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The Changing Landscape: The Urbanization of Knox County, Tennessee

Charles Steven Brown
University of Tennessee, Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Charles Steven Brown entitled "The Changing Landscape: The Urbanization of Knox County, Tennessee." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Geography.

John Rehder, Major Professor

We have read this thesis and recommend its acceptance:

Bruce Ralston, Ron Foresta

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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The Changing Landscape:
The Urbanization of Knox County, Tennessee

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Charles Steven Brown

May 2007

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ABSTRACT

Land use change, in the form of urbanization, is no longer limited to existing municipal boundaries. This change, however, is neither haphazard in direction nor unpredictable in scope. It is a series of highly evolved trends that have become one of the most highly studied and researched phenomenon in the social and physical sciences.

To examine land use change as urbanization for middle tier metropolitan area, Knoxville and Knox County Tennessee were chosen as sites for my research. While Knoxville still serves as the cultural, physical and governmental center for the area, residential and commercial development have scattered throughout the county. Population and urbanization levels have, in fact, grown more rapidly outside the city limits and especially outside Knoxville's Central Core Sector throughout the period covered by this research.

This study, using U.S. Census data and NLCD (National Land Cover Data) information from the Environmental Protection Agency, catalogs the 2001 level of urbanization within Knox County and compares it with the 1992 level. The difference between these two was statistically assessed and a GIS based LUC (Land Use Change) model was created to project future urban growth. The projections generated by the model indicate that the majority of urban development will occur directionally within the individual sectors over time. The model also indicates that the growth within the specific sectors will fluctuate as other processes of urban change take over. This combination of factors returns a series of projections that is not only feasible but logical as well.

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CHAPTER I

INTRODUCTION

The economic and social effects of land use change have been widely researched by economists, sociologists, and cultural geographers. As the long-term and far reaching environmental impacts associated with land use change have become better understood, the study of evolving landscapes has gained relevance not only to physical geographers but scientists in the fields of ecology, hydrology, climatology and other scientific study. Seldom, however, has the interconnectedness of the land use process been consolidated and analyzed within the format of a GIS (Geographic Information System) based growth model.

This thesis will address this issue by using a GIS based analysis to investigate the physical and social elements as they impact the physical aspects of land use change in the urbanization process for sectors of Knox County, Tennessee. I hypothesize that land use change to urban is primarily driven by the proximity to existing urbanization within a specific spatial region mitigated only by the physical conditions of the existing landscape. I also hypothesize that readily available data is sufficient to establish historic and current levels of urbanization and to create a growth model for projecting future levels. The testing of these two hypothesizes will increase the understanding of the factors behind urban growth and the feasibility of using NLCD (National Land Cover Data) information for studying urban growth.

Whether called "sprawl," "urban growth," or "suburbanization," the most obvious and most studied type of land use change is the transformation of rural land into the urbanized landscape so prevalent at the fringes of the modern metropolitan entity. Hall and Hay summarized that urban change would follow one of four paths. Three relate to growth: from metropolitan cores to fringes; from urban to rural areas; from older manufacturing areas to newer service areas, and are indicative of an expanding urban footprint. The fourth urban change would occur as a reduction of a "…larger metropolitan area to smaller area," a shrinking process that counters the norm (Hall and Hay, 1980). Urban growth, however, does not mysteriously sprout overnight from the fertile soils of the rural countryside. It is driven by two major underlying factors; a substantial change in population and a change in the economic make up of the region. Emigration and Immigration, which have served to increase and shift the populations of regions, counties, cities, towns, and, to a lesser extent, the rural communities around them, has created a changing level of demand for residential development. Economic change can be the byproduct of an ongoing shift from an industrial/manufacturing-based economy to a service/technology driven one. The resulting dispersion of employment/commercial sites into the metropolitan fringe has only served to increase the speed by which the spatial footprint of many American urbanized areas is changing.

1.1 Purpose of the Study

The purpose of this study is to catalog the existing urbanized areas of Knox County, Tennessee, compare it to the previous level of urbanization, research the historical and social factors involved in creating the level of growth and create a LUC (Land Use Change) model to project future urban growth. The study will also investigate the feasibility of using NLCD data for classifying current and past land use.

1.2 Definitions

The word *URBAN* has many definitions. In my study, I will use the classifications derived from the land cover and land use classification established by J. R. Anderson, E. E. Hardy, and J. T. Roach in 1972 for the United States Geological Survey. The original classification has been variously called the "Anderson Classification" or the USGS Land Use / Land Cover Classification. Since 2001, classification guidelines have been modified under the Multi-Resolution Land Characteristics Consortium or MRLC (Environmental Protection Agency website, 2006).

The class of *URBAN* designated as "Class 20 – Developed" will apply to all land use types that have a developed surface area of thirty percent or greater. This also includes all sub categories of class 20.

Input data for all classifications is National Land Cover Data or NLCD; however, as classifications evolved, terms and number have changed (Table 1.1). For the 1993 NLCD classifications, sub-categories 23 (industrial, commercial, and other highly developed areas) and 22 (apartment complexes, housing projects, etc.) are joined by class 21 (most residential housing areas). Under the 2001 NLCD classifications the terminology changes slightly and the numbers shift upward. In it the sub-category 24 (Developed, High Intensity) and 23 (Developed, Medium Intensity) are certainly urbanized. By definition, class 22 (Developed, Low intensity) can include areas with 20 – 49 percent impervious surface, but since "anything above twenty-five percent is considered to have a major environmental impact on the area around it" (Yankee, 2005); it is included in the urban category.

Table 1.1 Knox County NLCD Classification Schemes (Level II)

1992 Scheme	2001 Scheme
11 - Open Water	11 - Open Water
21 - Low Intensity Residential 22 - High Intensity Residential 23 - Commercial/Industrial/Transportation	21 - Developed, Open Space 22 - Developed, Low Intensity 23 - Developed, Medium Intensity 24 - Developed, High Intensity
31 - Bare Rock/Sand/Clay 32 - Quarries/Strip Mines/Gravel Pits 33 - Transitional	31 - Barren Land 32 - Unconsolidated Shore
41 - Deciduous Forest 42 - Evergreen Forest 43 - Mixed Forest	41 - Deciduous Forest 42 - Evergreen Forest 43 - Mixed Forest
61 - Orchards/Vineyards/Other	
71 - Grasslands/Herbaceous	72 - Grasslands/Herbaceous
81 - Pasture/Hay 82 - Row Crops 85 - Urban/Recreational Grasses	81 - Pasture/Hay 82 - Cultivated Crops
91 - Woody Wetlands 92 - Emergent Herbaceous Wetlands	90 - Woody Wetlands 95 - Emergent Herbaceous Wetland

Source: U.S. Environmental Protection Agency

RURAL, identifies all areas that are not classified as urban, protected land (federal, state, city or county parks), rock or gravel quarries and pits, or water. It also includes forest, marginally developed land in farms, and residential areas that have a developed surface area of less than thirty percent.

Also included under the "rural" umbrella are classes 21, in the 2001 classifications, and class 85, in the 1993 classifications. Both classifications include "urbanized" gardens and "large lot" residential developments with lawns exceeding one-half acre. While both classifications include "urbanized" or "developed" open areas or grass lands (golf courses, parks, etc.) which would seem to exclude them from consideration, golf courses are subject to "selling-out" for urbanized development. The Deane Hill Golf Course and Country Club that became a multi-use urbanized development is such an example. Major parks are considered to be no-build areas and have been manually excluded from the rural classification.

Urban / Rural Fringe is the name given to the rural areas in close proximity to urbanized areas. This buffer will be calculated at two-hundred meter intervals (the size of the grids used in the study) and will range from two-hundred to eighteen-hundred meters from the areas designated as urban.

1.3 Land Use Change

Land Use Change is a process that can be applied to any spatial area that has undergone a modification in the surface usage. It can, in the larger scale, be applied to formally forested land that has been clear cut or burned to create farmland or pastures. While prevalent in pre-European and early European settlement times, it is a practice that is now rare because of the value of "virgin growth" wood products. Land use change can also be applied to farm, forest, and community areas that have been flooded as a result of dam construction.

For the purpose of this study, however, "land use change" is the terminology used to describe the transition of rural land to urban land.

1.4 Existing Research and Literature

Because of the multitude of factors involved in the study and projection of urban growth, there are a number of resources available for this study. To separate the resources used in this study, I have divided it into three distinct categories: The Knoxville study area; General urban trends in the United States; and urban growth models.

