



GST 102: Spatial Analysis Lab Series

Lab 5: Vector Data Analysis – Creating a Site Selection Model

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Introduction

This lab is part of a series of lab exercises designed through a grant initiative by the National Information, Security & Geospatial Technologies Consortium (NISGTC), funded by the United States Department of Labor in partnership with the Department of Education under the Trade Adjustment Assistance Community College and Career Training Grant Program (TAACCCT).

In this lab, we will look at streamlining the use of tools with a model. Using a model, we have the ability to string tools together using the output from one tool as the source of input for the next tool. It allows us to run a model and get an "answer," the results of the analysis.

Your instructor may require that you provide screen captures and/or exported files. Please check with your instructor for the requirements specific to your class.

This lab includes the following tasks:

1. Create a toolbox and add a model
2. Create a custom toolset
3. Build a site selection model

Objective: Understanding the Model Builder

The objective of this lab is for the student to understand the use and applications of the model builder.

Lab Settings

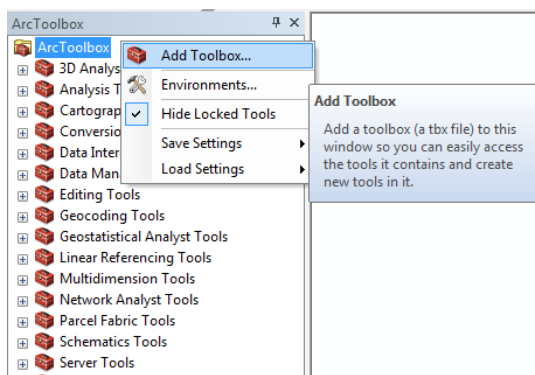
Required Virtual Machines and Applications

Windows Machine User Account	Train
Windows Machine User Password	Train1ng\$

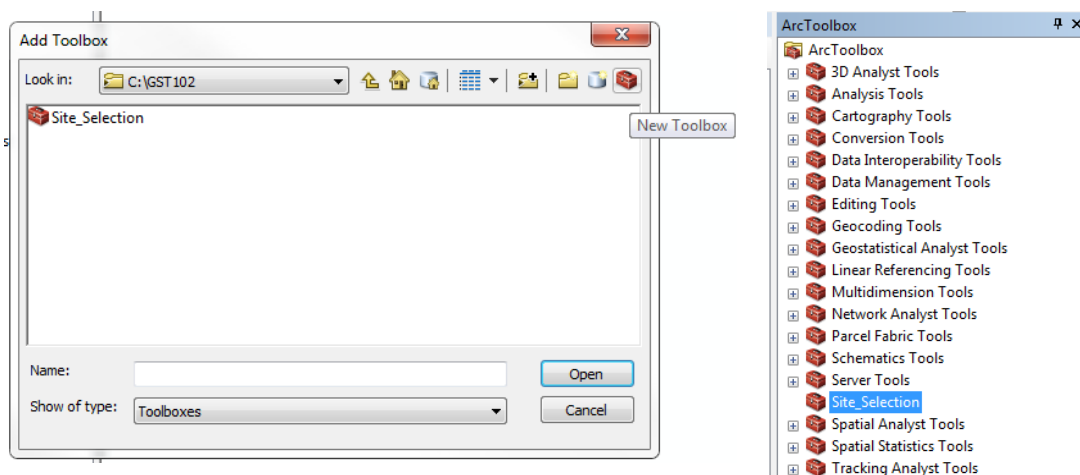
1 Creating a Toolbox

In order to create a model, it is necessary to create a toolbox that will contain the model. ArcGIS allows the user to create a custom toolbox. The toolbox can contain a set of custom built tools or just tools we use often in our analysis and geoprocessing.

1. Log into the computer, using the information provided in the Lab Settings section.
2. The data for this lab is located on the lab machine at: *Shared drive\GST 102\Lab 5*. Copy the Lab 5 folder into your C:\GST 102 folder.
3. Click **Start->All Programs->ArcGIS->ArcMap 10.1**. ArcMap will open.
4. Using the ArcCatalog tab in ArcMap, connect to the *GST102* folder you created on the C: drive.
5. Open ArcToolbox in ArcMap.
6. Right-click anywhere in the ArcToolbox window and click **Add Toolbox**.



