Section 26: Helicopter Landing Zones Model

Section Objective

Students will build a model to identify potential Helicopter Landing Zone sites

Class Notes

Spatial Modeler – Helicopter Landing Zones

Task 1: Identify Areas of Suitable Land Cover

The data we are using is from the U.S National Land Cover Database (NLCD), it is a thematic raster which contains a variety of land cover types. The first task is to identify which ground cover types are considered suitable for a HLZ

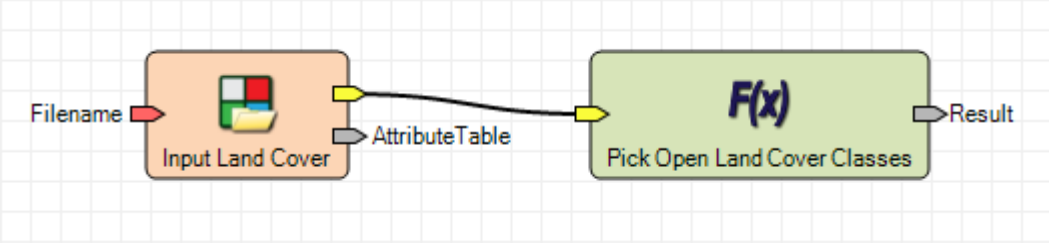
1. Go to **File > Open > Raster Layer** and open ***nlcd_n37w120.img***
2. Assess the image
3. Go to the **Table** tab and click **Show Attributes**

   Our first task is to identify which Land Cover types are suitable for a helicopter landing zone

4. Look at the column labeled NLCD 2011 Land Cover Class and note down the suitable class type and its corresponding Row number
5. Fill out the table below with the information

Row Number	Land Cover Class
31	Barren Land

6. Once complete, **close** the attribute table
7. Open a new Spatial Model by going to **File > New > Spatial Model Editor**
8. From the **Operators List** add a **Raster Input** Operator.
9. Right Click on Raster Input and select **Rename**. Name the operator **Input Land Cover**
10. Right Click on Raster Input and click **Properties**, the Properties Dialog will appear in the bottom right
11. Click on **Show** next to **Map Boundary**
12. Now add an **Expression** operator
13. Right click on the Expression operator and select **Rename**, rename the operator to **Pick Open Land Cover Classes**
14. With the **Expression** operator selected, click **Add Port** from the Spatial Modeler tab
15. **Link** Raster Out to **Input 1**



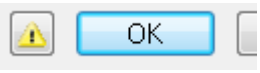
16. **Double click** on the **Expression** operator

    We will now use the values from the previous table you created to populate the query. We will use an EITHER IF query to select the class/row numbers from the table above

17. The Expression should be similar to:

    EITHER 1 IF (($Land_Cover eq 31) or ($Land_Cover eq 52) or ($Land_Cover eq 71) or ($Land_Cover eq 81) or ($Land_Cover eq 82)) OR 0 OTHERWISE

18. A warning icon will appear if there is a problem with the expression

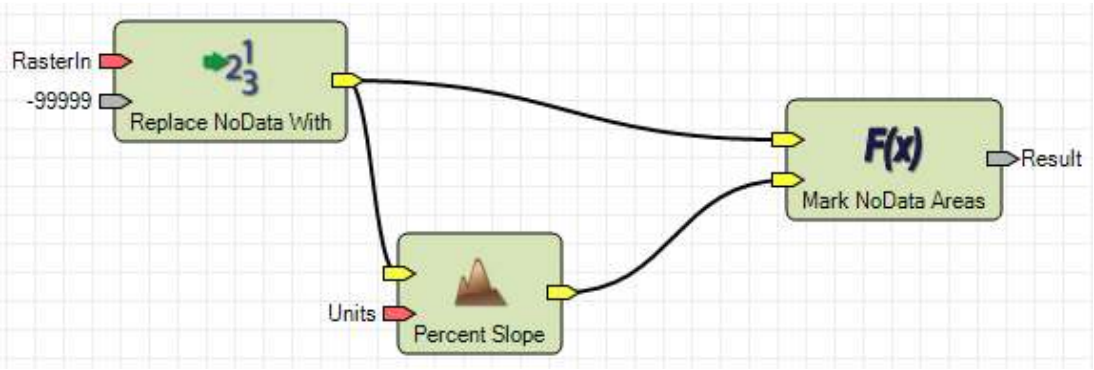


19. **Save** the spatial model by going to **File > Save As > Save Spatial Model as…**
20. Name the file **HLZ_finder.gmdx**

Task 2: Calculate Percentage Slope

We will now build a sub-model which calculates the percentage slope component

1. Add a **Sub-model** operator to the spatial model
2. 2. Right-Click the sub-model and rename it to **Calculate Percentage Slope**
3. 3. Double-Click on the sub-model. This will open the contents of the sub-model (Currently nothing). You will also notice in the calculate percentage slope sub-model in the contents pane
4. Add the following operators to the sub-model;
    - Replace NoData With
    - Percent Slope
    - Expression
5. **Rename** the **Expression Operator** to **Mark NoData Areas**
6. Add two **Input Ports** to the Expression (Right click > Add Port)
7. Link the Operators as below



8. Set the **Replace NoData** With **FillValue** to **-99999**

You will need to input this value in the properties window on the bottom right

Properties

Show	Name	Value	Objects Supported	Required
✔	RasterIn		Raster	✔
✔	FillValue	Integer (-99999)	Scalar, Raster	✔
✔	RasterOut		Raster	

We are using the value of -99999 to populate areas that fail to meet the criteria, normally we would use 0 but as this an evelation/slope model, 0 is a real value

9. **Double click** on the **Expression** Operator

   The expression operator allows us to input a custom query

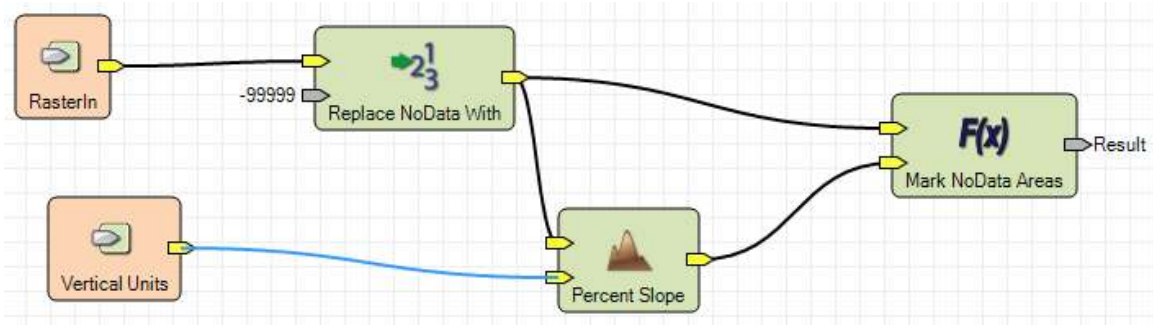
10. Input the following expression:

