



Cartographic Representations Tutorial



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Introduction to the cartographic representations tutorial

Introducing the cartographic representations tutorial

The cartographic representations tutorial introduces you to feature class representations that allow you to symbolize geographic features with a set of rules that are stored with your data in the geodatabase. Representation rules can create and draw dynamic geometry that differs from the feature shape, allowing a complex depiction of features without impacting the spatial integrity of your data. Representations provide greater control over the precision and definition of the symbolization of your data.

The complete tutorial consists of the following exercises. It will take you approximately two hours to complete.

1. [Learning the fundamentals of representations](#)
2. [Interacting with representation properties](#)
3. [Performing edits with representations](#)
4. [Working with free representations](#)
5. [Using geoprocessing tools for representations](#)

Tutorial data

The data for the Cartographic Representations tutorial is located in the <install drive>:\ArcGIS\ArcTutor\Representations folder when you install the ArcGIS Tutorial Data.

Exercise 1: Learning the fundamentals of representations

In this exercise, you will examine a map that needs to be updated with new symbology. You will use feature class representations to improve the map. Feature class representations give you greater flexibility and control of your map symbology by storing complex, rule-based symbols in the geodatabase along with the map data. You will learn different ways to create a feature class representation within a geodatabase and how to convert symbolized layers into feature class representations.

Complexity:
Beginner

Data Requirement:
ArcGIS Tutorial Data Setup

Data Path:
C:\ArcGIS\ArcTutor\Representations

Goal:
Improve a map by converting symbolized layers into feature class representations.



License: Creating and modifying feature class representations require an ArcEditor or ArcInfo license. You will need at least an ArcEditor license to complete the steps of this tutorial.



Caution: You must copy the tutorial data to a local directory to which you have write access. These exercises modify the databases provided to you, so you should make backup copies of them before you begin so you or someone else can follow the tutorial in the future.

Creating feature class representations in ArcMap

You will work with a topographic map of Austin, Texas. This map contains layers that are already symbolized for you. You will use representations to update and improve some of the symbology.



Steps:

1. [Start ArcMap](#).
2. Open Exercise_1.mxd from C:\ArcGIS\ArcTutor\Representation\Exercise_1.
3. Right-click the RoadL layer in the table of contents and click **Convert Symbology to Representation**.
The *Convert Symbology to Representation* dialog box opens.

Convert Symbology to Representation

Create a new representation in this layer's data source based on layer's current symbology.

Name:

Two new fields will be added to the feature class to store the IDs of the rules used to draw the features and data for any overrides applied to the features during editing:

Feature Class:

Rule ID Field:

Override Field:

Behavior When Representation Geometry Is Edited

☒ Store change to geometry as representation override

☐ Change the geometry of the supporting feature

Assign Representation Rules To

☒ All features

☐ Features in current extent

☐ Selected features


☒ Add new layer to map symbolized with this representation

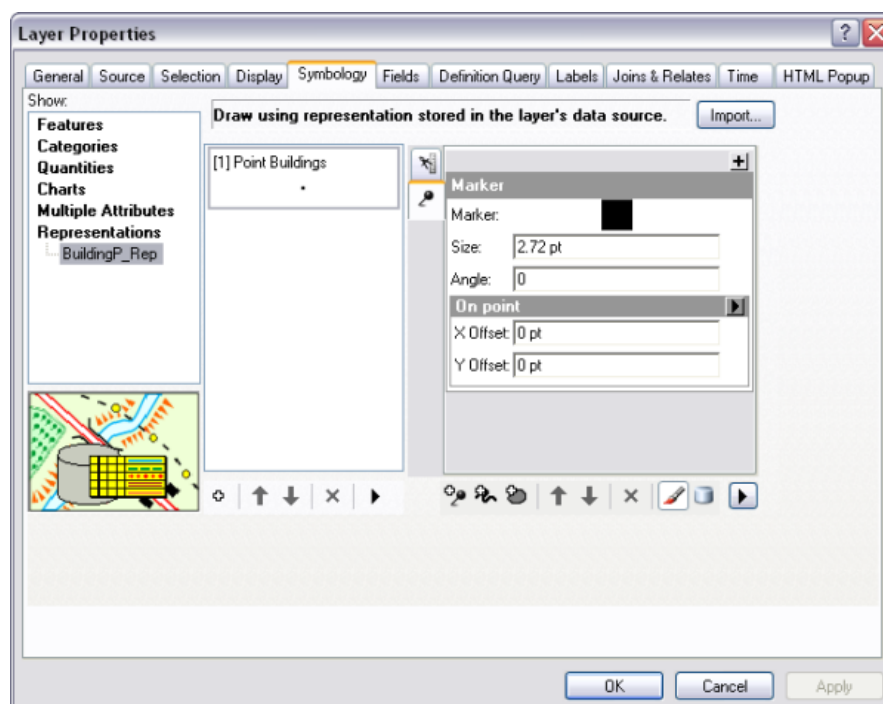
4. Examine all the default settings and click **Convert**.
 - The representation **Name** is automatically populated with the name of the feature class appended by the suffix `_Rep`.
 - **RuleID Field** is the name of the field that will store an integer value for a feature that references a particular representation rule that dictates how it will be symbolized. The default name for this field is RuleID.
 - **Override Field** is the field that stores any overrides to a representation rule for a feature. It is a BLOB field type. The default name for this field is Override.
 - The **Behavior When Representation Geometry Is Edited** property tells ArcGIS where to store geometry edits made with the representation editing tools. These changes can be stored in either the Override field or the Shape field of the feature class.
 - The new layer, RoadL_Rep, is added to the table of contents. The original RoadL layer (symbolized with unique values) is still in the table of contents below the RoadL_Rep layer.
5. Hold down the CTRL key and click any check box in the table of contents to turn all layers off. Check the RoadL and RoadL_Rep layers. Toggle these two layers on and off using the check boxes to visually compare how they are symbolized. You may want to zoom and pan in the map to see the differences and similarities.
6. Hold down the CTRL key and click an empty check box in the table of contents to turn all the layers on again.
7. Repeat steps 3 and 4 for the following layers:
 - RailroadL
 - TrailL

- HydroL
 - BuildingA
 - WetlandsA
8. When you have finished comparing the new layer to the original layers, hold down the **CTRL** key and click the six original layers in the table of contents to select them. Right-click one of the selected layers and click **Remove** to delete these layers from the map. Only the layers symbolized by representations (with **_Rep** suffixes) will remain.

Symbolizing layers with representations in ArcMap

Steps:

1. Click the **Add Data** button  and navigate to the BuildingP feature class (inside Representations_1.gdb, TopographicMap feature dataset). Click **Add** on the **Add Data** dialog box to add the feature class to the table of contents.
2. Right-click BuildingP and click **Properties**. The **Layer Properties** dialog box opens.
3. Click the **Symbology** tab.
4. Click **Representations** in the **Show** list on the dialog box. You will see a list of the available feature class representations for BuildingP_Rep. There is one representation rule for BuildingP_Rep, and it is shown with its properties.



5. Click **OK** to close the **Layer Properties** dialog box. The buildings on the map are symbolized with the black square defined in the Point Buildings representation rule in the BuildingP_Rep representation.

6. Click the BuildingP feature layer in the table of contents to select it. Click it again to highlight the name. Rename it by typing `BuildingP_Rep` to indicate to yourself that it is symbolized with representations.
7. Right-click the BuildingP_Rep feature layer and click **Open Attribute Table**.
8. Scroll right, if necessary, to see the Angle field.
The Angle field contains values that define the angles of the buildings as they appear on the ground, relative to either geographic or arithmetic orientation. Although buildings are typically captured and modeled as simple point locations for topographic maps at this scale (1:24,000), it is cartographically desirable to portray them at their true orientation. You will use the values in this field to orient building symbols later in [Exercise 2](#) of this tutorial.
9. Close the attribute table of the BuildingP_Rep layer.
10. Save the current map as Exercise_one.mxd and close ArcMap.

Preparing a feature class for a new representation in ArcCatalog

When working in ArcCatalog, you may want to create new representations for a feature class using existing symbology that you are familiar with. In ArcMap, the **Layer Properties** dialog box provides this information, whereas in ArcCatalog, the information about symbology is derived from a layer file. You can create layer files for your feature classes with symbology of your choosing for those times when you choose to create representations in ArcCatalog. In ArcCatalog, you can accomplish this through ModelBuilder, at the **Python** window, with a script with the ArcPy commands, with the [Add Representation](#) geoprocessing tool, or through the **Feature Class Properties** dialog box. You can also work with a feature class and its properties from the **Catalog** window in ArcMap.

Create a feature class representation in ArcCatalog

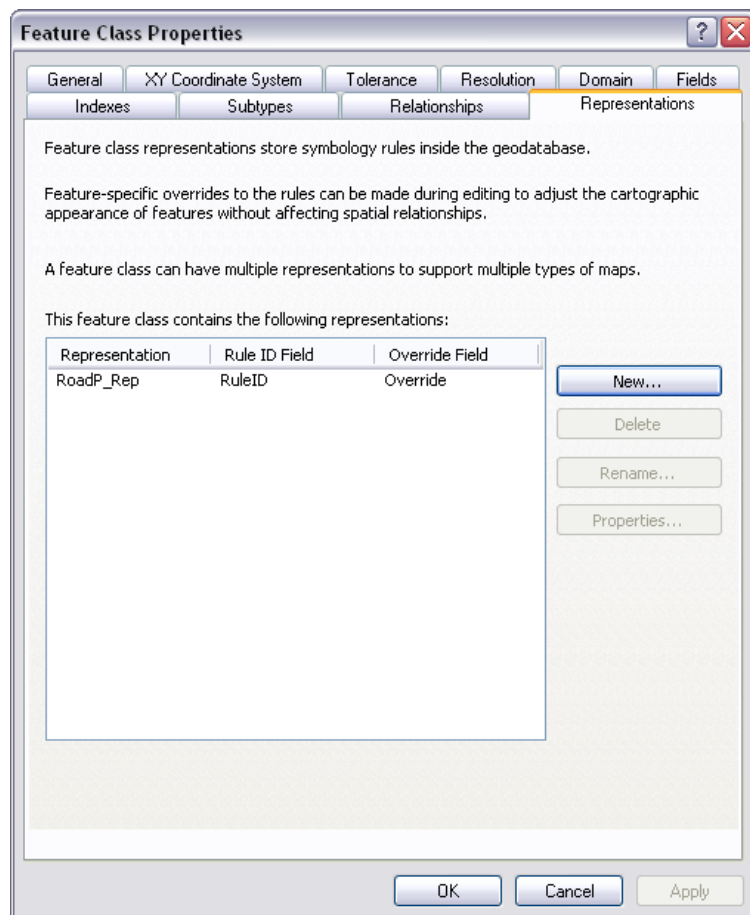
Steps:

1. Start ArcCatalog.
2. Right-click the feature class RoadP (inside the TopographicMap feature dataset, in Representations_1.gdb) in the Catalog tree and choose **Properties**.
3. Click the **Representations** tab on the **Feature Class Properties** dialog box.
The list is empty because the RoadP feature class does not have any feature class representations. You will add one now.
4. Click **New**.
The **New Representation** dialog box opens. Note the similarities between this dialog box and the **Convert Symbology to Representation** dialog box in ArcMap you used earlier in this exercise.
5. Keep the default name RoadP_Rep and the default field names RuleID and Override.
6. Check the box to import representation rules from a layer file. Navigate to the RoadP layer.lyr in the Exercise_1 folder.
You can import rules from any layer file. Checking this box allows you to choose where your representation rules come from.