1.4.1 Resources Dealing with the Knoxville Study Area

As with most studies involving changes in population in specific spatial areas, U.S. Census data is instrumental in establishing historic and current levels of occupation. In this study, county and census tract population data from 1980, 1990 and 2000 are used. Also from the census data, median housing values (from the 1990 census) and median owner-occupied housing values (from the 2000 census) are used to establish a wealth-factor for each tract. This wealth-factor is one of the social factors used in the regression analysis of urban growth in Knox County during the period between 1992 and 2001 and will be discussed in greater detail in the "Culturally Driven Settlement Patterns" section of Chapter III in this paper.

Data and information from the Knoxville/Knox County Planning Commission are incorporated since local zoning and planning can have a major impact on the long-term land use change within a given sector. This information adds not only the actual changes to the land use but also provides an interesting overview on the projected changes within the study area.

Selected published books, reports, and maps on Knoxville have been important sources for the study. Dr. Bruce Wheeler's book, Knoxville, Tennessee: A Mountain City in the New South, provides important insight into the historical changes of Knoxville and Knox County while the local newspaper, the News Sentinel offers current and future growth plans. Homer Hoyt's research and growth projection for Knoxville in the Federal Housing Administration (FHA) report, THE STRUCTURE AND GROWTH OF RESIDENTAL NEIGHBORHOODS IN AMERICAN CITIES, is used for comparison to actual growth (Hoyt 1939). Other localized publications include "Sector Plans" (MPC various years), Development in the 80's (MPC 1990), and maps from 1967 (Knox County) and 1986 (Hearne Brothers 1986) which are used for a visual comparison of the urban growth.

1.4.2 General Urban Growth Trends

Mobility, both intra-county and inter-county, has been the major driving force behind America's shifting population since its first settlement by Europeans. Nationwide, by 1962 nearly one out of six homeowners moved to another home. Lansing's Propensity to Move, was part of a larger study, Geographic Mobility of Labor that was prepared jointly for the U.S. Department of Commerce, Area Redevelopment

Administration; U.S. Department of Health, Education, and Welfare, Social Security Administration; and the U.S. Department of Labor, Bureau of Employment Security. The results showed that of the fifteen percent that moved, nine percent moved intra-county while six percent moved to a different county. Lansing's study also indicated that the two categories that comprised the highest percentage of "mobile" residents were those in which the "head-of-household" was under thirty-five and those with the highest level of education (Lansing, 1962).

William Frey and Alden Speare, Jr. in Regional and Metropolitan Growth and Decline in the United States, reiterated that a shift in residential development, coupled with a change in population growth, first became noticeable in the 1960's and have become even more prevalent since. The 1970's saw the first time of the twentieth century in which the non-metropolitan areas grew faster than the metropolitan parts of the country (Frey and Speare, Jr. 1988).

In Edgeless Cities, Lang questions the "newness" of the new-metropolitan form. He points out that in the early decades of the twentieth century "uptowns" began to form a few miles from the original downtown centers. Fueled in part by the availability of streetcars and later automobiles to loosen the grip on commerce once held by the central business district merchants, these new commercial centers catered almost exclusively to a rapidly decentralizing population (Lang, 2003).

Also observing this dispersion, Kivell notes that individual cities display, "morphologies and land use patterns which range from the very formal and carefully ordered to apparently haphazard collections of buildings, spaces and activities". He continues by considering the "power" inherent in land ownership, the land as a basis for planning, and the land as an environment (Kivell, 1993).

Bender proposed that there were five elements to the ongoing population shift away from the urbanized core: economic activities dispersing into rural areas; services disperse into rural areas as basic industries do; new employment opportunities entice new migration; wage growth entices further migration; and increasing transportation cost encourages even greater migration, as individuals seek to live closer to their place of employment (Bender, 1977).

1.4.3 Urban Growth Model

Urban growth models exist in many forms and variations as evidenced by the research paper UPlan: A Versatile Urban Growth Model for Transportation Planning, which was presented at the January 2003 annual meeting of the Transportation Research Board, which details five distinct types of urban growth models (Johnston and Shabazian 2002). Since three of the five dealt specifically with transportation based modeling, only information from their "Proximity-Based Forecasting" and "Simple Land Use Models" proved beneficial to my research.

A different approach is employed by the USGS (United States Geological Survey) for the Middle Rio Grande Basin Study. David Hester's Modeling Albuquerque's Urban Growth, a part of that study, maps Albuquerque's historical landscape and uses land use/land cover (LULC) data to model the region's future growth (Hester 2000). Hester's research, more closely matching the premise of this thesis, proved very helpful.

The urban growth study that prompted this thesis is the research completed by Jeffery Allen and Kang Shou Lu for the Strom Thurmond Institute at Clemson University, which built on an earlier study completed by the Berkeley-Charleston-Dorchester Council of Governments, the University of South Carolina and the South Carolina Department of Natural Resources. That study, on the urban growth of the metropolitan Charleston area, shares many of the same elements used in my research.

Resources used for GIS and remote sensing are Applied Logistic Regression, (Hosmer and Lemeshow 2000), People and Pixels (released by the National Research Council 1998), GIS, Spatial Analysis and Modeling (Maguire et al 2005), Concepts and Techniques of Geographic Information Systems (Lo and Yeung 2002), GIS Modeling in Raster (DeMers 2002), Cartography: Thematic Map Design (Dent 1999), and Remote Sensing of the Environment (Jensen 2000).

CHAPTER II

STUDY AREA CHARACTERISTICS

2.1 Historic Overview of Study Area and Urban Growth

This study of Knox County is the study of Knoxville's urban growth and, in later years, the county residents' resistance to said growth. From its inception in the late eighteenth century until the early to mid-nineteenth century Knoxville served as a distribution point for products grown and harvested in Knox and surrounding counties. The introduction of the railroad in the 1830's greatly enhanced Knoxville's position as a "cross-roads" for products and people traveling between Ohio, Kentucky, western New York, Western Pennsylvania and regions south. Also during this period wealthy merchants and land owners created a spatial shift in commercial and political influence with their residential expansion west of the city (Wheeler 2005).

Post Civil War Knoxville, like most southern cities, experienced a strengthening of the economic and racial segregation. Blacks and, to a lesser degree, poor whites were economically pushed into the eastern and southeastern "downwind" portions of the city and county. Here the soot and ash from coal fired industrial plants and locomotive engines created an urban blight condition that has outlived the factors that created it. Continued property value segregation was reiterated in 1939 with the Federal Housing Administration (FHA) report, THE STRUCTURE AND GROWTH OF RESIDENTAL NEIGHBORHOODS IN AMERICAN CITIES. Homer Hoyt, who authored the classic study and the "sector model" of city development, researched and diagramed, through segmented concentric rings, the predicted growth patterns for twenty-five cities across the county. His projections were based on the housing values in effect at the time and the theory that growth would directionally follow wealth. For Knoxville, Hoyt's research and projection indicated that growth, as indicated with darker shades, would primarily concentrate in a westerly direction with a secondary direction toward the northeast (Figure 2.1). Only one area, representing the western end (toward the central business district) of Magnolia Avenue, was projected to have appreciable urban growth (Hoyt 1939) in an easterly direction.

The early 1940's saw little obvious change to the spatial footprint of Knoxville as attention turned to the war in Europe and the South Pacific. Behind the scenes, however, things were radically different. Employment and wages skyrocketed as Alcoa, the aluminum manufacturer located twenty miles south of Knox County, geared up for military production. Furthermore, America's "Secret City," (Oak Ridge) sprang from the mud and clay just across the Anderson County line. Both helped set the stage for a major future shift in urbanization.

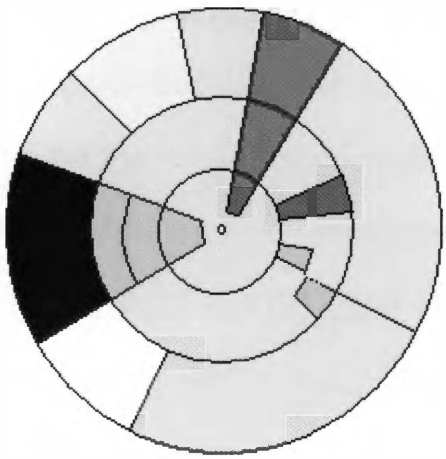


Figure 2.1 Hoyt's 1939 prediction of Knoxville's growth

The late 1940's and throughout the 1950s were marked by the continuation of TVA's (Tennessee Valley Authority) dam and power plant construction and by the arrival of the Interstate Road system into Knox County. The improvement in transportation technology reinforced Knoxville's place as a crossroads and distribution center while the widespread availability of inexpensive electric power not only enticed industrial construction but allowed for a decentralization of development.

