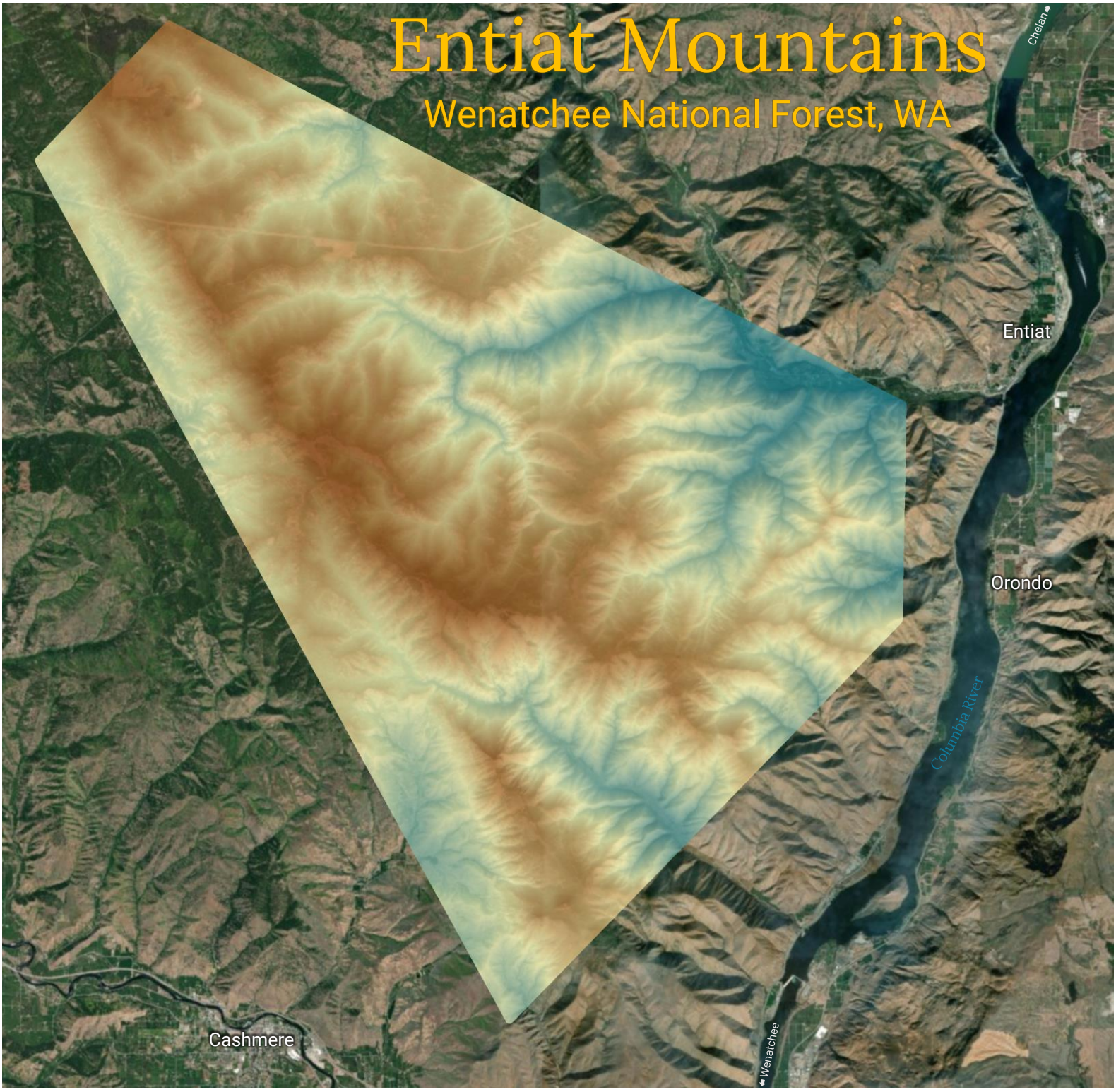
Entiat Mountains

Wenatchee National Forest, WA



LANDSLIDE SUSCEPTIBILITY
LiDAR
&
SLOPE ANALYSIS

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LANDSLIDE SUSCEPTIBILITY USING SLOPE ANALYSIS

The goal of this project was to identify landslide susceptibility for the Entiat Mountains located within the Wenatchee National Forest in Washington state. Landslide susceptibility is the spatial probability of landslide occurrence. Spatial probability for landslides can be calculated using LiDAR (Light Detection and Ranging) data to calculate the slope angle in order to identify percent change in elevation. The slope data is then combined with water flow & accumulation data, geological data, geomorphological data, and environmental data to get an accurate understanding of landslide susceptibility for a given area. Due to the time constraints of this project, only a slope percent analysis was performed for the given area.