7. Check the box to assign rules to the features that match the layer file.
This option is only available when the layer file you are importing rules from has the same source as the current feature class. Checking this option will assign representation rules to individual features.

Your dialog box should look like the one below.

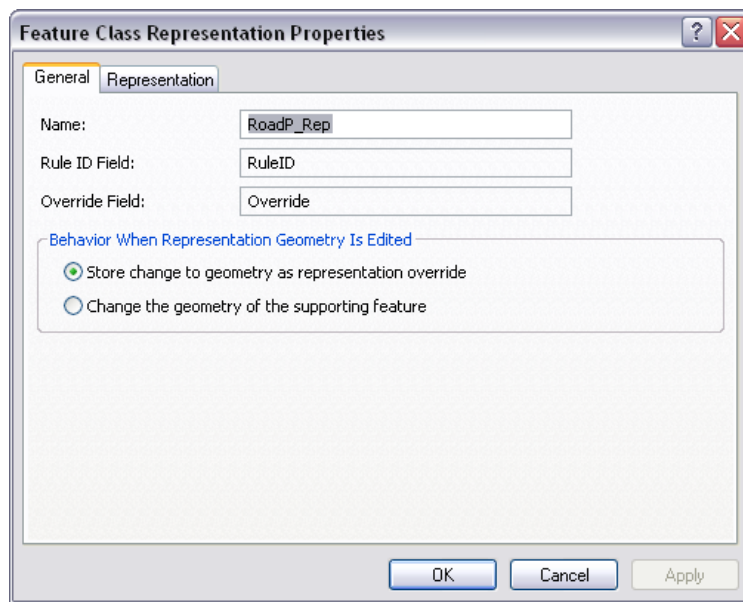
8. Click **Finish**.
The new RoadP_Rep feature class representation appears on the **Representations** tab of the **Feature Class Properties** dialog box.




Examining feature class representation properties in ArcCatalog

Steps:

1. With the **Feature Class Properties** dialog box still open, click RoadP_Rep and click **Properties**.
The **Feature Class Representation Properties** dialog box opens.
2. Click the **General** tab if necessary.



The **General** tab shows the name of the feature class representation and the two field names, as well as the geometry editing behavior setting. This setting and the name of the feature class representation can be changed from this pane, but for this exercise, leave them as is.

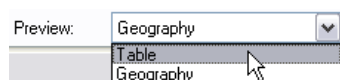
You can use the Help button  at the top of the dialog box to click any item on this menu to learn more about the components of feature class representations.

3. Click the **Representation** tab.

You will notice that the symbol size is now 2.72 points instead of 4 points as before the conversion. Before conversion, the symbol was a character marker symbol. These symbols are stored as glyphs in a font. The envelope of the glyph is 4 points in size, whereas the symbol inside the envelope is actually 2.72 points. The symbol has converted correctly into a representation, even if the numbers seem unexpected. When you are in ArcMap, you can switch back and forth from the Representation renderer to the Features renderer to see that the new and old symbols are the same size.

This tab lists the representation rules that are part of the RoadP_Rep feature class representation, which currently has only one representation rule, Rule_1.

4. Click the name of the representation rule, Rule_1. Once the text is selected, type Road Caps to rename the representation rule.
5. Click **OK** to close the **Feature Class Representation Properties** dialog box.
6. Click **OK** to close the **Feature Class Properties** dialog box.
7. With the RoadP feature class still selected in the Catalog tree, click the **Preview** tab and choose **Table** from the pull-down menu.



8. Examine the attribute table to see the two new columns that have been added: RuleID and Override. The RuleID field stores the numeric values associated with representation rules, in

this case, representation rule 1. The Override field will store any feature-level exceptions you make to the representation rules during editing.

| RuleID | Override |
|--------|----------|
| Rule_1 | Blob |
| Rule_1 | Blob |
| Rule_1 | Blob |
| Rule_1 | Blob |
| Rule_1 | Blob |
| Rule_1 | Blob |

9. Exit ArcCatalog.

Congratulations, you've completed exercise 1.

Things created and accomplished in this exercise:

- Created a feature class representation in ArcCatalog
- Added a new representation
- Symbolized a layer with a representation in ArcMap
- Renamed a representation in symbology
- Converted symbology to representation in ArcMap

Exercise 2: Interacting with representation properties

In this exercise, you will work in ArcMap to understand how to interact with feature class representations and how representation rules drive the way features are displayed on a map. You will start by learning how to add a representation rule to one of the feature class representations you created in [Exercise 1](#). You will learn to interact with marker, line, and fill symbology as defined by representation rules. You will learn how to modify representation rules by adding and modifying symbol layers and geometric effects.

Complexity:
Beginner

Data Requirement:
ArcGIS Tutorial Data Setup


Data Path:
C:\ArcGIS\ArcTutor\Representations

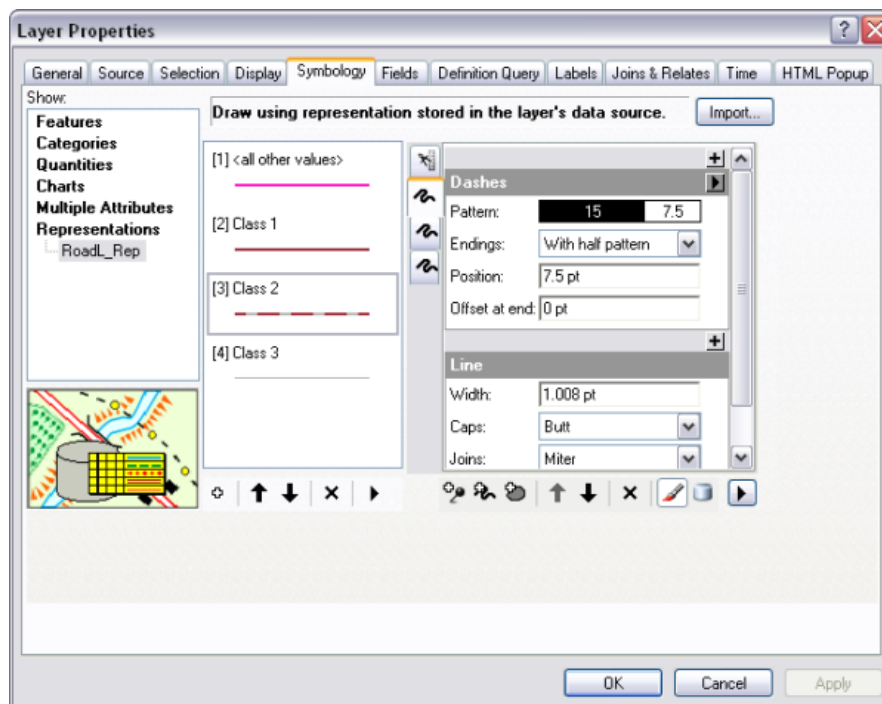
Goal:
Understand how to interact with feature class representations and how representation rules drive the way features are displayed on a map.

As you work on this exercise, keep in mind that representation properties cannot be changed on the **Layer Properties** dialog box when an edit session is open.


Examining representation rules

Steps:

1. [Start ArcMap](#).
2. Continue with the map document from Exercise 1 or open Exercise_2.mxd.
3. Ensure that the **Editor** and **Representation** toolbars are visible. If not, click **Customize > Toolbars** and add each toolbar.
4. Double-click RoadL_Rep in the table of contents to open the **Layer Properties** dialog box.
5. Click the **Symbology** tab.
The RoadL_Rep layer is symbolized with the RoadL_Rep feature class representation, which contains four representation rules. These four rules have been translated from the four symbol categories present in the original symbolized layer from which the feature class representation was derived.
6. Click the third representation rule, Class 2, in the list. The right side of the dialog box shows the properties of that representation rule.
The Class 2 representation rule consists of three stroke symbol layers, indicated by the three stacked tabs showing a stroke squiggle.
7. Click the first (topmost) line tab  in the list of symbol layers.




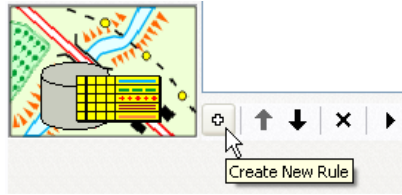
This symbol layer includes the **Dashes** geometric effect to place red solid lines in alternating intervals along the linear geometry of the feature. This symbol layer is at the top of the symbol layer stack for this rule, so it is the last to draw and therefore appears above the other two symbol layers.


8. Click the second, then the third line symbol layer tabs  in this representation rule. Neither of these symbol layers includes a geometric effect. The bottommost symbol layer is a solid, thick black line and is the first to be drawn. The second symbol layer is a slightly thinner, white line. Together they give the appearance of a cased line symbol.
9. Click **OK** to close the **Layer Properties** dialog box.
10. Repeat steps 4 through 10, if desired, to see how other symbol categories were translated into representation rules when you created feature class representations in Exercise 1.

Adding new representation rules

Steps:

1. Click **Bookmarks > 1) Buildings**.
2. Double-click BuildingP_Rep in the table of contents to open the **Layer Properties** dialog box.
3. Click the **Create New Rule** button  to add a new representation rule to the BuildingP_Rep feature class representation.



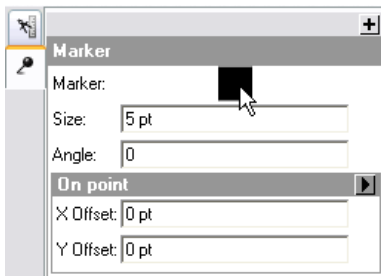
4. Click the **Layer Options** button  and click **Units > Points**.
5. Click the name of the new rule, Rule_2, to select it.

Rule_2

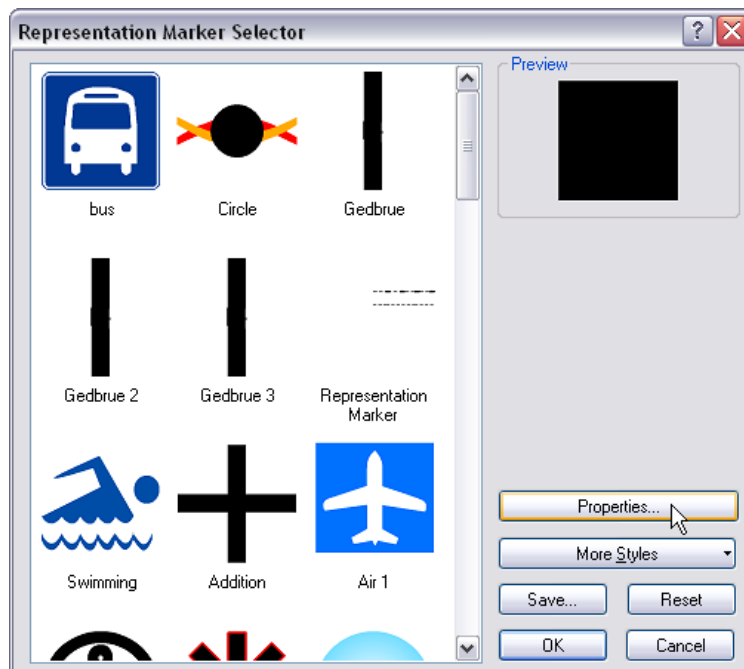
Type New Buildings to rename it.

