Term Project (Site Suitability)

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Releasability

I do not give my consent to have my work shared with current or future students as an example. Examples can often limit creativity and coding is exactly that, creative.

Abstract

First responders in Virginia deal with a complex problem set when attempting to provide life saving care to people who are injured. Often valuable time is lost as first responders deal with a myriad of issues, the main being traffic. Virginia has some of the worst traffic in the nation which could critically delay ambulatory care. This project will create a code (generating a solution from user inputs) in order to leverage ArcPRO tools to select suitable sites for a medavac/evac style helicopter.

By providing both this service, first responders can accurately adjust the treatment plans for the most critically injured people and save precious time by evacuating them from a predesignated area. Currently, within the state of Virginia depending upon the location of the incident often ambulances will transport the injured or complete a drop off style exchange at a standardized helicopter landing zone. This tool will be comprised of tools to select locations which will be suitable. According to Delisio (1998),” The ideal landing zone is a level, 100-by-100-foot or larger area of grass or hard surface. Most civilian medevac helicopters in use today have a main rotor diameter of 35-50 feet and a fuselage length with main rotor blades turning of 40-50 feet. U.S. military helicopters are much larger.” Furthermore,” The landing zone should be as close to the accident scene as possible without jeopardizing the safety of the personnel on the

ground. A landing zone close to the scene saves time but safety must never be compromised. Some communities have designated landing zones such as school athletic fields."

This tool utilized a county-based data set in order to test the results and baseline the data size relevant to the outputs. Stafford County, just an hour north of Richmond, VA was used for the tools data.

Introduction

Each year lives are lost due to the timeliness of care. There are many factors which can influence this such as, traffic, remoteness of the incident and emergency response time. In a critical event the loss of time can quickly equate to the loss of life. Each year thousands of people are saved by the care they receive as a direct use of air ambulance (Medavac) technology. A definite hindrance to its use is knowing where it can be used. In some remote and extreme causes the aircraft can be fitted with a lifting device to access the patient. This is not as common in many suburban and urbanized areas.

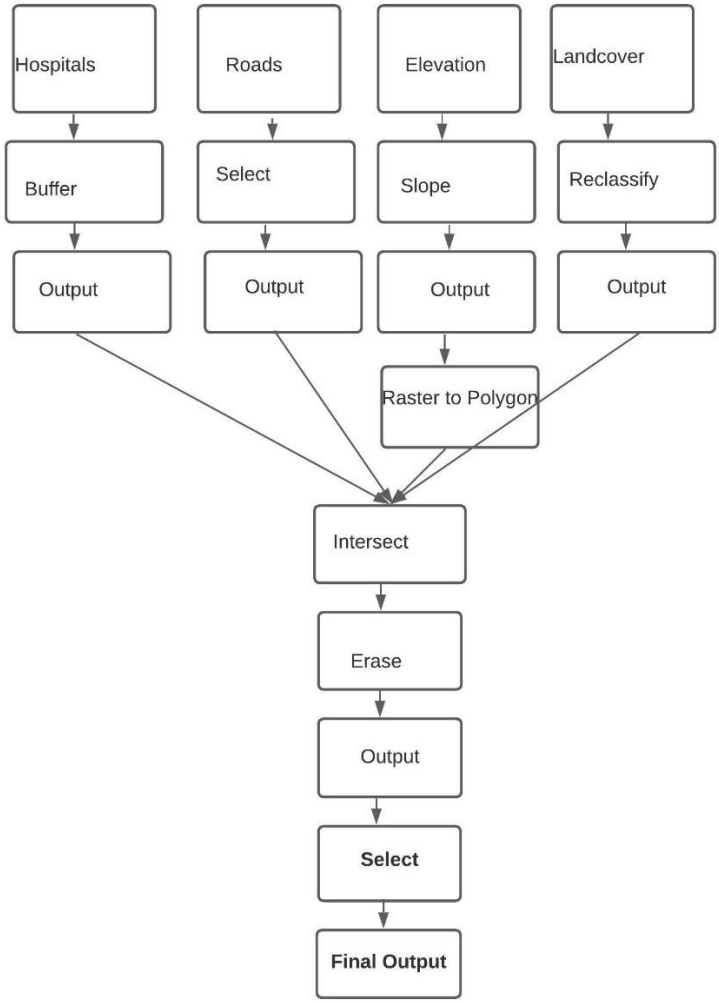
I developed this project to provide the user with maximum results from a geographic information system to display possible helicopter landing zones based on the base criteria many pilots fly from. I incorporated elevation data to ensure the slope of the area would not exceed a safe 10%. I also buffered the three large trauma facilities to provide the end user with a distance estimate to that facility. Landcover data from United States Geological Service provided the composition of the area. Lastly because most accidents happen on roads the United States road network was incorporated.

