Using a Lidar LAS Dataset to Create a Bare Earth Raster

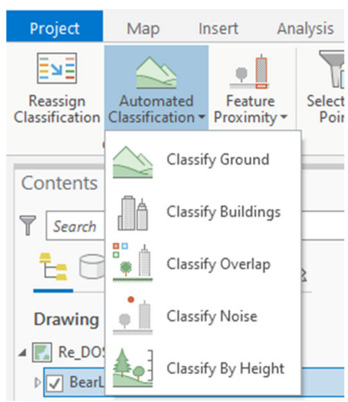
To complete this workflow, you will need LAS files which have been imported into ArcGIS as an LAS dataset (LASD).

Begin by checking the statistics for the LASD. Use the space below to record the number and percentage of points classified as ground returns (HINT: view this by opening the LASD properties from the **Catalog pane**).

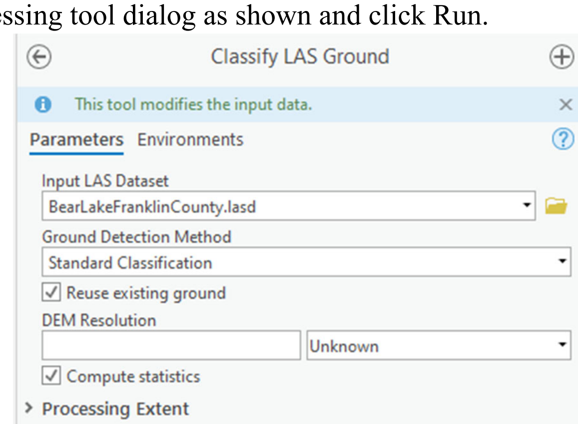
Project Name:	Number of returns	Percent of returns
Original		
After automated classification		

We frequently see less than 30% of points classified as ground returns. To improve this, we will use Esri's Automated Ground Classification tool. If the LAS dataset already has 50% or more ground returns, skip the re-classification step.

1. Select the LASD from the **Contents pane**
2. From the LAS Dataset section, click the Classification menu
3. From the Classification ribbon, click AUTOMATED CLASSIFICATION—CLASSIFY GROUND



4. Complete the Geoprocessing tool dialog as shown and click Run.



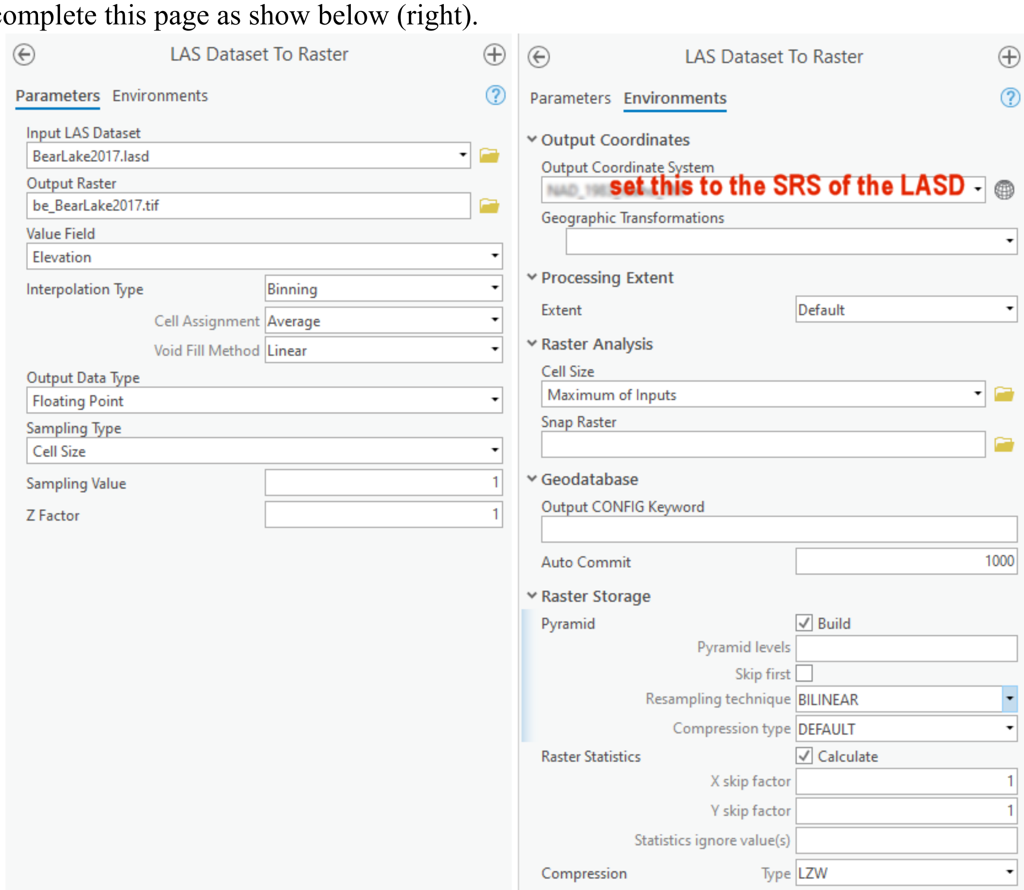
5. Check the number and percent of ground returns once processing has completed.

