

Optional Exercise

Ideal Landing Zones



Introduction

In this exercise we will explore how to create data using canopy height models, DEM, and preexisting shapefiles. The data that will be created will enable the user to visualize areas of intersecting low angle slope and non-old growth forest. This workflow can be applied to all sorts of other data and will set a base for users to select and create parameters for site selection for helicopter landing zones.

Objectives

- Learn how to create relevant data for choosing ideal areas for helicopter landing zones.
- Choose ideal landing zones based on the deliverables created.

Required Data

- **DEM.tif**
- **CanopyHeight.tif**
- **Roads.shp** (substitute at user discretion if you have a file you'd like to use).

Prerequisites

- Have ArcGIS 10.x installed on computer and have a basic understanding of how to use the software.
- Completion of previous exercises is helpful but not necessary to run this exercise.



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Part 1: Preparing Data

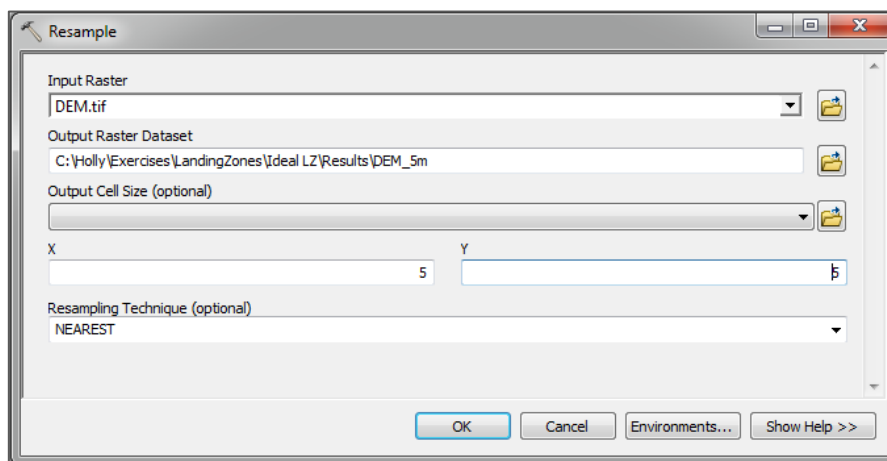
Before we can begin identifying areas suitable for landing sites, the data must be simplified for our purposes. In the first part of the process, we will resample the existing 1 meter resolution Digital Elevation Model (DEM) to 5 meters. This creates a more general slope of a given area, which is ideal for this purpose because too much detail can over or under predict ideal landing zones.

A. Resample DEM to 5m

1. Open **ArcMap 10.x** (Start, All Programs, ArcGIS, ArcMap 10.x).
2. In a blank .mxd, click **Add Data**.



3. Navigate to the Raster folder within your Data folder and add **DEM.tif** and **CanopyHeight.tif**
4. Open the **Resample** tool by opening **ArcToolbox, Data Management Tools, Raster, Raster Processing** and then click **Resample**.

