Exercise 1: Preparing for analysis

ArcMap 10.7 | Other versions

Available with Spatial Analyst license.

- Organizing your data
- Setting your workspace
- Adding data to your ArcMap session
- Saving your map document

Complexity:
Beginner

Data Requirement:
ArcGIS Tutorial Data for Desktop

In this exercise, you will prepare for analysis by first copying the tutorial data locally, then creating a geodatabase for your results.

Organizing your data

Before working with ArcGIS Spatial Analyst extension tools, you will organize your tutorial data.

Locating tutorial data

1. Navigate to the location in your file browser where you installed the tutorial data,

for example, if you installed ArcGIS on your **C:** drive, go to **C:\arcgis\ArcTutor**.

2. Right-click the Spatial Analyst folder and select **Copy**.

3. Browse to your working directory, for example, your **C:** drive.

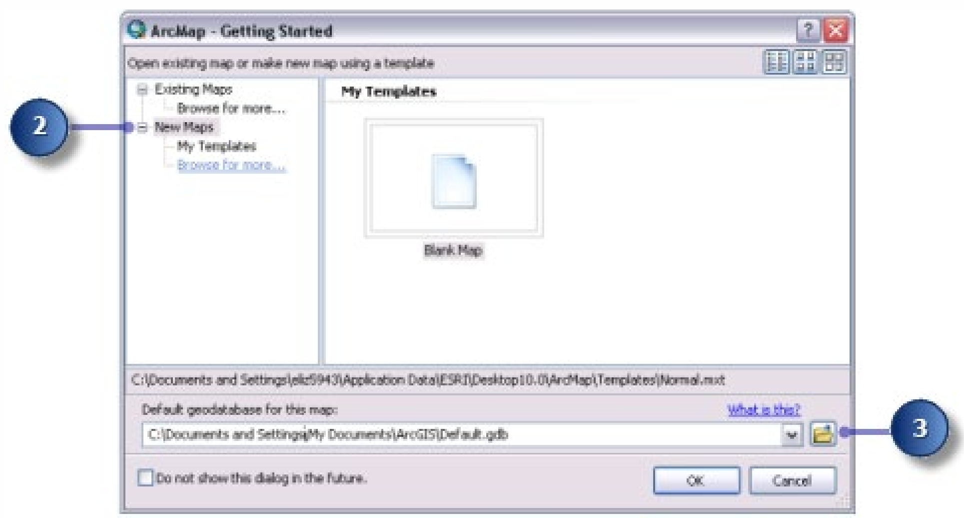
4. Right-click **C:** (or an alternative drive) and select **Paste**.

Starting ArcMap

1. Start ArcMap by either double-clicking a shortcut installed on your desktop or clicking **Start > All Programs > ArcGIS > ArcMap**.

2. Click **New Maps** in the **ArcMap - Getting Started** window if it is not already highlighted.

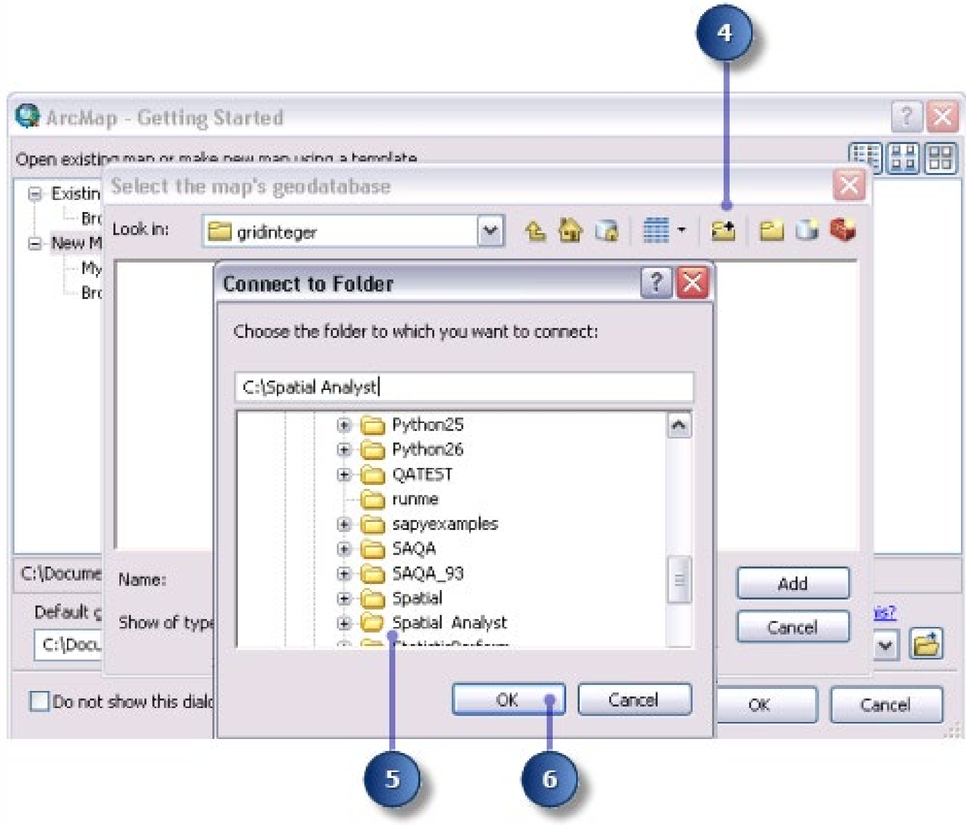
3. Click the **Open** button.



4. Click the **Connect to folder** button in the **Select the map's geodatabase** window.

5. Browse to and click the working copy of the Spatial Analyst folder just created.

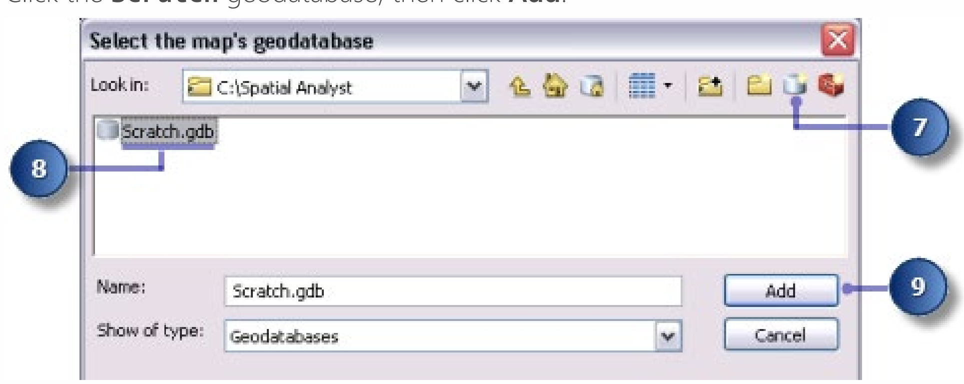
6. Click **OK**.



7 Click the **New File Geodatabase** button.

8 Name the new file geodatabase **`Scratch`**.

9 Click the **`Scratch`** geodatabase, then click **Add**.

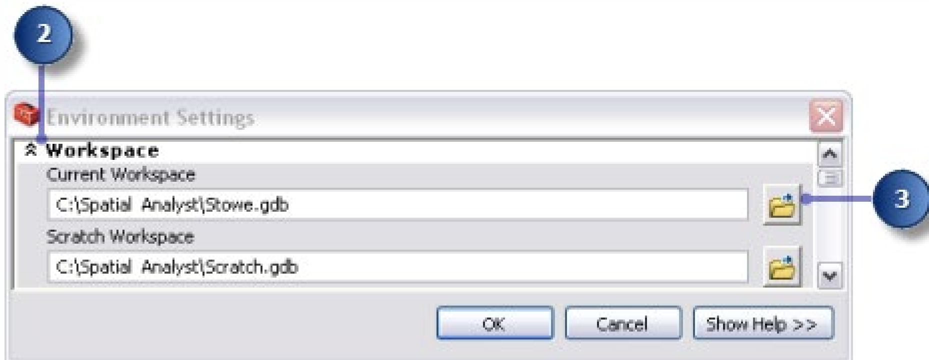


10 Click **OK**.

Setting your workspace

Both your current and scratch workspaces are currently set to your **`Scratch.gdb`** geodatabase. For this workflow, you will access data from **`Stowe.gdb`**, which is in the Spatial Analyst folder and contains your data. The output will be written to **`Scratch.gdb`**.

1. Click the menu **Geoprocessing > Environments**.
2. Click **Workspace** to expand the environment settings related to workspaces.
3. For **Current Workspace**, navigate to your **`Stowe.gdb`** in your Spatial Analyst folder.

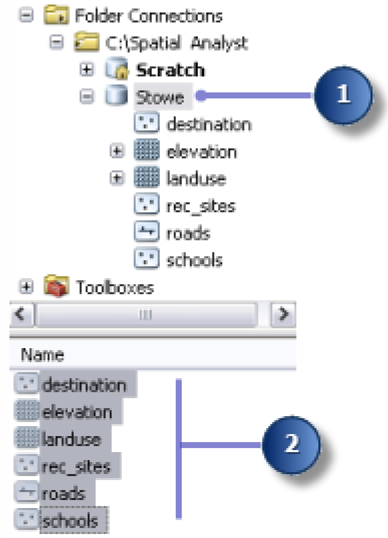


4. Click **Add**.
5. Click **OK**.

   Your scratch workspace is already set to your **`Scratch.gdb`** geodatabase.

Adding data to your ArcMap session

1. At the top of the **Catalog** window, click the **Toggle Contents Panel** button until you can see both the Catalog tree and the Contents panel.
2. In the Catalog tree, click **`Stowe.gdb`**.
3. In the Contents panel, select all the datasets while holding the Shift key, then release the Shift key and drag and drop the data into the ArcMap table of contents.



You should see the four feature classes and two rasters in the table of contents.

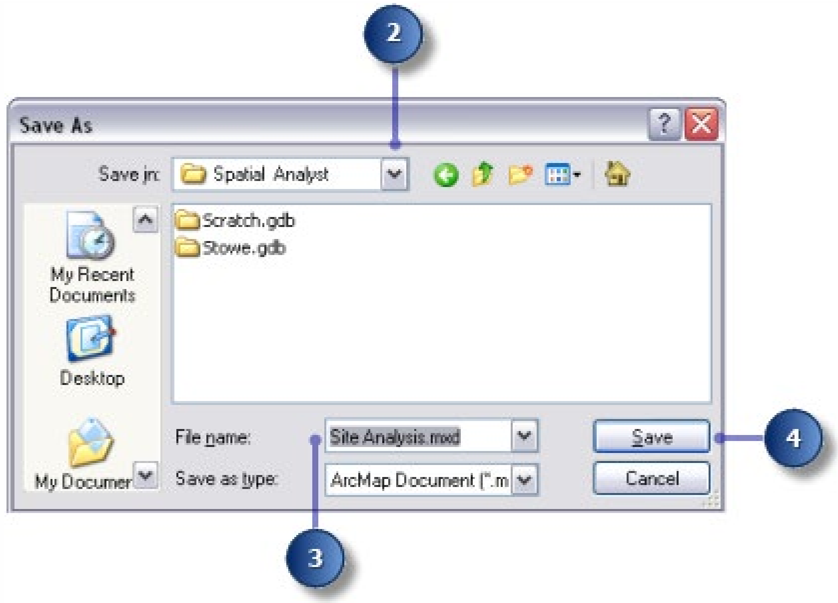
Saving your map document

1 On the **Standard** toolbar, click the **Save** button.

2 Browse to the working copy of the folder.

3 For **File name**, enter **`Site Analysis.mxd`**.

4 Click **Save**.



Summary

You have prepared a workspace in which the datasets created by following the tutorial workflow will be created. You can now proceed to Exercise 2.

Related topics

- About the ArcGIS Spatial Analyst extension Tutorial
- Exercise 2: Accessing the extension and exploring the data
- Exercise 3: Finding a site for a new school
- Exercise 4: Finding an alternate access route

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Exercise 2: Accessing the extension and exploring the data

ArcMap 10.7 | Other versions

Available with Spatial Analyst license.

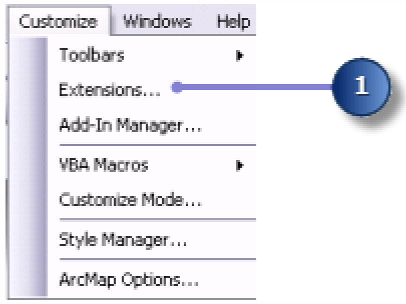
Complexity:
Beginner

Data Requirement:
ArcGIS Tutorial Data for Desktop

You will learn how to enable theArcGIS Spatial Analyst extension, access the Spatial Analyst toolbar, and search for geoprocessing tools. You will create a hillshade output to display transparently with your other layers, make a histogram of your land-use layer, and select elements on your map. This exercise will take approximately 15 minutes to complete.

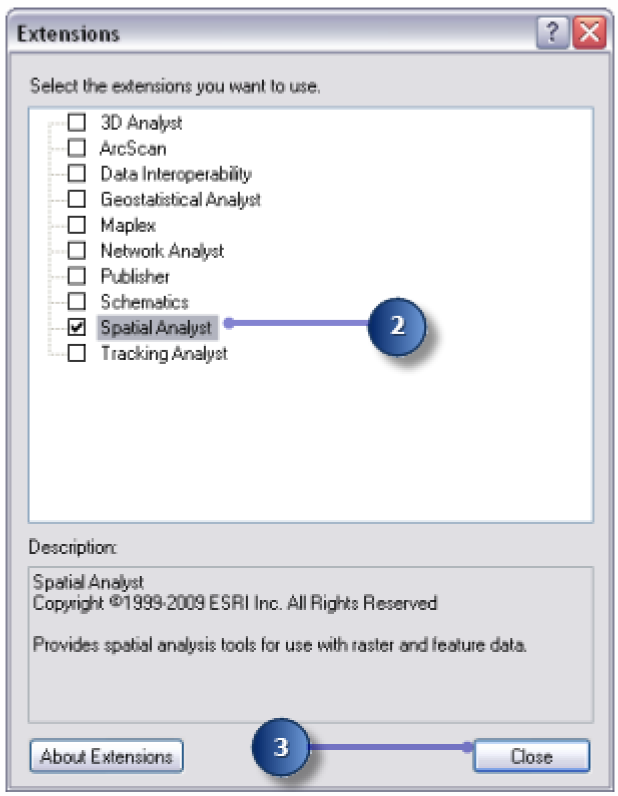
Checking out an ArcGIS Spatial Analyst extension license

1 Click the **Customize** > **Extensions** menu.



2 Check the **Spatial Analyst** check box.

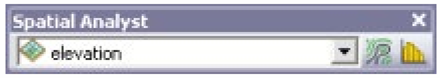
3 Click **Close**.



Add the Spatial Analyst Toolbar

The **Spatial Analyst** toolbar contains a **Create Contour** tool and a **Histogram** button.

1. Click **Customize > Toolbars > Spatial Analyst** on the main menu.

   The **Spatial Analyst** toolbar is added to your ArcMap session.

Creating a hillshade

A hillshade is a shaded relief raster created by using an elevation raster and setting an illumination source (typically the sun) at a user-specified azimuth (the angular direction of the illumination source, in positive degrees from 0 to 360) and altitude (the angle of the illumination source above the horizon). The visual effect of a hillshade can be dramatic when it is displayed under other layers with transparency set in your ArcMap display. You'll run the Hillshade tool so you can view and explore the output from this tool with the rest of your input data later in this exercise.

1. Open the Hillshade tool.

   > w Note:
   >
   > These substeps show how to use the **Search** window to locate the Hillshade tool.
   >
   > 1. Click **Search**.
   > 2. Click **Tools**.
   > 3. Type **`Hillshade`**.
   > 4. Click the **Search** button, or click Enter.
   > 5. Click the Hillshade (Spatial Analyst) tool from the Spatial Analyst toolbox, not the 3D Analyst toolbox.

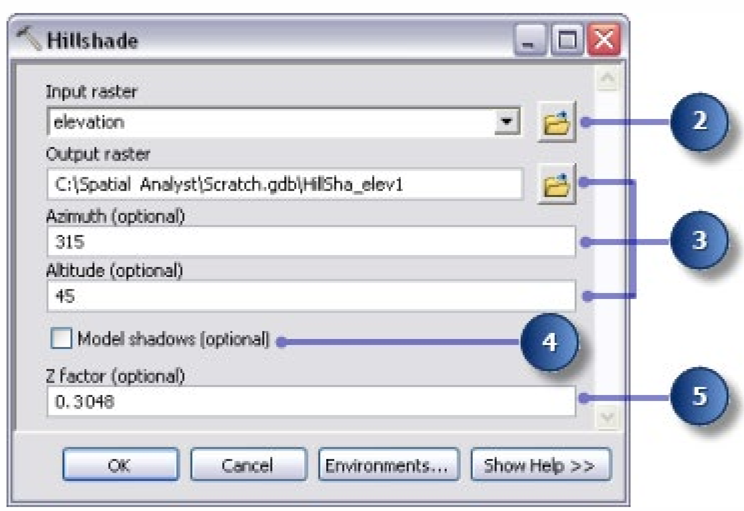
2 Select elevation from the drop-down list for the **Input raster**.

3 Leave the default for the **Output raster**, **Azimuth**, and **Altitude**parameters.

4 Accept the default and leave **Model shadows** unchecked, so the local illumination of the surface will be calculated whether or not a cell falls in the shadow of another cell.

5 Type a value of **`0.3048`** for the **Z factor**.

The x,y units in this elevation data are in meters, and the z-values (the elevation values) are in feet. Since there are 0.3048 meters in one foot, multiplying the z-values by a factor of 0.3048 will convert them to meters.



{ Dive-in:

If your x-, y-, and z-values are all in the same unit of measure (for example, if they are all in meters), you can accept the default **Z factor** of

1, so the z-units are not converted. Setting an appropriate z-factor is critical for good results if your input surface is stored in a geographic coordinate system (for example, the x,y units are a spherical measurement, such as decimal degrees or decimal seconds). The z-factor can also be used for exaggeration of the terrain.