The New Buildings representation rule consists of a single marker symbol layer with a default representation marker (a 5-point black square). You are going to change this to a 2-point red square instead.

6. Inside the marker symbol layer, click the black square representation marker.



The **Representation Marker Selector** dialog box opens.

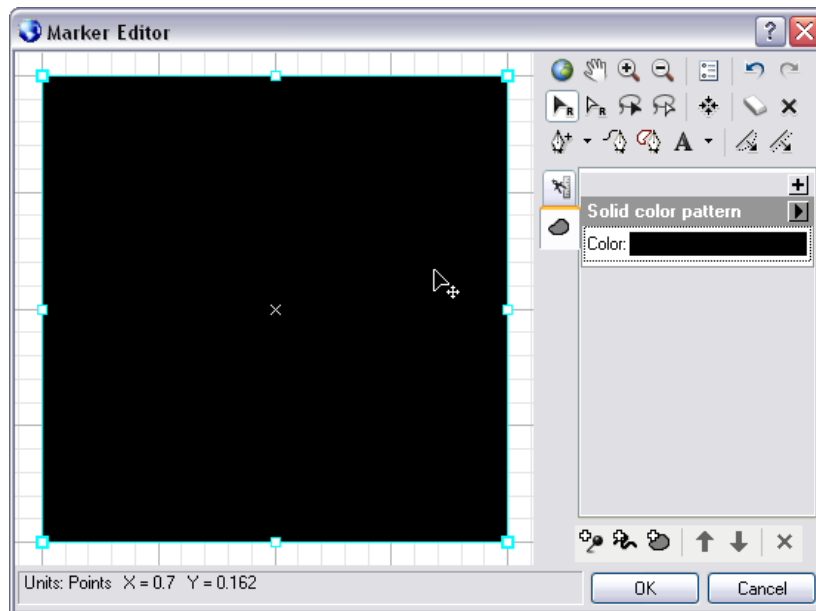


7. Click **Properties**.

The **Marker Editor** opens with the black representation marker filling the canvas.

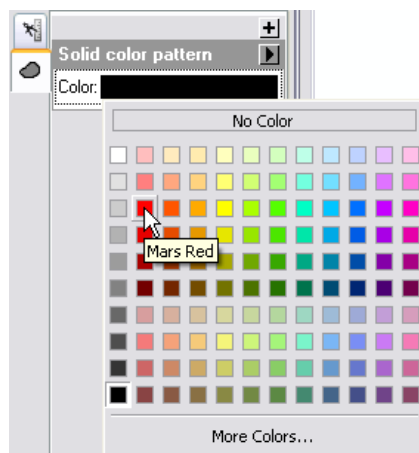
8. Use the **Select Part** tool  to select the representation marker.

A representation marker is made up of symbol layers and geometric effects just as representation rules are. This representation marker consists of a single fill symbol layer, filling the square with solid black.

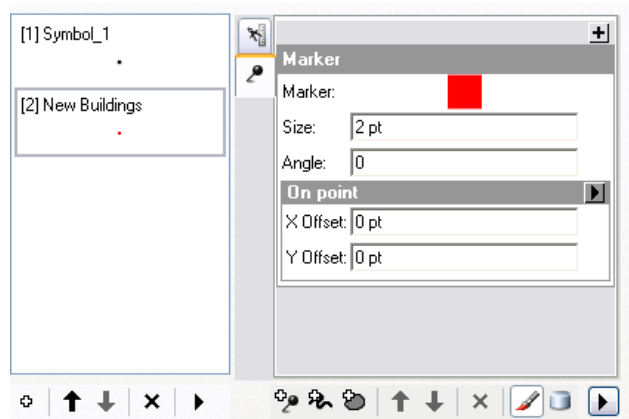


9. Click the swatch next to the **Color** property in the fill symbol layer and choose a red from the palette that opens.

The representation marker turns red.



10. Click **OK** to close **Marker Editor**, then click **OK** to close the **Representation Marker Selector** dialog box.
11. Click the **Size** property text box. Type 2 and press ENTER.
The New Buildings representation rule is now symbolized with a marker symbol layer containing a 2-point red square.

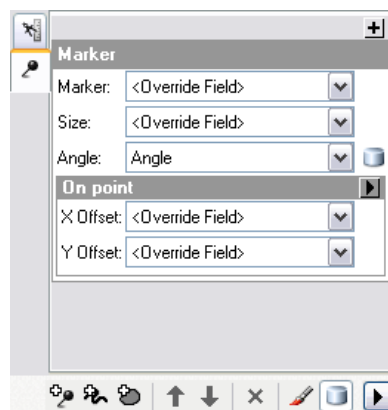


12. Click **OK**.

A **Warning** dialog box appears to let you know that the changes you are making to a rule will be stored in your database.




Click **OK** to accept and close the warning. View the results and notice that the points are still symbolized with the default symbol. They are symbolized this way because their values in the RuleID field are all set to 1.




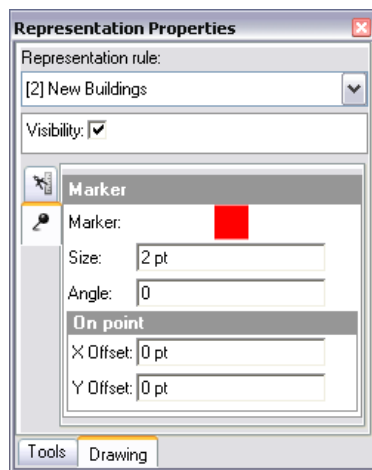
Applying new representation rules to features

Steps:

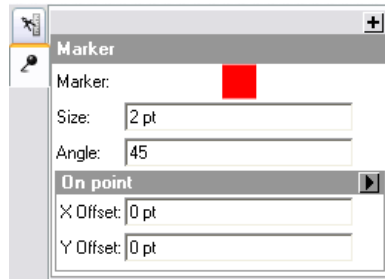
1. Right-click the BuildingP_Rep layer in the table of contents and click **Selection > Make this the only selectable layer**.
2. [Start editing](#).
3. Select some of the buildings in the current view using the **Select** tool  on the **Representation** toolbar.



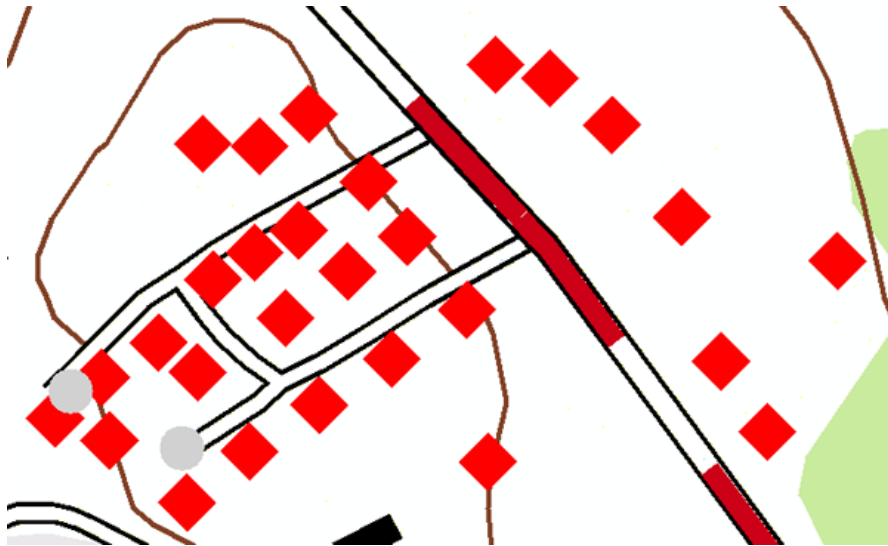
4. Open the **Representation Properties** window using the **Representation Properties** button  on the **Representation** toolbar.
5. On the **Representation Properties** window click the **Representation rule** pull-down list and choose the New Buildings rule to apply to all the selected buildings.




6. Close the **Representation Properties** window, save your edits, then stop editing.
7. Open the layer properties of BuildingP_Rep.
8. Choose the New Buildings representation rule.
9. Type 45 for the **Angle** value.

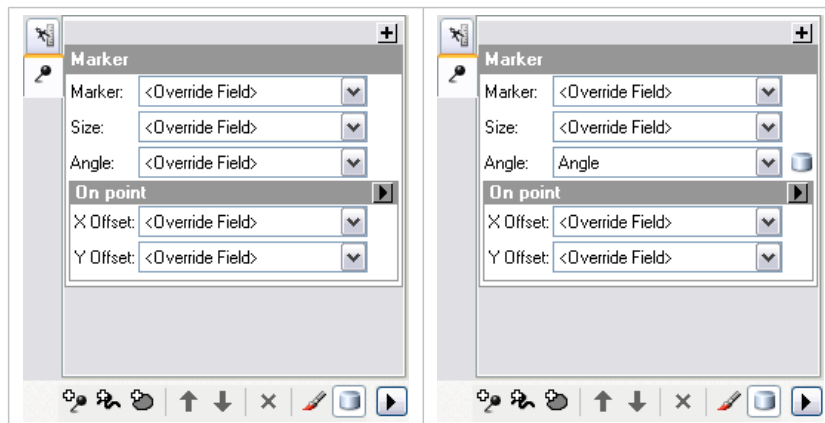


10. Click **Apply** and move the dialog box out of the way to see the changes. Note that all buildings following this representation rule are now angled 45 degrees from horizontal.



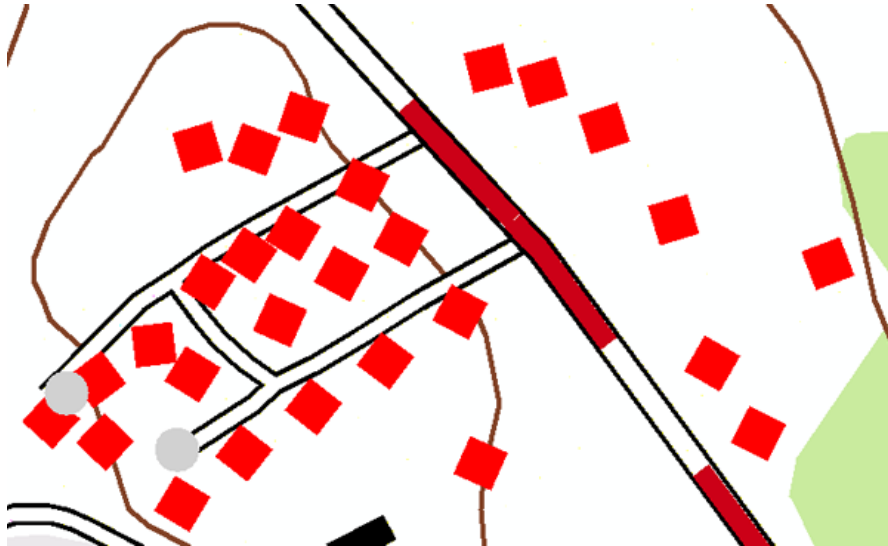
Now you will learn how to set unique angle values for each building. Stop editing and save edits.