    EITHER 999 IF ($Input1 == -99999) OR $Input2 OTHERWISE

11. **Add** a **Port Input** Operator, rename it to ***Input DEM*** and connect it to **RasterIn**

12. **Add** a **Port Input** Operator, rename it to ***Vertical Units*** and connect it to **Units**

13. **Add** a **Port Output** Operator, rename it to **Percent Slope with NoData** and connect it to Result



14. From the Contents pane click on **Spatial Model**

15. **Add** a **Raster Input** Operator, rename it to ***Input DEM*** and connect it to the ***RasterIn*** port of the Calculate Percent Slope sub-model

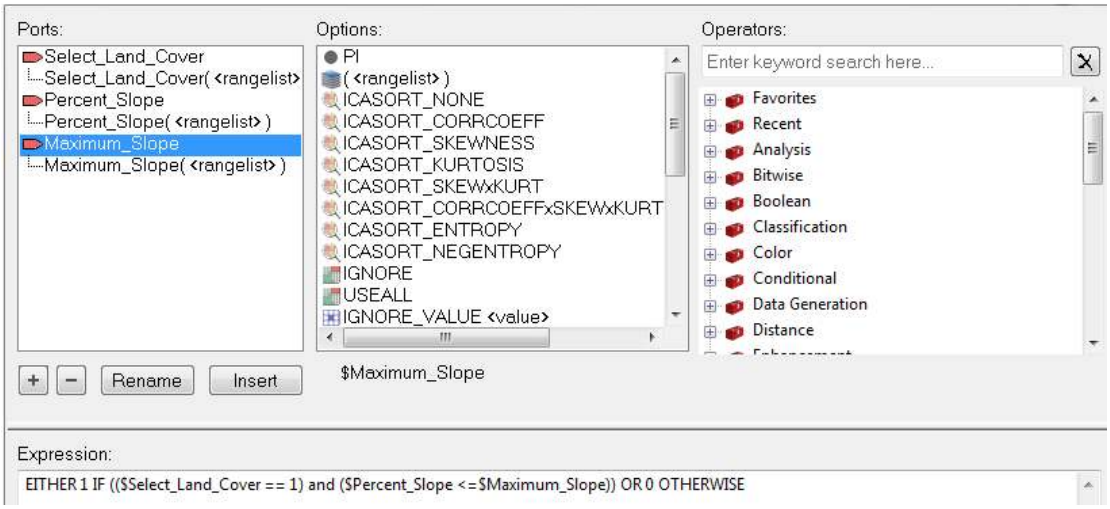
16. **Save** the Model

Task 3: Combine Land Cover and Slope Constraints

We will now build an expression to combine the land cover and the slope constraints. Remember we are building this model to be ran as GUI so we won't be hardcoding any slope degree values.

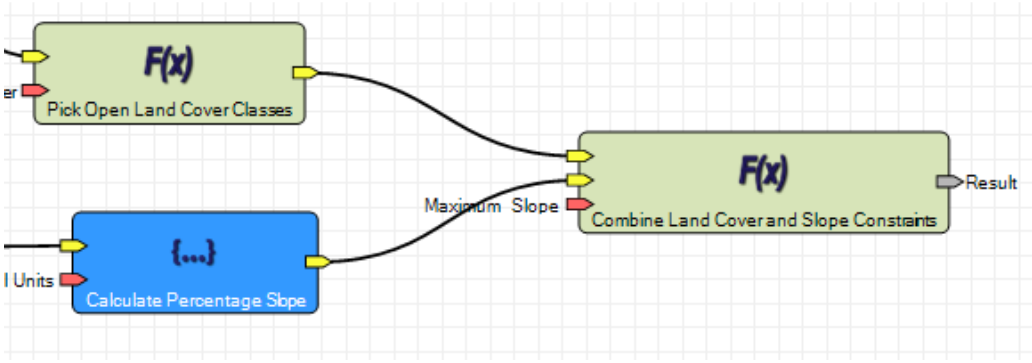
1. **Add** an **Expression** operator and rename it to ***Combine Land Cover and Slope Constraints***
2. **Double-click** on the expression operator
3. From the Ports list on the lift click the "**+**" button and add three ports
4. **Right-click** on each port and rename them as below:
    - Select_Land_Cvoer
    - Percent_Slope
    - Maximum_Slope
5. Input the following Expression

    EITHER 1 IF (($Select_Land_Cover == 1) and ($Percent_Slope <= $Maximum_Slope)) OR 0 OTHERWISE



This expression will output pixels which we have determined to be suitable land cover and which are also less than a maximum percentage slope value

6. **Connect** the Output ***Result*** port to the ***Select Land Cover*** Input Port
7. **Connect** the ***Percent Slope with NoData*** to the ***Percent Slope*** Input Port

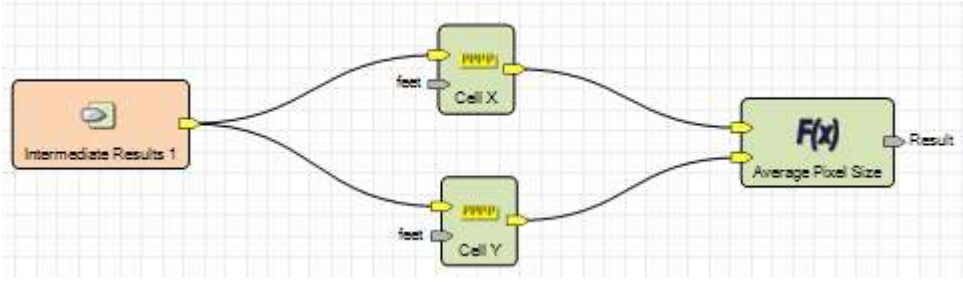


Task 4: Apply Minimum Width

This sub-model is quite complex. It will search a radius around clumps of pixels which have met both criteria.