Next, we need to convert the LASD to a raster surface layer.

1. Select the LASD from the Contents pane.
2. From the LAS Dataset Layer section, click the Appearance menu

3. From the Appearance ribbon, click LAS points drop-down menu (see the Filters section)
4. Choose Ground.
5. From the Contents pane, open the LASD properties page.
6. Open the Surface Constraints section.
7. Turn off the Breaklines. The breaklines are still part of the LASD but will not constrain our output to the extent of the breaklines.
8. Click the Data menu of the LAS Dataset section.
9. From the Data ribbon, click Export (HINT: this button is found on the left side of the ribbon).
10. Choose Raster.

11. Complete the LAS Dataset to Raster geoprocessing Parameters tool as shown below (left). Be sure to set the cell size sampling value to 1 (one). In addition, open the Environments tab and complete this page as show below (right).



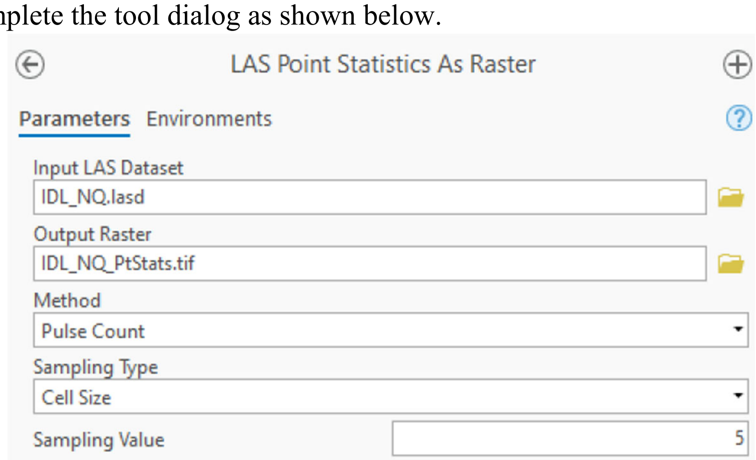
12. Click Run.

Most lidar projects do not conform to a nice rectangular shape like the standard 7.5' topographic quadrangle series maps but instead reflect the shape of study area, a county, or a national forest. Raster layers however are always rectangular and so we can expect some irrelevant data to be created when we generate a raster layer from our LAS dataset. As a result, we need to clip the raster layer to the extent of the real lidar data. The output raster layer will still be rectangular in shape but those pixels that were not derived from actual lidar data will be reclassified to `NoData` instead of containing interpolated and misleading data values.

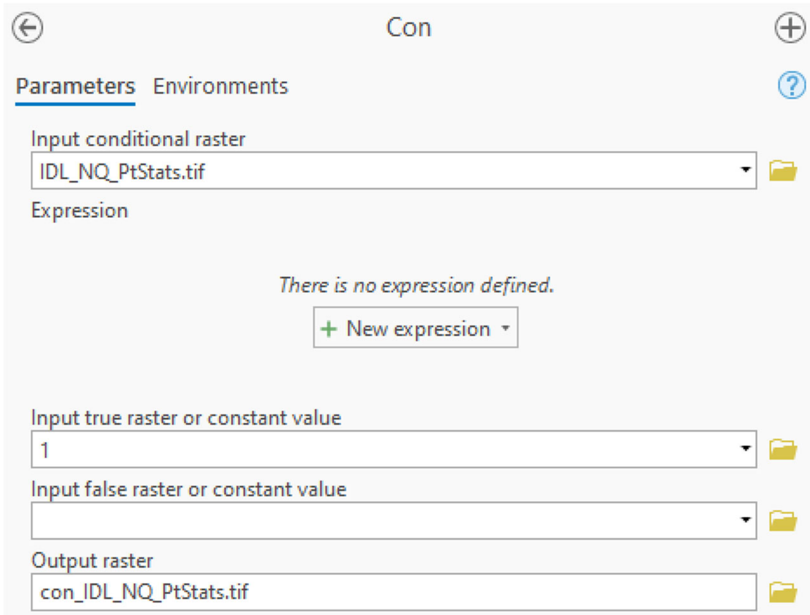
> I have created a python script that automates steps 13-18. You can use the `LAS to Data Area Polygon with Variables.py`. You should be aware of what this script is doing however, so be sure to read through the process or run it manually once.

