

# The Persistence of Political Segregation: Racial Underbounding in North Carolina

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Racial residential segregation remains a fact of life in the South. While there is less racial residential segregation in southern metropolitan areas than there is across the rest of the nation, we know little about racial segregation or its consequences in small towns across the South. This paper examines racial residential segregation in small North Carolina towns, focusing in particular on political exclusion as a form of segregation.

Political exclusion, or “underbounding” as Aiken (1987) labeled it, occurs when African American neighborhoods are kept just outside of a town’s boundaries, resulting in lower levels of services, reduced access to infrastructure, and limited or no political voice in land-use and permitting decisions. African American communities are systematically excluded from towns by administrative decisions made by elected and appointed officials and the gerrymandered exclusion of African American residents from small towns of the South.

Considerable attention was given to southern towns during the civil rights and voting rights drives in the 1960s. Since then, little attention has been paid to racial segregation in small southern towns by journalists or social scientists, and institutionalized segregation has taken new forms. While overt discrimination is less common in towns across the south, local institutions, such as public schools, have re-segregated (Orfield 2001). And in spite of increased numbers of African Americans elected to local councils and commissions, the real political power in most southern towns still resides with the local white elite, whose political, governmental and commercial interests inevitably intersect, and whose commercial interests override public interests (Johnson et al. 2003). Both the relative isolation of such towns and the mundane nature of institutionalized regulatory segregation have largely kept the discriminatory practices and results from the public eye.

This paper describes underbounding in several North Carolina towns, using public Geographic Information Systems (GIS) data. The maps showing underbounding are a snapshot of the existing situation; they tell us nothing about the processes that resulted in exclusion or more inclusive spatial arrangement. Considerable empirical work remains to identify causes and consequences, but the process of annexation in North Carolina appears to be a central factor leading to racial exclusion.

#### *Previous Research*

Research on racial residential segregation in American cities has a long and distinguished position in the social sciences (e.g. Jahn et al. 1947; Duncan and Duncan 1955; White 1986, Massey and Denton 1993). While segregation of African Americans appears to have declined modestly nationally (Logan et al. 2004; Iceland and Weinberg 2002; Glaeser and Vigdor 2001),

hypersegregation of African Americans marks many metropolitan areas, notably in the North and Midwest (Wilkes and Iceland 2004). There is an extensive research literature on causes and consequences of the segregation and isolation of African Americans in central cities (e.g. Goldsmith and Blakely 1992; Massey and Denton, 1993; Oliver and Shapiro, 1995; Wilson 1990, 1996) and on policies aimed at addressing these problems (e.g. White and Shy 2002). Causes of segregation and isolation of African Americans and other minorities in central cities include: *de jure* racial residential segregation from the early 1900s (Massey and Denton, 1993); race-restrictive covenants (Ford and Griffin, 1979); racial steering on the part of real estate agents in private housing markets, and on the part of governmental officials in public housing, restricting Blacks to certain (usually aging and deteriorating) parts of cities (Galster and Godfrey, 2003; Foster et al. 2002); redlining of racially-transitioning areas within cities by financial institutions (Goering and Wienk, 1996; Oliver and Shapiro, 1995; Squires, 1997); and exclusionary and expulsive zoning ordinances — laws and regulations instituted to control the social and economic composition of neighborhoods, used most often in suburban jurisdictions (Thomas and Ritzdorf, 1997; Rabin, 1989). These techniques have been used historically and contemporaneously to create and maintain segregated housing patterns and have contributed to the increasing concentration of poverty, and to the growth of an underclass in U.S. cities (Massey and Denton 1993).

Segregation in and around southern towns differs from the metropolitan patterns in four primary ways. First, owing to differences in scale, the potential exists for greater interracial exposure and interaction in small southern towns than in U.S. central cities. Second, residential segregation in small towns is fragmented (see Figures 1 and 2). Third, the historic land ownership patterns of freed slaves and the settlement patterns of rural black migrants during the 1960s and 1970s resulted in high concentrations of blacks located just outside the borders of towns as well as segregated within towns (Cromartie and Beale 1994). This concentration of African Americans around the periphery of southern towns is an alternative form of social and economic isolation (Aiken 1985; 1987; 1990). Fourth, political boundaries continue to be drawn to exclude African American neighborhoods.

The history of the manipulation of town boundaries to exclude and isolate African Americans is better known among legal scholars than by social scientists or the public. For example, in the mid-1950s, Tuskegee, Alabama, redrew its town boundaries to remove black neighborhoods, an action reversed in 1960 by the Supreme Court in *Gomillion v. Lightfoot*. Annexation dilutes the African American vote within a town if only white areas are annexed, a process recognized in Section 5 of the

Voting Rights Act. Clearance for annexation is required across much of the South ([www.usdoj.gov/crt/voting/sec\\_5/about.htm](http://www.usdoj.gov/crt/voting/sec_5/about.htm)), though enforcement of this provision is, at best, occasional. Aiken (1987) examines the legal aspects of underbounding in the Yazoo Delta. However, there is no more recent empirical research on the effects of municipal annexations on segregation.

In North Carolina, exclusionary segregation results in part from the state's annexation laws and planning practices. These laws give towns the discretion to annex only properties with high tax values, even non-contiguous properties, resulting in discontinuous boundaries that skip over poor and Black neighborhoods (Joyner and Parnell 2003). Whether the unintentional outcome of fiscally driven annexation processes or the intentional result of institutionalized actions by local governments, Blacks are excluded from towns and the associated political and material benefits. One case study documents in detail the processes and consequences of institutionalized exclusion (Parnell et al. 2003). Vestiges of Jim Crow are a part of daily life and racial discrimination is embedded in the seemingly ordinary planning actions of small southern towns (Johnson et al. 2003). The processes vary state-to-state, but the resulting racial gerrymandering is the same.<sup>1</sup>

#### *Geographic Information Systems and Data*

Geographic Information Systems (GIS) is a system of hardware and software used for storage, retrieval, mapping, and analysis of geographic data. GIS is a powerful tool to examine patterns of racial disparities in the drawing of city boundaries and zoning districts, provision of city services such as water and sewer, and selective application of zoning regulations in cities and counties across North Carolina. Public GIS data from local planning departments, state agencies, the U.S. Census and other sources has reached a level of coverage that allows detailed examination of spatial patterns of discrimination in most North Carolina communities.

The data for this analysis are from multiple sources. First, racial data and some boundary files are from Census 2000. Most city boundaries are from local government planning and tax assessment offices, as are most sewer and water lines and streets.

One key political jurisdiction that we examine is Extraterritorial Jurisdiction (ETJ). ETJ was created as an area outside of a town's boundaries over which the town has complete land-use, permitting and zoning control. The rationale for an ETJ is that it is a mechanism for rational planning

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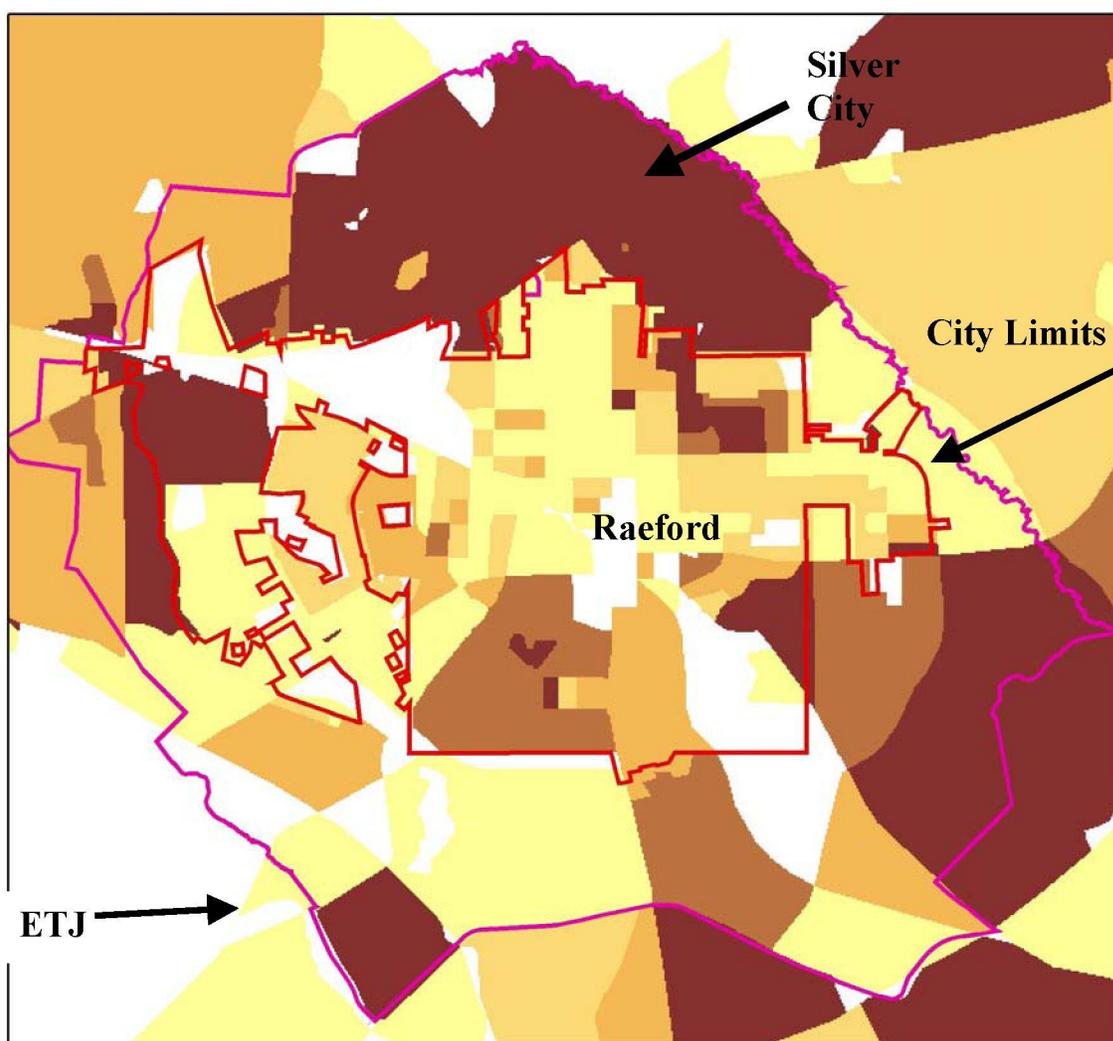
<sup>1</sup> For example, Aiken (1990) documents the use of HUD money to building housing projects outside of towns in Mississippi. A second example is Charlottesville, VA., where a majority of the public school students are black. The city is paid annually by the surrounding Albemarle County, where there are relatively few blacks in the public schools, not to annex any properties.

for growth. Residents of an ETJ have no elected representative in the town government that makes decisions regarding their property. Further, there is no mechanism that limits the duration that an area can stay within an ETJ before annexation occurs, allowing some towns to keep “less desirable” neighborhoods in their ETJ in potential perpetuity.

*Examples of Racial Underbounding*

The maps in this paper illustrate patterns of racial residential segregation in small cities and towns that we have found across North Carolina.<sup>2</sup> Map 1 shows Raeford, N.C. and the surrounding area.

**Map 1: Raeford, Hoke County, N.C.**



The red line shows the city limits, and the purple line shows the boundary of Raeford's Extraterritorial

<sup>2</sup> Each form of segregation (e.g. underbounding) is not found in every place, but racial residential segregation is present in all North Carolina towns with minority populations.

Jurisdiction. Of the 3,386 town residents in Census 2000, 1,786 are white (53%), 1,386 (41%) are African American, and the balance are of other, multiracial backgrounds. However, the racial composition of the ETJ is overwhelmingly (74%) African American. Outside the northern border of Raeford is a concentration of African Americans in an unincorporated town called Silver City. Silver City is recognized as a Census Designated Place (CDP). CDPs are defined by the Census Bureau as, “closely settled, named, unincorporated communities that generally contain a mixture of residential, commercial, and retail areas similar to those found in incorporated places of similar sizes.”<sup>3</sup> In 2000, the population of Silver City was 1,146, of which 1,080 (94%) were African Americans and 39 (3%) were white. Silver City is a town in all ways except legally. Because it is in Raeford’s ETJ, residents of Silver City must obtain building permits and all other land-use permits from the Raeford government, but the Silver City residents cannot vote in Raeford elections. If Silver City were to be merged with Raeford, African Americans would comprise 54% of the population and would be in a position to have majority political control.