1. **Add** a **Sub-model** operator and **rename** it to ***Apply Minimum Width***
2. **Double click** on the **sub-model**
3. **Add** a **Port Input** operator and **rename** it **Intermediate Results 1**
4. **Add** a **Cell X** and a **Cell Y** operator
5. **Right click** on the **Meters** port off **Cell X**, select **Configure** and change to ***feet***. Do the same for **Cell Y**
6. **Connect Intermediate Results 1** to both the **Cell X** and **Cell Y** operator
7. **Add** an **Expression** operator and **rename** it to **Average Pixel Size**
8. **Double Click** on the **Expression** operator and add the following expression

   ($Input1+ $Input2) / 2.0



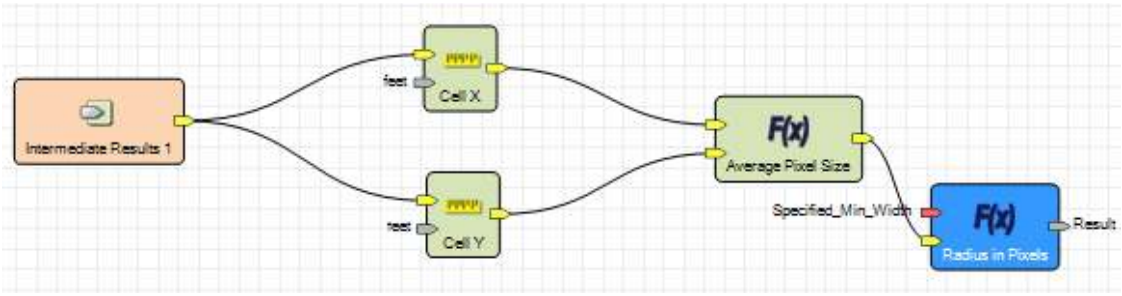
   This expression finds the average pixel size

9. Add another **Expression** operator and rename it to **Radius in Pixels**
10. Double Click on the **Expression** operator
11. Click the **+** button and add two ports
12. Name them **Specified_Min_Width** and **Ave_Pixel_Size** respectively
13. 13. Input the following Expression;

max(integer(round(($Specified_Min_Width / $Ave_Pixel_Size / 2.0) - 0.5)),0)

   This query is using the max statistical operator to identify the radius in pixels. The criteria and units (feet or meters) will be introduced later. The round expression simply rounds the number to the nearest integer

14. Click **OK**
15. **Connect** the **Average Pixel Size** Result to the **Ave Pixel Size** Input



16. **Add** a **Search** operator and **rename** it to ***Search Inward***

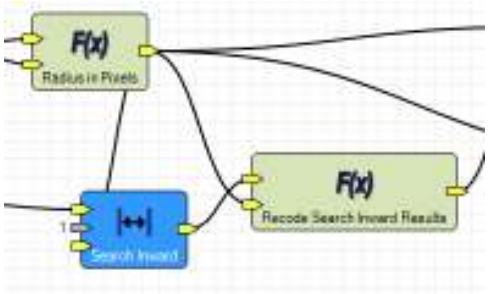
    Search performs a proximity analysis on the input raster. The distance in pixels to search is specified by Search Distance

17. **Connect Intermediate Results 1** to **Raster In**
18. **Connect** the **Result** port from **Radius in Pixels** to the "**1**" port of **Search Inward**
19. **Add** an **Expression** operator and **rename** it to ***Recode Search Inward Results***
20. **Double click** on the **Expression** operator
21. **Add** two Ports and rename them **Search_Results** and **Search_Radius**.
22. Input the following expression

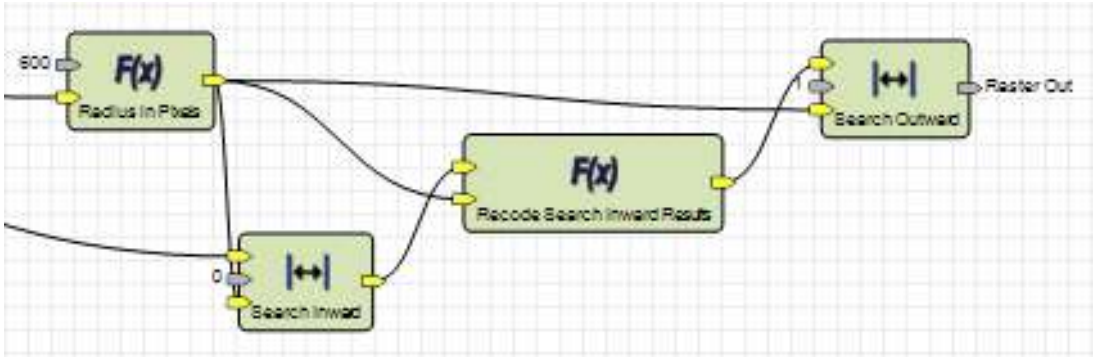
    EITHER 1 IF ($Search_Results > $Search_Radius) OR 0 OTHERWISE

    This expression is simply finding search results (our input) are greater than the search radius

23. Click **OK**
24. **Connect** the RasterOut of **Search Inward** to the **Search_Results** port
25. **Connect** the Output port of **Radius in Pixels** to the **Search_Radius**, "**1**" port



26. **Connect** the Output port of **Radius in Pixels** to the **Search_Radius**, "**1**" port
27. In the Properties dialog change the Value for Class 1 to **Integer (0)**
28. **Add** another **Search** operator to the model and rename it to **Search Outward**
29. **Connect** the **Result** port from ***Recode Search Inward Results*** to **Raster In** of **Search Outward**
30. **Connect** the **Radius in Pixel** output port to the **Class 1** input port of **Search Outward**
31. In the **Properties** dialog change the Value for Class 1 to **Integer (1)**



32. **Add** an **Expression** operator to the model and rename it to **Recode Search Outward Results**