The late 1950's and into the 1960's witnessed a change in not only the spatial footprint of the city but a change in the demographics within portions of the city as well. Interstate Highways and urban renewal redefined downtown Knoxville and its surrounding communities. Many of the poverty level families and individuals displaced by the Interstate construction and the urban renewal projects were relocated into public housing units along Magnolia Avenue (Kerns, 1967). This one change in population demographics had far reaching influences on urban growth within Knoxville and Knox County. Holston Hills, an upper middle class neighborhood located further east than the new housing projects, suddenly found itself isolated from the Knoxville central core. Lower, middle and upper middle income whites, from the Magnolia Avenue area and surrounding neighborhoods, fleeing the sudden influx of black residents and falling property values moved north and west. The City of Knoxville responded to this virtual hemorrhage of tax paying residents by annexing the newly vibrant communities (Wheeler, 2005).

The annexation process continued throughout the 1970's, 1980's and into the 1990's as the city, in an effort to maintain and often increase tax revenues, simply incorporated an ever increasing amount of the county's landscape. Farragut, formally a small but growing community twenty-five miles southwest of the Knoxville city core, finally incorporated in the late 1980's as a means to avoid Knoxville's seemingly insatiable appetite for taxing growth. By the late 1990's, finger annexation, versus the more traditional block style of annexation, became the norm as the City of Knoxville, in an effort to reduce the number of anti-annexation lawsuits filed, simply shifted their attention to the businesses that lined the major roads that intersected with areas already within the city limits. This shift in philosophy became even more apparent with the unusual shape Knoxville's city limits began to show.

By 2000 multiple communities had grown enough to be classified as urban both within and outside the official city limits of the incorporated municipalities. These communities, and their extensive level of development, are the reason that this thesis considers land use change, in the form of urbanization, on the county level without regard to prescribed political boundaries.

2.2 Detailed Study Areas

This thesis explores the urbanization of Knox County at three separate levels: Knox County as a whole (Figure 2.2); The Northeast, Southeast, Southwest, Northwest and Central Core Sectors of Knox County (Figure 2.3); and 1992 Census Tracts 54-00, 58-02, and 63-00 (Figure 2.4). The tracts were chosen because they are at the outer boundaries of the county and are connected to the Central core by an interstate.

At the county level, the study considers the overall amount of spatial area that should, based on population growth estimates and the urban growth model, transition from non-urban to urban.