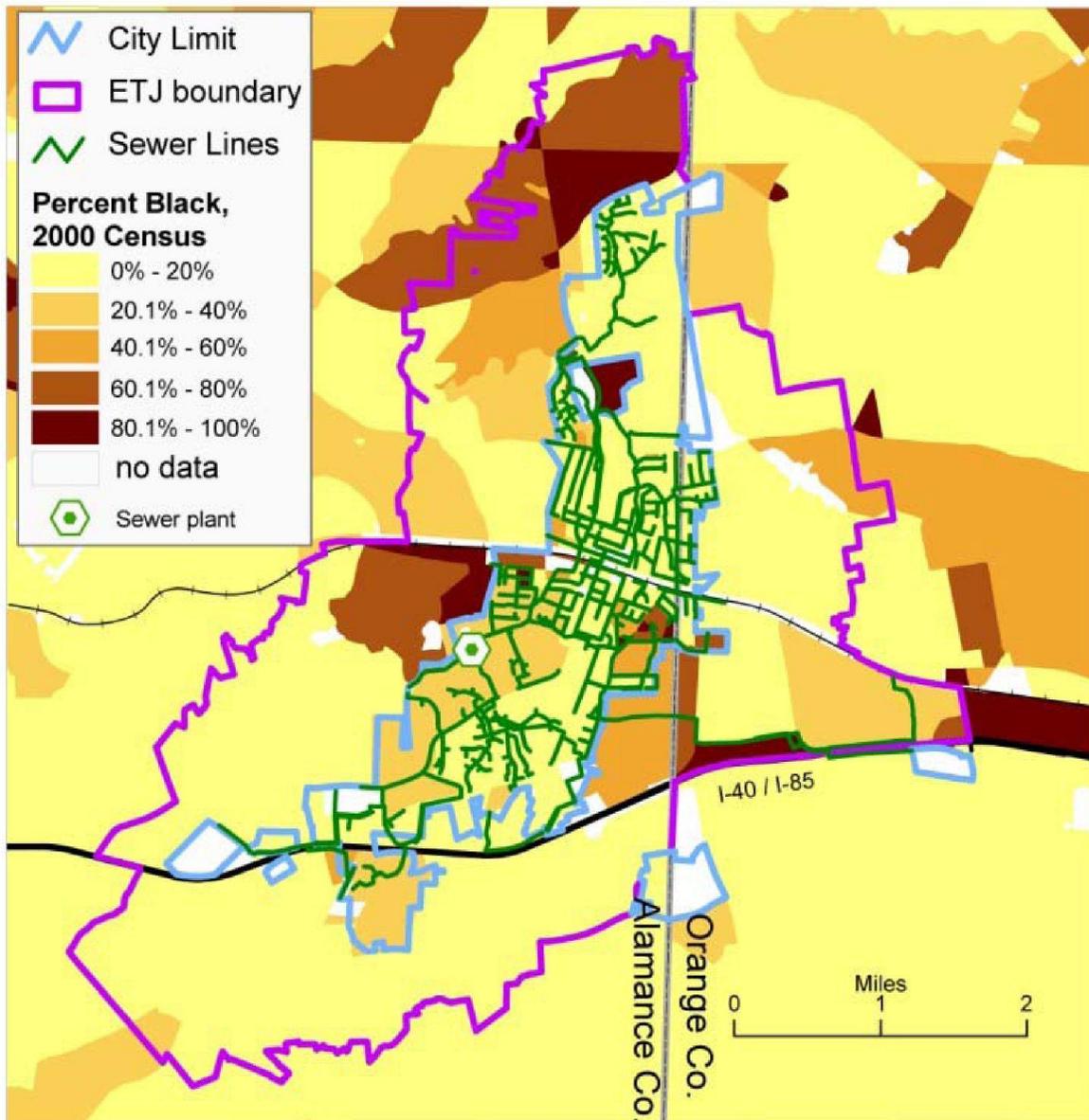
Map 2 shows Mebane, N.C, and the surrounding area.<sup>4</sup> The African American communities of West End, White Level, and Buckhorn/Perry Hill have been deliberately excluded from Mebane (Johnson et al. 2003; Parnell et al. 2003). West End and White Level border Mebane. Neither have sewer, though West End sits next to the sewerage treatment plant, and the sludge trucks from the plant ran through West End until several years ago. Residents of White Level requested annexation in 1997 because of problems with their septic tanks, but the town took no action. Human fecal bacteria attributed to failing septic systems have been found in all three neighborhoods (West End Revitalization Association 2003). Both White Level and West End are in Mebane’s ETJ, as shown in Figure 2. A small part of Buckhorn/Perry Hill is in Mebane’s ETJ, and this area was rezoned from residential to manufacturing with no input from the residents. Note Mebane’s use of satellite annexation for expansion. Joyner and Parnell (2003) documents the processes and consequences of institutionalized exclusion in Mebane in greater detail.

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<sup>3</sup> Complete information can be found at <http://www.census.gov/geo/www/psapage.html#CDP>.

<sup>4</sup> Mebane is the first place we mapped underbonding. This pattern was identified by Omega Wilson, President of the West End Revitalization Association, a CDC fighting for equitable resources for the communities and to block a proposed bypass that affects both West End and White Level.

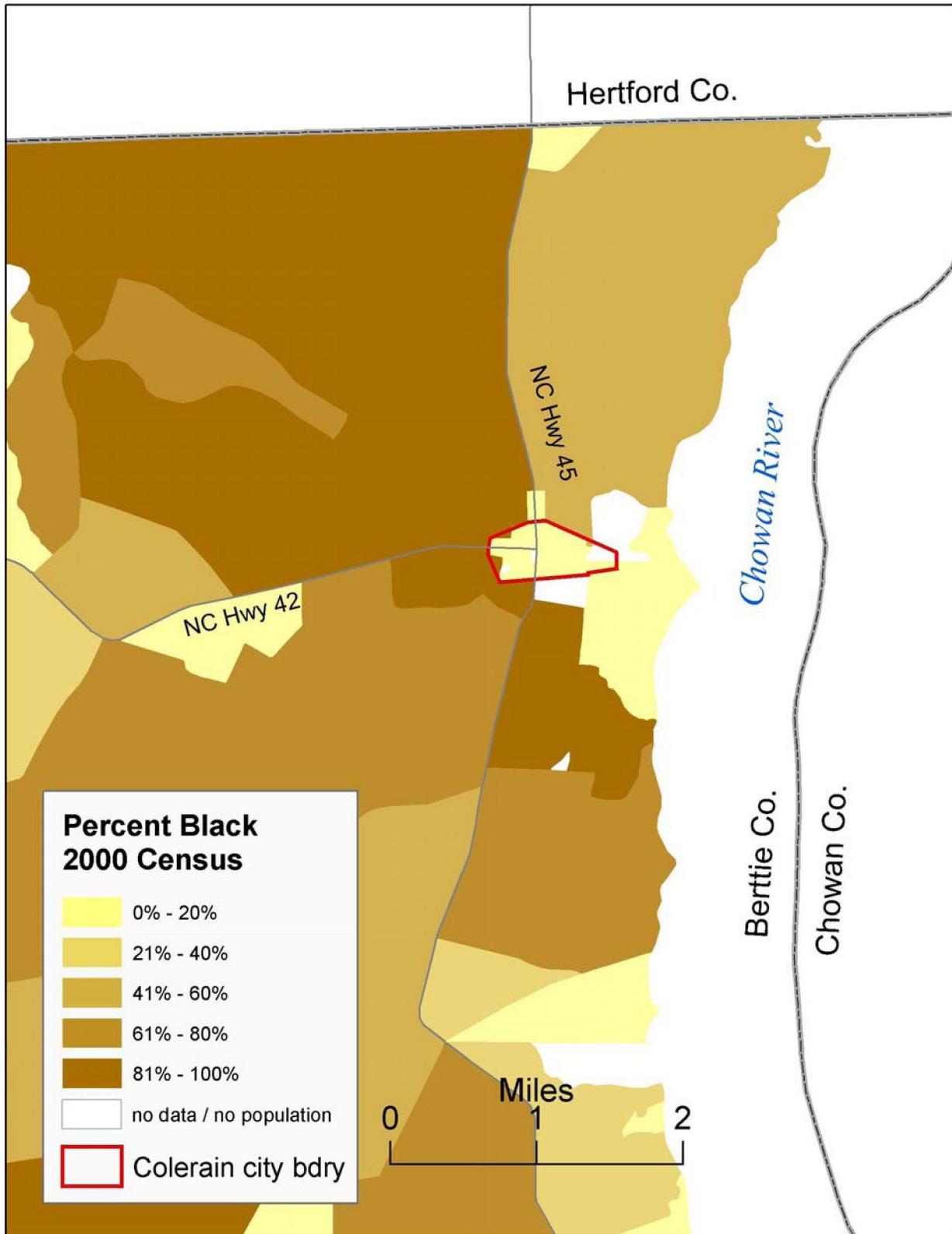
**Map 2: Mebane, Alamance and Orange Counties, N.C.**



**Figure 2** (below): Mebane, NC (Orange and Alamance Counties). Illustrates concentration of Black neighborhoods outside of city limits and within extra-territorial jurisdiction; withholding of sewer service from Black neighborhoods (note sewer plant adjacent to unserved Black communities); multiple satellite annexations of commercial tracts (blue boxes along interstate). *City limits, ETJ, sewer lines from Triangle J Council of Government GIS files; demography from 2000 Census; transportation lines from ESRI Corp.*

Colerain, a small farming and fishing town in Bertie County, is shown in Map 3.

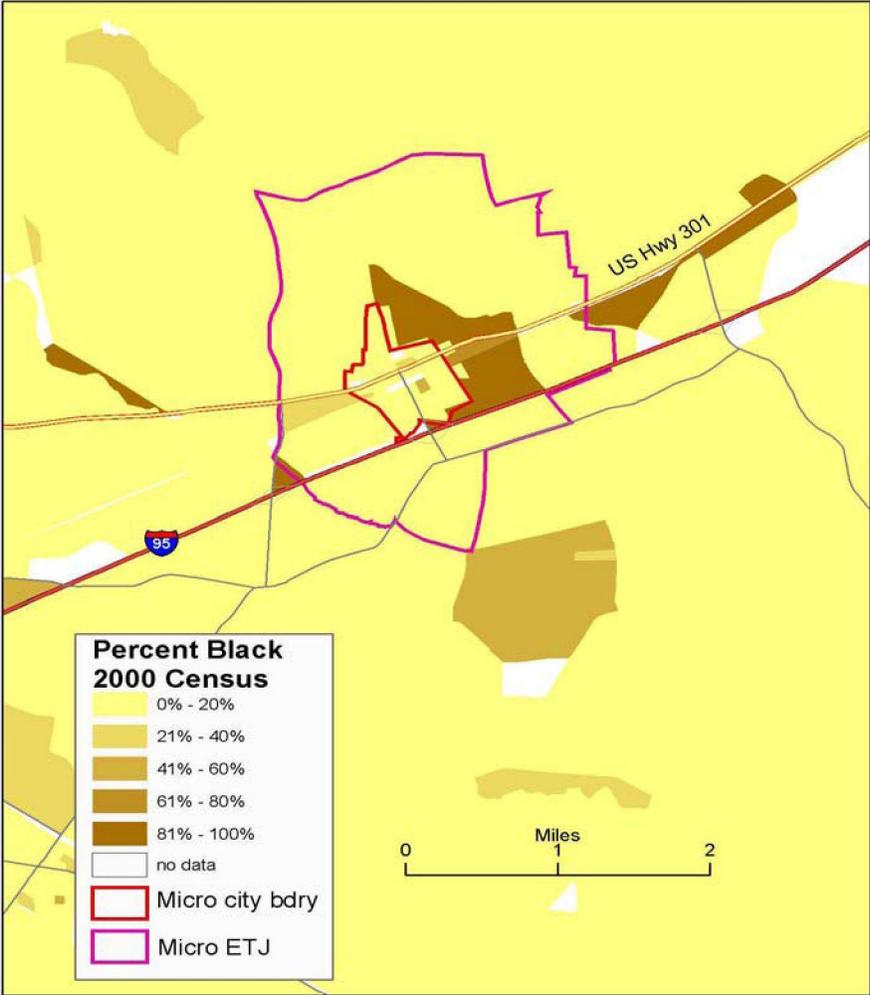
**Map 3: Colerain, Bertie County, N.C.**



This town is a white enclave (93%) in a predominantly African American county (63%). The census blocks bordering Colerain are overwhelmingly African American (79%), and if the small, all-white waterfront subdivision along the bluffs of the Chowan River is excluded, almost entirely African American.

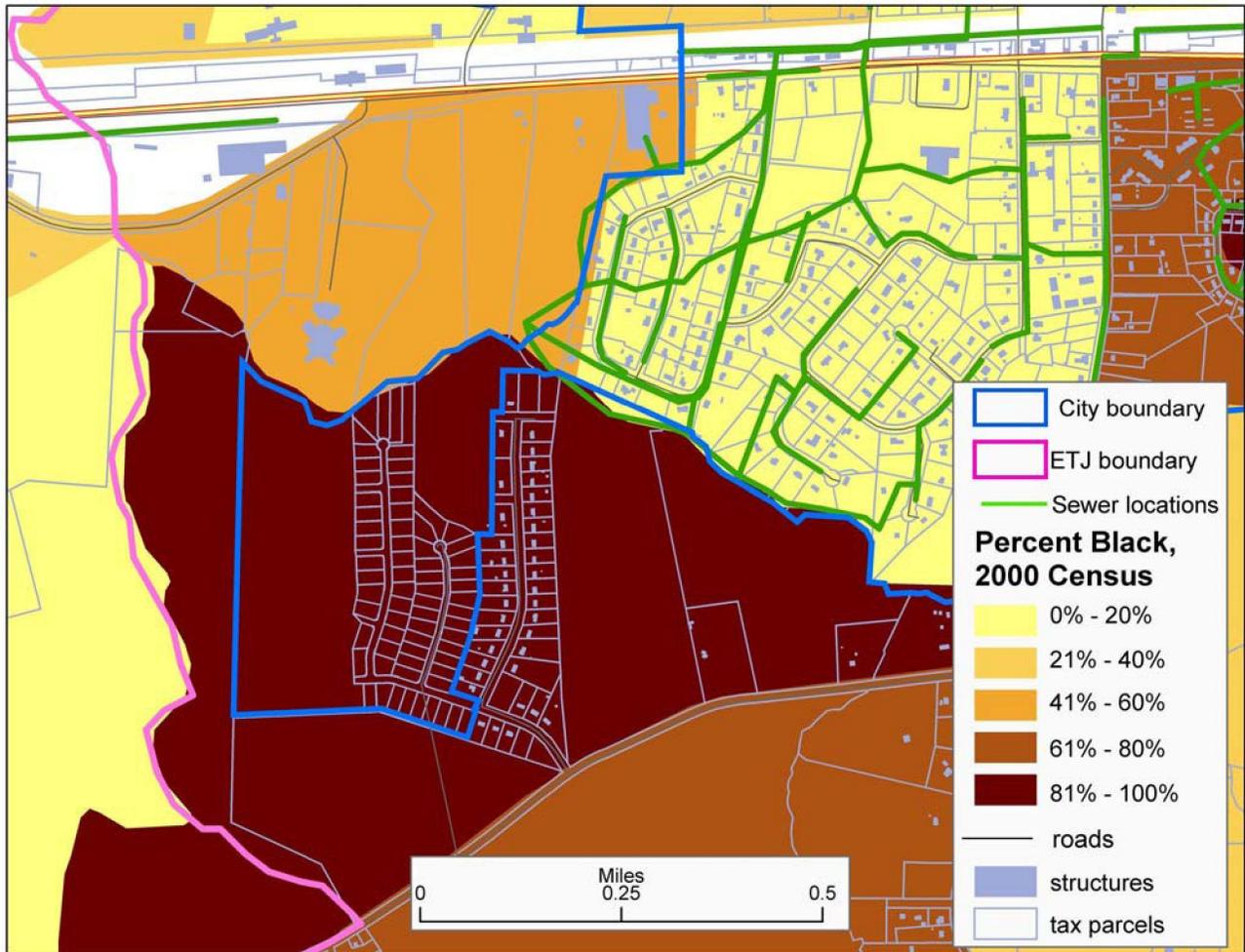
Micro, shown in Map 4, is a small town in Johnston County. This town of 454 has only 35 African American residents, but the area on the eastern border of the town is almost completely African American. Note that the excluded African Americans are within Micro's ETJ.

