Fire Susceptibility in Arcata

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Abstract

This past year as many as 1000 people in the US have died from domestic fires. This may be because of the increase in the spread speed of fire due to more synthetic materials being used. The increase of fire spread as well as the lack of adaptation in city layout means that fireteams have less time to react when a fire is started. Our plan throughout this project is to demonstrate to the general public the many risks that areas may be subjected to. We have compiled data on hydrant location, fire stations and road maps to create a potential hazard map that identifies areas where fire teams may not be able to respond before serious structural damage. Our proposal for those who lie within these hazard zones are to practice a swift emergency management plan with the goal of eliminating hesitation when calling in a fire and evacuating as quickly as possible.

Introduction

Recent studies have shown that while back in the 1980's a person might have around 17 minutes to escape a house fire, today the critical evacuation time is closer to 3 or 4 minutes [Rosen 2016]. Due to recent changes in home furnishings to more natural, less chemically saturated materials, the relative speed of domestic fire expansion has increased 400%. This means that local fire departments have had to adapt their response correspondingly to ensure the safety of civilians and an early containment of the fire. That being said the relative positions of hydrants had remained the same for decades and the Arcata city layout has not been significantly altered either. Our project is based off the current layout of Arcata namely the relative positions of buildings to roadside fire hydrants for the purpose of evaluating the varying levels of susceptibility to uncontrolled fire. We hope to represent these possible hazards through areas based on their relative access to water, time of fire department response, and speed of fire spread.

Methods

Our GIS Project was to map out the locations of fire hydrants around the Arcata area to show the strongest and weakest areas of fire protection. To evaluate this, we have attained data from the Humboldt County GIS portal and collected data on:

- California map
- Locations of hydrants
- Humboldt fire stations
- Road maps
- City boundaries

We also contacted the local fire departments to see what the standard hose lengths are on their trucks, average travel response time and what the average on site response time might be to certain areas in the city. We also conducted online research on the average speed of fire growth to see vulnerability based on time. Each data set was examined to ensure that they would be correct representations of what was needed. ArcMap 10.2.2 was used to display the data, relying mainly on the Buffer and Clip functions. With all this data we hope to represent the safeness of certain areas based on their relative access to water, time of fire department response, and speed of fire spread.

In order to find which areas were within reach of the average hose length carried by firetrucks (1,000ft) buffers were added to the fire hydrants and only a few areas were not within those parameters. To show distance from stations multiple buffers were made around the stations and then layered on top of each other. These were then cut to areas only around the roads for ascetic purposes.