We will begin by delineating the real Data area from lidar points. Before proceeding, look up the point spacing of the lidar data (also called the nominal point spacing (NPS)) and follow these steps to delineate the data area (HINT: to find the NPS open the properties of the LAS dataset from the Catalog pane and see the LAS files section. Point spacing is shown for each tile).

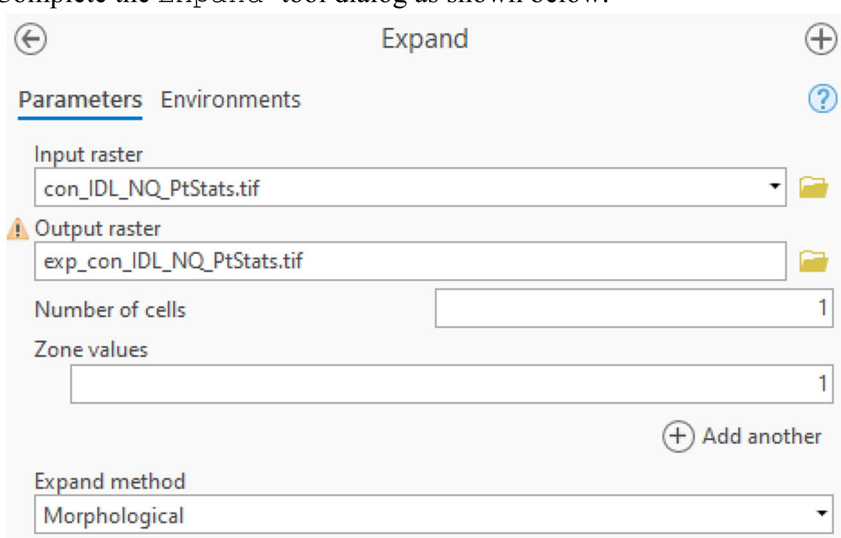
13. Rasterize the lidar points using the `LAS Point Statistics As Raster` geoprocessing tool.
    a. Specify a value for CELLSIZE that is several times larger than the average point spacing of the lidar data. A good place to start is four times the nominal point spacing and a value of 2-5 tends to work well.
    b. Complete the tool dialog as shown below.



14. Assign one value to all <u>data</u> cells using the `CON` geoprocessing tool.
    a. Using the Con geoprocessing tool in this workflow simply turns all pixels containing data into pixels with a single value (1). In this step, we will take the output from the previous LAS Point Statistics as Raster tool and provide a constant value for a positive expression. All non-zero pixel values will be considered a positive expression and assigned the constant value. Since PULSE_COUNT was used as the cell assignment method, any pixel with a lidar point return in it must have a value greater than zero, i.e. a positive value.
    b. Complete the dialog as show in the figure below.

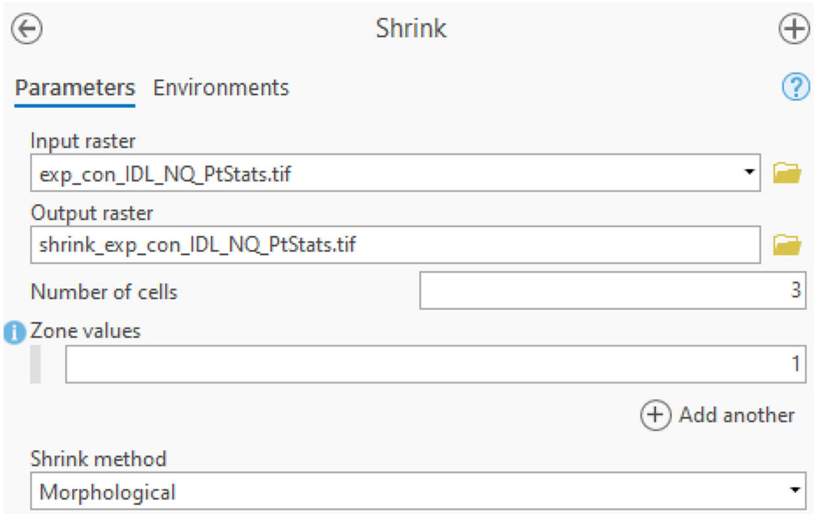


15. Next, we need to fill small `NoData` areas using the `Expand` geoprocessing tool. Most of these errors can be eliminated using the Expand tool. You want to remove or fill these pixels so the subsequent polygon produced during vectorization does not contain holes.
    a. Complete the `Expand` tool dialog as shown below.