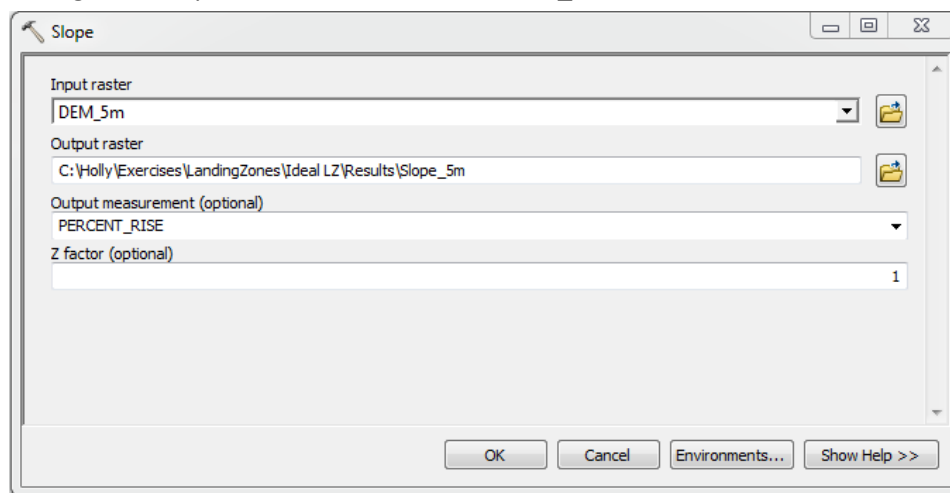


- i. For **Input Raster** select the **DEM.tif** file.
- ii. For **Output Raster Dataset** click the yellow folder icon and navigate to your data folder. Name your file **DEM_5m.tif**
- iii. Keep **Output Cell Size** empty.
- iv. For both **X** and **Y** enter **5** in the corresponding cells.
- v. Leave **Resampling Technique** as **NEAREST**.
- vi. Click **OK** to run the tool.

Your output should be a lower resolution version of your original DEM. The purpose for creating this file is to generalize the slope over a given area. The results derived from this file will show larger areas that are best suited for landing zones.

B. Get slope from the resampled DEM

1. Next, we will generate a slope raster from the resampled DEM using the spatial analyst toolbox. Navigate to this tool by opening **ArcToolbox**, **Spatial Analyst Tools**, **Surface**, and then **Slope**.
 - i. Before operating this tool, ensure that Spatial Analyst is enabled by clicking the **Customize** tab in the main ArcMap window and then click **Extensions...** from the dropdown menu.
 - ii. Click a check mark in the box next to **Spatial Analyst** if one is not already there. Close the window.
2. For **Input Raster** choose **DEM_5m.tif**.
3. Navigate to your output folder and name the file **Slope_5m.tif**.
4. Change the output measurement to **PERCENT_RISE**.



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

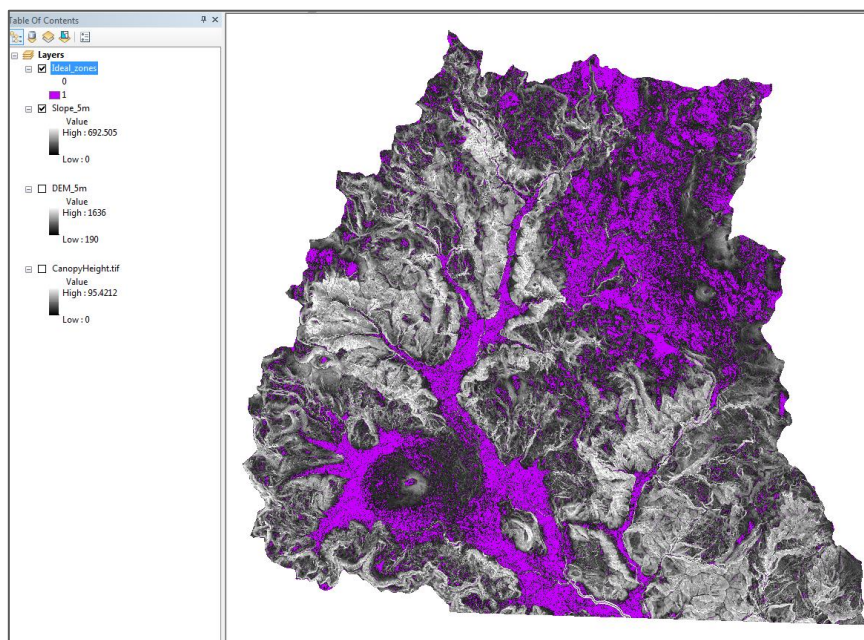
Part 2: Derive Ideal Landing Zones

A. Derive results with Raster Calculator

1. Open the Raster Calculator tool by navigating to **ArcToolbox**, **Spatial Analyst**, **Map Algebra**, and then **Raster Calculator**.
2. Since the ideal zone is 10 percent rise or less, our first statement will be "**Slope_5m**" <= 10.
3. The second requirement is that a landing zone cannot be placed in Old Growth forests. So the second statement should be similar to "**CanopyHeight.tif**" < 45.72. This height can be changed to reflect the user's specifications.
 - i. It is important to follow the syntax requirements to run statements in raster calculator. Your statement should look like the following to run correctly
("Slope_5m" <=10)&("CanopyHeight.tif" < 45.72)
4. For **Output Raster** navigate to your output folder and name the file **Ideal_Zones.tif**.