**Map 4, Micro, Johnston County, N.C.**



Map 5, Wingate, North Carolina, shows a newly-annexed area in a census block that was over 95% African American in 2000. By adding the parcel boundaries from the county property tax GIS files and the building footprints from the county planning department, one can see that the annexation is of a new subdivision. None of properties with existing houses occupied by African Americans were annexed. Union County has become a suburb of Charlotte and has the highest growth rate in the state,

**Map 5: Wingate,NC**

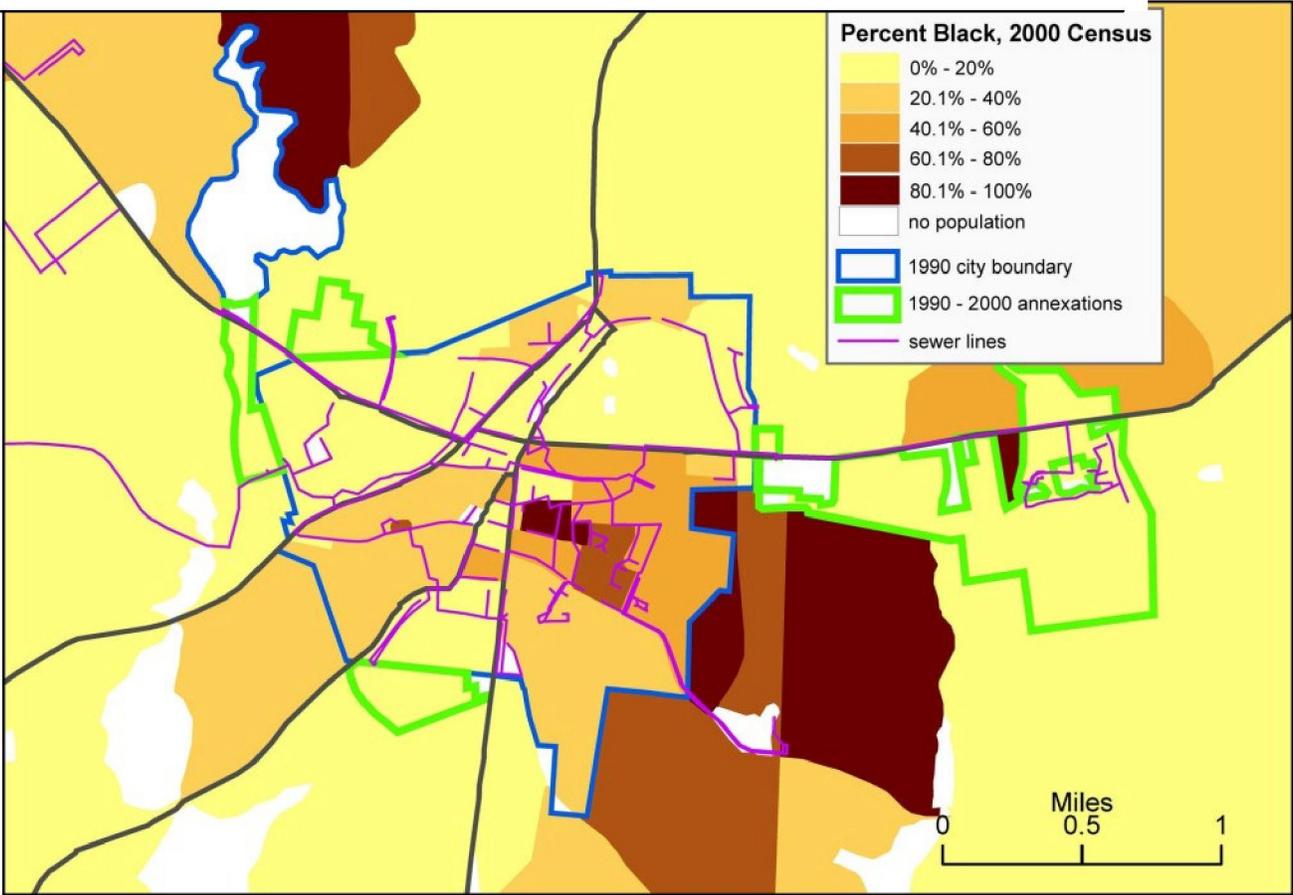


along with the highest median family income for whites (Census 2000 SF3). The white population in this county grew by more than 50,000 during the 1990s, while the African American population grew by less than 2,000. One finding in the 1987 Pleasant Grove case was, “plans for relatively expensive housing there [which] indicated that it was likely to be developed for use by white persons only” (*City of Pleasant Grove v. United States*, 479 U.S. 462 (1987)).

Map 6 shows the 1990 and 2000 boundaries of Creedmoor, North Carolina with its racial composition. The 1990 boundary (blue line) excludes the African American residents on the western

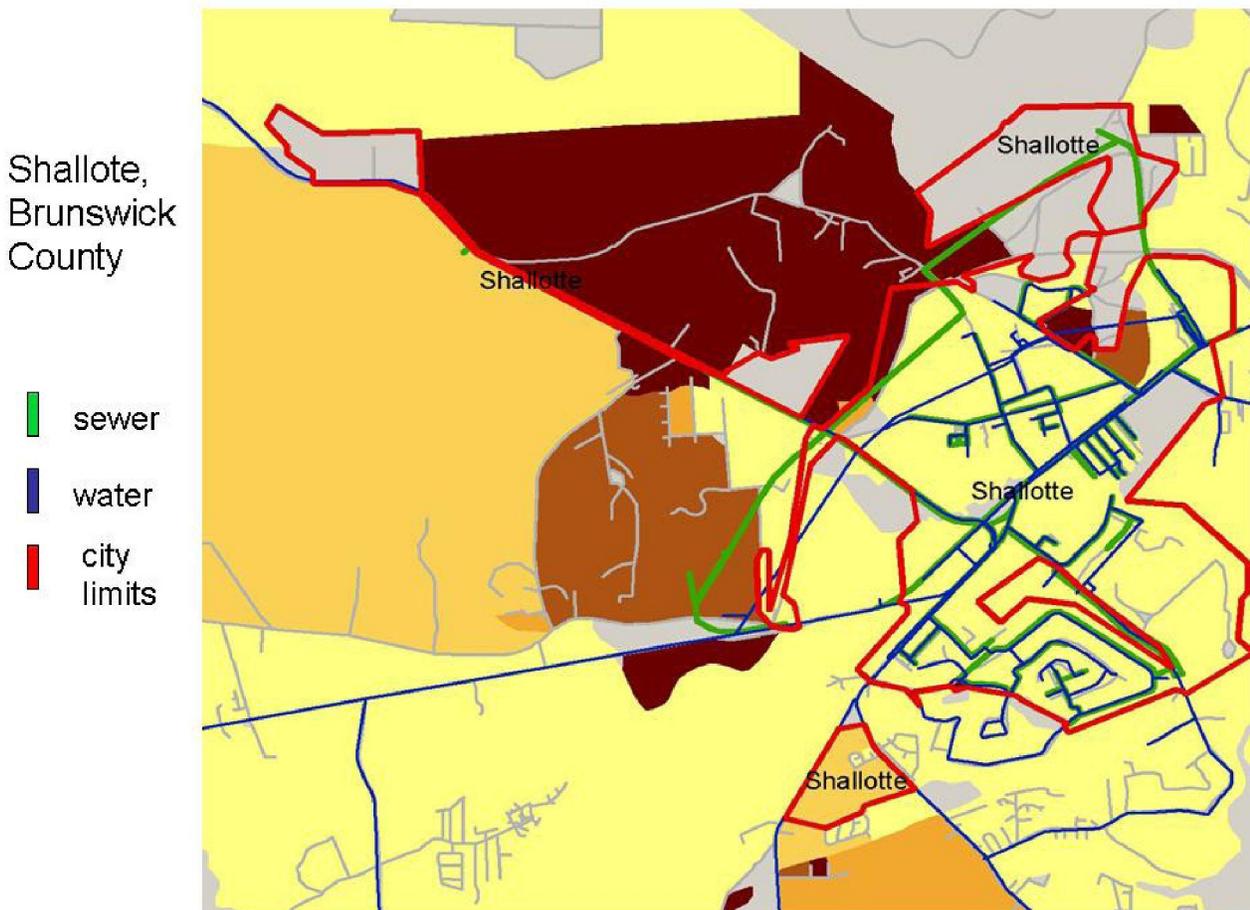
and southwestern sides of the town. Creedmoor annexed considerable area between 1990 and 2000. None of the annexations on the western side of town include any of the large African neighborhood excluded by the 1990 boundary, and the new boundaries specifically goes around another African American neighborhood.

**Map 6: Creedmoor, NC**



Shallotte, in Brunswick County, has an unusually complex city limit, with a satellite annexation, balloon annexations to commercial areas and a clear pattern of racial exclusion (Map 7). On three different borders, African American neighborhoods are just outside of the town limits. One balloon annexation runs along a road on the border of an African American neighborhood, but the residents are not included.

**Map 7: Shallotte, N.C.**



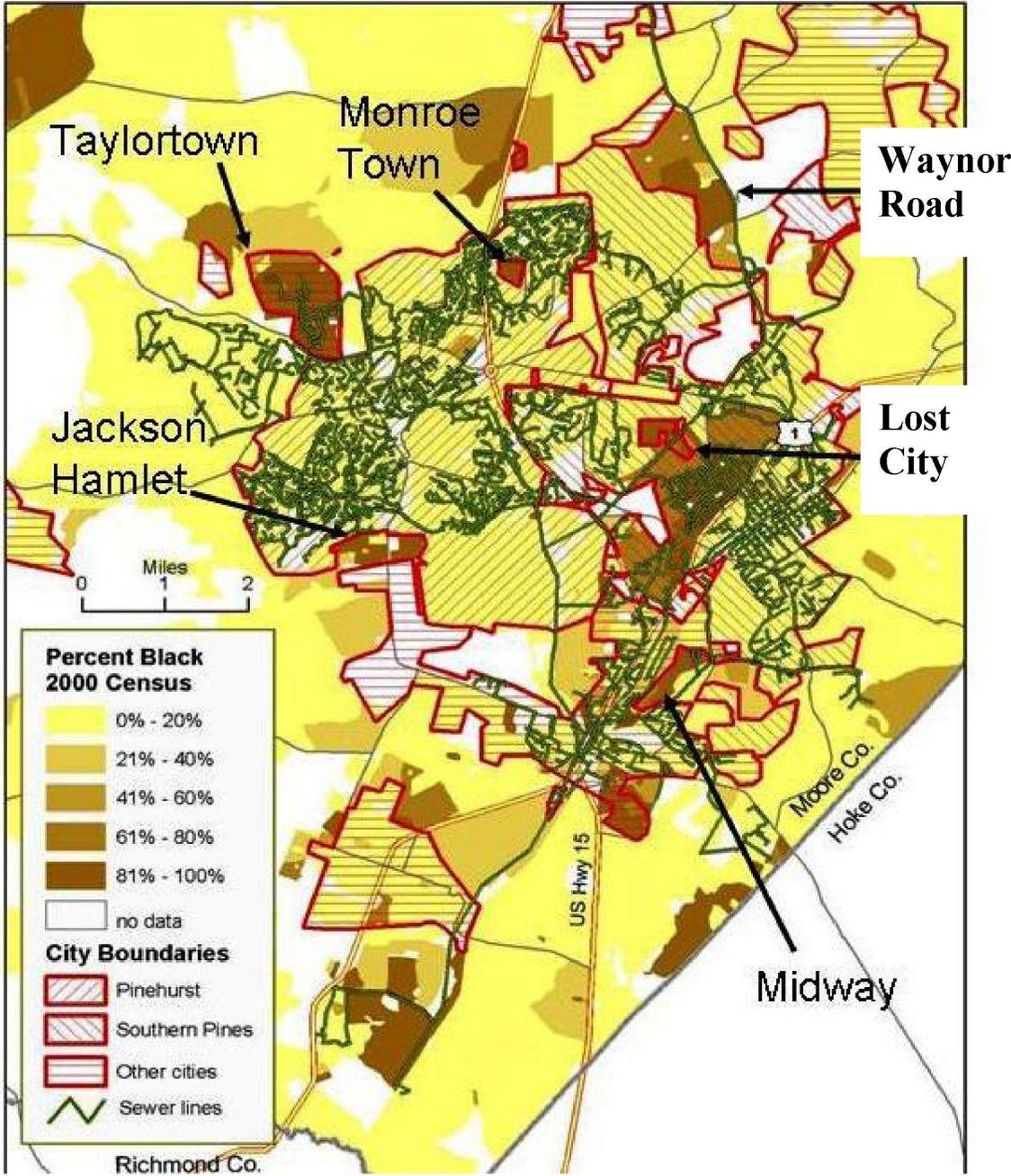
*Case Study: Southern Moore County*

This section examines in detail a pattern of underbunding in southern Moore County, in and around the towns of Pinehurst, Southern Pines and Aberdeen. This area is shown in Map 8.

The situation in southern Moore County is a good illustration of the ways that residential segregation in small southern towns differs from the urban pattern that has received so much attention. Urban segregation is a concentration of African Americans in central cities, with exclusionary zoning and other mechanisms in surrounding suburbs making movement out of the central city difficult. In the towns of the South, the African American population is much more spatially fragmented, with large and small communities within and outside of towns. There clearly are concentrations of African Americans in towns, notably – in this situation in Moore County – in west Southern Pines. These differences come from the very different settlement histories, the urban pattern resulting from migration in the early and mid-twentieth century and the rural and small town pattern rooted in the

settlements following slavery and subsequent opportunities in rail yards, factories and other sources of employment.

