



USING LIDAR TO EXAMINE A CIVIL WAR EARTHWORK

Colonial National Historical Park, Virginia

Abstract

The purpose of this exercise is to demonstrate the value of LIDAR data in finding historical constructed artifacts. The exercise will guide the user through the process of acquiring LIDAR data, processing it for use in ArcGIS and adding additional layers to demonstrate the value of the data in finding a Civil War era earthen canon fortification called a redoubt. The DEM used is derived from the LIDAR data and ArcGIS will recreate a similar product with the LIDAR being converted to a TIN first and then to other products.

Authors:

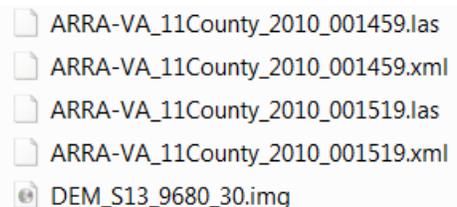
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Using LiDAR to examine a Civil War Earthwork

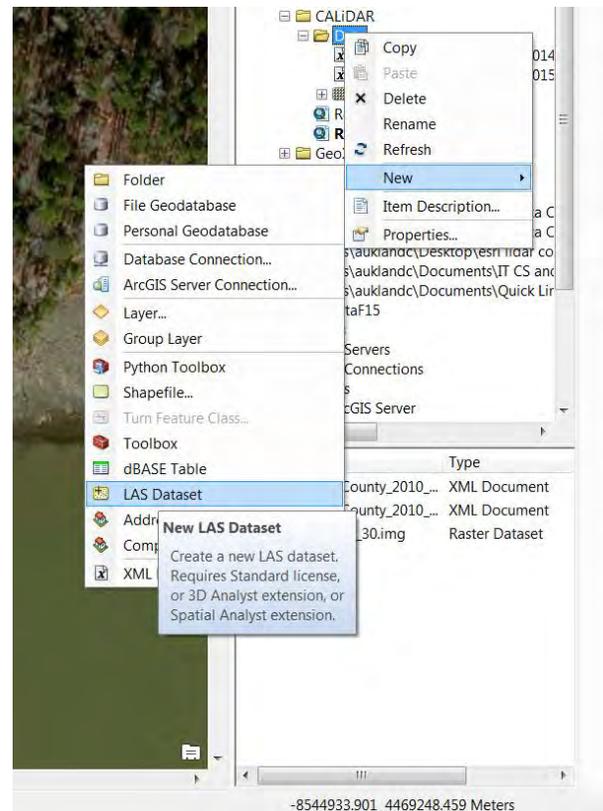
1. Download the **LiDARExercise.zip** file to your desktop or other drive and unzip it. You may want to make a folder connection to the location of this folder.
2. Inside the **LiDARExercise** folder is a **Data** folder where I have already downloaded the data you need for this exercise. Downloading LiDAR data can be time consuming and complex to understand.
3. Open the **Redoubt.mxd** map document inside the folder. The map document has a basemap and several bookmarks that we will use to orient you.
4. Familiarize yourself with the study area. Go to each of the bookmarks and look around, review where you are in Virginia.
 - a. Go to Bookmarks, Select Virginia,
 - b. then select Jamestown Island, on the James River in eastern Virginia near Williamsburg and Yorktown,
 - c. finally select the Redoubt Bookmark, which zooms you in to the location of the Earthwork.
5. We would like to view this area in 3D to be able to see the Civil War Earthwork that is below the trees in the image. But we cannot see through the trees in imagery, even this leaf off imagery. Try to zoom in and see if you can recognize the perfect square that makes up the earthwork. Bet you can't! But we will 😊
6. There is plenty of data online that we can use to accomplish this. In this exercise I have downloaded the data for you, but you can download it yourself if you are completing this exercise using your own data from the National Map at : <http://viewer.nationalmap.gov/basic/#startUp> Our data consists of five files:

Two pairs of files that define the LiDAR point cloud data and metadata and one file that is a Digital Elevation Model (that we can create ourselves using the LiDAR point cloud, but that is another class). These files are in the Data folder that you were provided.