11. Open the **Layer Properties** dialog box again. Click the **Display field overrides** button . This will tell the **Angle** property to find its values from within the database.
12. Choose the **Angle** field from the pull-down list to be the explicit field for the angle property.



13. Click **OK**.

Note that the buildings are now angled according to the values stored in the Angle attribute field of the data.

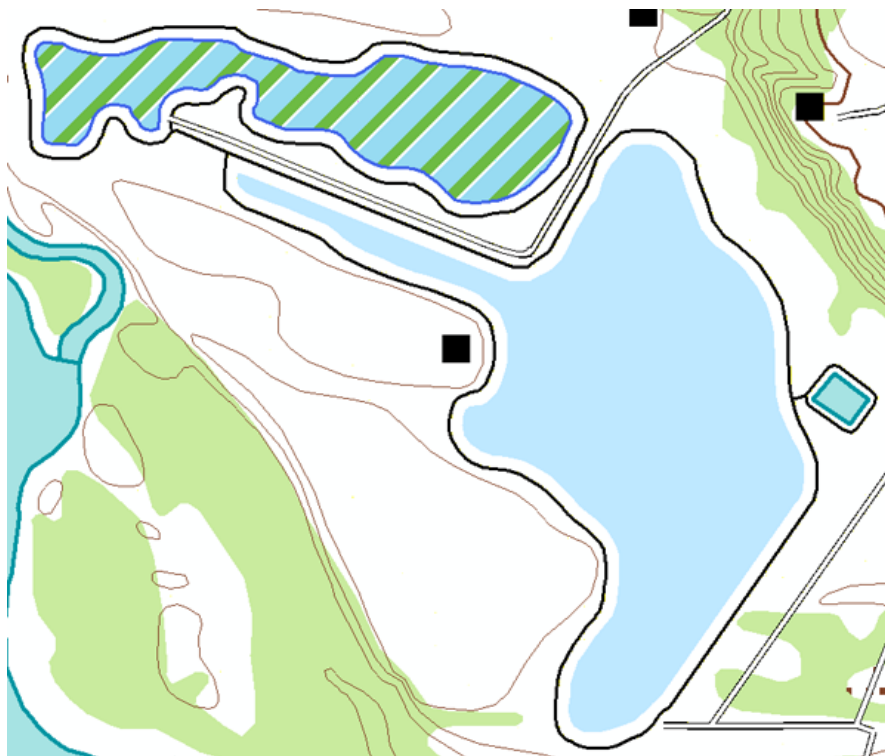


Adding geometric effects to representation rules

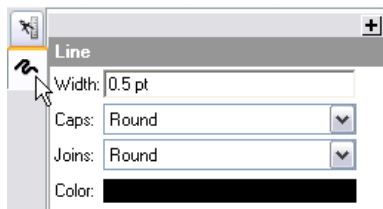
According to new specifications for the map, the symbol for trails must change to a double dashed line instead of the single black line as found in the old map. To accomplish this task, you will add some geometric effects to the representation rules. Adding geometric effects does not alter the underlying geometry of your features; rather, they allow you more control over the way your features are symbolized.


Steps:

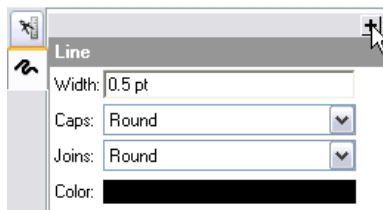
1. Click **Bookmarks > 2) Trail and Swamp**.



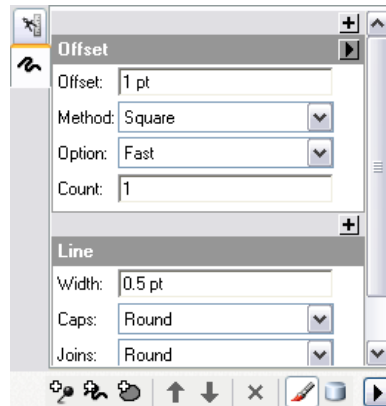
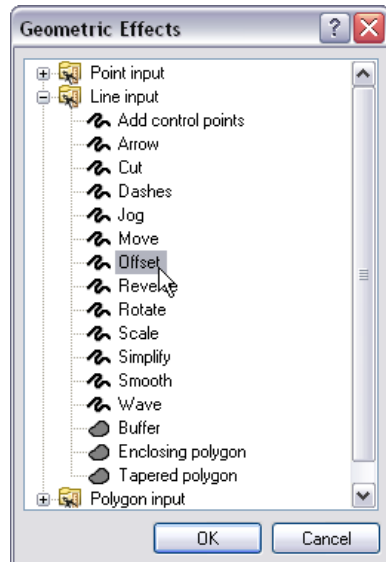
2. Make TrailL_Rep the only selectable layer.
3. Open the **Layer Properties** dialog box for TrailL_Rep.
4. Click the representation rule named Trail and click the line symbol layer.




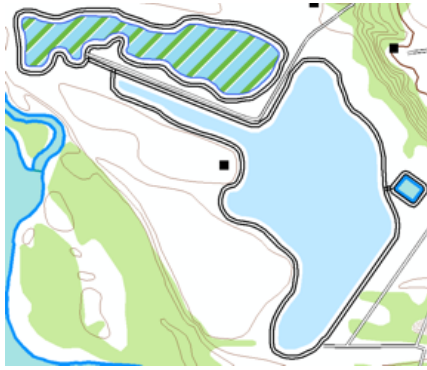
5. Click the **Add** button  to see the **Geometric Effects** dialog box.




6. Expand the **Line input** folder and click **Offset**.

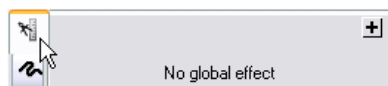



7. Click **OK** to close the **Geometric Effects** dialog box and add the **Offset** geometric effect to the rule.
8. In the **Offset** text box, type 0.5 for the value.
9. Add a new layer to this representation rule by clicking the **Add New Stroke Layer** button  as shown below. Notice that a new layer is added to the rule.
Note that the newly added stroke layer has the default line width of 1.
10. Type 0.5 in the **Width** text box.
11. You will now add a line-to-line **Offset** geometric effect in this new stroke layer, just as you did before in steps 5 and 6.
12. For this stroke layer, however, type -0.5 in the **Offset** text box.
13. Click **Apply** to see the result on the map.

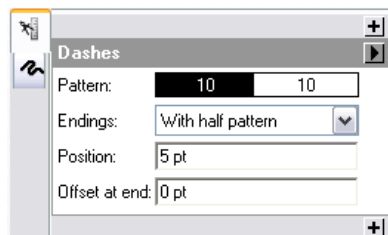


Geometric effects can be added to an individual symbol layer in a representation rule as you have just seen above. They can, however, be applied to all layers as well. To apply a geometric effect to all the symbol layers in a representation rule, it must be added as a global effect. You will learn how to make this happen.

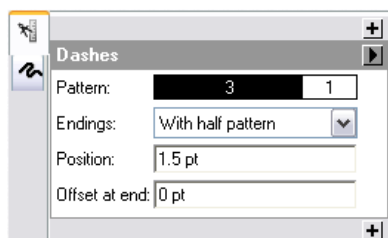
14. Click the top-level tab  to expand the global effects section of the rule. You will see a message indicating that there are no global effects at this time.



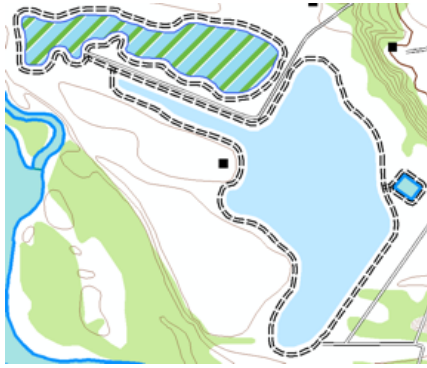
15. Click the **Add** button  to open the **Geometric Effects** dialog box.
16. Choose the **Dashes** geometric effect from under the **Line** input heading and click **OK**. A new dialog box is added to the global effects section of the representation rule. Note the default values provided for dash pattern symbology.



17. To change the values, type 3 1 in the **Pattern** text box. Be sure to include a space between the two numbers.




18. Click **OK** to see the result.

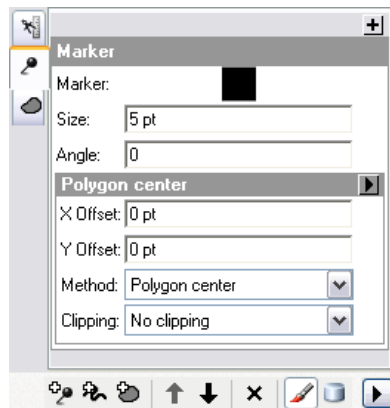


Notice that global effects impact all symbol layers.

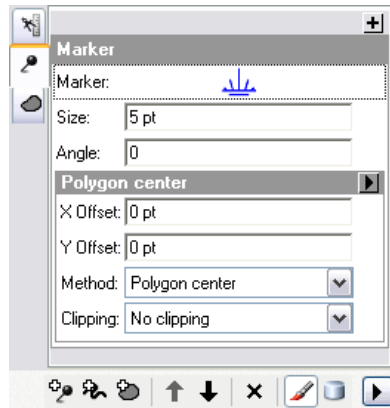
Adding markers to polygon symbology


Steps:

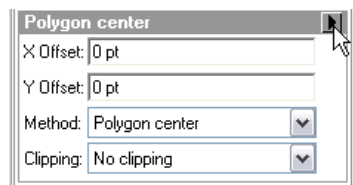
1. Open the **Layer Properties** dialog box for WetlandsA_Rep.
2. Choose the swamp representation rule.
In the original map, swamps are symbolized simply with the color Sodalite Blue. You will add a marker symbol layer to the representation rule to make the swamp symbology more user-friendly.
3. Click the **Add New Marker Layer** button .
Notice that a default representation marker and marker placement style is included with the new symbol layer.



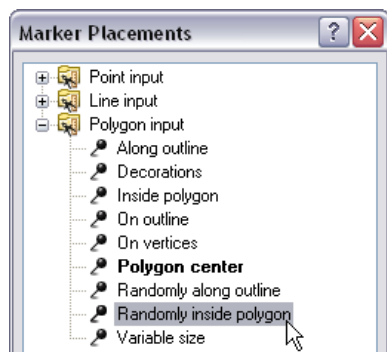
4. Click the black square representation marker to open the **Representation Marker Selector** dialog box.
5. Click the Swamp symbol from the **Representation Marker Selector** dialog box and click **OK**.



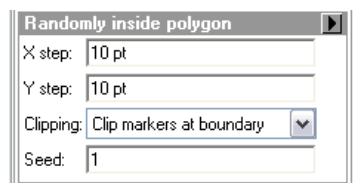
6. Type 3 in the **Size** text box to change the size.
Notice that the default marker placement style **Polygon center** is included in this marker symbol layer, which places only one marker in each polygon. Instead, you will change the marker placement style to one that puts many markers within the polygon.
7. Open the **Marker Placements** dialog box by clicking the arrow  next to the placement label.