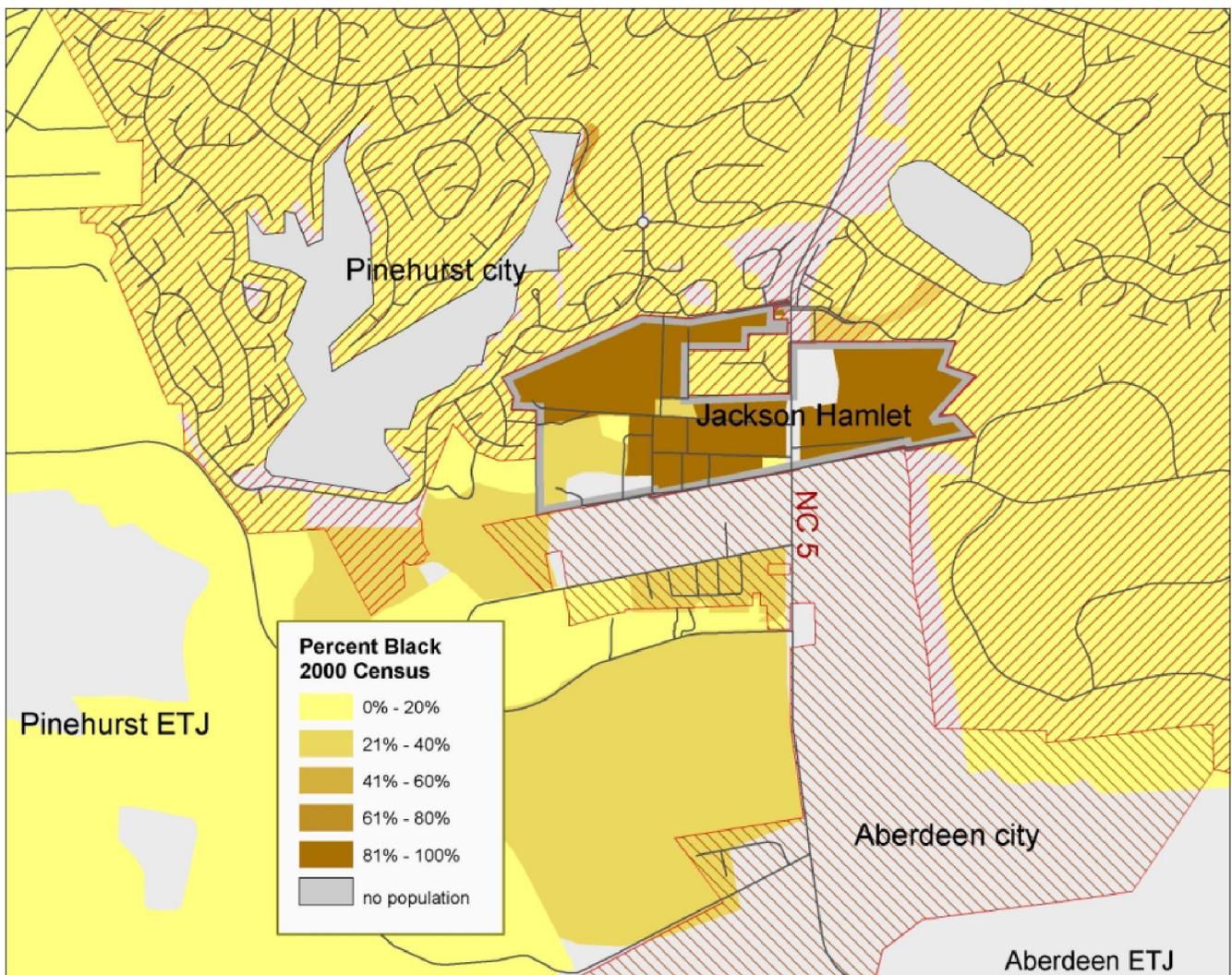
**Map 5: Southern Moore County, N.C.**  
**African American neighborhoods with which we are working**  
**in partnership with the UNC Center for Civil Rights**



Underbounding—the exclusion of African American neighborhoods from towns — is clearly seen in all of the figures of southern Moore County. Map 8 identifies five excluded neighborhoods:

Jackson Hamlet, Monroe Town, Waynor Road, Lost City and Midway. Taylortown is a predominantly African American town bordering Pinehurst that incorporated in 1987. All of the other neighborhoods are in an ETJ of the various towns. Pinehurst excludes two neighborhoods: Jackson Hamlet and Monroe Town. Jackson Hamlet is the larger of the two neighborhoods, with approximately 250 residents. It is shown in Map 9. The neighborhood contains many small houses on small lots and three churches. The sewer lines stop at the border of Jackson Hamlet, though water lines have been in place since the late 1990s as a result of a Community Development Block Grant to Moore County. There is a white enclave, Abingdon Square Condominiums, in the middle of Jackson Hamlet, and it

**Map 6: Jackson Hamlet, Moore County, N.C.**



has been annexed by Pinehurst and benefits from complete city services. Monroe Town is totally surrounded by Pinehurst, and borders Pinehurst No. 6 Golf Course.

In a *Fayetteville Observer* story by Julie Oliver, the head of the Pinehurst No. 6 homeowners

association said that he didn't even know Monroe Town was there. We have been told that Monroe Town has sewer lines, but this is not shown in the GIS files obtained from Moore County in July, 2004, and there are no manhole covers in the street. Both of these neighborhoods are in the extraterritorial jurisdiction of Pinehurst, so the residents must obtain permission for all changes in land-use (such as subdivision) and all building permits from a government where they have no representation and no vote.

The Waynor Road neighborhood is located across Highway 22 from the Moore County Airport, and is bordered by Southern Pines and a satellite annexation of Carthage. Southern Pines has satellite annexations of three parcels on the same side of Highway 22 as Waynor Road, but none of the African American neighborhood has been annexed. This neighborhood has neither water nor sewer. The residents petitioned Southern Pines for annexation in order to get water and sewer. Their request was denied. Waynor Road is in Southern Pines' ETJ.

Lost City is surrounded by Southern Pines. The residents are all African American, but there are relatively few people living there. They have water but not sewer service. Lost City borders African American neighborhoods in Southern Pines, and those residents have complained that Lost City is used as a dump by contractors and others. Citizens have organized clean-ups of Lost City, but the dumping resumes when no one is watching. No one watches because Lost City is not patrolled by Southern Pines police. The Moore County Sheriff's Department is responsible for patrolling Lost City, but access is through Southern Pines. Kyle Sonnenberg, former City Manager of Southern Pines, attributed part of the problem to the absentee ownership of much of Lost City. According to the Mr. Sonnenberg, Lost City property owners were not interested in being annexed, and the town would not involuntarily annex the area.

The Midway Community is bordered by Aberdeen. The residents recently received public water services, but most residents do not have sewer. Midway falls under Aberdeen's ETJ. Representatives of the community and the town recently met to examine options concerning annexation and infrastructure. Additional concerns for Midway residents dependent on public well water are the two priority superfund sites – both pesticide dumps – within a mile of the community.

### *Discussion*

The history of every municipality is idiosyncratic, and these histories are often cited as reasons for not annexing minority neighborhoods. However, the widespread pattern of racial exclusion shown

in these examples – as well as in numerous cases from Cleveland County to Brunswick County – are evidence of a widespread process resulting in racial exclusion. One major factor is this process is the practice of annexation in North Carolina.

In North Carolina, exclusionary segregation results from the state's annexation and planning laws. These laws give towns the discretion to annex only properties with high tax values, even non-contiguous properties, which may result in a confusing maze of boundaries that jump over poor and Black neighborhoods to include wealthy new ones (Joyner and Parnell 2003). For each area to be involuntarily annexed, municipalities in North Carolina must provide all major municipal services performed within the municipality. Such services include police protection, fire protection, solid waste collection, and street maintenance services, and these must be extended to the area to be annexed on the date of annexation on substantially the same basis and in the same manner as such services are provided within the rest of the municipality prior to annexation (N.C. General Statute § 160A-47). The extension of water and sewer lines must be completed within two years of the effective date of annexation. This requirement differs from voluntary annexations – the case with most new neighborhoods, which are usually provided services by the developers, who build the cost of the services into the price of the properties.<sup>5</sup>

While this requirement for provision of services appears to be equitable, it acts as a disincentive to annex older areas without city services, as is frequently the case with African American neighborhoods on the borders of towns. Residents of older neighborhoods are left to finance such improvements themselves if they are to be provided prior to annexation, or to rely on the municipality to pay for the services. A state law requires a statement showing how the proposed annexation will affect the city's finances and services, including estimates of city revenue changes. Thus the cost of annexation of these minority neighborhoods is made explicit to the municipality – a cost that is in direct opposition to current policies of town planners and town governments to maximize revenue, since most minority communities consist of lower-value housing<sup>6</sup> and few commercial establishments. The rule-of-thumb adopted by most municipalities has been stated as the “cost of providing municipal services [should] not be outweighed by the revenues anticipated from the annexation.” This rationale,

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<sup>5</sup> “Costs of Investment, Edmonton’s Urban Land Intensification Strategy,” Audit Report V Urban Planning Approaches, Edmonton, Canada, November 22, 2001.

<http://www.edmonton.ca/infraplan/smartchoices/audit/Final%20Report%205.pdf>

<sup>6</sup> 2000 U.S. Census: median value owner-occupied housing white alone: \$122,800; African American alone: \$80,600.

together with the provision that that a wealthier area would be “more desirable ... because of their [sic] profitability” and that the excluded minority population “would place a strain on city services that would be too great for the city to absorb, and that unlike the [white] area annexed ... would not generate enough revenue to cover the cost of extending services thereto,” was explicitly accepted by the Department of Justice in 1997 when reviewing annexation applications – as long as the rationale is claimed as the primary consideration in annexation, and not deviated from.<sup>7</sup>

Annexation laws and practices in North Carolina are under great scrutiny, but the attention is on municipal powers of involuntary annexation. Cary and Fayetteville and other municipalities have recently annexed areas to increase their tax bases and to increase the use of sewerage and other existing investments. No attention is given to the areas never even considered for annexation. This paper documents the resulting racial inequality that results.

The essence of the argument was made fifty years ago in *Brown v. Board of Education*: that segregation in and of itself damages African Americans by institutionalizing a subordinate position in American life. Our research in North Carolina shows that racial residential segregation in medium and small towns outside of urban centers institutionalizes subordinate positions for African Americans by diminishing or denying their political status in local affairs, by limiting their access to public services, and by reducing the value of their property. This institutionalization has taken place in local planning boards and town councils, as they shape the local social and political ecology. Whether unintentional as the boards and councils focus entirely on the fiscal aspects of annexation or intentional and cynical manipulation of these annexation laws and practices, the institutionalized subordination of African American citizens continues.

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<sup>7</sup> Letter from Isabelle Katz Pinzler, Acting Assistant Attorney General, Civil Rights Division, Office of the Assistant Attorney General, U.S. Department of Justice, Washington, D.C. 20035 March 17, 1997

## REFERENCES

- Aiken, CS., 1985. "New Settlement Patterns of Rural Blacks in the American South," *Geographical Review*, 75.
- Aiken, CS., 1987. "Race as a Factor in Municipal Underbunding." *Annals of the Association of American Geographers*, 77.
- Aiken, CS., 1990. "A New Type of Black Ghetto in the Plantation Couth" *Annals of the Association of American Geographers* 80.
- Duncan, OD and B Duncan. 1955. "A Methodological Analysis of Segregation Indices." *American Journal of Sociology* 60.
- Foster, AW, Mitchell, F, and Fienberg, SE., 2002. "Measuring Housing Discrimination in a National Study: Report on a Workshop." Committee on National Statistics, National Research Council. National Academy Press: Washington, DC.
- Galster, G and Godfrey, E, 2003. "By Words and Deeds: Racial Steering by Real Estate Agents in the U.S. in 2000." Presented at the Population Studies Center, Univ of Michigan.
- Glaeser, EL. and J Vigdor. 2001. "Racial Segregation in the 2000 Census: Promising News." Center on Urban and Metropolitan Policy, Brookings Institution.
- Goering , J and R Wienk, eds., 1996. Mortgage Lending, Racial Discrimination and Federal Policy. Urban Institute Press: Washington, DC:
- Goldsmith, W.W. and Blakely, E.J., 1993. Separate Societies: Poverty and Inequality in U.S. Cities Temple University Press: Philadelphia:
- Iceland, J and DH. Weinberg 2002. "Racial and Ethnic Residential Segregation in the United States: 1980-2000." *Census 2000 Special Reports*. Series CENSR-3.

Jahn, JA, CF Schmid and C Schrag. 1947. "The measurement of Ecological Separation." *American Sociological Review* 12

Johnson, JH, Jr., AM Parnell, AM Joyner, B. Marsh and C. Christman. 2003. "Racial Apartheid in a Small Southern Town." *Review of Black Political Economy* 31

Joyner, AM and AM Parnell. 2003. "Annexation and Racial Exclusion." Presented at the Institute of Government, UNC-Chapel Hill, December 9

Massey, D.S. and Denton, N.A., 1993. American Apartheid: Segregation and the Making of the Underclass. Harvard University Press: Cambridge.

Oliver, M. and Shapiro, T, 1995. Black Wealth/White Wealth: The Intersections of Race, Class and Racial Inequality. Routledge: New York.

Orfield, G. 2001 "Schools More Separate: Consequences of a Decade of Resegregation." The Civil Rights Project, Harvard University

Parnell, AM, AM Joyner, B Marsh and C Christman., 2003. "Addressing Local Disparities in Local Government Action." Mebane, NC: Cedar Grove Institute for Sustainable Communities.

Rabin, Y., 1989. "Expulsive Zoning: The Inequitable Legacy of Euclid," in C. Harr and J. Kayden, eds., Zoning and the American Dream: Promises Still to Keep. American Planning Association Press: Washington: DC:

Squires, GD (ed), 1997. Insurance Redlining: Disinvestment, Reinvestment and the Evolving Role of Financial Institutions. Urban Institute Press: Washington, DC.

Thomas, JM and M Ritzdorf. (eds.) 1997. Urban Planning and the African American Community: In the Shadows. Sage Publications: Thousand Oaks, CA.

White, MJ. 1986 “Segregation and Diversity Measures in Population Distribution.” *Population Index* 52.

White, MJ and E. Shy. 2002. “Housing Segregation: Policy Issues for an Increasingly Diverse Society.”

Pp. 159-184 in NA Denton and SE Tolnay (eds). American Diversity: A Demographic Challenge for the Twenty-first Century. SUNY Press: Albany

Wilkes, R and J Iceland. 2004. “Hypersegregation in the Twenty-First Century” *Demography* 44.

WERA. 2002. “Failing Septic Systems and Contaminated Well Water.” [www.wera-nc.org/News/epa/epaej\\_1202.htm](http://www.wera-nc.org/News/epa/epaej_1202.htm)

**An integrated County level spatial impact assessment of Hurricane Floyd  
combining data on damages and social vulnerability**

Working paper, December 2002.