The compilation of this data can easily provide first responders and other emergency services with the capability to forecast the closer helicopter landing zone to a patient and then automatically forward that information to the responding emergency workers. The automates a process of manually looking through charts, and map data in order to guess where a suitable landing area would be.

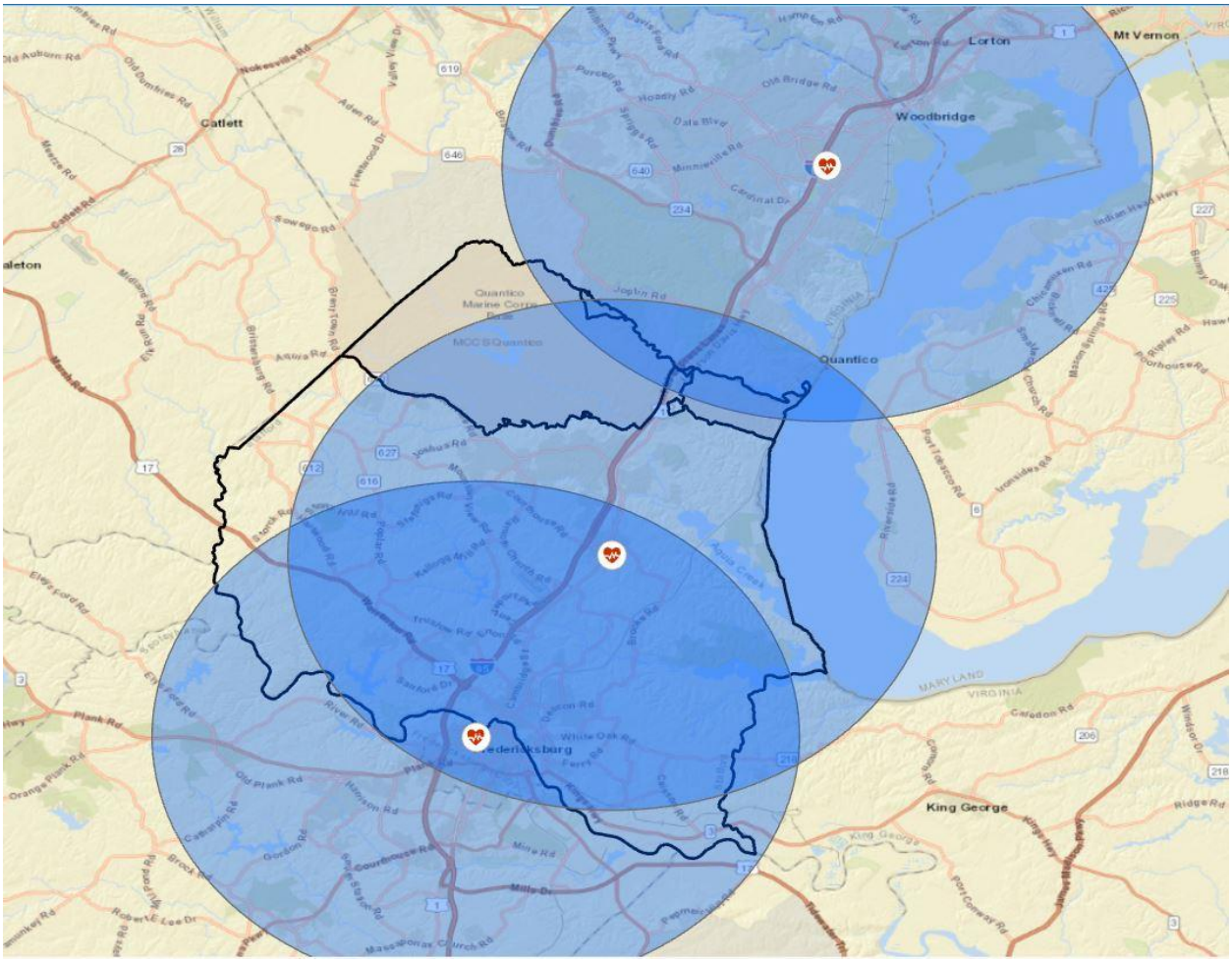
The research question of this project: Can a tool be created to provide first responders with the ability to leverage air assets? This tool creates a vector layer which shows where acceptable areas within the stated boundary are.

