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Evaluating Urban Growth in Greenville County, South Carolina

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Camille Lasley, Introduction to Geographic Information Systems (GIS), Fall 2016

Introduction

Changes in land usage can have specific impacts on the overall environmental health of a community. Land use or land cover is defined as the characteristics of the earth's surface represented by the distribution of vegetation, water, soil, and other features such as those created by human activity (Rawat et. al., 2015). Urbanization is a process that decreases the amount of natural spaces such as forested areas. It replaces them with impervious surfaces. The more impervious surfaces due to urbanization means that there is more run-off during rain events (Hundecha et. al. 2004). This has the potential to cause harmful flooding to homes and businesses.

Application of remote sensing technology and Geographic Information Systems (GIS) have allowed for better monitoring of changes in land use. Satellite data like Landsat Thematic Mapper (TM) has been used for over 30 years by the United States Geological Survey (USGS) to obtain accurate and detailed information about the earth's surface (Rawat et. al., 2015). GIS can be used to analyze Landsat data and create land cover maps such as these. The expanse of urbanization can then be tracked using this technology.

Development within Greenville County has been steadily growing since the 1990's and is expected to expand even further in the coming years (Campbell et. al, 2008). Keeping up with the growth allows for better urban planning of the city. The goal of this project is to locate areas of urban growth within the county and determine the amount of change that has occurred within ten years.

Methods

Land cover data was collected from the National Landover Database (NLCD) for 2001 as well as 2011. NLCD provides a compilation of Landsat satellite data that covers the entire continental United States. NLCD contains 16-class land cover classification scheme based on the USGS land cover class definitions. The data for the entire country was then clipped down to only contain information regarding Greenville County. ArcGIS was used to create land cover data maps. These raw land cover data maps are shown in figures 2 and 3.

The data sets for both years were then combined into one single layer. This layer contained 135 classes with unique values that indicate the type of land cover that changed on a cell by cell basis. Classes that indicated human development were then extracted into a new layer. The new layer was reclassified by development intensity. This is shown in figures 4 and 5. Calculations could then be performed on the data. Landsat data has a spatial resolution of 30 by 30 meters. Therefore, each pixel on the map represents an area of land that is 30 by 30 meters. Using this information, areas could be calculated for the land cover classes of interest.

Census data was also collected to give further context to the grown of the county within the 10 years of the study. Total population, urban population, and rural population was accessed using the NHGIS (National Historic Geographic Information System) website. The data was taken from the closes decennial censuses to the NLCD data. Therefore data was used from the 2000 and 2010 censuses.

Results

Land Cover Change (2001-2011)

LAND COVER CLASS	AREA IN 2001 (KM²)	% OF TOTAL AREA	AREA IN 2011(KM²)	% OF TOTAL AREA	% CHANGE
DEVELOPED	531.71	25.8	588.72	28.6	10.7%
FORESTED	1068.63	51.9	1018.39	49.5	-4.7%
GRASSLAND	126.47	6.1	134.33	6.5	6.2%
AGRICULTURE /PASTURES	252.12	12.3	231.01	11.2	-8.4%