33. **Double click** on the **expression**

34. **Add** two Ports and rename them **Search_Results** and **Search_Radius**

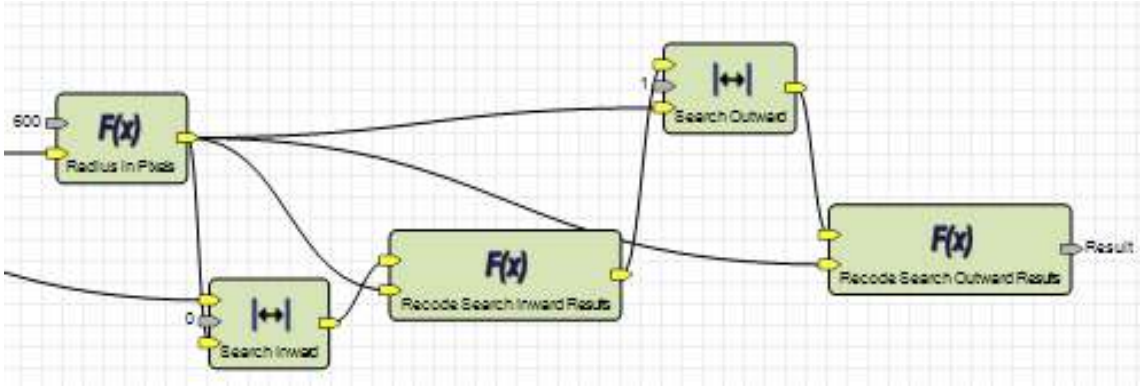
35. Input the following Expression

    EITHER 1 IF ($Search_Results <= $Search_Radius) OR 0 OTHERWISE

    This query recodes any search result that is less than or equal to the search radius as 1

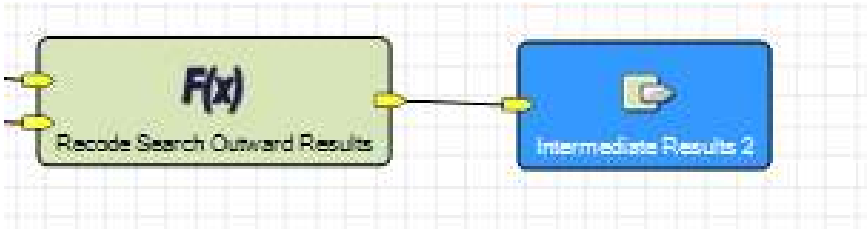
36. **Connect** the Raster Out from **Search Outward** to **Search_Results**

37. **Connect** the Radius in Pixels output port to **Search_Radius**

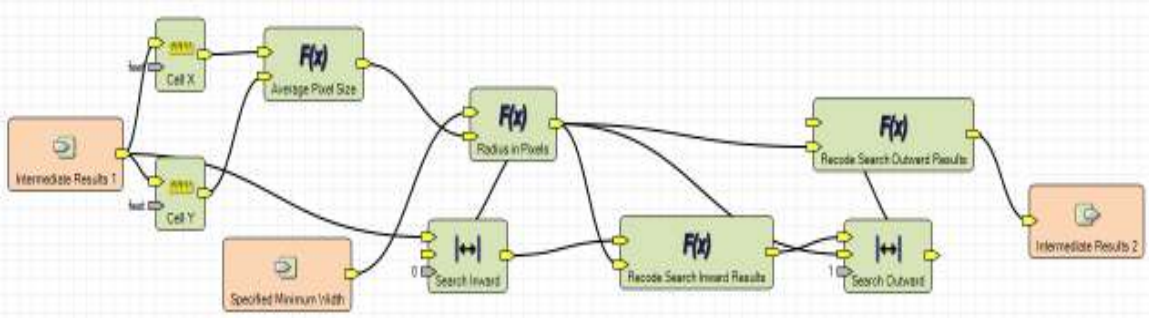


38. **Add** a **Port Output** and **rename** it ***Intermediate Results 2***

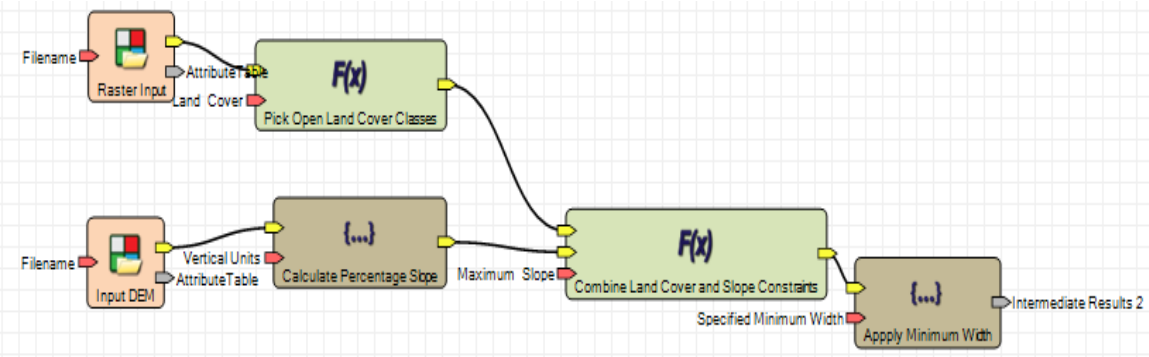
39. **Connect** the **Result** port of the ***Recode Search Outward Results*** to the new output Port



40. **Add** a **Port Input** and **rename** it to **Specified Minimum Width**. **Connect** it to the ***Specified_Min_Width*** port of ***Radius in Pixels***



41. **Save** the model
42. From the contents pane, go back to the Spatial Model
43. **Connect** the **Output Result** of the ***Combine*** expression to the ***Intermediate Results 1 port***

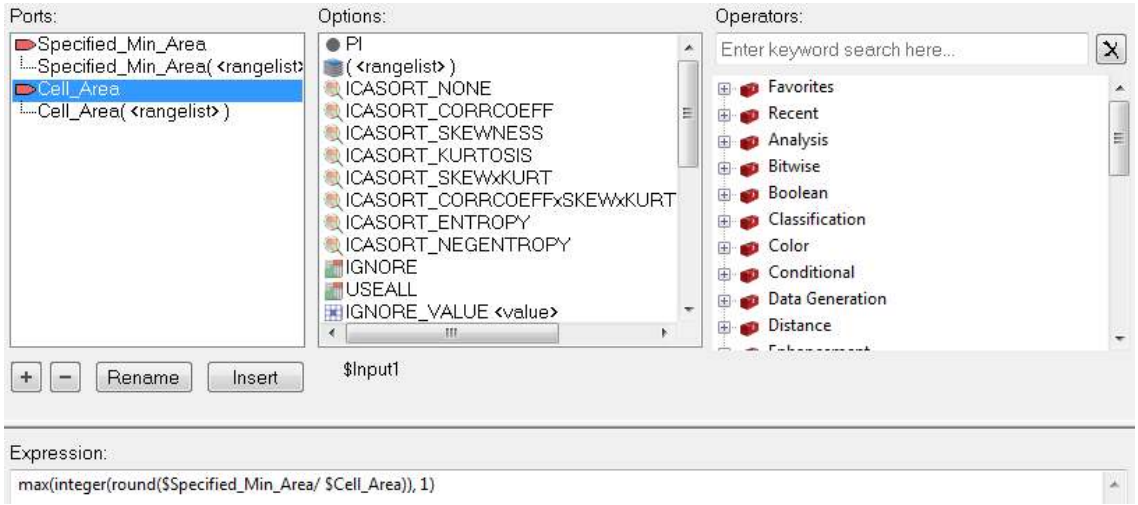


Task 5: Apply Minimum Area

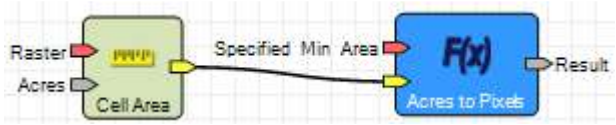
This sub-model applies the minimum area criteria