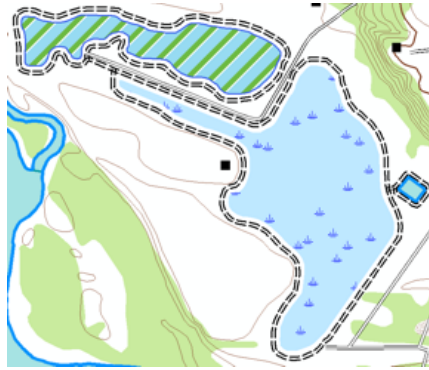
8. Under the **Polygon input** heading, choose **Randomly inside polygon**.



9. Click **OK** to close the **Marker Placements** dialog box.



10. Click **OK** to close the **Layer Properties** dialog box.
You can now see that there is a pattern of random swamp symbols.



11. If you want to proceed to the next exercise, leave ArcMap open.
12. If you want to return to this tutorial later, save this map document as Exercise_two.mxd and exit ArcMap.

Congratulations, you've completed exercise 2.

Things created and accomplished in this exercise:

- Adding a new rule to a feature class representation
- Setting only one selectable layer
- Editing representation properties
- Choosing the type of unit measurement
- Interacting with the **Representation Properties** dialog box
- Mapping representation rules to explicit fields
- Adding a new marker layer to a representation rule
- Interacting with the **Marker Placements** dialog box
- Using the **Marker Editor** and **Marker Selector** dialog boxes
- Changing properties of a marker layer
- Adding a new stroke layer to a representation rule
- Changing properties of a stroke layer
- Interacting with the **Geometric Effects** dialog box
- Adding the Offset geometric effect and Dashes geometric effect
- Changing properties of geometric effects
- Adding global effects

[Exercise 3](#) covers the representation editing experience. By editing feature representations, you will learn the impacts of modifying shapes and representation parameters and how they become overrides to the representation rules. You will interact with the selection and editing tools and see how both the appearance and properties of representations are changed.

Exercise 3: Performing edits with representations

In this exercise, you will be working with representation shape and property overrides. You will see how edits can be made to representations without changing the underlying geometry of the features involved. You will experience the WYSIWYG (what you see is what you get) editing environment that gives you feedback on the appearance of your interactive edits before you commit to them.

Complexity:
Beginner

Data Requirement:
ArcGIS Tutorial Data Setup

Data Path:
C:\ArcGIS\ArcTutor\Representations

Goal:
Learn about using the representation editing environment to override the shape and properties of feature representations.



Note:


The results from your edits do not need to perfectly match the results pictured in the graphics of this tutorial. The goal is for you to get used to the expected behavior of the Representation editing tools. Practice with all the tools until you feel comfortable.

Editing feature representations


Steps:

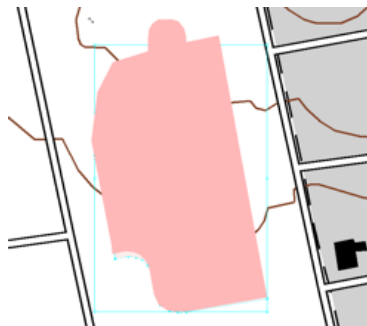
1. Continue with your current map document from [Exercise 2](#) or open Exercise_3.mxd from the Exercise 3 folder.
2. Open the **Representation** toolbar and the **Editor** toolbar if they are not already open.
3. Click **Bookmarks > 3) Area Building**.







4. Make BuildingA_Rep the only selectable layer in the table of contents.
5. Start editing.
6. Using the **Select** tool  on the **Representation** toolbar, select the new building. Note the rectangular selection box around it.





7. Rest the mouse pointer on any corner handle, and when the cursor becomes an arrow , drag the arrow to resize the building.




 **Caution:** When resting the mouse pointer, the corner is very sensitive; you may see the tool change from an arrow symbol to a rotate symbol .

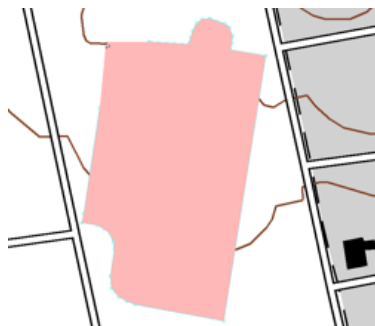
8. Once again, rest the pointer above a corner handle until the cursor becomes a curved arrow . Drag to rotate the building.
9. Click the **Direct Select** tool  on the **Representation** toolbar. Notice how the selection rectangle is no longer visible but the vertices defining the outline of the building are all selected.



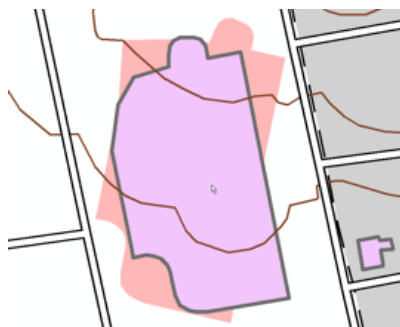
There is a difference between the two selection tools found on the **Representation** toolbar. The **Select** tool  is used to select whole features and provides options to perform edits on the selected feature or features. The **Direct Select** tool  is used to select a part or parts of features

and provides options to perform edits on the selected part or parts of the selected feature or features.

10. Select one vertex by dragging a box around the vertex with the **Direct Select** tool . Notice that selected vertices are solid and unselected vertices are hollow.
11. Drag the selected vertex away from the others to reshape the feature.



12. Stop editing and save your edits.
13. Add the BuildingA feature class from the location where you have Exercise_2.gdb stored and use the default symbology that appears (your default color may be different). Note that the original shape has not changed even though the representation was edited.




14. Remove the newly added BuildingA feature class.

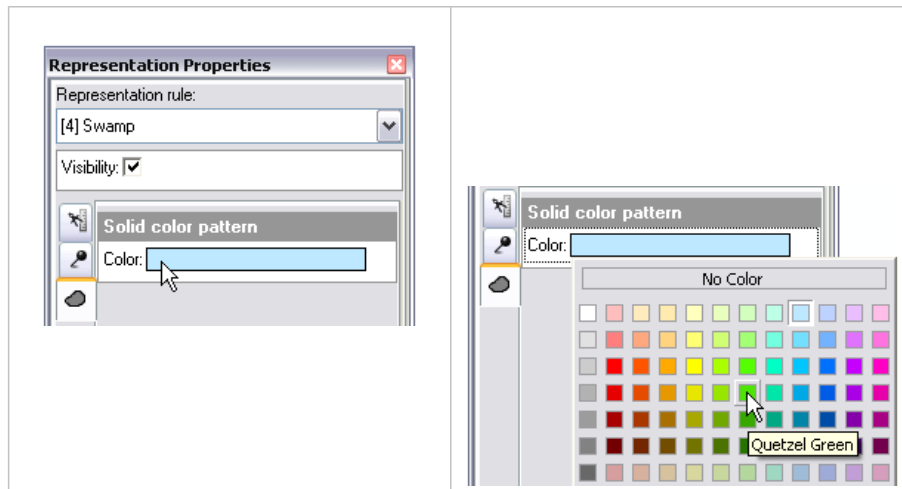
Representation Properties dialog box: Drawing tab

You will now work with the **Drawing** tab of the **Representation Properties** window. This tab looks similar to what you see for a representation layer on the **Layer Properties** dialog box in that it lists the properties of the representation rule, but in this case, it is the properties of the rule as they apply to the selected feature(s). The structure of a rule cannot be changed while editing; only the values of the properties provided by the rule can be changed.


Steps:

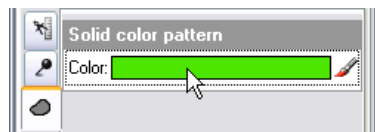
1. Click **Bookmarks > 2) Trail and Swamp**.
2. Make WetlandsA_Rep your only selectable layer.
3. Start editing and select a swamp polygon using the **Select** tool .
4. Open the **Representation Properties** window to examine your selected feature.


- You will now create an override of the background color of the swamp. Click the **Color** box below the **Solid color pattern** heading. Choose any green color you like.

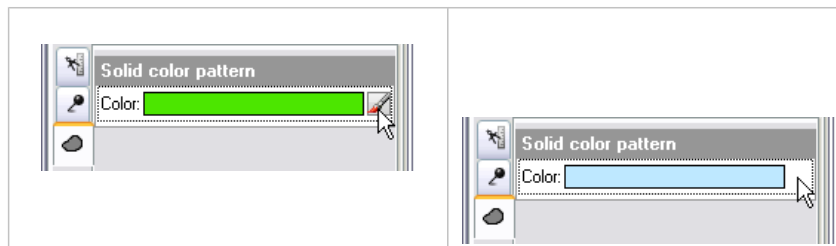


All other swamps in the map still follow the original rule, but this particular swamp has a color override. All other properties of the rule are still followed.

A paintbrush icon  appears to the right of the **Color** box to indicate that this property has an override.



- Click the paintbrush icon . It disappears, and the background color of the swamp returns to blue. The override has been removed.




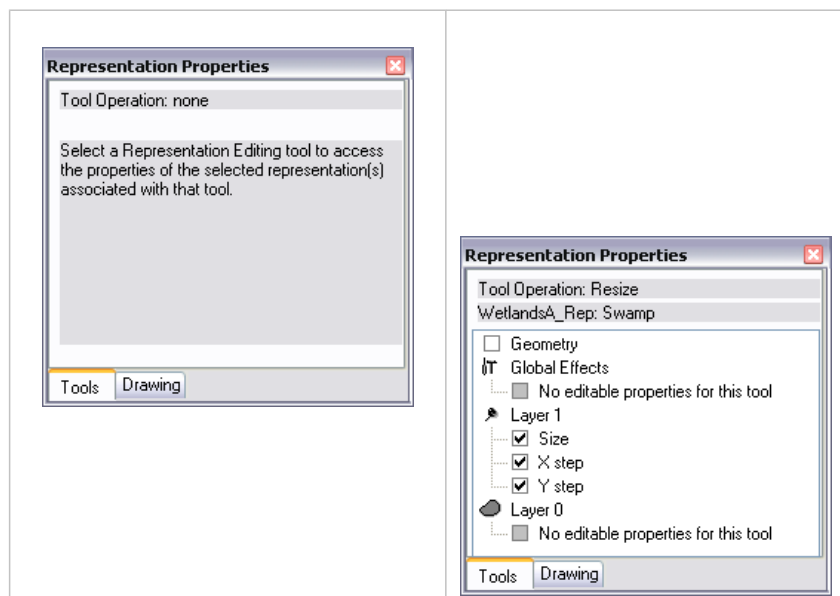
- With the swamp still selected, choose the Bog representation rule from the drop-down list. The feature representation now follows the representation rule for a bog and is symbolized accordingly.
- Click the **Representation rule** arrow again and choose Swamp to return the symbol to the original rule. Keep the Swamp feature selected and the **Representation Properties** window open as you proceed to the next step.


Representation Properties dialog box: Tools tab

You will now work with the other tab on the **Representation Properties** window, the **Tools** tab. This tab lists geometry and other drawing properties of the selected feature or features that can be modified with the use of the currently selected representation editing tool. Any combination of geometry and drawing properties can be modified simultaneously using the current tool simply by checking and unchecking the properties.

The list of available properties varies with the representation editing tool that is currently selected. Any modifications to drawing properties made in this way will become overrides for the representation. Modifications to the geometry will be stored either in the Override field of the feature class if the representation was created with that option (as it was for this exercise) or in the Shape field if that option was chosen when the representation was created.