Figure 1: Table showing change in major land cover classes. The developed category includes all intensities of urban development. The forested category includes deciduous, evergreen, and mixed forest land cover classes. The agriculture category includes both the cultivated crops as well as the pasture land cover classes. The grassland category only includes information from the grassland land cover class.
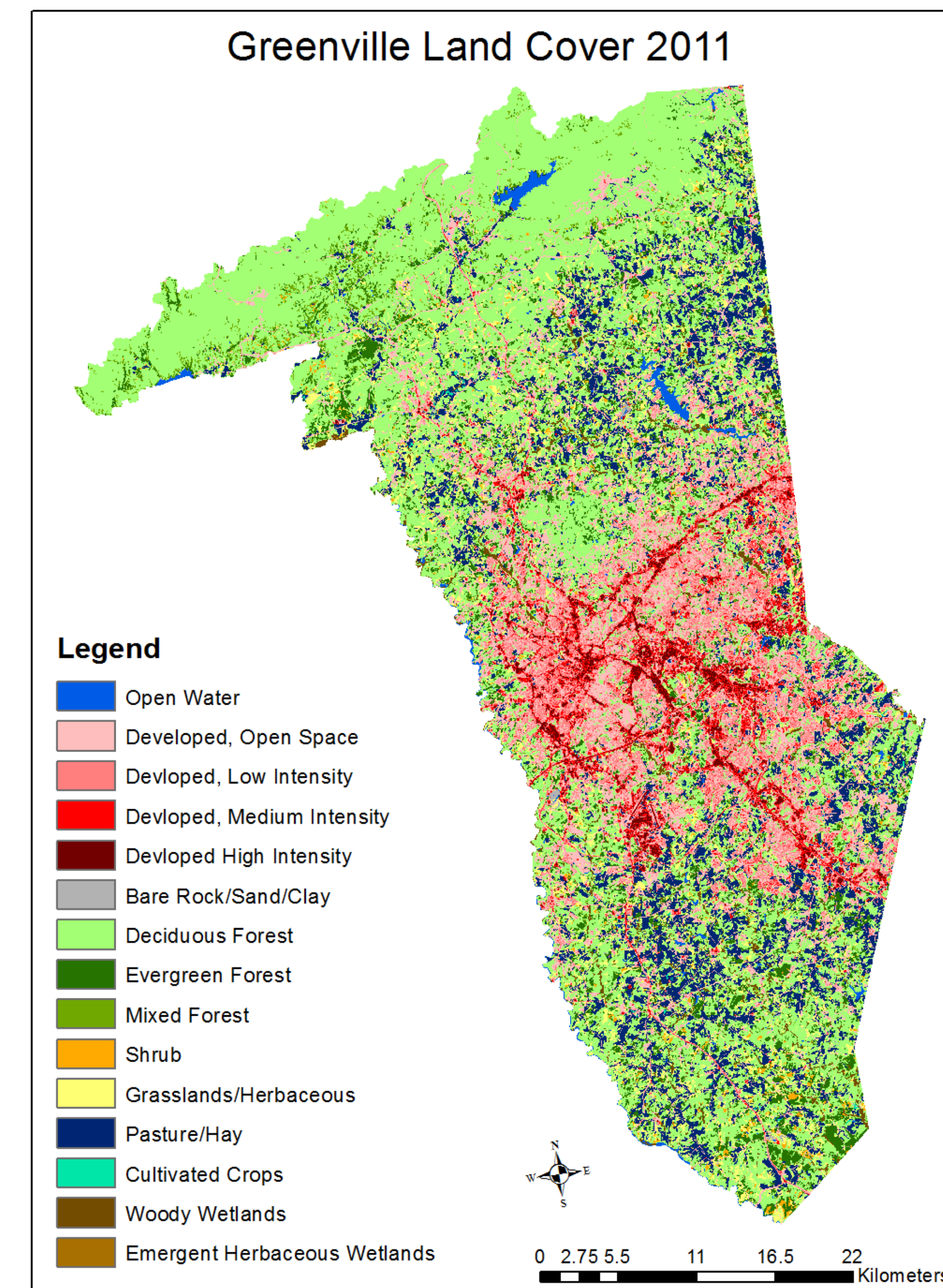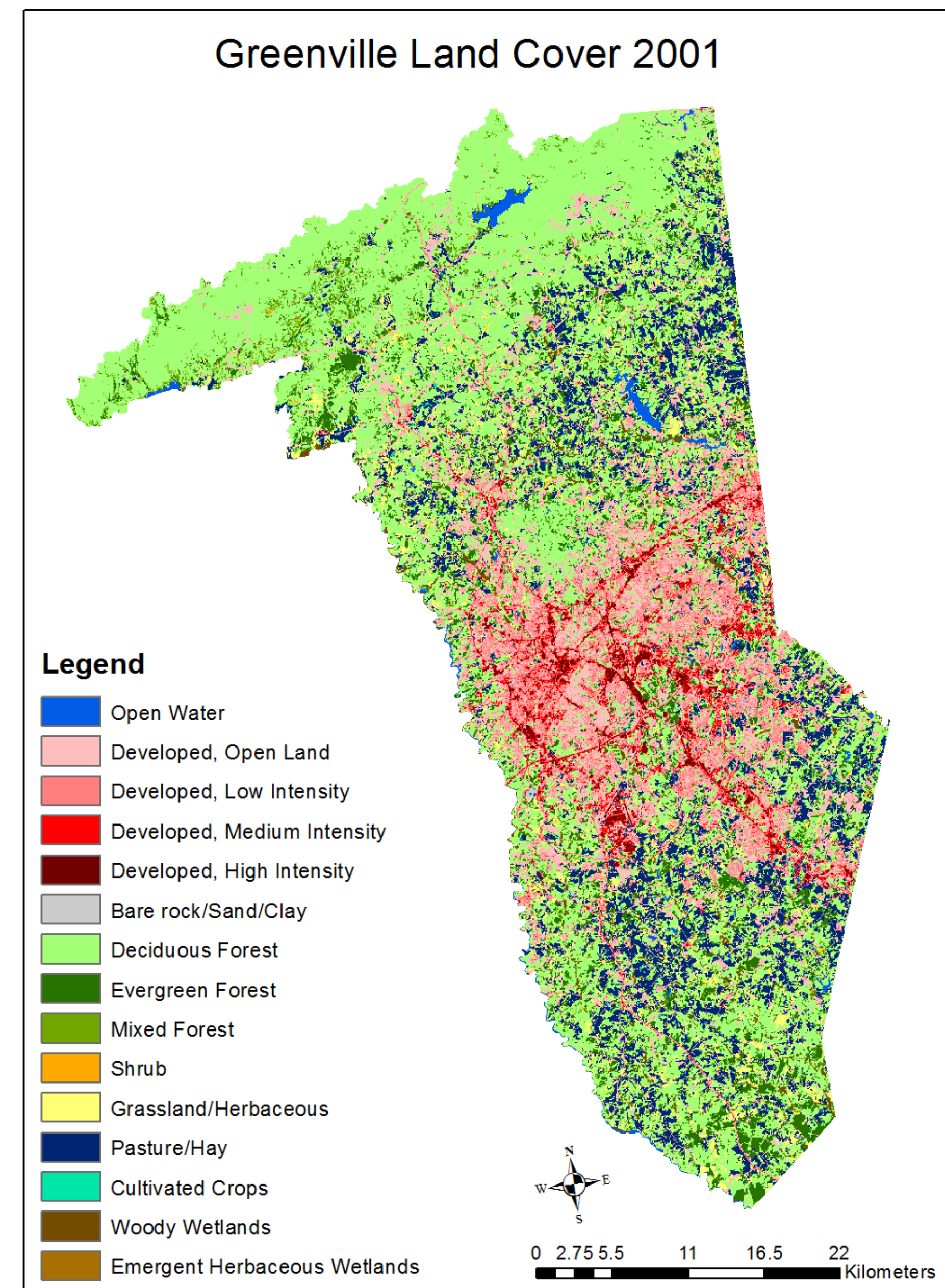
Results

