ModelBuilder for Beginners

Background
In this exercise you will automate parts of the Site Selection exercise by using ESRI’s ModelBuilder. The site selection module uses several ArcMap tools to select a site for a new visitor center at a National Wildlife Refuge in Concord, Massachusetts. Much of the land within the refuge would be inappropriate for a visitor center. Some of it is critical habitat for rare species, while other areas are wetlands. Here we will narrow down the appropriate building locations.

Today we will:

Create a simple model
Increase complexity by combining or adding other tools and models
Save the model to the toolbox for reuse and export the script
Automate the below processes
  • Select by attributes
  • Copy Features
  • Clip
  • Buffer

Open ArcMap and add layers.
These are the layers you will add; directions are below.
  • Vernal Pools_2003 (Vernal pools are areas that are wet during part of the year, but not always.)
  • GreatMeadows (A section of Great Meadows Wildlife Refuge)
  • PrioritySpecies_2003 (Priority habitat for rare species)
  • DEP wetlands (DEP delineation of wetland vs upland habitat) –Note: click okay when it displays the warning about no spatial reference

To add this data:
1. Click on the icon.
2. Navigate to the folder on the desktop named Data needed for Model Builder exercise; select each file by name, holding down the control key to select all layers in the dialog box that pops up. Click on add. The layers have been added to your map.

Once you’ve added these files, you are ready to begin the next step.

ModelBuilder allows the user to create unique toolboxes that draw from the standard tools and are organized for the specific user’s needs. You can create the model in either ArcMap or ArcCatalog. Today we will create the model in ArcCatalog.
Create a model inside a toolbox in ArcCatalog

1. Open ArcCatalog and navigate to C:\Program Files\ArcGIS\ArcToolbox\Toolboxes or wherever the instructor specifies.
2. Right click in the white area near the toolboxes and select New then select “Toolbox” (Rename the toolbox to “Site selection” by right clicking and selecting Rename.)
3. Right click on the toolbox you created and select New then select Model.

You should see a window like this, which represents a model in Edit mode:

![Model window](image)

It's good practice to rename a new model so that you can easily identify it. This is especially true if you're working with more than one model or with a model that will be shared.

To rename a model, you edit the label in the Model Properties dialog box.

4. In the ModelBuilder window, from the Model menu, choose Model Properties.
5. In the General tab, rename the model label “Select by Attribute”
6. Click OK

You are now ready for the next part.

For the next step, go back to ArcMap and make sure the toolboxes are showing (click the icon on the toolbar if you aren’t seeing the list of toolboxes).

Create a model that selects by attribute

1. Navigate to the toolbox you just created (Site Selection) and expand the menu. (If the toolbox isn’t there, right click in an empty white area and choose Add Toolbox. Navigate to the toolbox you just created (Catalog\Toolboxes\System Toolboxes). Click “Select by Attribute” once and click open.
2. Right click on the model and select edit. The empty model window will pop up. This is where you will build your model.
3. Add a tool to your model. We’re going to add ‘select layer by attribute’. This is under “Data Management” in the “Layers and Table Views” Toolbox and is called “Select Layer by
Attribute”. Click on the tool and drag it into the model window. Note that it automatically generates an output variable. Note also that the model is just an outline at this point. It is not ready to run.

4. Add the DEP wetlands shapefile to the model by clicking on it in the table of contents and dragging it over to the model window.

5. Connect the data to the “Site Selection” tool by clicking on the connection icon (Click the icon, click an element (for example, DEP wetlands), then click an appropriate tool (for example select layer by attribute).) When you connect the data to the model, you will see the colors fill in, indicating the model is ready to run.

![Model Diagram]

6. You can move or resize the elements (tools and datasets) by clicking on them and dragging the shapes. Try this now. Occasionally, a variable may be added on top of another. If something seems to have “disappeared” trying moving the shapes to see if one element is hidden behind another.