As you can see below, when features are selected, the **Tools** tab will indicate which representation editing tool is currently selected. When there is no representation editing tool selected, the **Tools** tab will appear as it does below left. For example, when the representation **Resize** tool  is selected, the **Tools** tab appears as it does below right.



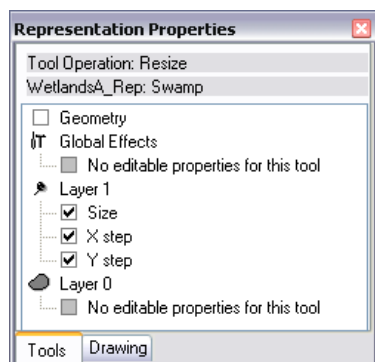
Once you have completed this section of the exercise, you can return to the **Tools** tab, if you want, and try different combinations of the check boxes. In this section, you will be working with the **Resize** tool , and the goal is to change the appearance of the pattern symbology used in the Swamp representation rule.

The **X step** and **Y step** properties determine the pattern of the marker symbols as they appear within a polygon, whereas the **Size** property determines the size of the marker symbol. The **Geometry** property determines whether the shape of the feature is adjusted. Keep in mind that changes to the underlying geometry of the feature will only occur if your representations were created with that option. Otherwise, changes to the shape will be stored in the Override field.

Steps:


1. Click the **Tools** tab on the **Representation Properties** window.
2. Click the **Resize** tool  on the **Representation** toolbar.


For the swamp feature representation, you will see that the parameters for **Size**, **X step**, and **Y step** are selected by default. Leave these as they are and make sure the **Geometry** option is unchecked.





This way, only the markers are resized, not the polygon.




3. Drag the **Resize** tool  anywhere near (or on) the swamp. As you drag the pointer, you see a line to guide your change and see the swamp symbol dynamically change. When you are satisfied with the changes you have made, release the mouse button.

 **Note:** Your result may vary dramatically from the one depicted in this exercise—this is okay and should be expected. The movement you make with your mouse is reflected on-screen. Keep in mind that even a little bit of movement can make larger than expected changes on-screen.

The pattern of swamp symbols becomes more or less dense, depending on the direction you dragged. The density is based on the **X step** and **Y step** property values. The size of the swamp symbol is different after you have finished dragging the **Resize** tool . The **Size** property value is the basis for the size of a symbol.






4. Click the **Drawing** tab on the **Representation Properties** window to see the overrides that you've just created. Note that the **X step** and **Y step** parameters have the paintbrush icon  adjacent to them, indicating an override.

 **Note:** Your results may vary and do not have to match.

5. Save your edits and stop editing.
6. If you want to proceed to [Exercise 4](#), leave ArcMap open.
7. If you want to return to this tutorial later, save the map document as Exercise_three.mxd and exit ArcMap.

Congratulations, you've completed Exercise 3.

Things created and accomplished in this exercise

- Resizing features using the **Select** tool 
- Rotating features using the **Select** tool 
- Reshaping features using the **Select** tool 
- Reshaping features using the **Direct Select** tool 
- Using the **Drawing** tab on the **Representation Properties** window
- Using the **Tools** tab on the **Representation Properties** window
- Creating an override
- Removing an override
- Using the **Resize** tool 

Exercise 4: Working with free representations

When authoring your map, you may encounter instances where a unique or significant feature requires specialized symbology. Overrides to a representation rule can usually provide this flexibility, but in some instances, they may not be enough. In situations where you may be tempted to simply draw a graphic to get the appearance you need, try a free representation instead. A free representation allows you to take control of all the parts of a representation rule by converting the dynamic geometry into real geometry that you can interact with. The representation rule becomes unique to the feature, and its structure can be modified as necessary. The easiest way to understand free representations is to make one and modify it.

Complexity:
Beginner

Data Requirement:
ArcGIS Tutorial Data Setup

Data Path:
C:\ArcGIS\ArcTutor\Representations

Goal:
Learn how to create and modify free representations.

Understand, however, that all this flexibility comes with a small price. Once you create a free representation, the underlying feature is no longer following any representation rule. That means updates to the representation rules will not be reflected in this feature. A complete, independent representation rule will exist for this feature, stored in the Override field. This means that excessive use of free representations can bloat the feature class and adversely affect drawing performance.

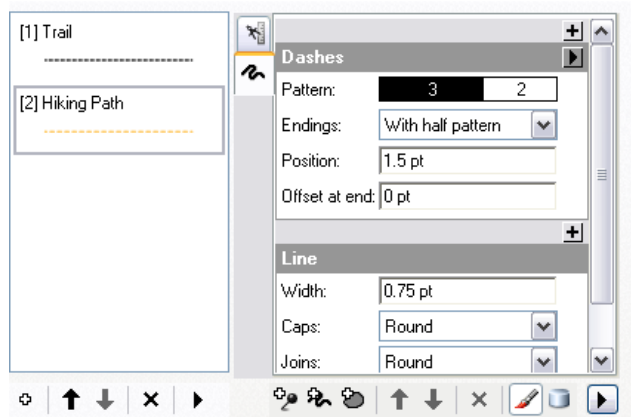
In this exercise, you will work through the creation and modification of a free representation for a dashed line portraying a hiking path.


Creating a free representation

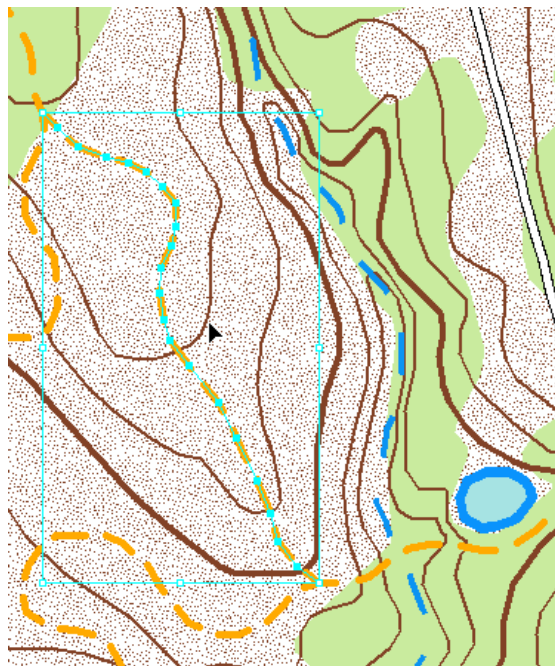
In this section, you will learn how to create a free representation from a feature representation.


Steps:

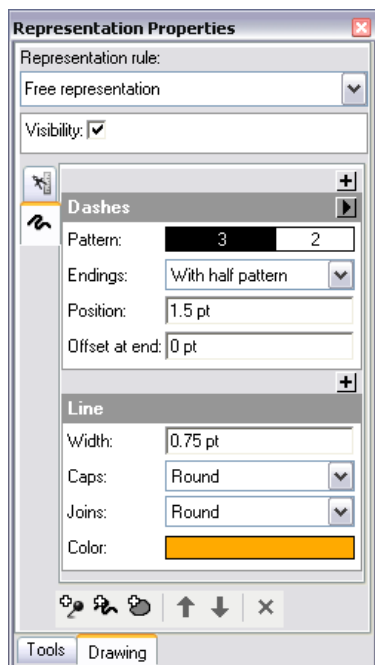
1. Continue with your current map document from Exercise 1, 2, or 3 or open Exercise_4.mxd from the Exercise 4 folder.
2. Open the **Representation** toolbar and the **Editor** toolbar if they are not already open.
3. Click **Bookmarks > 4) Hiking Path**.
4. Open the **Layer Properties** dialog box for the TrailL_Rep layer.
5. On the **Symbology** tab, click the Hiking Path rule.
Notice that the rule is composed of a single stroke symbol layer with one geometric effect, Dashes.



6. Click **OK** to close the **Layer Properties** dialog box.
7. In the table of contents window, make the TrailL_Rep layer the only selectable layer.
8. Start editing and select a section of the hiking path with the **Select** tool  from the **Representation** toolbar.



9. On the **Representation** toolbar, convert this feature to a free representation by clicking **Representation > Free Representation > Convert to Free Representation**.
10. To view the structure of the free representation you just created, click the **Representation Properties** button  on the **Representation** toolbar to open the **Representation Properties** window. Click the **Drawing** tab.





Examine the contents of the representation rule as it applies to the currently selected feature, which is now a free representation. Notice that all the components of the representation rule (Hiking Path) to which the feature was originally assigned are still here. The difference is that the feature no longer follows that rule. In fact, the menu at the top of the **Drawing** tab now reads **Free Representation**. In addition, there are now also buttons below and within the rule components that can be used to modify the structure. Since the rule is wholly independent of this feature, you can add or remove symbol layers and add, remove, or change geometric effects and marker placement styles.

Modifying free representations

Steps:

1. With the same feature still selected and the **Representation Properties** window still open, notice that this independent representation rule still contains the Dashes geometric effect that was present in the Hiking Path representation rule. Recall that geometric effects make dynamic geometry. That means the feature is still a line, but before it is drawn with a symbol, it is interpreted as individual dashes. Notice that the currently selected line shows vertices along the whole line, even in between dashes. During this next step, you will make the dashes actual representation geometry, so you can interact with them individually. To do this, you will use another command on the **Representation** toolbar. Click **Representation > Free Representation > Convert Effect to Geometry**.

Notice that the Dashes geometric effect is no longer present in the representation rule structure in the **Representation Properties** window. It has been removed and converted to actual representation geometry. Notice also that just the dashes are selected in the canvas. No selected geometry or vertices are visible between dashes. Use the **Undo**  and **Redo**  buttons on the **Standard** toolbar to see this change again if you missed it.

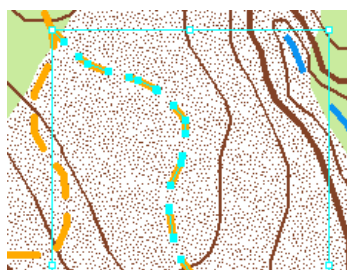
2. Converting the dynamic dashes geometric effect to actual geometry results in small individual lines grouped together in a multipart line. To interact with a single dash, you need to ungroup these elements. To do this, use the **Representation** toolbar and click **Representation > Free Representation > Ungroup Elements**.


This command explodes the multipart geometry. Now each individual segment has its own rule. In this case, the rule is a simple one, just a solid orange line. Since multiple segments with individual rules are now selected, the **Representation Properties** window is unable to display one rule. The following message appears:

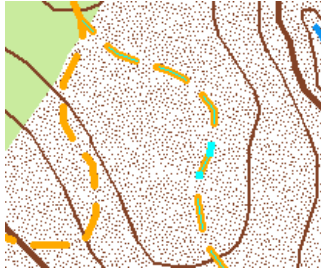


At this point, you could click the **Edit Free Representation** button to open **Free Representation Editor** and continue from there. In this exercise, you will continue to use the **Representation** toolbar instead. Once you complete this exercise, you might want to try to accomplish these same steps from this point on another feature using **Free Representation Editor**.