Figure 2 (left) and Figure 3 (right): Land cover classification maps created using NLCD data. Figure 2 shows the total land usage of Greenville County in 2001. Figure 3 represents the land usage of Greenville County in 2011.
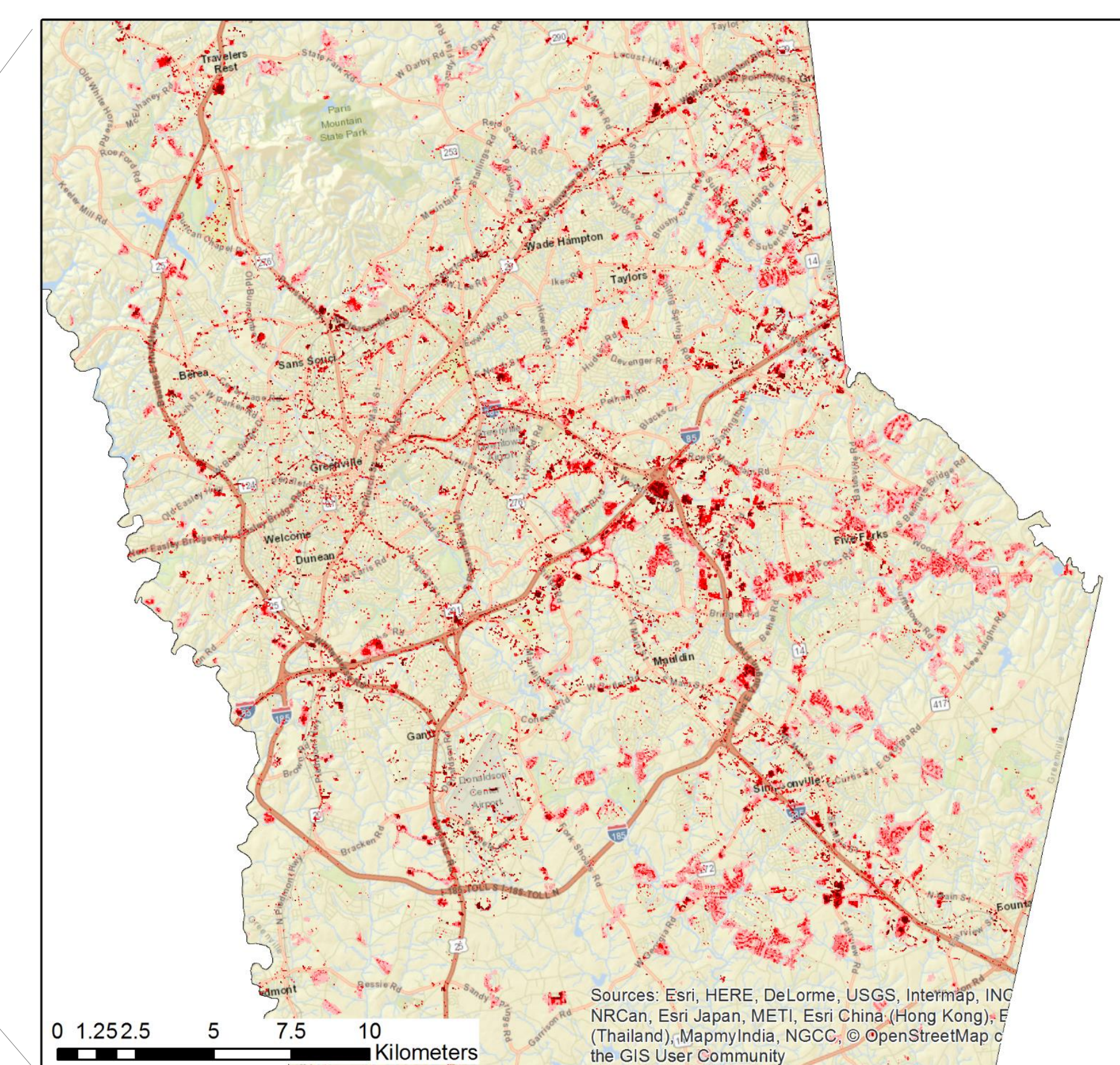