Materials and Methods

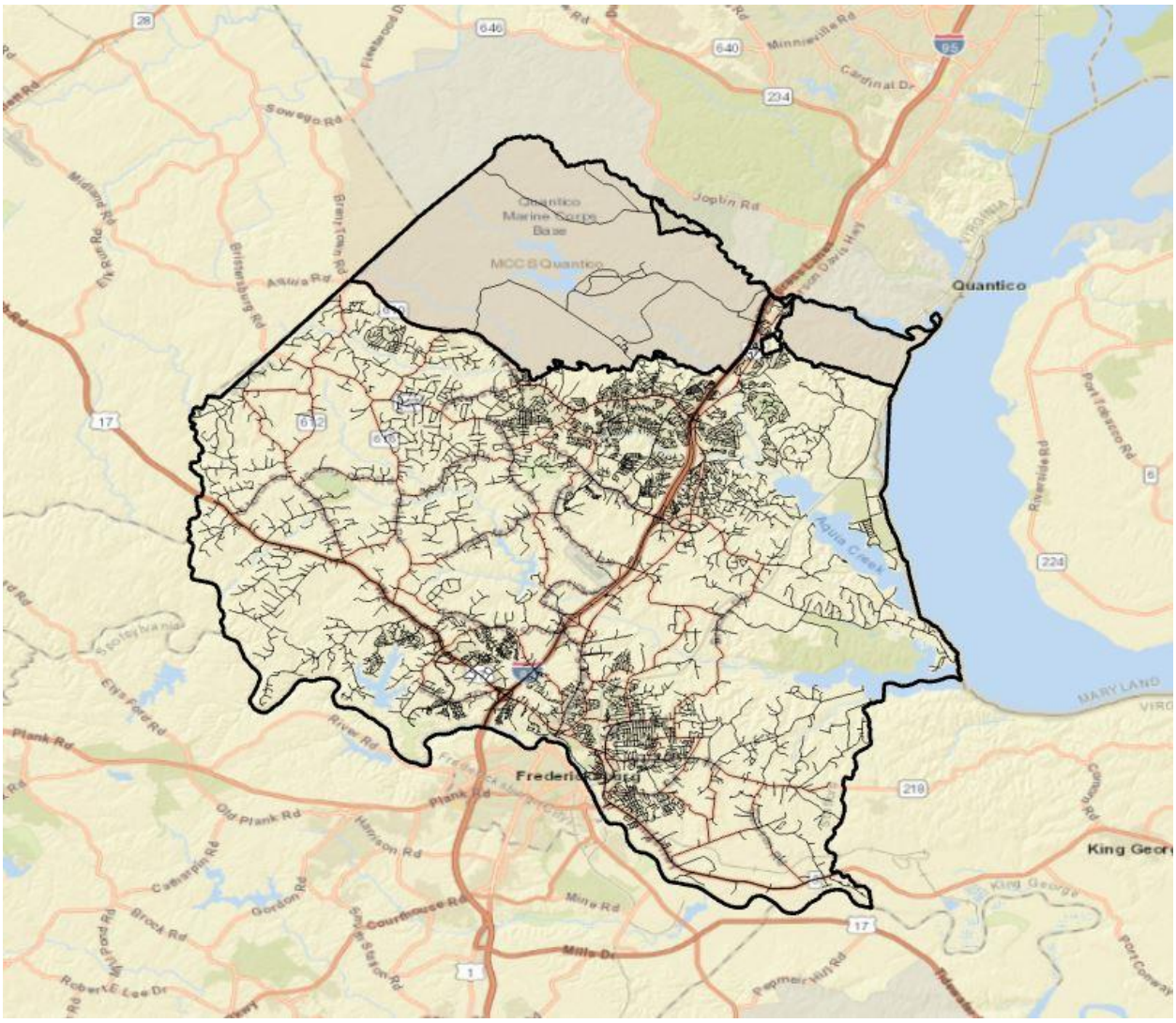
I gathered data from Stafford County GIS office because they are the local subject matter experts at the county level. They provided both hospital and road data which was published on ArcGIS Online. Next, I utilized USGS to ingest the National Landcover Dataset. I used a similar repository in VGIN Maps to retrieve the digital elevation model of Virginia. I added in a ListRasters and a ListFeaturesClasses function in order for the user to verify they have the correct data before use. These four data sets were able to populate the chart seen below:



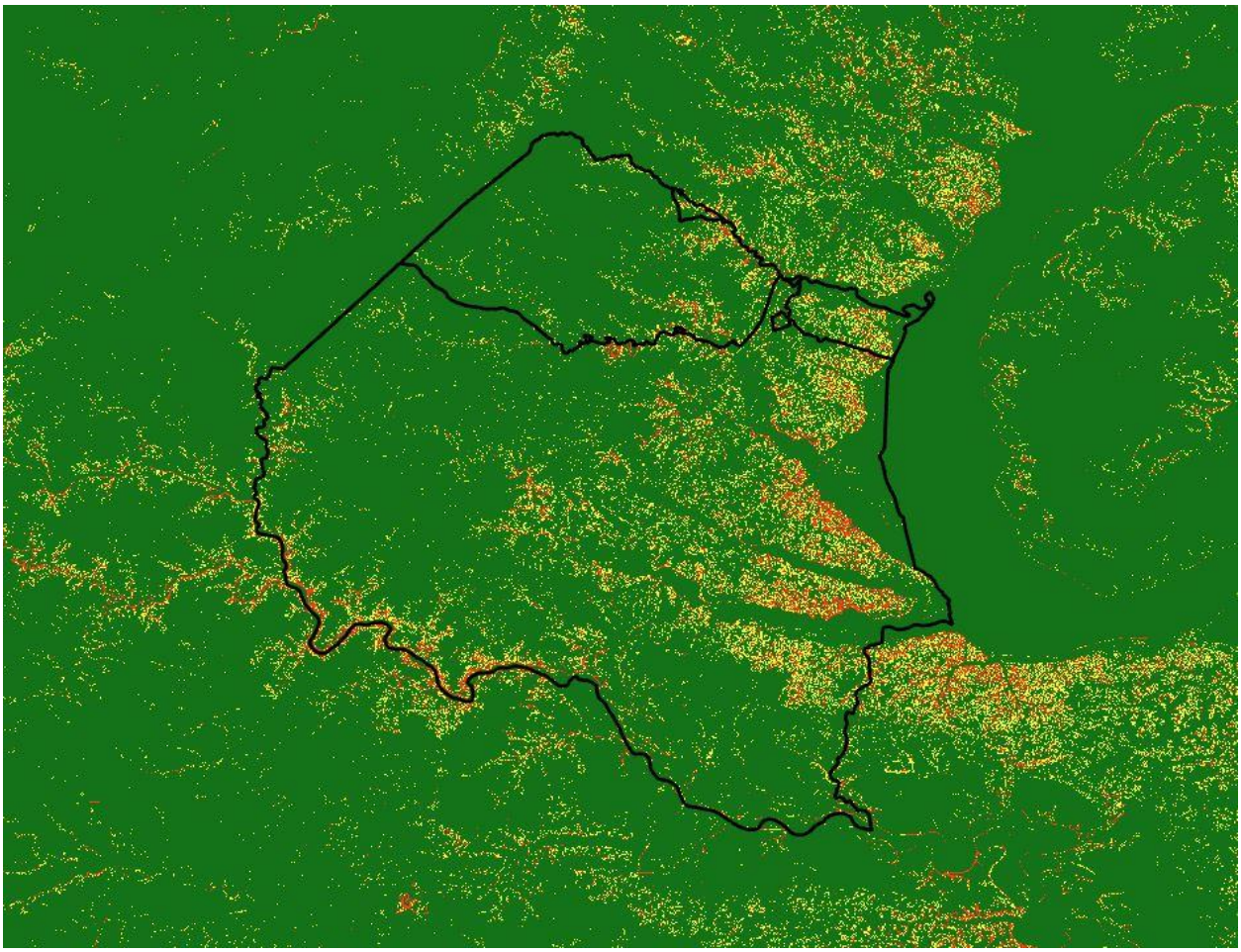
To complete my analysis through this code I worked through multiple GIS processes. First, I buffered the hospitals 10 miles which generated overlapping service areas.