The output will be a thematic map with the values “0” and “1”, where 0 equals areas that are not suited to the statement, and 1 equals areas that fulfill the statement. Next we will symbolize the layers to visually check that the outputs are correct.

5. In the Table of Contents, turn off all layers except **Slope_5m** and **Ideal_Zones**.
6. Open the layer properties of **Ideal_Zones** by right-clicking and selecting **Properties...**
7. Under the Symbolology tab, select **Unique Values** in the **Show:** window on the left.
8. Click the color box next to “0” in the symbol window. Choose **No Color**.
9. Follow the same steps for value “1”, but instead select a color that is easy for you to see against the white and black gradient of the slope layer.



10. With this layout, use the Pan and Zoom tools to explore your output. Does it seem to line up with areas of low slope?



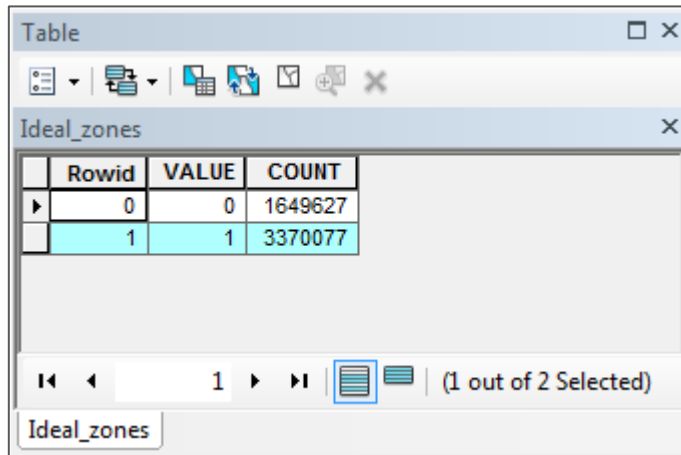
Part 3: Cleaning up the data

Before we are able to use this data to make a decision on ideal landing zones, we need to simplify the data further. First we will omit data that isn’t relevant (non-ideal slope areas, or “0” values in the Ideal_Zones layer) and omit areas that intersect roads.

A. Simplifying the output raster

1. First, we will simplify the outputs in our **Ideal_Zones** layer to generalize the results to take away some noise from the data using the **Majority Filter**.

2. Before opening the filter, open the attribute table of **Ideal_zones**.
3. Click the grey box next to **Rowid "1"** so that it becomes selected (highlighted in blue). This will select all raster cells in the layer with the value of "1". Your data window should show those areas highlighted.



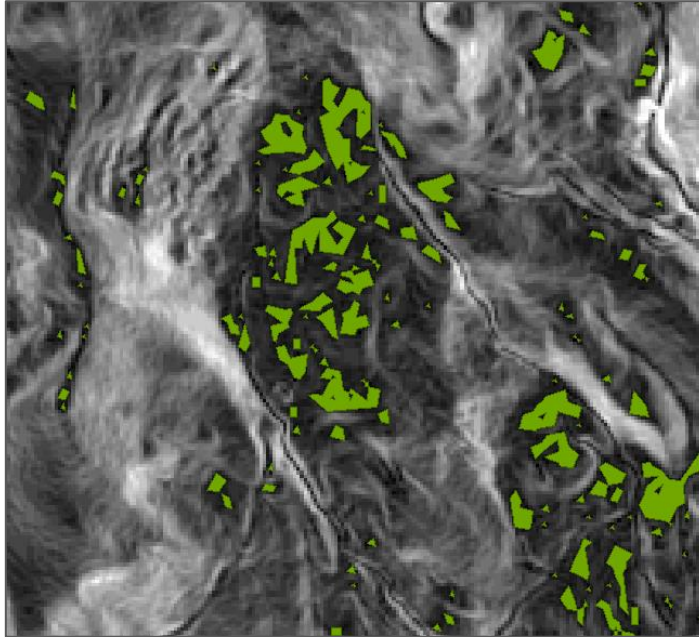
Rowid	VALUE	COUNT
0	0	1649627
1	1	3370077

4. Selecting this attribute prior to running a tool will make it so only the ideal areas ("1") are processed in the next step.
5. Next we will run the **Majority Filter** on the selected attributes. Open the filter by navigating to **ArcToolbox, Spatial Analyst Toolbox, Generalization**, and then click **Majority Filter**.
 - i. For **Input Raster** choose **Ideal_zones**.
 - ii. For the **Output raster**, navigate to your results folder and name the output **Ideal_filter**.
 - iii. Keep the other default options. Click **OK** to run the tool.
6. The output should have only one value type in the attribute table.