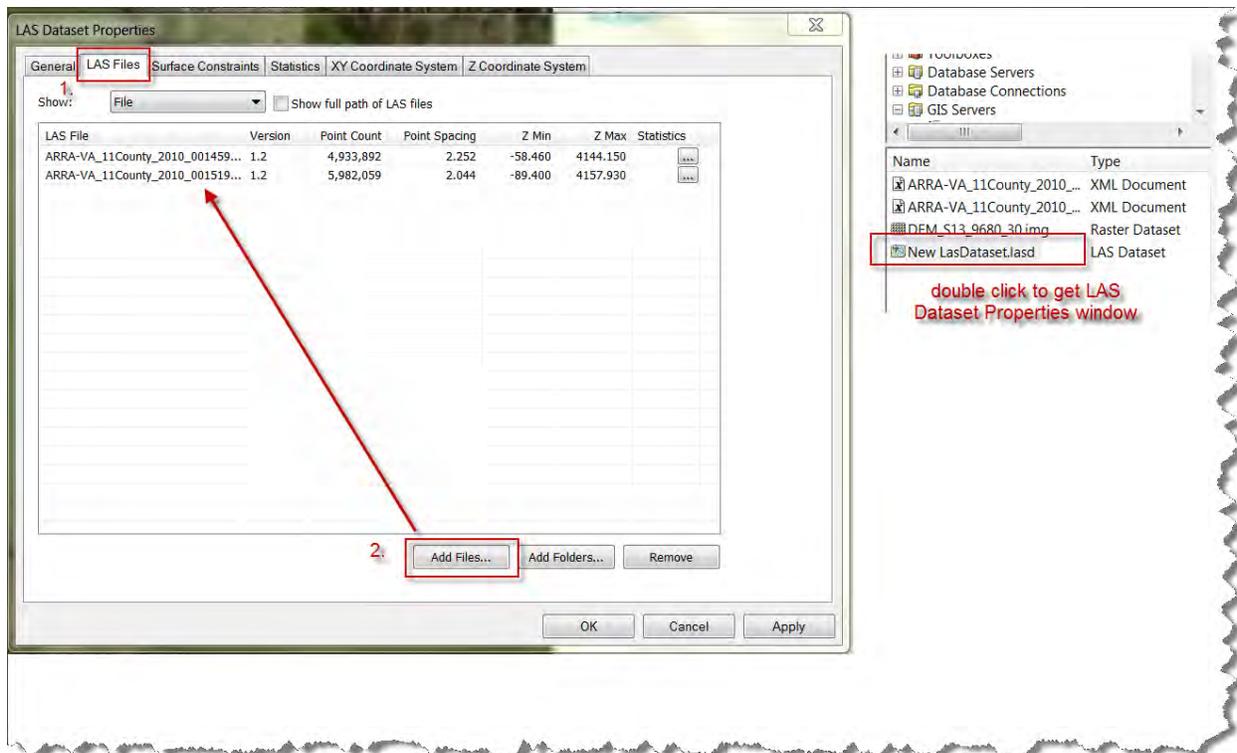


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7. Let's begin! To view the LiDAR point cloud in ArcMap we have to create what is known as a LAS dataset. It combines the LiDAR data files we downloaded into a useable form for ArcGIS. In ArcCatalog...right click the Data folder and add a LAS Dataset. Name it **Redoubt**.

