Natural and Human Influences on Flood Zones in Wake County

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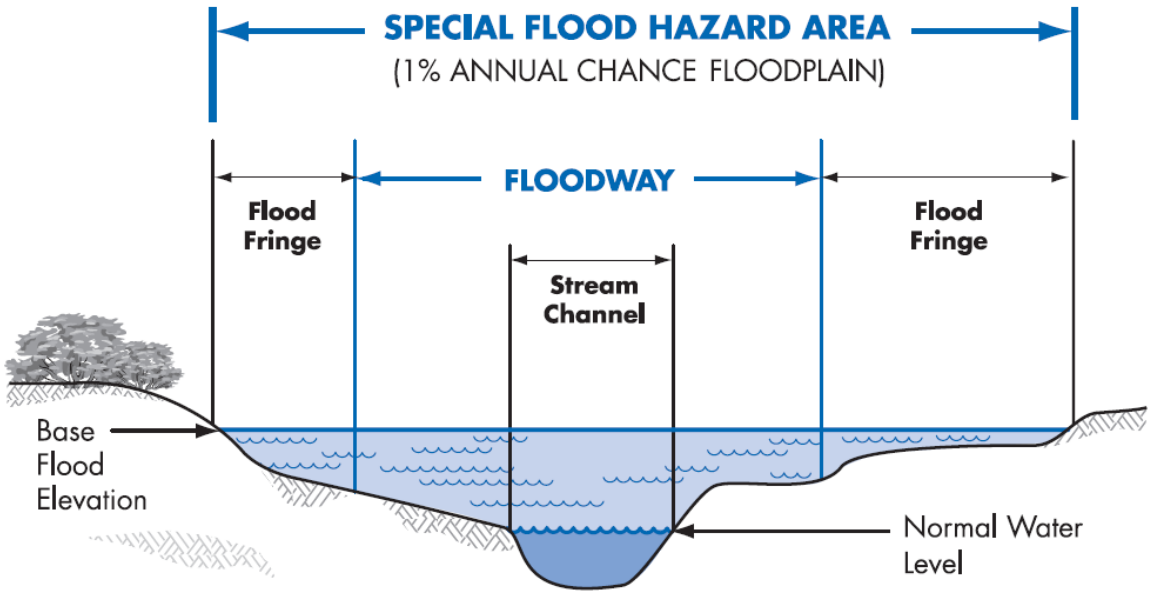
Introduction

The use of Geographic Information Systems (GIS) to analyze the potential for flooding has been an invaluable technique developed in the last decade. With the help of technology, states have the potential to predict the extent of flood damage and prevent the loss of many lives and limit damage. In September of 1999, Hurricane Floyd struck the state of North Carolina and many other states along the eastern seaboard threatening the livelihood of many. Soon after the devastation, the Governor of the North Carolina at the time, Governor James B. Hunt, and the Federal Emergency Management Agency (FEMA) decided that a technological advance needed to be made. In 2000, the North Carolina Flood Mapping program was developed with the purpose of 1) improving flood information 2) providing a technical means to warn emergency managers and residents in time and 3) lessening the overall impact of flooding. The North Carolina Flood Mapping data that has developed since 2000 is the basis for this analysis (NC Flood Maps). In conjunction with population trends, it important to evaluate how continued growth across Wake County would affect the easily impressionable landscape.

There are many influences that can be considered when trying to determine the width of a flood zone and the resulting impact. They can range from natural factors like precipitation amounts and elevation to human effects including an increase in

impervious surfaces. The standard used by the North Carolina Flood Mapping program to determine flood zone width is called the one-percent annual floodplain and accounts for the area of land that has a one-percent chance of being flooded in a one-year time span as seen in Figure 1. This particular standard is made using a hydrological model built with LIDAR data. Utilizing this data for the North Carolina Flood Mapping methods has allowed for elevation to be considered in conjunction with water flow measured at different gages across the evaluated area (NC Flood Maps).