Results

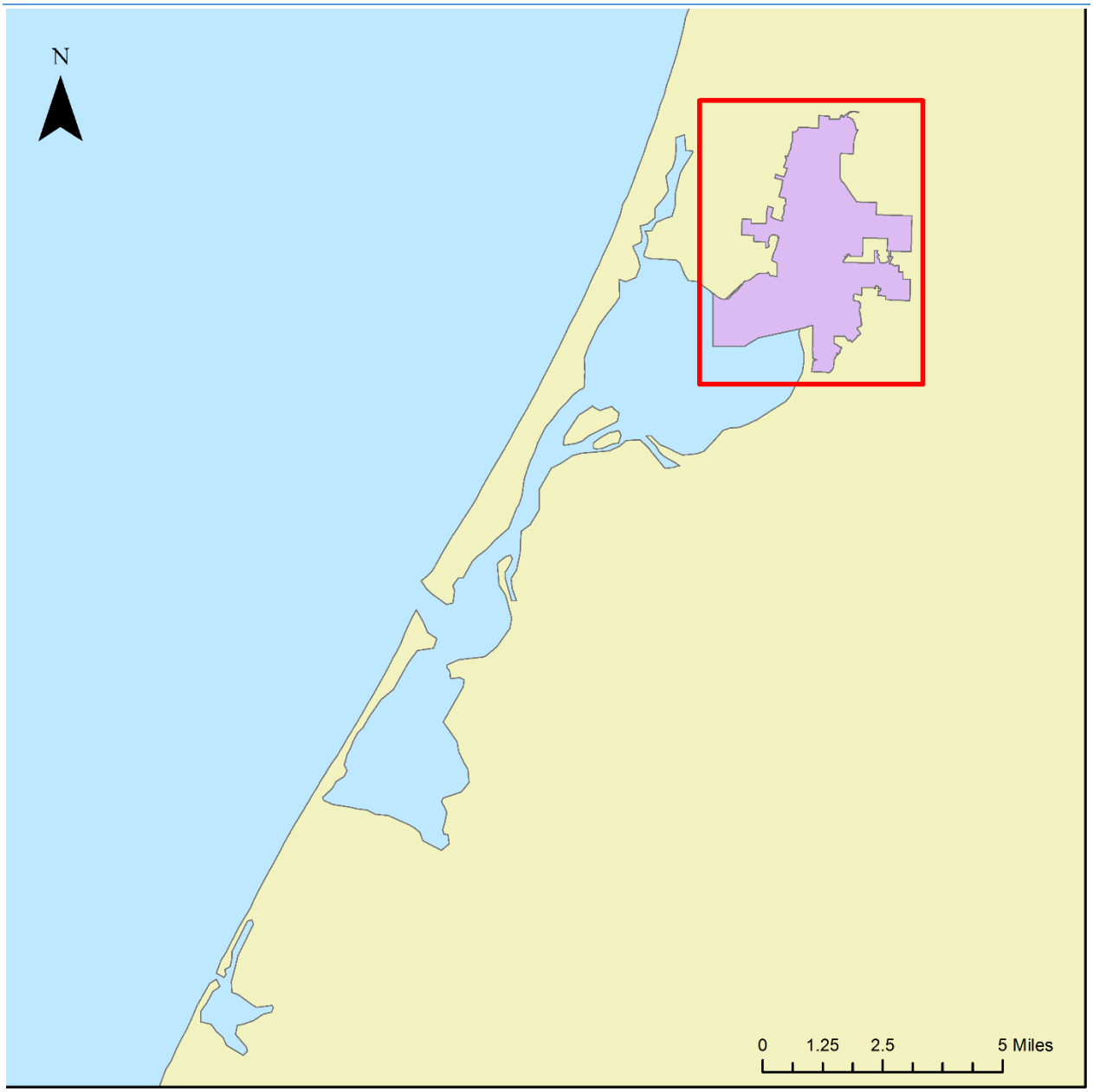

Fig. 1 Locator Map *Relative to Humboldt Bay

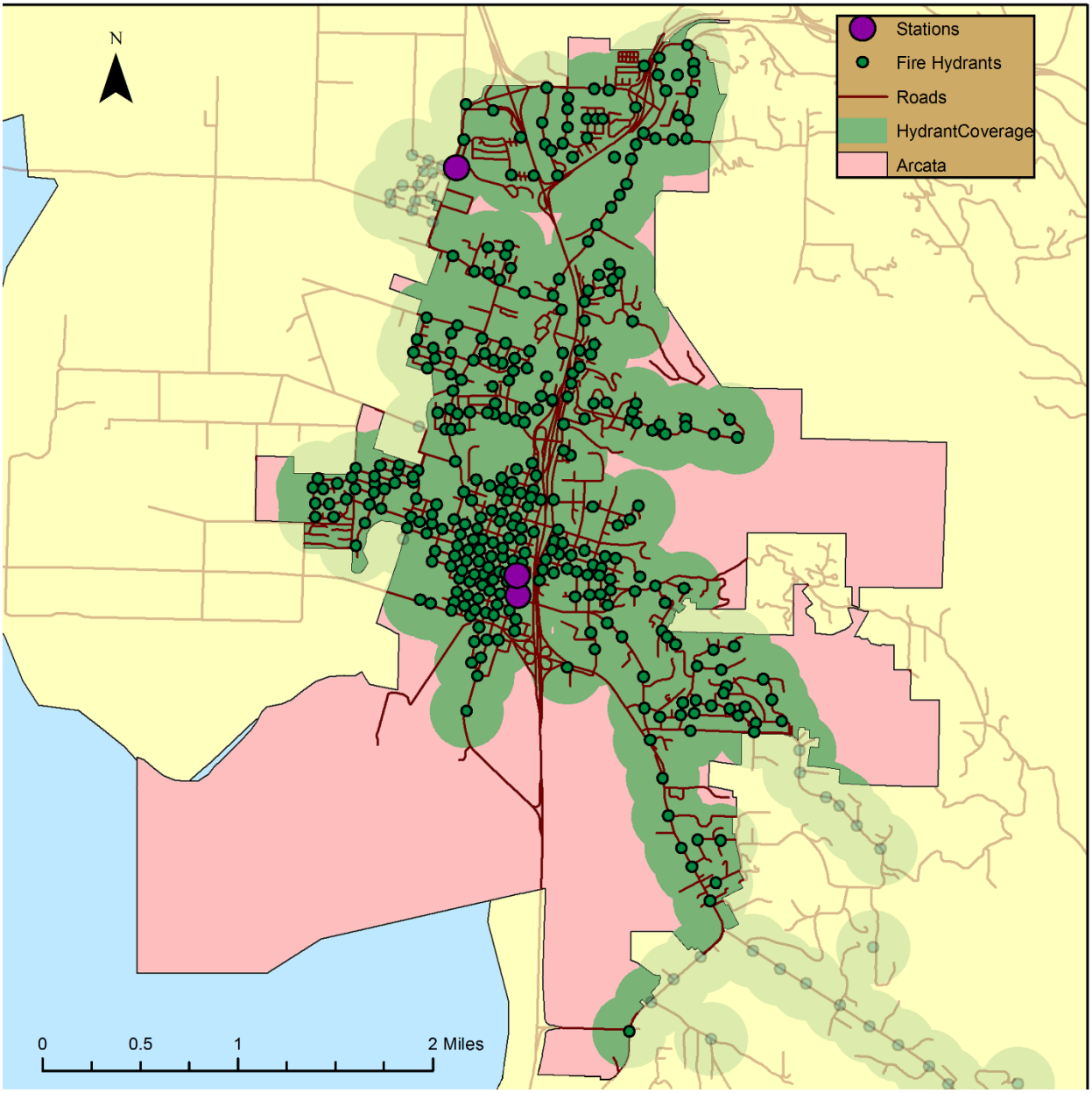

Fig. 2 Hydrant coverage

The hydrant coverage map shows a 1,000 foot buffer around each fire hydrant in the Arcata town area to represent the distance of coverage using the longest hose carried on a fire truck. We referenced our local fire department to get the max hose length of 1,000 feet.