B. Create a polygon layer

Before we can omit roads from the ideal areas, the data types need to be the same. Since the road layer is a vector layer, the **Ideal_filter** raster layer needs to be converted to polygon. This will also bring us a step closer to having data that can be used to select landing zone sites.

1. Open the **Raster to Polygon** tool by navigating to **ArcToolbox, Conversion tools, From Raster**, and then **Raster to Polygon**.
 - i. Set **Input raster** to **Ideal_filter**
 - ii. Leave **Field** as its default.
 - iii. For Output polygon features navigate to your output folder and name the file **Ideal_Zones_poly**
 - iv. Leave the checkmark on for **Simplify polygons**.
 - v. Click **OK** to run the tool.



*The output will create individual polygons of the aggregated raster cells from the previous file. While exploring the output from this process, note that there are areas that match the criteria for slope and old growth avoidance, but do not necessarily seem large enough for our needs. To omit small areas from the final product, we must calculate the area of the polygons and then create an output using only the polygons that fit our size criteria using **Calculate Geometry...***

C. Calculating geometry

1. First a Field must be created in the Attribute table of **Ideal_Zones_poly**. Right-Click the layer and select **Open Attribute Table** from the menu.
2. Click the Table Options button and select **Add Field...** from the menu



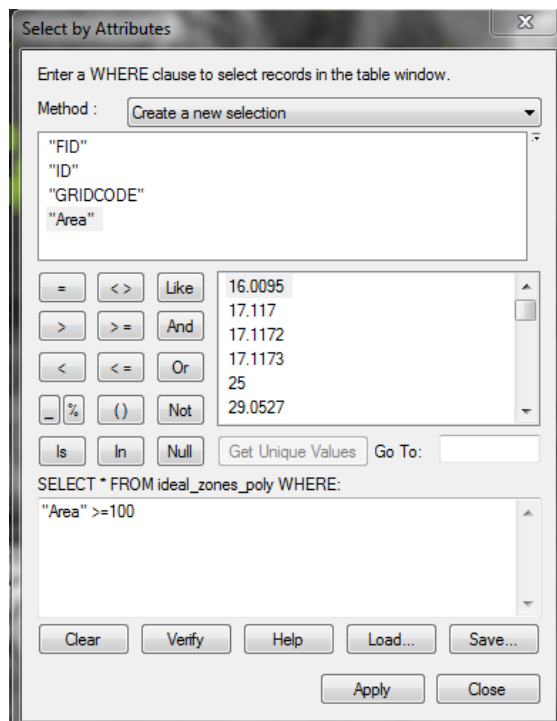
3. Name the field **Area_meter** and set **Type** to **Float**. Click **OK**.
4. Right click this field in the attribute table and select **Calculate Geometry**.
5. Set the **Property** to **Area**.
6. The **Coordinate System** should be set to **Use coordinate system of the data source**.
7. Set **Units** to **Square Meters [sq m]** if it isn't already.
8. Click **OK** to run the tool.

D. Select Polygons Based on Area

1. Next we will eliminate areas that are smaller than **100 sq. meters**. (This area selection is for example only. The user can input any area that suits their needs).
2. While still in the attribute table window, click on the **Select by Attributes** button.



3. Double-click **"Area"** in the top window to place it as a variable in the statement window.
4. Type **>=** (Greater than or Equal to) **100**. See below for help.

