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Agriculture

Lesson 7

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Vineyard Site Suitability Analysis Conducted by Jeanette Shutay

Selecting an optimal site for a vineyard is a complex process that includes multiple datasets generated from GIS and GPS technologies, multiple data preparation steps, and the synthesis of data layers presented through data visualization (Mathews, 2013). The purpose of this project was to identify a suitable vineyard site based on several site requirements (King, Walrath, & Zeiders, 1999-2020) leveraging data obtained via GIS and GPS technologies. The site requirements were as follows:

- Not in a floodplain and no more than 100 meters from a stream
- Agriculture or undeveloped landuse type
- Slope orientation (aspect) between 112-337 degrees or flat land
- Average maximum wind speed of 25 mph or less
- Average minimum temperature greater than 35 degrees
- Soil depth between 31-72 inches
- Soil that has medium to high drainage (values of 1.5-3)

Data Preparation

The first step of the project was to acquire and upload the required data to a new ArcMap project, and ensure that the map units were set to meters and the display units were set to miles (King, Walrath, & Zeiders, 1999-2020). Next, the geoprocessing environment needed to be specified by selecting "same layer as elevation" in the processing extent category, and the cell size was set to 10 (King, Walrath, & Zeiders, 1999-2020). Once the geoprocessing environment was specified, a spatial operation known as a *dissolve* was conducted on the landuse polygon feature (King, Walrath, & Zeiders, 1999-2020). Finally, vector data was converted to a raster format (King, Walrath, & Zeiders, 1999-2020).

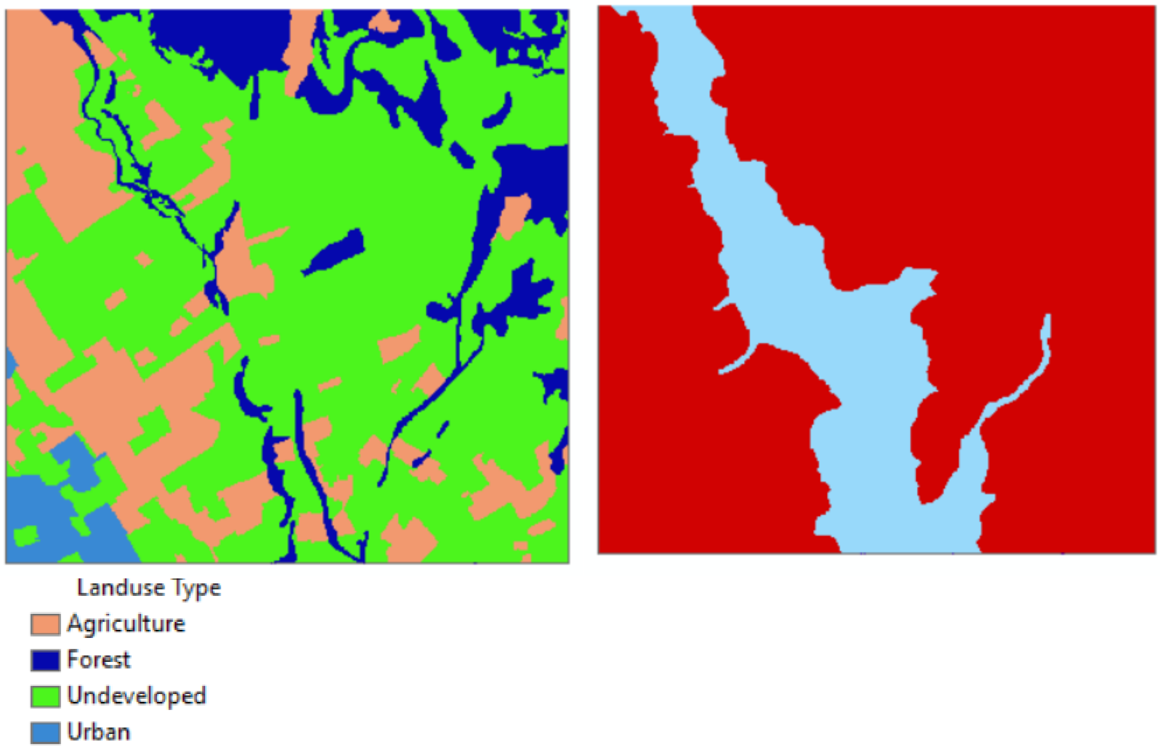


Figure 1. *Landuse raster map (left) and floodplain raster map (right) where red indicates the presence of a floodplain.*