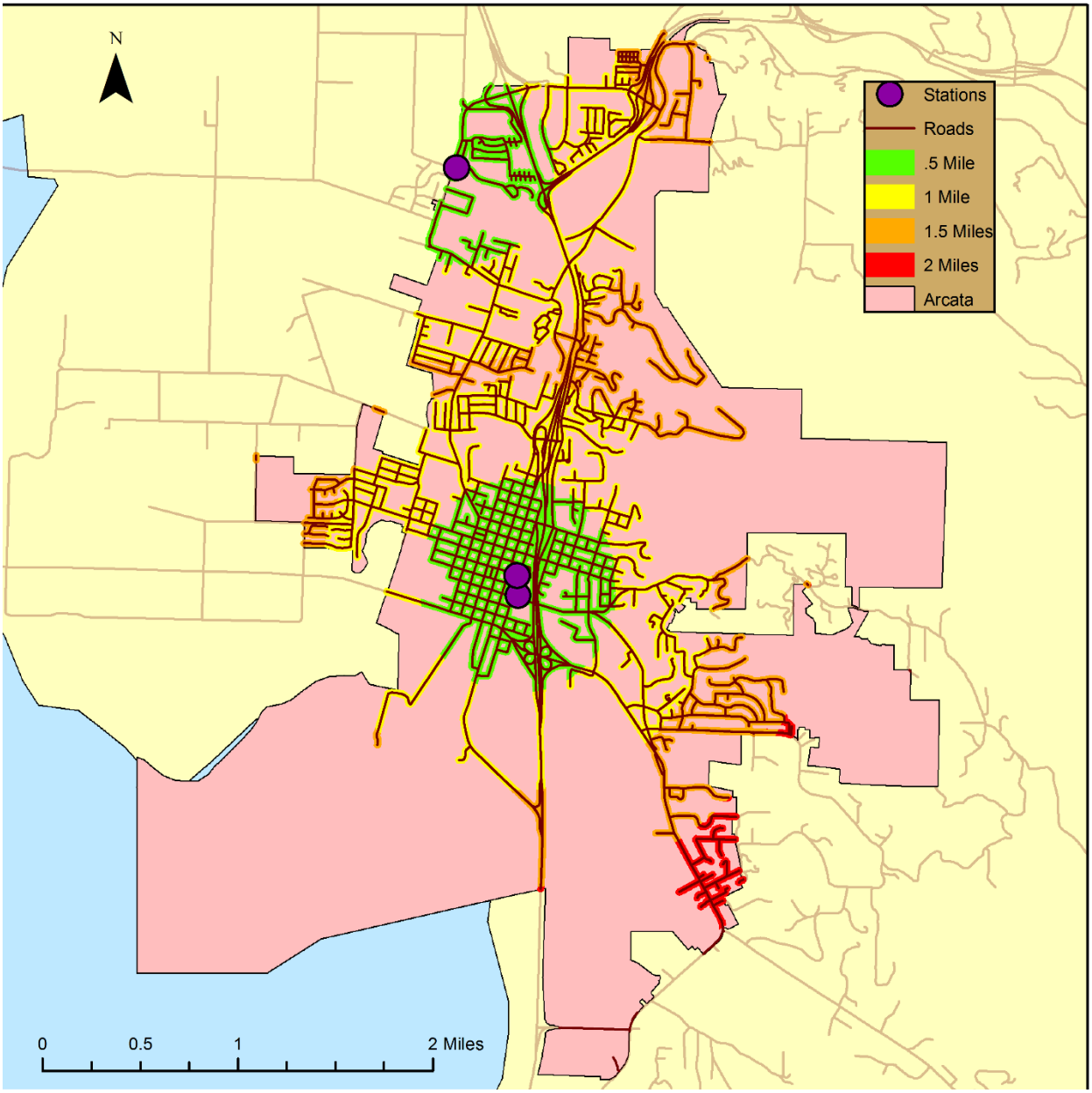

Fig. 3 Distance from station

In our distance from station map (fig. 3), we set buffers from the stations at .5, 1, 1.5, and 2 mile intervals and colored them distinctly. Given a relative inner city travel speed of 30mph and 45mph we calculated a range of between 1:20 mins to 2:00 min travel times per mile accounting for the many intersections and one way roads. The speeds where estimated by best and worst case scenarios of traffic.

$$\frac{30miles}{hr} * \frac{1hr}{60min} = 0.5miles/min \qquad \frac{1mile}{0.5\text{miles/min}} = 2\ mins\ /\ mile$$

$$\frac{45miles}{hr} * \frac{1hr}{60min} = .75\text{miles/min} \qquad \frac{1mile}{0.5\text{miles/min}} = 1\ min\ 20\ sec\ /\ mile$$