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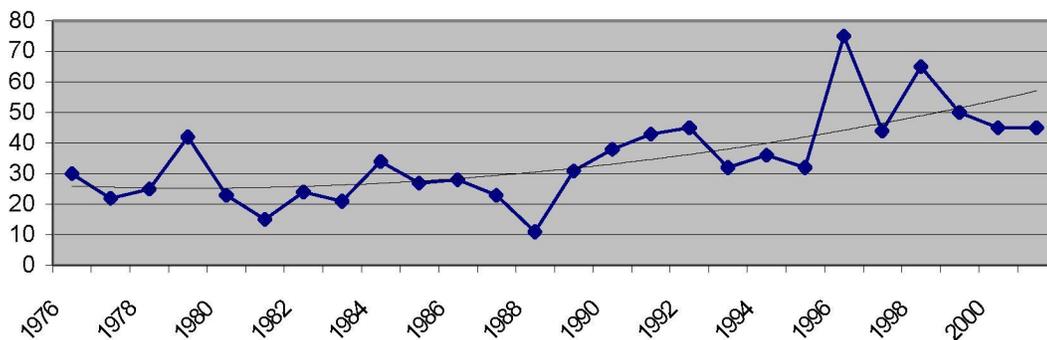
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## 1. Introduction

Disaster theorists have argued that what is urgently needed is research that explores the links between the increase and expansion of disasters, and the dominant ideas, institutions, and practices that motivate social vulnerability (Hoffman & Oliver-Smith, 2002; Pulwarty & Riebsame, 1997). Hurricanes in particular are increasingly recognized as drivers of changes that trigger mechanisms leading to adaptive strategies (Konrad, 1985). What historical and geographic analysis of disasters can accomplish is to demonstrate that if disasters have become more frequent over time—as illustrated in Figure 1 below—it is not simply because there are more natural hazards, but rather that our communities and societies have become more vulnerable (Martine & Guzman, 2002; Virginia Garcia-Acosta, 2001.). Disasters then have to be seen as the result of an encounter between hazards and people who are vulnerable, not just physically, but also economically, politically, demographically and culturally. The main thesis in this paper is that in the case of Hurricane Floyd, pre-existing social

**Figure 1. : Total Major Disaster Declarations, USA**  
(source: FEMA)



vulnerabilities amplified the damages inflicted on the landscape. Furthermore, it is acknowledged that these social vulnerabilities have deep historical roots related to land use patterns and segregation, and should therefore be included in spatial analysis of the damage impact.

The main question explored in this paper is how geographic information models can integrate both social vulnerability and damage estimates in order to provide a integrated damage estimate better able to assess the impact of the disaster as experienced by the people on the ground. Using publicly available impact and demographic data combined with qualitative interviews, both damage and social vulnerabilities indexes were created North Carolina at the county level and using relatively easy spatial methods. Combining these indexes, a spatial model was evaluated to the extent in which it provides an integrated assessment of the impact of hurricane Floyd that is 1) capable of combining both social vulnerabilities with damage measurements and 2) able to provide a narrative that follows the experiences of peoples on the ground.

## **2. Data and method**

In order to assess how social vulnerability and damages to disaster must be interpreted in the case of Hurricane Floyd, field visits were made to the city of Kinston (Lenoir Couty<sup>2</sup>), Grifton (Pitt County), and Greenville (Pitt County), all severely impacted by flooding. Flood victims and officials were interviewed in order to gain a qualitative understanding of the social vulnerabilities and hurricane impacts. Based on this knowledge, quantitative data was collected and modeled within a geographic information system in the form of an overall index

of damages and social vulnerability to disaster. Quantitative data sources were collected and derived from various state and federal agencies and are shown in Table 1. These data included statistics on: agricultural damages (crops affected and lost); business impacts (small, medium, and large); unemployment insurance claims; housing structures damaged, repaired, and replaced; National Flood Insurance Program losses and number of policies; the number of vacant housing units; households below the poverty line; households with one member older than sixty years of age; and general housing values.

In order to create a general damage index, a selection of these statistics was spatially mapped and indexed in four separate indexes: housing damages (buy-outs), displacements, business impacts, agricultural impacts. These data were spatially represented in a normalized form and averaged (without weighting) to create one larger damage index. Similarly, a general index of social vulnerability was created by taking the average of four separate social vulnerability indexes, including lack of flood insurance coverage, the percentage of households below the poverty line, the percentage of households with one member older than sixty years of age, and the availability of affordable housing.

**Table 1. Data used**

<b>Description</b>	<b>Data variables</b>	<b>Date</b>	<b>Source</b>
Agricultural Damage	<ul style="list-style-type: none"> <li>• Crop acres affected</li> <li>• Crops total dollars lost</li> </ul>	September 16, 1999	North Carolina Department of Agriculture and Consumer Services, Agricultural Statistics Division
Business Impacts	<ul style="list-style-type: none"> <li>• Business impact level (severe,</li> </ul>	November	A Socioeconomic

<sup>2</sup> See the addendum for spatial county references.

	<p>moderate, minor)</p> <ul style="list-style-type: none"> <li>• Total number of small businesses impacted (1-9 worker)</li> <li>• Total number of medium businesses impacted (10-99 workers)</li> <li>• Total number of large businesses impacted (over 100 workers)</li> </ul>	r 12, 1999	Impact Analysis for Coastal North Carolina: Hurricane Floyd Business Impact Survey Regional Development Services, East Carolina University
<ul style="list-style-type: none"> <li>• Mitigation Program Housing Structures Damaged</li> </ul>	<ul style="list-style-type: none"> <li>• Number of structures damaged</li> </ul>	9/1/01	North Carolina Redevelopment Center Hurricane Floyd Mitigation Status Report
<ul style="list-style-type: none"> <li>• Crisis Housing Assistance Fund</li> </ul>	<ul style="list-style-type: none"> <li>• Units Repaired</li> <li>• Units Replaced</li> </ul>	July 2002	North Carolina Redevelopment Center
<ul style="list-style-type: none"> <li>• State Acquisition and Relocation Fund (SARF)</li> </ul>	<ul style="list-style-type: none"> <li>• Units Relocated</li> </ul>	July 2002	North Carolina Redevelopment Center
<ul style="list-style-type: none"> <li>• National Flood Insurance Program Losses</li> </ul>	<ul style="list-style-type: none"> <li>• Total Losses</li> <li>• Closed losses</li> <li>• Open losses</li> <li>• Closed losses without payment</li> </ul>	1978 - Dec. 2001	Federal Emergency Management National Flood Insurance Program
<ul style="list-style-type: none"> <li>• National Flood Insurance Program Policies</li> </ul>	<ul style="list-style-type: none"> <li>• Policies in the coverage amount for policies in force.</li> <li>• Written Premium In Force</li> <li>• Insurance in Force</li> </ul>	Dec. 2001	Federal Emergency Management National Flood Insurance Program
<ul style="list-style-type: none"> <li>• U.S. Census 2000</li> </ul>	<ul style="list-style-type: none"> <li>• households below the poverty line</li> <li>• percentage of households with one member older than sixty years of age</li> <li>• Housing values</li> <li>• Other vacant housing units</li> </ul>	2000	U.S. Census Bureau. Department of Commerce.

Finally, the two indexes were combined in a general Impact Index. Generally, in order to create damage and social vulnerability data that can be compared, the various data sets collected were divided by the total county specific population and then normalized into standard deviations using Z-scores. Z-scores provides a standard deviation score from a mean of zero, allowing statistical significance at an alpha of 0.05 to be identified as exceeding either exceeding -1.96 or +1.96<sup>3</sup>. The calculated z-scores for each county were then averaged out across category specific indicators to obtain a housing score, buy-out score, business score, etc. It must be noted here that the resulting index scores described do not any longer allow identification of statistical significance based on their face values (even though it might appear as such). Reason is that the index scores are averages of z-scores from different normal distributions, and the new (averaged) distribution has a different normal distribution (mean and standard deviation) that would need to be standardized on its own accord.

### **3. Results**

#### **3.1 Damage Scores**

*Buy-out score:*

For the impact on housing (which indirectly measures population displacement), two measures were used. First of all the numbers of structures replaced, repaired, or relocated per

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<sup>3</sup>

$$z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$$

Now i.e. the relative deviation of sample is a standard normal variate from which it is extremely useful to draw statistical inference. We know that the standard normal variate is our z - score. 68% area under the curve lies between -1 and +1, 95% (statistically significant) area under the curve lies between -1.96 and +1.96, 99% lies between -2.58 and +2.58 and 99.73% lies between -3 and +3. In other words, only 5% area under the normal curve lies beyond  $\pm 1.96$ , 1% , beyond  $\pm 2.58$  and 0.27% lies beyond  $\pm 3$ . These areas also indicate the

capita as counted by the North Carolina Redevelopment Center for the Crisis Housing and Assistance Fund per July 2002. To create a "Buy-out score," the number of structures replaced, repaired, and relocated (SARF) were standardized and averaged to serve as the "buy-out score" used in the index. The final score is mapped in Figure 2.

*Displacement score:*

A second, the number of vacant structures as captured by the Census 2000 was used to determine the impact of the floods on housing (and population). As can be seen in Table 2 below, general vacancy rate (as a percentage of the total number of units in a county) however was negatively correlated with housing, business and agricultural damages, which suggests that this rate does not capture Floyd related vacancies, but instead seasonal vacancies associated with high income populations. Yet, a positive correlation with the floodplain insurance program coverage data obtained from the National Floodplain Insurance Program (NFIP) would suggest that these are vacancies located in flood prone areas.

**Table 2 Analysis of U.S. Census 2000 vacancy data for flood impact**

<b>Damage</b>	<b>% Vacancies</b>	<b>% Other Vacancies</b>
Floodplain insurance in force	.485	-.251*
Floodplain insurance written premium in force	.513	-.220*
Floodplain insurance total losses	.362	n.s.
Floodplain insurance losses that have been closed without payment.	.416	.231*
Floodplain insurance total losses paid	-.248	n.s.
Structures damaged	-.216*	.253*
Structures repaired	-.342	.283*
Structures replaced	-.347	.335
Renters relocated (in dollars)	-.280	.360

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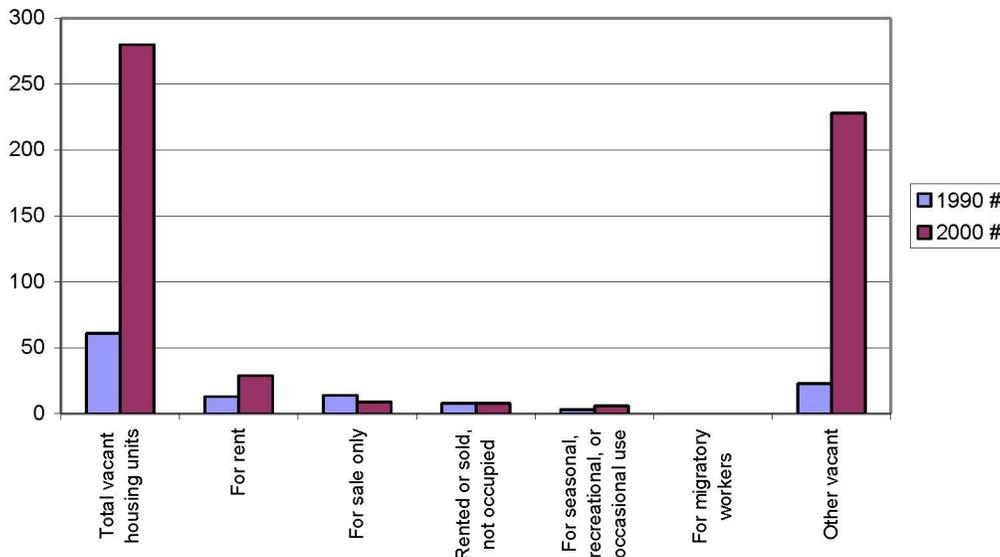
probabilities that the z - score exceeds these values i.e. the probability that z - score will exceed 1.96 numerically is 0.05.

Business damage level	-.542	.343
% small business impacted	-.607	.341
% medium business impacted	-.579	.349
% large business impacted	-.583	.267
Crops acres affected	-.560	.388
Crops total losses in dollars	-.392	.393

All probabilities significant < 0.01, except \*=significant p<0.05

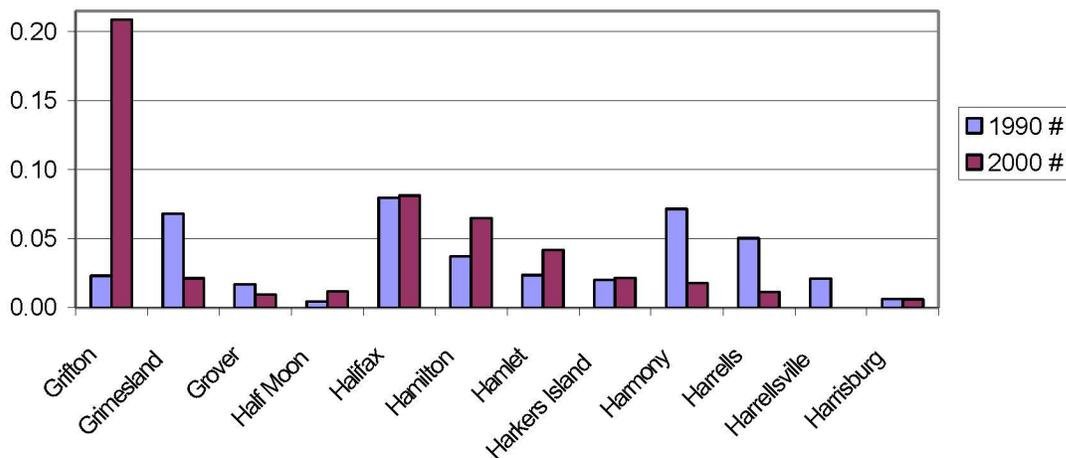
However, it is known, many of the people flooded by Hurricane Floyd were black populations who were often not insured against flooding due to general poverty. Thus, this suggest again a population that is seasonal and thus coastal, instead of riverine. While doing fieldwork, it appeared that for the much impacted rural town of Grifton (Pitt County), the number of vacant houses rose from 6.2% in 1990 to 25.6% in 2000. Most of these increases were caused by the floods, the Town Manager indicated. Illustrated in Figure 3 below, all of this rise was categorized as "Other Vacant." Exploring this category, the correlation patterned appeared to confirm a more rural, poor, and vulnerable population, where damages were all correlated positively, and flood insurance generally lacked.

**Figure 3 Vacancy status (frequency) census 1990 and 2000, Grifton, NC**



Spatial investigation of the distribution of the census categories Vacancies and Other Vacancies did however not further support this notion, since both indicator appeared to have the highest positive deviations from the mean located at the northern coastal counties. For the purpose of the analysis here, it was concluded that the category Other Vacancies would be the best housing loss indicator. The difference between the Censuses of 1990 and 2000 Other Vacancies categories (each relative to the total number of housing units in a county) was taken to indicate a flood related impact. Although some error might be part of this, since general economic decline can also induce an increase in vacancies, a random comparison with other towns in North Carolina suggest this to not be the case, as shown in Figure 4. The final score is mapped in Figure 5.