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

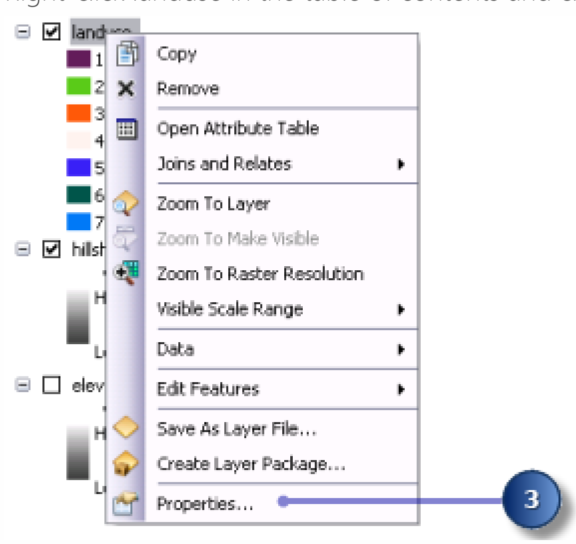
Displaying and exploring data

You will now explore the display capabilities of ArcMap by changing the symbology of one of the layers and applying transparency so you can see the hillshade output you have created underneath your other layers in the display.

1 In the table of contents, click and drag the hillshade result below the landuse layer.

2 Uncheck the elevation layer in the table of contents.

3 Right-click landuse in the table of contents and click **Properties**.



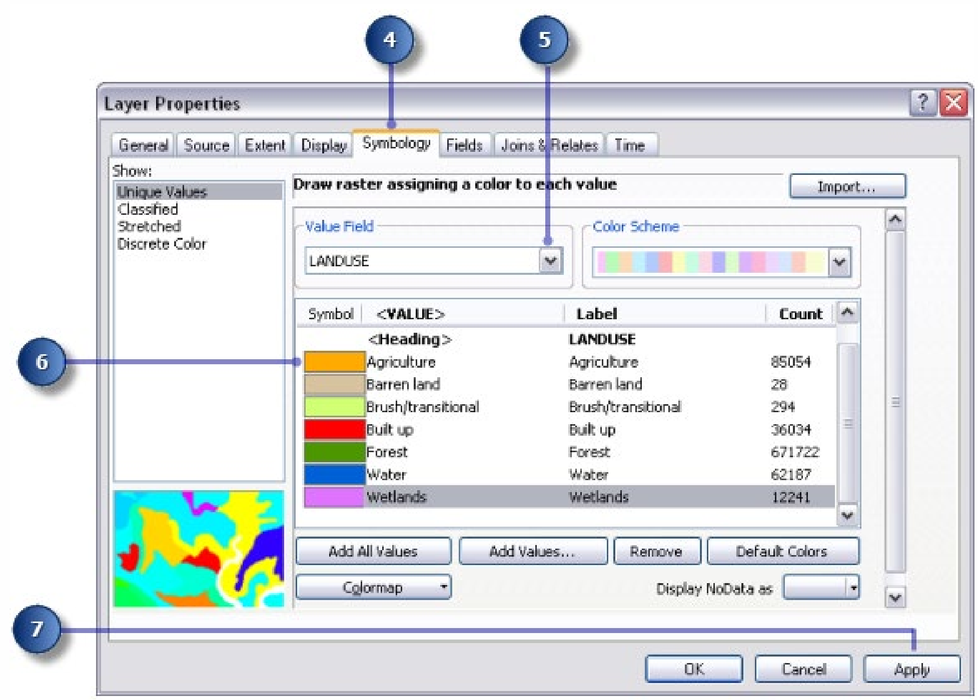
4 Click the **Symbology** tab.

All land-use categories are currently drawn in random colors with the **Unique Values** renderer, based on the **Value Field**. You will change the **Value Field** setting to be more meaningful and change the symbology to show a more appropriate color for each land-use type on the map.

5 Click the **Value Field** drop-down arrow and click **LANDUSE**. This is a string field in the landuse attribute table that describes each land-use type.

6 Double-click each **symbol** and choose a suitable color to represent each land-use type (for example, agriculture is orange; built up areas, red; forest, green; water, blue; and wetlands, purple).

7 Click **Apply**.

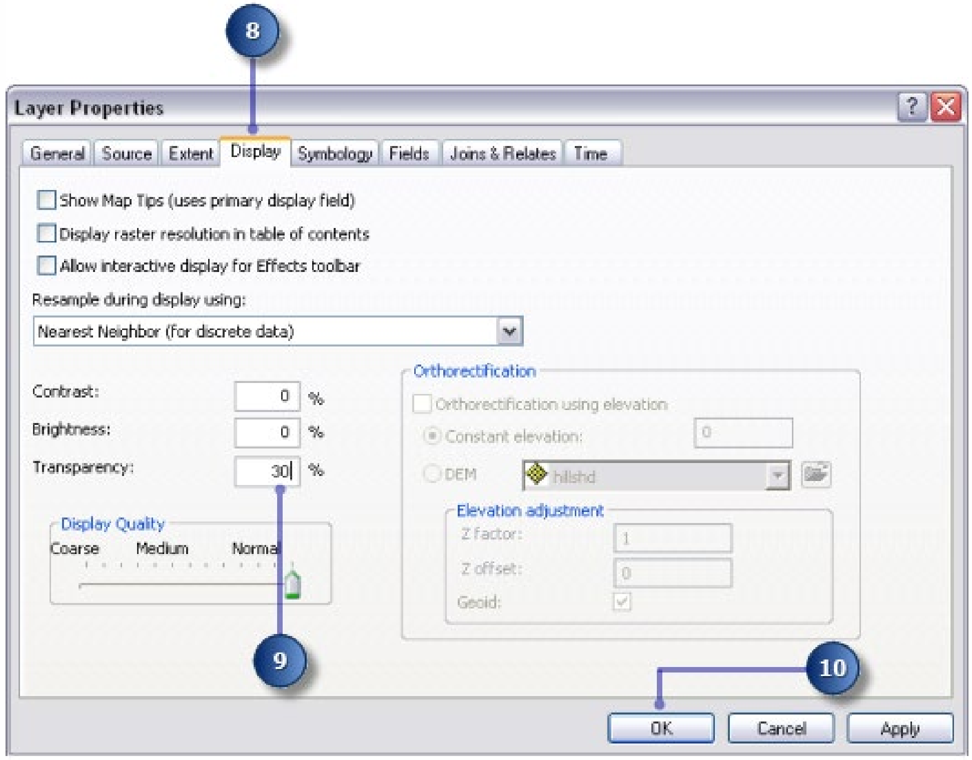


The changes you make are reflected in the table of contents and in the map display.

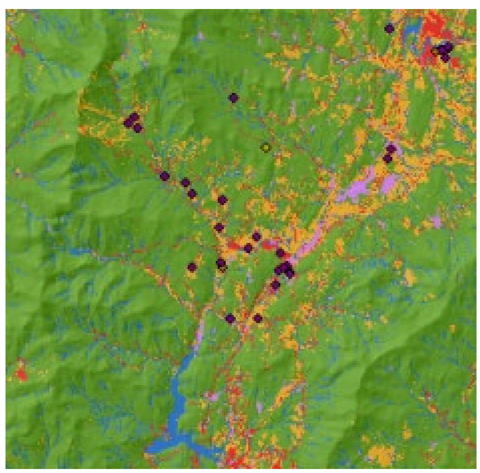
8 Click the **Display** tab.

9 Change the **Transparency** from **0**% to **30**%.

10 Click **OK**.



The hillshade layer can now be seen underneath the landuse layer, giving a vivid impression of the terrain.

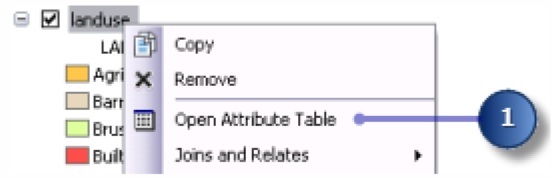


Land use and hillshade map

Select features on the map

Examining the attribute table gives you an idea of the number of cells of each attribute in the dataset.

1 Right-click the landuse layer in the table of contents and click **Open Attribute Table**.



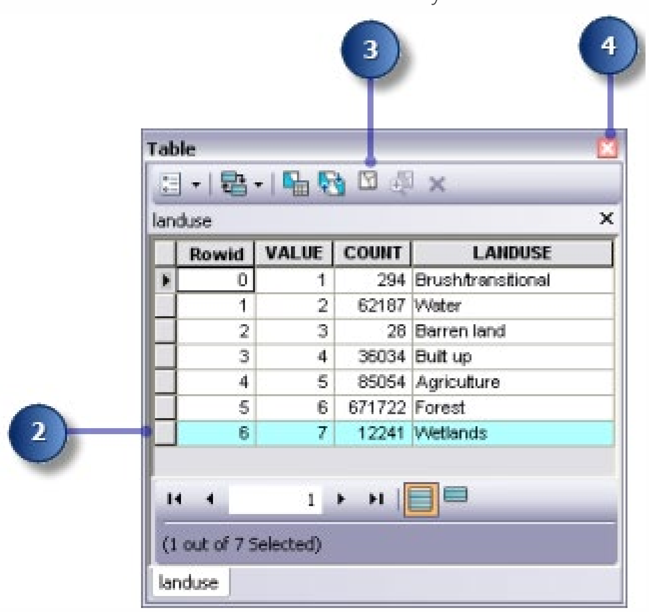
The **COUNT** field identifies the number of cells in the dataset of each value. Notice that Forest (value of 6) has the largest count, followed by Agriculture (value of 5), then Water (value of 2).

2 Click the row representing Wetlands (value of 7).

This selected set, all areas where the land-use type is Wetlands, is highlighted on the map.

3 Click the **Unselect all the currently selected records** button in the menu of the **Table** window.

4 Click the attribute table for landuse layer and the **Table** window.



Identifying features on the map

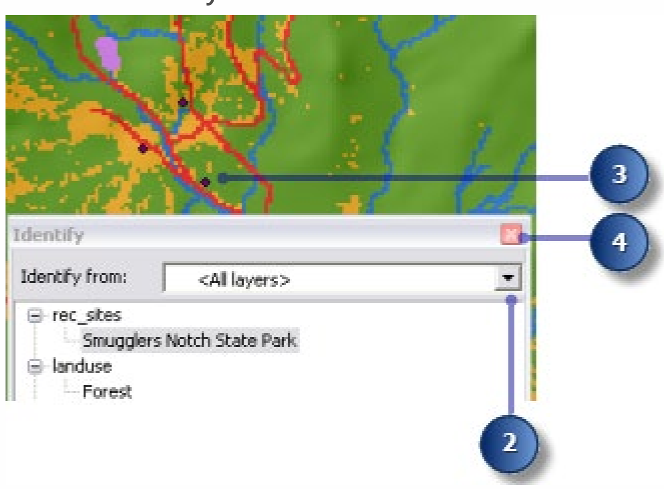
1. Click the **Identify** tool on the **Tools** toolbar and click any location on your map.

2. Click the **Identify from** drop-down arrow on the **Identify** dialog box and click **<All layers>**.

3. Click a rec_site point to identify the features in this particular location.

> w Note:
>
> Your display will not be zoomed in this much; this is only to show the location of the recreation site to click.

4. Close the **Identify** window.



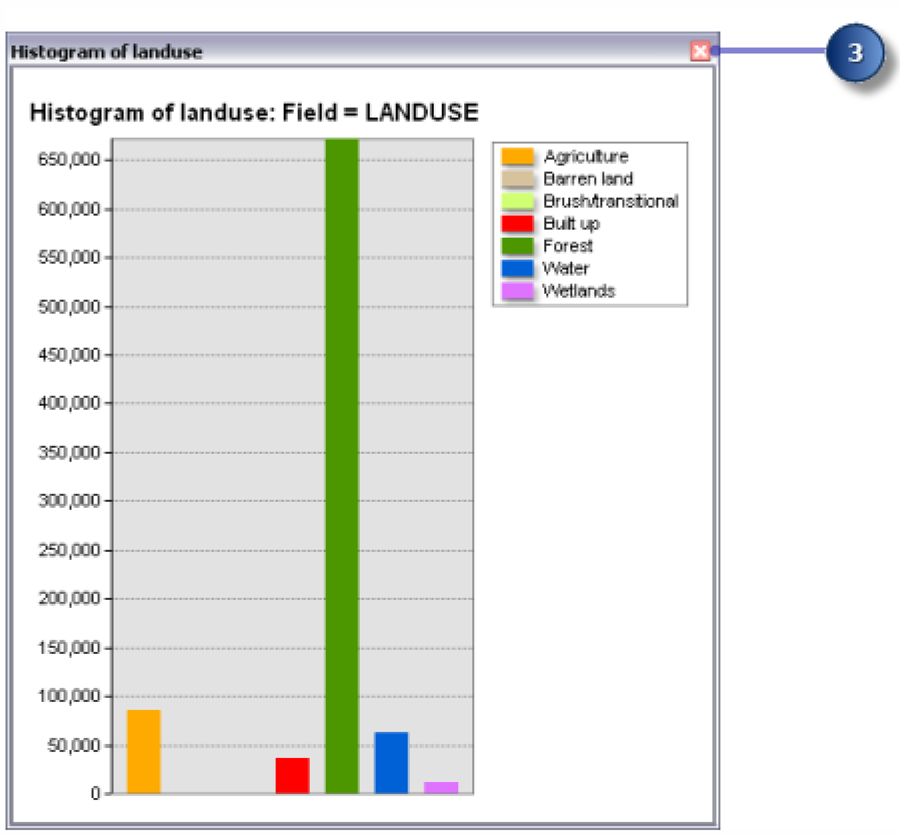
Examining a histogram

1 On the **Spatial Analyst** toolbar, click the **Layer** drop-down arrow and click landuse.

2 Click the **Histogram** button .

The histogram displays the number of cells of each type of land use.

3 Close the **Histogram of landuse** window.



Saving the map document

As the last step in this exercise, you'll save the changes to your map document. You'll use this map document in the next exercise.

1 On the Standard toolbar, click the **Save** button .

Summary

In this exercise, you explored the tutorial data and learned how to access and run Spatial Analyst tools. In the next exercise, you will build a model by adding tools from the Spatial Analyst Tools toolbox to ModelBuilder to run a sequence of tools that will locate the areas that are suitable for building a new school.

You can proceed to exercise 3 or stop and complete the tutorial at a later time. If you do not proceed to exercise 3 now, do not delete your working copy of the tutorial data.

Related topics

- About the ArcGIS Spatial Analyst extension Tutorial
- Exercise 1: Preparing for analysis
- Exercise 3: Finding a site for a new school
- Exercise 4: Finding an alternate access route

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Exercise 3: Finding a site for a new school

ArcMap 10.7 | Other versions

Available with Spatial Analyst license.

Complexity:

Beginner

Data Requirement:

ArcGIS Tutorial Data for Desktop

In this exercise, you'll build a suitability model with ArcGIS Spatial Analyst extension tools that finds suitable locations for a new school. The steps to produce such a suitability model are outlined below.

Your input datasets in this exercise are landuse, elevation, rec_sites, and schools. You will derive slope, distance to recreation sites, and distance to existing schools. Then you'll reclassify these derived datasets to a common scale from 1 to 10. You'll weight them and the landuse dataset according to a percentage of influence, and combine them to produce a map displaying suitable locations for the new school. You'll then select the optimal site for the new school from the alternatives.

This exercise will take approximately 45 minutes to complete. Start this exercise with your Site Analysis map document, created in exercise 1, open.

Creating a new toolbox

You'll first create a new toolbox to hold the models you'll create in this exercise and the next exercise.

1 Create a new toolbox in your Spatial Analyst folder. Name the toolbox **`Site Analysis Tools`**.

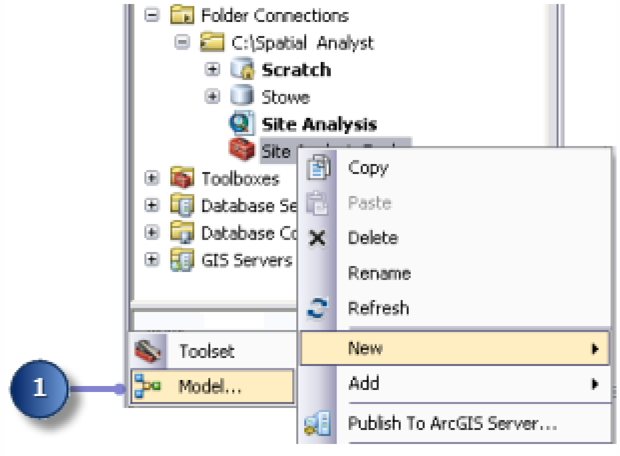
> Tip:
>
> For more information on creating a toolbox, see Creating a custom toolbox.

Creating a new model

You'll create a model to perform Spatial Analyst tasks. A model is built by stringing tools together in ModelBuilder. Once your model is created, you can easily experiment with parameter values, use different input data, run the model over and over again, and share it with others. To find out more about ModelBuilder, see What is ModelBuilder.

In this exercise, you'll create a model to find a suitable location for a new school.

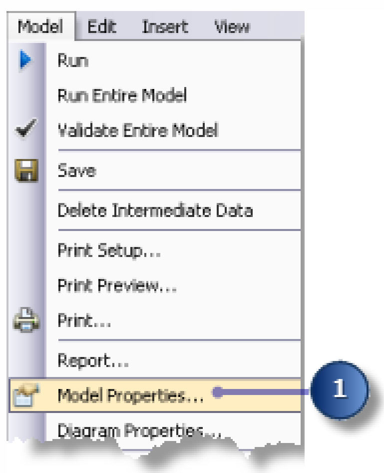
1 Right-click the Site Analysis Tools toolbox and click **New > Model**.



An empty ModelBuilder session opens.