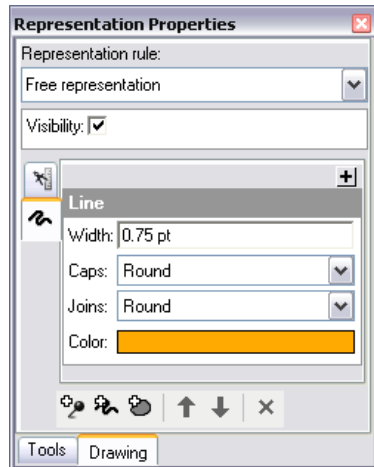
3. Zoom in to the topmost section of the selected feature.




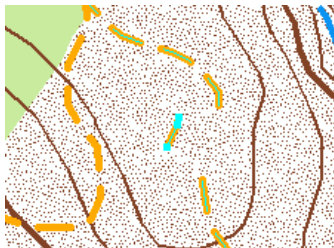
4. Click the **Clear Selected Features** button on the **Tools** toolbar to unselect the group of subelements.
5. Using the **Direct Select** tool  on the **Representation** toolbar, select a single dash.





The **Representation Properties** window now shows the rule of the selected segment.



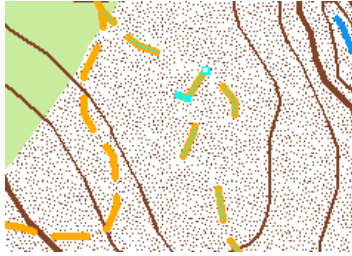
6. Using the **Direct Select** tool , move the segment you have selected.



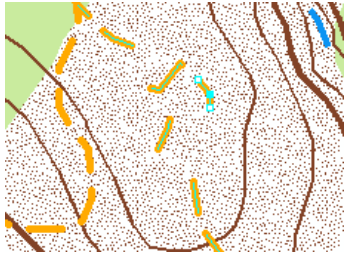
7. Use the **Direct Select** tool to select two vertices of a new segment.

 **Tip:** You may want to experiment with the **Select Part**, **Unselect Part**, and **Delete Part** commands on the shortcut menu of the **Direct Select** tool  to achieve this. Open the shortcut menu by right-clicking on the canvas.

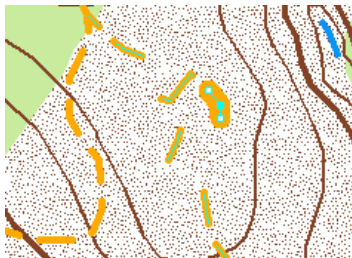
8. Use the **Direct Select** tool to move the selected vertices.



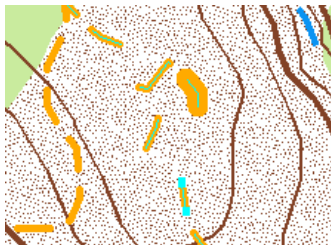
9. Select a different dash with the **Direct Select** tool.



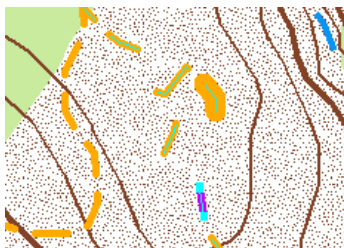
10. Type 2 in the **Width** text box on the **Representation Properties** window to resize the segment.



11. Select another dash.



12. Click the **Color** box on the **Representation Properties** window to choose a new color for the segment.



13. Clear the selected features.

You can now see that with a free representation, you can modify the appearance of a single feature exactly as necessary. You could use this technique to ensure that dashes fall precisely where you want them, to delineate a very specific line or outline, or to avoid other map details. As an advanced exercise, try using **Free Representation Editor** to accomplish some of these tasks and even add geometry into the same feature.

Keep in mind that although free representations provide nearly indefinite customization, they will not respond to any representation rule updates, and they can impact the drawing performance if they are used excessively. If you find that you are using many free representations, you may want to consider the way your data and/or your representation rules are structured.

14. Save your edits and stop editing.

15. Save your map as Exercise_four.mxd. Close ArcMap.

Congratulations, you've completed Exercise 4.

Things created and accomplished in this exercise

- Converting features to free representations
- Converting effects to geometry
- Ungrouping elements
- Editing free representation structure

In [Exercise 5](#), you will learn how to use the geoprocessing tools for representations.

Exercise 5: Using geoprocessing tools for representations

This exercise covers a hypothetical map production workflow.

Geoprocessing tools are used for the automation of tasks that would normally be performed manually. You will use geoprocessing tools to add representations to selected feature classes, set the type of line caps for road features, add control points to roads and rivers to control their dash patterns, align buildings to roads, create bridges and tunnels, and determine where features are graphically too close to each other. This exercise uses geoprocessing tools found in the [Cartography toolbox](#).

Complexity:
Beginner

Data Requirement:
ArcGIS Tutorial Data Setup

Data Path:
C:\ArcGIS\ArcTutor\Representations

Goal:
Understand how to use geoprocessing to work with representations.

Using geoprocessing tools for representations

Steps:

1. Start ArcCatalog and navigate to the Exercise_5 folder.
 - a. You need to create layer files for some feature classes to use the geoprocessing tools: Right-click each feature class and click **Create Layer**. Accept the default name and location for the layer file.
 - BuildingP (in the TopographicMap feature dataset)
 - HydroL (in the Hydrography feature dataset)
 - RoadL (in the TopographicMap feature dataset)
 - RailroadL (in the TopographicMap feature dataset)
2. Click **Geoprocessing > Environments** to establish some settings to assist in your use of geoprocessing tools. These settings control how your data is processed and the location where the results are saved.
3. Expand the **Cartography** section.
4. Choose **Same as Input** for the **Cartographic Coordinate System** parameter.
5. Type 24000 for the **Reference Scale** parameter.
6. Expand the **Workspace** section.
7. To populate **Current Workspace**, navigate to the location where you stored Exercise_5 and choose the TopographicMap feature dataset inside the Representations_5 geodatabase. This is used as the default location for the output from geoprocessing tools.
8. Click **OK** to close the **Environment Settings** dialog box.

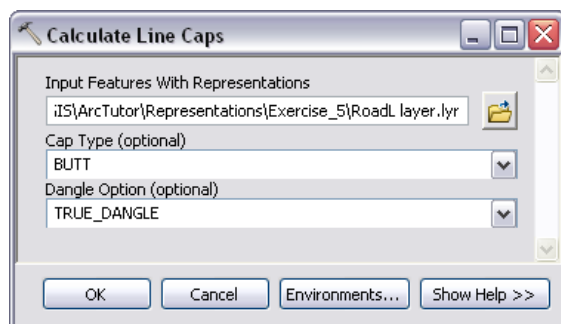
Geoprocessing tools for symbology enhancement

First, you will use the [Calculate Line Caps](#) geoprocessing tool to change the line caps on some roads.

Steps:

1. Click **Geoprocessing > Search for tools** to find and open the Calculate Line Caps tool.

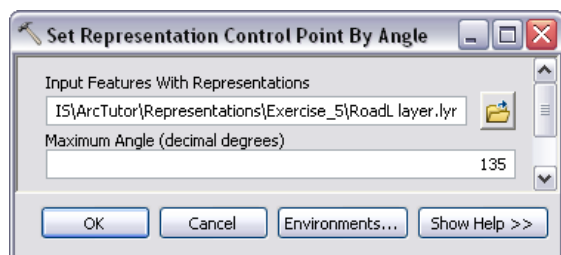
2. Choose RoadL layer.lyr for the **Input Features With Representations** parameter.
3. Choose **BUTT** for the **Cap Type** parameter.
4. Choose **TRUE_DANGLE** for the **Dangle Option** parameter.



5. Click **OK** to run the tool.
Next, you will add representation control points to the roads and rivers layers. Representation control points enhance the symbology of your features when a linear feature makes a sharp turn by forcing representation symbology to behave a specific way at these points. They are used in conjunction with geometric effects and marker placement styles that have a repeating pattern, like dashes for example.

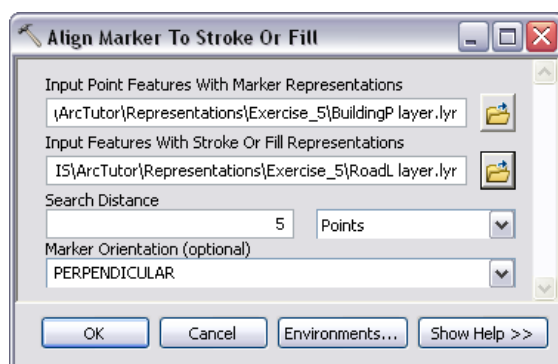
You will use the [Set Representation Control Point By Angle](#) geoprocessing tool twice: first on RoadL, then on HydroL.

6. Click **Geoprocessing > Search for tools** to find and open the Set Representation Control Point By Angle tool.
7. Choose RoadL layer.lyr for the **Input Features With Representations** parameter.
8. Type 135 for the **Maximum Angle** parameter.



9. Click **OK** to run the tool.
10. Run the **Set Representation Control Point By Angle** tool again on the HydroL layer using the same **Maximum Angle parameter** value of 135.
11. Next, you will align all the buildings on your map to nearby roads. The [Align Marker To Stroke Or Fill](#) tool selects point feature representations within a certain distance of line or fill feature representations and rotate the points to the angle of the lines. You will run this tool twice: first with the BuildingP layer against the RoadL layer, then the BuildingP layer against the HydroL layer.

12. Click **Geoprocessing > Search for tools** to find and open the Align Marker To Stroke Or Fill tool.
13. Choose BuildingP layer.lyr for the **Input Features With Marker Representations** parameter and RoadL layer.lyr for the **Input Features With Stroke Or Fill Representations** parameter.
14. Type 5 for **Search Distance**. Make sure **Points** are set as the unit of measurement and **PERPENDICULAR** is set for the optional **Marker Orientation** parameter.
15. Click **OK** to run the tool.




16. Repeat the previous step using the HydroL layer.lyr to align the features of BuildingP Layer.lyr.

Geoprocessing tools for complex features

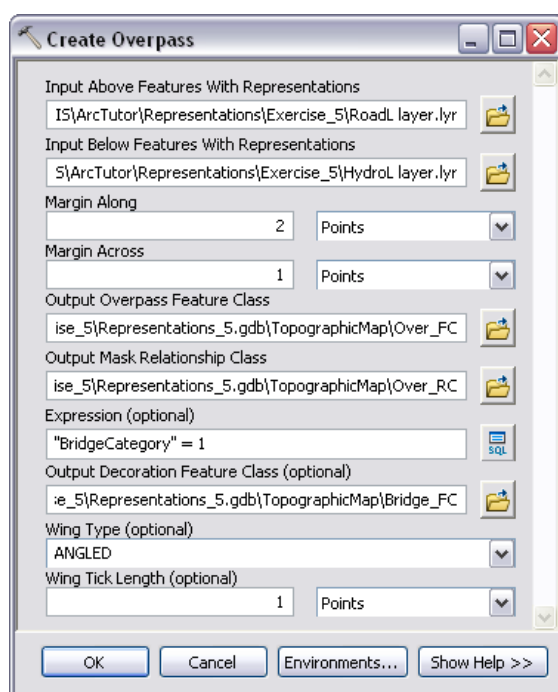
You will create symbology for a situation in which you have information about the location for bridges and tunnels but no data. You know from some fields in your feature classes that you have roads crossing over rivers as well as roads and railroads crossing above and below each other. This information tells you that at those locations where two features intersect each other, one feature crosses above the other. For your maps, you want to use this information to create bridge and tunnel symbology.