**Fig. 4 Vacancy status (relative to total units) censuses 1990 and 2000 for random places in North Carolina**



*Business impact score:*

Damages for small (1-9 employees), medium (10-99 employees) and large (over 100 employees) were taken from the Hurricane Floyd Business impact survey as done by the

regional development Services, East North Carolina University. Although a crude measure of small, medium, and large impact was present in the data, the z-score method was chosen for consistency and comparability. In addition, this method automatically corrects for the fact that the loss of one large business does not equal the loss of one small business, since it provides a standardized impact by size relative to the mean. The total business impact score was taken as the average of these deviations. The final score is mapped in Figure 5.

*Agricultural impact score:*

The agricultural impact was measured through the losses in dollars and the acres affected as provided by the North Carolina Department of Agriculture and Consumer Services, Agricultural Statistics Division, Sept. 1999. The average was taken of the z-scores to create the index. The final score is mapped in Figure 6.

Figure 2

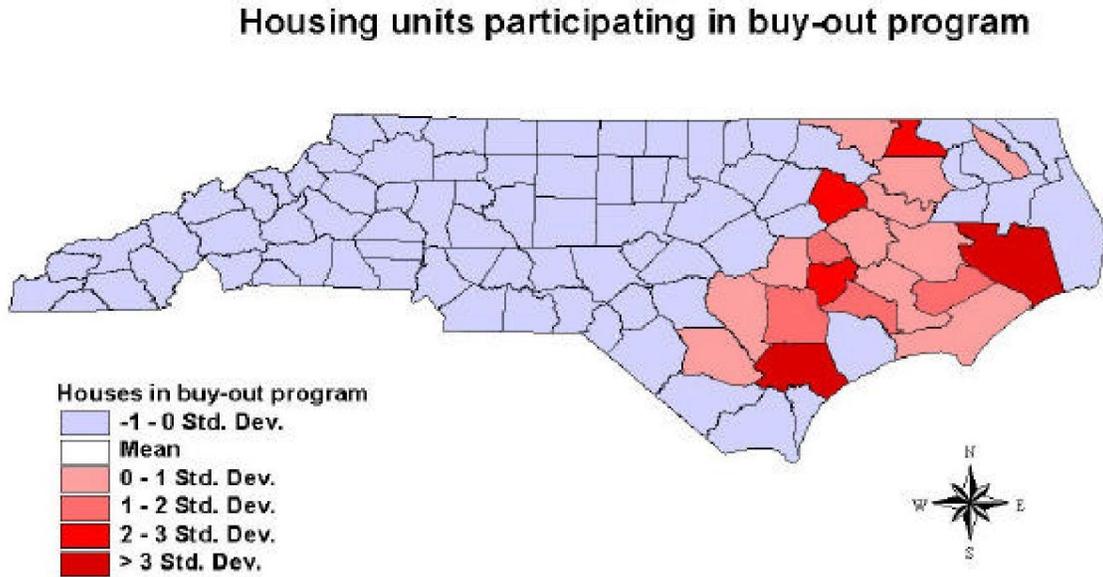


Figure 5

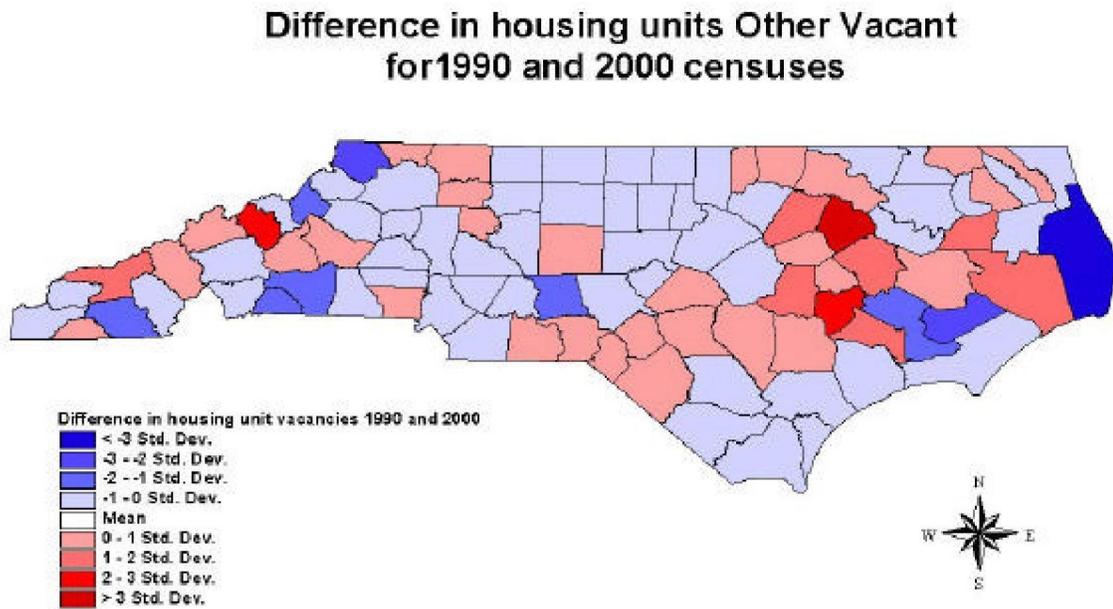


Figure 6

### Business Impact

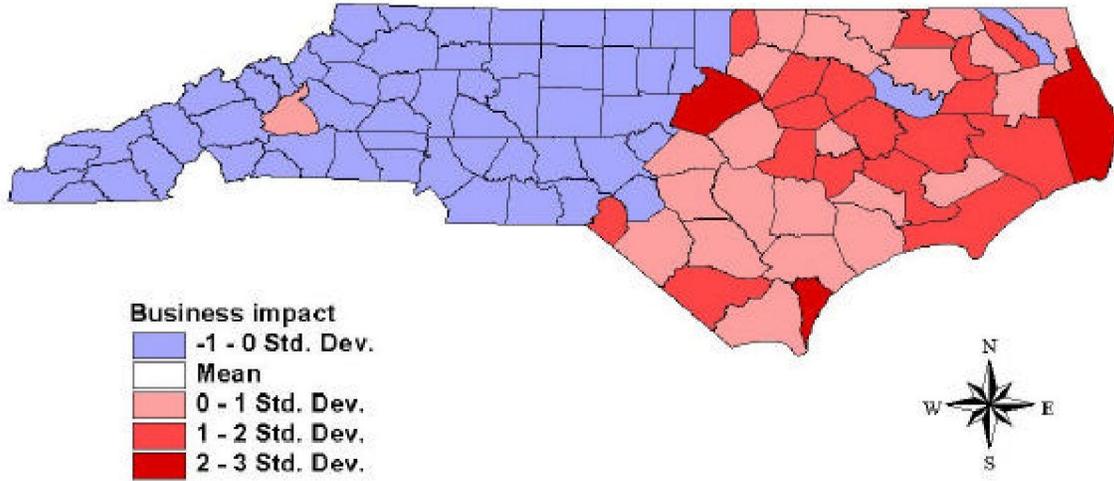
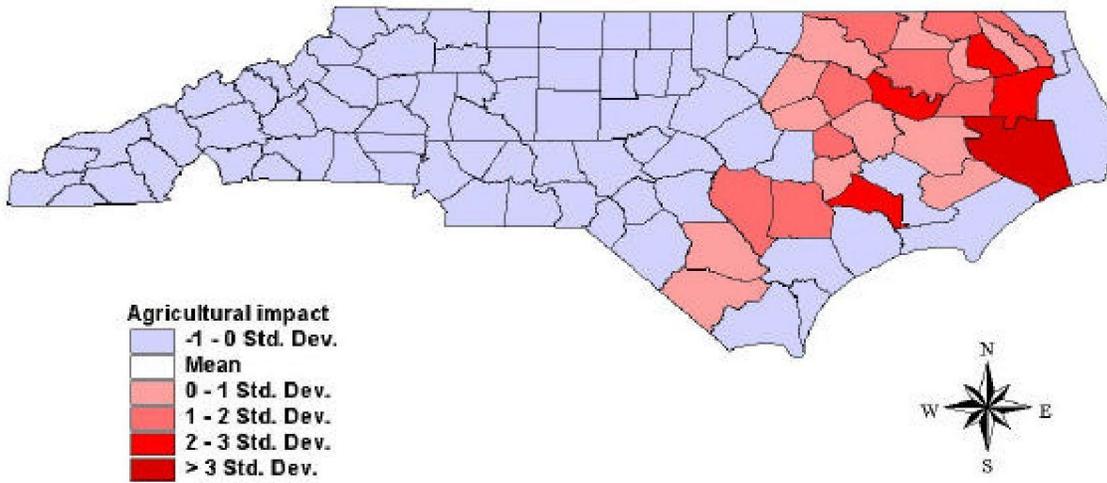


Figure 7

### Agricultural Impact



### **3.2 Vulnerability**

Based on the qualitative introduction, the impact of hurricane Floyd on the socio-demographic vulnerability emphasizes a relationship with race, poverty, and elderly people. In her masters paper for the Department of Epidemiology at UNC-CH, Stephanie Freedman (2000) has shown that the mean estimated percentage of flooded land was found to vary with race and poverty in the entire western coastal plain/piedmont region and the Pitt and Edgecombe counties subregions. In both analyses, the mean estimated percentage of flooded land was most linearly related to the percentage of poverty. Poor and nonwhite individuals seem to have been disproportional affected by the flooding, especially in more densely populated block groups. For most areas, the impact of Floyd thus has definite environmental justice character, supporting the thesis that introduced this section that the actual impact of the flooding is a mix of both social vulnerability and flood extent, and not the latter alone.

This relationship can be illustrated with flood damage data from Pitt County. From interviews with officials it has become clear that in Pitt County the City of Grifton was hard hit by Neuse river flooding and suffered a significant population decline causing a budget crisis. Speaking to the town manager, he acknowledged that the area affected was a historical African-American neighborhood. This pattern is to a certain extent similar for the city of Greenville.

When calculated according to the census data, across all North Carolina counties strong correlation exists between the percentage of households in poverty and racial categories, especially for whites ( $r=-.666$ ,  $p=.000$ ) and blacks ( $r=.636$ ,  $p=.636$ ), and in lesser extent for

American indians ( $r=.307$ ,  $p=.002$ , not shown in table), and Asians ( $r=-.334$ ,  $p=.001$ ), but not for hispanic migrants. Since poverty usually equates with living in vulnerable conditions, one would expect significant racial difference in the damages occurred by Floyd, wherein minorities would be more affected and less covered by flood insurance. Significant correlation were indeed found between census 2000 populations by race and the damage data collected, as shown in Table 3 below.

**Table 3 U.S. census 2000 populations by race and the damage data**

<b>Damage</b>	<b>% White</b>	<b>% Black</b>	<b>% Asian</b>	<b>% Hispanic</b>
Structures damaged	-.216*	.240*	n.s.	n.s.
Structures repaired	-.342	.332	n.s.	.262
Structures replaced	-.347	.355	n.s.	n.s.
Renters relocated (in dollars)	-.280	.299		
Business damage level	-.542	.372	n.s.	n.s.
% small business impacted	-.607	.561	-.201*	n.s.
% medium business impacted	-.579	.617	-.213*	n.s.
% large business impacted	-.583	.604	-.219*	n.s.
Crops acres affected	-.560	.506	-.208*	.207*
Crops total losses in dollars	-.392	.382	n.s.	.384
% households below the poverty line	-.666	.636	-.334	n.s.

All probabilities significant  $< 0.01$ , except \*=significant  $p<0.05$

From this table, it appears that the more white people lived in a certain county, the less the damages on businesses, housing, and agriculture. Vice versa, the more black people lived in a certain area, the more such damages. Trends for Asian populations largely followed white populations, while the more Hispanics in a county the more structures were repaired, and crops affected and lost.

In addition, an population specially vulnerable to disaster are elderly. Age and environmental vulnerability combine to create a subpopulation possibly suffering severe health care setbacks when disaster strikes. The geographic effects of flooding on elders are illustrated by an article in the Washington Post, "Floods Hit Elderly Hard. For Many Independence Was Lost Along With Homes." Covering the impacts of hurricane Floyd related in Edgecombe county, North Carolina, the author writes:

"What we have found out is that this flood has caused a large number of people to become dependent after many years of being independent, said Mark Hensley of the Upper Coastal Plain Area Agency on Aging in Rocky Mount, which serves some of the hardest hit. 'For an older person, this is particularly important, because familiarity with their surroundings is a key to maintaining their independence'" (Associated press, Nov. 29, 1999, page A3).

Another illustration comes from the results of the Institute of Aging's Senior Citizens of Princeville Effort (The SCOPE Project), which emphasizes that lack of transportation and physical limitations and resulting need for disaster preparedness training are main issues of concern affecting Princeville adults (a heavily flooded town during Floyd). When elderly citizens lose their independence due to disorientation, a loss of community and decreased mobility, emotional distress can cause and increased likelihood for new health concerns and health impairments.

Conversations with officials at the Area Agency On Aging supports this view. One official explained that the health care problems encountered had more to do with mobility and less with actual changed health needs<sup>4</sup>. According to her, temporary housing provided by FEMA was not designed to be accessible for people with mobility issues, while people who relocated with their families in different areas did have problems of adjustment to new health care environments. During the flood itself, FEMA and Red Cross bureaucracies appeared very insensitive to elders health care problems, making senior citizens wait in line for hours to get vouchers or food. In the long term, a slight increase in long term care and a decrease in home-care was observed. Yet, as she explained, so far, there has been no evidence for a change in health care accessibility patterns. In her opinion, Floyd flooding did not change the health care situation for elderly seniors. It brought in a lot of money for specialized health care needs, but did not change the system: "They did not have enough money to buy prescription drugs before Floyd, some were overtreated, some were undertreated, and this is still the case after Floyd. Geriatric health care still follows where the money goes."

In another conversation, an Area Agency of Aging official outlined a clear time frame of geriatric support<sup>5</sup>. During Floyd, the county health departments had special arrangements for the elderly, which included help for the stranded, special clinics, medication support, etc. Special support groups and health departments sent people, mostly volunteers, out in the rural areas to assist in needs. Yet, after this initial post-Floyd year, support for these programs has died down and assistance has reverted back to its original state. Yet, elderly people still live in

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<sup>4</sup> Personal communication, February 2002: Louisa Cox, Area Agency on Aging Region Q Director, Mid-East Commission, Washington NC.