Surface Operations

In this step of the analysis, two additional layers were created from the elevation raster data, which include hillshade and aspect layers (King, Walrath, & Zeiders, 1999-2020). Once the layers were created, the raster layers were interpolated from sample points to create a soil depth, soil drainage, minimum temperature, and maximum wind speed layer. Figure 2 contains the soil depth and soil drainage maps, and Figure 3 contains the minimum temperature and maximum wind speed maps.

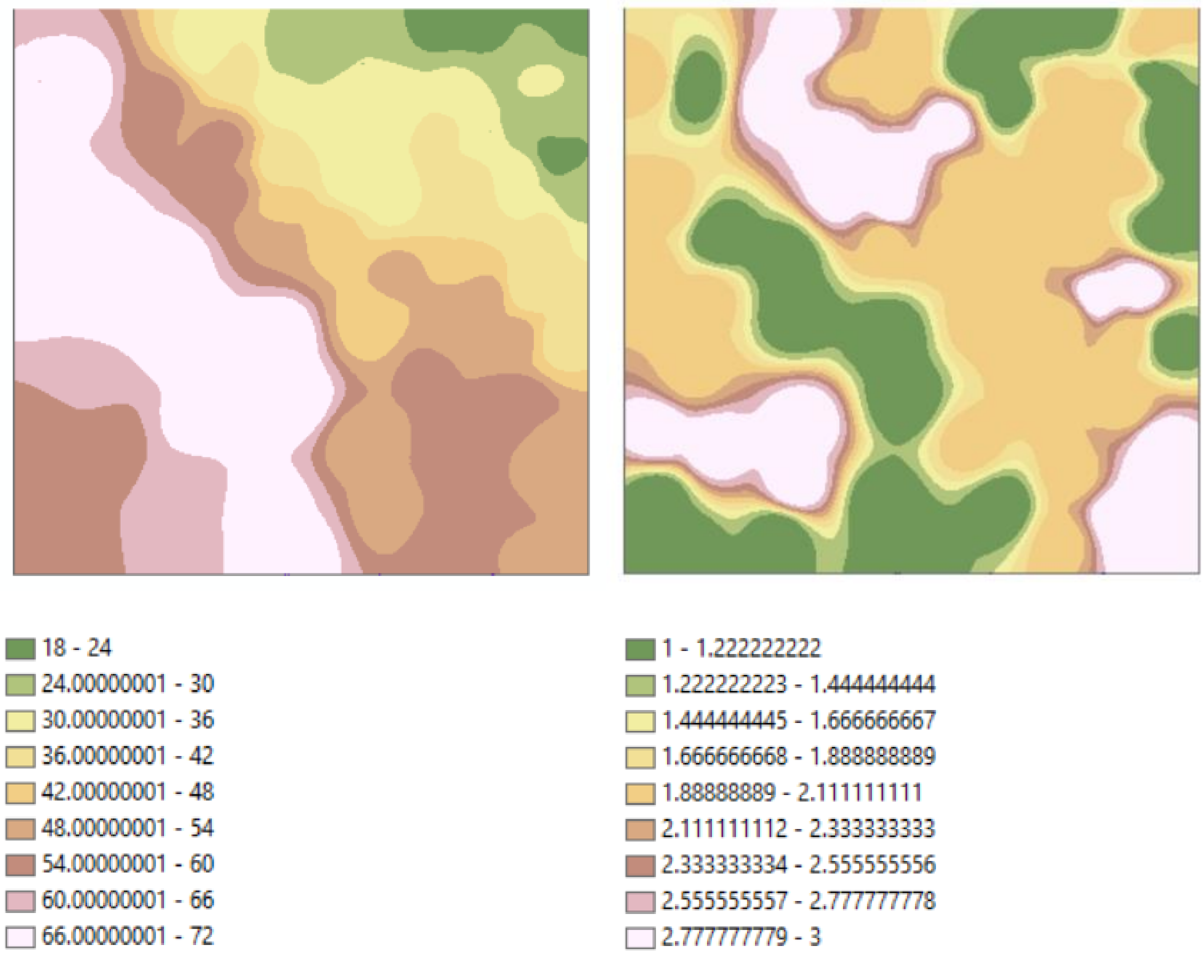
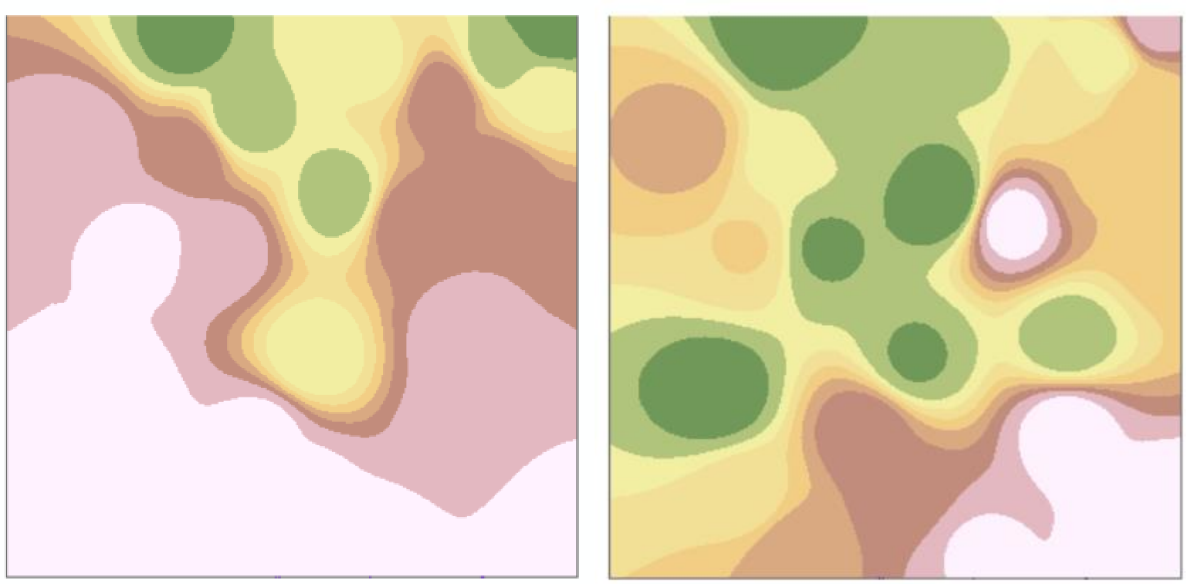