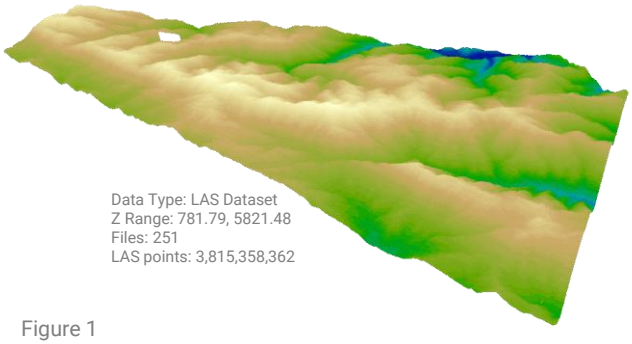

Figure 1

For this analysis, the Entiat Range was selected to analyze how safe the area is for general outdoor activities. 2013 Entiat Range LiDAR data was collected from the Puget Sound LiDAR Consortium. LiDAR is a remote sensing technology that uses pulses from a laser to profile the Earth's surface which can then be used to create 3D models. To make a finished profile of the area, 251 files were downloaded which contained a total of 3.8 billion LiDAR points (figure 1). The main challenge during the analysis can be attributed to file size and the potential for software to lag out while processing the data, causing the computer to crash. Due to the amount of LiDAR points, spatial resolution and accuracy were not a concern. The total download time for the 251 files was about 25 minutes. After the downloads were complete, the compressed LAZ files were converted to LAS files using the LAZ decompressor LASzip. Due to the magnitude of the files, the extraction time was around 35 minutes. While the decompression tool was working, the program became unresponsive until all of the LAZ files were unzipped.

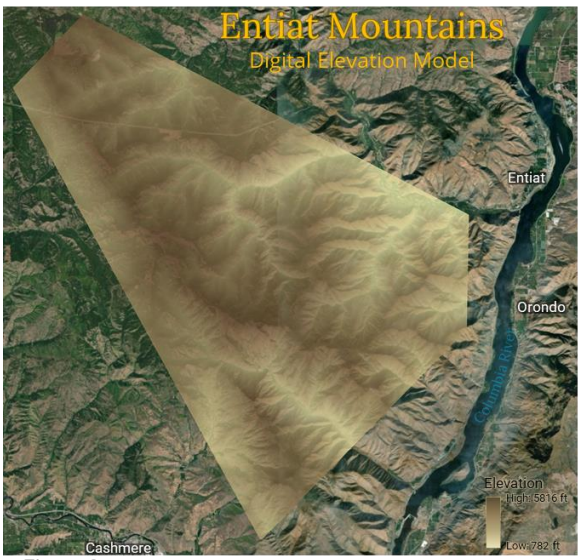

Figure 2

The 251 LAS files were then loaded into ArcScene where a LASDataset was created from them. The ground returns, or bare-earth, were used to create a Digital Elevation Model or DEM (figures 2 & 5). Another model, which used the first returns, called a DSM (digital surface model) was also generated (figure 3). Both models were produced by using the 'LAS Dataset to Raster' tool and filtering returns in theLASDataset. There is only a 6ft elevation variant between the DEM and DSM due to the lack of vegetation in Eastern Washington.

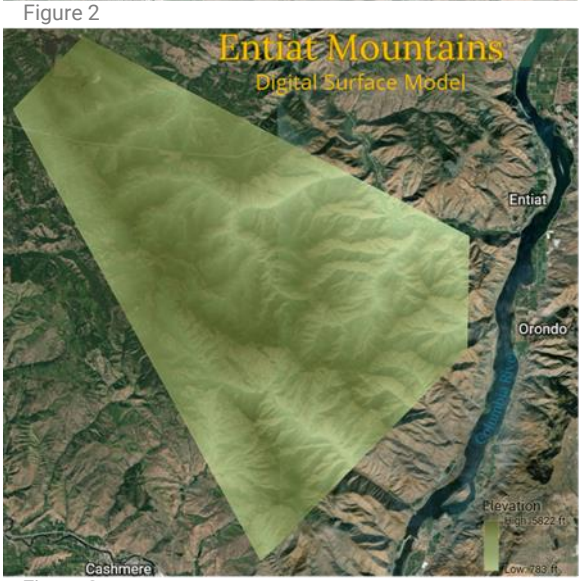

Figure 3

Utilizing the DEM, a slope analysis was performed in ArcMap using both the spatial analyst and 3D analyst slope toolsets. The results (figures 4 & 6) highlight areas where the slope is at the steepest angle in bright red. These areas have the highest chance for a landslide, while the areas in green have the lowest probability of a landslide.