Figure 1. Special Flood Hazard Area

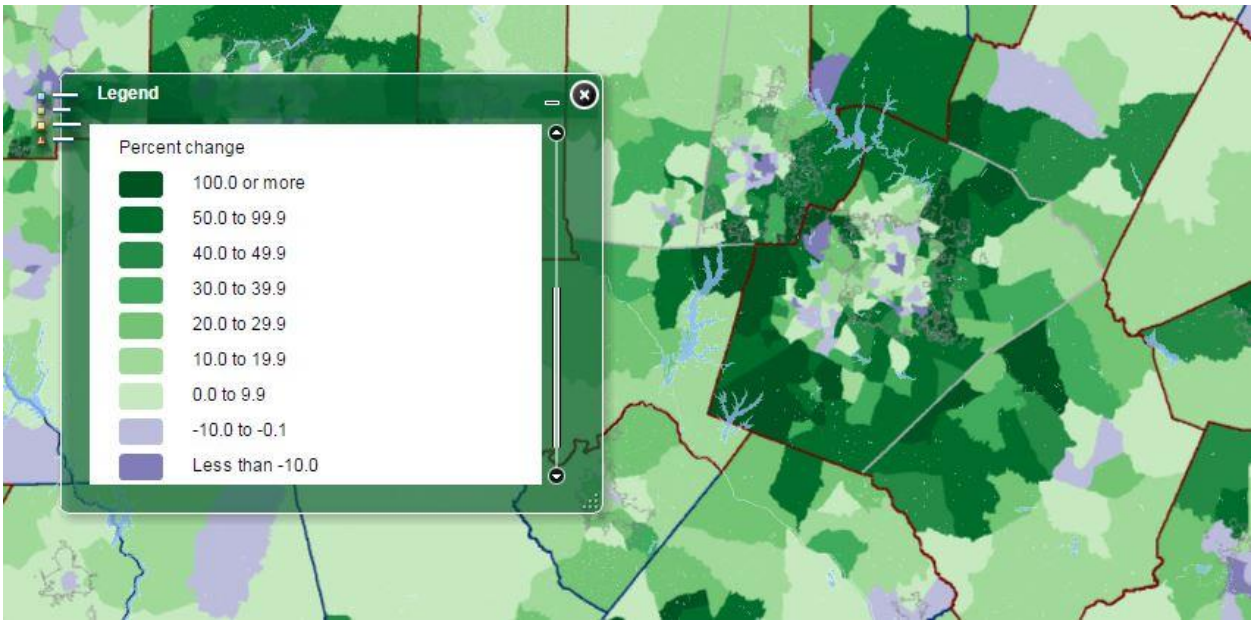


Graphic obtained the 2008 North Carolina Floodplain Management Quick Guide

Between 2000 and 2010, Wake County had an increase in population from 633,517 to 906,944 people (U.S. Census Bureau). The surplus in population was not uniformly absorbed across the county. Through data provided by the United States Census Bureau, significant increases can actually be seen in the outer portion of the county. This trend was expected as bigger cities in the United States continue their

pattern of suburbanization. For this reason, careful observations must be made in the next few years regarding how increases in population affect the landscape and its ability to handle additional stresses when flooding occurs.

Figure 2. North Carolina Population Change 2000-2010. U.S. Census Bureau.