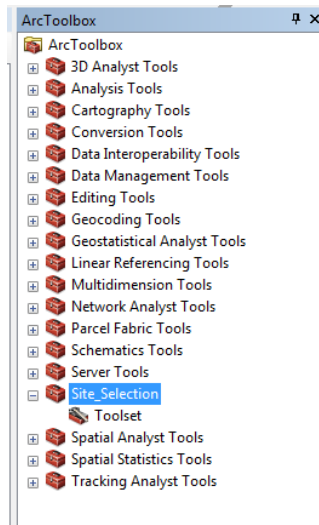
7. You will save your toolbox in your *GST102* folder. Click the **New Toolbox** button. A toolbox named *Toolbox.tbx* will appear. Rename your toolbox **Site_Selection**. Select your new toolbox and click Open. Your toolbox will be added to the ArcToolbox window.



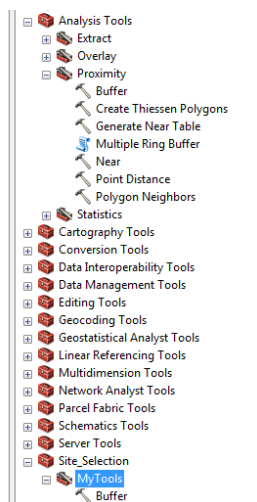
8. Keep ArcMap open, you will continue to use it in the next task.

2 Selecting a Custom Toolset and Adding a Model to the Toolbox

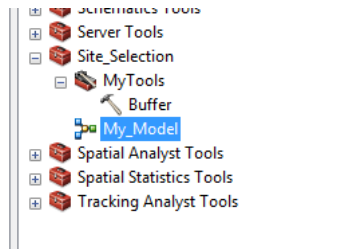
1. Right-click on the Toolbox and Select **New->Toolset**. Name it **My_Tools**.



2. This toolset will be used to contain all the tools we will use in the site selection model. We will add the buffer tool by clicking and dragging it from **Analysis Tools->Proximity->Buffer** toolset in the ArcToolbox into our **My_Tools** toolset.



3. Now, we will add a model to the **Site_Selection** Toolbox. Right-click on the Site_Selection toolbox, click **New->Model** the Model Window will open, exit it and save the changes. Rename the model to **My_Model1** by clicking on it and then clicking on it again.



4. Keep ArcMap open, since we will use this toolbox and build the model in the next task.

3 Building a Site Selection model

When building a site selection model we are usually faced with a scenario. This scenario will have constraints to which we have to adhere in order to find a solution. The scenario below is a site selection, which you will perform using the model builder. The best method to solve a scenario like the one below is to extract the constraints from the paragraph and list them. From the list, you should transcribe them into something that can be entered into a GIS such as operations: buffer, intersect, =, <>, etc.

Scenario

A company is looking to lease a helipad in Nueces County for their company helicopter. The company is situated in Nueces County and is looking to be within 5 miles of the Corpus Christi city limits but not inside the city limits. The pilot's request is that the airport or heliport be at least 1/2 mile away from any source of water, in case their engine fails just after takeoff or landing. The airport must also be within a mile from a County (C) road. Use your knowledge of GIS and the analysis features to find the best solution.

In the tables below you will see that we have extracted information from the scenario and transcribed it into GIS terminology. This first table shows the data layers and their descriptors to help us be sure we have all the datasets we need for the project and to clarify where our raw data is located:

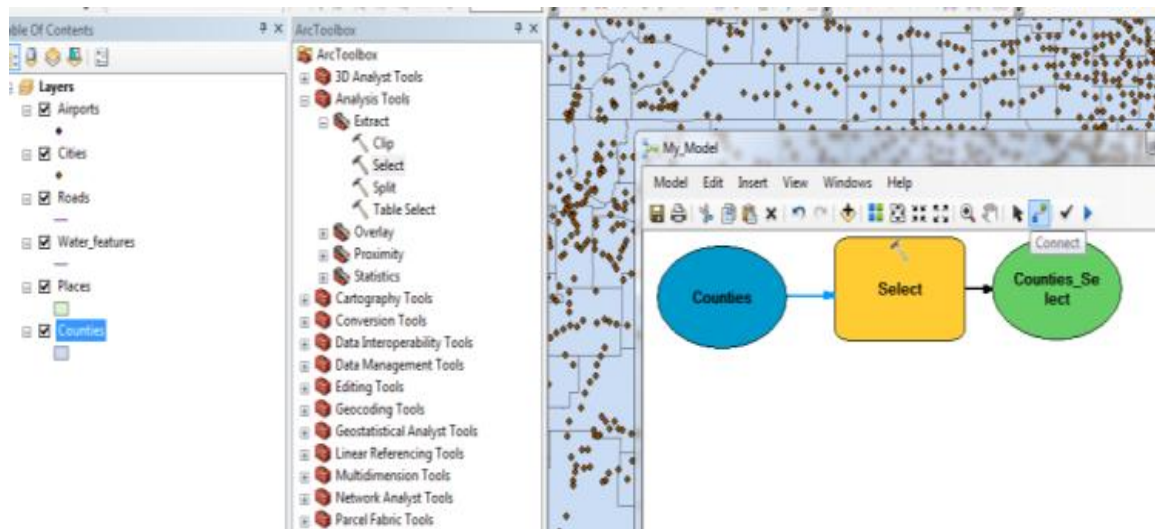
Data Layer	Description
Airports	Airports, Airfields, Heliports of the USA
Places	City Limits of Populated Areas
Water_Features	Rivers in Nueces
Counties	Counties of the USA
Roads	Roads of Nueces

The second table summarizes the qualifications given in the scenario and then transcribes it into GIS terminology by specifying which operations should be run to complete the project.

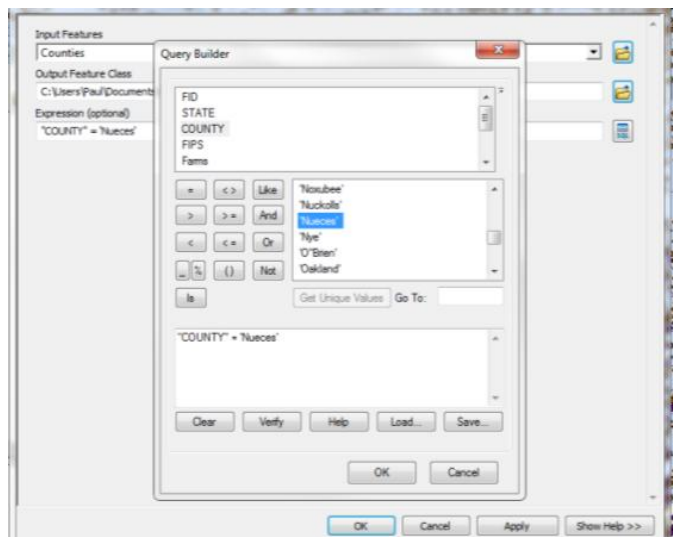
Constraint	GIS Terminology
Nueces County	Select Nueces County
Within 5 miles outside Corpus Christi city limits but not inside city limits	Buffer 5 miles around Corpus Christi City limits
Heliport 1/2 mile from any source of water	Buffer 0.5 miles from rivers
A mile of a County road (C) road	Buffer a mile from road with RTTYPE C


In this lab exercise, we are going to use the model builder to identify a solution. Model builder is an alternative method for running operations and can sometimes be useful for organizing and tracking the operations used on your datasets. However, Model builder can also sometimes be touchy, so be sure to follow the correct order of steps and occasionally verify that the operation has run correctly. Each time you verify, it is a good idea to save your work so you won't have to start from scratch if something does go wrong.