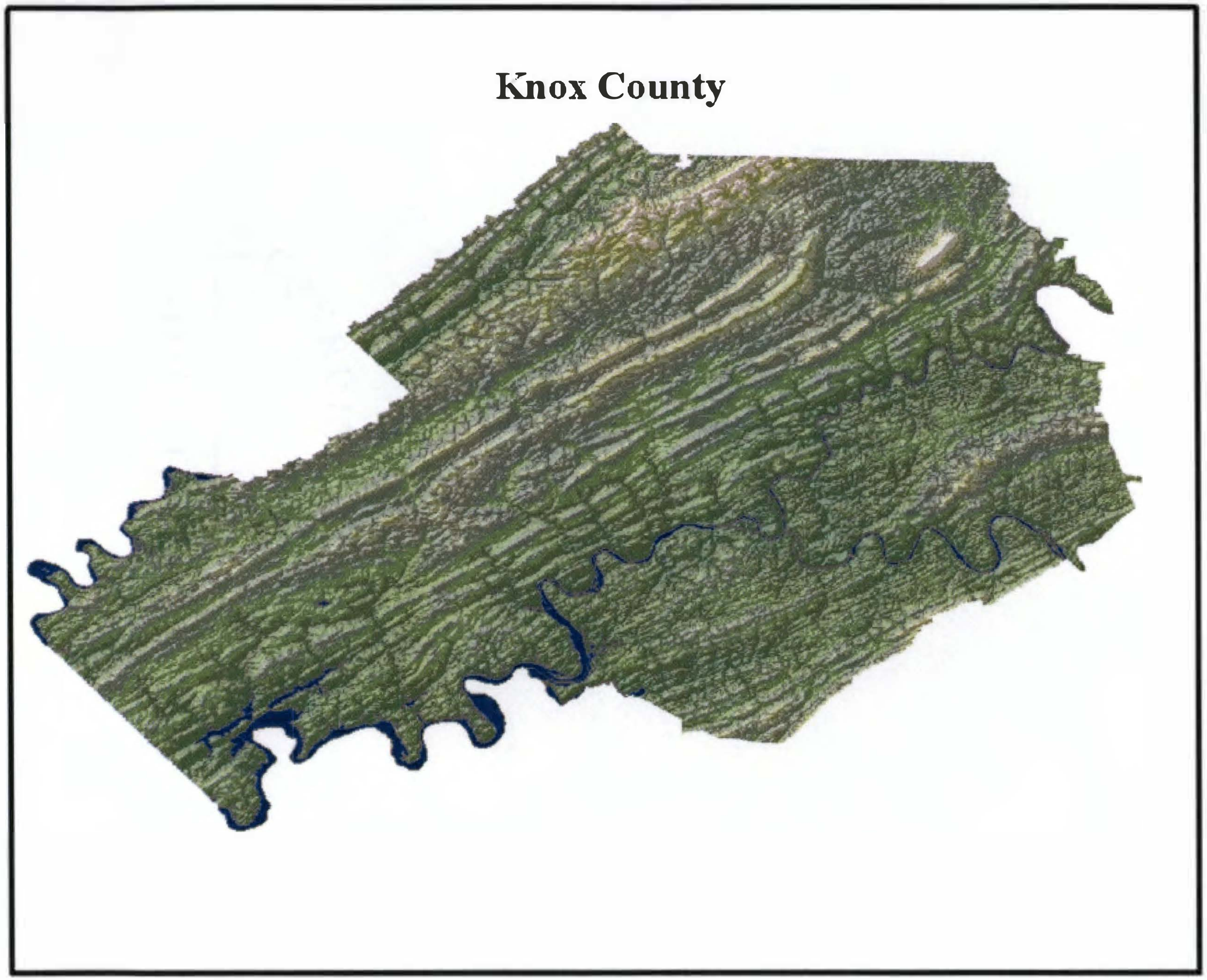


Figure 2.2 Knox County

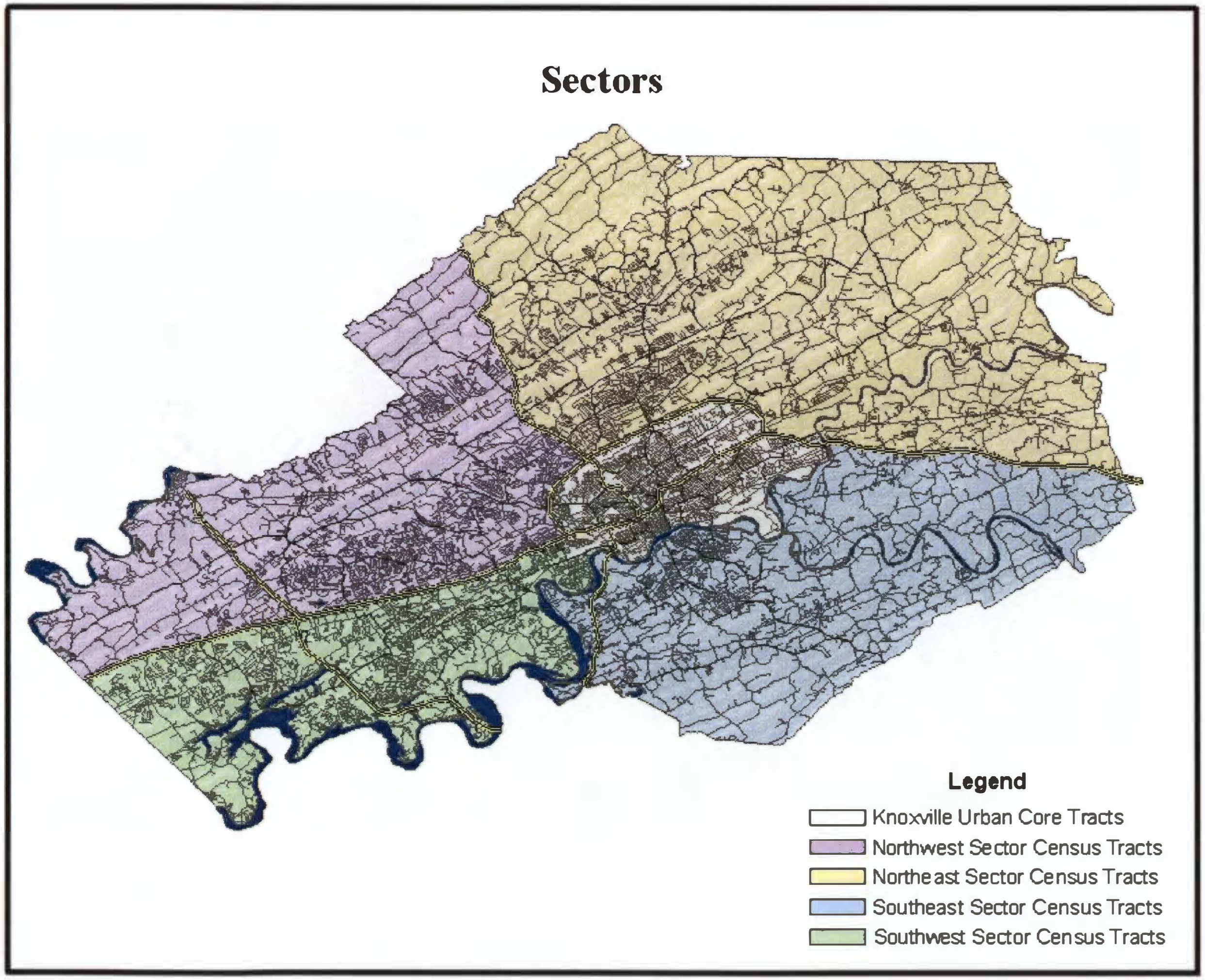


Figure 2.3 Knox County Sectors

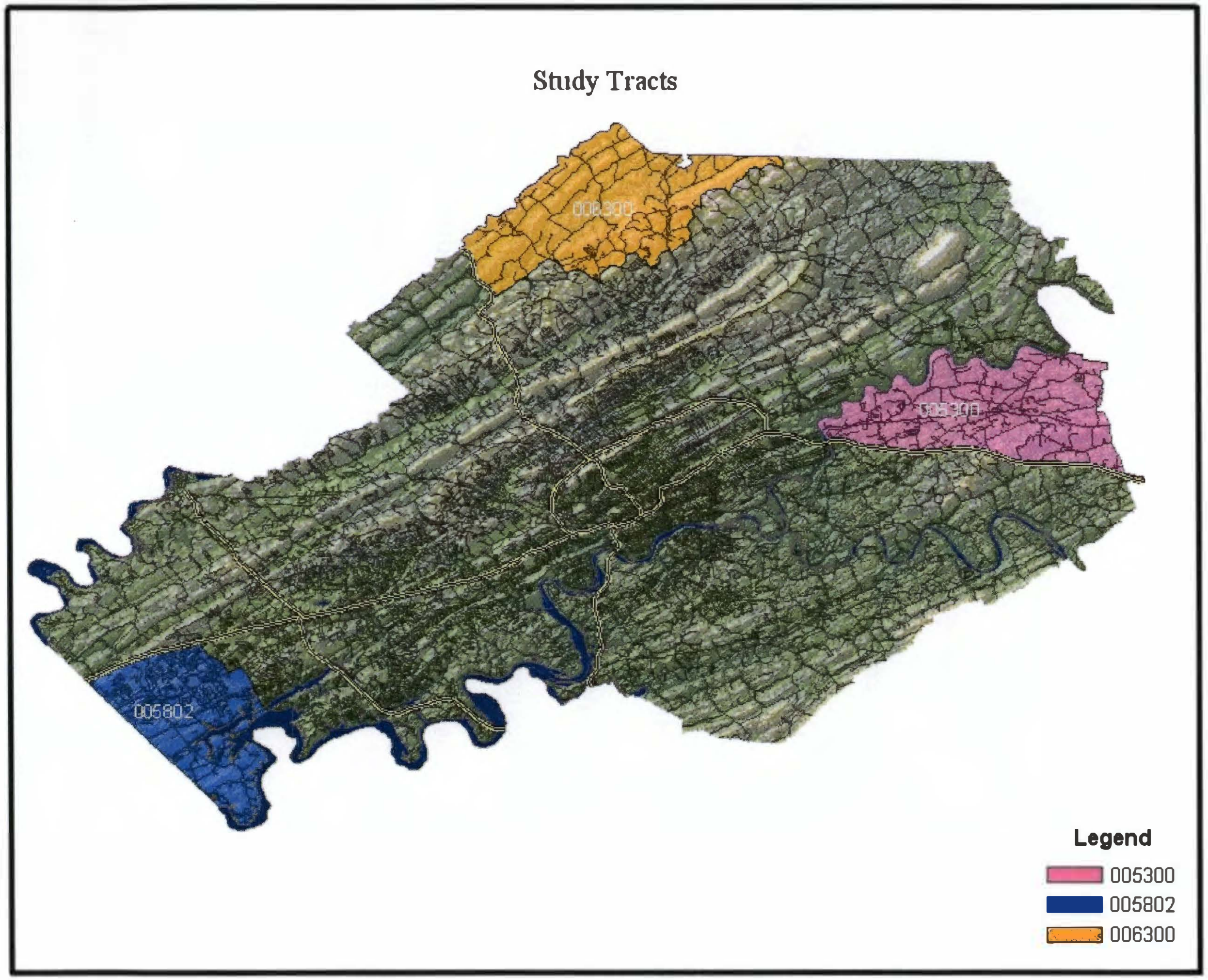


Figure 2.4 Knox County Study Tracts

At the sector level the county is separated into five distinct study areas. Each is defined using man-made and natural terrain breaks and includes the 1990 census tracts that best fit those spatial areas.

2.2.1 The Central Core Sector

The Central Core Sector (Figure 2.5) is best described as the area between the I-640 Bypass and the Tennessee River. Best known as the center of the City of Knoxville, since it contains the central business district, the Central Core Sector is comprised of twenty-eight individual census tracts. It includes the City of Knoxville and Knox County governmental seats as well as the main campus of The University of Tennessee. Other icons in the sector include the Knoxville Zoo, the World's Fair Park and several of Knoxville's adjacent older neighborhoods.

Different portions of the sector have been experiencing urban renewal and redevelopment since the mid 1960's with the latest (post 2000) being a series of warehouse to loft type apartments and condominiums. Another type of urban improvement is also underway as roads and the inner-city connector, Neyland drive / James White Parkway, are being reconfigured to improve traffic flow.

The Central Core Sector is unique among the sectors in Knox County in that it is the only sector to experience a population decline between 1980 and 1990 and then again between 1990 and 2000 (Table 2.1). The Central Core Sector also has the highest percentage of African-American residents in Knox County with over twenty-eight percent in 1990 and over thirty percent in 2000.