Renaming the model

1 On the model's main menu, click **Model** > **Model Properties**.

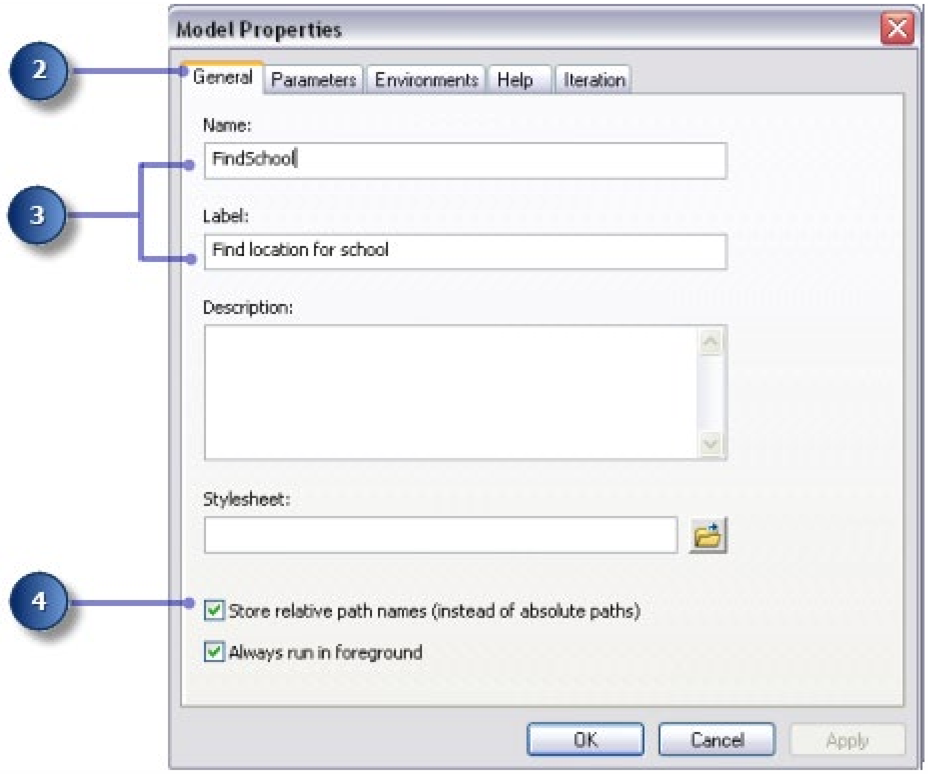


2 Click the **General tab**.

3 Type **`FindSchool`** in the **Name** text box and **`Find location for school`** in the **Label** text box.

The name is used in scripting and at the Python window. The label is the display name for the model.

4 Check the **Store relative path names (instead of absolute paths)** check box.



Checking this box sets all source paths referenced by the tool as relative to the location of the toolbox; therefore, if the model is moved to a different directory, it will still be able to be executed successfully.

Specifying environment settings

Before you perform analysis on your data, you should set any relevant environment settings. For more information on how to set environments and the hierarchy between analysis environments, see The analysis environment of the ArcGIS Spatial Analyst extension.

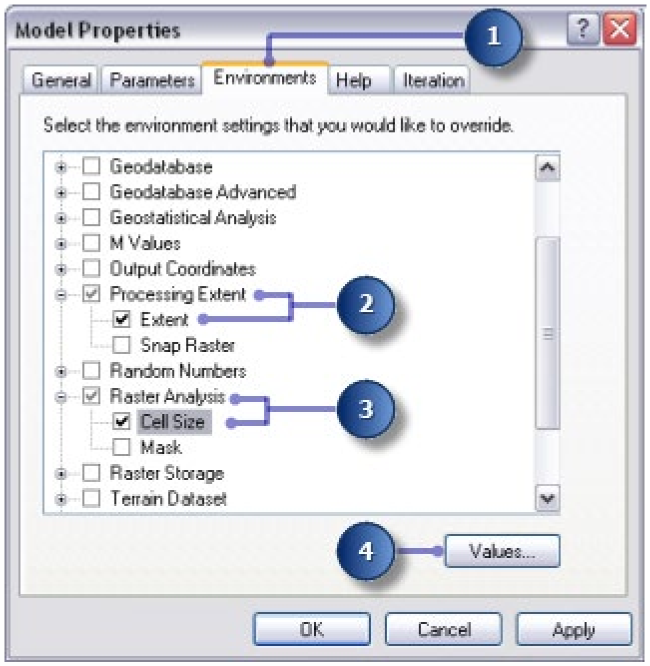
Because your environment settings apply to each process of this model only, you'll set environment settings for the model.

1. Click the **Environments** tab.
2. Expand **Processing Extent** and check **Extent**.
3. Expand **Raster Analysis** and check **Cell Size**.

☐ Tip:

The **Current Workspace** and the **Scratch Workspace** are already set, as these environment settings are inherited from the map document.

4 Click **Values**.



5 Expand **Processing Extent**. Set the **Extent** by clicking the drop-down arrow and choosing **Same as Layer elevation**.

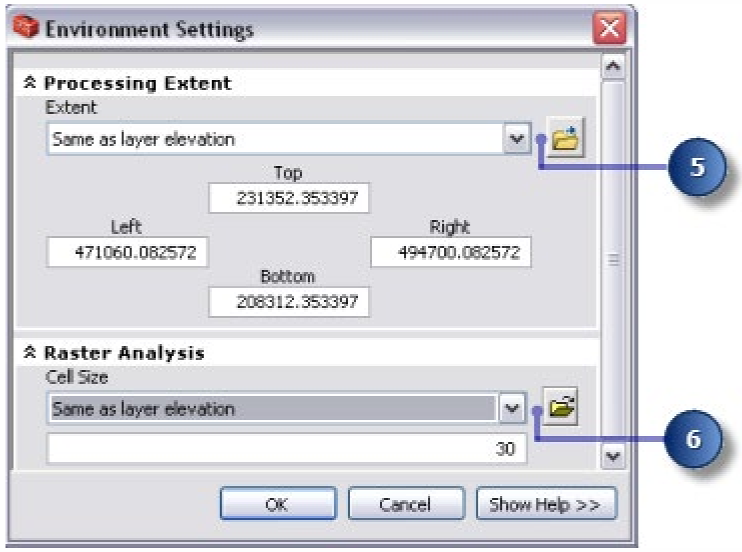
6 Expand **Raster Analysis**. Set the **Cell Size** by clicking the drop-down arrow and choosing **Same as Layer elevation**.

The cell size of your elevation layer will be applied to all subsequent raster outputs. Your elevation dataset has the largest cell size (30 meters).

Caution:

Setting a smaller cell size than your largest input will not mean you have more detailed information in subsequent raster results; you will just have more cells of the same value, which may affect your display and calculation speeds. Although the software does not prevent it, it is considered incorrect to set a cell size smaller than your largest input cell size.

7 Click **OK** in the **Environment Settings** window.



8 Click **OK** in the **Model Properties** window.

9 On the toolbar, click the **Save** button.

Tip:

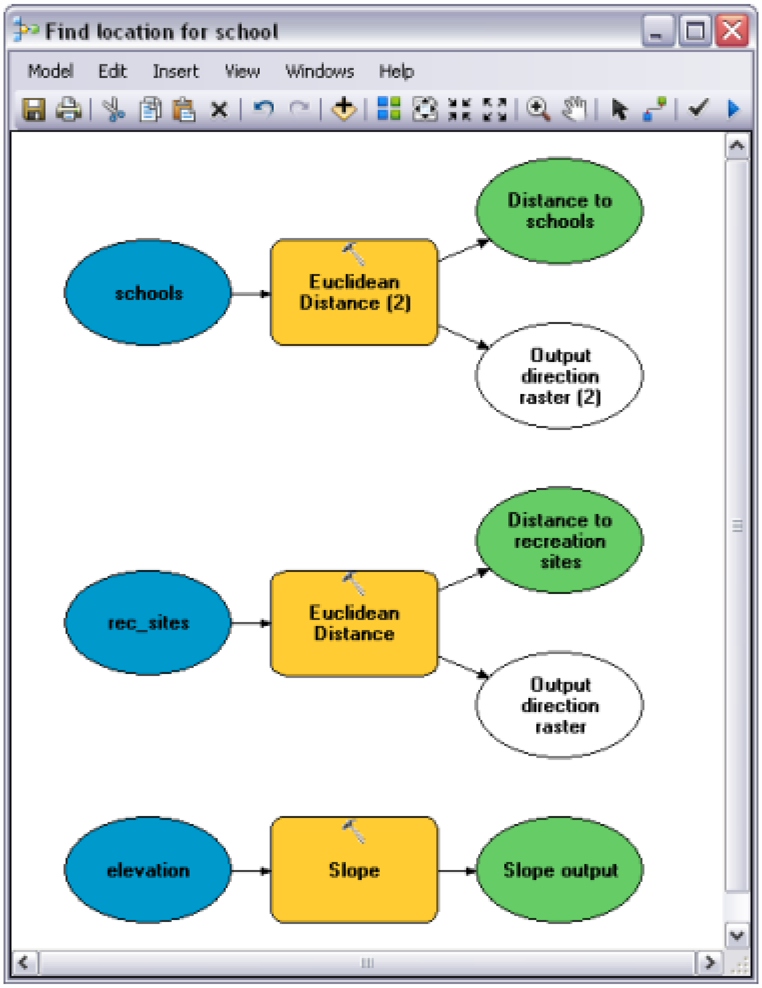
The model's properties are updated. If at any point you want to close the model and continue later, right-click the model in the **ArcToolbox** window and click **Edit** to continue with the tutorial.

Deriving datasets

You are ready to process your project data to locate suitable areas for the new school. You'll derive the following from your project data:

- Slope from the elevation dataset
- Distance from recreation sites from the rec_sites dataset
- Distance from existing schools from the schools dataset

This first section of your model will look like the following:



1. From your **table of contents**, drag the layers elevation, rec_sites, and schools onto your model.

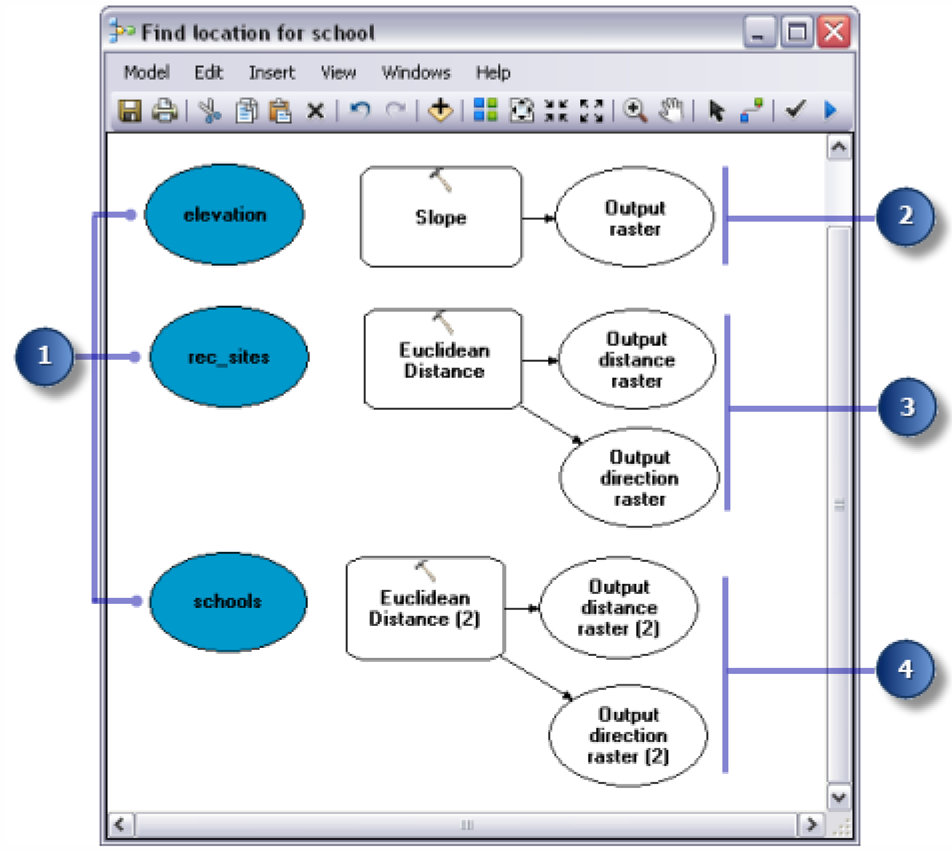
2. Click and drag the Slope tool from the Spatial Analyst Surface toolset onto your model and place it in line with your elevation data.

   An element that references the Slope tool is created in the display window.

3. Locate the Euclidean Distance tool in the Spatial Analyst Tools toolbox Distance toolset. Click and drag the Euclidean Distance tool onto your model and place it in line with rec_sites.

4. Repeat the previous step, but this time place the Euclidean Distance tool in line with schools.

   Notice that each time the same tool is added to a model, the name of the tool element is appended with a number. The second time Euclidean Distance was added to your model, the label consisted of the tool name followed by (2). You can change these labels if you want, but it's unnecessary for this example.



5 Click the **Add Connection** tool .

6 Use the **Add Connection** tool to connect the elevation dataset to the Slope tool. To do this, click elevation, then click the Slope tool, after which you'll see a pop-up menu. Choose Input raster.

7 Repeat the previous step, this time connecting rec_sites to the Euclidean Distance tool and choosing Input raster or feature source data on the pop-up menu. Do the same to connect schools to the Euclidean Distance (2) tool.

> w Note:
>
> The process (consisting of the input data, tool, and default output data elements) is now filled with a solid color, meaning it's ready to run. The direction output element of Euclidean Distance is uncolored, since it's optional and by default is left undefined in the tool. If you were to run the model now, it would run using the default parameters for each tool.

8. On the model toolbar, click the **Select** tool, because you no longer need the **Add Connection** tool.

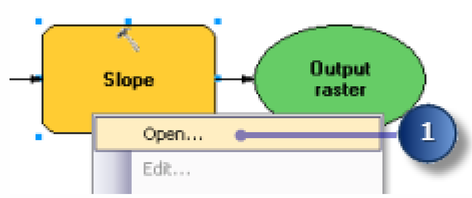
9. Click the **Auto Layout** button, then click the **Full View** button to apply the current diagram properties to the elements and place them within the display window.

10. On the toolbar, click the **Save** button.

Deriving slope from elevation

Since the area is mountainous, you need to find areas of relatively flat land on which to build, so you'll take into consideration the slope of the land.

1. Right-click the Slope tool and click **Open**, or double-click the Slope tool.



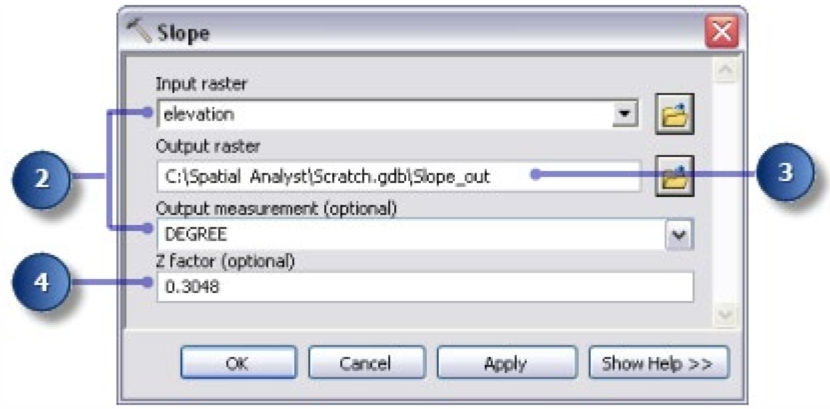
2. Leave the **Input raster** and the **Output measurement** as the default values.

3. Accept the default location for the value of the **Output raster** parameter, but type **`slope_out`** for the name.

   A meaningful output name, **`slope_out`**, has been provided to help locate this data later in exercise 3.

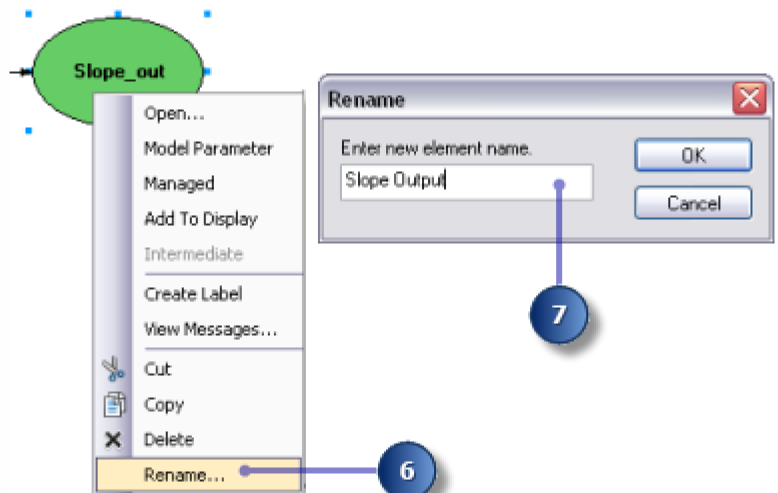
4. For the **Z factor**, type **`0.3048`** to convert the z-values to the same unit of measure as the x,y units (from feet to meters).

5. Click **OK**.



6 Right-click the output variable from the Slope tool and click **Rename**.

7 Type **`Slope Output`** then click **OK**.



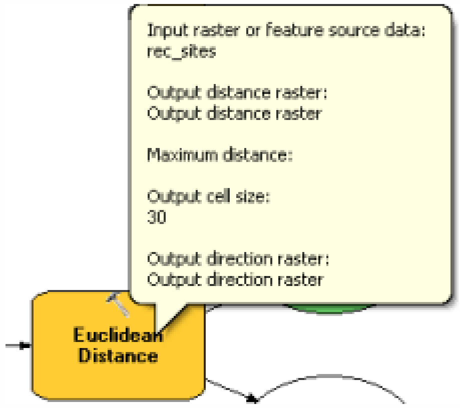
Caution:

Renaming an element label does not alter the name of the output on disk. A layer will be added to the Table of Contents called Slope Output, which references data on disk called Slope_out.

Deriving distance from recreation sites

To find locations close to recreation sites, you must first calculate the Euclidean (straight-line) distance from recreation sites.

1 Hover over the Euclidean Distance tool connected to rec_sites. You can see all the default parameters set for this tool. There is no need to adjust any of these parameters.



You accepted the default for the **Maximum distance**, thus leaving this parameter empty. Therefore, the edge of the output raster is used as the maximum distance. The **Output cell size** is taken from the environment setting previously set to that of your elevation data. In this exercise, the **Output direction raster** is not required.