Figure 4 (left) and Figure 5 (above): Maps showing new development within Greenville County from 2001 and 2011. This map does not include areas that were previously developed and experienced no further change within the 10 years of this study. Figure 5 is zoomed in to show the area with the most development in greater detail.
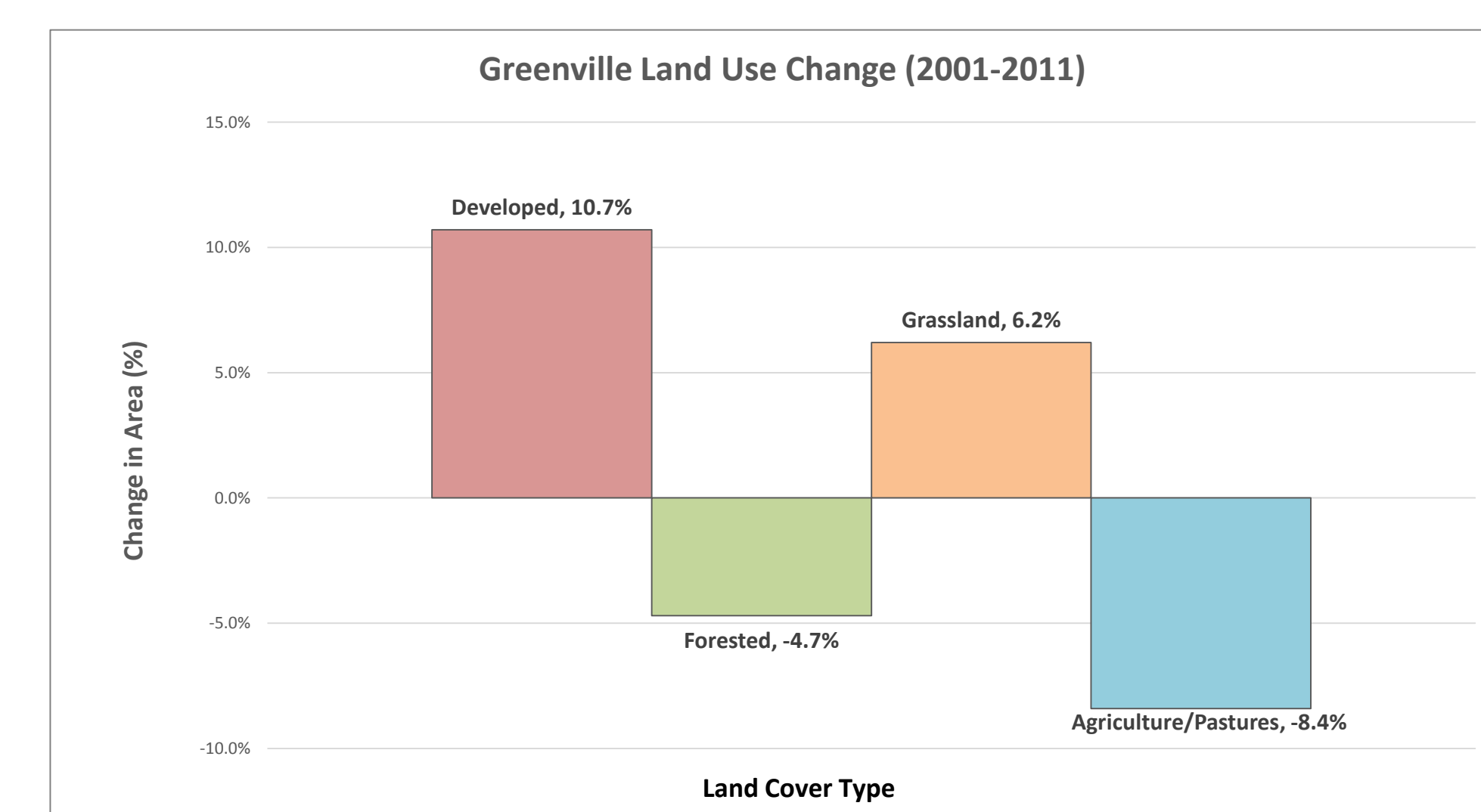