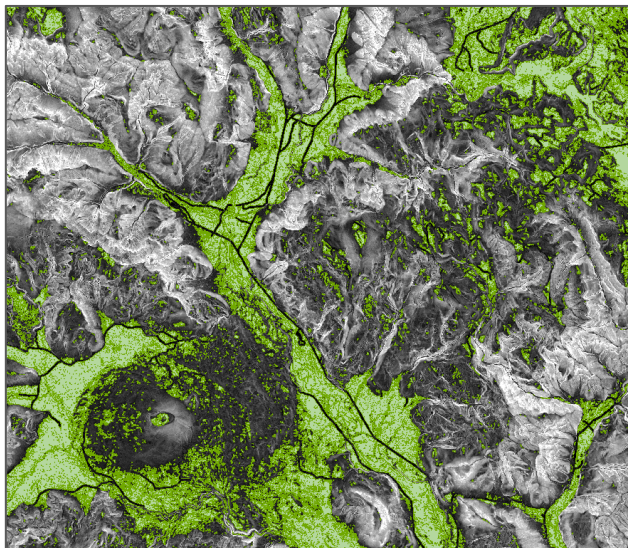


5. Click **Apply**.
6. In your attributes table the areas that are 100 square meters and larger should all be selected. **Close** the Select by Attributes window.
7. With the polygons still selected, right-click **Ideal_Zones_poly** in the Table of Contents and select **Data**, then **Export Data...**
 - i. For **Export**, ensure **Selected Features** is selected.
 - ii. Keep the coordinate system as **this layer's source data**.
 - iii. For **Output feature class** navigate to your output folder and name the file **Ideal_Zones_area**.
 - iv. Click **OK** to run the tool.
8. Click **Yes** when asked to add to map as layer.
9. The new layer should now only include polygon areas larger than 100 sq meters. Use the Identify tool to explore the data and verify this process.



E. Eliminate Roads

1. Click the **Add Data** button and navigate to your data folder and select **Roads.shp**. (User can input any area-specific road data that may be more comprehensive than the file provided in the exercise folder).
2. First, we want to create a polygon buffer for the roads since it is likely that for practical use a certain amount of area around roads will want to be avoided in landing zone areas.
3. Open the **Buffer** tool by navigating to **ArcToolbox, Analysis Tools, Proximity**, and then click **Buffer**.
 - i. For **Input Features** choose **Roads**.
 - ii. For **Output Feature Class** navigate to your output folder and name the file **Roads_30m_buffer.shp**.
 - iii. Choose **Linear unit** as your **Distance** and input **30** as your value. Ensure that the measurement type is **Meters**.
 - iv. Keep all other options as default. Click **OK** to run the tool.
4. Next we will eliminate the newly created road buffer from the Ideal Landing Zones layer using the **Erase** tool.
5. Navigate to the Erase tool by opening **ArcToolbox, Analysis Tools, Overlay**, and then click **Erase**.
 - i. For Input Features choose **Ideal_Zones_area**.
 - ii. For Erase Features choose **Roads_30m_buffer**.
 - iii. For **Output Feature Class** navigate to your output folder and name the file **Ideal_Landing_Zones**.
 - iv. Keep the other options as their default. Click **OK** to run the tool.



Your output should now only show areas that are in areas of 10 degrees or less of slope, not within an old growth stand, larger than 100 sq meters, and are not within 30 meters of a road. You can use a similar process in the Erase tool to further eliminate water bodies and other polygon areas specified by

the project parameters that you may want to exclude from the final shapefile product. We are now ready to work with the shapefile and choose potential landing zones.

Part 4: Point Placement (Option 1)

There are many options for pinpointing desired areas for landing zones. In this next step, we will discuss two of those options, both of which have their own benefits and drawbacks. The first, Point Placement, is beneficial for giving the user control to place a point within an area, with the drawback being there are no statistics directly associated with that point. The second option is Select by Polygon, which allows for statistics to be associated with Landing Zone choice, but the location isn't as specific as Point Placement.

A. Create a new layer

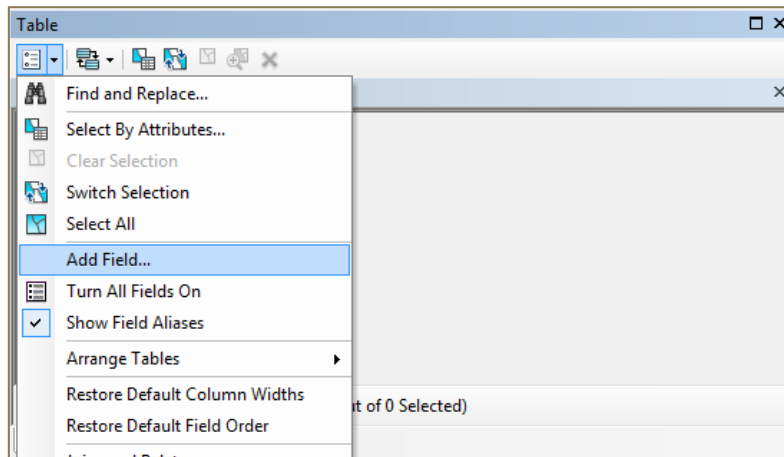
1. Within ArcMap, open ArcCatalog.