Figure 2. *Soil depth map (left) and soil drainage map (right).*



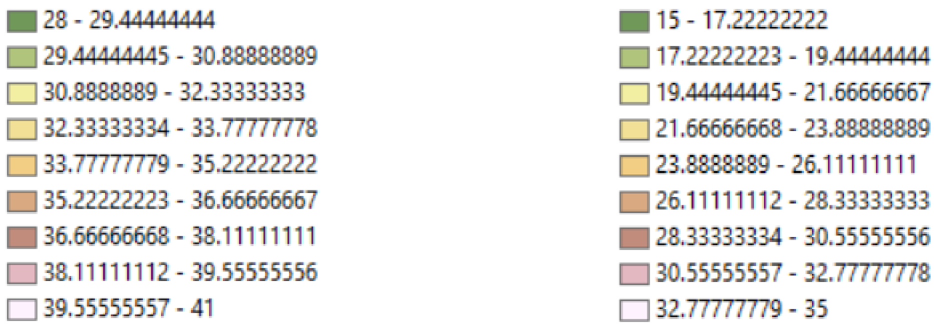


Figure 3. *Minimum temperature map (left) and maximum wind speed map (right).*

Buffering and Reclassifying Raster Data

The first step in this stage of the process was to insert a buffer around the hydro raster layer to create a new feature with the buffer (refer to Figure 4) and then reclassify the layer into a binary feature indicating whether or not the land is desirable (King, Walrath, & Zeiders, 1999-2020). In fact, all the layers were reclassified into a binary (desirable / undesirable) layer.