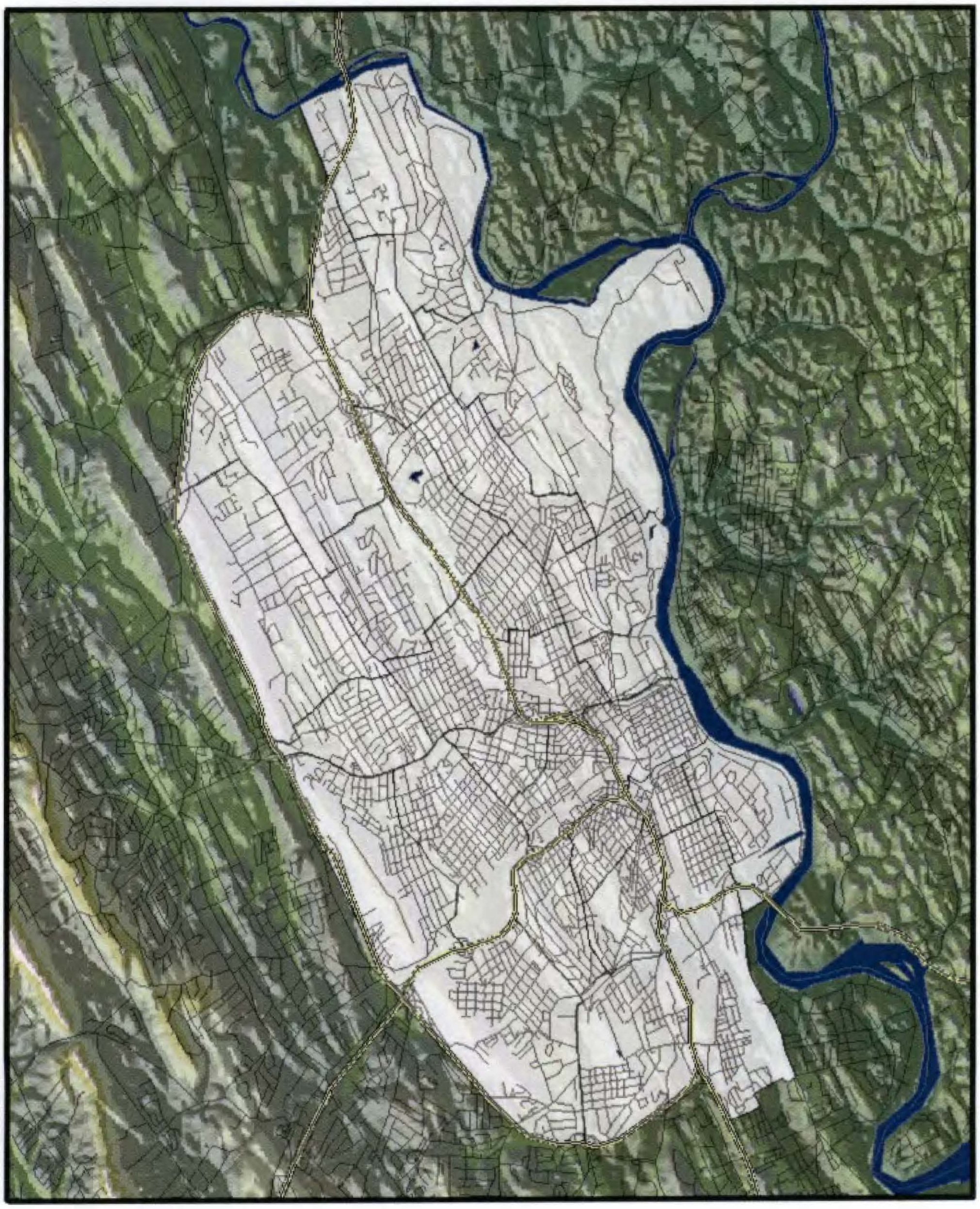


Figure 2.5 Central Core Sector

Table 2.1 Central Core Sector Population Change

Tract	1980	1990		2000	
100	1471	1470	*	1300	*
200	1684	1284	*	1270	*
300	2350	1979	*	1904	*
400	891	725	*	744	
500	3239	2602	*	2620	
600	3879	3339	*	2745	*
700	1936	2041		1646	*
900	8284	6613	*	7628	
1000	1739	1923		1513	*
1100	3145	3461		2614	*
1200	2926	2489	*	969	*
1300	1939	1479	*	1382	*
1400	4130	3838	*	3301	*
1500	4395	3767	*	3538	*
1600	3359	3118	*	2935	*
1700	3114	2960	*	2764	*
1800	2827	2453	*	2317	*
1900	2513	2045	*	1856	*
2000	4521	3560	*	3389	*
2100	2917	2550	*	2561	
2600	2785	2260	*	2309	
2700	3263	2919	*	2585	*
2800	4582	4362	*	3863	*
2900	3913	3370	*	3467	
3000	3892	3924		4326	
3100	3034	2669	*	2880	
3200	3937	3410	*	3024	*
3300	2328	2149	*	2190	
Totals	88993	78759	*	73640	*

Data Source: U.S. Census (* - Denotes Population Decline)

2.2.2 The Northeast Sector

The Northeast Sector (Figure 2.6) includes all of the land east of Interstate 75, north of Interstate 40 and outside the Central Core and is comprised of seventeen census tracts (Table 2.2) Industrial, commercial and distribution centers flank the interstates and major roads while Knoxville Center (formally East Town Mall) anchors the area just east of the I-640 bypass. Carter, Gibbs, Halls Crossroads, and Fountain City are major communities within the sector.

Radiating outward from the I-640 bypass, the sector includes three distinct thoroughfares Broadway / Maynardville Pike, Tazewell Pike and Rutledge Pike. Broadway / Maynardville Pike is heavily commercialized from I-640 to the Union County line. Rutledge Pike, in the southeastern portion of the sector, is the connector between Rutledge and Knoxville and has experienced a moderate amount of urbanization on the western end. Tazewell Pike, other than the short distance within the Fountain City community, is primarily a residential thoroughfare.

While five of the tracts within the sector experienced population declines during the period between 1980 and 1990 and three declined between 1990 and 2000, the overall sector movement has been upward. The majority of the increase is to be attributed to the growth at Hall's Crossroads, a magnet bedroom community, located near the center of the sector. The African-American population within the tract increased by more than five-hundred during the period between 1990 and 2000 yet still remained at less than two and a half percent. This low number established the Northeast Sector as the least diverse, racially, of all five sectors.

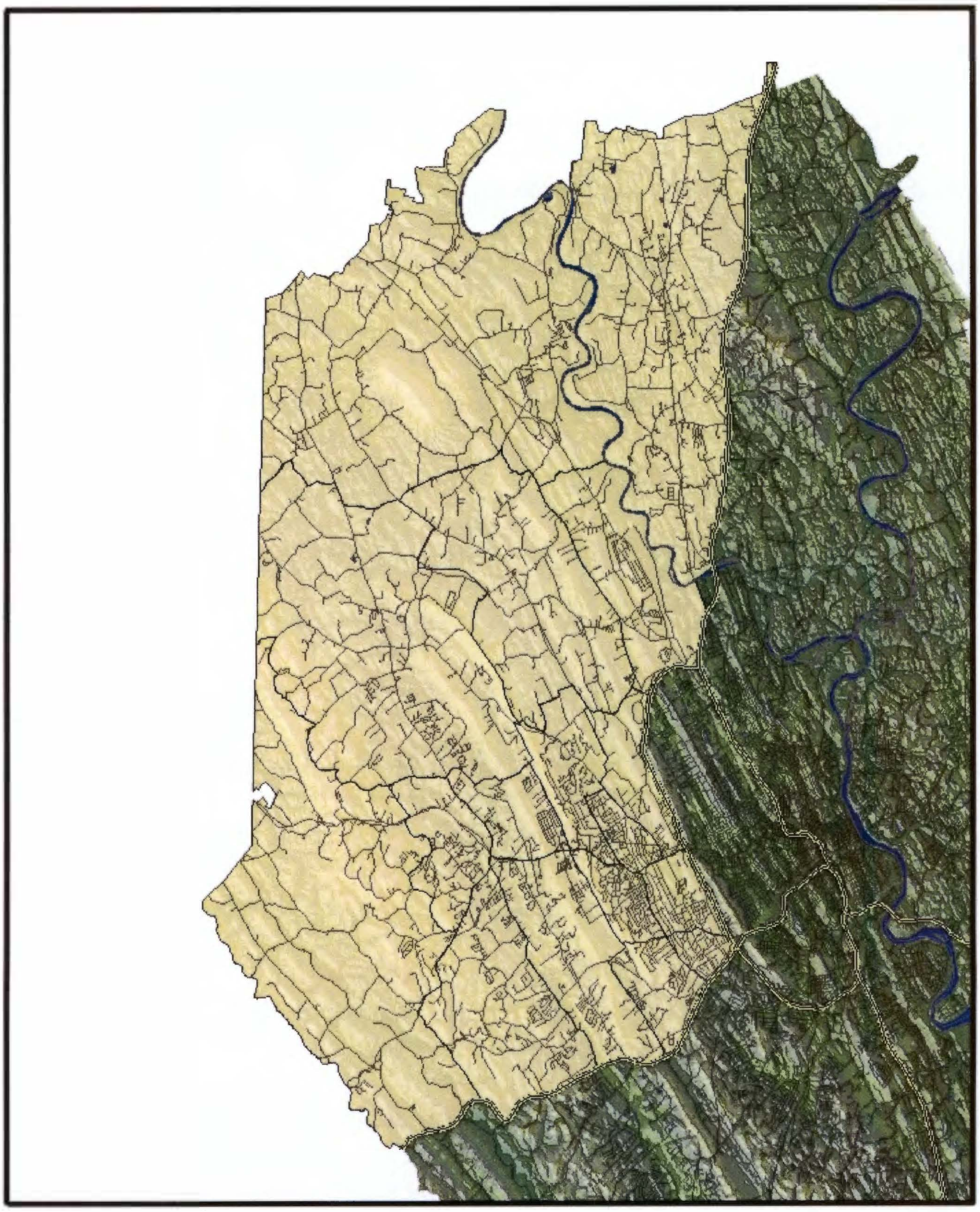


Figure 2.6 Northeast Sector

Table 2.2 Northeast Sector Population Changes

Tract	1980	1990		2000	
4000	3313	3335		3504	
4100	4311	4259	*	3969	*
4200	3647	3443	*	3422	*
4300	2311	1873	*	2028	
4900	3039	3536		4239	
5000	4369	3856	*	3956	
5100	2721	3042		4225	
5201	3979	4002		4467	
5202	2711	2797		2690	*
5300	6296	6224	*	6812	
6201	4315	5039		7098	
6202	2493	2604		3701	
6203	3260	4133		4482	
6204	5484	5784		7506	
6300	4573	5080		6170	
6400	5207	6418		8646	
6500	5789	5776	*	6013	
Totals	67818	71201		82928	

Data Source: U.S. Census (* Denotes Population Decline)

2.2.3 The Southeast Sector

The Southeast Sector (Figure 2.7) is the area south of the Tennessee River in the central and western portions and south of Interstate 40 in the east. It is comprised of ten census tracts (Table 2.3) and is flanked by commercial development along Alcoa Highway in the west and industrial development in the Forks of the River Industrial Park in the east. It is the only sector that is separated from the Central Core by water and has the lowest population and the second lowest growth rate.