2. Navigate to your Data folder for this exercise and right-click, select **New** and then **Shapefile...** from the dropdown menu.
3. Name the layer **Ideal_Zones_Points**.
4. Set **Feature Type** to **Point**
5. Click **Edit** in the Spatial Reference section. .
6. In the Spatial Reference Properties window, click the Add Coordinate System button towards the top right of the window and then select **import**.
7. Next, navigate to the location of any of your exercise data (e.g., DEM.tif), select a file and click **Add**. Notice that **NAD_1983_Oregon_Washington_Albers** is added to the Spatial Reference Properties window. Select that coordinate system and click **OK**.
8. Leave all other options in the Create New Shapefile window unchecked and click **OK**.

B. Project layer and add points

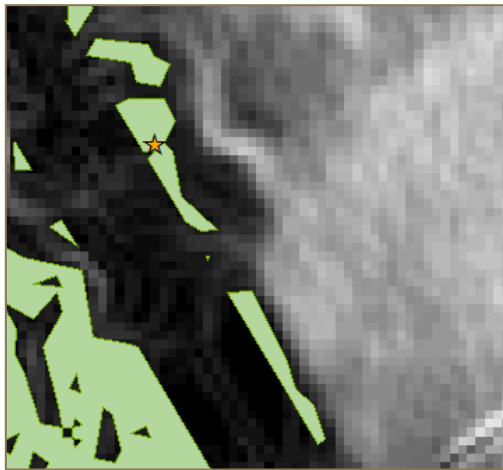
1. Before we begin editing, we will add a "Notes" attribute to the points shapefile so the user can enter any additional information pertaining to a placed point.
2. Right-click on **Ideal_Zones_Point** table in the Table of Contents and select **Open Attribute Table** from the dropdown menu.
3. Click **Table Options** and then **Add Field**.



4. For **Name**, type **Notes**.
5. For **Type** select **Text**.
6. In **Field Properties** next to **Length**, enter **200**. This is the amount of characters you can add to that particular field. If needed, you can increase that number. Click **OK**.
7. Next, we will start adding features. Right-click on the **Ideal_Zones_Point** layer and select **Edit Features, Start Editing** from the dropdown menu.
8. Click the **Create Features** button in the **Editor** toolbar.



9. There will be a default point type that has already been created, but the user can change this by double-clicking on the symbol of the point layer in the Table of Contents.
10. Make sure your **Ideal_Landing_Zones** layer is turned on and that there is a reference layer on as well. The **Slope_5m** layer we've already created is a good reference, but if the user has imagery they would like to use, add it to the map now.
11. Navigate to an area of interest for a landing zone, using the **Ideal_Landing_Zones** as a reference.
12. In the **Create Features** box, select your point template. You will see as you move over the map window that your mouse is "hollow" and there is a point attached to it. Click to "drop" that point on your area of interest.



13. If you would like to add additional information about this point, right-click on **Ideal_Zones_Point** in the Table of Contents and select **Open Attribute Table** from the dropdown menu. Add any notes or other information.
14. From the **Editor** toolbar, click **Edit, Save Edits**.
15. Continue panning around and adding points.
16. Once you have placed enough points, click **Editor** and **Save Edits**.
17. Next, click **Editor** and then **Stop Editing** to end the edit session.

This concludes the basics on how to add points to a user-created point file. This process is good for outlining general areas of interest for landing zones and can be useful for visual representations of location-based landing zones. The next option will provide instructions on how to create a layer that has information associated with the selection.