2 Rename the output variable from the Euclidean Distance tool **`Distance to recreation sites`**.

Deriving distance from schools

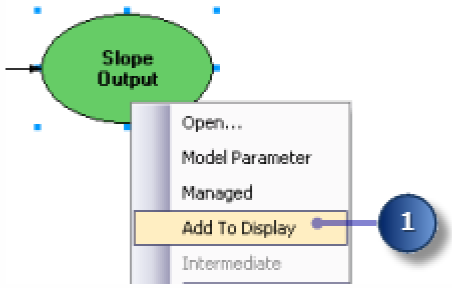
To find locations away from existing schools, you must first calculate the Euclidean (straight-line) distance from schools.

1 Hover over the Euclidean Distance (2) tool connected to schools. You can see all the default parameters set for this tool. There is no need to adjust any of these parameters.

2 Rename the output variable from the Euclidean Distance (2) tool **`Distance to schools`**.

Run model to derive datasets

Right-click each of the output variables (Slope output, Distance to recreation sites, 1 and Distance to schools) then click **Add To Display**.

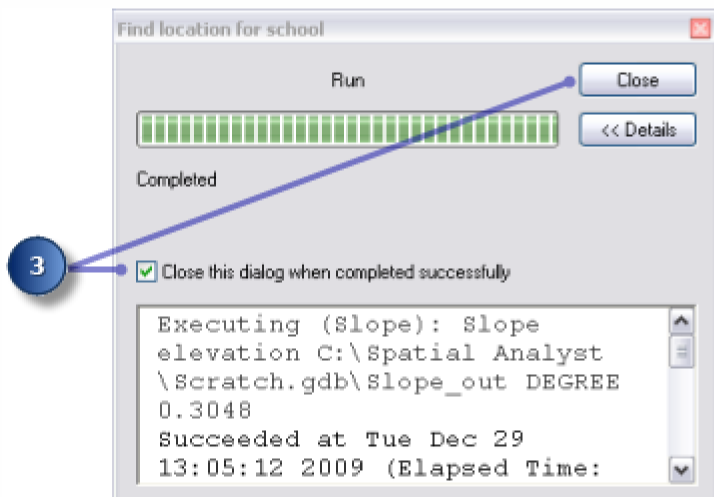


With the **Add To Display** property on, the data referenced by the variable will be added to the display each time the model is run.

2 Click the **Run** button on the model toolbar to execute the three tools—Slope, Euclidean Distance, and Euclidean Distance (2)—in your model.

Notice that as the tool runs, its progress is documented on the progress dialog box, and the tool that references the tool is highlighted in red. When the tools have finished running, the tool and its output become shaded, indicating that the output has been created on disk.

3 If the progress dialog box is present, check the **Close this dialog when completed successfully** check box, then click **Close**.

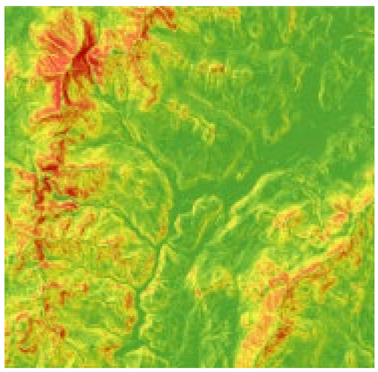


4 Examine the layers added to your ArcMap display.

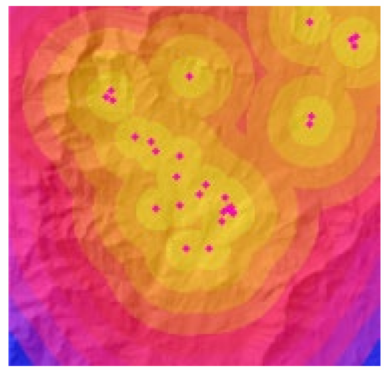
For a better view, you can change the transparency of the target reviewing layer, and display the hillshade layer (created in Exercise 2) under it to have a vivid

> impression of the terrain, just like the result maps below. For example, to view the Distance to recreation sites layer, in the table of contents, click and drag the rec_sites layer over the Distance to recreation sites layer, and drag the hillshade layer under that. Uncheck unnecessary layers in the table of contents. Then change the transparency of the Distance to recreation sites layer from the default of 0 to 30. You'll see results like the Distance from recreation sites map showed below.

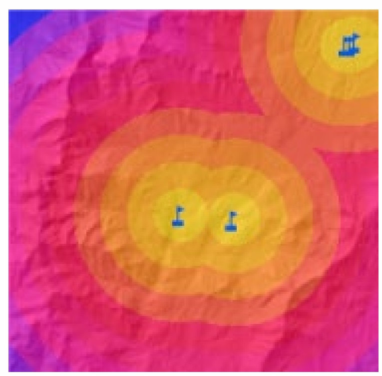
On the Slope Output layer, steep slopes are displayed in red and less steep slopes in green in the output layer. On the Distance to recreation sites layer, distances increase the farther you are from a recreation site. On the Distance to schools layer, distances increase the farther you are from a school.



Slope output map



Distance from recreation sites map



Distance from schools map

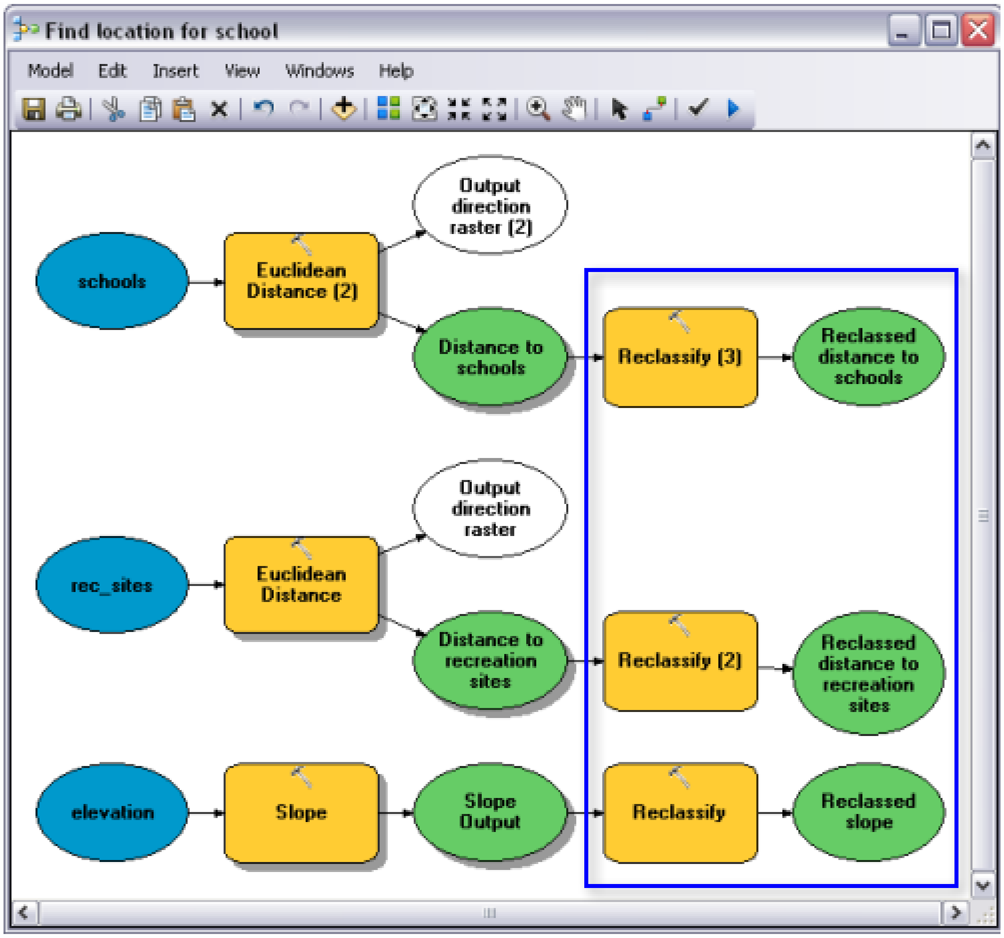
Reclassifying datasets

Deriving datasets, such as slope, is the first step when building a suitability model. Each cell in your study area now has a value for each input criteria (slope, land use, distance to recreation sites, and distance to schools). You need to combine the derived datasets so you can create your suitability map, which will identify the potential locations for the new school. However, it is not possible to combine them in their present form—for example, combining a cell value in which slope equals 15 degrees with a cell value for land use that equals 7 (forest)—and get a meaningful answer that you can compare to other locations. To combine the datasets, they first need to be set to a common measurement scale, such as 1 to 10. That common measurement scale is what determines how suitable a particular location—each cell—is for building a new school. Higher values indicate more suitable locations for the school.

Using the Weighted Overlay tool, you can weight the values of each dataset, and then combine them. However, the inputs for the Weighted Overlay tool must contain discrete, integer values. Land-use data is already categorized into discrete values; for example, forest equals a value of 7, so you can add this dataset directly into the Weighted Overlay tool and assign each cell a new value on the common measurement scale of 1 to 10 (you'll do this later in the tutorial). The values in the datasets you derived in previous steps are all floating-point, continuous datasets, categorized into ranges, and they must first be reclassified so that each range of values is assigned one discrete integer value. Potentially, the value given to each range can be any number, provided you note the range that the value corresponds to. This is because you can weight these values within the Weighted Overlay tool—the next step after reclassifying the derived datasets. However, it's easier to weight the cell values for derived datasets while reclassifying. In the Weighted Overlay tool, you can accept the default and leave the scale values the same as the input values.

You'll reclassify each derived dataset to a common measurement scale, giving each range a discrete integer value between 1 and 10. Higher values will be given to attributes within each dataset that are more suitable for locating the school.

This section of your model will look like the following:



1. Locate the Reclassify tool in the Spatial Analyst Tools toolbox Reclass toolset. Click and drag the Reclassify tool onto ModelBuilder in line with Slope Output. Add another Reclassify tool in line with Distance to recreation sites and another in line with Distance to schools.

2. Click the **Add Connection** tool. Use the connect tool to connect the following:
   a. Slope Output to the Reclassify tool
   b. Distance to recreation sites to the Reclassify (2) tool
   c. Distance to schools to the Reclassify(3) tool

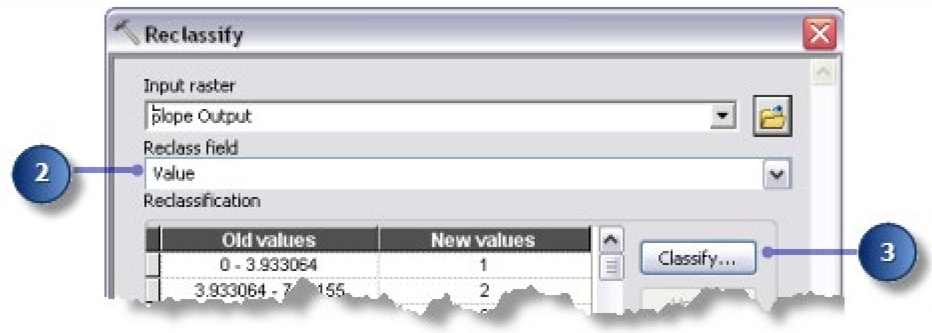
3. On the model toolbar, click the **Select** tool.

4. Click the **Auto Layout** button, then click the **Full View** button.

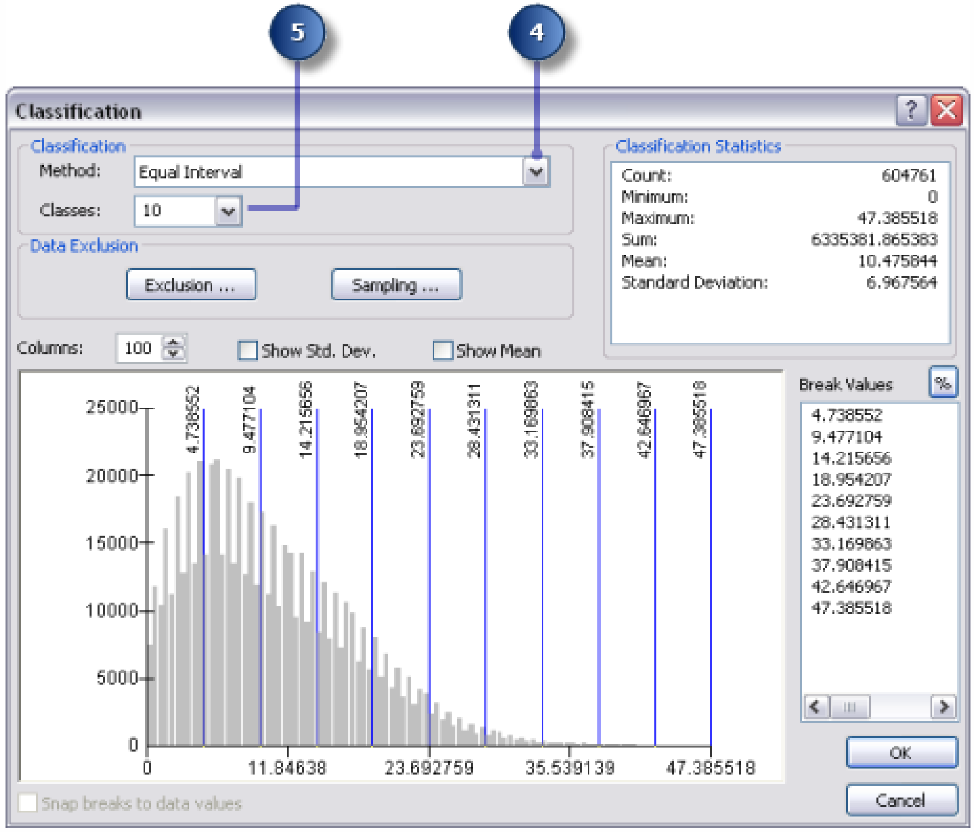
Reclassifying slope

It is preferable that the new school site be located on relatively flat ground. You'll reclassify the slope output, slicing the values into equal intervals. You'll assign a value of 10 to the most suitable range of slopes (those with the lowest angle of slope) and 1 to the least suitable range of slopes (those with the steepest angle of slope) and linearly rank the values in between.

1. Open the Reclassify tool connected to the Slope Output variable.
2. Accept the default for the **Reclass field** parameter so the **`Value`** field will be used.
3. Click **Classify**.



4. Click the **Method** drop-down arrow and click **Equal Interval**.
5. Click the **Classes** drop-down arrow and click **10**.
6. Click **OK**.

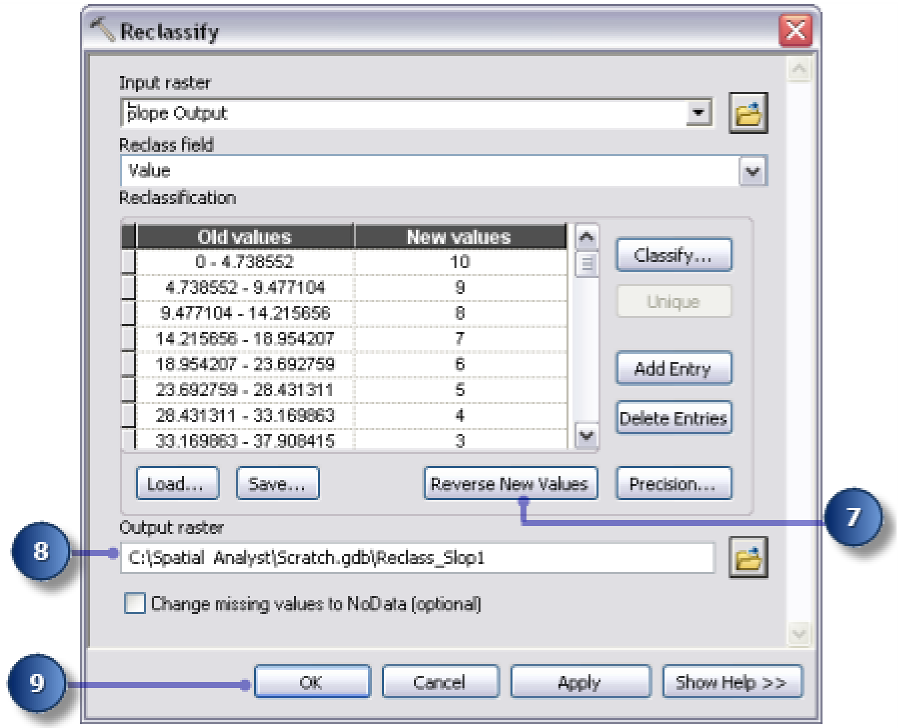


7 Click **Reverse New Values**.

Reversing the values applies higher new values to the values representing less steep slope, since these areas are more suitable for building.

8 Accept the default for the **Output raster** parameter.

9 Click **OK**.



10 Rename the output variable from the Reclassify tool to **`Reclassed slope`**.

Reclassifying distance to recreation sites

The school should be located as close as possible to a recreational facility. You'll reclassify the distance to recreation sites output, assigning the number 10 to ranges of values that represent areas closest to recreation sites (the most suitable locations), assigning the number 1 to ranges of values that represent areas far from recreation sites (the least suitable locations), and ranking the values linearly in between.

1 Open the Reclassify tool connected to the Distance to recreation sites variable.

2 Accept the default for the **Reclass field** parameter so the **`Value`** field will be used.

3 Click **Classify**.

4 Set the **Method** to **Equal Interval** and the number of **Classes** to **10**.

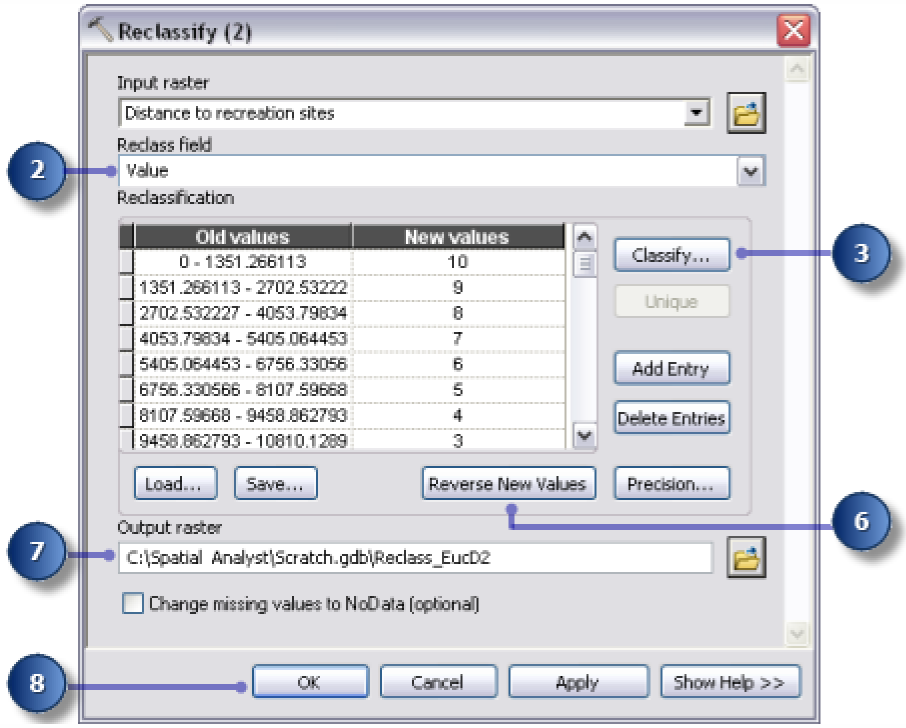
5 Click **OK**.