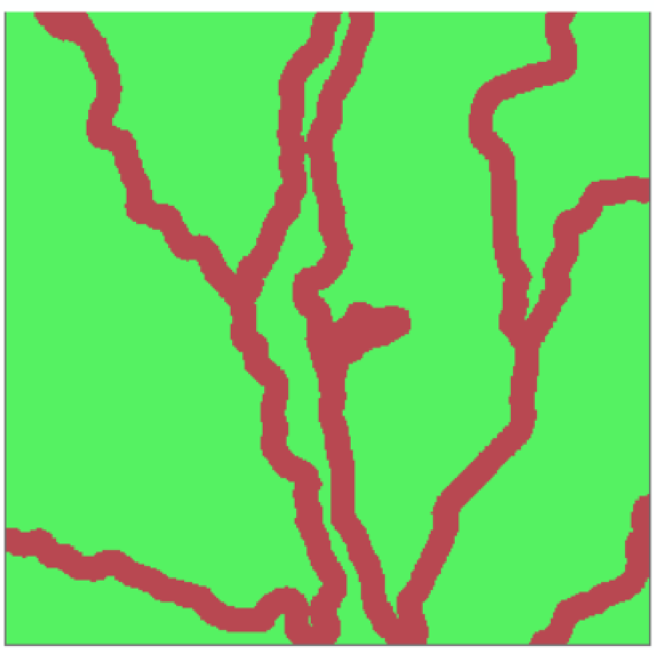


Figure 4. *Hydro raster with buffer map.*

The reclassification of the landuse raster layer is featured in Figure 5. Desirable attributes included agricultural and undeveloped landuse types (King, Walrath, & Zeiders, 1999-2020).

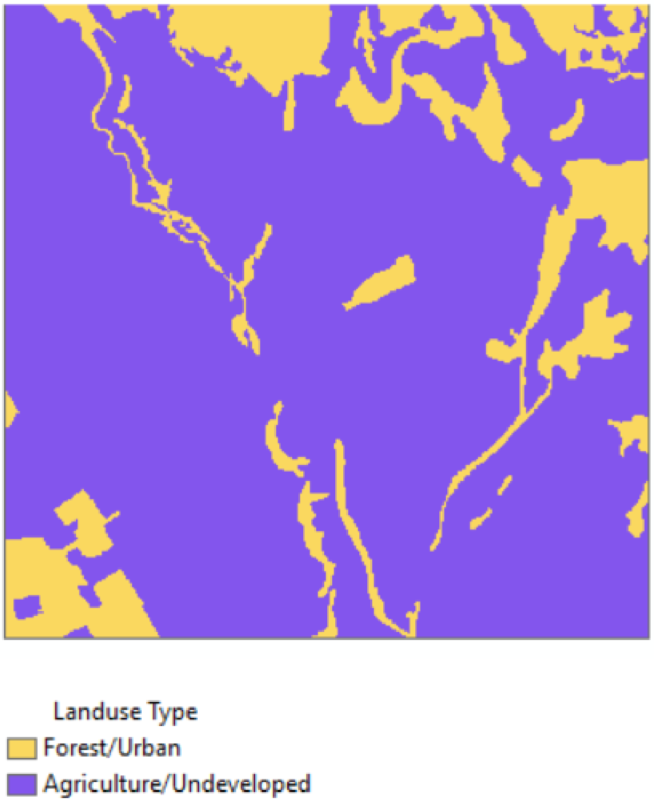


Figure 5. *Reclassification of landuse type layer.*

Next, the aspect layer was reclassified so that only flat land and land oriented to the SE, S, SW, W, or NW would be considered desirable (King, Walrath, & Zeiders, 1999-2020). Figure 6 contains the reclassified aspect layer where the bright green reflects the desirable land. Finally, the minimum temperature, maximum wind speed, soil depth, and soil drainage layers were reclassified into binary variables based on the desirability of the attributes. The climate data are presented in Figure 7 and the soil data are presented in Figure 8.

