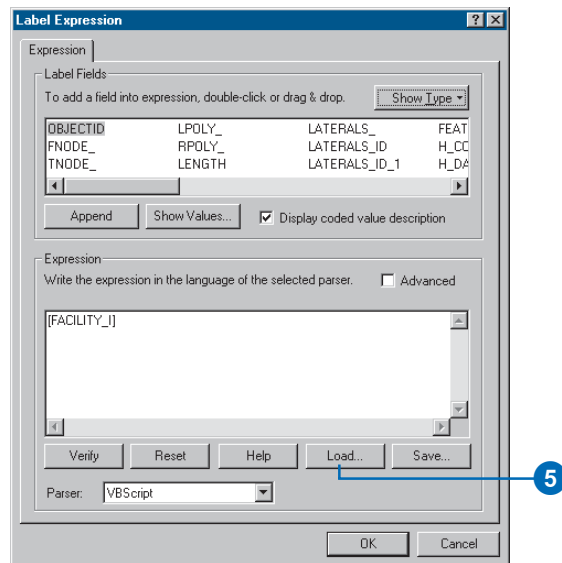


2. Click the text color dropdown arrow and click a red swatch from the palette.
3. Click the Bold and Italic buttons.
4. Click Expression.

Sometimes you want to label features with the content of a single field. The Label Field dropdown list lets you select a single field with which to label features. At other times, you may want to create more complex labels. The Label Expression dialog box lets you construct labels by concatenating one or more fields and other text. You can also add logic to the label expression using a scripting language.

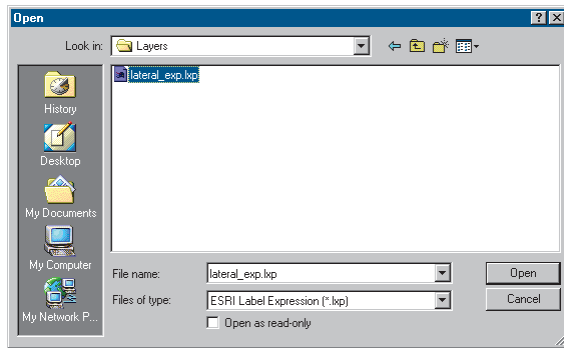
To create the labels for the hydrant laterals, you'll load a label expression that has been saved to a file.

5. Click Load.



The label expression has been saved to a file called "lateral_exp.lxp" in the Layers folder for the BuildingaGeodatabase tutorial folder.

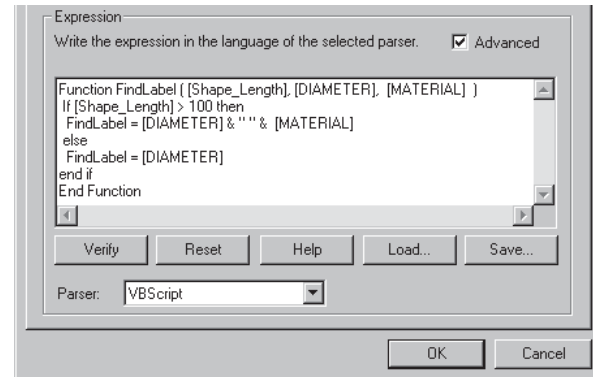
6. Navigate to the Layers folder, click lateral_exp.lxp, and click Open.



This VBScript expression evaluates the length of each lateral; if its value is greater than 200, it labels the lateral with the contents of the DIAMETER field, a space, and the contents of the MATERIAL field. If the length is less than 200, it labels the lateral with the contents of the DIAMETER field.

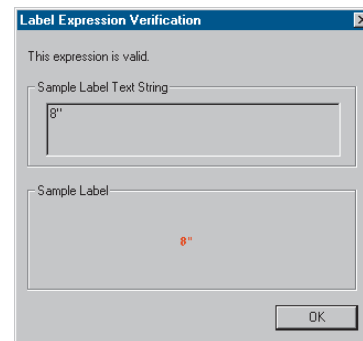
You will adjust this expression for the Hydrant laterals so that Hydrant laterals longer than 100 feet get the more complete labels.

7. Click in the Expression box and change the value in the If statement from 200 to 100. Click Verify.



The expression is tested and a sample is displayed.

8. Click OK on the Label Expression Verification dialog box and click OK on the Label Expression dialog box.



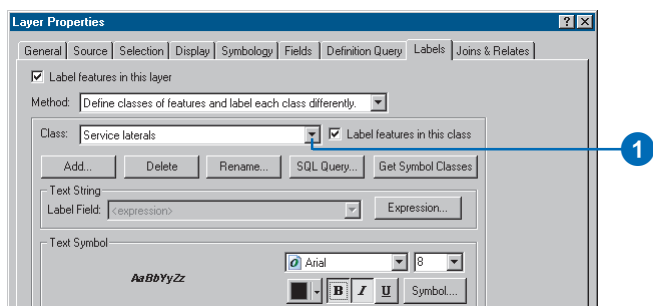
You've created an expression for the Hydrant laterals label class. Next you'll create expressions for the label classes of the other subtypes.

Defining the labels for the service laterals

The service laterals tend to be shorter than the hydrant laterals. For this exercise, it is only important to show their material type when they are longer than 200 feet, so you will load the label expression again and use it without modifying it.

1. Click the Class dropdown list and click Service laterals.

Now you can set up the label parameters for this label class.

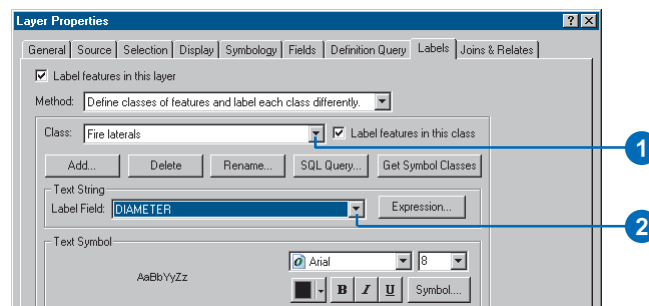


2. Use the same procedure that you just used to define the labels for the Hydrant laterals, but make these labels black, and do not modify the label expression after you load it.

Defining the labels for other laterals

You've loaded label expressions for the Hydrant laterals and Service laterals. Now you'll define the labels for Fire laterals, Unknown laterals, and the <all other values> class. Because these classes are less common and only the diameter is of interest, you will use the Diameter field alone to label these features.

1. Click the Class dropdown list and click Fire laterals.



2. Click the Label Field dropdown list and click DIAMETER.
3. Use the same procedure to set the labels for the Unknown and <all other values> label classes.
4. Click OK on the Layer Properties dialog box.

The labels are drawn on the map. The Hydrant laterals are labeled in red, and because of the label expression, the longer ones are also labeled with their material type.

You've created labels for the different subtypes of laterals, using the symbology classes in ArcMap to derive the label classes. Now you will convert the labels to annotation in the geodatabase.

Setting the reference scale for the labels

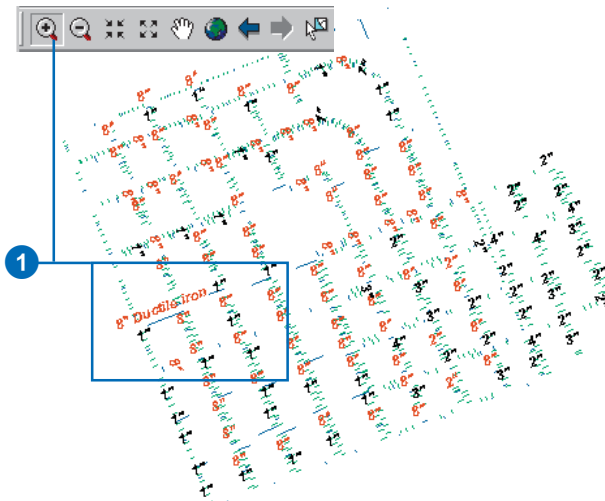
Labels are dynamic—they are regenerated when you pan and zoom around the map. By default, they will be drawn using the same size symbol, regardless of the scale to which you zoom. Not all features can be labeled using an 8 point font at the full extent of the feature class, but if you

zoom in, there will be more space around the features, so more labels will be drawn.

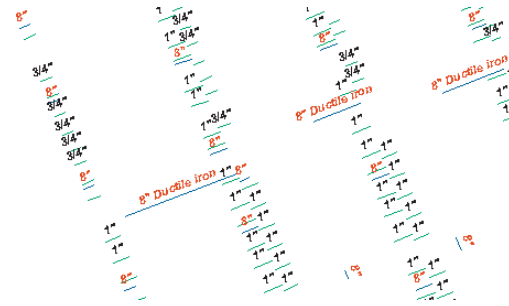
Unlike labels, annotation is static. Annotation features are stored. They have a fixed location and a reference scale, so when you zoom in, the text gets larger on the screen.

You can make labels behave more like annotation by setting a reference scale. This should be the scale at which the map will most commonly be used. When you convert the labels to annotation, you want the annotation to have the right reference scale so it will be drawn at the right size, relative to the features, on the maps you create.

1. Click the Zoom In tool and click and drag a box around some of the laterals on the eastern edge of the data.



Labels are now drawn for more of the laterals.



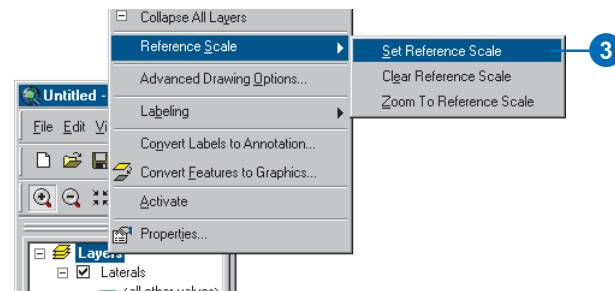
2. Type 1000 in the Scale box and press Enter.