Eight of the ten census tracts experienced a population decline between 1980 and 1990 which drove the overall sector's population down. Four of those tracts and the overall sector rebounded upward between 1990 and 2000. The African-American population grew from one-thousand and eight in 1990 to one-thousand six-hundred and sixty-three in 2000, an increase of nearly sixty-five percent.

Table 2.3 Southeast Sector Population Changes

Tract	1980	1990		2000	
800	2539	2172	*	3587	
2200	4800	4172	*	4095	*
2300	3592	3297	*	3207	*
2400	4794	3793	*	3758	*
3400	4465	4245	*	3869	*
3500	4638	3674	*	3905	
5400	6283	6133	*	6501	
5500	5812	5823		6089	
5601	5290	5180	*	5577	
5602	2912	3108		3665	
	45125	41597		44253	

Data Source: U.S. Census (* Denotes Population Decline)

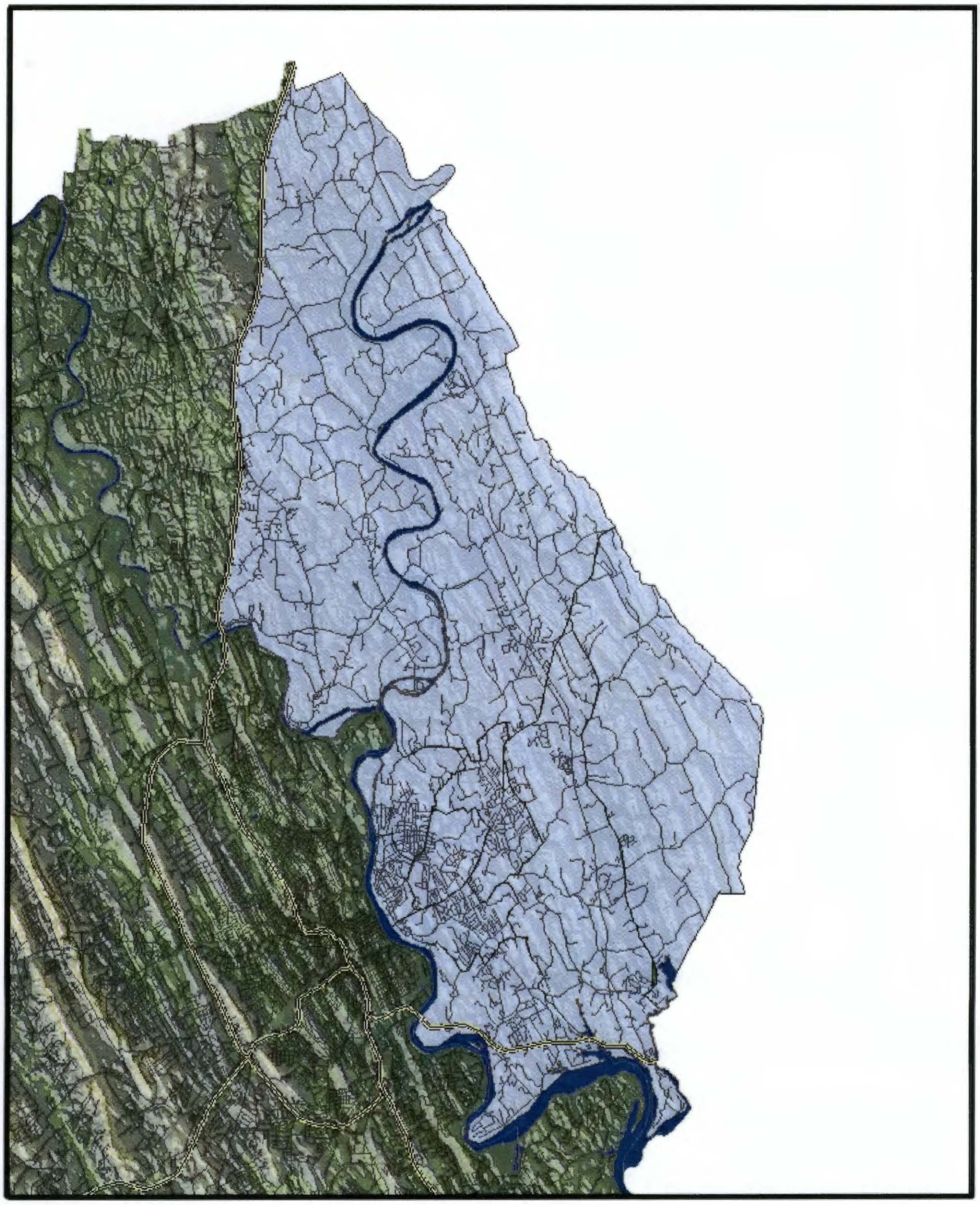


Figure 2.7 Southeast Sector

2.2.4 The Southwest Sector

The Southwest Sector (Figure 2.8) is the area west of the Central Core and south of Interstate 40. In the 1980 and 1990 census tract designations, the sector was comprised of ten census tracts. For the 2000 census, three tracts were divided creating a total of thirteen tracts (Table 2.4). While bisected north to south by Pellissippi Parkway, the sector is best defined by the major east-west roads within it. Kingston Pike, paralleling the interstate in the northern part of the sector is the old established commercial thoroughfare, anchored by West Town Mall near the West Hills' interstate exit, for all but a short span in the western most tract in the sector. Since 2000, Parkside Drive, bisecting the land between Kingston Pike and the interstate and stretching from Cedar Bluff Road to Campbell Station Road, has received the most intensive amount of commercial development. Multiple new car dealerships now line the road as well as the newly developed Turkey Creek commercial development which is the third primary retail development in Knox County. Westland Drive, in the center of the sector, and Northshore Drive, paralleling the river to the south, have been the driving forces in residential development.

While not the most populous, the Southwest Sector is the fastest growing in both population percentage and in commercial development. Between 1980 and 1990 the population grew by a little over thirty percent. Between 1990 and 2000 this growth had slowed slightly too a little over twenty-eight percent. The African-American population in the sector grew by an equally high twenty-eight percent during the period from 1990 to 2000 but at less than three percent of the total population it remained low.