1. **Add** a **Sub-model** operator and **rename** it to ***Apply Minimum Area***
2. **Double click** on the **Sub-model**
3. **Add** a **Cell Area** Operator
4. **Double Click** on hectare and change to ***acres***
5. **Add** an **Expression** operator and **rename** it to **Acres to Pixels**
6. **Double click** on the **Expression** operator
7. **Ad** two ports and name them ***Specified_Min_Area*** and ***Cell_Area***
8. Input the following **Expression**

   max(integer(round($Specified_Min_Area/ $Cell_Area)), 1)



9. **Connect** the **Output** operator of **Cell Area** to the **Cell Input** operator of **Acres to Pixels**

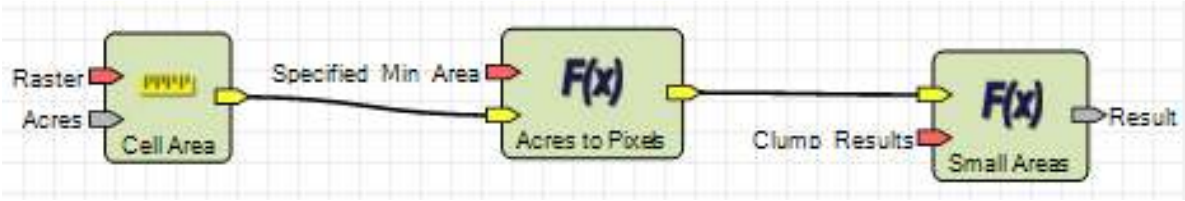


10. **Add** another **Expression** operator and rename it to ***Small Areas***
11. **Double click** on the **Expression** operator
12. **Add** two ports and name them ***Area_in_Pixels*** and ***Clump_Results***
13. **Add** the following expression:

    SieveTable ($Area_in_Pixels , Histogram ($Clump_Results))

    The SieveTable operator works with the clump operator remove clumps less or greater than a certain size

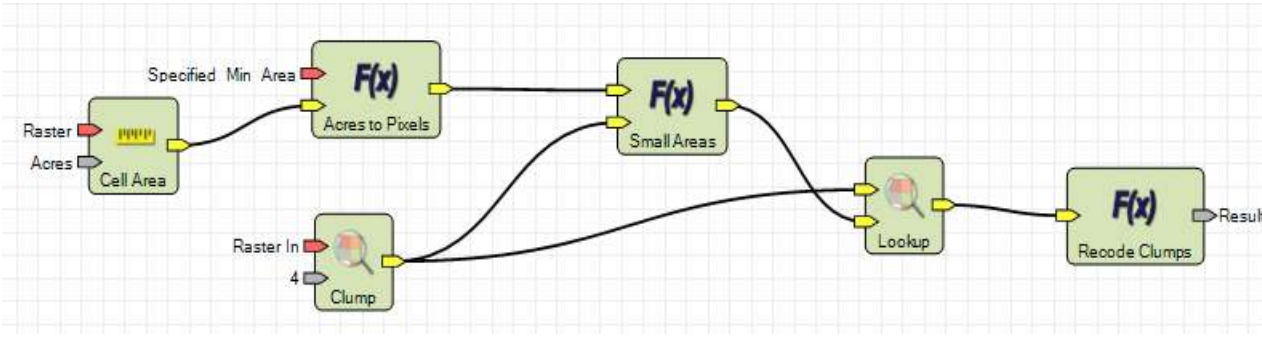
14. **Connect** ***Acres to Pixels*** to ***Small Areas***



15. **Add** a **Clump** operator
16. **Connect** the **Raster Out** of **Clump** to **Clump Results**
17. Add a **Lookup** operator
18. **Connect** the **Clump** output port to the **Lookup, Input** port.
19. **Connect** the **Small Areas Result** port to the **Lookup Table** port
20. **Add** an **Expression** operator and rename it to ***Recode Clumps***
21. **Double-click** on the **Expression** operator
22. **Add** a port and name it ***Sieve_Results***
23. Input the following expression;

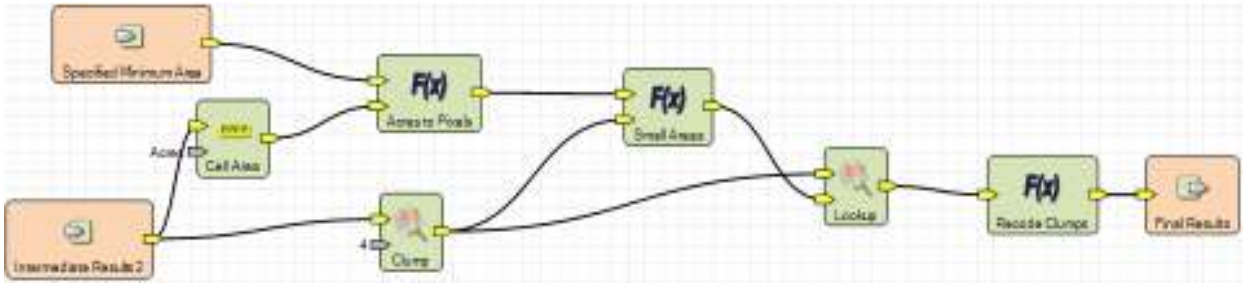
    EITHER 1 IF ($Sieve_Results > 0) OR 0 OTHERWISE