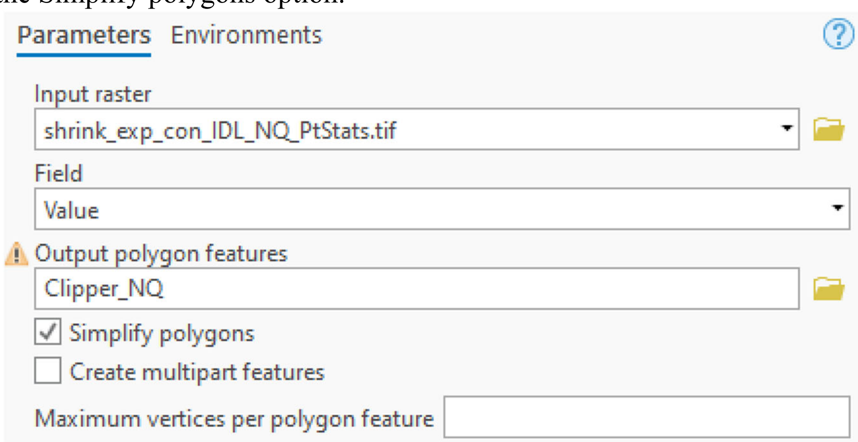


The Expand tool sees the pixels on the edge of the raster layer as empty and thus "pushes the zone of interest outward". To fix this by-product of the Expand process, we will now use the shrink tool.

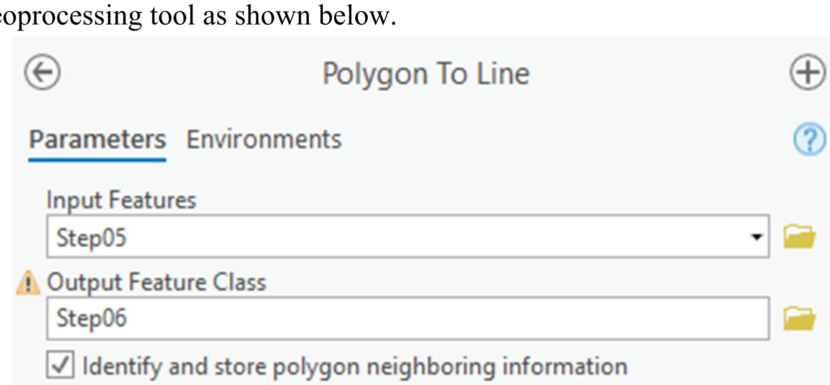
16. Reduce the overall extent of data pixels using the `Shrink` geoprocessing tool as shown in the figure below.



17. Vectorize the raster with the `Raster To Polygon` geoprocessing tool. Be sure to check or turn on the Simplify polygons option.

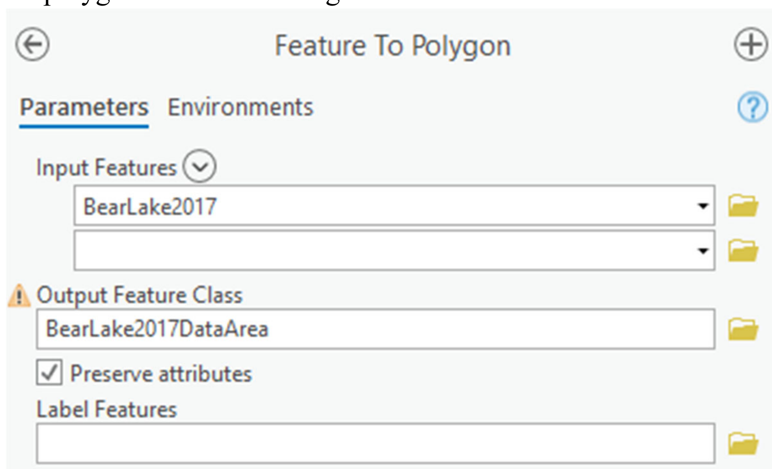


18. The `Raster To Polygon` tool creates a new polygon feature class. The result is representative of the data extent of the lidar point returns however it is likely you will see a number of interior polygons. To begin the process of creating a single, clean polygon, we will convert the polygon feature class into a line feature class. To do this, use the `Polygon to Line` geoprocessing tool as shown below.