6 Click **Reverse New Values**.

Clicking **Reverse New Values** makes it so that distances close to recreational facilities receive a higher new value, since these areas are more desirable.

7 Accept the default path and name for the **Output raster** parameter.

8 Click **OK**.



9 Rename the output variable from the Reclassify (2) tool `Reclassed distance to recreation sites`.

Tip:

To resize the output variable element, Reclassed distance to recreation sites, click the element and move the mouse pointer over one of the blue handles surrounding the element, then click and drag to resize the element so all text can be seen.

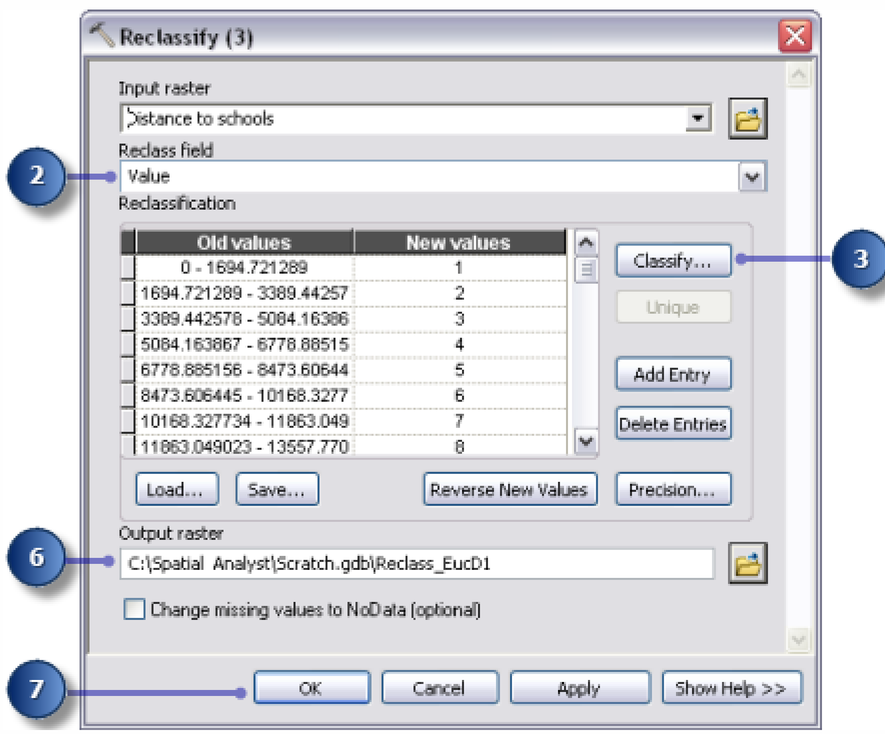
Reclassifying distance to schools

It's necessary to locate the new school away from existing schools to avoid encroaching on their catchment areas. You'll reclassify the Distance to schools layer, assigning a value of 10 to areas farthest from existing schools (the most suitable locations), assigning a value of 1 to areas near existing schools (the least suitable locations), and linearly ranking the values in between. By doing this, you'll determine which areas are near and which areas are far from existing schools.

1. Open the Reclassify (3) tool.
2. Accept the default for the **Reclass field** parameter so the **`Value`** field will be used.
3. Click **Classify**.
4. Set the **Method** to **Equal Interval** and the number of **Classes** to **10**.
5. Click **OK**.

   You want to position the school away from existing schools, so you'll assign larger numbers to ranges of values that represent locations farther away, because these locations are most desirable. Since the default assigns high **New values** (more suitable locations) to higher ranges of **Old values** (locations farther away from existing schools), you do not need to change any values at this time.

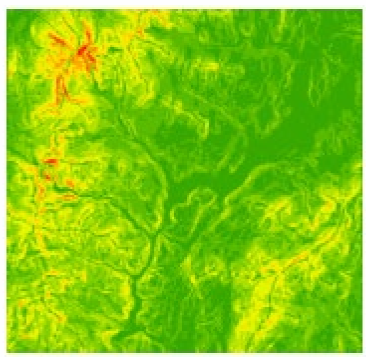
6. Accept the default for the **Output raster** parameter.
7. Click **OK**.



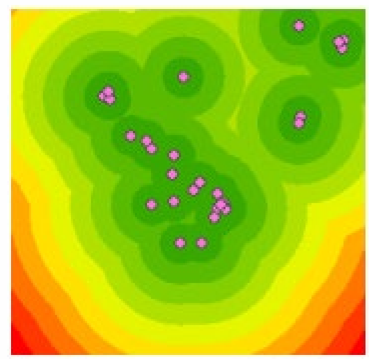
8 Rename the output variable from the Reclassify (3) tool Reclassed distance to schools.

Executing the Reclassify operation

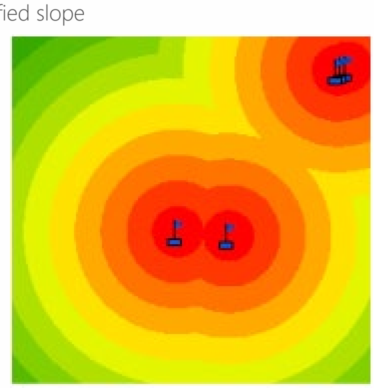
1. Right-click each of the variable outputs—Reclassed slope, Reclassed distance to recreation sites, and Reclassed distance to schools—and click **Add To Display**.
2. Click the **Run** button to execute the three Reclassify tools in your model.
3. On the toolbar, click the **Save** button.
4. Examine the layers added to your ArcMap display. To have a better view, you can, for example drag the rec_sites layer over the reclassified distance to recreation sites layer, so you can see the 10 distance rings starting from the origins of recreation sites. You can customize your map by changing points symbology, such as the map shown below. Do the same to the reclassified distance to schools layer.



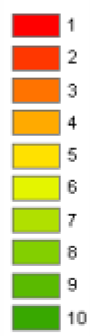
Reclassified slope



Reclassified distance to recreation sites



Reclassified distance to schools



Legend

Locations with higher values (with low gradient slopes, close to recreation sites, and away from existing schools) are more suitable than locations with lower values (with steeper slopes, far from recreation, and close to existing schools).

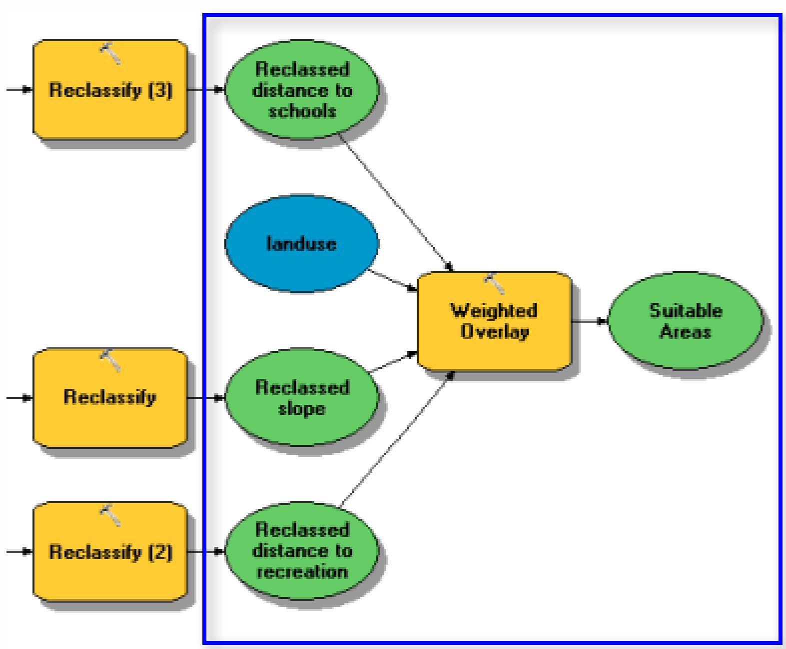
Weighting and combining datasets

You are now ready to combine the reclassified datasets and land use to find the most suitable locations. The values of the reclassified datasets representing slope, distance to recreation sites, and distance to schools have all been reclassified to a common measurement scale (more suitable cells have higher values). The landuse dataset is still in its original form because you can weight the cell values for this dataset as part of the weighted overlay process. Values representing areas of water and wetlands will be restricted. You'll also mark slope values that are less than 4 (the least suitable because they are too steep) as restricted so these values can be excluded. If all datasets were equally important, you could simply combine them, giving each equal influence; however, you've been informed that it's preferable to locate the new school close to recreational facilities and away from other schools. You'll weight all the inputs, assigning each a percentage of influence. The higher the percentage, the more influence a particular input will have in the suitability model.

You'll assign the inputs the following percentages of influence:

```
Reclassed distance to rec_sites: 50%
Reclassed distance to schools: 25%
Reclassed slope: 13%
landuse: 12%
```

This section of your model will look like the following:



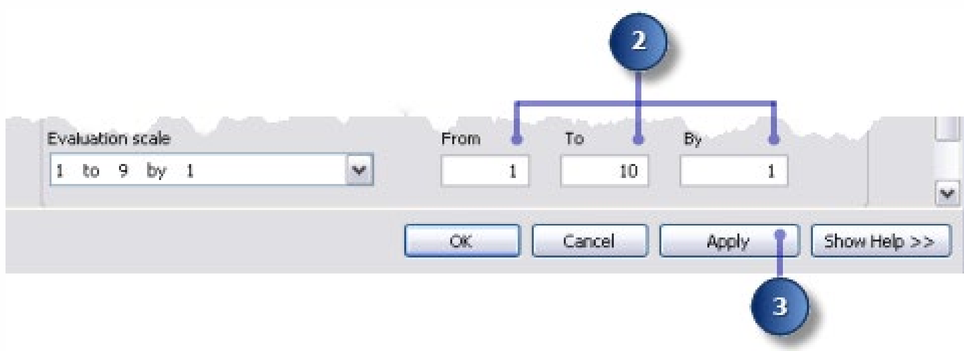
1. Click and drag the Weighted Overlay tool, located in the Spatial Analyst toolbox Overlay toolset, into ModelBuilder.

Setting up the Weighted Overlay operation

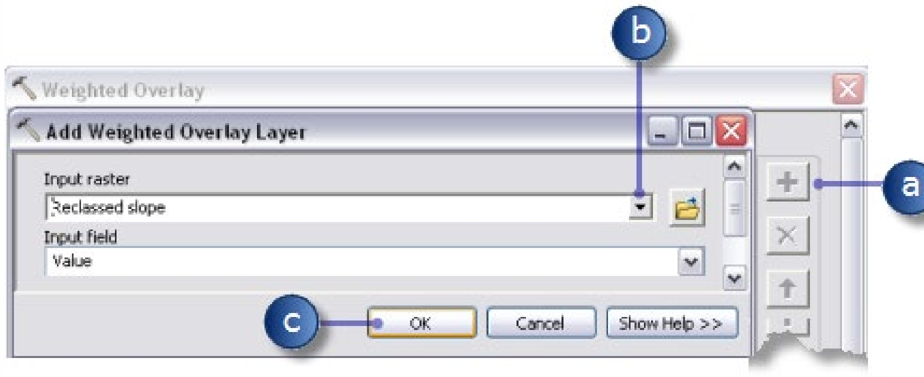
1. Open the Weighted Overlay tool.
2. Type **`1`**, **`10`**, and **`1`** in the **From**, **To**, and **By** text boxes, respectively.

   The default **evaluation scale** is from 1 to 9 by 1. A scale of 1 to 10 was used when reclassifying datasets, so before adding input rasters to the Weighted Overlay tool, you want to set the evaluation scale from 1 to 10 by 1. This means you'll avoid having to update the scale values after adding your input datasets.

3. Click **Apply**.



4. Add the Reclassed slope to the Weighted Overlay tool.
   a. Click the **Add raster row** button.
   b. For the input raster, choose Reclassed slope from the drop-down list and leave the input field as **`Value`**.
   c. Click **OK**.

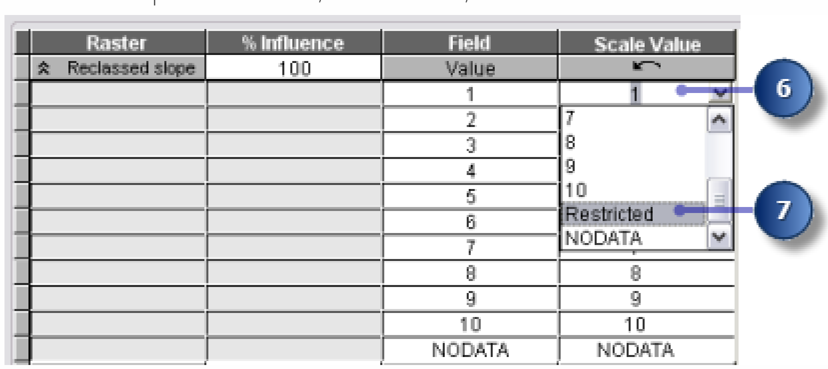


The raster is added to the **Weighted Overlay Table**. The **Field** column displays the values of the Reclassed slope data. The **Scale Value** column mimics the **Field** column because the **Evaluation scale** was set to encompass the range of values in each input raster. You could modify the **Scale Values** for each class at this point, but for this input, the values were already weighted appropriately at the time of reclassifying.

5 Repeat the previous step for each of the reclassified datasets, including Reclassed distance to schools and Reclassed distance to recreation sites.

6 For the Reclassed slope input, in the **Scale Value** column, click the cell with a value of 1.

7 Click the drop-down arrow, scroll down, and click **Restricted**.



You know you don't want to build on slopes greater than about 33 percent, even if all other conditions are ideal. You'll make values from 1 to 3 restricted, since these values represent slopes from 33.431043 to 47.758633 (the maximum slope).

{ Dive-in:

Setting a **Scale Value** to **Restricted** assigns a value to that cell in the output weighted overlay result that is the minimum value of the evaluation scale set minus 1 (zero in this exercise). If there are no inputs to the Weighted Overlay tool with cells of NoData, you could use NoData as the scale value to exclude certain values. However, if you have NoData cells in any of your inputs, it is safest to use **Restricted**. Potentially, a result from the Weighted Overlay tool could contain cells of NoData that have come from one or more of the inputs (NoData on any input equals NoData in the result) and restricted areas that you intentionally excluded. NoData and Restricted values should not be confused. Each serves a specific purpose. There may be areas of NoData for which you don't know the value but that are actually suitable areas. If you use NoData to exclude certain cell values and there is NoData in one or more inputs, you will not know whether a cell of NoData means the area is restricted from use or there was no input data available in that location.

8 Set **Scale Values** of 2 and 3 to **Restricted**.

9 Add the landuse layer, this time setting the **Input field** to **`LANDUSE`**. Click **OK**.

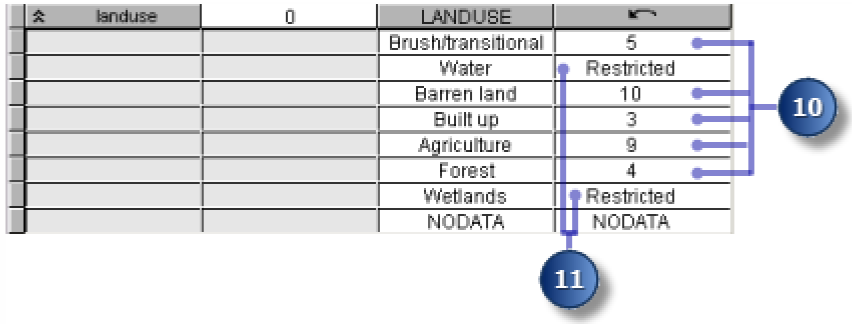
You'll now weight the scale values of the landuse layer so they are comparable with the other inputs. A lower value indicates that a particular land-use type is less suitable for building. The scale values for Water and Wetlands will be set as Restricted, since they cannot be built on and should be excluded.

10 Change the default **Scale Values** for the landuse layer to the following values:

- Brush/transitional—5
- Barren land—10
- Built up—3
- Agriculture—9
- Forest—4

11 Set the **Scale Values** representing **`Water`** and **`Wetlands`** to **Restricted**.

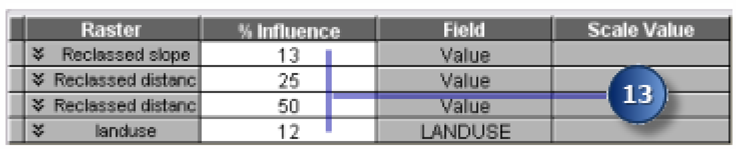
12 Collapse each raster in the **Weighted overlay table**.



You'll now assign a percentage of influence to each raster, based on how much importance (or weight) each should have in the final suitability map.

13 In the **% Influence** column, type the percentages for each of the input rasters as follows:

- Reclassed slope to **13**
- Reclassed distance to schools to **25**
- Reclassed distance to recreation sites to **50**
- Reclassed landuse to **12**



Tip:

Move the mouse pointer over the name of an input raster to view the entire name.