Even more of the labels are now drawn. This is the scale at which the data will usually be drawn, so you will now set the reference scale for the map and the annotation that you create from it.

3. Right-click Layers, point to Reference Scale, and click Set Reference Scale.

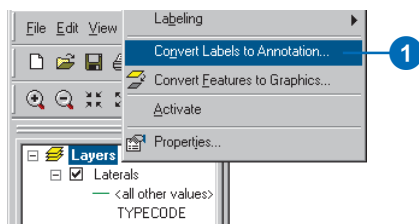
Now, when you zoom in or out, the labels will get larger or smaller.



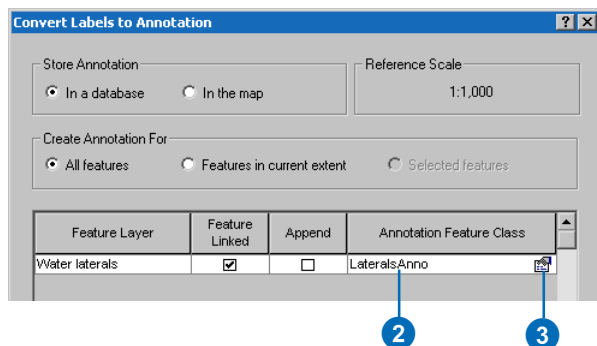
Converting the labels to annotation

Now that the reference scale is set, you can convert the labels to annotation and store them in your geodatabase. You will convert the label classes into subtypes of a single feature-linked annotation feature class. This process requires an ArcEditor or ArcInfo licensed seat of ArcMap. With an ArcView seat, you can create annotation from labels but not feature-linked annotation.

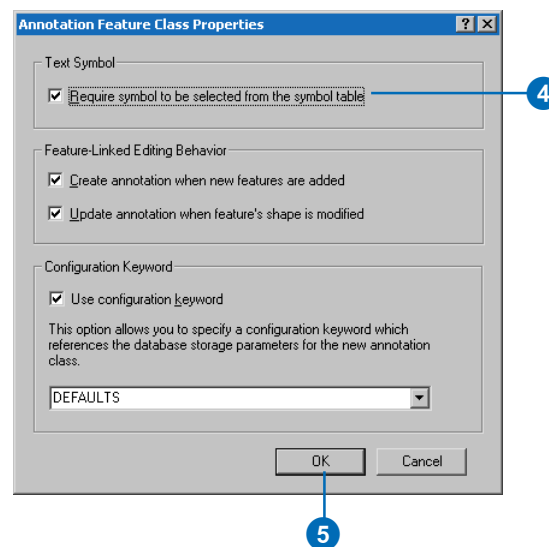
1. Right-click Layers and click Convert Labels to Annotation.



2. Click in the Annotation Feature Class column for the Laterals feature layer and rename the output annotation feature class "LateralsAnno".
3. Click the Properties button.



4. Check the box to Require symbol to be selected from the symbol table.

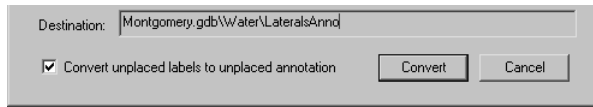


This will reduce the storage space needed in the geodatabase for the annotation. Each annotation feature will reference a symbology table in the geodatabase, rather than storing all its own symbology information. You will not be able to store graphics in this annotation feature class.

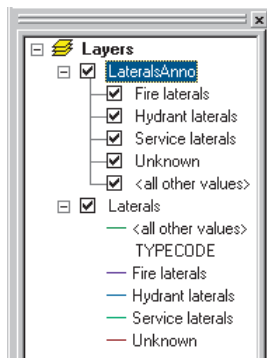
The check boxes for the two feature-linked annotation editing behavior options are checked by default. New annotation will be created when new laterals are added, and existing annotation will move when laterals are moved or reshaped.

5. Click OK.

6. Click Convert.



A message box will appear showing the progress of the conversion process. After a short time, it will finish.



The labels are converted to a set of annotation classes within a single annotation feature class. A relationship class is also created that links the annotation to the laterals.

7. Close ArcMap.

You've created an annotation feature class in the geodatabase. The annotation classes within it correspond to the subclasses of the laterals feature class. Some of these annotation classes have special symbology, as well as logic to annotate certain features with extra information. When the Laterals feature class is edited in ArcMap, the corresponding annotation features will be created or

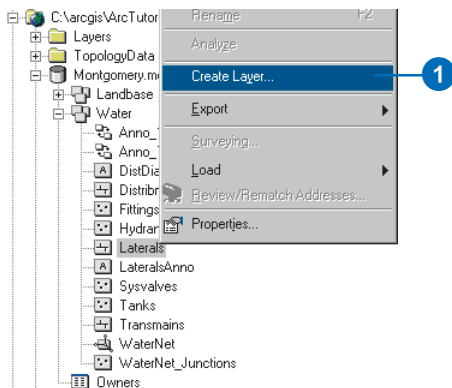
modified using the symbology and annotation expression you created.

Exercise 7: Creating layers for your geodatabase data

To make browsing for and symbolizing data more convenient, you can create layers from your geodatabase data and use these layers in ArcMap. Most of the layers you will need have been created for you; they are stored in the Layers folder in your tutorial directory. In this exercise, you will create new layers for the Laterals and the LateralsAnno feature classes.

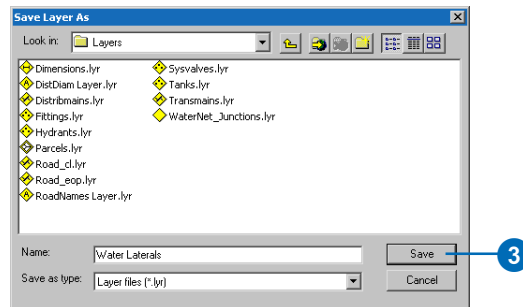
Creating the Laterals layer

1. In ArcCatalog, right-click the Laterals feature class and click Create Layer.



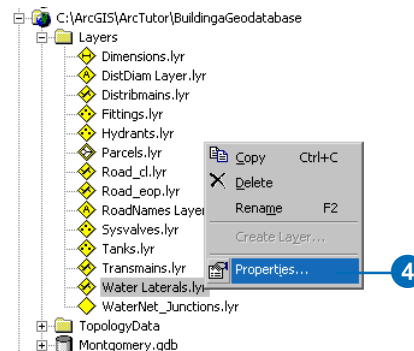
2. Browse to the Layers folder under your tutorial directory and type “Water Laterals” for the name of the new layer.

3. Click Save.

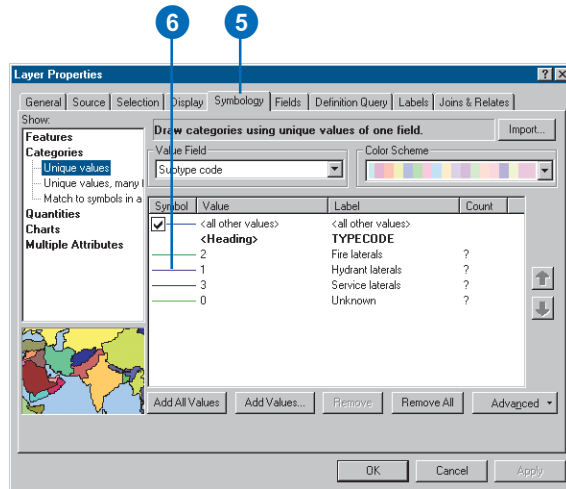


The new layer is created. You will modify the properties of the layer to add symbology.

4. Open the Layers folder in the ArcCatalog tree, right-click the Water Laterals layer, then click Properties.



You can use the Layer Properties dialog box to modify many aspects of a layer, such as its visible scale and transparency. In this case, you will modify its symbology.

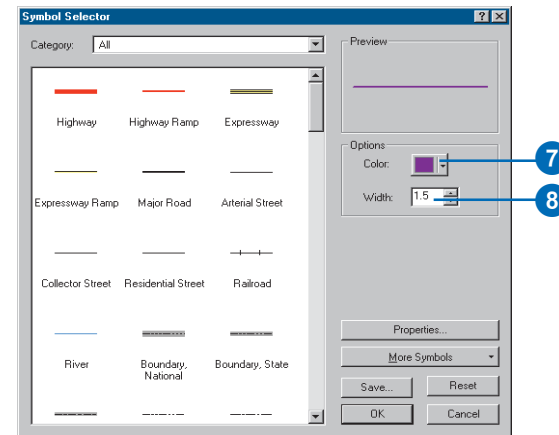


5. Click the Symbology tab.

By default, the Unique values classification based on the subtype field is used to symbolize the layer. This is the setting you want, but you must modify the symbology of each subtype.

6. Double-click the colored line next to Hydrant laterals.
The Symbol Selector dialog box appears. You will use this dialog box to set the symbol properties for the laterals.

7. Click the Color dropdown arrow and click a purple patch on the color palette to make the line purple.

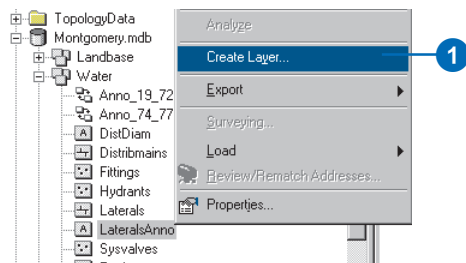


8. Type "1.5" in the width text box to give the line a width of 1.5.
9. Click OK.
10. Repeat steps 6 through 9 for the Fire laterals, making the symbol a red line with a width of 1.5.
11. Repeat steps 6 through 9 for the Service laterals, making the symbol a dark blue line with a width of 1.5.
12. Click OK to close the Properties dialog box.