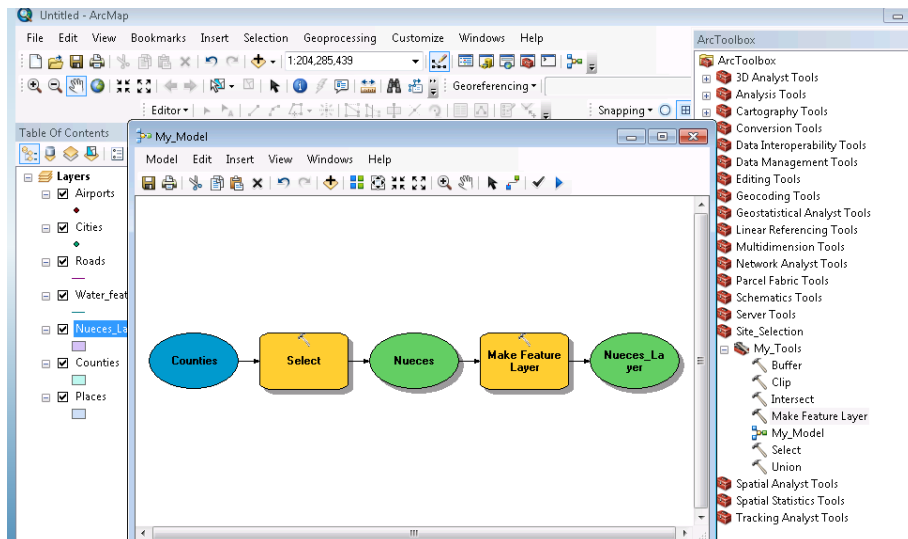
1. Add the six shapefiles in your Lab 5 folder to your map. Ignore the Unknown Spatial Reference warning.
2. **Open ArcToolbox.**
3. Your toolbox, **Site_Selection**, should still be accessible, if not: Right-click anywhere in the ArcToolbox Window and Click **Add Toolbox**.
4. Navigate to your **Site_Selection** toolbox in *C:\GST102* and click Open. The **Site_Selection** toolbox will be added to the ArcToolbox window.
5. Expand the **Site_Selection** toolbox and right click on the **My_Model** and click **Edit**. This will open the model window.
6. In order to add a tool to the model, we click and drag the tool from ArcToolbox to the model window. Don't forget to also put the tools you use in the **My_Tools** toolset into your toolbox.
7. When we look at these scenarios, we first want to cut the dataset down to only the areas we need. Consider the first constraint. The airport must be in Nueces County. This is the boundary of your dataset, anything beyond the boundary is not needed. We are going to select Nueces County from the states layer and make a new feature class from it.
 - a. Drag the Select tool (found in the Extract toolbox) onto the model window. **Drag the Counties** Dataset from the Table of Contents to the model window. Use the **Connect** button (highlighted in the screenshot below) to connect the dataset to the tool (Select) and click **Input Features**. Selecting Input Features tells the model that your Counties layer will be your input to the tool. After a few seconds, an output in the model window will show up named Counties_Select as is shown in the screenshot below. Right-click on the Counties_Select layer and Rename it Nueces.



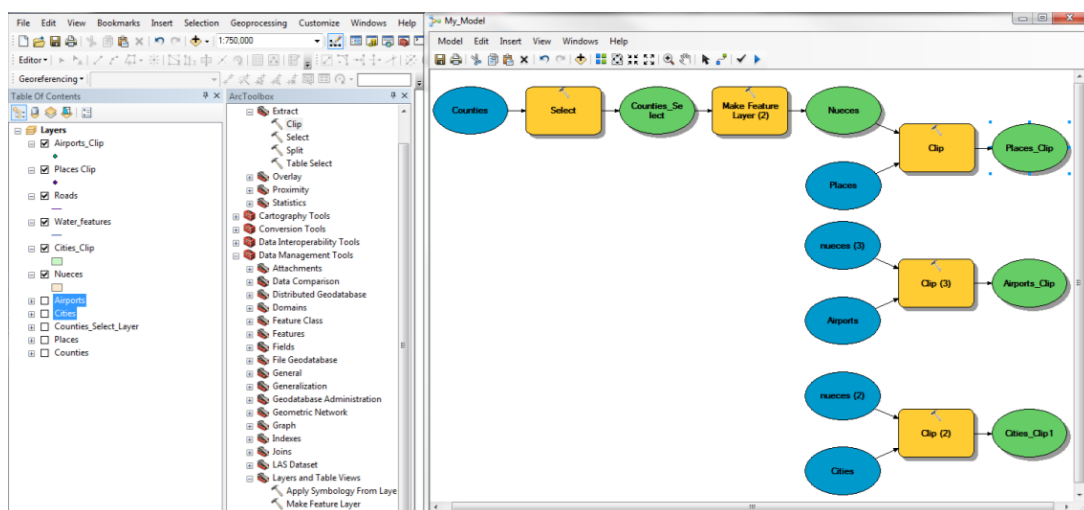
- b. Double-click on the Select tool bubble. The Select window will open. Click the button next to the Expression textbox and create the query **"COUNTY" = 'Nueces'** using the query builder shown in the screenshot below. Click **OK** twice. Don't forget to **add** the Select Tool to your My_Tools toolset.