14 Accept the default for the **Output raster** parameter.

15 Click **OK**.

Executing the Weighted Overlay operation

1 Click the **Auto Layout** button, then click the **Full View** button.

2 Rename the output variable from the Weighted Overlay tool to `Suitable Areas`

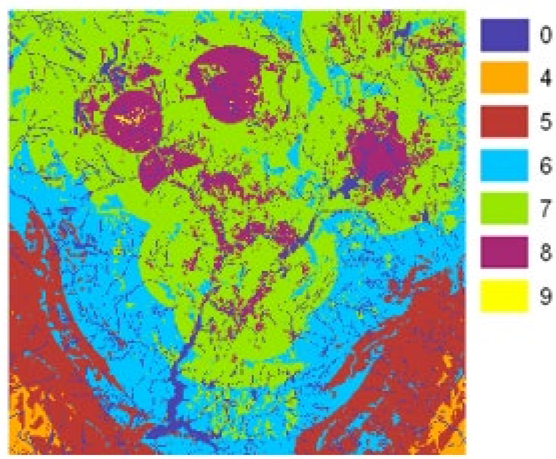
then click **OK**.

3 Right-click the Suitable Areas variable and click **Add To Display**.

4 Run the Weighted Overlay tool.

5 On the toolbar, click the **Save** button.

Examine the layer added to your ArcMap display. Locations with higher values indicate more suitable sites—areas that are on less steep slopes of suitable land-use types, closer to recreational facilities, and away from existing schools. Notice that the areas you marked as restricted have a value of zero.

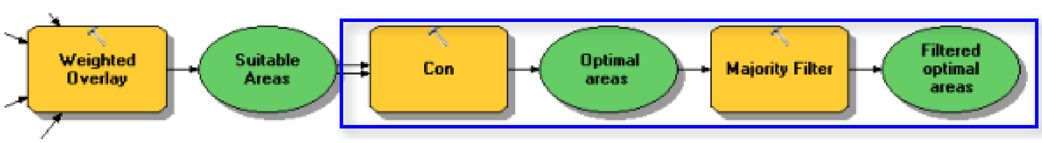


Suitable Areas map

Selecting optimal sites

On your layer, each pixel has a value that indicates how suitable that location is for a new school. Pixels with the value of 9 are most suitable, and pixels with the value of 0 are not suitable. Therefore, the optimal site location for a new school has the value of 9. Another criteria for an optimal location is the size of the suitable area. A suitable location would include several pixels with value of 9 being connected.

This section of your model will look like the following:



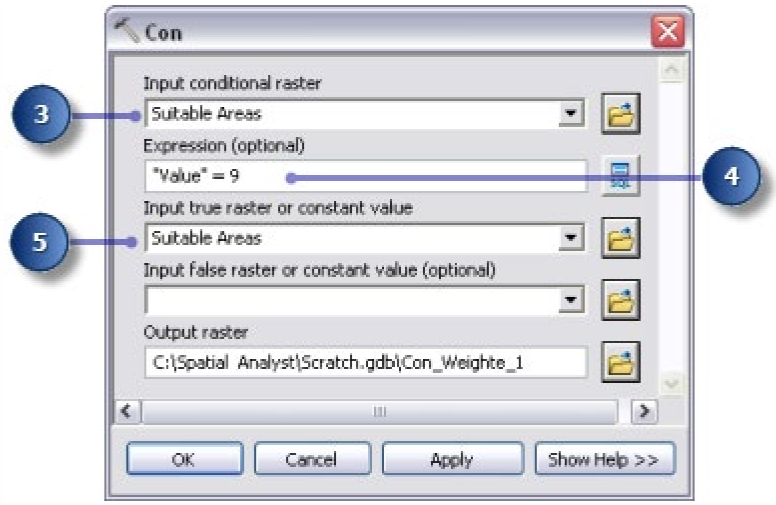
Extract optimal sites using the Con tool

You'll use a conditional expression in the Con tool to extract only the optimal sites. It's been decided that those sites that are considered optimal must have a suitability value of 9 (the highest value in the suit_areas output). In the conditional expression, all areas with a value of 9 will retain their original value (9). Areas with a value of less than 9 will be changed to NoData.

1. Click and drag the Con tool, located in the Conditional toolset, into ModelBuilder.
2. Open the Con tool.
3. Click the **Input Conditional Raster** value drop-down arrow and click the Suitable Areas variable.
4. Type the condition **`Value = 9`** for the value of the **Expression** parameter.
5. Click the **Input true raster or constant** value drop-down arrow and click the Suitable Areas variable.

   If the condition you enter is true, then the value of the cells of the Input true raster or constant value will be applied to the cells of the output raster.
6. Leave the value for the **Input false raster or constant value** parameter blank.

   Leaving the **Input false raster or constant value** parameter blank will apply the default. The default is that any value in the **Input conditional raster** that doesn't meet the condition you enter will be assigned NoData in the output raster.
7. Accept the default for the **Output raster** parameter.
8. Click **OK**.



9. Click the **Auto Layout** button , then click the **Full View** button .
10. Rename the output variable from the Con tool **`Optimal areas`** then click **OK**.
11. Right-click Optimal areas and click **Add To Display**.
12. Run the Con tool.

Examine the layer added to your ArcMap display. These are the optimal site locations for the new school. There are many single cells representing optimal locations. These 30-meter cells are too small for the school site. You'll clean up the result, removing these small areas, using the Majority Filter tool.

Refine the optimal areas using the Majority Filter tool

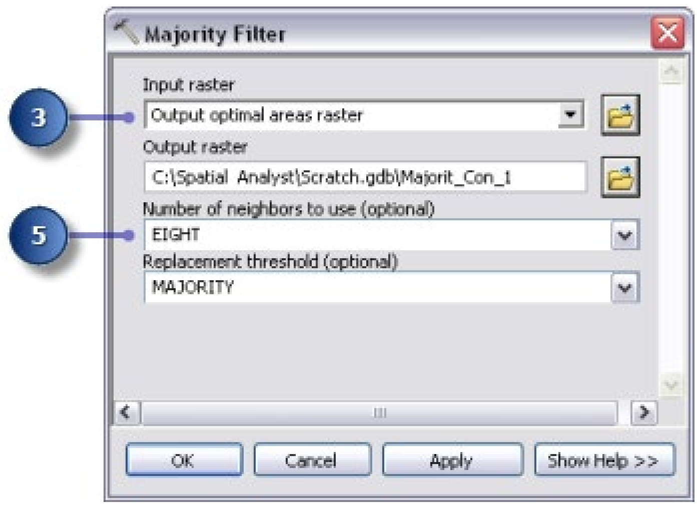
1. Click the Majority Filter tool, located in the Spatial Analyst Tools toolbox Generalization toolset, and add it to ModelBuilder.
2. Open the Majority Filter tool.
3. Click the **Input raster** drop-down arrow and click the Optimal areas raster variable.
4. Accept the default **Output raster** parameter.
5. Click the **Number of neighbors to use** drop-down arrow and click **EIGHT**.

This option specifies the number of neighboring cells to use in the kernel of the filter. The kernel of the filter will be the eight nearest neighbors (a 3-by-3 cell window) to the present cell.

6 Accept the default to use **MAJORITY** as the **Replacement threshold**.

Using **MAJORITY** as the **Replacement threshold** means five out of eight connected cells must have the same value for the present cell to retain its value.

7 Click **OK**.



8 Rename the output variable from the Majority Filter tool **`Filtered optimal areas`**.

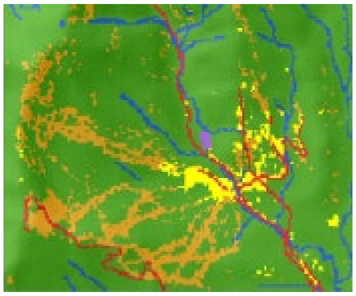
9 Right-click the Filtered optimal areas and click **Add To Display**.

10 Run the Majority Filter tool.

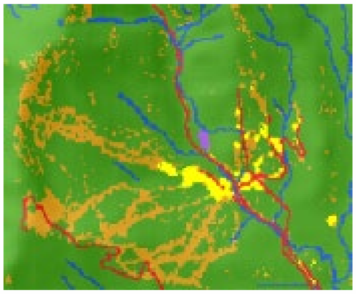
11 On the toolbar, click the **Save** button and close your model.

Examine the layer added to your ArcMap display. Compare Filtered optimal areas and Optimal areas. Many optimal areas that were considered too small in area have been removed.

> w Note:
>
> If you want to remove areas of multiple cells, use the Nibble tool also located in the Generalization toolset.



Map of optimal areas output from the Con tool



Map of optimal areas output from the Majority Filter tool

Selecting the best site

You've discovered the optimal sites for building the new school. All the locations in the Filtered optimal areas layer are suitable. The last step in this exercise is to locate the best site out of the alternatives. The roads layer displays the roads within the town of Stowe. By examining the Filtered optimal areas layer with the roads layer, you'll see that there are some suitable areas for the school site that are not close to roads within the town. You'll first exclude these areas by locating suitable sites that are intersected by roads. Then you'll locate the best site based on area. An optimal school site is larger than 10 acres, or 40,469 square meters.

You'll first convert the Filtered optimal areas raster to a feature class inside a geodatabase so you can use the area field that's generated. You'll use the Select Layer By Location tool to select features that are intersected by roads. Then you'll use the Select Layer By Attribute tool to identify the optimal site from the alternatives, based on area. Finally, you'll create a new feature class from the selection that you'll use in the next exercise.

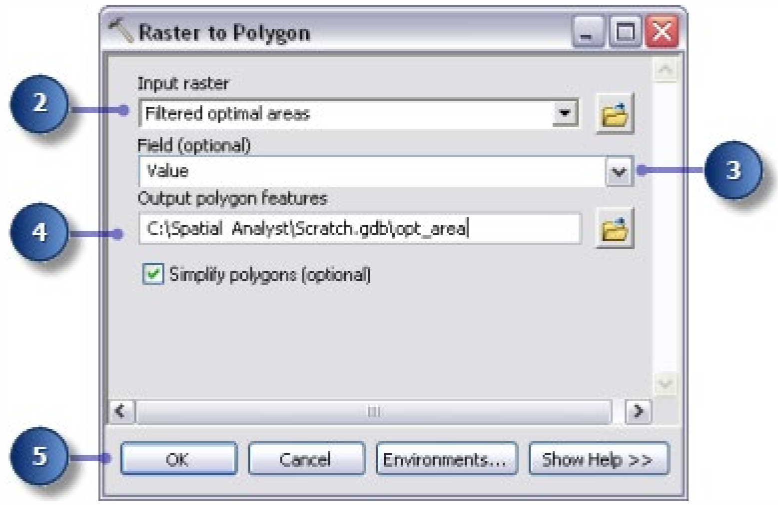
Executing the Raster to Polygon tool

1. Open the Raster To Polygon tool in the Conversion Tools toolbox, in the From Raster toolset.
2. Click the **Input raster** drop-down arrow and click the **`Filtered optimal areas`** raster layer.
3. Leave the default for the **Field** parameter as **`VALUE`**.

4 Accept the default **Output polygon features** parameter path, but change the name to **opt_area**.

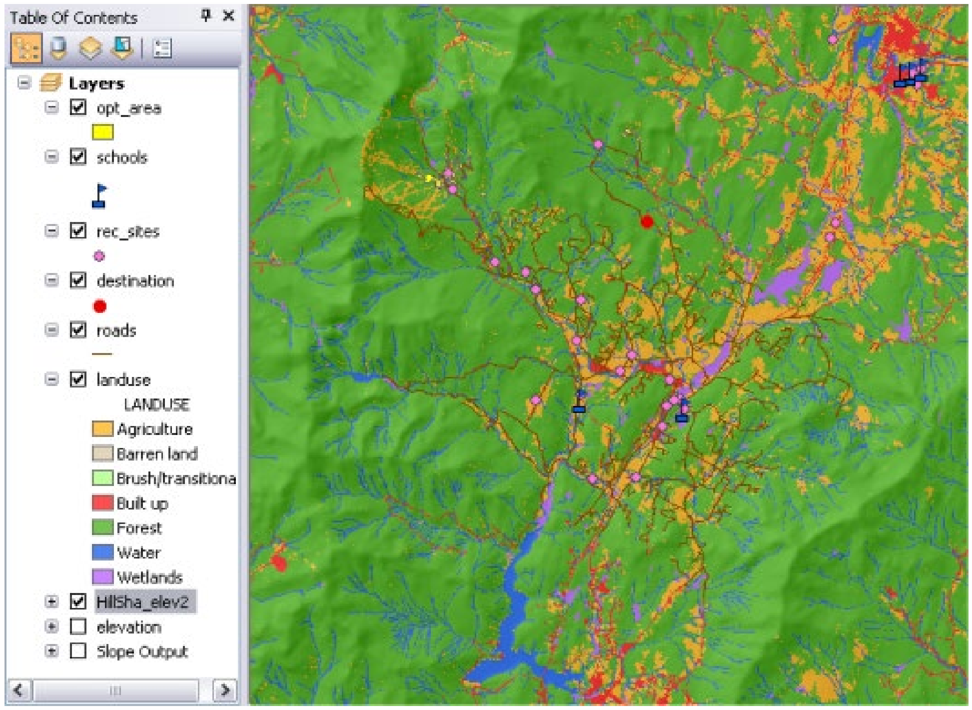
5 Leave the default checked to **Simplify polygons**. The polygons will be simplified to reduce the stair-step effect when a raster is converted to a polygon.

6 Click **OK**.



Executing the Select By Location tool

1 Leave the landuse, elevation, hillshade, destination, roads, rec_sites, schools, Slope Output, and opt_area layers in the table of contents. In the table of contents, right-click the layers to be removed, and click **Remove**. Press and hold the Shift key to select multiple layers. Your ArcMap table of contents display should resemble the following screen capture:



2 Open the Select Layer By Location tool in the Data Management toolbox, in the Layers and Table Views toolset.

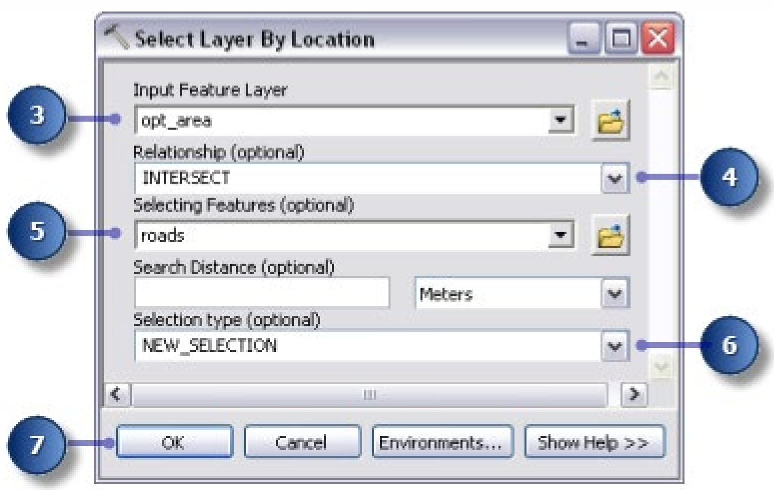
3 For **Input Feature Layer**, choose opt_area from the drop-down list.

4 For the **Relationship** parameter, accept the default, which is **INTERSECT**.

5 Click the **Selecting Features** drop-down arrow and click the Roads layer.

6 Accept the default for the **Selection type** parameter, which is **NEW_SELECTION**.

7 Click **OK**.

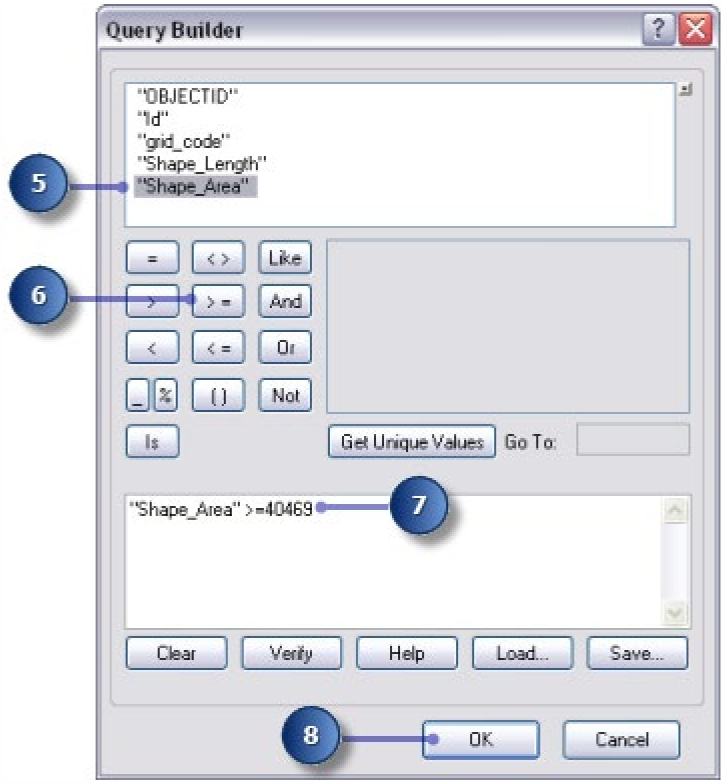


All features that intersect roads are selected in the display.

Executing the Select Layer By Attribute tool

1. Open the Select Layer By Attribute tool in the Data Management toolbox, in the Layers and Table Views toolset.
2. For **Layer Name of Table View**, choose opt_area from the drop-down list.
3. For the **Selection type** parameter, choose **SUBSET_SELECTION**.
4. Click the query builder button.

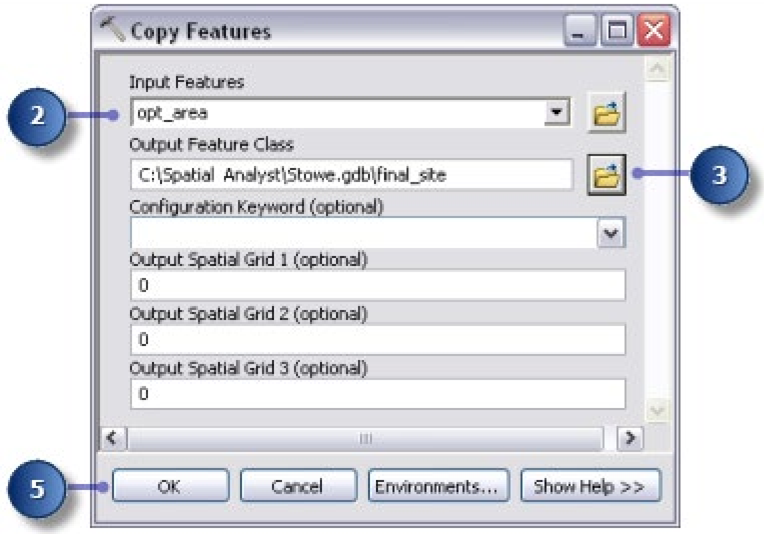
5. Double-click **`Shape_Area`** in the list of fields to enter the field into the expression text box.
6. Click the greater than or equal to button > =.
7. Type **`40469`**.
8. Click **OK**, then click **OK** again.