24. **Connect** the ***Lookup Output*** to ***Sieve Results***

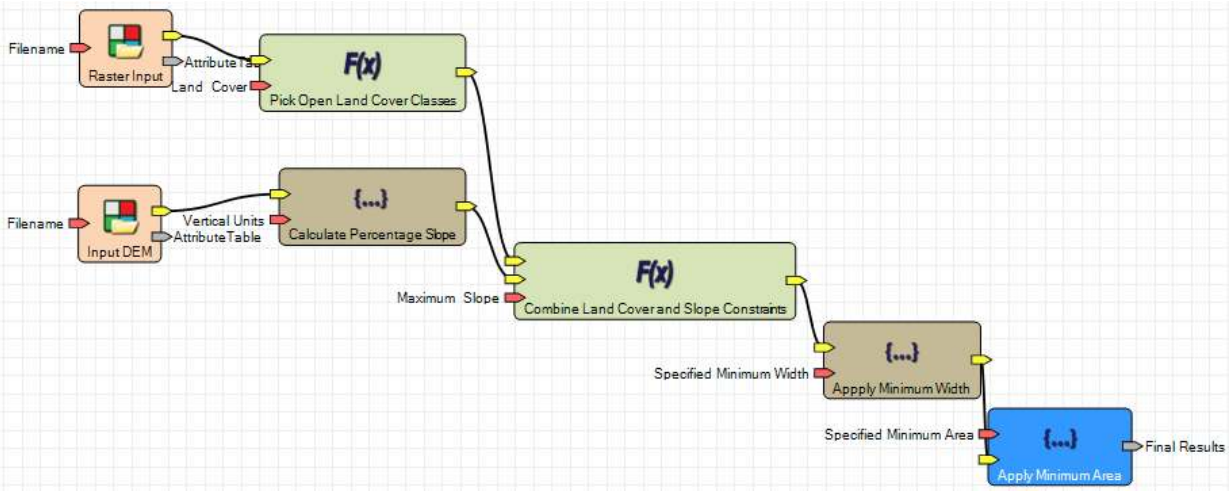


25. **Add** a **Port Input** and rename it to ***Specified Minimum Area***. **Connect** it to the ***Specified_Min_Area*** input of Acres to Pixels.
26. **Add** another Port Input and **rename** it to **Intermediate Results 2**. **Connect** it to the **Cell Area**, **Raster** Input. Then **connect** it to the **Raster In** of **Clump**

27. **Add** a **Port Output** and **rename** it to **Final Results**, **connect** the Result from **Recode Clumps** to it



28. **Save** the model
29. From the contents pane, go back to the Spatial Model
30. **Connect** the two **Intermediate Results 2** ports to each other



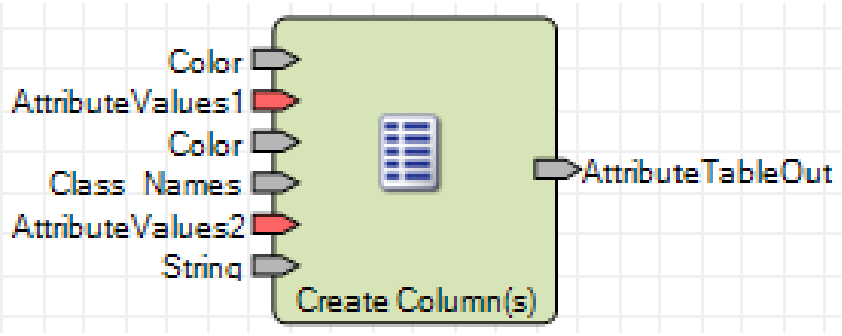
Task 6: Attach Colors and Attributes

1. **Add** a **Sub-model** operator and **rename** it to ***Attach Colors and Attributes***
2. **Double-click** on the **expression**
3. **Add** a **Create Columns** Operator
4. **Right click** on the **Create Columns** operator and select **Add Port**
5. From the **Properties** window make the following additions to the **Value column**

Show	Name	Value
	AttributeTableIn	
✔	AttributeName1	Color
✔	AttributeValues1	
	LayerNumbers1	
✔	TableType1	Color
✔	AttributeName2	Class_Names
✔	AttributeValues2	
	LayerNumbers2	
✔	TableType2	String
✔	AttributeTableOut	

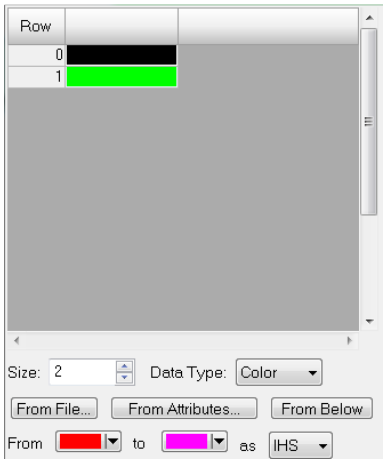
6. Right-click on the following ports and hide them
    - AttributeTableIn
    - LayerNumbers1
    - Layer Numbers2

7. Your Create Columns Operator should look like below;



8. Add a **Custom Table Input** operator. **Rename** it to ***Color Table***
9. **Double-click** on the **Color Table** operator
10. For the **Data Type**, choose **Color**
11. Change **Size** to **2**
12. Change the Color of **Row 1** to **Green**

13. Click **OK**

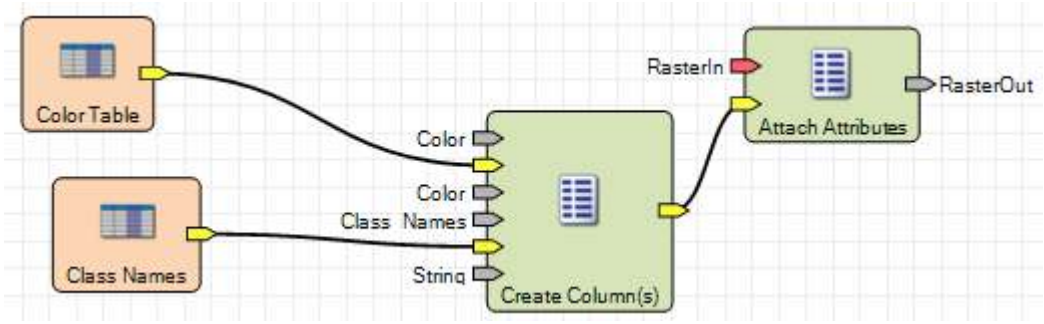


14. **Connect** the **Color Table** to **AttributeValues1**
15. Add another **Custom Table Input** and **rename** it to ***Class Names***
16. With **Class Names** selected add the following to the value row.