The [Create Overpass](#) geoprocessing tool performs this complicated operation. There are a significant number of parameters on this tool, and care must be taken when entering values for all parameters. This tool will help you symbolize features in a way that clearly indicates one feature is crossing over the other. This is done using masks to hide one feature and a new linear feature class for the bridge or tunnel symbol.

Steps:

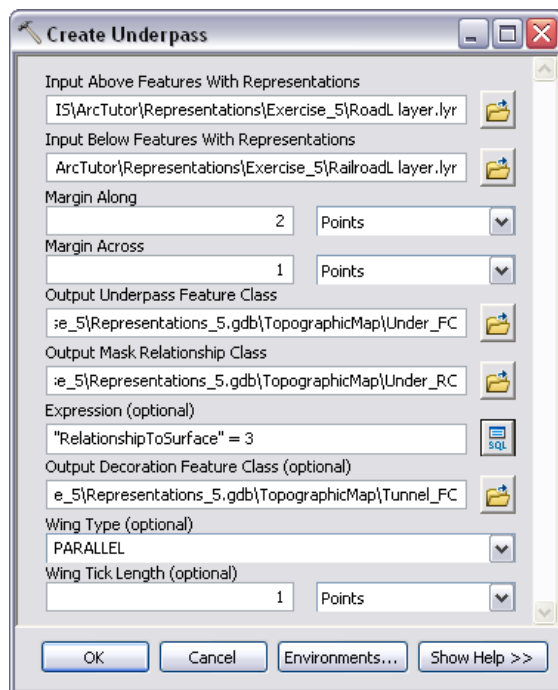
1. Open the Create Overpass tool.
2. Choose RoadL layer.lyr for **Input Above Features With Representations** and HydroL layer.lyr for **Input Below Features With Representations**.
3. Type 2 for **Margin Along** and type 1 for **Margin Across**, then choose **Points** for both from the drop-down lists for the unit of measurement.
4. Next, you will specify the mask feature class (**Output Overpass Feature Class**) and mask relationship class (**Output Mask Relationship Class**). Type Over_FC and Over_RC for the names of the new feature class and relationship class.
5. Click the **SQL** button  to open the **Query Builder** dialog box.

6. You can choose to enter a SQL expression to refine your selection. Without a SQL expression, the tool will process every feature in your feature class. For example, you may want to place a bridge at every location where a road crosses a river, or your data might not have an attribute field on which to make a refinement selection to make the tool process on a smaller set of data. In this exercise, a field indicates where a crossing occurs. On the **Query Builder** dialog box, enter the query as follows: "BridgeCategory" = 1.
7. Click **OK** to close the **Query Builder** dialog box.
8. Type `Bridge_FC` for the **Output Decoration Feature Class**.
9. Choose **ANGLED** for the **Wing Type**.
10. Type `1` and choose **Points** for the **Wing Tick Length** parameter.
Your dialog box should look like the one below.



11. Click **OK** to run the tool.
When the tool is complete, you will have created two new feature classes and a relationship class to use in your map to display bridges. The mask will be linked to RoadL with the relationship class.
12. Now you will create some underpasses at the locations where you know that railroads pass underneath roads. The process will be nearly identical to Overpass with a few minor differences, which will be pointed out as you proceed through this section. Open the [Create Underpass](#) tool.
13. Choose RoadL layer.lyr for **Input Above Features With Representations** and RailroadL layer.lyr for **Input Below Features With Representations**.
14. Type `2` for **Margin Along** and type `1` for **Margin Across**, then choose **Points** in both cases for the unit of measurement.

15. Type `Under_FC` and `Under_RC` for the **Output Underpass Feature Class** and the **Output Mask Relationship Class**.
 16. For the **Expression** parameter enter `"RelationshipToSurface" = 3`.
 17. Type `Tunnel_FC` for the **Output Decoration Feature Class** parameter.
 18. Choose **PARALLEL** for the **Wing Type**.
 19. Type `1` for the **Wing Tick Length** and choose **Points** for the unit of measurement.
- Now that you have populated all the parameter values, your dialog box should look like the following:



20. Click **OK** to run the tool.

Geoprocessing tools for finding graphic conflicts

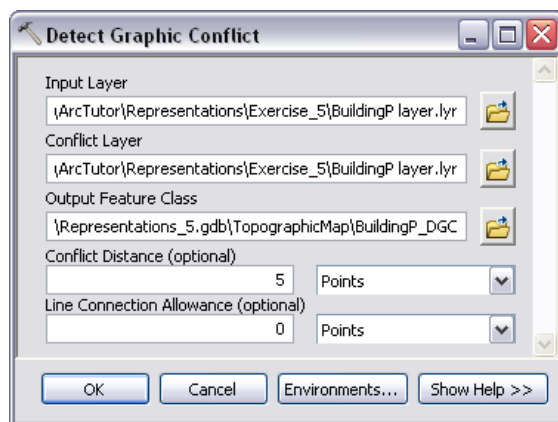
Now that you have run a series of geoprocessing tools on your data, the final step is to find out where your symbolized data is overlapping. The [Detect Graphic Conflict](#) tool creates a polygon feature class that you can use to visually locate incidents of overlap. You will use this tool to identify the areas where buildings graphically overlap other buildings.

Steps:

1. Use `BuildingP layer.lyr` for both the **Input Layer** and **Conflict Layer** parameters. The **Output Feature Class** parameter will automatically populate.
2. In the **Output Feature Class**, navigate to your data location instead and type `BuildingP_DGC` as the feature class name.
3. Type `5` for the **Conflict Distance** parameter and choose **Points** from the drop-down list.

4. Type 0 for the **Line Connection Allowance** parameter and choose **Points** from the drop-down list.


Your dialog box should look like this:

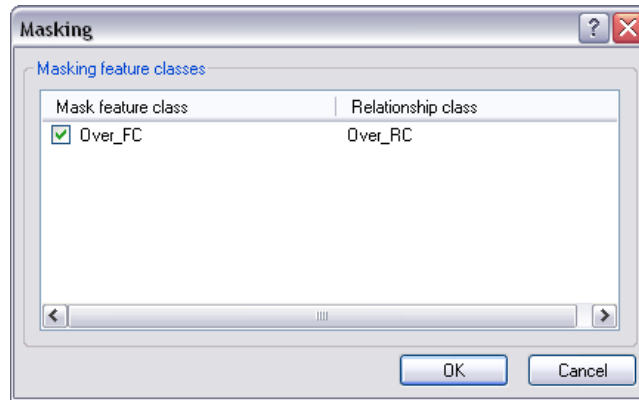



5. Click **OK** to run the tool.
Once complete, you will have a polygon feature class that will indicate where symbolized building features are closer than 5 points to each other at the reference scale set in the geoprocessing environments at the beginning of this exercise. Using a **Conflict Distance** of 0 in this tool will find features whose symbols graphically overlap at the reference scale.
6. Exit ArcCatalog.

Establishing the masking relationships

Steps:

1. Start ArcMap.
2. Open Exercise_5.mxd.
3. Add the following feature classes from the TopographicMap feature dataset to the map:
 - Over_FC
 - Under_FC
 - Bridge_FC
 - Tunnel_FC
 - BuildingP_DGC
4. For both Bridge_FC and Tunnel_FC, set the symbology to a 1-point wide solid black line.
5. Open the **Layer Properties** dialog box for the HydroL_Rep layer.
6. On the **Symbology** tab, click the **Layer Options** button , then click **Masking**.
7. Click the check box for Over_FC.



8. Click **OK** to close the **Masking** dialog box and the **Layer Properties** dialog box.
9. Click RailroadL_Rep and open the **Layer Properties** dialog box.
10. Click the **Layer Options** button , then click **Masking**.
11. Click the check box for Under_FC.
12. Click **OK** to close the **Masking** dialog box and the **Layer Properties** dialog box.
13. Turn off the Over_FC and Under_FC layers in the table of contents window.

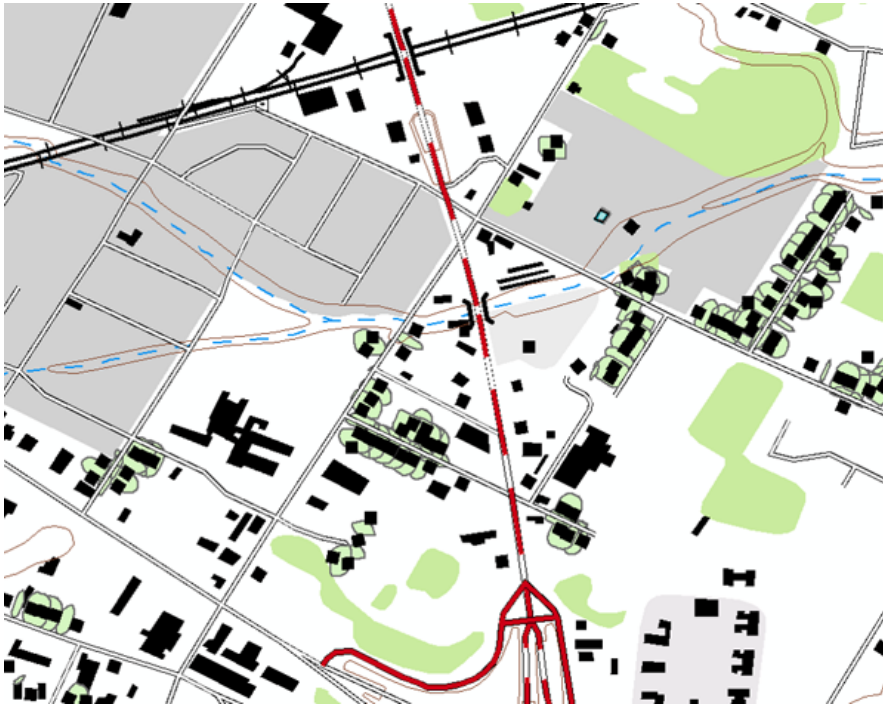
Viewing the results in ArcMap

When you started exercise 1, your map looked like the one below.



There were no bridges, the buildings were not aligned to the roads, and the dash pattern symbology on the roads was not well developed.

Now that you have run some geoprocessing tools, your map looks like the following:



Steps:

1. Click **Bookmarks > 5) Geoprocessing Results**.

Notice that the dash pattern on the roads has been adjusted, the result of using the Set Representation Control Point By Angle geoprocessing tool. The point buildings are now aligned to the roads, the result of the Align Marker To Stroke Or Fill geoprocessing tool. Bridge and tunnel symbology has been added where the road crosses the river and the railroad, and this masks out the river and railroad symbology—all the result of the Create Overpass geoprocessing tool. Finally, the polygons from BuildingP_DGC indicate the areas where point buildings are graphically too close.

Congratulations, you've completed Exercise 5.

Things created and accomplished in this exercise:

- Using the Calculate Line Caps geoprocessing tool
- Using the Set Representation Control Point By Angle geoprocessing tool
- Using the Align Marker To Stroke Or Fill geoprocessing tool
- Using the Create Overpass geoprocessing tool
- Using the Create Underpass geoprocessing tool
- Using the Detect Graphic Conflict tool
- Using feature-level masking in ArcMap