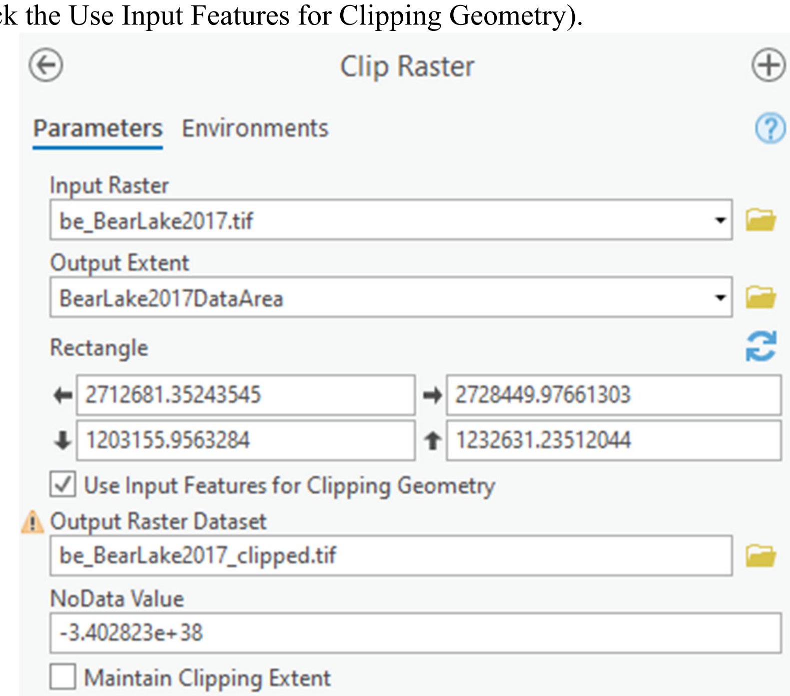


19. At this point, we are nearly done. To create a single, clean polygon you will need to manually edit the line feature class. Here are some tips to help you:
    a. First, I like to select the outermost perimeter line and save it to a new line feature class.
    b. Zoom into the new layer and pan around the perimeter looking for gaps along the perimeter. If you find some (this is likely), use the edit vertex tool to close these gaps.

20. With a good perimeter line, use the `Feature to Polygon` geoprocessing tool to convert this layer back into a polygon. Refer to the figure below as needed.

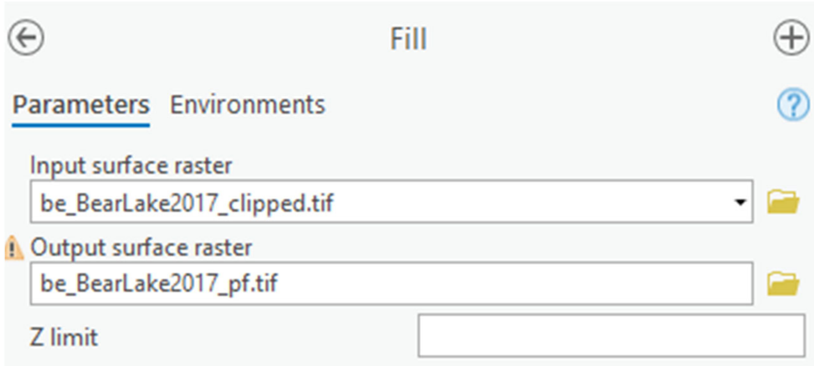


21. Use this polygon layer like a cookie cutter to clip the bare earth raster layer created in step 12 above. To do this, use the `Clip Raster` geoprocessing tool as shown below (be sure to turn on or check the Use Input Features for Clipping Geometry).



22. The final step in this process is to pit fill this output raster layer created in the previous step. To do this, use the `Fill` geoprocessing tool as shown below. Notice the naming protocol used for

the final and completed layer adds a "`pf`" suffix to the file name (NOTE: if the be layer has more than one part, use the following naming standard `be_BearLake2017pf_01.tif`)



23. A new bare earth layer has been created and is ready to be added into the Idaho Lidar Image Service. Let Keith know the process is completed along with the name and path to these new data.

END