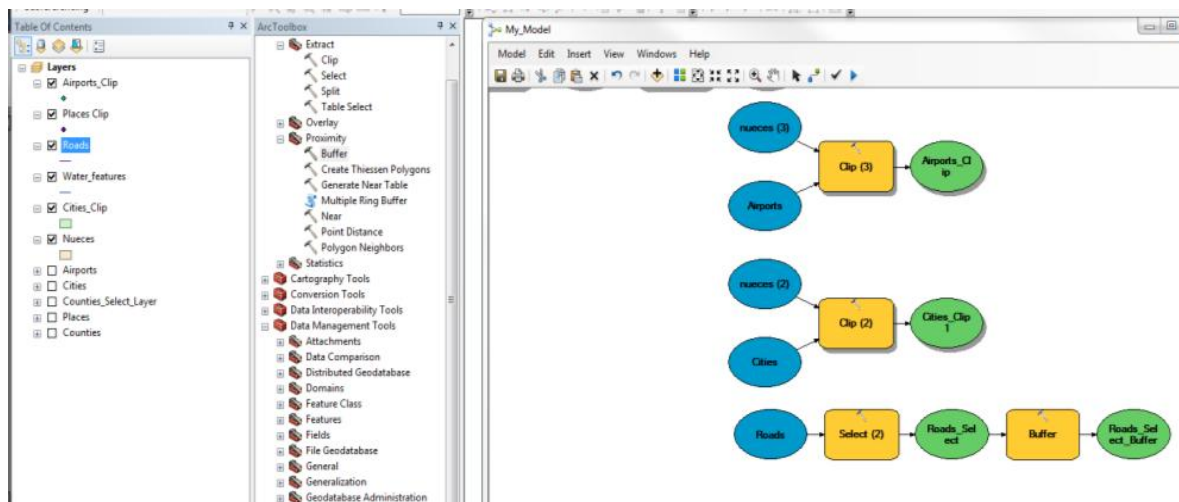
- c. Now add the **Make Feature Layer** tool (**Data Management->Layers and Table Views**) to the model and connect it to the **Nueces** layer. In order to add the layer you have just created to your map, right-click Nueces_Layer and click **Add To Display**. Click the **Run** button  to run the operation and create the new feature layer in your Table of Contents. Your model should now look like the one shown in the screenshot below.



- d. Next, we will use the Clip tool to clip the Airports, Cities, and Places layers to the Nueces feature class.
- e. Add the **Clip** tool to your model window.
- f. Connect the **Nueces_Layer** to the Clip tool and select **Clip Features** (this should set Nueces_Layer as your clipping layer).
- g. Drag the first layer you want to clip from the Table of Contents into the model builder (we will start with the Places layer).
- h. Connect the **Places** layer to the Clip tool and select **Input Features**. This should give you an output named **Places_Clip**. You can verify that the tool is clipping to the right layer by double-clicking on the Clip tool to open the Clip window. **Nueces_Layer** should be listed as the **Clip Features** and the **Places** layer should be listed as the **Input Features**.
- i. BEFORE adding the next feature class, right-click on the **Places_Clip** output and selects **Add To Display**.
- j. After adding it to the display, click the **Run** button to add the clipped layer to the Table of Contents.
- k. Now you can clip the other two layers. You will use the same basic method outlined in parts e-j to clip the next two layers with one significant difference. DO NOT connect your second Clip tool to the Nueces_Layer already in the model builder. For the other two feature classes, you will add a step between e and f where you will drag and drop the **Nueces_Layer** from the **Table of Contents** to eventually create a model that looks similar to the one in the screenshot below.
- l. Once you are done with all three clips, you can Remove the original Airports, Places, Counties, and Cities layers from your Table of Contents. This will reduce the size of the dataset and improve the efficiency of the processing.