Objectives

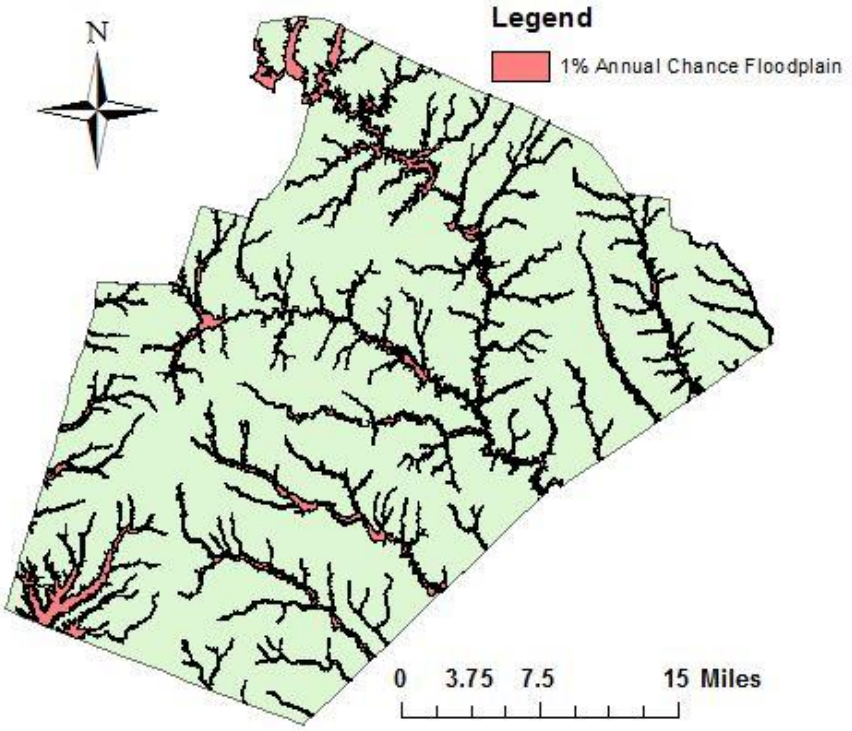
Unexpected flooding can have significant negative impacts in many parts of the United States if the area of concern is unprepared. This analysis will focus on a few of the factors that affect the extent of the flood impact area and consider how Wake County growth will change those factors in the coming decades. The findings from this county could have relevance on other areas of the country if correlations found and computations completed were duplicated. The factors considered will be the current projected floodplains, land cover, and impervious surfaces. These elements speak

directly to the models produced by North Carolina Flood Mapping and the existing use of land in the county.

Methods

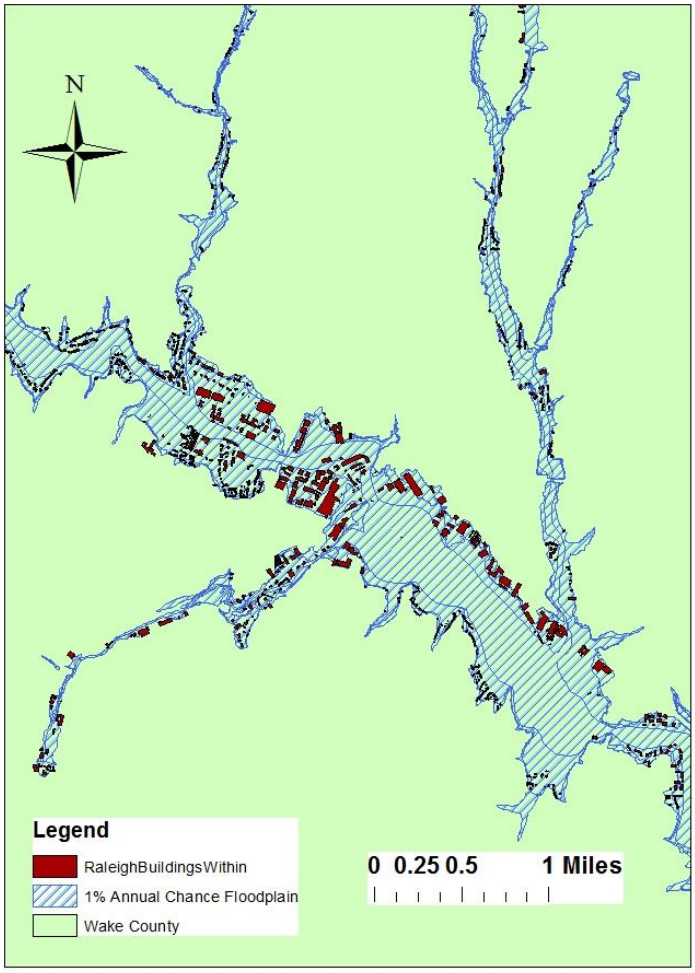
The data utilized for this analysis includes the one-percent annual floodplain maps, which was downloaded from the Digital Mapping part of the North Carolina Flood Mapping Program. Additional data was pulled from the GIS Server and included NHDPlusV2 map layer containing detailed information about the streams for the county. From this data watersheds and basins could be delineated for the area. Both land cover and impervious surface data came from the Multi-Resolution Land Characteristics Consortium (MRLC) for the year 2011. The database also provided percent change maps that spread from 2006 to 2011. The final layer including the building footprints for the city of Raleigh was provided by the Wake County GIS website.