Next we will add an SQL statement that will select all but the uplands from this dataset. Uplands refer to areas dry enough to build. In Massachusetts, buildings must be located at least 50 feet from all hydrologic features and wetlands. We are going to select and remove the features called uplands from the DEP wetlands dataset.

1. While looking at the model window, right click on the Select Layer tool (yellow rectangle) and choose Make Variable -> From Parameter and select Expression.

Q. What do they mean by expression?
A. You are adding an SQL expression (query). The SQL expression is how you indicate which records to select. This step adds the parameters for the SQL expression to the model.
2. Open the “expression” element (right click to open). You should see this form

3. Click on SQL to see the standard interface for constructing a select statement.
4. Fill in the form as you see it below to include everything but wetland.
   a. Scroll through the list at the top until you see “IT_VALDESC.” Double-click on it and you’ll see it populate the query box.
   b. Then click on < >, which is the symbol for “everything but” or “does not equal.”
   c. Notice the Get Unique Values button. Click on this to see the list of selected variables and select “upland”. Click OK on this form and the Expression form to save.
5. Right click on the output icon (Output Layer) and check the ‘Add to Display’ item so the output (the selected records) will be added to your map.
6. You are ready to run the model. Click on the run icon (the rightmost icon in the toolbar above) or click on the Model menu then click on Run.

You should see the features selected as below (You’ll probably need to uncheck the box in the table of contents then check it):
The above model highlighted features unsuitable for building out of a larger database that included suitable building area. The next step is to export the selected data in order to create a new file that includes only areas that are unsuitable for building. You can create a tool that will automate both the selecting and the exporting processes in ModelBuilder, using the output of one tool as the input for another.

1. If you closed your model window, reopen it by right clicking the “Select by Attribute” model in the “Site Selection” toolbox and choosing “Edit.”
2. Drag the “Copy features” tool from the toolbox to the model window. You will find it under Data Management Tools->Features->Copy Features.
3. Connect the output from the select tool to the copy features tool. Click on the add connection button in the model toolbar. Click the output from the select tool, and then click on the Copy Features tool. (Notice how the colors fill in when the input data element is added to the tool.)
4. Right click on the Copy Features tool and confirm that the correct input is chosen. Change the name of the Output Feature Class (2nd field) to OnlyWetlands.shp:
5. Click OK

6. Right click on the output icon “OnlyWetlands.shp” and check the ‘Add to Display’ item so the output dataset will be added to your map automatically after the model runs.

7. Run the model. Click on the run icon (the rightmost icon in the toolbar above) or click on the Model menu then click on Run.

8. Save and close the model. (From the menu bar select Save and Close.)
9. Compare the difference between DEP Wetlands and OnlyWetlands by toggling the DEP Wetlands check box. OnlyWetlands has all the areas upon which we cannot build, and it doesn’t have the areas called Upland any more.
10. Uncheck DEP Wetlands. You will use the OnlyWetlands shapefile in the next part of this exercise.

Model II
Create a model that will clip features to match another layer.

For the next step of this exercise, you will clip extra data from the vernal pools, priority habitats, and wetlands datasets so that you can concentrate on the important portion of your map. The datasets cover a much larger area than just Great Meadows NWR. The map will redraw more quickly without all the extra data.

Because we are looking for a place to build in Great Meadows, you want use the GreatMeadows layer as the clip feature to clip all of the other layers.

Q. What is the clip feature?
A. The clip feature will be used as a pattern or model for clipping data that you need out of a larger dataset. Think of it like a cookie cutter that you would use to clip a cookie out of rolled-out dough.

1. From ArcMap, create a new model in your toolbox by right clicking on the Site selection toolbox and selecting New->model.
2. Rename the model “Clip,” by right clicking on the model icon in the list under the toolbox and selecting rename, then typing the new name.
3. To the model window, add the Clip tool (in the Analysis Tools toolbox -> Extract). Click on and drag this tool over to the model window.
4. Add GreatMeadows as the Clip Feature. To do this, right click on the Clip icon in the model and then click on Make Variable then From Parameter then Clip Features.
5. Select the Clip Features oval, right click again and select Open. This gives you the form to select GreatMeadows as your clip feature. Click on the drop down arrow and select GreatMeadows. It should look like this:
6. The input features are the larger datasets that you will clip data from using the clip feature. (They are the rolled out cookie dough.) Add the Input Features icon by right clicking on the Clip icon then selecting Make Variable then From Parameter then Input Features.