Your Water Laterals layer is complete. You can now create the annotation layer for the water laterals.

Creating the Lateral Diameter layer

1. Right-click the LateralsAnno feature class and click Create Layer.



2. Navigate to the Layers folder and type “Water lateral diameter annotation” for the name of the new layer.
3. Click Save.

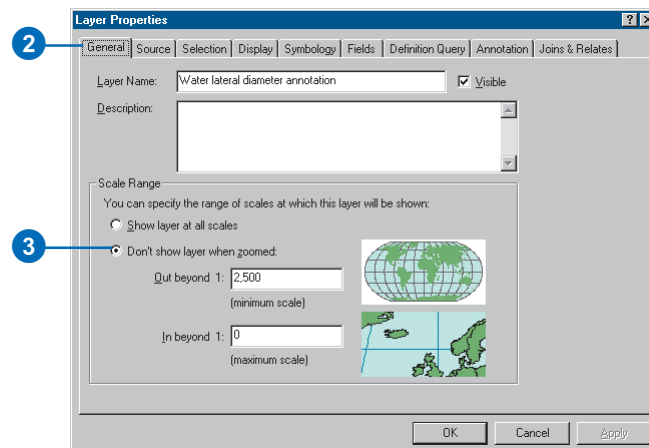
The new annotation layer is created. Since this layer points to an annotation feature class, the symbology is a property of the annotation, so it does not have to be set in the layer.

Setting a visible scale range for the layer

Annotation features are most useful within a fairly narrow range of map scales in which they are legible. It is often helpful to set a minimum and maximum scale within which annotation feature classes will be drawn. You can make this visible scale range a property of the annotation feature class itself or set it as a property of a layer that points to the annotation feature class. For large annotation feature classes and in multiuser environments, the former approach is best, as it is the most effective way to prevent large numbers of annotation features from being needlessly requested from the server.

For this exercise, assume that users of this feature class will usually add the layer you’ve created, rather than adding the annotation feature class directly.

1. In ArcCatalog, right-click Water lateral diameter annotation.lyr and click Properties.
2. Click the General tab.



3. Click the Don't show layer when zoomed button, type “2500” in the Out beyond 1 box, and click OK.

To set the scale range for an annotation feature class, right-click the annotation feature class in ArcCatalog, click Properties, and click the Annotation Classes tab. You can set a separate scale range for each annotation class in the annotation feature class. Click the Scale Range button to set the minimum and maximum visible scales.

You have successfully imported coverage and INFO data into your geodatabase and created subtypes, rules, a geometric network, and feature-linked annotation. Now you will create a topology.

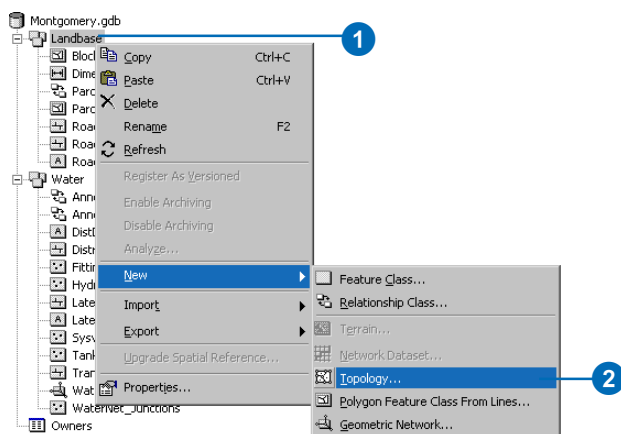
Exercise 8: Creating a topology

In Exercise 5, you created a geometric network. A geometric network is a specialized type of topological relationship that allows network tracing, analysis, and editing. In this exercise, you will create a geodatabase topology. A geodatabase topology allows you to specify rules that control the spatial relationships of features in a dataset. There are a variety of topology rules that you can apply to your data, depending on your organization's requirements. You will only apply two topology rules to this dataset.

Creating a topology

You'll create the topology to regulate two types of spatial relationships in this dataset. The first is that parcels should not overlap, and the second is that parcels that have been classified as residential must fall within blocks that are also classified as residential.

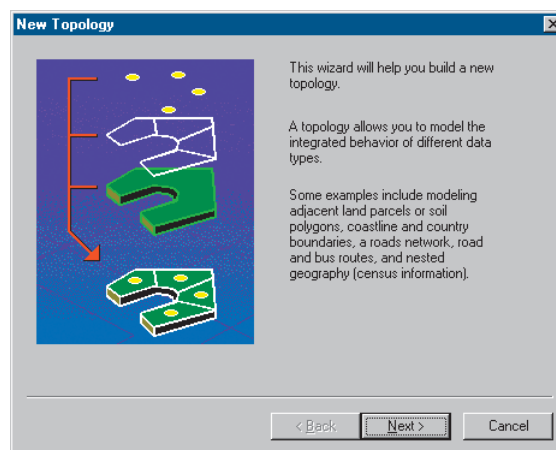
1. Navigate to the Landbase dataset in ArcCatalog.



This dataset contains several feature classes. You will create a topology using two feature classes—Parcels and Blocks.

2. Right-click Landbase, point to New, then click Topology.

The New Topology wizard starts. The first page provides a brief description of the wizard.

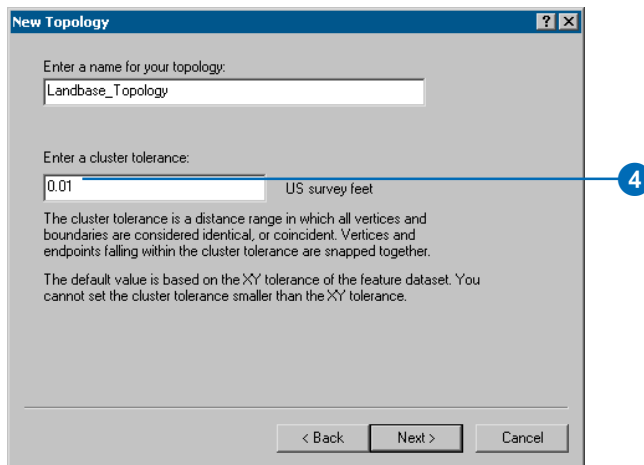


3. Click Next.

The wizard presents a default name and cluster tolerance for the topology. You will accept the default name that the wizard provides.

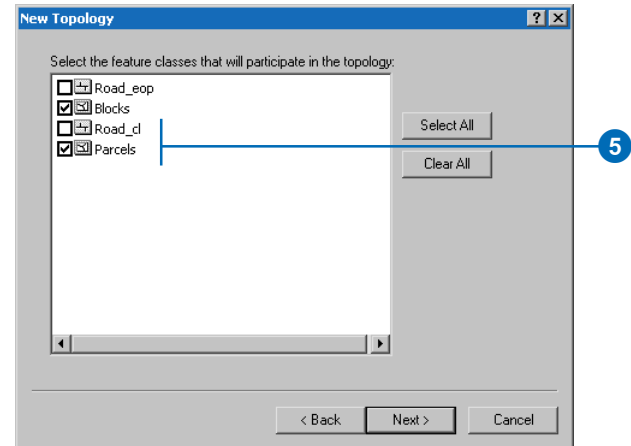
The default cluster tolerance is based on the XY Tolerance of the Landbase dataset.

4. Type “0.01” to set the new cluster tolerance, then click Next.



5. Check Blocks and Parcels.

These feature classes will participate in the topology.



One of the topology rules that you’ll create will concern the Parcels feature class, and the other will be between one subtype of Parcels and one subtype of Blocks, so both Blocks and Parcels feature classes must participate in the topology. If one of these feature classes were already participating in another topology or a geometric network or if they were registered as versioned in a multiuser geodatabase, it would not appear in the list of feature classes available to add to this topology.

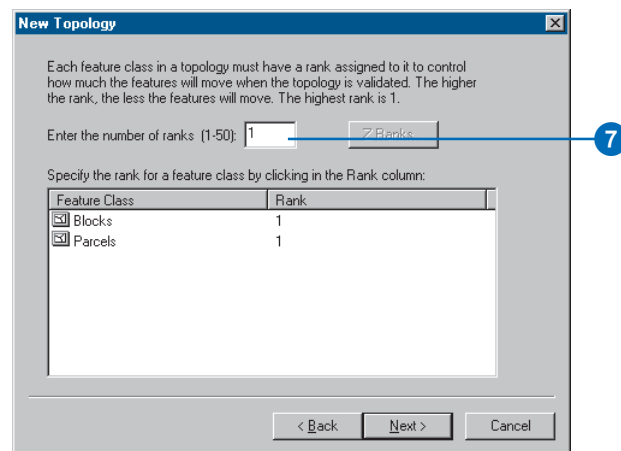
6. Click Next.

The next page of the wizard allows you to set the number of topology ranks and the rank of each feature class in the topology.

Ranks allow you to ensure that more accurately collected features are not snapped to the position of less accurately collected ones when the topology is validated. For example, if you were including a feature class that was collected using a survey grade global positioning system (GPS) unit and a feature class digitized from a 1:1,000,000-scale source map in the same topology, you might assign the GPS feature class a rank of 1 and the 1:1,000,000-scale source feature class a rank of 5. If you were to validate the topology, parts of features that fell within the cluster tolerance would snap together, with the less accurate ones moving to the location of the more accurate ones. The GPS features would not be moved to the position of the 1:1,000,000-scale features.