For visualization purposes, the undesirable areas were made to be transparent and all the reclassified layers were checked. The map with the layers showing only the desirable areas is featured in Figure 9.

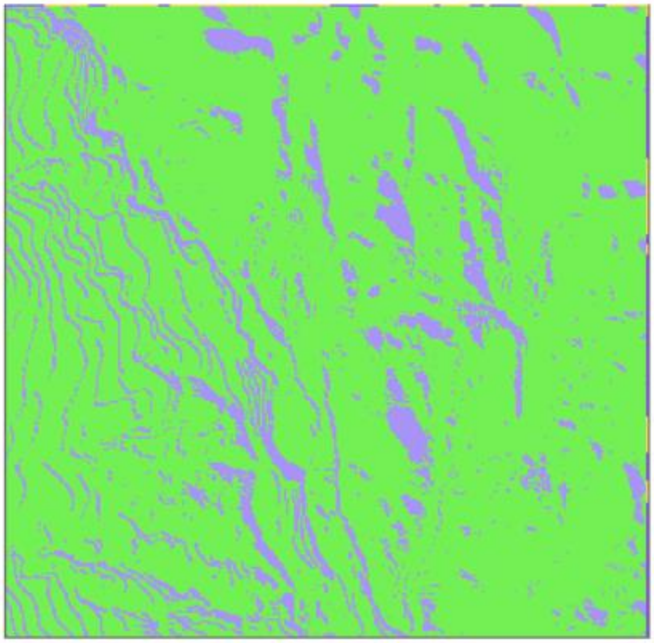


Figure 6. *Reclassification of aspect layer.*

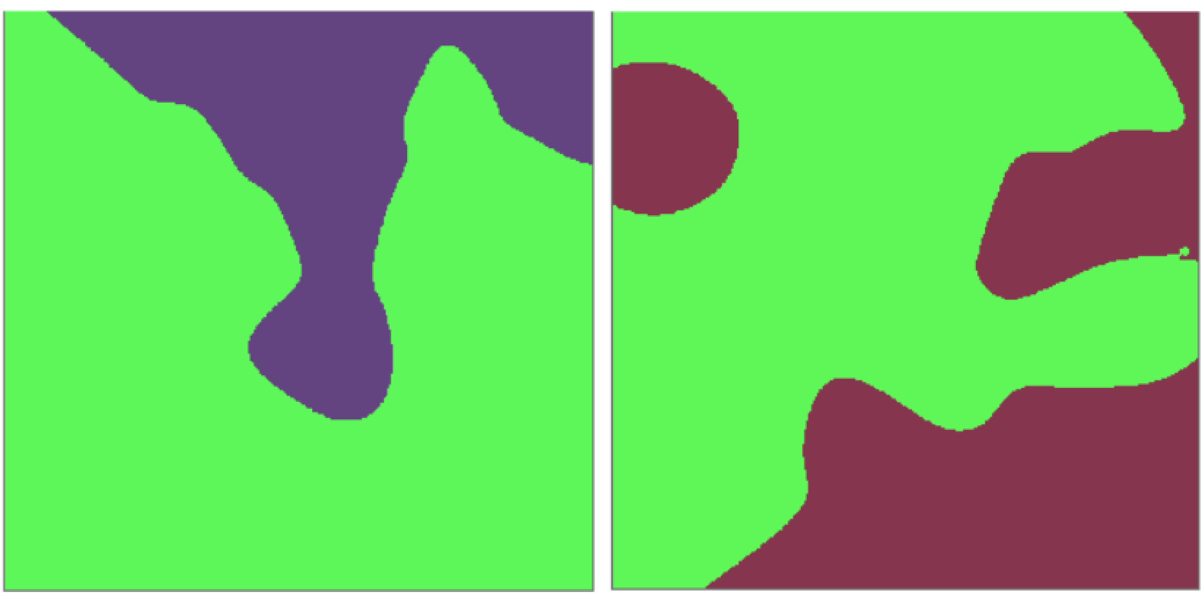


Figure 7. *Reclassified minimum temperature (left) and maximum wind speed (right) layers.*

Figure 8. *Reclassified soil depth (left) and soil drainage (right) layers.*

Figure 9. *Map showing all reclassified layers with only desirable areas showing.*

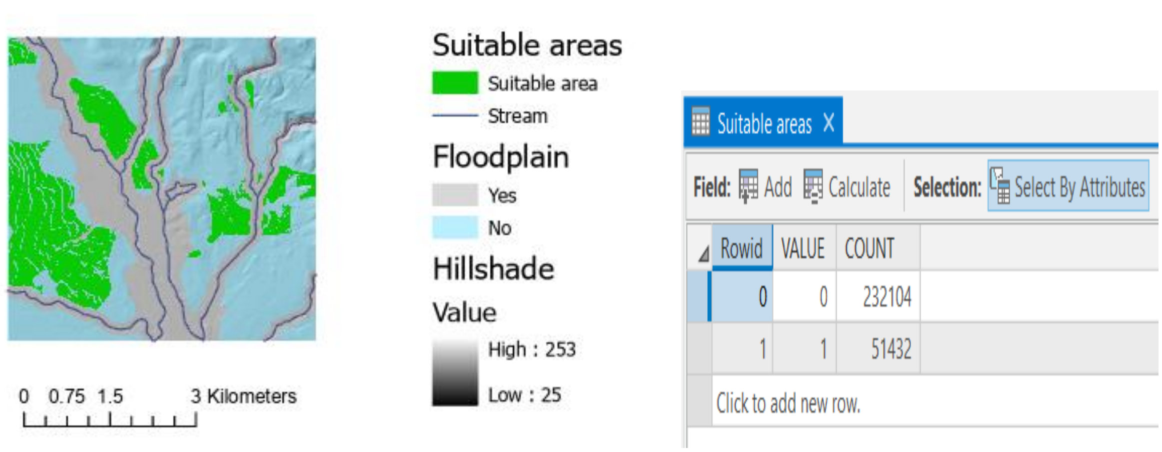
Combining Raster Layers

The final stage of the process consisted of combining layers into a single layer to identify the optimal site for the development of a vineyard. The map with the combined layers is provided in Figure 10.

Figure 10. *Map depicting desirable areas in green.*

Results and Conclusions

The purpose of this project was to identify a suitable vineyard site based on several site requirements leveraging data obtained via GIS and GPS technologies. Several factors were taken into consideration to classify areas as desirable (e.g., proximity to streams, floodplain, climate, soil, elevation, aspect). Based on the integration of these factors, suitable areas were identified and are shown in Figure 11. The results indicate that there are approximately 1,271 acres of suitable land. A layout of the map is provided in the Appendix.



Rowid	VALUE	COUNT
0	0	232104
1	1	51432

Figure 11. *Map illustrating suitable areas for vineyard development.*

Given that this analysis yielded more acres of land than needed, an additional requirement (layer) was added to increase the desirability of the site selected. The 1,271 acres were refined further to include only those areas that are privately owned, given that it would be difficult to convert public land to private land. The results featured in Figure 12 indicate that the number of available acres was reduced to approximately 550.

While this analysis is comprehensive and provides good information to guide decision-making around vineyard site selection, the analysis would benefit from data with higher resolution to better capture the spatial variability that naturally occurs within a vineyard block (Mathews, 2013). Also, since climate is a significant factor in the viability of the vineyard development, it would be good to consider projected climate changes (e.g., temperature and precipitation) in the next 10-30 years. Finally, although the final selection excluded public property, it would be good to consider other factors regarding the management of the private property identified as desirable such as the existence of conservation easements.