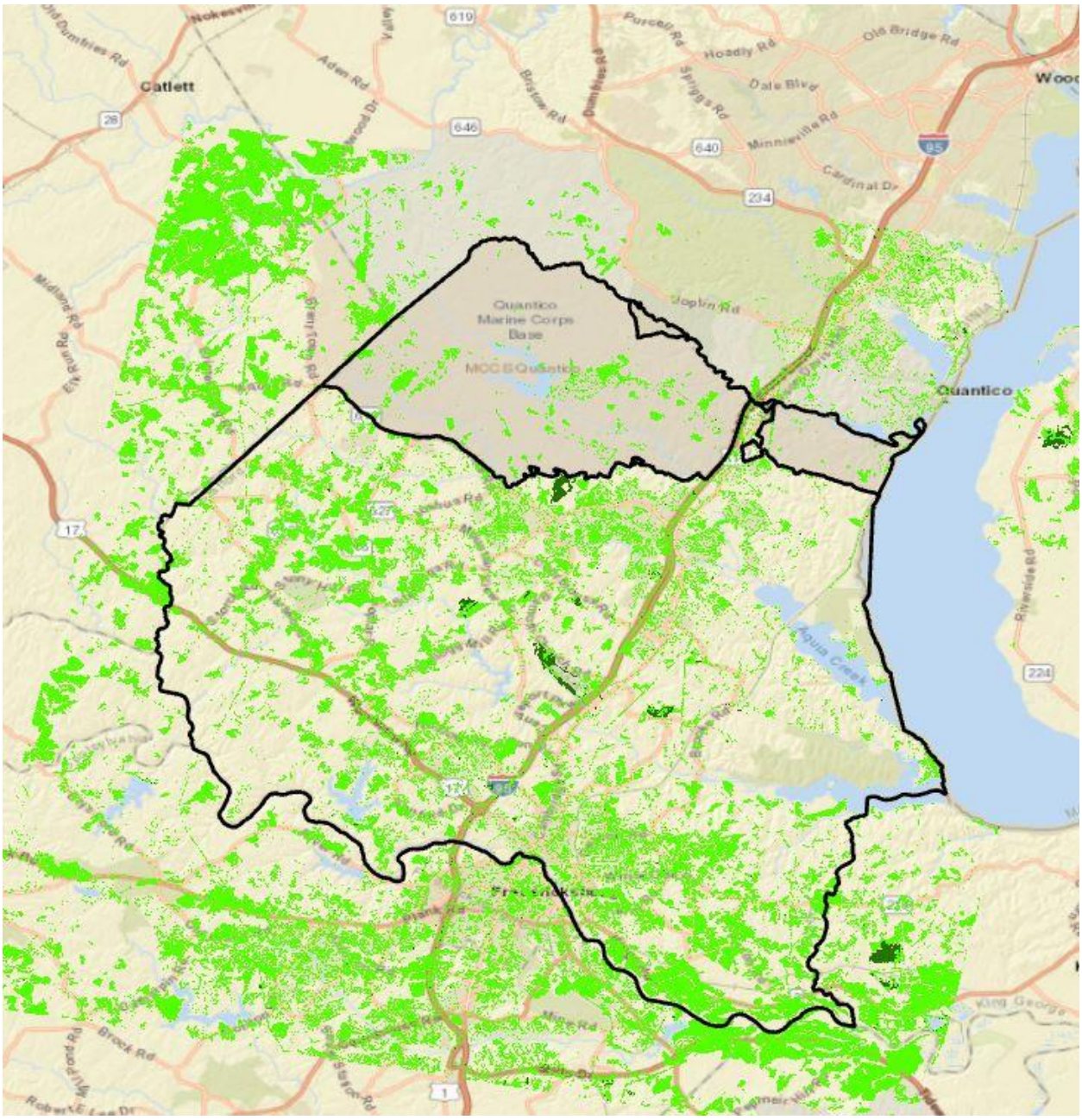
I then dissolved those areas into a single polygon creating the aerial service area. Next, I used select by location to locate all the roads within the county boundary because other roads would belong to different first responder stations.