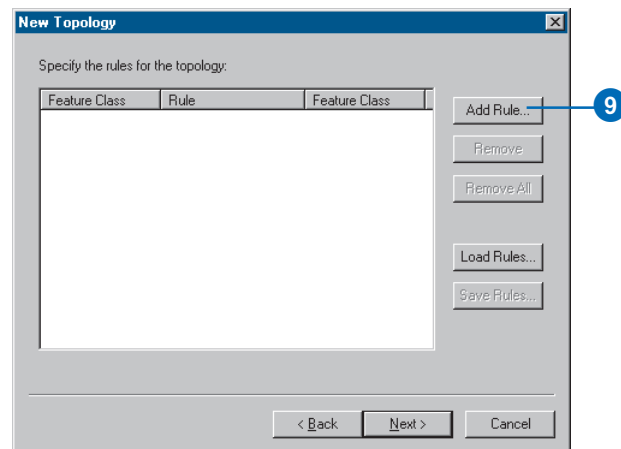
You can assign up to 50 different ranks, with 1 being the highest rank. In this topology, you will assume that all the feature classes are based on equally accurate data, so you will not assign more than one rank. Parcels and Blocks have equivalent levels of accuracy, since the Blocks feature class was derived from the parcel features.

7. Type “1” for the number of ranks.



8. Click Next.

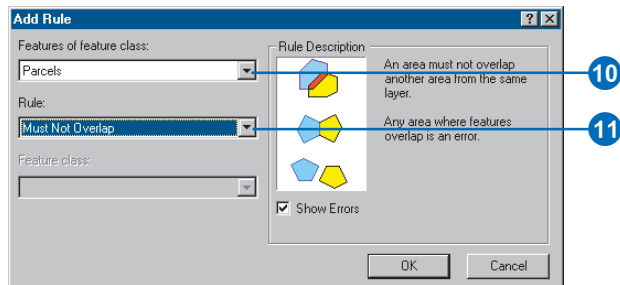
9. Click Add Rule.



Topology rules allow you to define the permissible spatial relationships of features within and between feature classes that participate in the topology.

Landownership parcels are usually not allowed to overlap each other. You will add a rule to prevent your parcel features from overlapping each other.

10. Click the Features of feature class dropdown arrow and click Parcels.

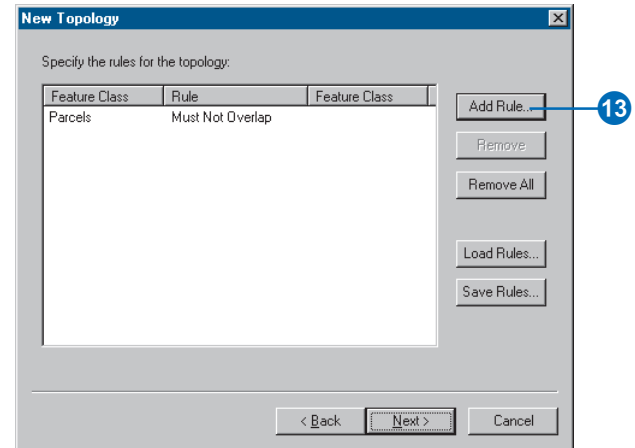


11. Click the Rule dropdown arrow and click Must Not Overlap.

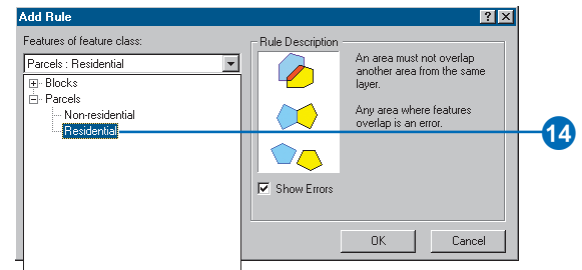
12. Click OK.

You've created a rule governing the topological relationship of features within the same feature class. Next you'll create a topology rule governing the topological relationship of features in particular subtypes of two different feature classes. Specifically, you'll make sure that residential parcels are covered by or contained within blocks also designated as residential.

13. Click Add Rule.

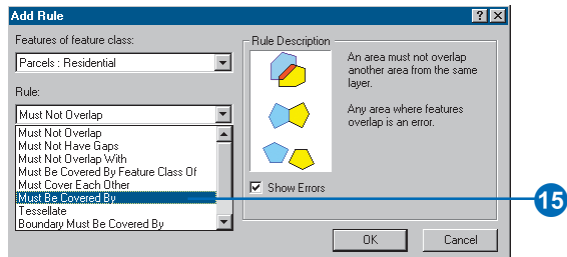


14. Click the Features of feature class dropdown arrow, click the plus sign to expand Parcels, and click Residential.

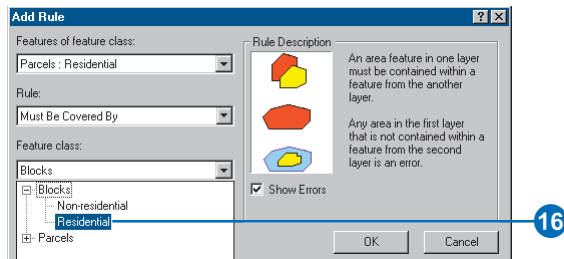


Residential is a subtype of the Parcels feature class that the planning department uses to represent parcels where people live.

15. Click the Rule dropdown arrow and click Must Be Covered By.



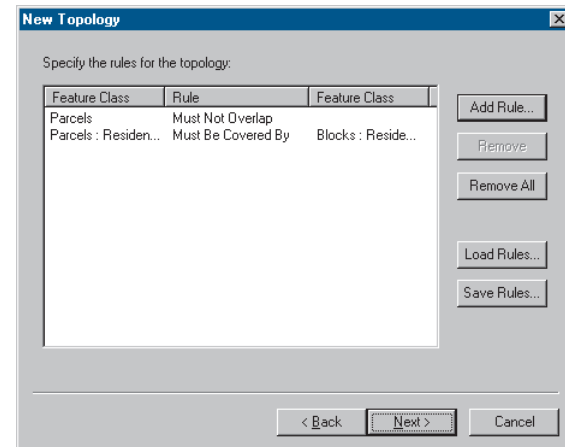
16. Click the Feature class dropdown arrow, click the plus sign to expand Blocks, and click Residential.



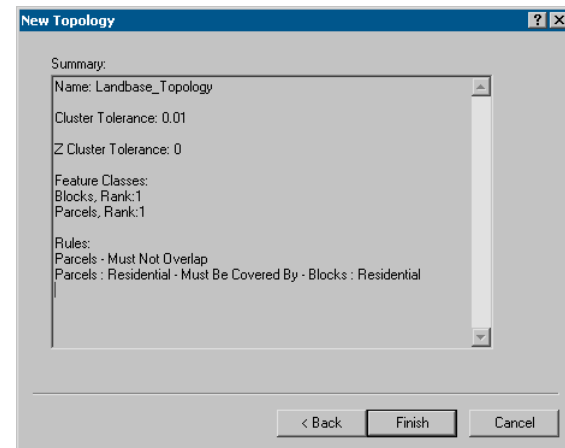
17. Click OK.

The topology rule is added to the list of rules for this topology.

18. Click Next.

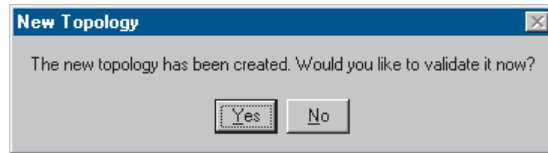


19. Click Finish.

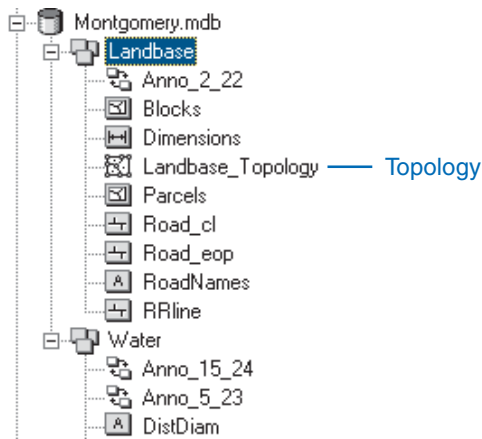


After the topology is created, you have the opportunity to validate it. You do not need to validate the topology immediately after creating it. Depending on your data and your work flow, it may make sense to assign different areas to data editors to validate and edit within ArcMap.

20. Click No.



The topology appears in the Landbase dataset.



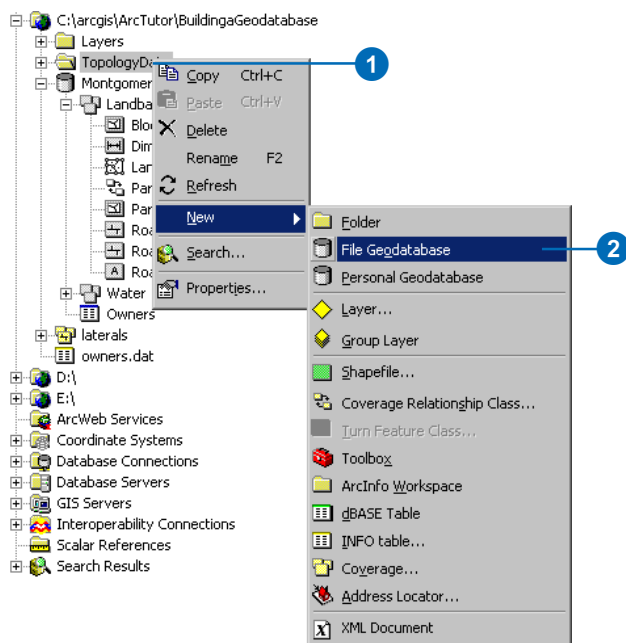
Exercise 9: Loading coverage data into a geodatabase topology

Imagine you manage water resources for a county. You want to create a geodatabase from existing data in coverages. You will import the relevant feature classes from a group of coverages for a reservoir; its flood stage inundation area; and contributing streams, as well as ponds, wells, and springs, within the watershed. You will then add topology rules that would be useful for managing this data.