    Table (2: "Background","Suitable for Helicopter Landing")

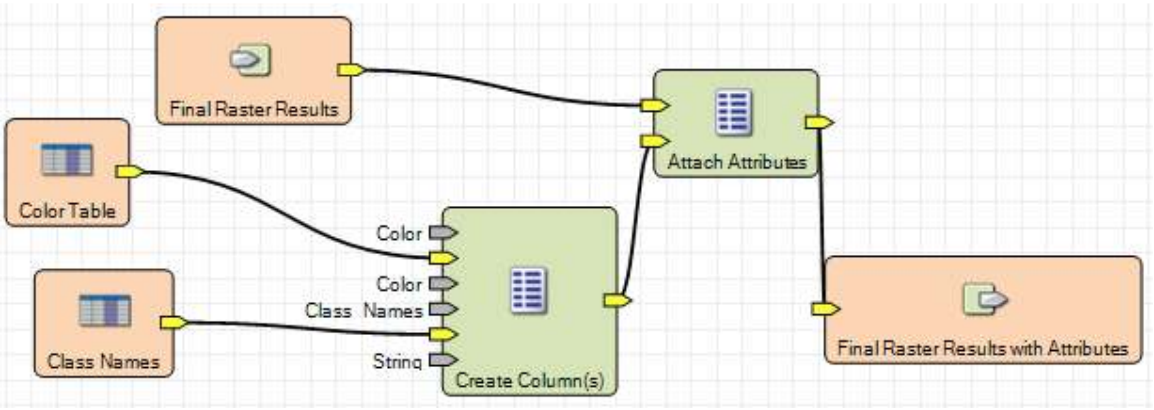
Show	Name	Value
	Value	Table (2: "Background","Suitable for Helicopter Landing")
✔	Table	

17. **Connect Class Names** to **Attribute Values 2**
18. Add an **Attach Attributes** operator
19. **Connect** the **AttributeTableOut** port to the **Attribute Table** port



20. Add a **Port Input** and name it **Final Raster Results**
21. **Connect** it to the **RasterIn** port of Attach Attributes
22. Add a **Port Output** operator and rename it to **Final Raster Results** with **Attributes**

23. Connect the output port of **Attach Attribute** to the input port of **Final Raster Results with Attributes**



24. **Save** the model

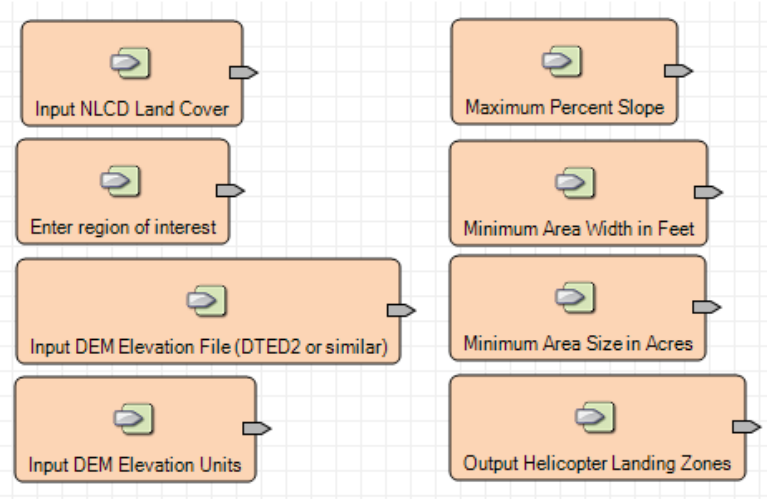
25. Go back to the Spatial Model

26. Connect **Final Results** to **Final Raster Results**

Task 7: Set Ports to Create a GUI

We will start by adding some Port Input operators

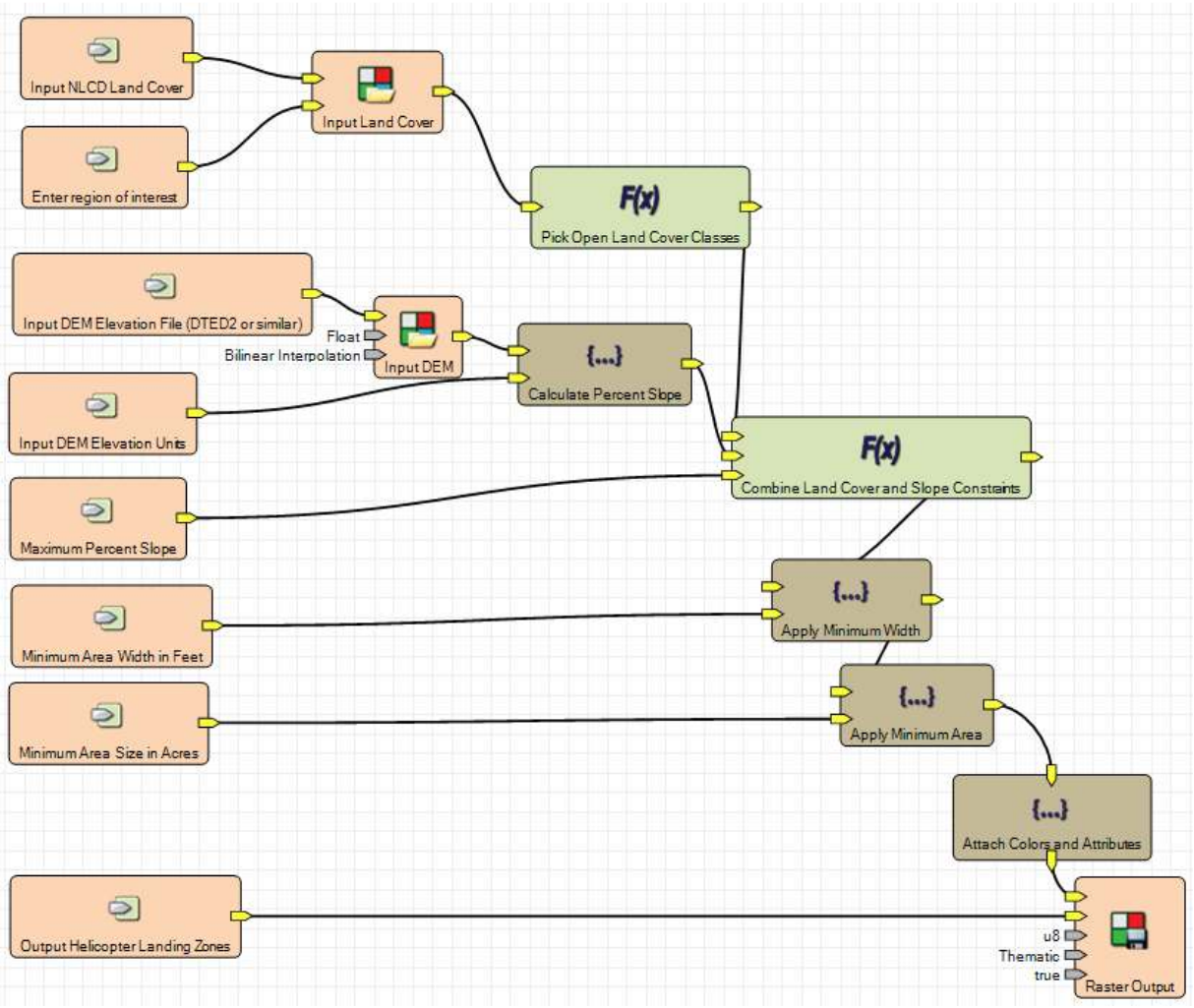
1. From the Operators list drag in **8 Port Input** Operators and rename them as below