<sup>5</sup> Shari Grant, Aging Specialist 3011, Eastern Carolina Council of Governments, Area Agency on Aging Region P, New Bern NC.

the same temporary facility. Many people lost valuable medical information, Medicaid cards, and are experiencing difficulties providing the needed information to reapply for Medicare and Medicaid. Moreover, transportation remains a huge issue, limiting access for many. Roads are still very bad. Many roads were washed and not repaired. As a consequence, personal mobility has decreased, public transportation is impeded, and it is harder to get volunteers to service the rural seniors.

Based on these suggested relationships a selection of variables was chosen from Census 1990 and 2000 as well as FEMA data: lack of flood insurance, the percentage of households living under the poverty level (which is taken as a proxy for the percentage of minorities, especially blacks, as illustrated above), the number of households with at least one member older than 60 years, and the average value of homes/real estate. At the county level, it was unfortunately not possible under time constraints to estimate the number of people living in the floodplains. Clearly, this would be an important additional/future indicator (but requires block level analysis over all counties). The make up of the vulnerability scores are described below.

*Lack of flood insurance coverage:*

Data from the Federal Emergency Management Agency were obtained showing the policy and insurance coverages for December 2001 and total losses for the period from 1978 through 2001, both under the National Flood Insurance Program for all North Carolina counties. These data were all averaged together and standardized to provide a general index of which the inverse shows the lack of flood insurance coverage in all counties. The patterns show a clear

concentration of flood insurance in coastal areas, but not in many areas that were damaged by hurricane Floyd, as shown in Figure 8

*Percentage of households below the poverty line:*

Taken as a proxy for minorities due to the high correlation shown in Table 3, this index is a standardization of Census 2000 data for all counties in North Carolina. The results shown in Figure 9 support the notion that the areas hit by hurricane Floyd are generally poor areas.

*Percentage of households with one member older than 60 years of age:*

This index is a standardization of Census 2000 data for all counties in North Carolina. The results shown in Figure 10 suggest that it is mostly northeastern and southeastern counties which have a large number of elderly people.

*Availability of affordable housing:*

Taken as the inverse of the value of homes as found in the Census 2000, this index shown in Figure 11 emphasizes the concentration of affordable housing in the rural areas stricken by the floods, with exception of the coastline, which is clearly not an affordable place to buy a home, and a corridor of counties following the Tar/Palmico River, with the exception of Edgecombe county. The same pattern is assumed for rent, since these are reflective of general home prices.

Figure 8

### Lack of flood insurance coverages and claims made (1978-2001)

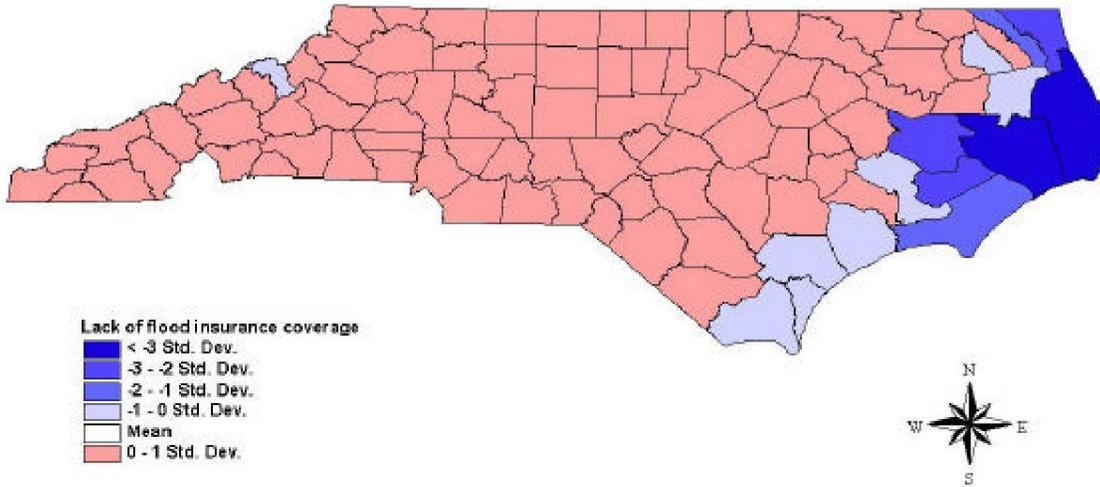


Figure 9

### Households below the poverty line

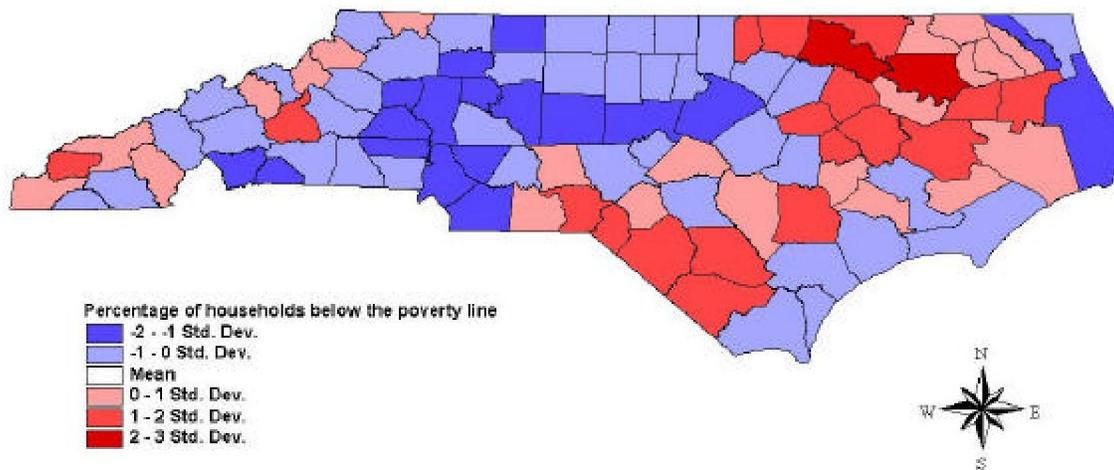


Figure 10

### Households with one or more persons above 60 years of age

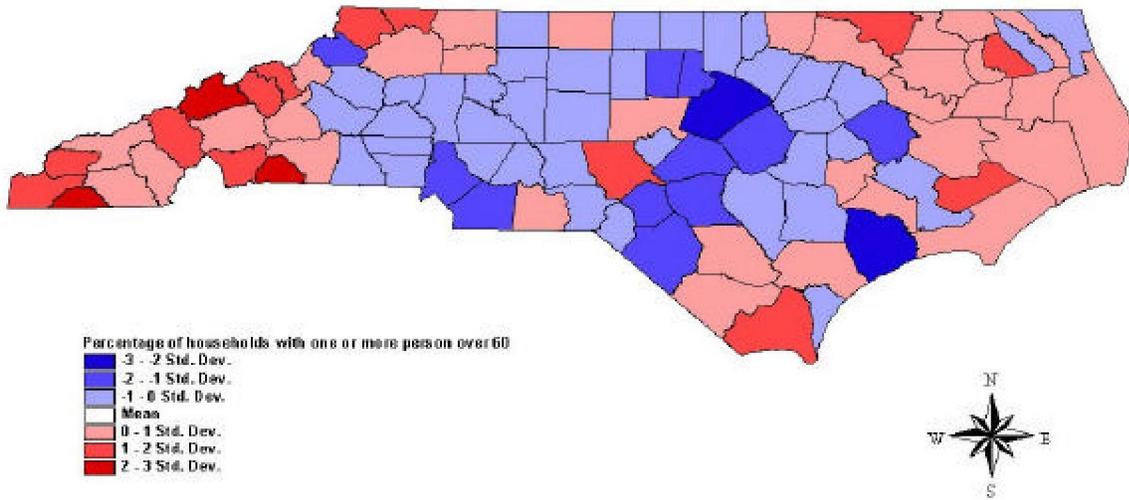
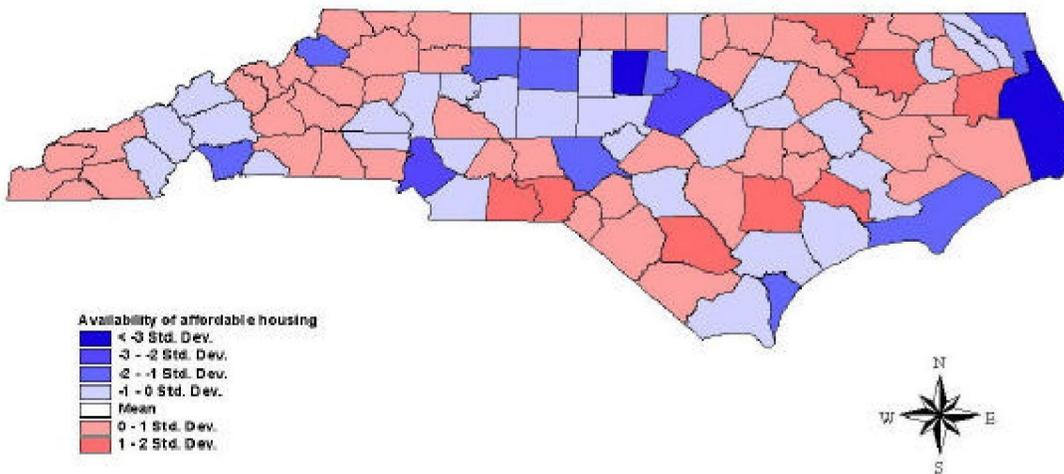


Figure 11

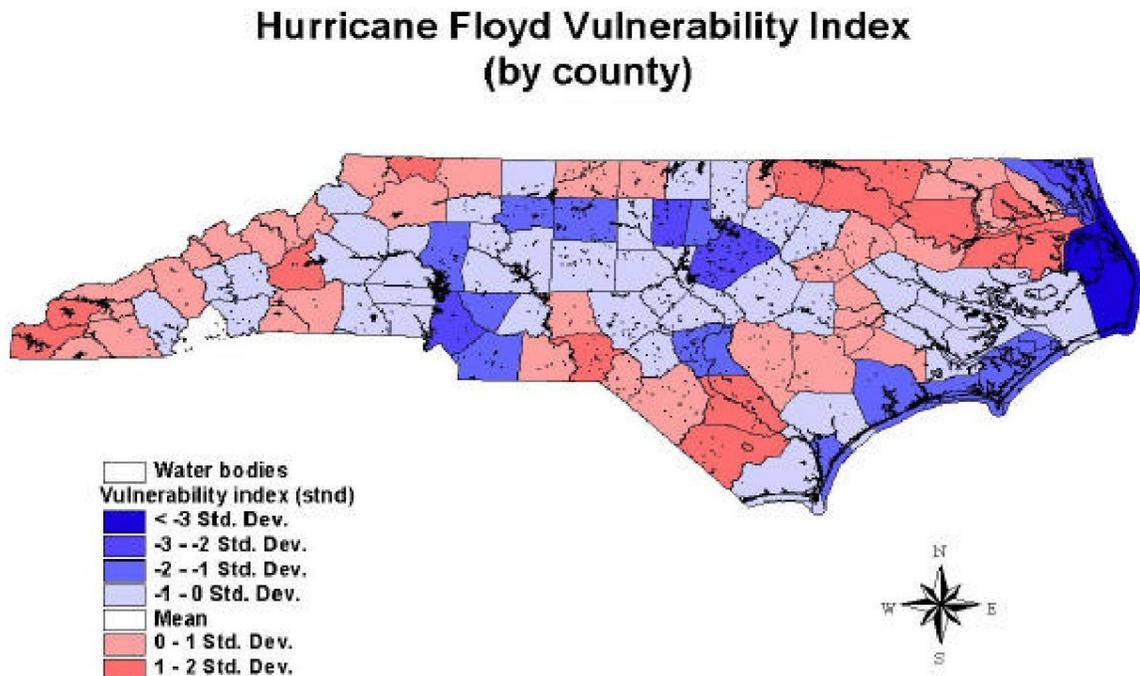
### Availability of affordable housing



### 3.3 Impact Index

Having shown detailed patterns of each damage and vulnerability, the following step has been the aggregation by means of averaging of all specific damage indexes and vulnerability indexes described in the two sections above into one coverage which shows the aggregate Damage Index and Vulnerability Index, shown in Figures 12 and 13. These indexes were then again standardized using the mapping function in ArcView, with the note that the original data do not any longer conform to standardization due to the averaging across different normal distributions.

