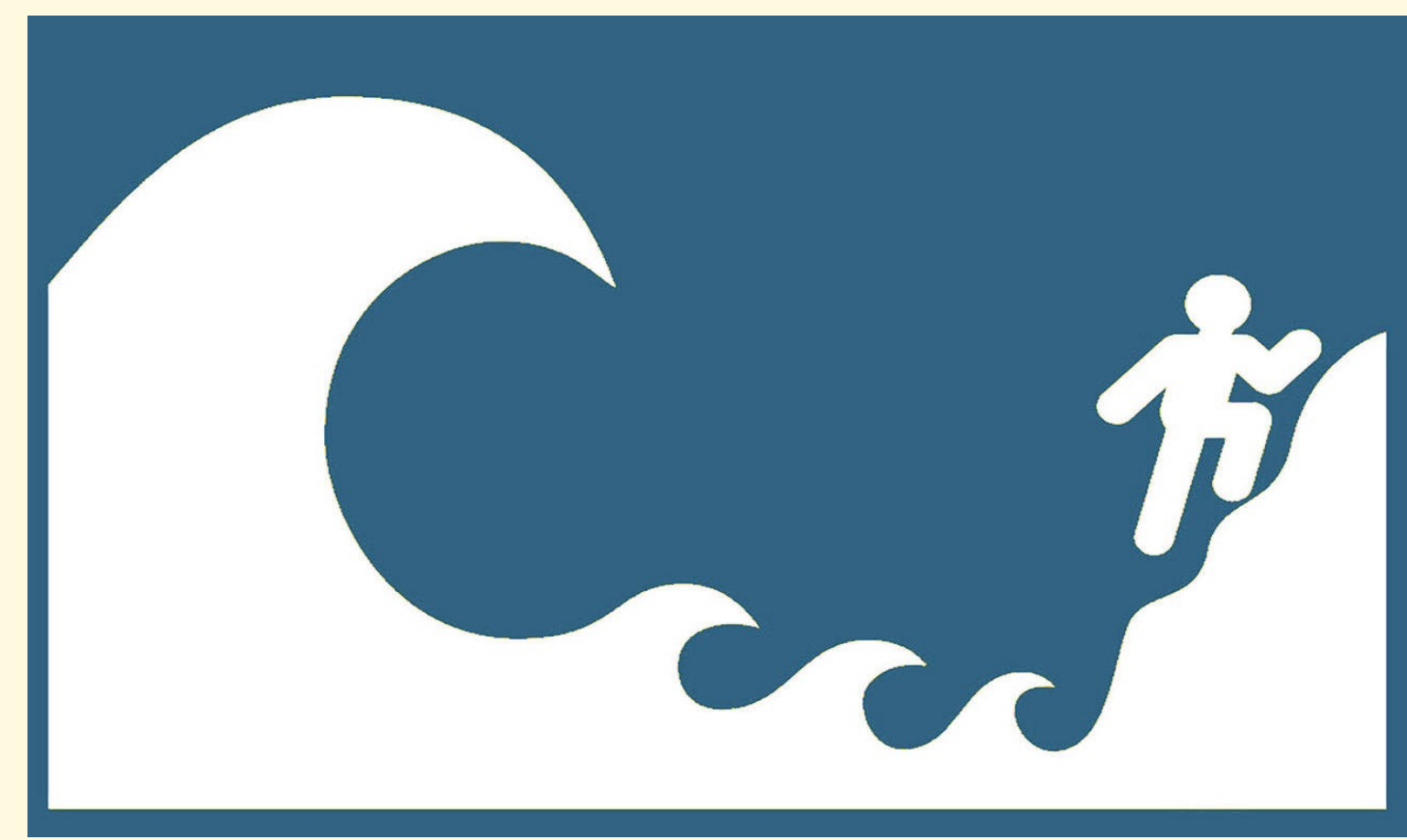


THE “BIG ONE”

- A network analysis of tsunami evacuation routes along the northern Oregon coast