Navigating to the data and creating a geodatabase

First, you'll find the existing data and create a geodatabase.

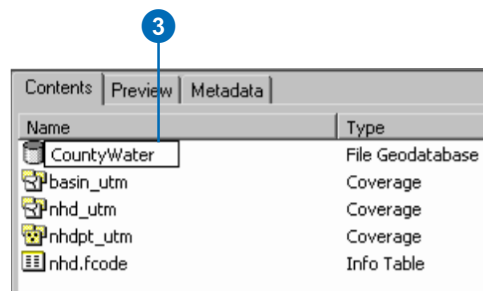
1. Navigate to the TopologyData folder in the BuildingGeodatabase folder.



2. Right-click TopologyData, point to New, then click File Geodatabase.

A new file geodatabase is created in the TopologyData folder. The temporary name, New File Geodatabase, is selected so you can easily rename it.

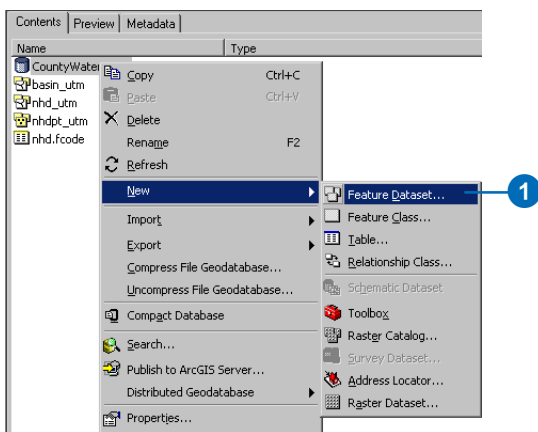
3. Type "CountyWater" and press the Enter key to rename the geodatabase.



You will be creating a topology to control the spatial relationships between some of the features and feature classes. Feature classes that participate in a topology must have the same spatial reference, so they must be in the same feature dataset. Since this geodatabase does not contain a feature dataset, you will create one.

Creating a new feature dataset

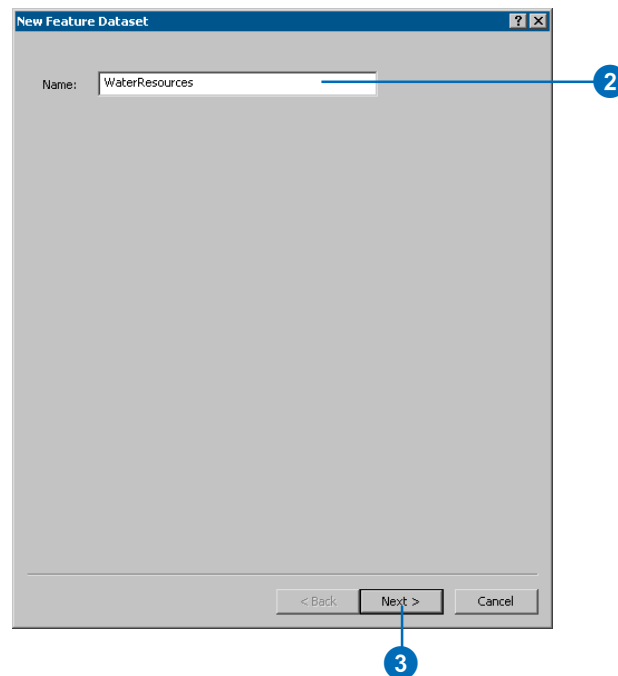
Geodatabase feature datasets can contain a number of feature classes that share a spatial reference. Because the feature classes share a spatial reference, they can participate in topologies and geometric networks with other feature classes in the dataset. In this step, you will create the dataset and calculate the correct XY domain for your data.



1. Right-click the CountyWater geodatabase, point to New, then click Feature Dataset.

The New Feature Dataset dialog box appears. Next, you'll name the dataset.

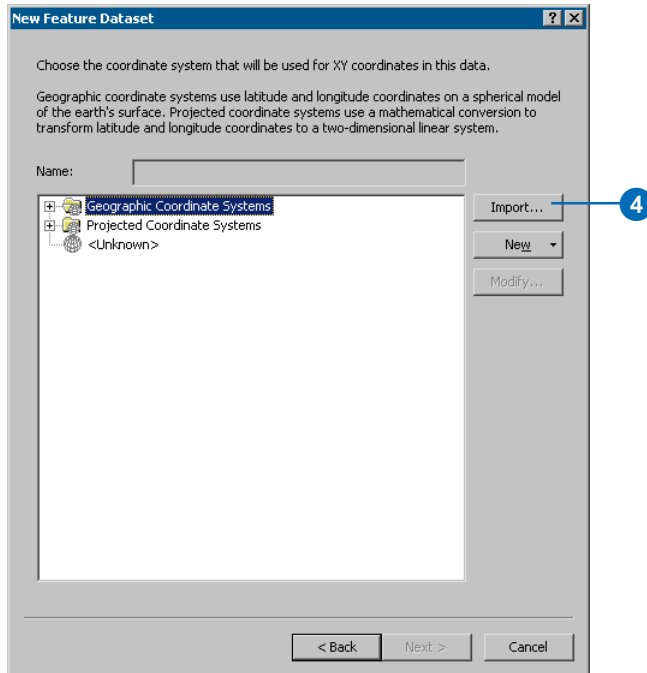
2. Type "WaterResources" in the Name text box.



3. Click Next.

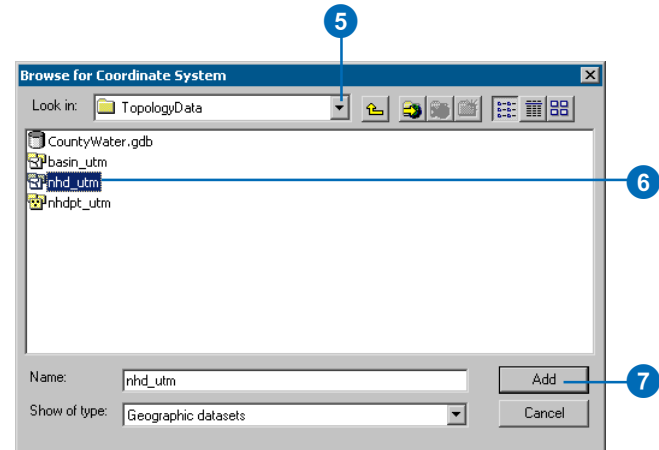
You will import the coordinate system information from one of the coverages.

4. Click Import.



The Browse for Coordinate System dialog box appears.

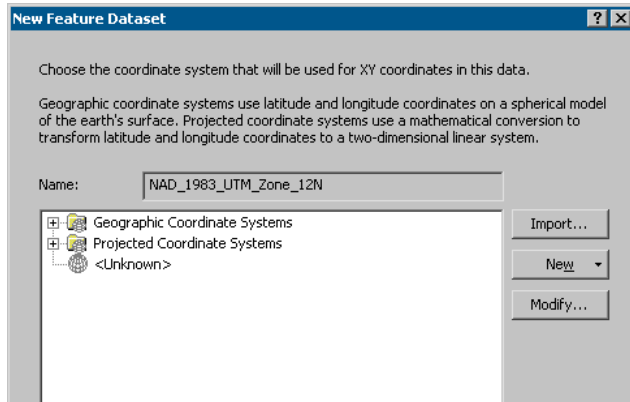
5. Navigate to the TopologyData folder in the BuildingaGeodatabase folder. The default installation path is C:\arcgis\ArcTutor\BuildingaGeodatabase.



You will import the coordinate system information from the nhd_utm coverage. This coverage is an area clipped from one cataloging unit of the National Hydrography Dataset. It has been projected from geographic coordinates into the Universal Transverse Mercator (UTM) coordinate system. The extent of this coverage is the same as the extent of the feature classes that you plan to load into the dataset.

6. Click nhd_utm.
7. Click Add.

The New Feature Dataset dialog box now shows the coordinate system information imported from the coverage.



8. Click Next.

Importing the coordinate system information from an existing coverage or feature class is one way to set the spatial reference for a feature dataset.

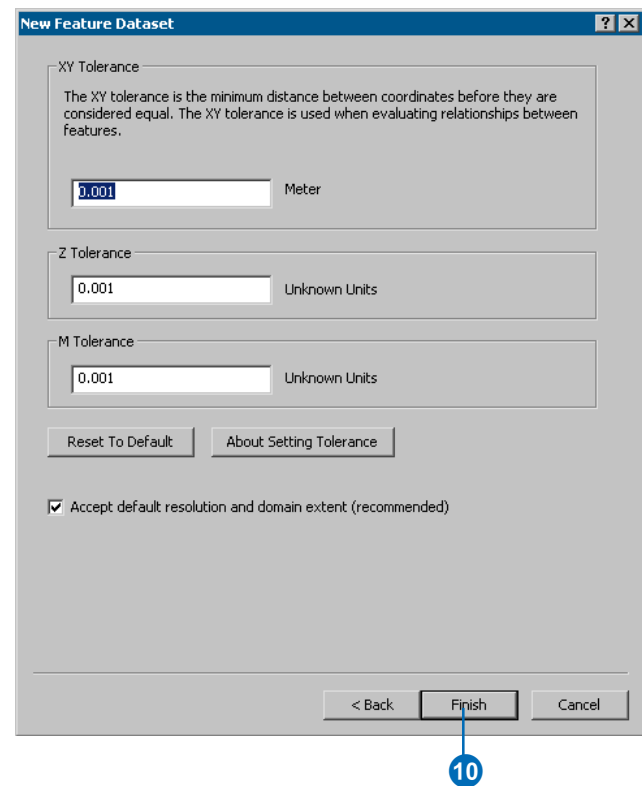
You have the option to set the Vertical Coordinate System for the dataset. In this case the Vertical Coordinate System is not important so you'll accept the default of "None".