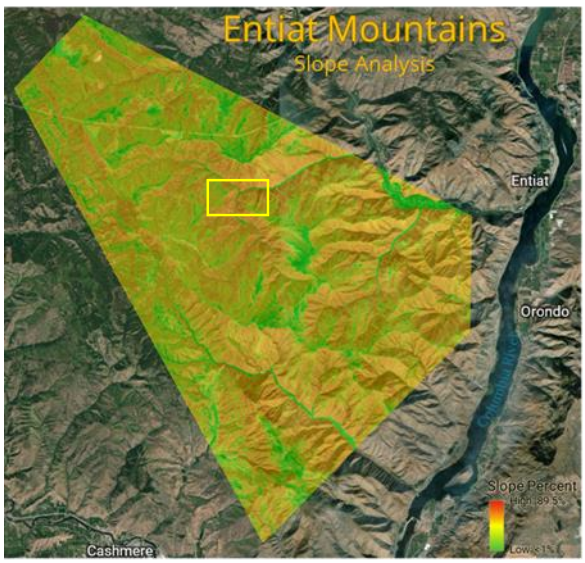

Figure 4: Supplemental Map area outlined in yellow

Further analysis could be performed to increase the accuracy of the landslide susceptibility assessment. Combining the slope analysis with water flow and in-depth geographic data would help refine landslide susceptibility in the Entiat Mountain Range.

Figure 1: LiDAR Points

Figure 2: Digital Elevation Model (DEM)

Figure 3: Digital Surface Model (DSM)

Figure 4: Slope Analysis

SUPPLEMENTAL MAPS

Enlarged DEM

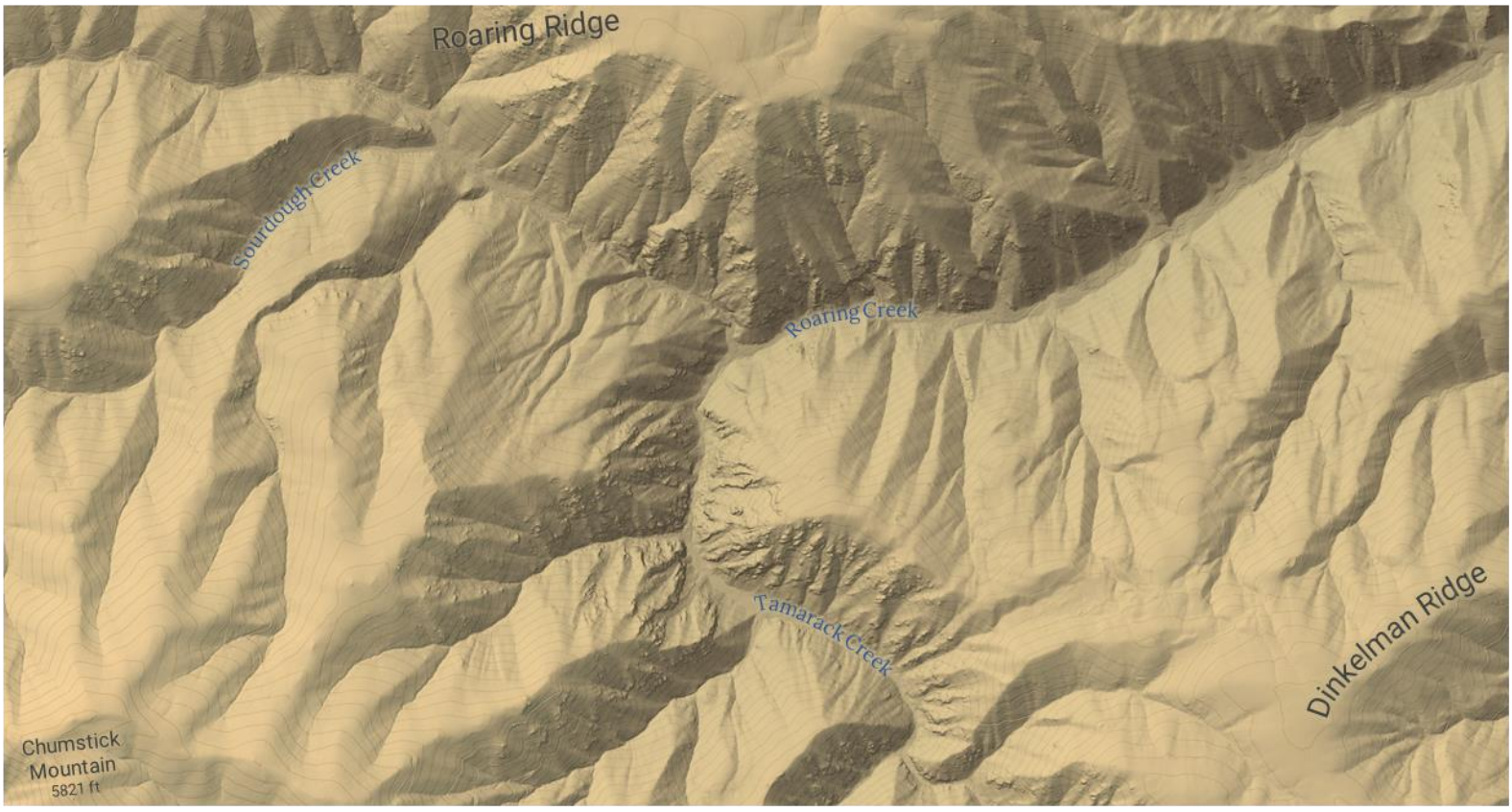

Figure 5: 100ft contour interval

Enlarged view of an area within the Entiat Range. DEM made from the bare-earth LiDAR returns.