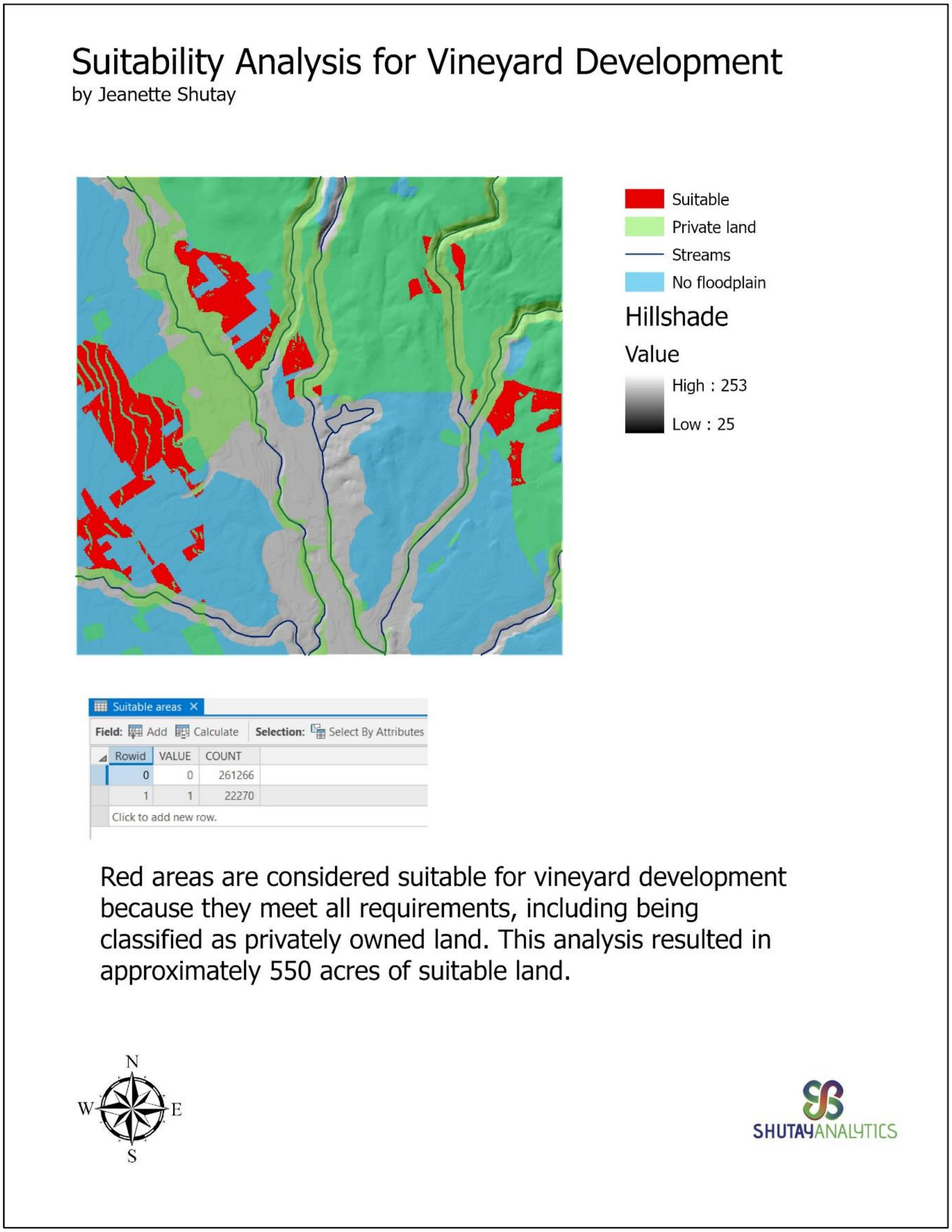


Figure 12. *Final map illustrating suitable areas for vineyard development.*