Figure 3. Wake County Floodplain



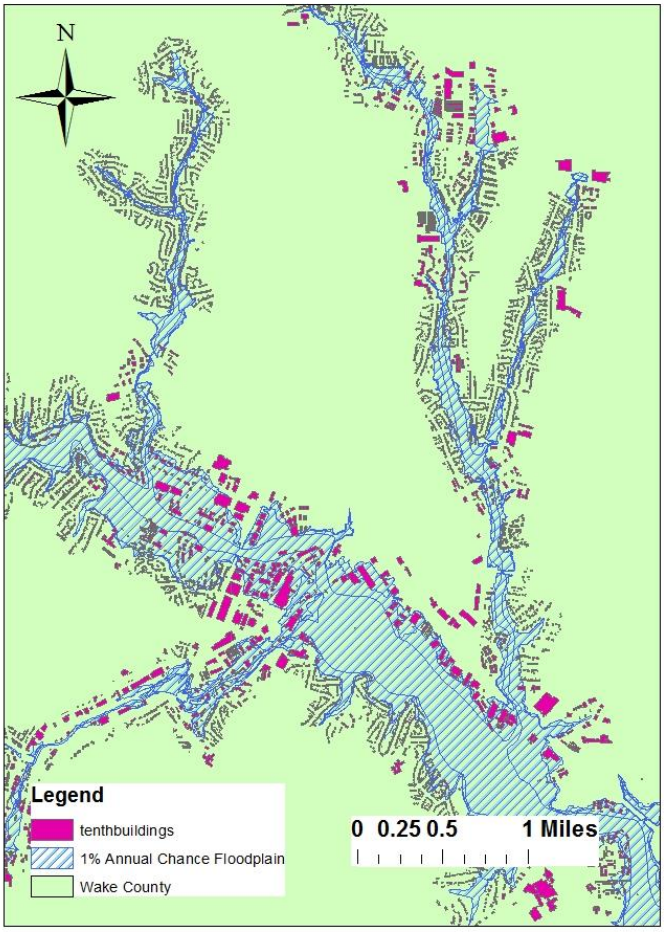
The first step for analysis was to find out how many buildings fell within the current standard for the one-percent annual floodplain. This evaluation required using the select by location tool in ArcMap to pull the buildings that fell within the flood zone polygons for the county.