I generated slope from the digital elevation model then reclassified it into two values (acceptable, other).



I reclassified the Landcover data into three categories (ideal, less ideal, worst). This allowed me to utilize the raster to polygon tool to change the original reclassified file into a vector format for later use in the code.

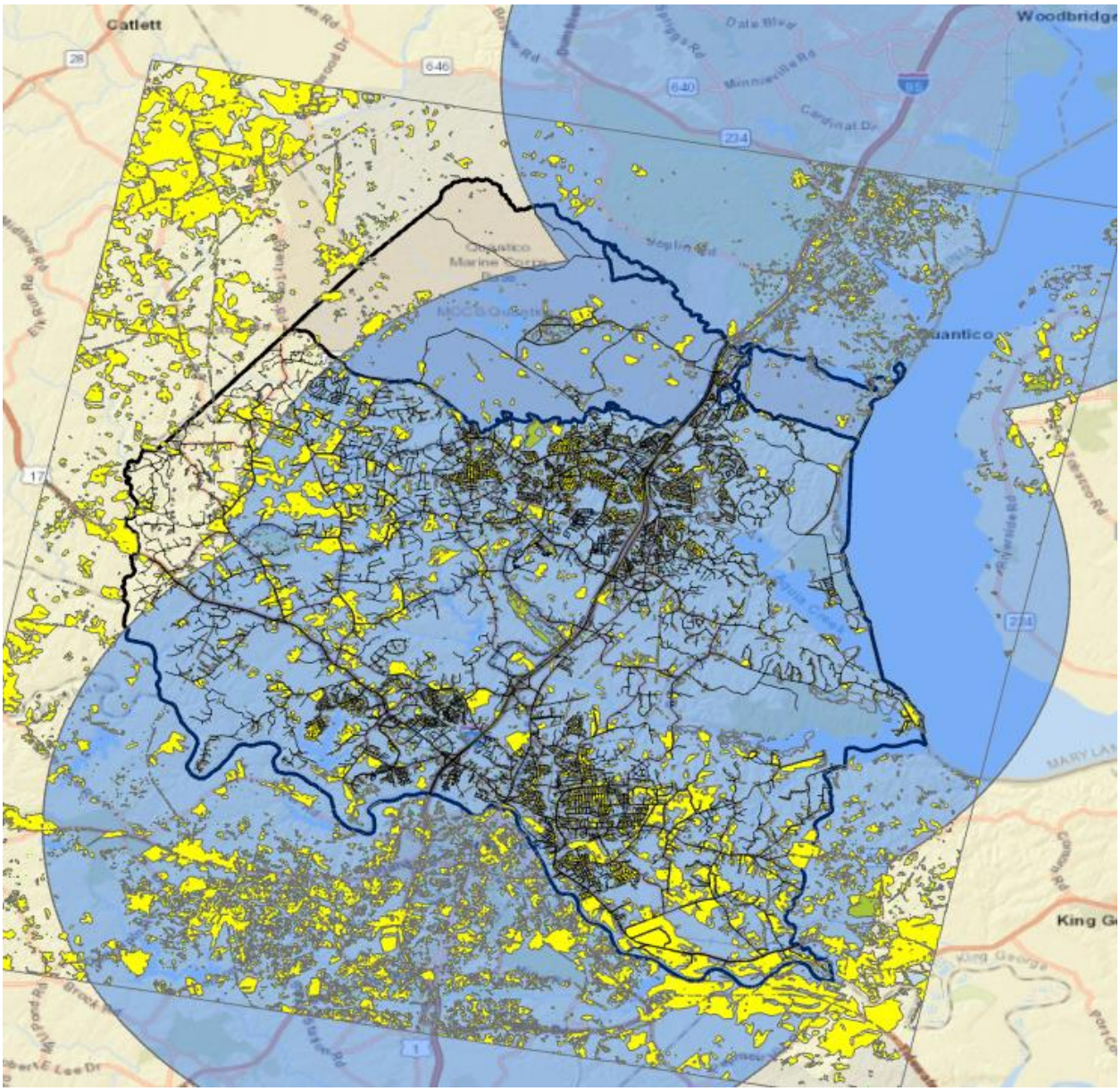


Next, I brought my vector values together in a merge to generate one polygon in which I could select the shape area I desired for the aircraft.

This methodology was chosen to replicate a waterfall style of problem solving. The initial data inputs were processed into their appropriate outputs. The outputs were then merged together to create a selectable (suitable) area for the helicopters.

Results

Due to the vast amount of densely populated forests and suburban housing the are for helicopter zones was severely limited without relying directly on the road networks.



Even with the large service area of the hospitals (10 mile per facility buffer was used) there are still limited areas for a successful flight. Even after grouping the Landcover areas with very large groups (as seen below) there was still a very small yield of acceptable areas to utilize.

NLCD_Land_Cover_Class
Open Water/Developed, Open Space/Developed, Medium Intensity/Developed, High Intensity/Deciduous Forest/Evergreen Forest/Mixed F
Developed, Low Intensity/Shrub/Scrub/Herbaceous/Hay/Pasture/Cultivated Crops
Barren Land
Emergent Herbaceous Wetlands

Without sacrificing the integrity of my analysis, I could have also changed some of the criteria but when involving aircraft, I wanted to err on the side of caution. The road network could have been further exploited to account for roads with high-speed access. That would have required a full network analysis with service areas.