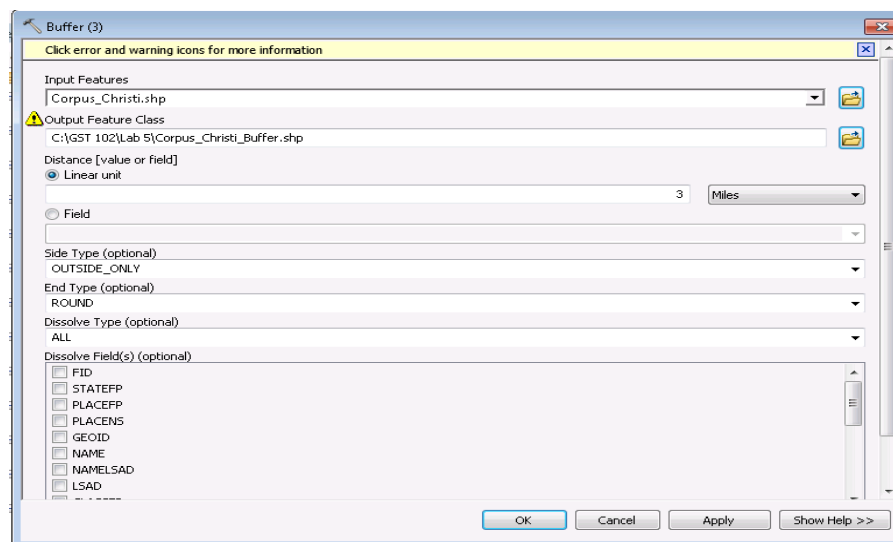


8. Next, we will create buffers for the features that need buffers.
 - a. To start, we will buffer the **Roads** layer. Add the **Roads** layer and the **Select** tool to the model.
 - b. Connect the **Roads** layer to the **Select** tool as the **Input Features**. Double-click on the **Select** tool and use the query builder to enter the expression **RTTYP = c** to select the country roads. Click **OK**.
 - c. Add and connect the **Buffer** tool to the **Roads_Select** and right-click on the **Buffer** tool to make the buffer 1 mile. Dissolve type **ALL**. Click **OK**.
 - d. Remember to right-click on the output and **Add To Display**. Then click **Run** to add the layer to the TOC. (If the Run fails because it cannot find the table, double-click on the Buffer tool and make sure that your Output Feature Class field is directing the file to C:\GST 102\Lab 5 folder. Click OK and repeat this step),