Figure 4. Raleigh Buildings in Flood Zone



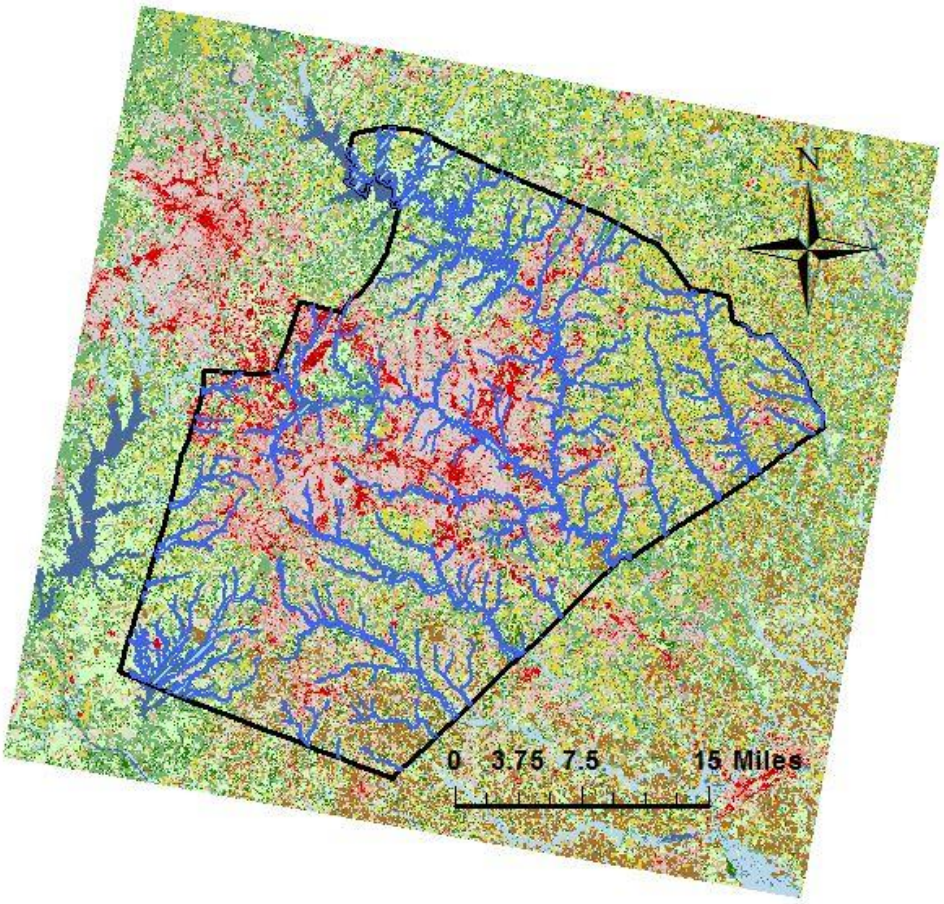
Following analysis of the current properties in risk, a tenth of a mile buffer was created around the flood zone to see how many additional properties would be effected if the flood zone were to increase. Other factors related to urbanization could be responsible for the expanse in the future so it is important to understand what is at risk for the county.

Figure 5. Raleigh Buildings in Flood One-Tenth Mile Buffer Zone



Once numbers were computed to determine the extent of the current flood impact area on buildings, a land cover map was analyzed to determine what the current use for the areas that fell within a short distance of the one-percent annual floodplain. The most obvious land use for the area shown in Figure 6 includes developed areas in the heart of Raleigh. There are pockets of bright red that indicate an area of more than eighty-percent development. The lighter shades of red and pink represent other fairly developed areas.