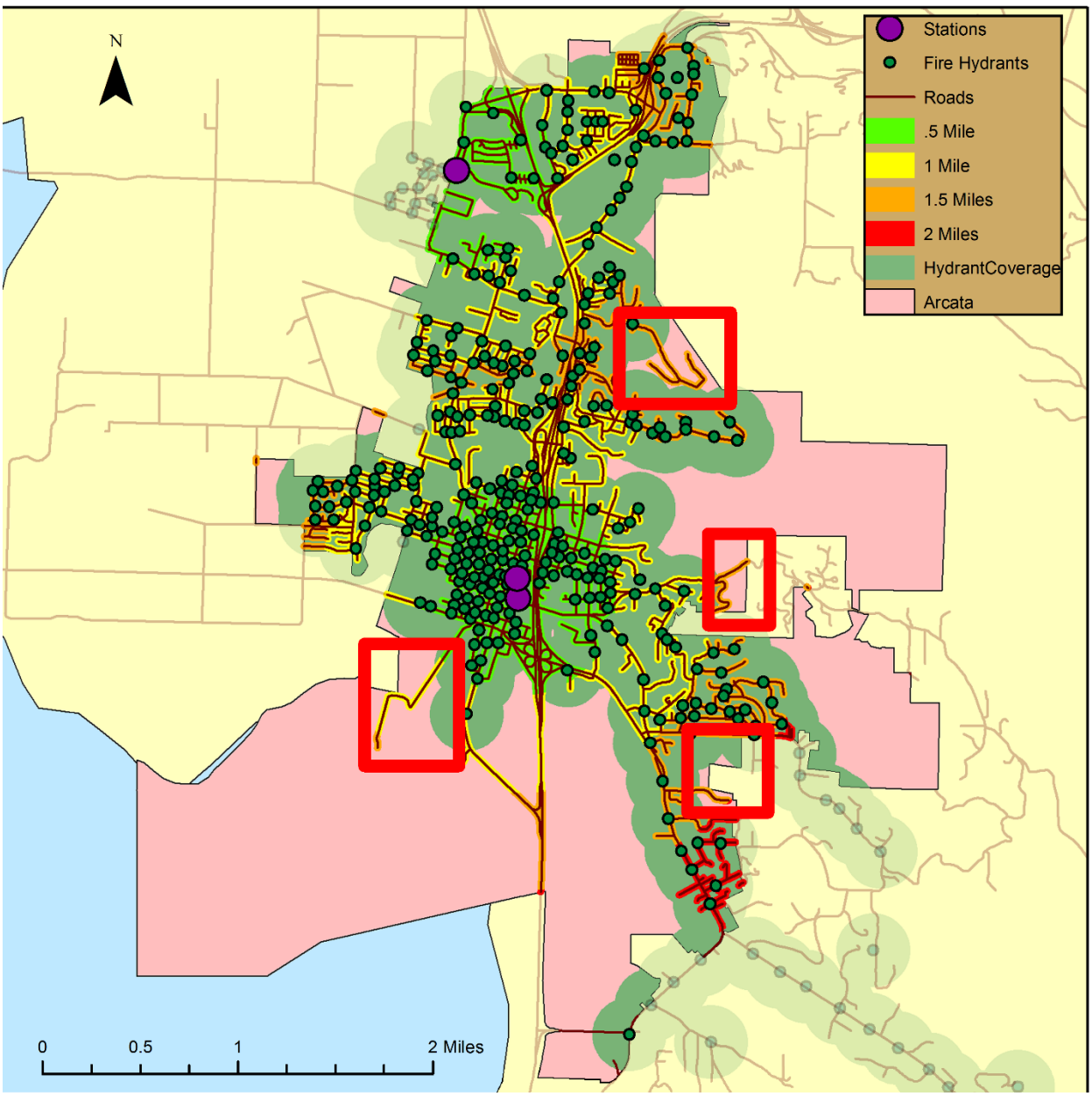

Fig. 4 Problem Areas

Problem areas are characterized by being at least a mile away form a fire station and lacked any street side fire hydrants.

Discussion

All maps are rough concepts and aren't fully complete since many things have to go into consideration of assessing fire risk. Some overlooked aspects may include building materials, wind speed, traffic situation, water dispersal range, or type of fire. It is also important to note that the distances from stations are calculated radially from the station and do not express the road distance, thus travel times may vary from prediction. Hydrant buffers were created with the idea that the fire truck parks on the street right next to the hydrant. Considering our possible sources of inaccuracy, we have tried to be as conservative as possible with our assessment and in doing so have created models that may over exaggerate potential risks. However, one should not look past our research but rather keep in mind fires can be unpredictable and have proven to become a great threat when not managed appropriately.

Conclusion

In terms on hydrant coverage (fig. 2), the entire Arcata center is quite well covered. There appears to be at least one hydrant for every street corner. The only lack of hydrant coverages occur on South I street, Woodland court and surprisingly on the HSU campus. However, we believe that since many of the school's buildings have built in fire hose hook ups, there wasn't as much need for street side hydrants.

After analyzing the distance from station map (fig. 3) and applying our travel time range of 1:20-2mins we rationalized that any structures in areas further than 1 mile away would have a higher risk of sustaining significant damage. These areas were mostly in the Sunny Brae and Bayside areas. At these areas response times rise to 2-4 mins at which point smoke and fire damage would compromise those inside.

After combining our data, we had projected possible problem areas (fig. 4) in the Arcata district. These areas possess qualities of lacking sufficient access to a fire hydrant and/or being at a distance of critical response time. We promote inhabitants of these areas to establish extra precautionary measures such as maintaining smoke detectors and fire alarms regularly, installing multiple portable fire extinguishers, and practicing an emergency plan regularly.

Acknowledgements

Rosen, Jeff, and Josh Davis. "Newer Homes and Furniture Burn Faster, Giving You Less Time to Escape a Fire." *Today*. N.p., 16 Jan. 2016. Web. 8 Dec. 2016.

"GIS Data Download | Humboldt County, CA - Official Website." GIS Data Download | Humboldt County, CA - Official Website. Accessed December 12, 2016. http://humboldtgov.org/276/GIS-Data-Download.