9. Click Next.

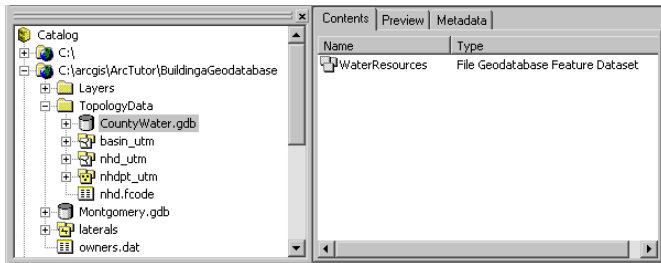
The next step is to set the XY Tolerance for the dataset. The XY Tolerance is used to resolve the location of coincident vertices during overlay of features and topology clustering. All of the features in a dataset share the same XY tolerance.

The default XY Tolerance is usually acceptable. In this case it is 0.001 meters. Your best data is accurate to a few meters, but you plan to add other data to the dataset in the future that could be accurate to a couple of centimeters. A millimeter XY tolerance will preserve centimeter level accuracy, so you'll accept the default value.

10. Click Finish.



The new WaterResources dataset is created in the CountyWater File Geodatabase.



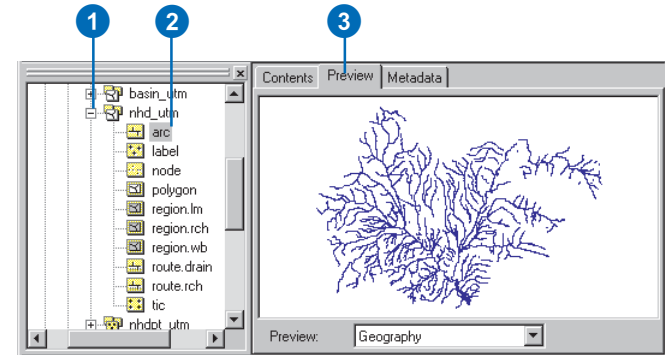
You've set the coordinate system and defined the XY Tolerance for the dataset so it can contain the feature classes from the coverages and maintain the shared geometry of the features without degrading their accuracy, or the accuracy of higher resolution data that you might add in the future. If you had data from shapefiles, or less accurate data, you might have set the XY Tolerance to a higher value (perhaps a few meters) in order to better integrate linework and automatically resolve overshoots, undershoots, dangles, and slivers during topological and overlay operations.

In the next section, you'll explore the coverages that contain the feature classes that you will add to the new dataset.

Exploring coverage feature classes

Coverages may contain a number of feature classes. The data that you will import into the dataset is stored in several feature classes in three different coverages.

1. Click the plus sign to expand the nhd_utm coverage.



2. Click the arc feature class.
3. Click the Preview tab.

You can see the features that are stored in this feature class.

The feature classes in coverages are topologically related to each other. The first feature class listed in this coverage is an arc feature class. Arc feature classes store linear features. In this coverage, there are two route feature classes. Routes are linear features that are collections of the features in the arc feature class. There is a single polygon feature class. Polygon feature classes are built from features in the arc and label feature classes. Each polygon is defined by a set of linear features from the arc feature class and has attributes stored with a label point from the label feature class. In this coverage, there are three region feature classes. Regions are area features that are collections of features from the polygon feature class.

4. Click the Zoom In tool.



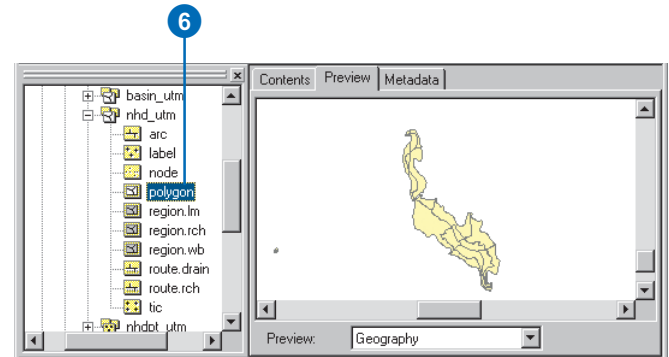
5. Click and drag a box around the southeastern part of the arc feature class in the Preview tab.



You can see a pattern that is like a stream channel system, except that it has some extra lines. These lines are present to define features in the polygon feature class.

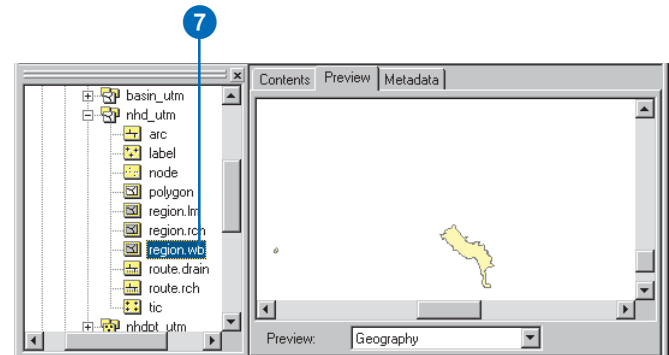


6. Click the polygon feature class.



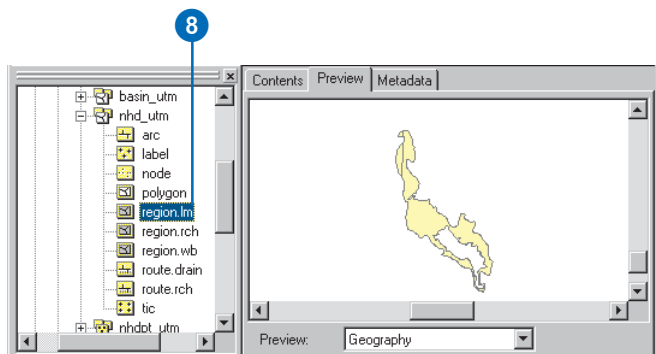
You can see a group of area features that look like puzzle pieces fitted together in the shape of a reservoir.

7. Click region.wb.



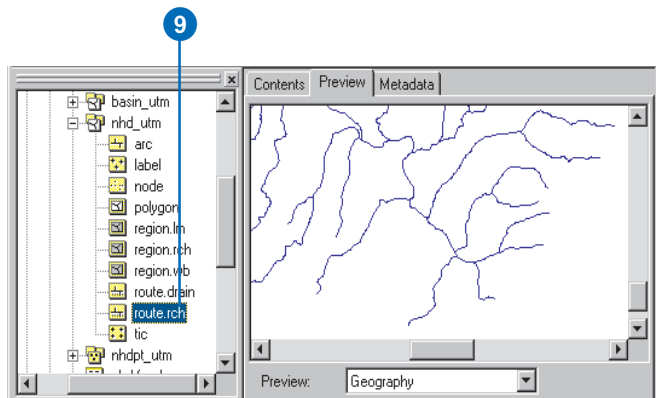
Now you can see a smaller area feature that is not divided into parts. This region feature represents the usual fill level of the reservoir. It is composed of some of the features from the polygon feature class.

8. Click region.lm.



You can see a larger area feature with a hole in it that matches the reservoir. This is the flood zone for the reservoir.

9. Click route.rch.



You can see the streams plus flow lines through the reservoir. The lines that define the reservoir and flood zone boundary are not part of this route feature class.

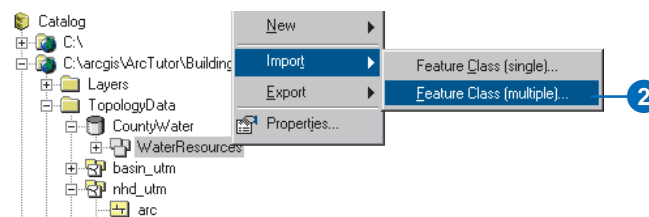
The other two coverages in this folder are basin_utm and nhdpt_utm. The basin_utm coverage has one polygon feature class containing a polygon that defines this watershed, and the nhdpt_utm coverage contains a point feature class with a set of points that shows the locations of springs, wells, and gauging stations within the watershed.

You have explored the contents of the existing coverages. Next, you will load some of the coverage feature classes into your new file geodatabase dataset.

Loading coverage feature classes into a dataset

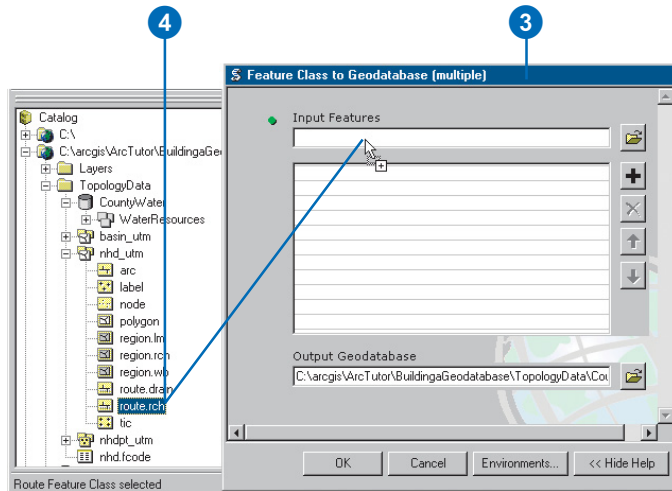
You will only load some of the feature classes from these coverages into the new dataset. The arc, label, and polygon feature classes in the nhd_utm coverage do not need to be loaded because they exist only to support the route and region feature classes. Similarly, the arc and label feature classes in basin_utm do not need to be loaded, as they only support the polygon feature class.

1. Navigate to the WaterResources dataset that you created in the CountyWater file geodatabase.
2. Right-click the WaterResources dataset, point to Import, and click Feature Class (multiple).