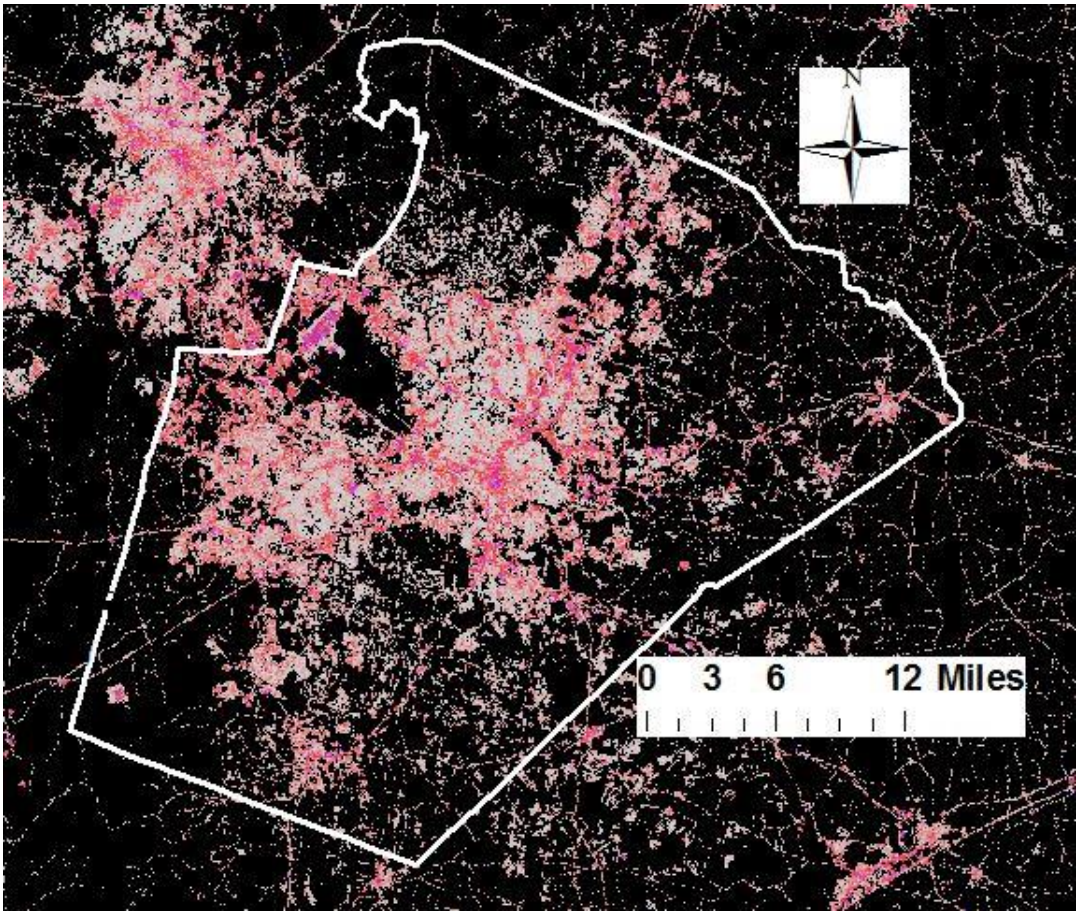
Figure 7. Wake County Land Cover



Another dominating feature in the 2011 Land Cover map is the green representing high amounts of vegetation. As of now, the vegetation is acting as a method for the ground to absorb greater amounts of water. The more it is removed, the higher chance there is of that particular area having significant runoff, which could lead to high discharge in the streams. If considered in combination with the population growth map (Figure 2), then the city of Raleigh and Wake County will need to consider how dense development is going to affect what the land looks like.

In Figure 7 the impervious surfaces are displayed for the county. There is an interesting correlation between the land cover data and impervious surfaces. Over ninety percent of the area that is considered developed in the land cover map is also considered eighty to one-hundred percent impervious. Although not a direct cause and effect relationship, there does seem to be some positive relationship. This could have many indications for how the city of Raleigh and Wake County could plan for the future. Perhaps, if there will be continued growth then there should be more of an attempt to include green roofs and green space amongst densely developed neighborhoods and commercial business parks. Not only would this prevent more widespread flood zones, but it would be appealing to the people occupying the area. The builders may not be as pleased with the additional zoning requirements, but it would benefit existing property owners and prevent high flood insurance rates in the near future if handled in such a manner.

Figure 7. Wake County Impervious Surface



Conclusion

Wake County will need to look ahead when considering how continued population growth will impact flood zones. Flooding impacts are often ignored when the area under consideration is far inland. This analysis shows that there is correlation between land cover use and the extent of impervious surfaces. The high rates of impervious surfaces will lead to additional runoff in close proximity to flood zone areas. This is already occurring in the central part of Wake County, but as the population spreads to the outer parts of the county, the influences of urbanization will as well. The

calculation with the Raleigh building footprint layer revealed that only 3,116 buildings, residential and commercial, fall within the current flood zone, but if the area were to be extended by just one-tenth of a mile on either side, then nearly 30,000 buildings would be at risk. The outcome from this report is most likely applicable to other growing counties across the nation and should be used when considering building zone requirements.

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