Figure 12



### Hurricane Floyd Damage Index (by county)

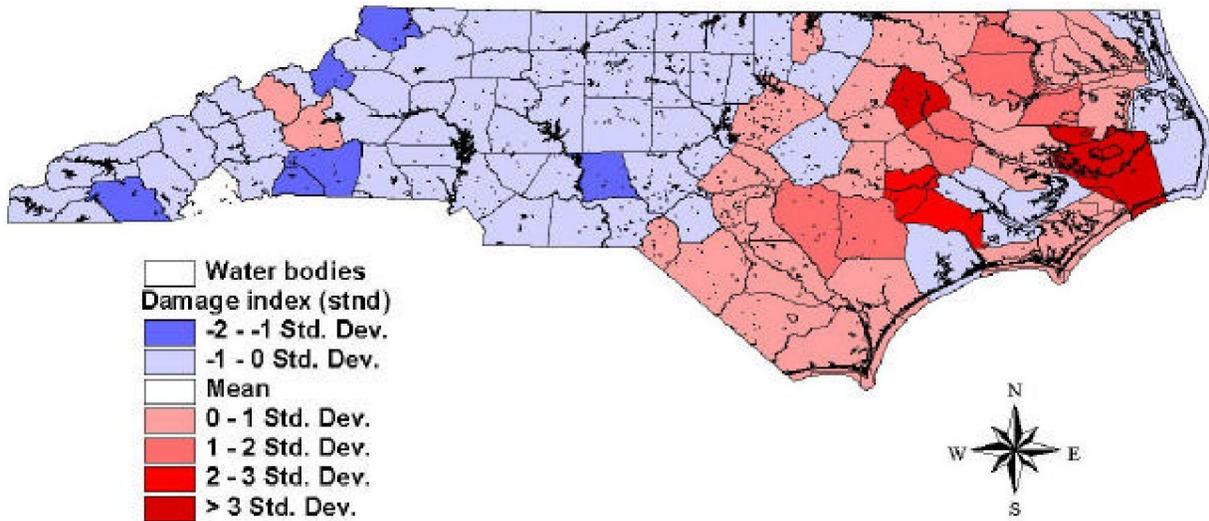


Figure 13

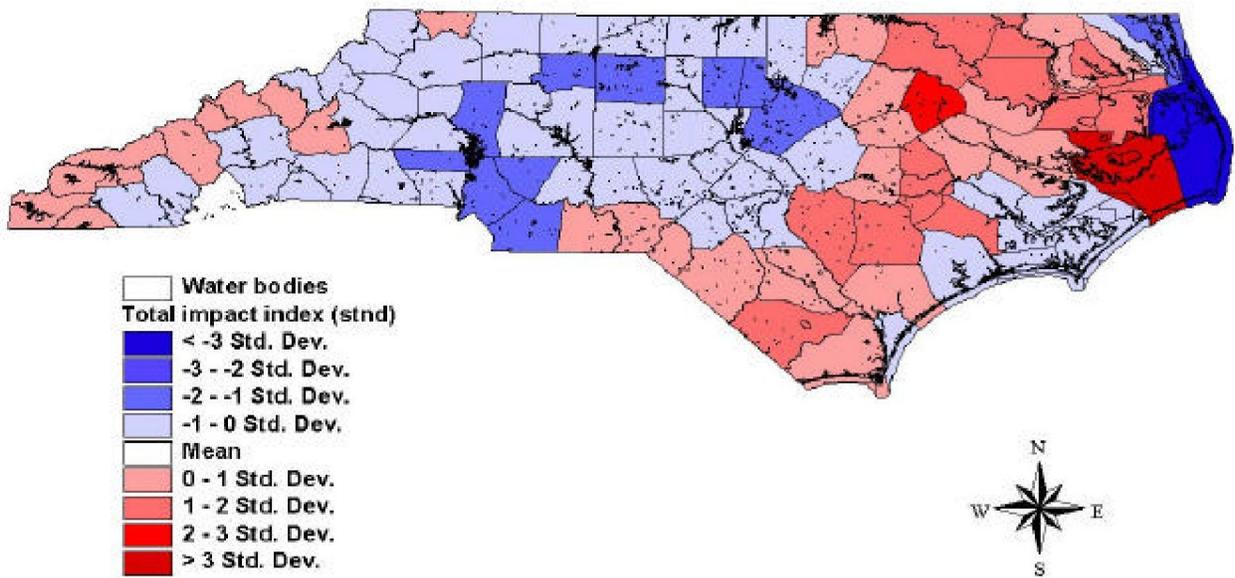
Analysis of the results shows that the composite or aggregate Damage Index (Fig. 13) shows that most of the eastern North Carolina counties affected by the Hurricane floods in a relatively homogeneous way. Jones, Lenoir, Hyde and Edgecombe Counties appear hardest hit. The coastal counties of Palmico, Craven, and Onslow, Dare, Johnston, and Currituck however seem to be less hard hit than most other Counties. For the coastal communities this could perhaps be explained due to the increased reliance on tourism and less on agriculture, as well as perhaps a better adaptation of housing structures to hurricane winds and flooding. Yet, the graph does represent the notion that with regard to Hurricane Floyd, the damages were mostly inland, and not coastal.

Looking at the Vulnerability Index (Fig 12) however, coastal communities generally appear less susceptible, and the focus shifts northeastern, where a band of vulnerable counties are located, stretching from Warren to Tyrell counties. Similarly, a band of vulnerable counties stretch south from Northhampton to Columbus counties, in a corridor merged in between the perhaps less vulnerable urbanization corridor which appears to end with Nash and Wayne Counties (and related to Wake, Raleigh) and the lesser vulnerability seen along the entire coastal stretch with its border at Pitt (Greenville) county.

Finally, this assessment of the impact of Hurricane Floyd concludes with the summed overlay of the Damage Index and the Vulnerability Index in order to get an Impact Index. This final step then shows the impact of the hurricane when taking into account both damages and vulnerabilities. No weights were applied in this summing of the indexes. Reason for this is that it is unclear how to determine the weights for the various damage indicators of housing, displacement, agriculture, and businesses, and the vulnerabilities related to age, poverty, housing values, and flood insurance. The major problem is that the choice of emphasis is dependent on what ones perspective is, e.g. a politician, real estate agent, farmer, flood victim, or small business owner. The index provided then is a general index of the impact, where each impact is weighted equally. The resulting map can be seen in Figure 14 below.

Figure 14

### Hurricane Floyd Impact Index (by county)



Not surprisingly, the Impact Index shows a pattern that mediates between the damages and the vulnerabilities of the eastern North Carolina social-demographic and physical landscape. Yet, the assessment of the impact suggest a more nuanced impact of the hurricane wherein about half of the coastal communities are suggested to be spared severe impacts, and the other half dealing with impact issues. Most striking however is the powerful singling out of Edgecombe and Hyde Counties. Hyde County appears to be ranking high in agricultural damages and business both, while being relatively low in home values and general income. Due to its position as a coastal county, a large number of flood insurance coverage can be found. In addition, this county is possibly reliant more on tourist dollars than Edgecombe County. The

story of Princeville in Edgecombe County is well known and made much headline news. Despite government funds ready to relocate their town after Floyd's devastation, the inhabitants of this historical place chose to stay put in the floodplains<sup>6</sup>. As the oldest town in America incorporated by freed slaves in 1865, the motivation to stay in this floodzone is one of based on shared historical consciousness and attachment to place. Indeed, the impact of the floods on "Freedom Hill" might reflect the story for the entire County, either because of repeated patterns at the county scale, or the extremeness of Princeville itself (aggregate).

Generally, the pattern of flood impacts is a broadening of that seen in the vulnerability analysis. Most impacted are a number of southern coastal counties, a corridor of counties stretching north in between coastal areas and urban piedmont, and a stretch of northern counties going east-west. It can be seen that for all these counties, damages as measured by this index are considered significant above the 95% level relative to the total impact of the hurricane on all North Carolina counties (including mountain areas where some flooding also occurred).

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<sup>6</sup> Sue Anne Pressley (1999) Princeville, N.C., Settled by Freed Slaves in 1865, Faces a New Struggle for Survival After Hurricane Floyd. *Washington Post*. October 3, 1999; Page A3

#### **4. Conclusion**

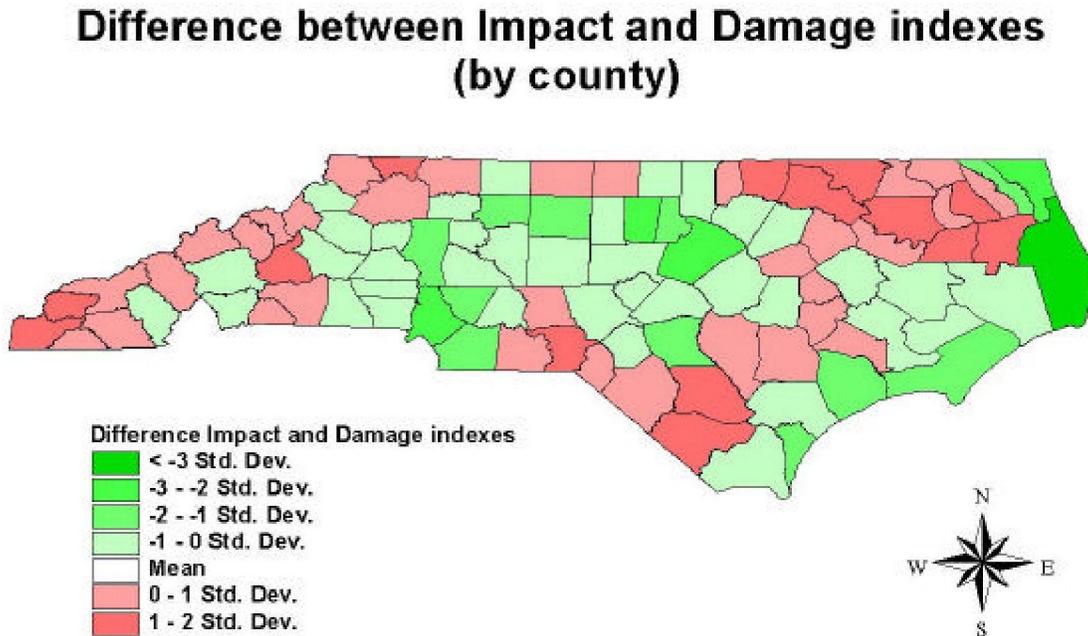
Field interviews with local officials and citizens suggested that both positive and negative impacts. On the negative side, the traumatic and destructive nature of a disaster the extent of Floyd obviously has caused a disproportionate impact on minorities and elderly of intense trauma, loss of public tax bases, geographic displacement, loss of historical floodplain neighborhoods (De Vries, 2002). On the other hand, new adaptive strategies have emerged: an intense new floodplain mapping program that will update the floodplain to a real-time integrated monitoring system; federal funds for public infrastructure developments pouring into a generally underdeveloped area; the creation of ecologically sound floodplain buffers through the federal buy-out program; and the possibilities for flood victims to relocate in better housing through the federal buy-out program. As the Town manager of the hard hit town of Grifton summarized: "I think we are much better prepared now for the next flood than we were ever before"<sup>7</sup>

The indexes shown here provide a new geographic method for assessing the impact of disasters such as Hurricane Floyd on landscapes that are characterized by both physical and social-demographic issues. Based on publicly available data, the final Impact Index provides a rare integration of both damages with social vulnerability across various spheres of analysis (e.g. economical, demographic, social, environmental). The adjustments based on this integration is shown in Figure 15, which shows the result of subtracting the Damage Index from the Impact Index.

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<sup>7</sup> Dave Populas, personal communication, September 2001

Figure 15



In some ways, this map serves the empowerment of those who have been and still are underserved. Mostly poor rural communities, either in between the urban center and coastal areas, or in the mountainous areas, are adjusted and their damage impact increased, while those that can afford to cope with the consequences of a major disaster are adjusted downward. I believe this type of building in of environmental justice concerns in spatial modeling is crucial if we are to give all an equal change to strive for quality of life.

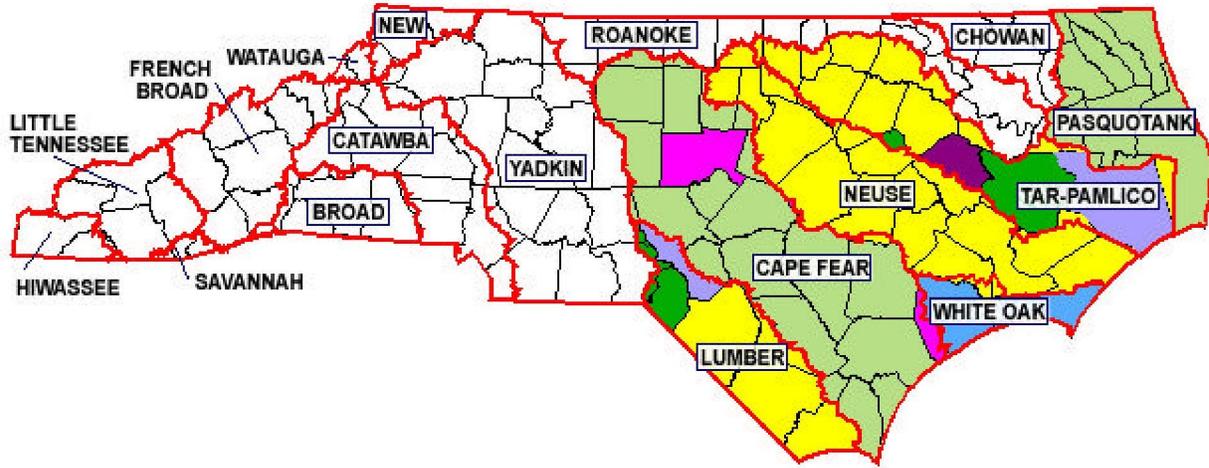
Integrating vulnerability with damages is not a new way of disaster analysis, especially not at the local, pragmatic scale. The Socioeconomic impact analysis for coastal North Carolina as as done by the Regional Development Service of East Carolina University does take into

account previous vulnerabilities in its assessment of business damages. Yet scientists appear to be most interested in modeling impact in a non-integrated fashion, focusing only on for example economic and business damages. Clearly, the impact of a disaster forces a political unity such as the county to adapt to its wrath. Taking into account all consequences at the same time is a crucial step in this effort. The attempt made here can only be seen as preliminary, since the breath of data collected is limited and the perspectives with which indexes can be created multitude. Yet the study hopefully provides a powerful aid which geographic information systems can bring to impact analysis, especially combined with ethnographic knowledge.

Based on this analysis, some critique can be given as well on the way in which the state has continued with the updating of floodplain maps and the implementation of its real-time flood warning system. As can be seen in Figure 16 below, most advances in floodplain mapping have been made in counties which do not score particularly high in the final Impact Index. To date, online Lidar floodplain maps are available for Onslow, Carteret, Pitt, Hyde, and Beaufort counties. With the exception of Hyde County and to a lesser extent valid for Pitt County, none of these counties had a relatively low impact of Hurricane Floyd. None of the counties in the northeast, urban-coastal corridor, and southeast appear even close to completion. Noted however must be the intention of State Emergency Management to make Edgecombe County the test-area for the real-time mapping program (this I believe is still undecided). If only the program will not be further postponed, this would be one advantage for the people of Freedom Hill.

**Figure 16 North Carolina Floodplain Mapping Program Progress**

Status



Map data current as of 8/16/02.

Click on a color-coded basin above to access scoping information.



## References

- Associated Press (2002) *Census must release estimates of 2000 undercount Appeals court ruling may affect where funds go*. William McCall, October 10, 2002
- De Vries, D.H. (2002) *Place and crisis: cultural memory in the eastern North Carolinian floodplains*. Paper presented at the American Anthropological Association annual meetings. New Orleans, November 2002
- Freedman, Stephanie (2000) *Flooding from Hurricane Floyd: What's poverty and race got to do with it?*. Masters paper, Department of Epidemiology.
- Hoffman, S.M. & Oliver-Smith A.O. (2002) *21*, Santa Fe, New Mexico: The School of American Research Press.
- Konrad, H.W. (1985) *Fallout of the Wars of the Chacs: The impact of hurricanes and Implications for Prehispanic Quintana Roo Maya Processes, Status, Structure, and Stratification: Current Archaeological Constructions*. The 16<sup>th</sup> Annual Conference of the University of Calgary Archaeological Association., Calgary, pp. 321-30.
- Martine & Guzman (2002) Population, poverty, and vulnerability: Mitigating the effects of natural disasters. In: *Environmental Change & Security Project Report*, Issue no.8, The Woodrow Wilson Center, Summer 2002.
- Pulwarty, R.S. and Riebsame, W.E. (1997) The political ecology of vulnerability to Hurricane-Related Hazards. In: Diaz H.F. and Pulwarty, R.S. (eds.) *Hurricanes: Climate and Socioeconomic Impacts*. Springer, Berlin.

Addendum: North Carolina County Names Reference Map

North Carolina County Reference Map