Part 5: Polygon Selection (Option 2)

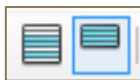
A. Create attributes

1. Similar to the process followed above, we first need to create a way to differentiate between areas that the user selects for a landing zone and the rest of the data. One of the ways to do this is by creating a user-defined attribute in the layer.
2. Right-click on **Ideal_Landing_Zones** in the Table of Contents.
3. Select **Open Attribute Table** from the dropdown menu.
4. From **Table Options**, click **Add Field**.
5. Name the field **Selection**.
6. For **Type** select **Text**.
7. Leave the Field Properties as default.
8. Click **OK**.

B. Start selecting and editing features



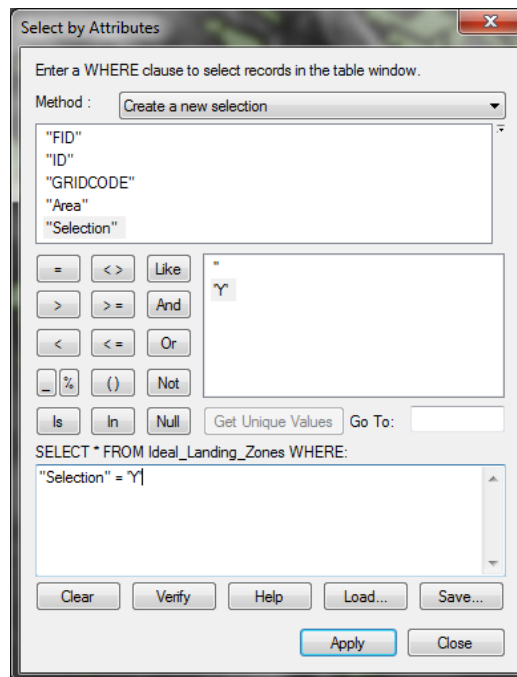
1. Right-click on **Ideal_Landing_Zones** in the table of contents and select **Edit Features** and then **Start Editing** from the dropdown menu.
2. Again, right-click **Ideal_Landing_Zones** and choose **Selection** and then **Make This The Only Selectable Layer**.
3. Again, right-click **Ideal_Landing_Zones** and click **Open Attribute Table**. This will be open during the whole selection process, so find a spot on the screen for the table that will not obstruct your view of the map.
4. With the Editor mouse selected, click on a polygon that you would like to choose for a landing zone. (If not already in an area that is ideal, use the Pan tool to navigate around your layer).
5. With a polygon selected, navigate to the open attribute table and click the Sort by Selected tool.



6. Within the Attributes for your selected polygon, enter **Y** in the **Selection** field.
7. Click **Editor** and then **Save Edits**.
8. Continue this process for as many sites as needed. Remember to periodically save your edits.
9. Once you have selected your sites, click **Editor** and then **Stop Editing**.
10. Within the attributes, click the **Select by Attributes** button.



11. Double-Click **"Selection"** to add it to the dialog box.
12. Click or type **"="** to add it to the dialog.
13. Click **Get Unique Values** to add the attribute table's values to the selectable options.
14. From that list, double-click **'Y'** to add it to the dialog. See below for help.



15. Click **Apply** and then **Close**.
16. All polygons that the user attributed as **Y** should now show as selected in both the attribute table and in the data window.
17. We will now export the selected data to its own layer by right-clicking on **Ideal_Landing_Zones** in the Table of Contents.
18. From the dropdown menu highlight **Data** and then select **Export Data...**
19. For **Export** ensure **Selected Features** is selected.
20. Select **this layer's source data** for the coordinate system.
21. For **Output feature class** navigate to your data folder and name the file **Ideal_Zones_Poly.shp**
22. Click **OK**.
23. Click **Yes** when asked to add the data to map as layer.

Note: Your newly exported layer should include all of the polygons that you attributed as Y. Also note that in the attribute table for this new layer, each polygon has the original associated area data. If desired, you can take the exported polygon layer and generate the suite of statistics using the methodology outlined in exercise 4.

The downside of this method is that although these landing zones meet all the basic criteria, they may be way too big to work with. In those cases, it may be best to use repeat the steps in Part 4-A of this exercise to create a polygon shapefile that you can manually place in a potential landing zone that will be more suitable in terms of size and shape.



Congratulations! You have successfully completed this exercise. You now have a visual and statistical layer of potential landing zones. The layers you created can be used in further processing and for map products if you wish. You should now know how to create and execute processes related to finding ideal landing zones, and should have the skills to include new parameters in your workflow.