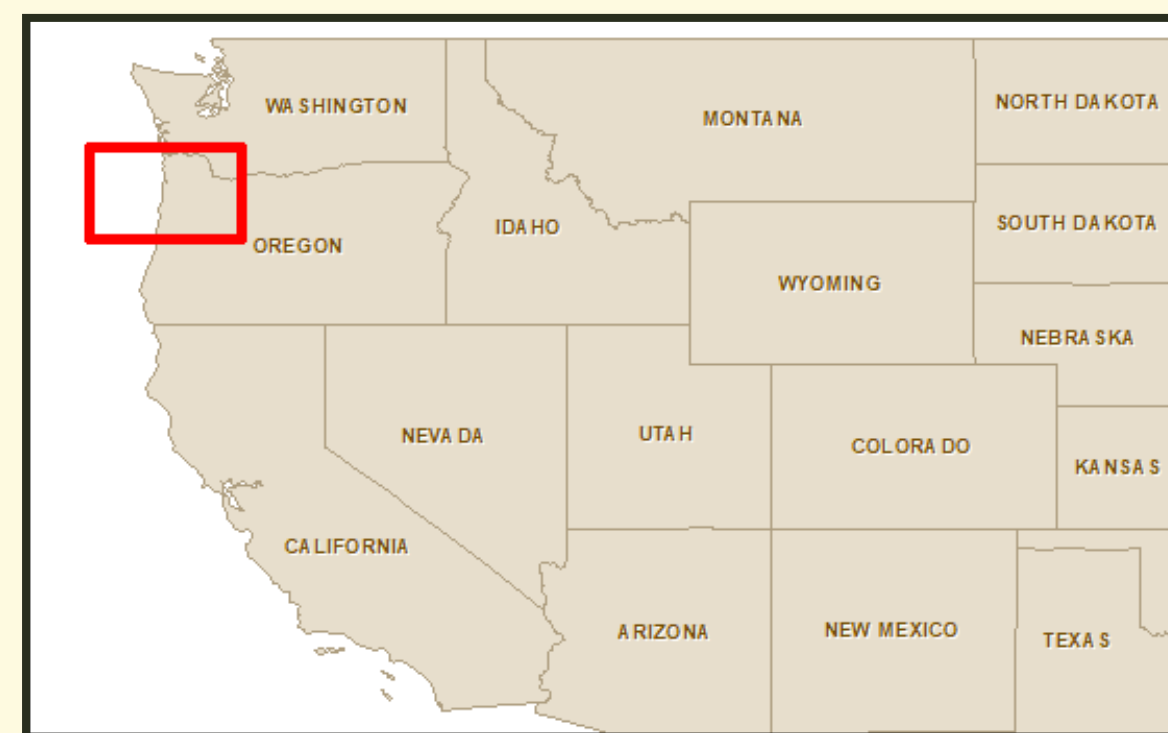
Evelyn Roozee | UEP 235 Adv. GIS | Spring 2020

BACKGROUND

For over a decade seismologists have ominously talked about the “big one” that is going to hit the west coast any moment. The “big one” is a 9.0 or higher magnitude earthquake expected to happen along the Cascadia fault line. This earthquake would cover around 140,000 square miles and create tsunami waves over 100 feet high in some areas (Schultz 2015). Scientists estimate there is a 1 in 3 chance of the “big one” occurring in the next 50 years (Schultz 2015). In 2011 Japan experienced an earthquake of 9.3 and within 15 minutes a massive tsunami wave hit the coast and traveled miles inward (Pletcher and Rafferty 2020). Japan is the most earthquake prepared country in the world and still

experienced over 10,000 deaths (Pletcher and Rafferty 2020). Oregon currently has evacuation plans along the coast for a tsunami event but not for one of this magnitude.

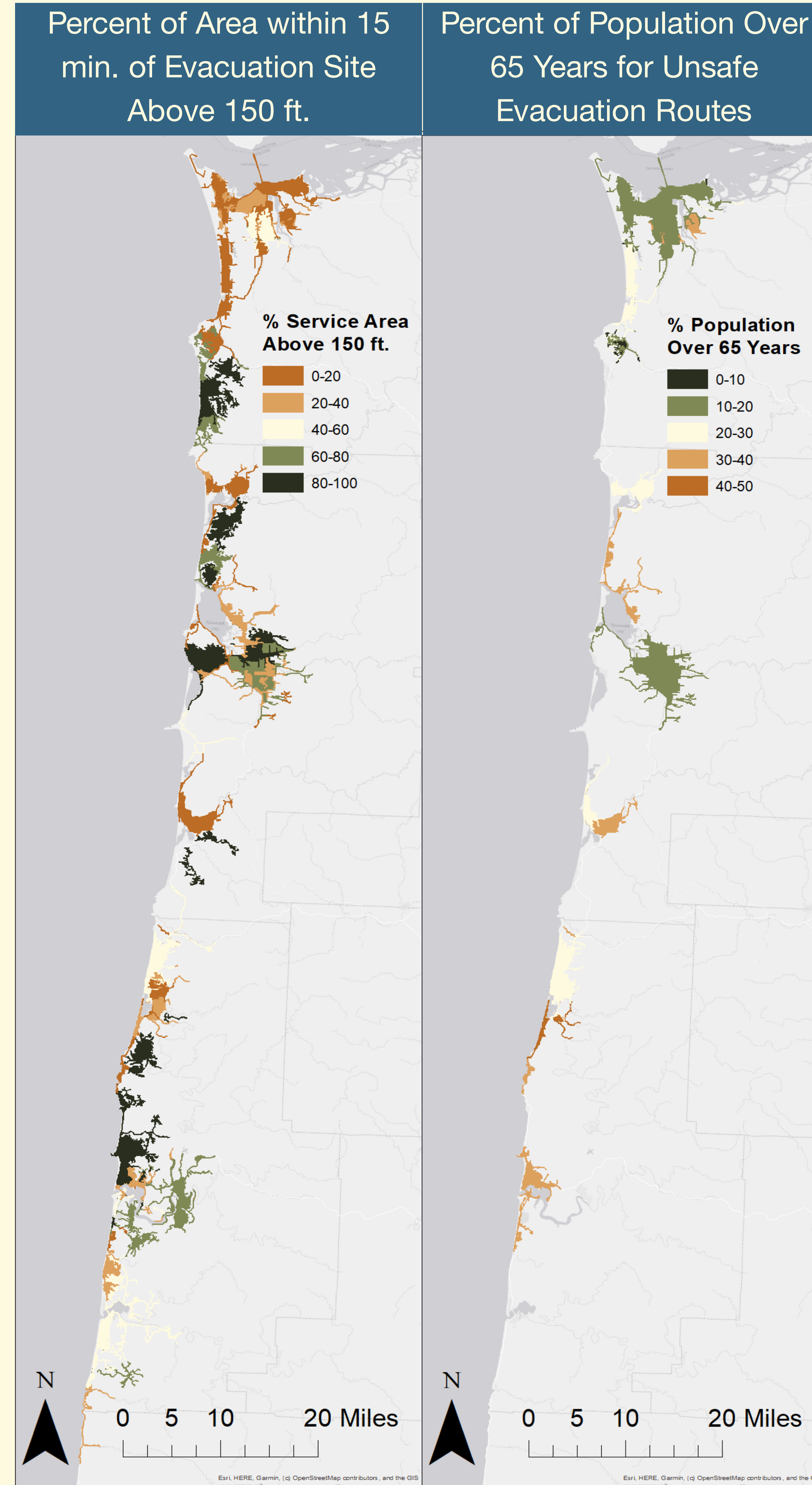
Research Question: Is it possible for people in the evacuation zone along the northwest Oregon coast to reach an elevation above 150 feet in 15 minutes? How many people will not be able to reach a safe elevation in time?