There is one feature that fits the criteria of being equal to or greater than 10 acres (40,469 square meters).

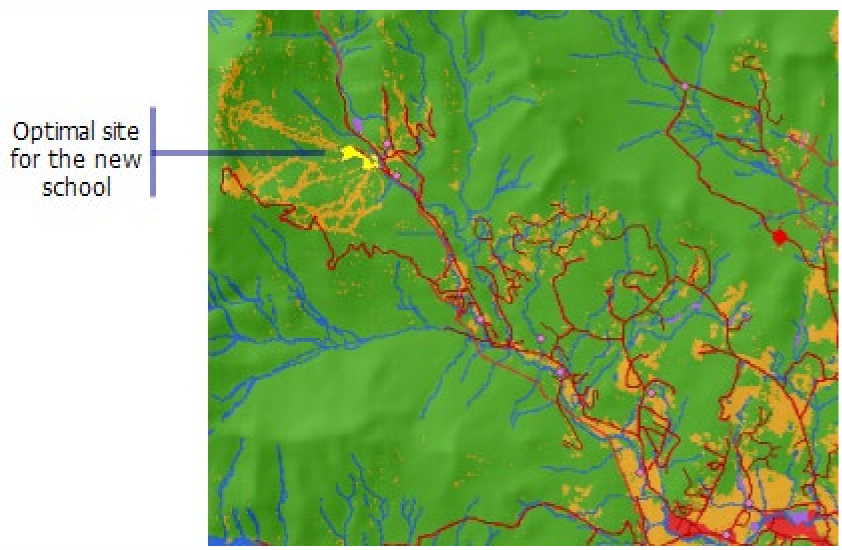
Executing the Copy Features tool

1. Open the Copy Features tool in the Data Management toolbox, in the Features toolset.
2. Click the **Input Features** drop-down arrow and click the opt_area layer.
3. Click the browse button  next to the **Output Feature Class** parameter and browse to **`C:\Spatial Analyst\Stowe.gdb`**. This stores your final result in your **`Stowe.gdb`** instead of your **`Scratch.gdb`**.
4. Type **`final_site`** for the name of the output feature class then click **Save**.
5. Click **OK** to run the tool.



6 Right-click opt_area in the table of contents and click **Remove**.

The final_site layer displays the location of the optimal site for the new school.



7 On the **Standard** toolbar, click the **Save** button.

Summary

You have now completed exercise 3. You can proceed to exercise 4, or you can stop and continue later.

Related topics

- About the ArcGIS Spatial Analyst extension Tutorial
- Exercise 1: Preparing for analysis
- Exercise 2: Accessing the extension and exploring the data
- Exercise 4: Finding an alternate access route

Exercise 4: Finding an alternate access route

ArcMap 10.7 | Other versions

L *Available with Spatial Analyst license.*

Complexity:

Beginner

Data Requirement:

ArcGIS Tutorial Data for Desktop

In this exercise, you'll find the best route for a new access road from the optimal school location site to a nearby road intersection. The general workflow you might follow to produce such a path are as follows:

1. Create the source dataset if necessary. The source is the school site (the final_site feature class) you created in exercise 3.
2. Create the cost dataset by deciding which datasets are required, reclassifying them to a common measurement scale, weighting them, and then combining them.
3. Perform cost distance analysis using the source and cost datasets as inputs. The

distance dataset created from this tool is a raster in which the value of each cell is the accumulated cost of traveling from each cell back to the source.
To find the least costly path, you need a direction dataset, which can be created as an additional dataset using the Cost Distance tool. This gives you a raster of the direction of the least costly path from each cell back to the source (in this exercise, the school site).

4. Create the destination dataset if necessary. In this exercise, the destination dataset is a point at a road junction.
5. Perform cost path analysis using the distance and direction datasets created with the Cost Distance tool.

This exercise will take approximately 30 minutes to complete. Start this exercise with your Site Analysis map document created in the previous exercise open.

Creating a new model

You'll create a new model, Find Best Route, inside your Site Analysis Tools toolbox. This model will calculate the best path through the landscape from the source (the school site) to the destination point, taking into consideration the slope of the land and the type of land use the path will cross.

Setting up the model

1. Right-click the **Site Analysis Tools** toolbox then click **New > Model**.

Renaming the model

1. On the main menu, click **Model > Model Properties**.

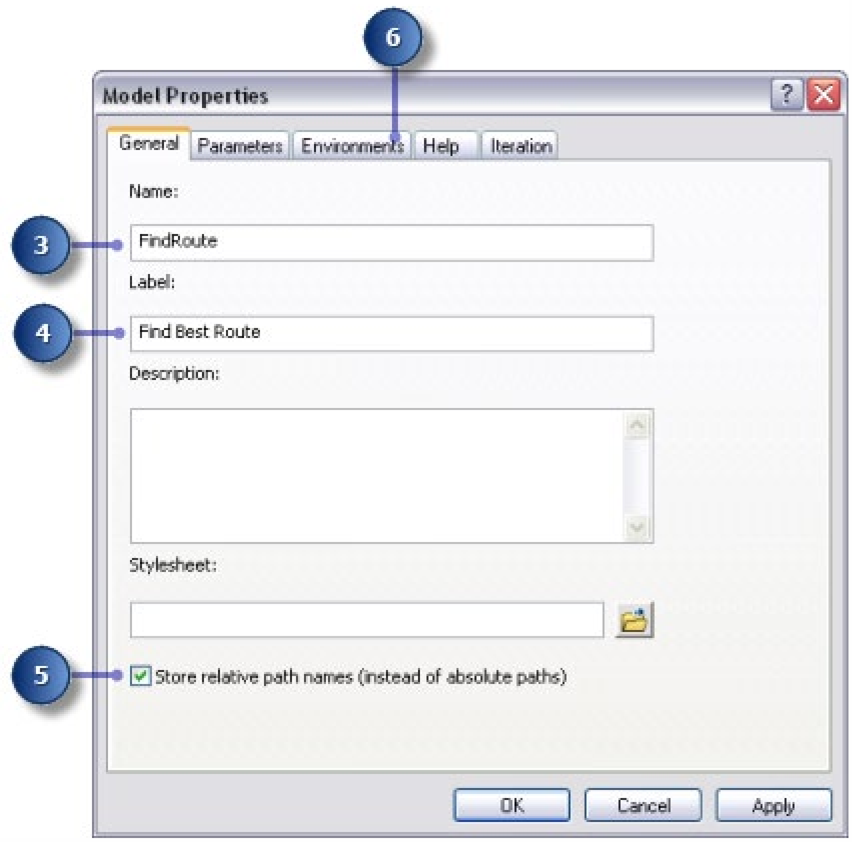
   w Note:

   The model properties and environments will be set as they were in the previous exercise.

2 Click the **General** tab and type **`FindRoute`** in the **Name** text box.

3 Type **`Find Best Route`** in the **Label** text box.

4 Check **Store relative path names (instead of absolute paths)**.



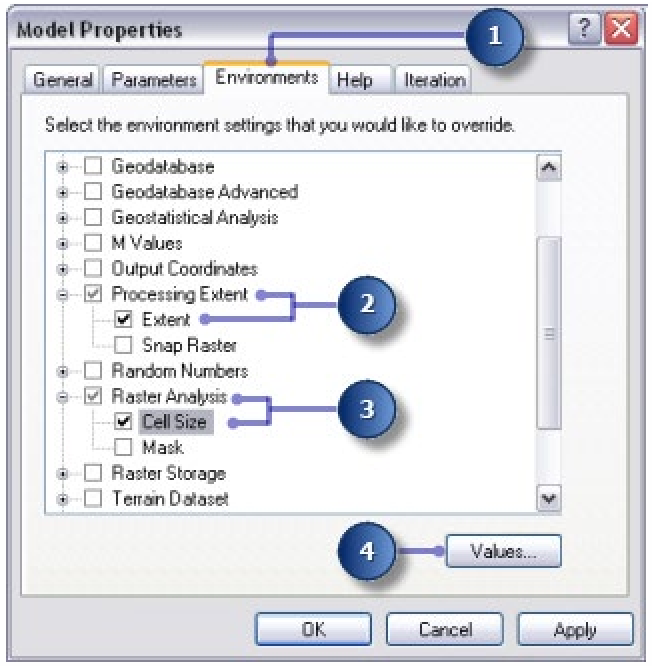
Specifying environment settings

1 Click the **Environments** tab.

2 Expand **Processing Extent** and check **Extent**.

3 Expand **Raster Analysis** and check **Cell Size**.

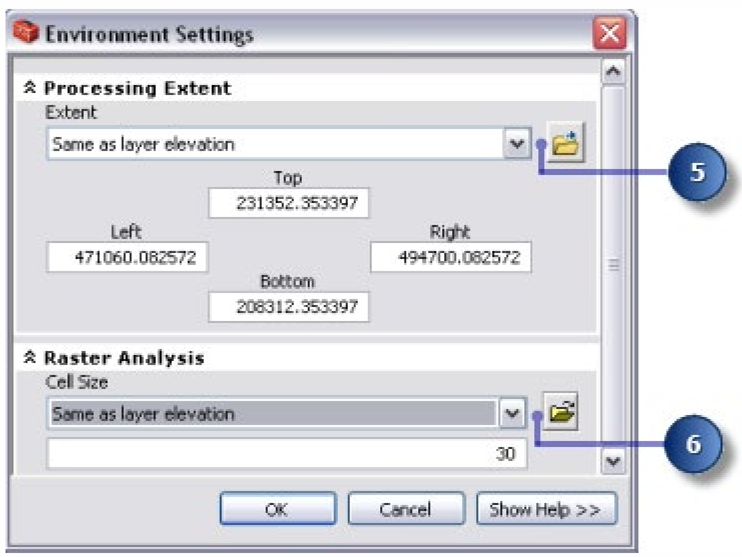
4 Click **Values**.



5 Expand **Processing Extent**. Set the **Extent** by clicking the drop-down arrow and choosing **Same as Layer elevation**.

6 Expand **Raster Analysis**. Set the **Cell Size** by clicking the drop-down arrow and choosing **Same as Layer elevation**.

7 Click **OK** in the **Environment Settings** window.



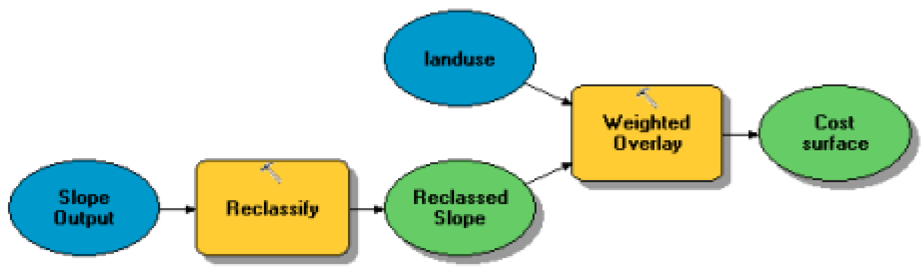
8 Click **OK** in the **Model Properties** window.

9 On the toolbar, click the **Save** button .

Creating the cost dataset

You created the source dataset, final_site, and a slope dataset, Slope Output, in the previous exercise. You'll create the cost dataset that will identify the cost of traveling over the landscape from any location back to the proposed new school site, based on the fact that it's costlier to traverse steep slopes and construct a road on certain land-use types.

This section of your model will look like the following:



Setting up the model

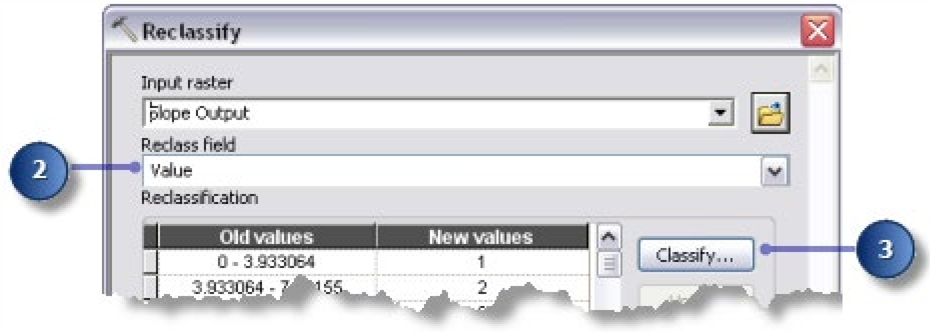
1. Add Slope Output to your model.
2. Locate the Reclassify tool and add it to ModelBuilder in line with Slope Output.
3. Click the **Add Connection** tool . Use the connect tool to connect Slope Output to the Reclassify tool, and select Input raster from the pop-up menu.
4. Click the **Select** tool  on the model toolbar.

Reclassifying slope

It is preferable that the new road traverses less steep slopes. You'll reclassify the Slope Output layer, slicing the values into equal intervals. You'll assign a value of 10 to the most costly slopes (those with the steepest angle of slope) and 1 to the least costly slopes (those with the least angle of slope) and rank the values in between linearly.

1. Open the Reclassify tool.
2. Accept the default for the **Reclass field** parameter so the Value field will be used.

3 Click **Classify**.

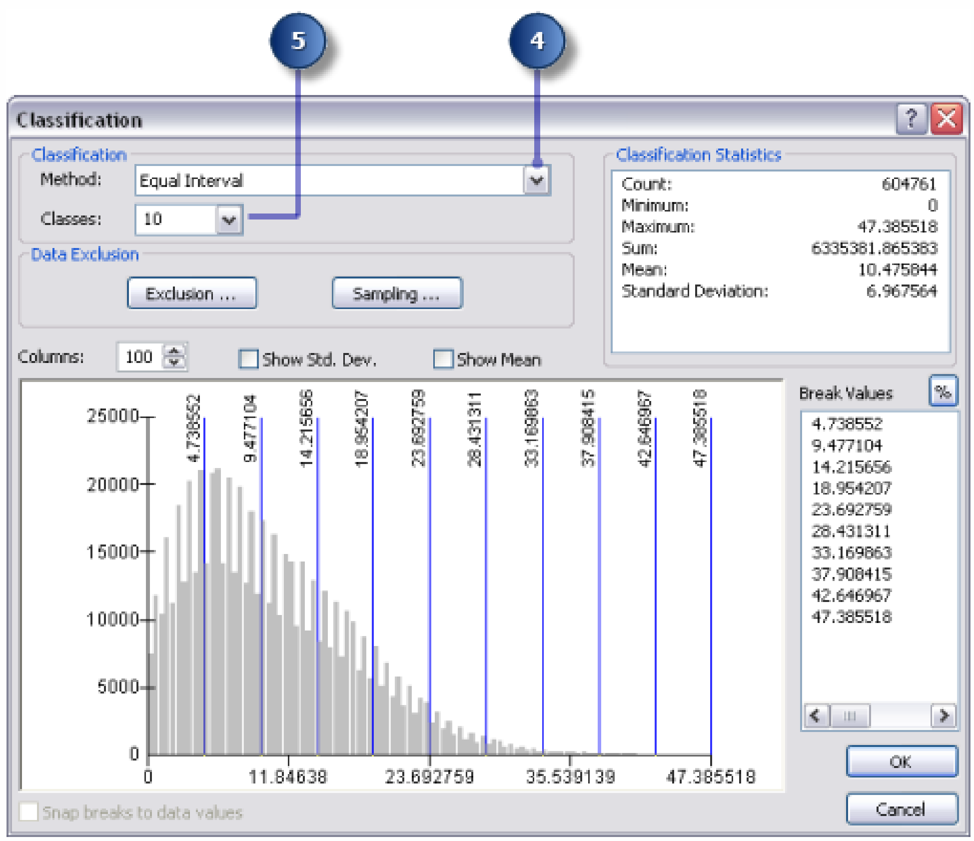


4 Click the **Method** drop-down arrow and click **Equal Interval**.

5 Click the **Classes** drop-down arrow and click **10**.

You want to avoid steep slopes when constructing the road, so steep slopes should be assigned higher values in the cost dataset. Because the default assigns higher values to steeper slopes, you do not need to change the default **New values** parameter.

6 Click **OK**.



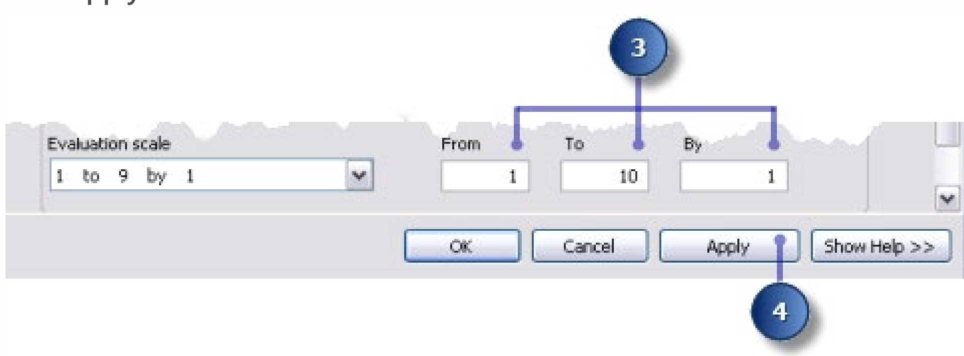
7. Accept the default for the **Output raster** parameter.
8. Click **OK**.
9. Rename the output variable from the Reclassify tool **`Reclassed slope`**.
10. Right-click the Reclassify tool and click **Run**.

Weighting and combining datasets

You'll now combine the Reclassed slope and landuse datasets to produce a dataset of the cost of building a road through each location in the landscape, in terms of steepness of slope and land-use type. In this model, each dataset has equal weight.

1. Locate the Weighted Overlay tool and add it to ModelBuilder in line with Reclassed slope.
2. Open the Weighted Overlay tool.