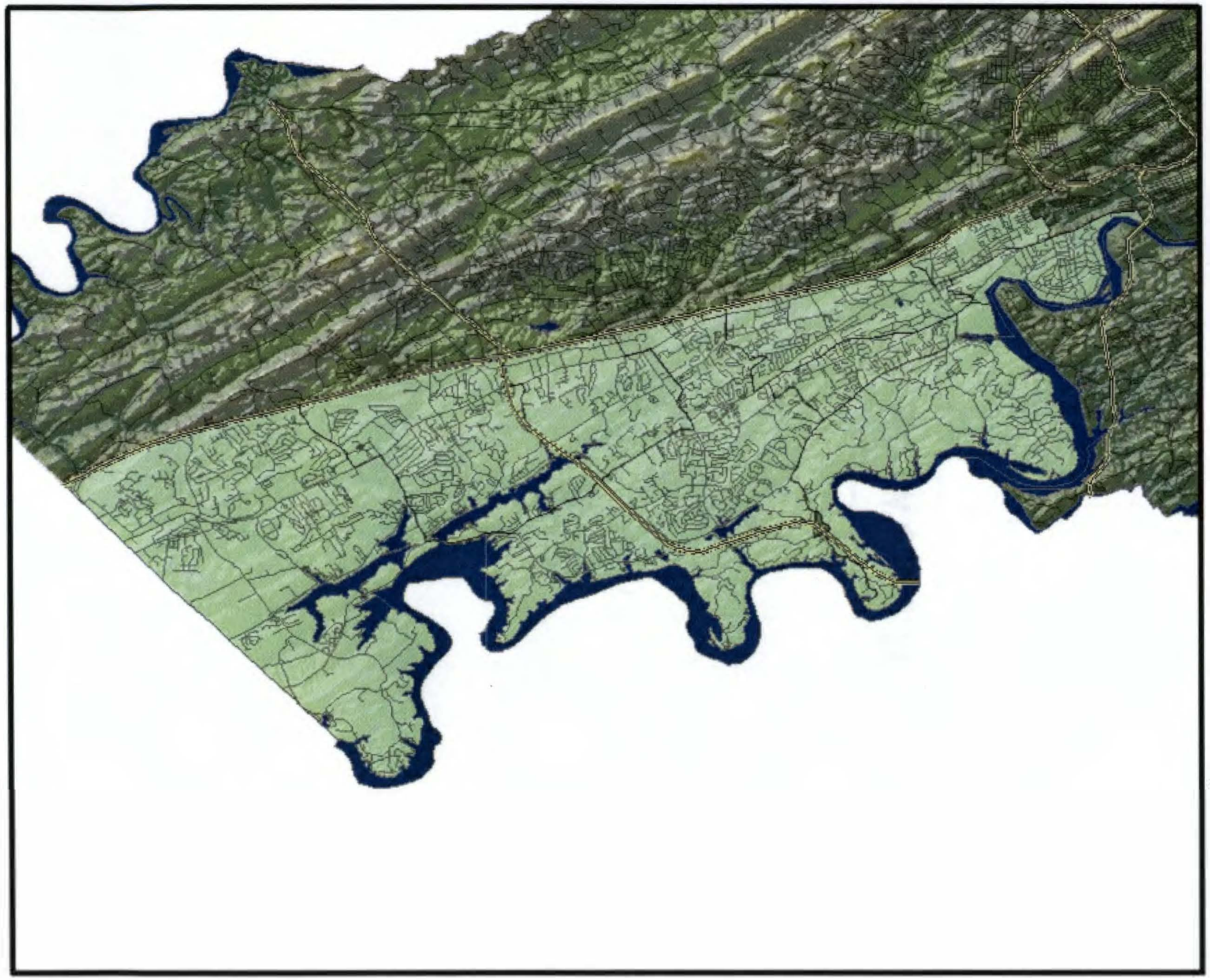


Figure 2.8 Southwest Sector

Table 2.4 Southwest Sector Population Changes

1980 Tract	1980	1990		2000 Tract	2000	
2500	3829	3640			3640	
3600	891	463	*		236	*
3700	4800	4025	*		3833	*
4401	3488	4509			4665	
4402	7339	7171	*		7980	
5701	3010	3578			4438	
5702	7436	13970		5704	4811	
				5705	16722	
5703	3420	4031			5069	
5801	5231	8457		5803	2674	
				5804	7138	
5802	6541	9988		5805	7342	
				5806	8225	
Totals	45985	59832			76773	

Data Source: U.S. Census (* - Denotes Population Decline)

2.2.5 The Northwest Sector

The Northwest Sector (Figure 2.9) is located north of Interstate 40 / 75, west of Interstate 75 and outside the I-640 bypass. In the period from 1980 to 1990, fourteen census tracts were included within the sector. One of these tracts (004602) was divided for the 2000 census giving the sector a total of fifteen (Table 2.5).

The Northwest Sector is also bisected north to south by Pellissippi Parkway, which serves as a thoroughfare between Blount and western Knox Counties and The City of Oak Ridge. This is important since the Oak Ridge National Laboratory (ORNL) is one of the major employers of highly educated and highly skilled workers in the area.

The sector is characterized by commercial and distribution development along the inner portions of Middlebrook Pike, Cedar Bluff Road, Merchant's Drive, Oak Ridge Highway and, to a lesser degree, Emory Road. Development is quite intensive along the inner portions of the sector as well as in close proximity to the interstates and main roads as evidenced by the number of urban grids. This amount of development, however, thins considerably with distance from the Central Core.

The Northwest Sector is the most populous sector in Knox County. Growth rates of a little over seventeen and a half percent between 1980 and 1990 and nearly twenty-four percent between 1990 and 2000 are fast approaching that of the less populous but fast growing Southwest Sector. The combination of higher availability of developable land and an increased diversity in population, based on the increase of African-American residents from three and a half percent in 1990 to nearly five percent in 2000, should allow for continued growth into the foreseeable future.

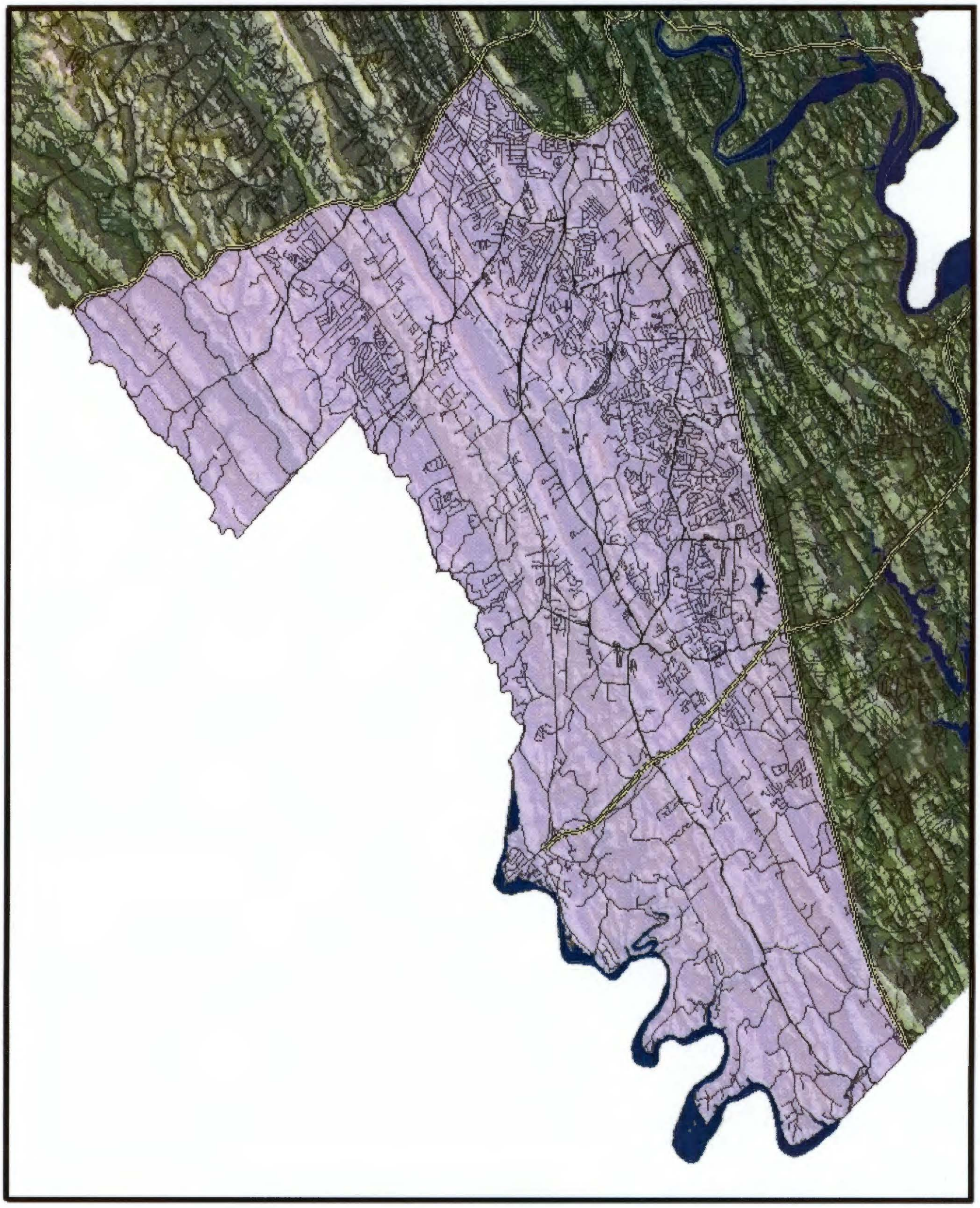


Figure 2.9 Northwest Sector

Table 2.5 Northwest Sector Population Change

1990 Tract	1980	1990		2000 Tract	2000
3800	5459	5979			6826
3900	6410	6385	*		6964
4500	4999	5266			5714
4601	4406	5646			6926
4602	7457	11366		4605	10658
				4606	4948
4603	7151	8963			9366
4604	3692	4592			6265
4700	3176	3472			3760
4800	4742	4105	*		4710
5901	4649	6184			7822
5902	3879	4918			6850
6000	6460	7753			10029
6101	7180	7264			9331
6102	2113	2487			4269
Totals	71773	84380			104438

Data Source: U.S. Census (* Denotes Population Decline)

2.3 Individual Census Tracts

Three census tracts have been chosen from the 1990 U.S. Census for study in greater detail. Each is located along the outer boundaries of the county and adjacent to an interstate. Geographically the three represent north, west and east sectors of the study area. Organizationally the three represent rural, transitional and "old-style" semi-urban. Each is unique enough to provide insight on the social and urban differentiation within the county.