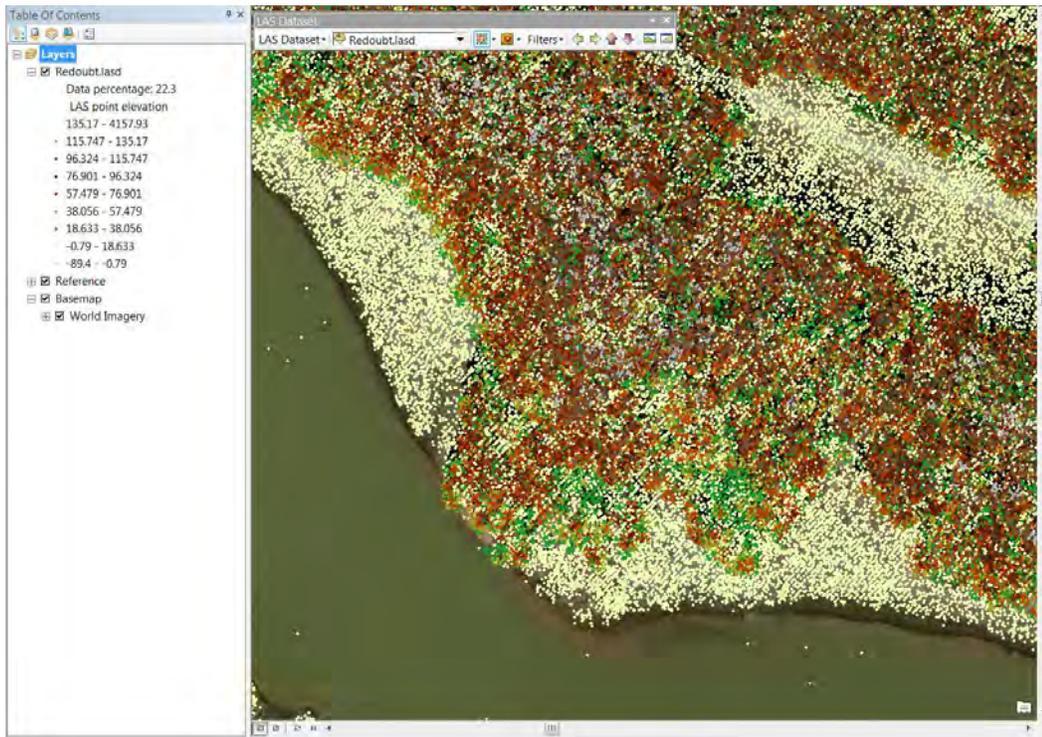


8. Double click on Redoubt.lasd, select the LAS Files tab and Add Files button to navigate to the location of the file and add the file to the dataset.