   The default evaluation scale is from 1 to 9 by 1. As in exercise 3, a scale of 1 to 10 was used when reclassifying the slope dataset, so before adding input rasters to the tool, you'll set the evaluation scale from 1 to 10 by 1. This means you'll avoid having to update the scale values after adding your input slope dataset.
3. Type **`1`**, **`10`**, and **`1`** in the **From**, **To**, and **By** text boxes, respectively.
4. Click **Apply**.

5. Click the **Add raster row** button ✚. For the **Input raster**, choose the Reclassed slope variable from the drop-down list and leave the **Input field** variable as Value. Click **OK**.

6 Click the **Add raster row** button ✚. This time, add the landuse layer. Set the **Input field** variable to Landuse then click **OK**.

You'll weight the scale values of the landuse layer so they're comparable with your Reclassed slope dataset. A higher value indicates that it's costlier to build a road through a particular land-use type.

7 Type the following **Scale Values**:

- **Brush/transitional—5**
- **Water—10**
- **Barren land—2**
- **Built up—9**
- **Agriculture—4**
- **Forest—8**
- **Wetlands—10**

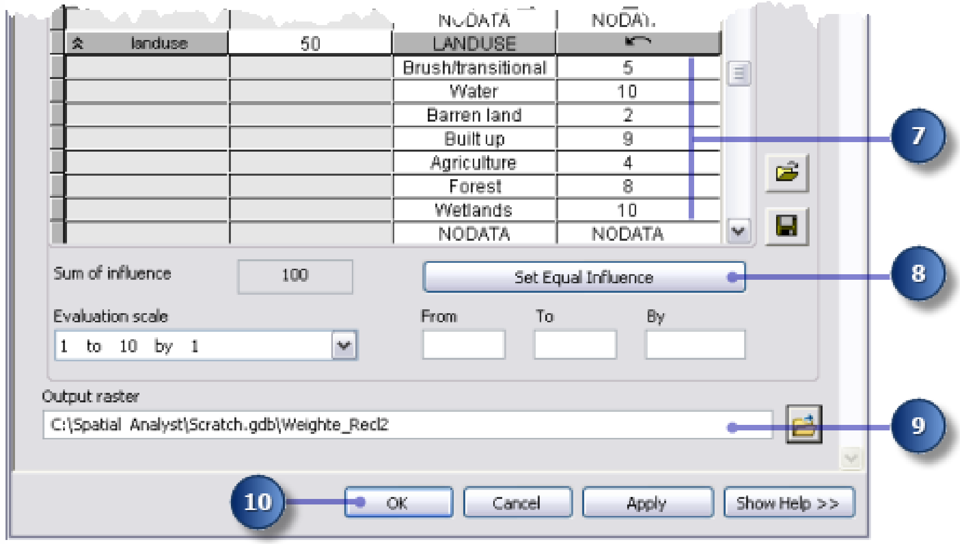
Caution:

Be cautious when using **Restricted** for the scale value when creating a cost surface. Using **Restricted** assigns a value to the cell that is the minimum value of the **evaluation scale** minus 1 (zero in this exercise), so your restricted areas will appear to be assigned the lowest cost when they're actually excluded from the analysis. Cells with this value should be rendered appropriately to avoid confusion. You could, instead, assign a high cost or set the **scale value** to NoData for areas you want to exclude from the analysis. If NoData is used, check first that there are no areas of NoData in your input rasters. If there are, it will be difficult to tell whether an area of NoData is there because it was excluded or there was no original information at that location for one of your inputs.

8 You'll now assign an equal percentage of influence to each raster, since they're both equally important in this analysis. Click **Set Equal Influence** to assign an equal percentage of influence (50 percent each) to each input raster.

9 Accept the default for **Output Raster**.

10 Click **OK**.



Executing Weighted Overlay

1 Click the **Auto Layout** button , then click the **Full View** button .

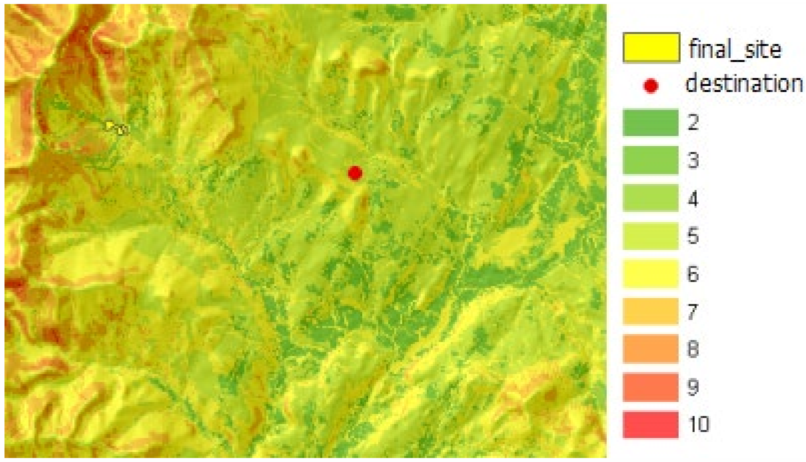
2 Rename the output variable from the Weighted Overlay tool **`Cost surface`** then click **OK**.

3 Right-click the Cost surface variable and click **Add To Display**.

4 Run the Weighted Overlay tool.

5 On the toolbar, click the **Save** button .

Examine the layer added to your ArcMap display. Locations with low values indicate areas that will be the least costly to build a road through.



Cost-surface map

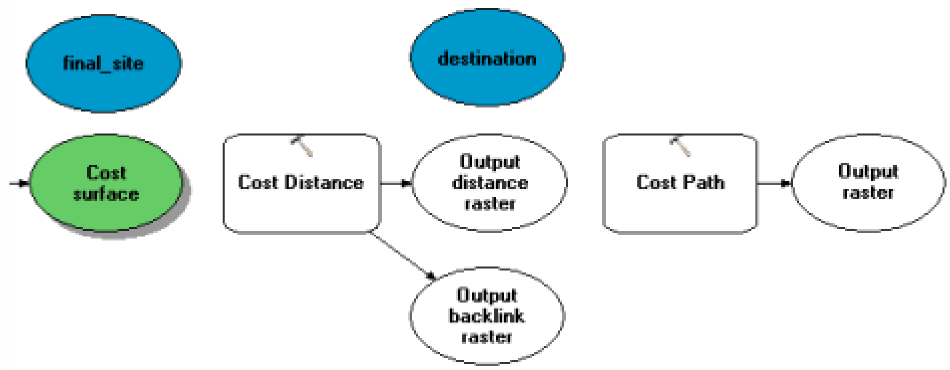
Finding the least costly path

To find the least costly path between the site for the new school, identified in exercise 3, and the destination site, the Cost Distance tool and the Cost Path tool will be used. There are two outputs from the Cost Distance tool. The **Output distance raster** shows the accumulated cost of traveling from any location (or cell) to the source (the school site). It does not contain information on which way to travel from a particular cell to the source, just how much it will cost to get there following the least costly path. The **Output backlink raster** shows which way to travel from any cell, following the least costly path back to the source. Using these outputs as inputs to the Cost Path tool, along with input destination data, you'll calculate the least cost path between the site for a new school and the destination site.

Setting up the model

1. Add the final_site and the destination layers to ModelBuilder.
2. Add the Cost Distance and the Cost Path tools to ModelBuilder.

   Both the Cost Distance and the Cost Path tools are located in the Spatial Analyst Tools toolbox in the Distance toolset.



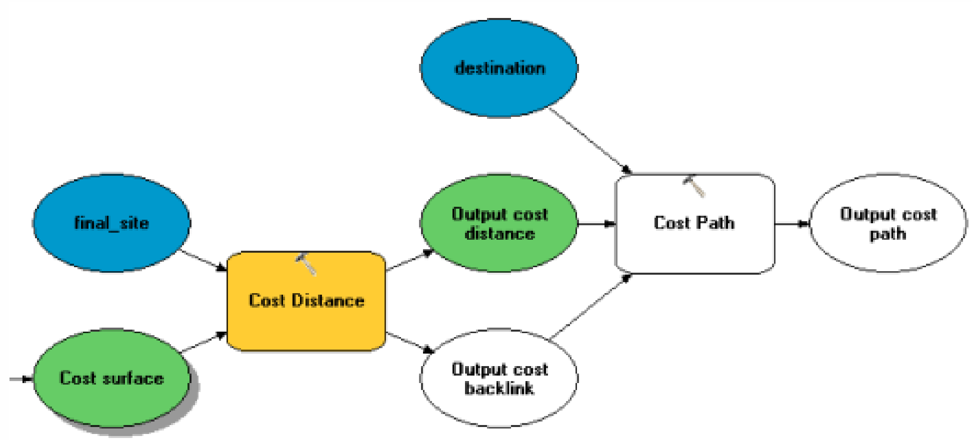
3 Use the **Add Connection** tool to first connect final_site to the Cost Distance tool, choosing Input raster or feature source data on the pop-up menu. Do the same to connect Cost surface to the Cost Distance tool, but this time choose Input cost raster instead.

4 Rename the Output distance raster variable **`Output cost distance`** and rename the Output backlink raster variable **`Output cost backlink`**.

5 Use the **Add Connection** tool to connect destination, Output cost distance, and Output cost backlink to the Cost Path tool. Next, choose Input raster or feature destination data, Input cost distance raster, and Input cost backlink raster when the connection menu pops up.

6 Rename Output raster **`Output cost path`**.

7 On the model toolbar, click the **Select** tool, the **Auto Layout** button, and the **Full View** button.



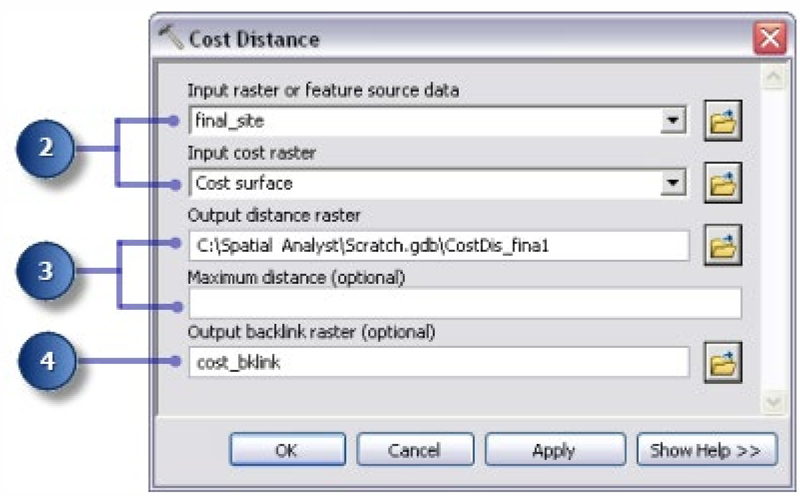
Setting Cost Distance parameters

You'll now run the Cost Distance tool using the cost dataset you just created (which identifies the cost of traveling through each cell) and the final_site layer (the source) you created in exercise 3. The outputs from this tool are a distance dataset in which each cell contains a value representing the accumulated least cost of traveling from that cell to the source and a backlink dataset that gives the direction of the least costly path from each cell back to the source.

1. Open the Cost Distance tool.
2. Confirm that the **Input raster or feature source data** parameter is the final_site layer and that the **Input cost raster** parameter is the Cost surface variable.
3. Accept the defaults for the **Output distance raster** and the **Maximum distance** parameters.
4. Type **`cost_bklink`** for the name of the **Output backlink raster** parameter.

   By default, the path to the scratch workspace (**`C:\Spatial Analyst\Scratch.gdb`**) will automatically be appended in front of the dataset name you just provided for the **Output backlink raster** parameter.

5. Click **OK**.



Setting Cost Path parameters

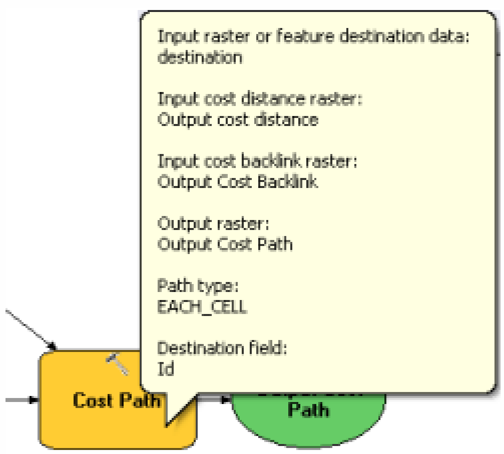
The Cost Distance tool outputs a distance raster and a backlink raster, each of which are used in the Cost Path tool. The **destination** layer was provided, and the layer is the starting point for the new road to the school site.

1. Hover over the Cost Path tool to verify that the parameters have the following input datasets:

   - **Input raster or feature destination data** is set to the destination layer.
   - **Input cost distance raster** is set to the Output cost distance variable.
   - **Input cost backlink raster** is set to the Output cost backlink variable.

2. Accept the default for the **Output raster**, **Path type**, and **Destination field** parameters.

   When the input feature destination data is processed, it will be converted temporarily to a raster as part of the processing. There will only be one cell in this raster, because there is only one destination point. The value for the Path type parameter can be left as EACH_CELL. Only one path will be created, since there is only one cell.



Running the cost distance analysis

1. Right-click the Output cost distance, Output cost backlink, and Output cost path variables then click **Add To Display**.
2. Run the Find Best Route model.

Examine the layers added to your ArcMap display. The Output cost path layer represents the least costly path from the school site to the destination point. It avoids steep slopes and certain land-use types that are considered costlier for constructing the road.

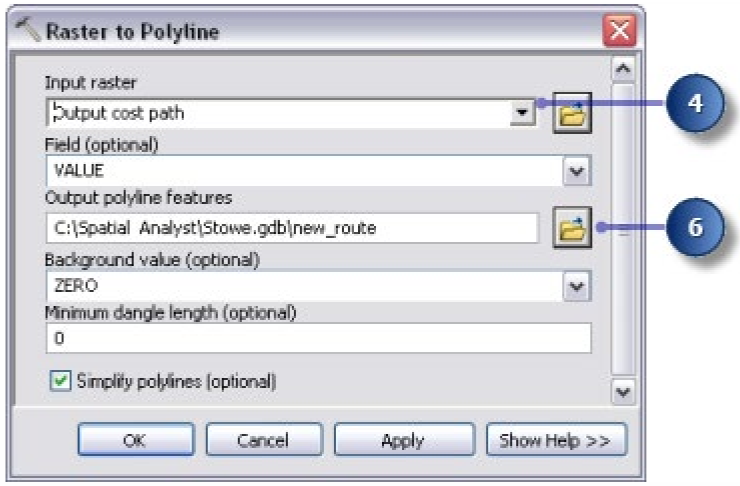
Raster to Polyline

Set parameters for Raster to Polyline

As a last step in your model, you'll convert the raster path to a polyline for display.

1. Remove the created layers Slope output, Reclassed slope, Cost surface, Output cost distance, and Output cost backlink so you can see the path displayed over the landuse and hillshd layers.
2. Add the Raster To Polyline tool to ModelBuilder.

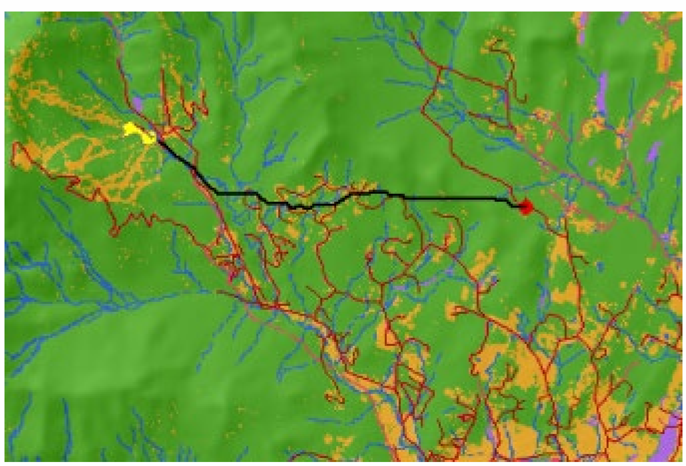
   The Raster To Polyline tool is in the Conversion Tools toolbox in the From Raster toolset.
3. Open the Raster To Polyline tool.
4. Click the **Input raster** drop-down arrow and choose the Output cost path variable.
5. Leave the **Field** parameter as VALUE.
6. Click the **Browse** button next to the **Output polyline features** parameter and browse to your **`Stowe`** file geodatabase **`C:\Spatial Analyst\Stowe.gdb`**.
7. Type **`new_route`** for the **Name** of the feature class then click **Save**.
8. Accept the defaults for all other parameters then click **OK**.



Run Raster to Polyline

1. Click the **Auto Layout** button, then click the **Full View** button.
2. Rename the new_route output variable **`Output route`**.
3. Right-click the Output route variable and click **Add To Display**.
4. Run the Raster To Polyline tool.

Examine the new_route layer that is added to your ArcMap display. The raster path has been converted to a polyline.



Map with the polyline representing the new route

You can easily change parameter values to experiment with different outcomes and rerun the model. Only the processes in the model that are dependent on the output of the altered process will need to be rerun. For example, lowering the weight applied to cell values where the landuse is **`Built up`** from **`9`** to **`1`** will alter the potential path for the new road considerably—it will tend to follow existing roads where it can, which may be a less costly option to consider.

Saving the map document

You've set relative paths for both models created in this tutorial, so if the toolbox containing the models and the data is moved (keeping the same structure between them) to a new location on disk, the paths to the data sources will be set relative to the position of the toolbox. By default, your map document is set to store relative path names to data sources.

1. On the toolbar, click the **Save** button .
2. Click **File > Exit**.

Summary

This brings you to the end of this tutorial. You've been introduced to some of the tools available with the ArcGIS Spatial Analyst extension, both through the Spatial Analyst toolbar and the Spatial Analyst Tools toolbox. You've learned how to build models that are reusable and can be shared with others. In particular, you've learned how to create a suitability map, and you've learned how to calculate the least costly path across a landscape. The sequences of steps involved can be applied to many different applications.

Related topics

- About the ArcGIS Spatial Analyst extension Tutorial
- Exercise 1: Preparing for analysis
- Exercise 2: Accessing the extension and exploring the data
- Exercise 3: Finding a site for a new school