Figure 6: Graph showing the percent change in land cover that was calculated in Figure 1.

Greenville Population

Year	Total	Urban	% Urban	Rural	% Rural
2010	451,225	394,345	87.4%	56,880	12.6%
2000	379,616	314,840	82.9%	64,776	17.1%

Figure 7: Table showing population changes within Greenville County from 2000 to 2010. This also includes Information about the breakdown of urban and rural populations.
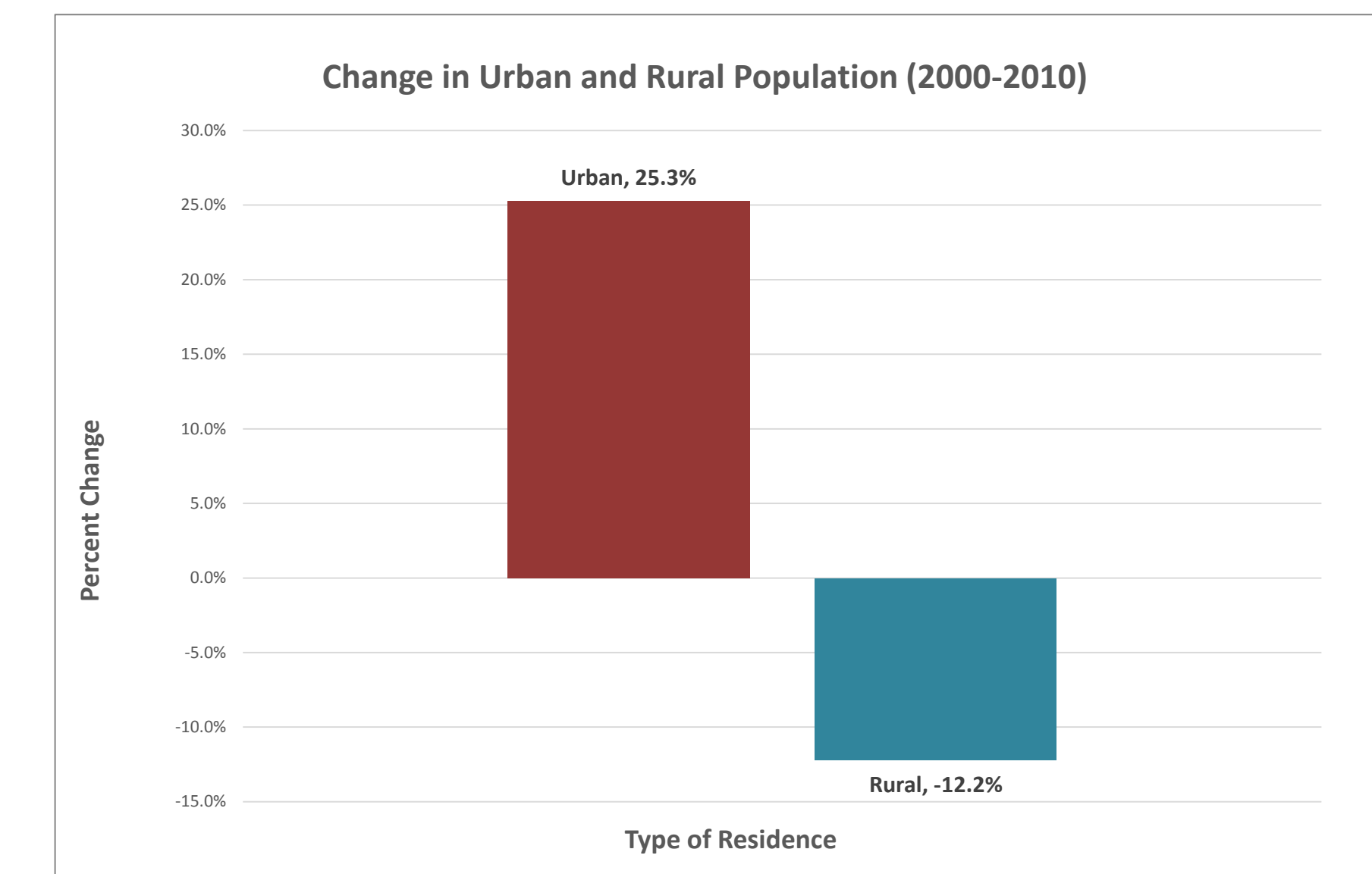
Results

Figure 8: Graph showing the change in the percent of the Greenville population in regards to both rural and urban populations. Data was collected from the decennial censuses of 2000 and 2011.

Discussion and Future Directions

According to this analysis, there was a 10.7% increase in the amount of developed land within the county. This resulted in a gain of 57 square kilometers of developed land. Because of this urbanization there was a 4.7% loss in forested areas. This means that the county lost over 50 square kilometers of forests within 10 years. The census data from 2000 and 2010 also indicate a push towards more urban living rather than rural. In order to accommodate the movement, more land has to be developed into houses or commercial complexes to support the growing urban population.

Figures 4 and 5 show different patterns of development. Around major road ways there are clusters of high intensity development. These clusters could be commercial development. Further away from these roads are different kinds of developments. These look to be more residential due to their lower intensity.

Even though this project has shown how Greenville county has grown, it is synthesized from data collected 5 years ago. Within this time there has been a substantial amount of development, urbanization, and deforestation within the county. New land cover data, as well as updated census data, would allow for a more up to date information about urbanization. In the future, this process could be repeated again to get more accurate data about the current state of the county.

References

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Data Sources

Acknowledgements

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