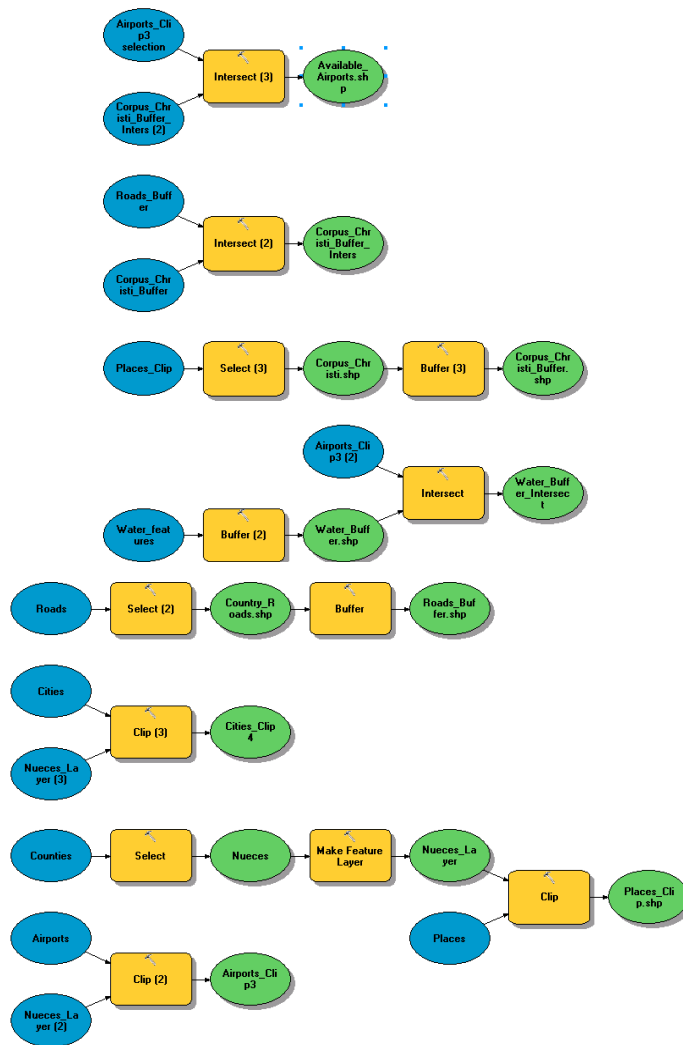
9. Next, we will buffer the **Water_features** layer and then create a layer that includes all of the airports that meet the qualification of being at least 0.5 miles away from a water feature.
 - a. Drag and drop the **Water_features** layer into your model window. Add the **Buffer** tool and connect to the **Water_features** layer. Double-click the **Buffer** tool to buffer 0.5 miles from the water features (remember to dissolve ALL). **Add To Display** the output layer and then **Run** the model.
 - b. Add the **Intersect** tool to My_Tools and the model window. Add the **Airports_Clip** layer. Connect the **Airports_Clip** layer and **Water_features_Buffer** layers as the two inputs to the **Intersect**. Double-click on the **Intersect** tool, verify the input layers, assign the output folder and name, and make sure **ALL** is selected in the **Join Attributes** dropdown. Click **OK**. Add the output to the display and Click **Run**. This will create a layer with all the airports we don't want for our site.
 - c. To select the airports we *do* want to choose from for our site, first right-click on the **Airports_Clip** layer, go to **Selection** and click **Select All**. Next, you will click **Selection** from the main menu then choose **Select By Location**. For the Selection method choose **remove from the currently selected features in**. Our **Target layer** will be the **Airport_Clip** layer and our **Source layer** will be

- the **Water_features_Airport_Intersect** layer you just created. Make sure the **Spatial selection method for target layer feature(s)** is selected as **intersect the source layer feature**. This will select all the airports except those shared by both these layers.
- d. Finally, create a layer from your selection by right-clicking on the **Airports_Clip** layer and click **Selection->Create Layer From Selected Features**. This should create a layer of all the airports at least 0.5 miles away from any water features.
10. The next step is to create a layer by buffering around the Corpus Christi city limits.
- a. In your model, first use the **Select** tool to select Corpus Christi city from the **Places_Clip** layer. Then use the **Buffer** tool on that output to include the area 5 miles around the city limits. This process is essentially the same as what you did in Task 6. n-q with the Roads layer. The only major difference is that you are buffering around a polygon. To do this, when you fill out the Buffer tool parameters be sure to select **OUTSIDE_ONLY** from the **Side Type** option dropdown (see screenshot below).



11. Now we need to start combining our buffered areas to narrow down our potential airports.
- a. First, let's intersect our **City_Limits_Buffer** and our **Roads_Select_Buffer** in our model. This will require dragging those two layers from the TOC and assigning them as **Input Features** for the **Intersect** tool to create a layer that gives you the areas that satisfy for the roads qualification and the city limits qualification. Use a similar method to intersect these two layers as you used in Step 7b.
 - b. Lastly, we just need to use these same methods to intersect our output we created in the last step (Step 9a) and the water features/airport output we created in Step 7d. This time be sure and double-click on the **Intersect** tool and name the output something like **Available_Airports**. This will be your final site selection layer and include only the airports that fit all of the

qualifications in the scenario. Your final model should look something like the one in the screenshot below.



- Finally, create a map using the procedures used in previous labs; include: a title, scale bar, north arrow, and a legend. Title the map as: "YourLastName"GST102Lab5.

Conclusion

In this lab, we can see the use of model builder and building models, the use of personal toolboxes and custom toolsets. Building models provides a way to streamline our operations and processing of datasets.

Discussion Questions

1. How does model builder make spatial analysis easier?
2. Why do toolsets streamline the process?
3. Is it better to have more or fewer constraints? Explain your answer.