Enlarged Slope Analysis

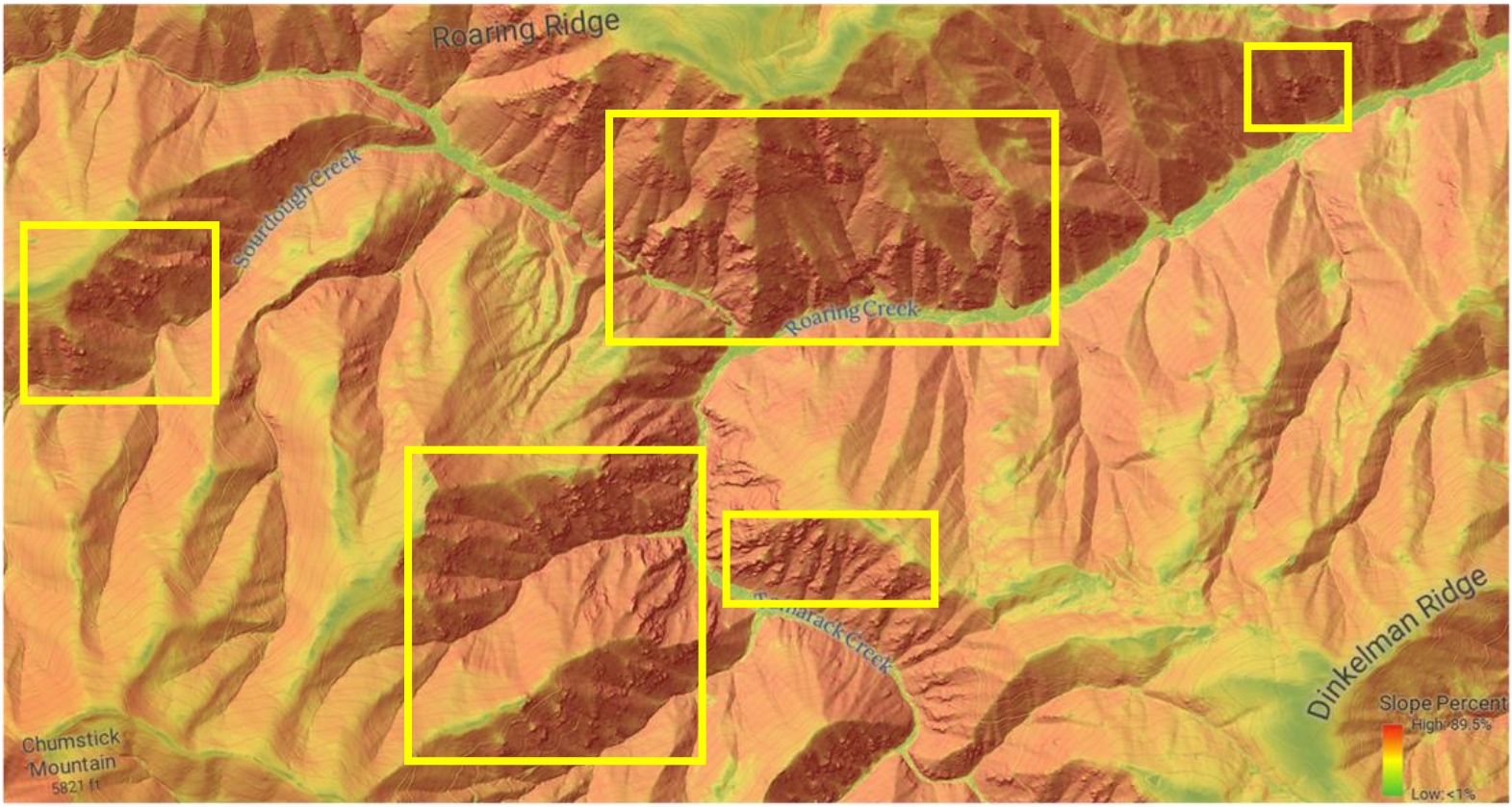

Figure 6: 100ft contour interval

Enlarged view of an area within the Entiat Range. Areas with high landslide susceptibility are outlined in yellow.