My results could also be changed by included emergency service locations such as fire departments who have a higher level of care capability as opposed to the general public. The county currently deploys a system of overlapping fail safes to ensure the use of the aircraft is minimalized.

Discussion and Conclusions

The dense infrastructure and full tree growth severely lowers the amount of suitable helicopter landing zones the county. The county will have to heavily rely on a system of hand off areas in order to properly administer timely care. This is a process of driving the victim to a designated location in order to transport them to a helicopter.

This work was limited by precise helicopter data. The county leverages multiple private and state level assets with different requirements to land anywhere outside of a proper landing zone. Some of the aircraft is more ruggedized to withstand the abuse of landing on varying surfaces. The code I created allowed me to generalize based on a multitude of different aircraft.

Future evolutions of the tool (code) would account for individual aircraft characteristics such as rotor width and flight distance. Incorporating the technical specifications of the individual helicopter would provide a more exact approximation of the required area. I would

also generate a service area map which would outline the owners of each area and how far they serviced. This would aid in cross coordinating the transportation.

Lastly, this data can be used to aid decision makers in the direction of the county. All too often the ramifications of the decisions leaders make are not understood until they can visually see it. I would use this data to show were the gaps in coverage where and make suggestions for future subsidized landing areas within the county.

Reference

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Stafford County GIS. (2022). https://data-staffordva-gis.opendata.arcgis.com/search?tags=Boundaries

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