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Appendix

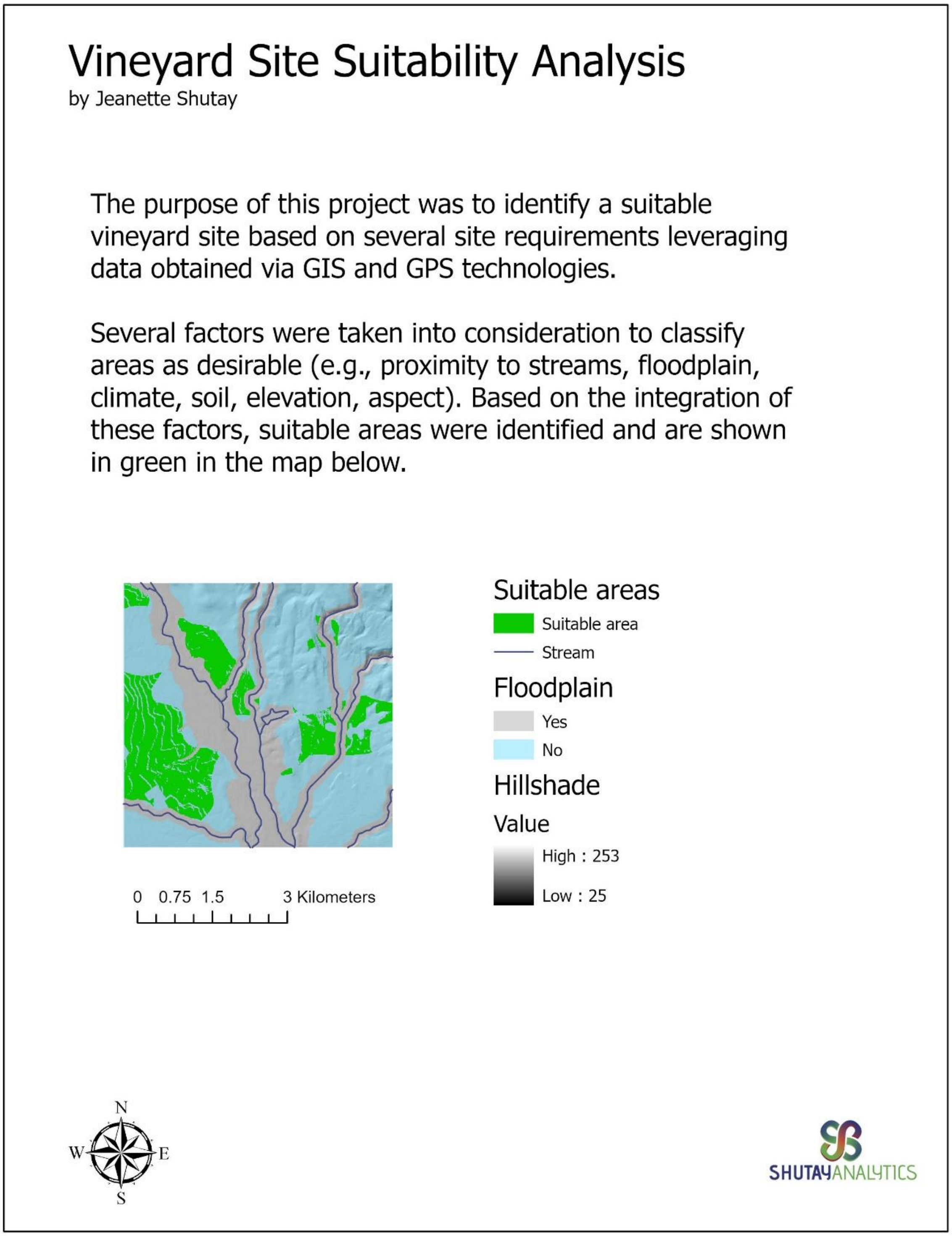

Figure 13. *Map layout for vineyard suitability analysis.*