You will load the stream data first.

3. Move the Feature Class to Geodatabase (multiple) dialog box so you can see it and the Catalog tree side by side.

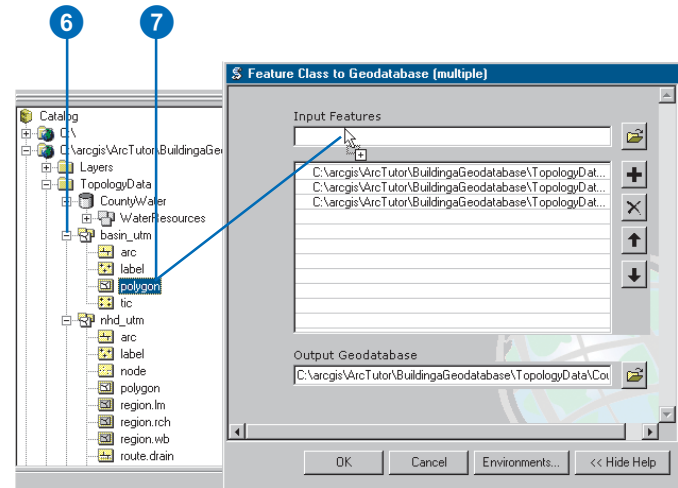


4. Click and drag the route.rch feature class to the Input Features text box of the Feature Class to Geodatabase (multiple) dialog box.

The route.rch feature class is added to the list of feature classes that will be loaded into the geodatabase.

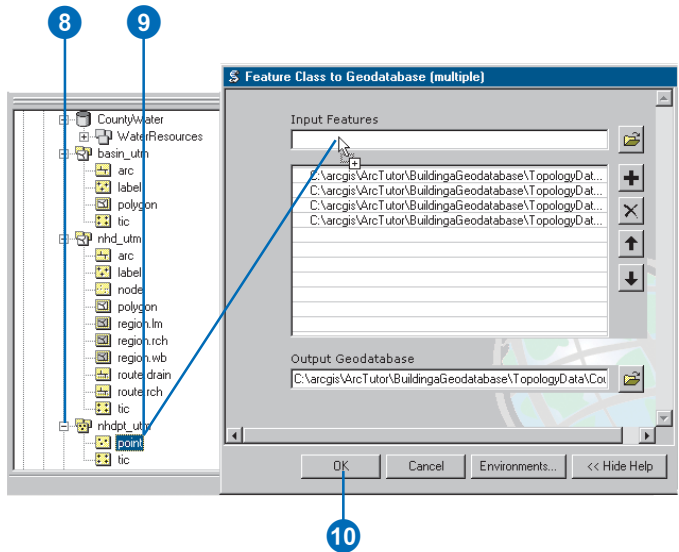
5. Use the same technique to add the region.wb and region.lm feature classes from the nhd_utm coverage to the list.

6. Click the plus sign to expand the basin_utm coverage.



7. Click and drag the polygon feature class of the basin_utm coverage to the Input Features text box of the Feature Class to Geodatabase (multiple) dialog box.

8. Click the plus sign to expand the nhdpt_utm coverage.



9. Click and drag the point feature class of the nhdpt_utm coverage to the Input Features text box of the Feature Class to Geodatabase (multiple) dialog box.

10. Click OK.

The feature classes are loaded into the feature dataset.

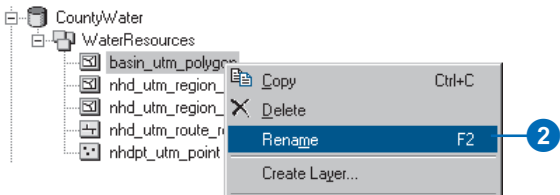
11. Click Close.

If you choose to skip the data loading process, you can find a compressed copy of the final geodatabase, named CountyWater.zip, in the TopologyData folder.

Renaming the feature classes

Now that the feature classes have been loaded, you will give them more descriptive names.

1. Double-click the WaterResources feature dataset.
2. Right-click basin_utm_polygon and click Rename.



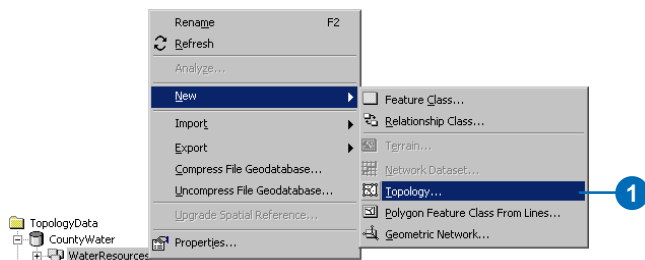
3. Type “watershed” and press the Enter key.
4. Use the same technique to change the names for the other feature classes, using the table below.

Feature class name	New feature class name
basin_utm:	
basin_utm_polygon	watershed
nhd_utm:	
nhd_utm_region_wb	waterbodies
nhd_utm_region_lm	floodzones
nhd_utm_route_rch	streams
nhdpt_utm:	
nhdpt_utm_point	hydro_points

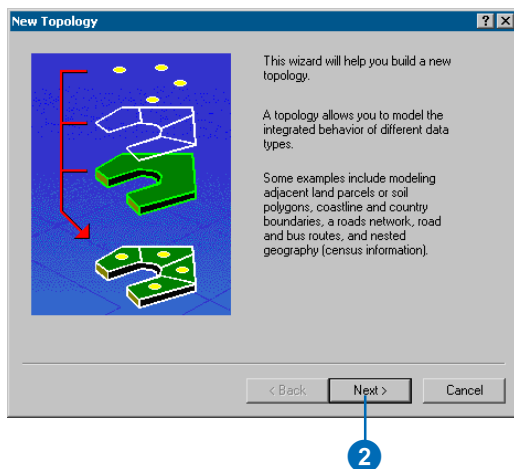
Creating a topology

Now that the feature classes have been renamed, you will create a topology to regulate certain spatial relationships between and within these feature classes.

1. Right-click the WaterResources feature dataset, point to New, and click Topology.



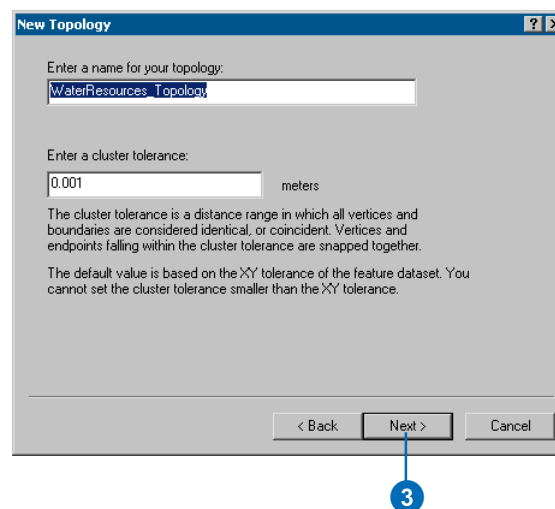
2. Click Next.



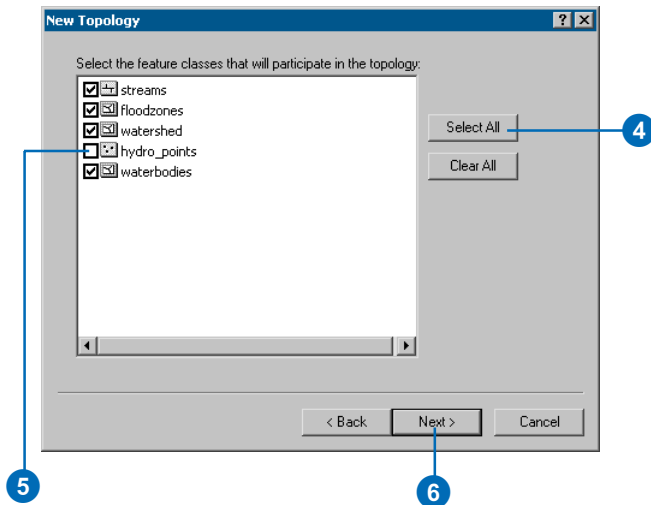
You could use this dialog box to rename the topology or increase the cluster tolerance. The default cluster tolerance is the XY Tolerance of the dataset. Parts of features within 0.001 meters of each other will be snapped together when the topology is validated. The cluster tolerance cannot be made smaller than the XY Tolerance, although it can be made larger.

Increasing the cluster tolerance to 0.5, for example, would cause vertices of features within 0.5 meters of each other to be snapped together in topology clustering. For this exercise, you will accept the default name and cluster tolerance.

3. Click Next.



4. Click Select All.



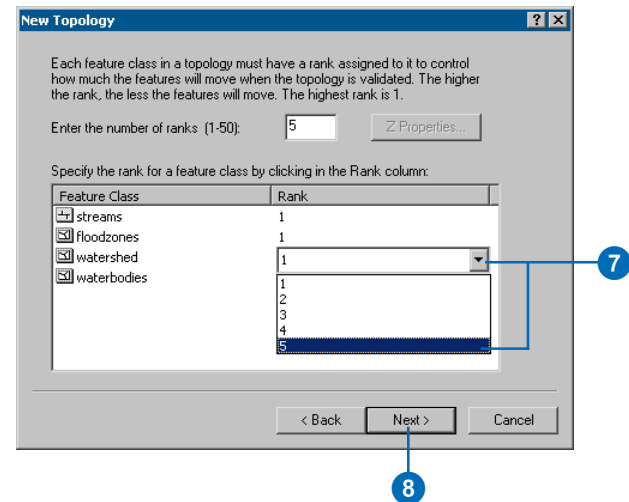
All but one of these feature classes will participate in the topology.