Your model will look similar to this:

There are 3 data layers to clip using the clipping feature (vernal pools, wetlands and priority habitat). Before adding our input features, we will need to change the number of times the model will run. For the Selection by Attribute model, the model ran once (one input that produced one output – selected features without uplands). This time we want to run it 3 times, once for each of the three layers that we want to clip.

7. On the menu bar of the model window, click on Model then click on Model Properties. Go to the Iteration tab and change to run 3 times as you see below:
8. Press OK to continue.

9. Next, set the ModelBuilder properties to indicate that you will be adding a list of 3 input features (rather than one feature several times), right click on the Input Features icon and then click on Properties and fill it in as you see below, then click OK.
Now right click on the Input Features icon and then click on Open. You should see this form:
10. Double click on “1” to add the first layer (Vernal Pools_2003). You should see this form:

11. Select the Vernal_Pools_2003 layer from the drop down list and then click OK.
12. Click on the + sign to add two more layers.
13. Using steps 11 & 12 add the Priority_Species_2003 and OnlyWetlands layers.
14. Press OK on the input features window to continue.

Now you need to name the three output layers. ModelBuilder assumes that you will want to have three outputs for three inputs, but you need to specify names and a path to where the files will be saved.

15. Right click on the Output icon and click on Open to see a similar form for the output files as you used for the input files. Rename your layers to look like this (with order of layers being the same for the outputs as for the inputs):
11. Click on OK to close it. Right click on the output icon and check the ‘Add to Display’ item so the output dataset will be added to your map automatically after the model runs.

Your model should look like this:

16. Run this model. Uncheck the original data layers to compare the clipped and unclipped layers. Notice that the output datasets are much smaller than what you started with. (Leave them unchecked for the next steps).

Add another process to the model.

You can create a tool that will automate multiple processes in ModelBuilder, using the output of one tool as the input for another. In the site selection exercise, buildings cannot be constructed within 50 feet of water features and in this case we plan to leave a 50 foot buffer between habitat for priority species as well. Here we will use the clipped datasets from the model and create a 50 foot buffer around the features.

1. If the window for the ClipFeatures model is closed, open it by right clicking on the icon and selecting Edit.
2. Add the Buffer tool to the model by dragging it to the window. It can be found in the toolbox under Analysis Tools-> Proximity
3. Because we want the Buffer to be a distance (50 ft.), we need to add that as a parameter. Right click and select Make Variable-> From Parameter ->Distance [value or field]
4. Right click on the Distance variable, select Open, and fill in a Linear unit of 50 feet. Click OK.

![Image showing Distance variable settings](image.png)

Next, add the data to the model. We are going to use the output from the ClipFeature tool as input for the buffer tool. We can link these two tools together to create a more complex model.

5. Connect the output from the clip tool to the buffer tool. Click on the add connection button in the model toolbar, click the output from the clip tool, then click on the Buffer tool. (Notice how the colors fill in when the input data element is added to the tool.

6. The output features will be renamed to show the process done in this step but inherit the file name from the last process, so you don’t need to rename the files here.

7. Right click on the output icon and check the ‘Add to Display’ item so your new layers will be added to you map.

8. Run this model. Can you tell which areas of the Wildlife Refuge will support a visitor center according to these parameters?

**Export the model in Python, VBScript or Jscript**

You want to be able to share what you’ve done with others, and to document the process in a way that doesn’t require the use of ArcMap. You can export these processes to Python, VBScript or Jscript.

1. From the menu bar of whichever model you’d like to export, click Model -> Export -> To Script -> Python
2. Save the file to desktop (File name: ClipBuffer_script.py)
3. To view the text, right click on file and select edit.