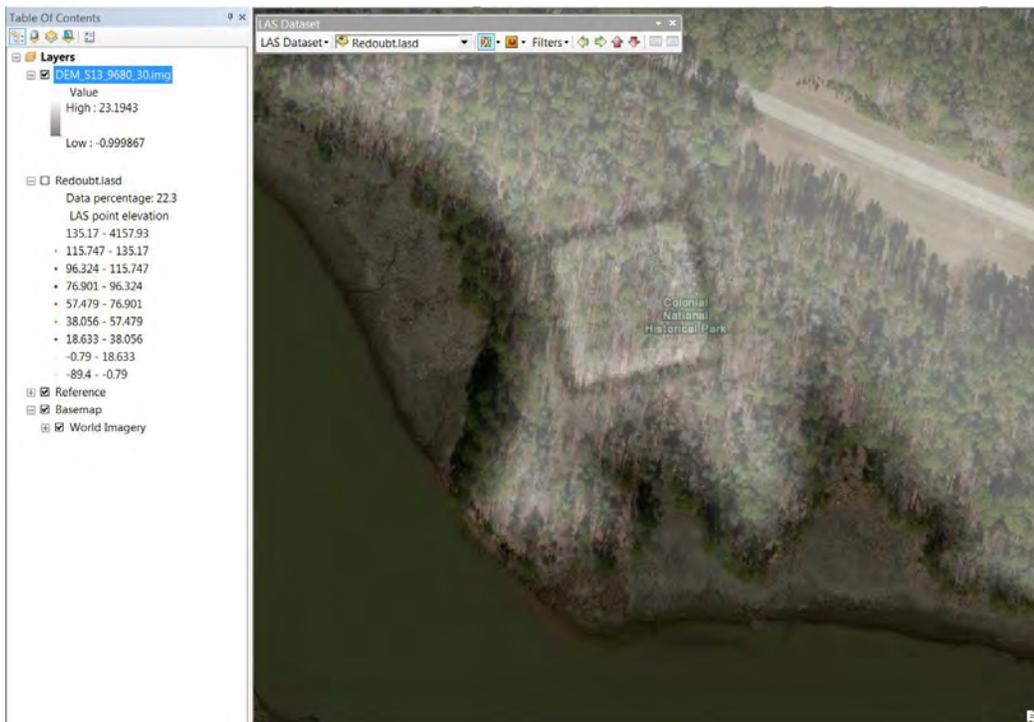


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9. Drag the Redoubt.lasd file to your Table of Contents You will see the point cloud that is symbolized by elevation:



10. Now add the DEM image and it is easy to see the location of the redoubt. Change the transparency of the DEM and turn off the point cloud. You will be able to see where the earthwork is in relationship to the trees!



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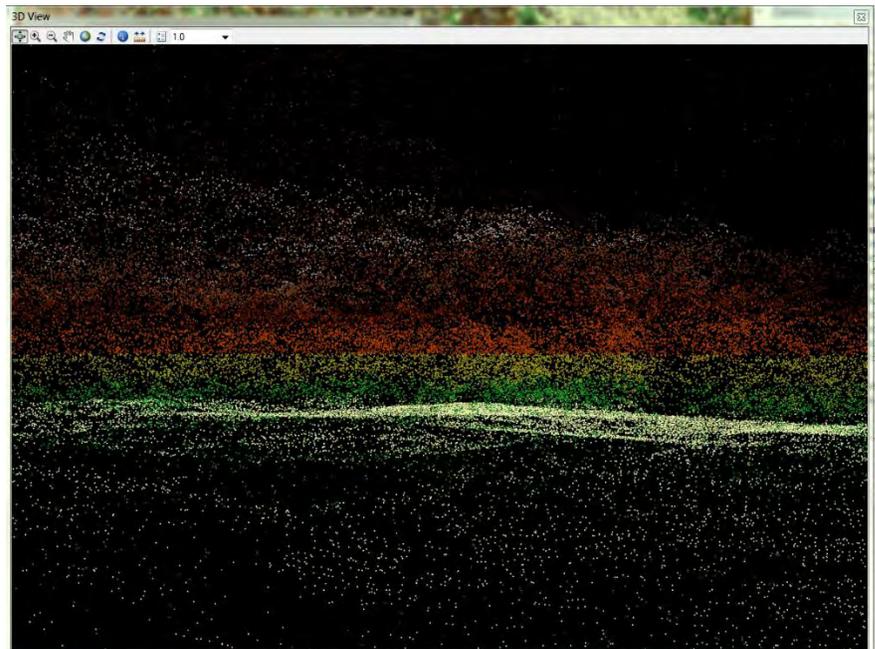
11. Now let's add some tools so we can manipulate the LiDAR point cloud. Under **Customize...Toolbars** select **...LAS Dataset**. Make sure the **3D Analyst** and **Spatial Analyst** in the **Extensions** area are also selected. Turn off the visibility of the DEM and select the Earthwork Bookmark.
12. Your LAS Dataset toolbar should look like this:



The first button of the LAS Dataset Toolbar can be used to show the classification of the data points. The density of point display and value of classifications can also be controlled under the layer properties.

Examine the contents of the drop down buttons to the right of the filename. Each of these are quick views of the LiDAR data.

13. Let's take a closer look at our point cloud. Select the **Elevation** in the first button dropdown, **All** under **Filters** and click the last button to open a 3D window. This shows all of the points in the point cloud as shown to the right. You can change the filter to show only the ground points to remove the trees from the view and see only the terrain. Try them!