5. Uncheck hydro_points.

You do not need to manage any spatial relationships for these point features.

6. Click Next.

7. Click in the Rank column for the watershed feature class and click 5.



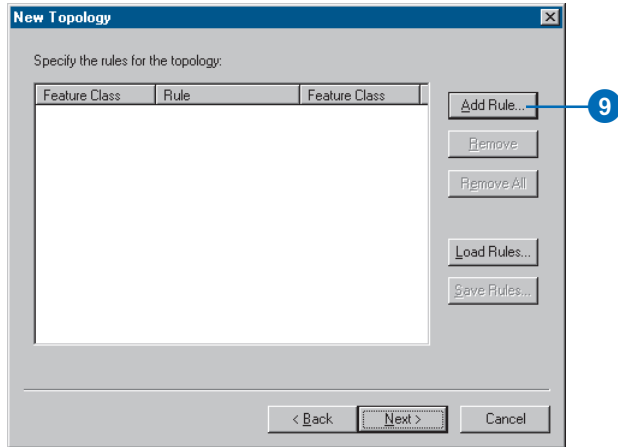
The watershed feature class contains the least accurate data in the dataset. It was heads-up digitized around the streams upstream from the reservoir to create an approximate boundary. Since it is lower quality data, you should set it to a lower rank of 5. This will prevent features in higher ranking feature classes from being snapped to it when the topology is validated. The other feature classes are all of equal accuracy, so you'll leave them at rank 1.

8. Click Next.

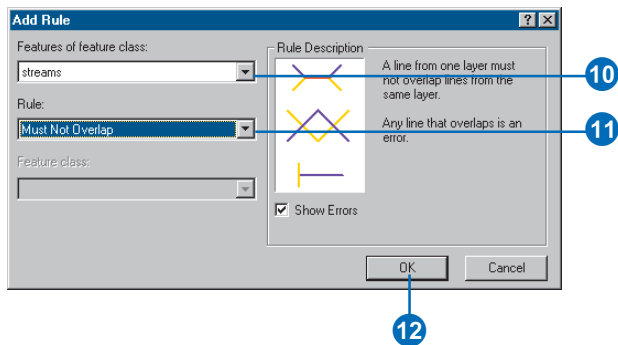
There are a number of spatial relationships that you will regulate with this topology. You want to be sure that features in all the feature classes do not overlap, that the area features in the floodzones and waterbodies feature

classes do not overlap each other, and that the stream features do not have pseudonodes.

9. Click Add Rule.



10. Click the Features of feature class dropdown arrow and click streams.



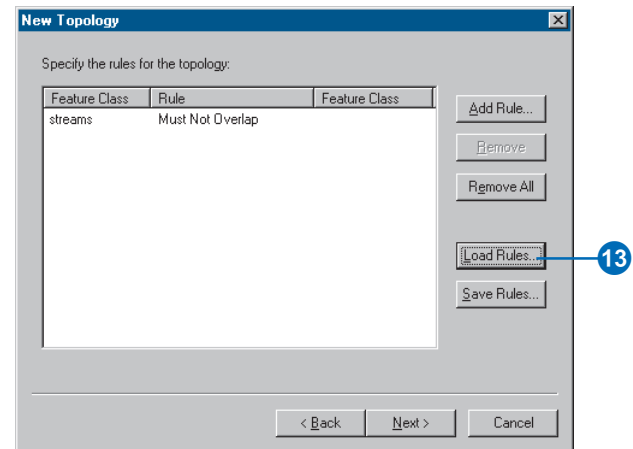
11. Click the Rule dropdown arrow and click Must Not Overlap.

12. Click OK.

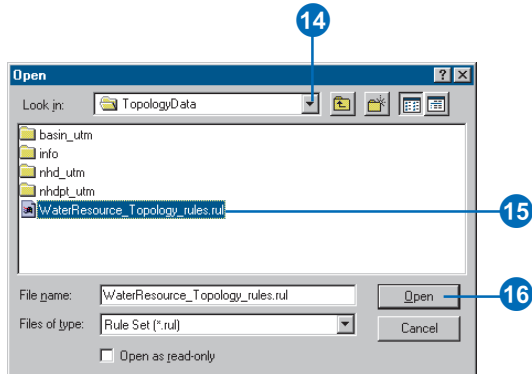
The rule is added to the list on this panel of the wizard.

You would ordinarily continue adding topology rules for each of the topological relationships that you want to define. The rules for this topology have been stored in a rule set file, so you will load them.

13. Click Load Rules.



14. Navigate to the TopologyData folder. The default installation path is
C:\arcgis\ArcTutor\BuildingaGeodatabase\TopologyData.

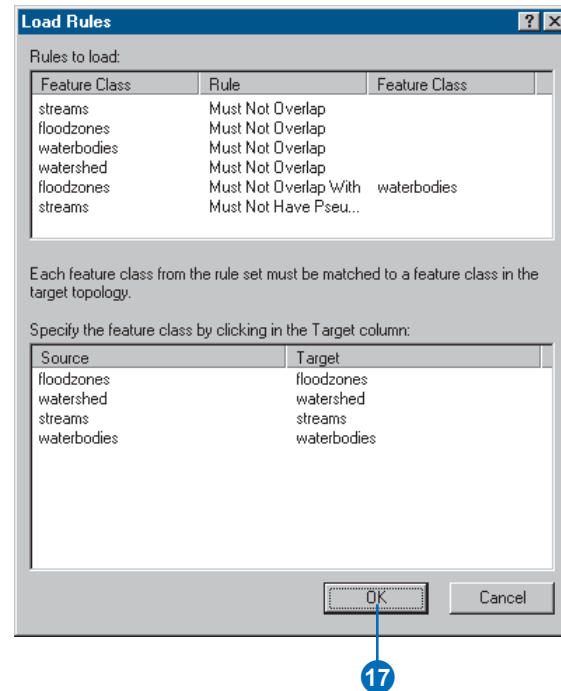


15. Click WaterResource_Topology_rules.rul.

16. Click Open.

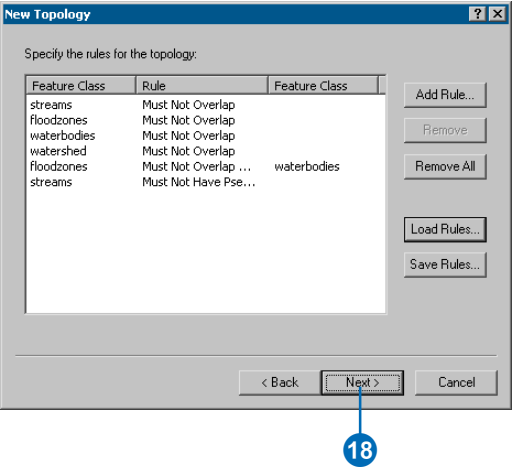
The Load Rules dialog box appears. If the feature classes mentioned in the rules do not have the same names as the feature classes in the dataset, you can use this dialog box to match them.

17. Click OK.

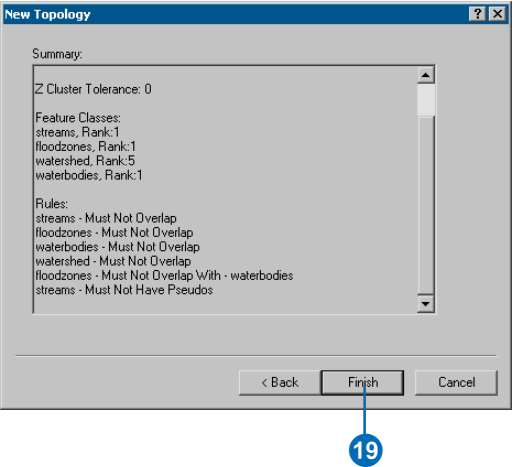


The rules are added to the topology.

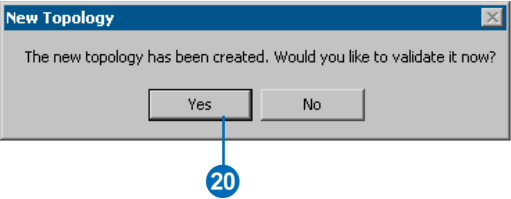
18. Click Next.



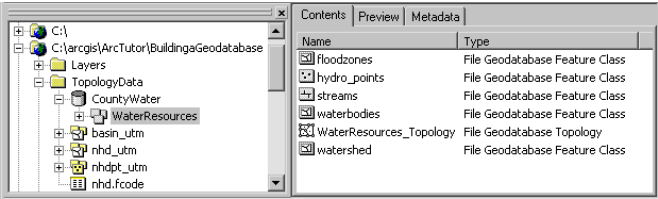
19. Click Finish.



20. Click Yes.



The new topology is added to the dataset and validated.



In this exercise, you learned how to create a geodatabase and a new dataset for loading topological data. You defined the coordinate system and XY Tolerance. You loaded topological data from coverages, leaving out unnecessary feature classes. Finally, you created a geodatabase topology to define a specific set of permissible spatial relationships between features within feature classes and between feature classes.

In the first exercise in this tutorial, you learned how to begin organizing data for a geodatabase in ArcCatalog.

In Exercise 2, you learned how to import tables and feature classes into a geodatabase.

In Exercise 3, you learned how to create subtypes and attribute domains in a geodatabase.

In Exercise 4, you learned how to create relationships between objects in a geodatabase.

In Exercise 5, you learned how to build a geometric network in a geodatabase.

In Exercise 6, you learned how to create feature-linked annotation in a geodatabase.

In Exercise 7, you learned how to create layers pointing to feature classes in a geodatabase.

In Exercise 8, you learned how to create a geodatabase topology.

In Exercise 9, you learned how to create a new dataset in which to load topological data and how to create a new topology.

To learn more about these topics see the ArcGIS Desktop Help system.