DATA AND METHODS

Elevation: DEM 10 foot elevation raster made by the United States Geological Survey found at usgs.gov
Evacuation zone: polygon layer of tsunami evacuation zone along the Oregon coast made by The Oregon Department of Geology and Mineral Industries (2013) found at Oregon Spatial Data Library
Census block groups: TIGER/Line shapefile made by US Census Bureau (2019) found at catalog.data.gov
Network: transportation network of Oregon made by Oregon Department of Transportation (2017) found at Oregon Spatial Data Library
Population/demographic: table of total population and percent of the population above 65 years old by census block group from American Community Survey 2017 5-year estimates found at sociaexplorer.com

Evacuation points were created by selecting centroids of census block groups in the evacuation zone. Using the Oregon transportation network a service area was created for each evacuation point up to 31680 feet away. 31680 feet is approximately the distance traveled in 15 minutes going 25 mph. The elevation raster for Oregon was reclassified into three categories (1 = 0-150 feet, 2 = 150-300 feet, 3 = >300 feet). The zonal statistics tool was used to calculate the proportion of each service area above 150 feet. Census block groups with less than 20% of their service area above 150 feet were selected. The total population and the percent of the population above 65 years old of selected unsafe census block groups was calculated. Two maps were created one showing the percent of the service areas above 150 feet and one showing the percent of the population above 65 years old in the most unsafe service areas.



RESULTS AND CONCLUSIONS

The analysis found that 37 out of the 96 census block groups in the evacuation zone had less than 20% of their service area above 150 feet. The total population of unsafe census block groups is approximately 37,182 people. The population of all census groups analyzed is 98,678 meaning 37.7% of the population is unsafe. These unsafe census block groups also have 8,230 people over the age of 65 who are even less likely to be able to evacuate in time. The block group that has the highest population of elderly people (44%) and only 6% of the service area being above 150 feet is Lincoln County Oregon Block Group 2 Census tract 9506.01. The results of this analysis show that there are a substantial amount of people along the Oregon coast who would

not be able to evacuate to a high enough elevation in time to escape a tsunami from “the big one”. Oregon should strengthen the disaster preparedness of these areas in order to reduce the potential death toll from a tsunami following a 9.0 or higher earthquake.

Number of block groups in danger (out of 96)	37
Total population of in danger block groups	37182
Elderly population of in danger block groups (65+)	8230

Figure 1: Table showing demographic information of in danger block groups that had zonal statistics results showing that less than 20% of the service area is above 150 feet.

FUTURE WORK

One major limitation of the analysis is that the service area was created based on the assumption that people could evacuate in cars at 25 mph. This might not be the case due to traffic, lack of car availability, and speed limits. Future research should include speed limits in the network analysis and analyze service areas for both walking and driving. Another limitation is that tsunami waves will not be the same height across the Oregon coast. Some locations will be hit with waves smaller than 100 feet and therefore do not need to evacuate to an elevation greater than 150 feet. Future research

should take in to account variations in wave height set different evacuation heights for census block groups.

DATA SOURCES:
 American Community Survey 20175-year estimates | US Census Bureau | Oregon Spatial Clearing House | United States Geological Survey (USGS)

PROJECTION:
 Lambert Conformal Conic
 NAD_1983_HARN_Oregon_Statewide_Lamber_Feet.

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 Schulz, Kathryn. “The Earthquake That Will Devastate the Pacific Northwest.” *The New Yorker*, 13 July 2015, www.newyorker.com/magazine/2015/07/20/the-really-big-one.
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