14. We can also see a profile view of the point cloud more easily by selecting **Elevation** on the first button (circled). **Ground** for Filters and select the circled **Profile View** button.



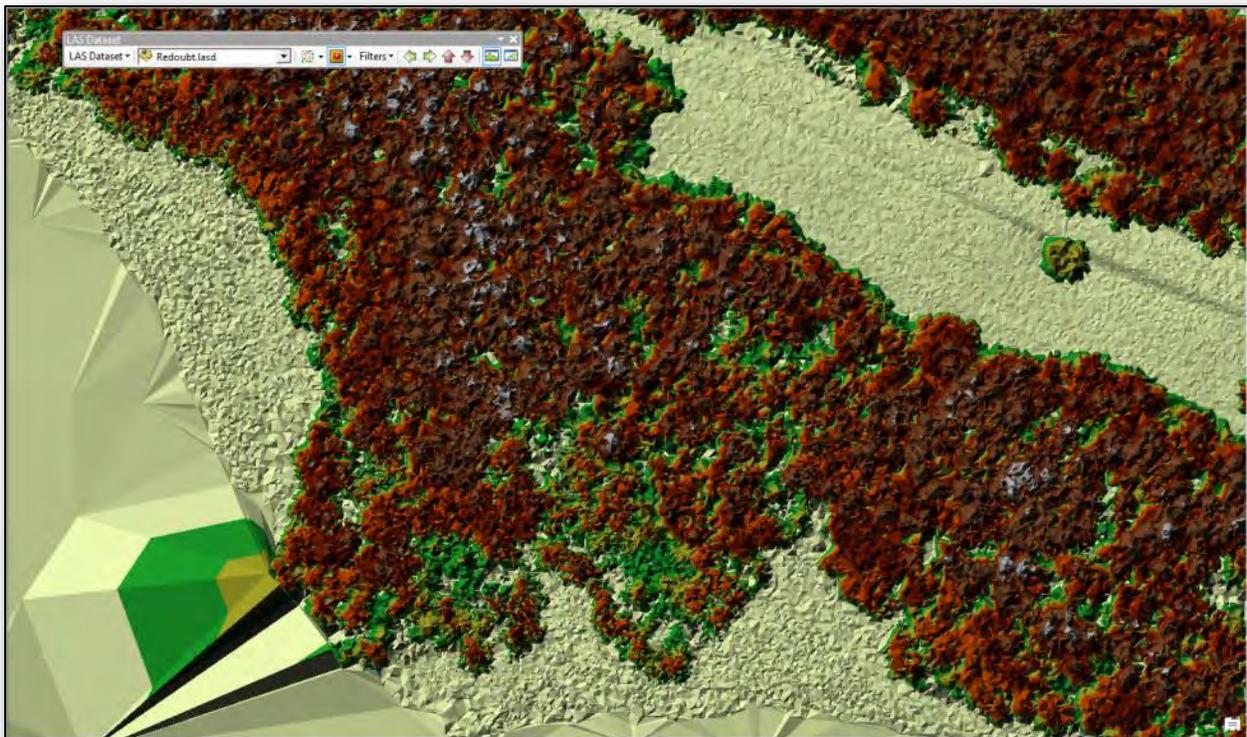
Nothing happens until you select three points. The first two points are the start and end and the third indicates the width of the view. Turn on the DEM layer to help select the start end and width as shown.

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Repeat several times with different widths for the third point. Change the filter to All and repeat to see the trees present.