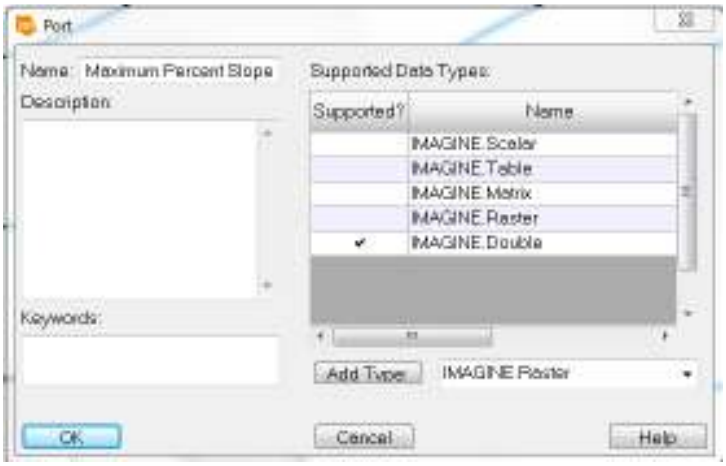
2. Using the table below, create the following connections between ports

Port	**Operator**	**Port Name**
Input NLCD Land Cover	Input Land Cover	Filename
Enter Region of Interest	Input Land Cover	MapBoundary
Input DEM Elevation File (DTED2 or similar)	InputDEM	Filename
Input DEM Elevation Units	Calculate Percent	Vertical Units
Maximum Percent Slope	Combine Land Cover and Slope Constraints	Maximum_Slope
Minimum Area Width in Feet	Apply Minimum Width	Specified Minimum Width
Minimum Area Size in Acres	Apply Minimum Area	Specified Minimum Area
Output Helicopter Landing Zones	RasterOutput	FilenameIn

3. You model should like the one below

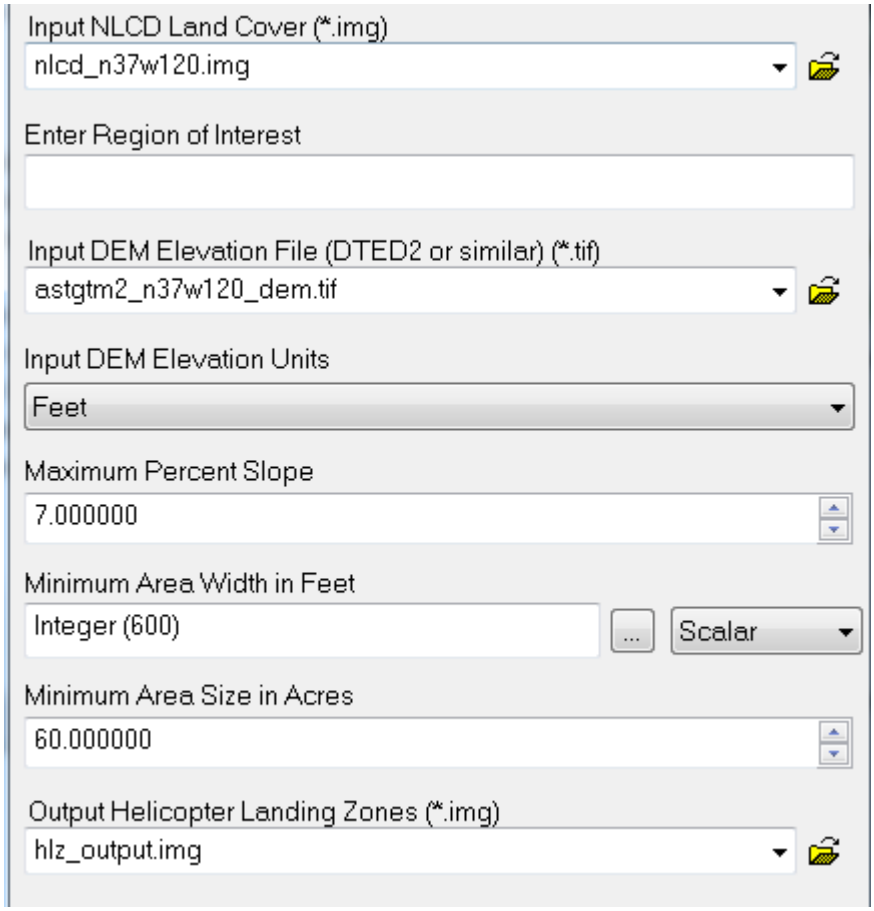


4. **Double-Click** on the **Maximum Percent Slope** port
5. From the drop-down list select **IMAGINE.Double** and click **Add Type**
6. Turn Support **OFF** for all other data types



7. Click **OK**
8. Complete the same process for the **Minimum Area Size in Acres** and the **Minimum Area Width in Feet** port
9. Go to **File > Save As > Spatial Model As..**
10. Name the output ***HLZ Model.gmdx***
11. **Close** the Spatial Model Editor window in IMAGINE

    We will now launch the model with it's GUI
12. From the **Toolbox** tab go to **Spatial Model Editor** > **Launch Spatial Model**
13. Add ***nlcd_n37w120.img*** as the Input NLCD Land Cover dataset
14. Add ***astgtm2_n37w120_dem.tif*** as the Input DEM Elevation file
15. Make the Elevation units **Feet**
16. Set the Maximum Percent slope as **7**
17. Set minimum area width in feet to **600**
18. Set minimum area size in Acres at **60**
19. Name the Output HLZ File ***hlz_output.img***



Class Notes