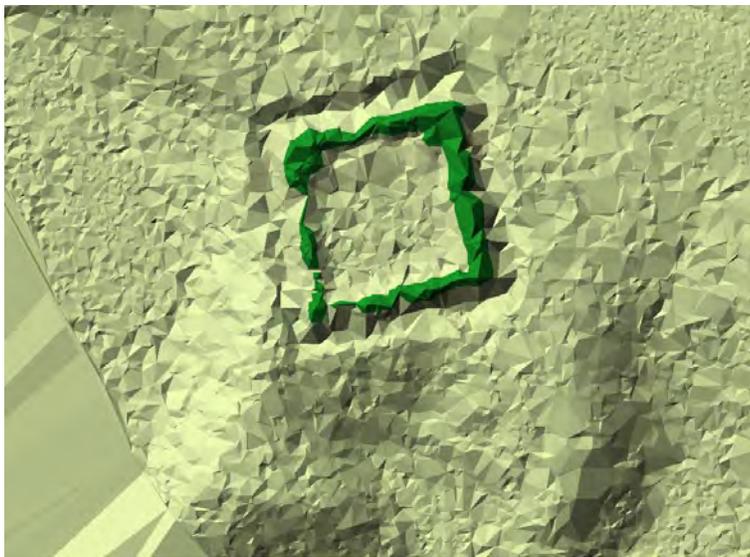
15. Now, let's look at a quick view of a digital elevation, change second button to **Elevation** and the **Filters** to **first return** and see the how well the trees and vegetation match the Basemap.



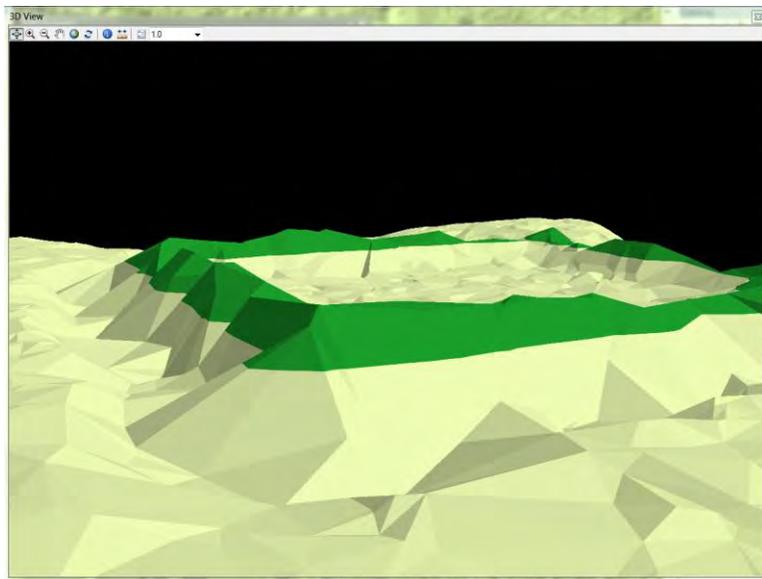
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16. Finally, let's look at a terrain by filtering out all but the ground returns from the LiDAR so we don't get trees in the way of our view of the ground.

Select the **Elevation** in the second button dropdown, **Ground** under Filters (here is where you are taking out all of the points that are above ground level and the earthwork really jumps out-it is not obscured by all of the trees covering it which is why you cannot see it in the imagery). Can you see the Earthwork now?



And let's try 3D, by clicking on the last button. Zoom in and out and turn the model. Note how tall the walls of the earthwork are (see the legend)! You can get an idea of how this looks in real life.



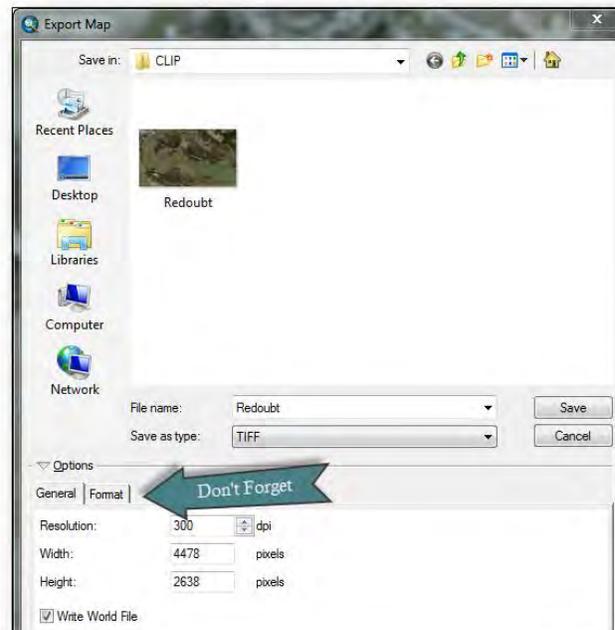
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And for reference, here is photo of this area from the ground (it was a rainy day!). You can see how well the software filters out the ground data-the area is covered with huge trees:



17. We have seen a model of the terrain but wouldn't it be cool to view the imagery in 3D over the earthwork? We can do that using ArcScene (you have it in the ArcGIS folder, it came with ArcGIS). We will drape the flatland imagery over the Digital Elevation model! Let's get started.

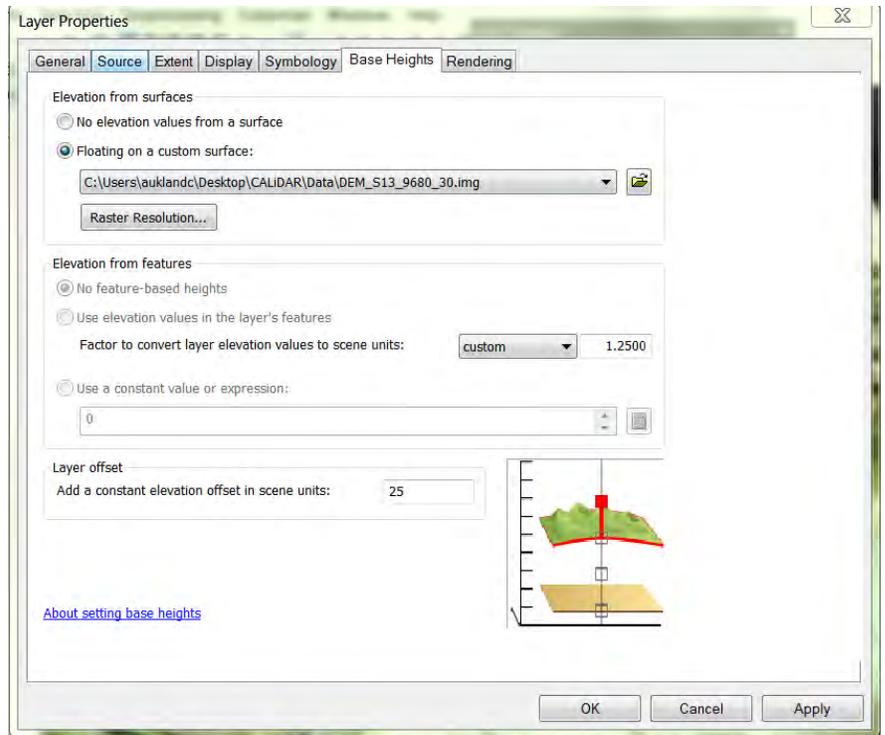
18. We will need the imagery where the Earthwork is. Close the 3D View window and Zoom to the Earthwork bookmark. Go to FILE..EXPORT MAP so that we can save a clip of the online Basemap image for use in ArcScene. Save as RedoubtBase.tiff in your Data folder. Make sure the format is TIFF, write a World File, increase the resolution to 300 dpi, and under the Format tab select Write GeoTIFF Tags and then save. See the screenshot and Note: This export can take a long while!



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19. Start ArcScene and add the DEM_S13_9680_30 and RedoubtBase tiff images.

Under the TIFF image properties set the following settings under the Base Height tab. Change the Factor values (I have 1.25) to exaggerate differences in display features. Select the DEM as height by choosing it for Floating on a custom surface and then add a 25 unit layer offset.



Now you can see the Earthwork “under the trees” 😊