2.3.1 East Knox County (Census Tract 005300)

East Knox County's census tract 005300 is located between the Holston River and Interstate 40 in the eastern portion of East Knox County (Figure 2.10). Population has remained fairly constant, falling from six-thousand two-hundred and ninety-six in 1980 to six-thousand two-hundred and twenty-two in 1990 before rebounding to six-thousand eight-hundred and twelve in 2000. This equates to a population increase of a little over eight and a half percent. The number of African-Americans in the tract increased from one-hundred and four in 1990 to one-hundred and nineteen in 2000 but, because of the small number, a little over one and a half percent of the total population in 2000, the area is considerably less diverse than the tracts to the west of it.

Despite the existence of a major thoroughfare, Ashville Highway, bisecting the tract, the atmosphere is one of an area caught in a time warp. Many of the business lining Ashville Highway are still the same type of "Mom and Pop" establishments that have existed in the area since the 1950's and 1960's. Residents still must travel to Jefferson

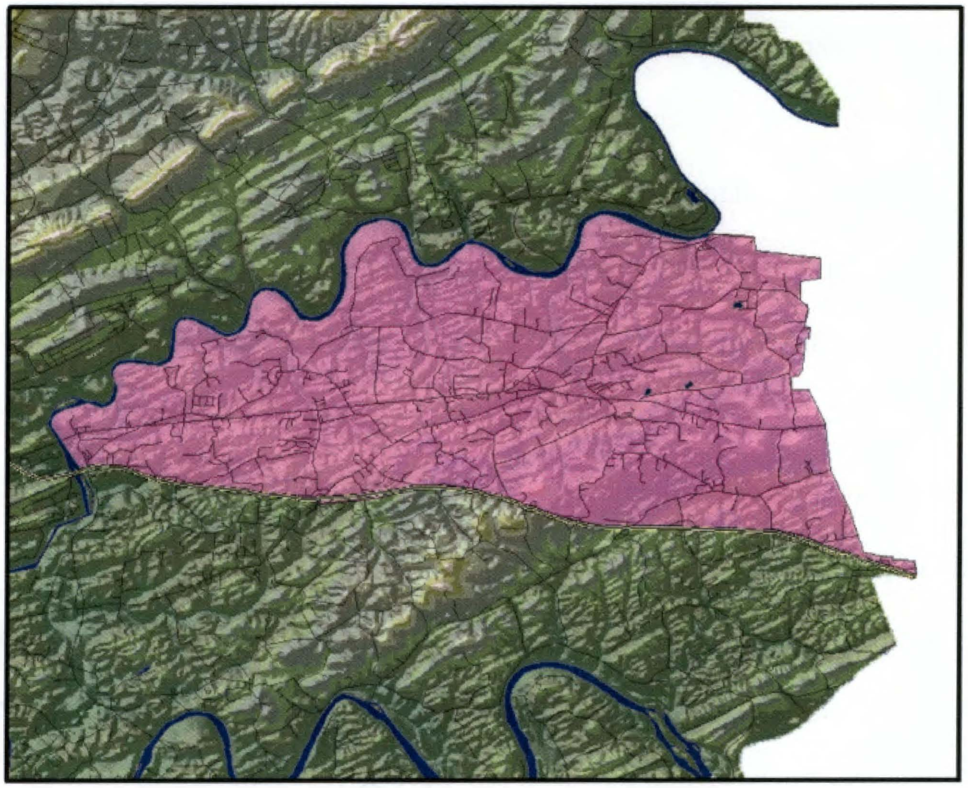


Figure 2.10 East Knox County (Census Tract 005300)

City (across the Jefferson County line) to Knoxville to shop at a primary or secondary level retailer. Other commercial growth, fast-food restaurants, chain restaurants and hotels have established a presence in the areas adjacent to the Ashville Highway and Strawberry Plains Interstate exits. Residential growth has been concentrated in small pockets scattered throughout the tract. This has increased the number of housing units in the tract from two-thousand four-hundred and sixty-one in 1990 to two-thousand nine-hundred and sixty-five in 2000. While residential development has continued to gain speed in the tract since 2000, potentially major changes are being considered for the southeastern portion.

Lauded by local government officials and long range planners as essential for the long term growth of the county, a three-hundred and seventy-five plus acre industrial park development has been approved near the Midway Interstate exit in the tract. This approval, however, is being hotly contested by residents concerned over losing their semi-rural identity.

2.3.2 West Knox County (1990 Census Tract 005802)

West Knox County's census tract 005802 is located between Interstate 40 / 75 and the Tennessee River in the southwest portion of Knox County (Figure 2.11). Much of the Town of Farragut is located within the tract as are Farragut Elementary, Farragut Middle and Farragut High Schools. Kingston Pike serves as both a major thoroughfare and connecting route between Lenoir City, just across the Loudon County line, The Town of Farragut and Knoxville. It is also the main commercial road in the tract with high levels

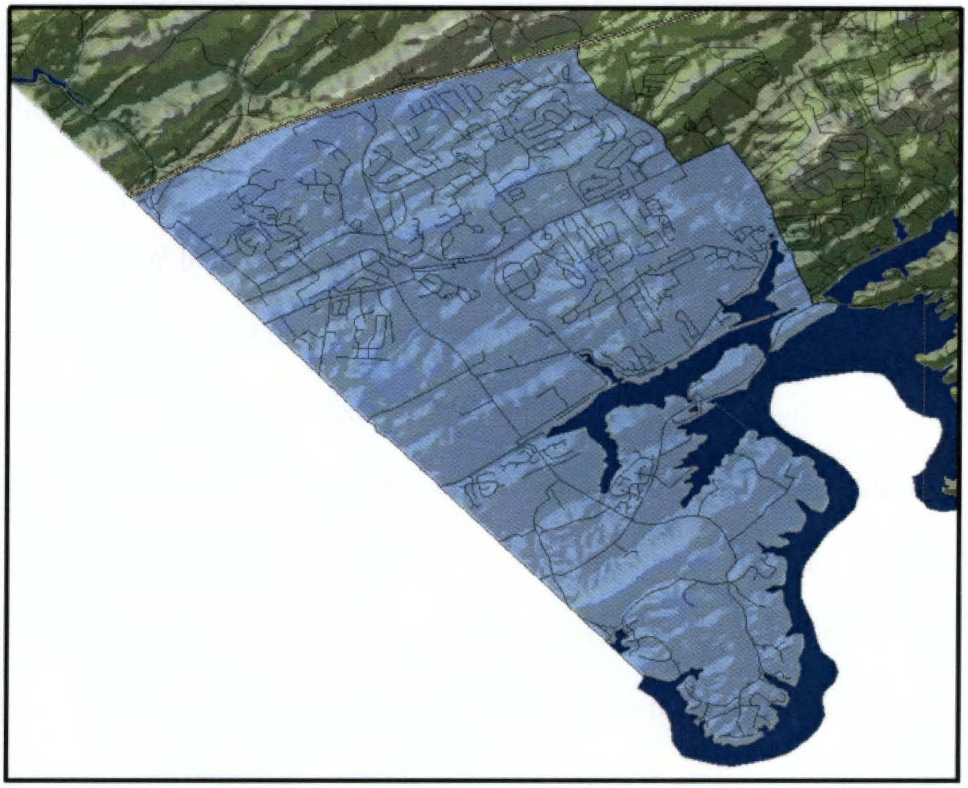


Figure 2.11 Southwest Knox County (Census Tract 005802)

of development within the eastern one half of the tract and more moderate levels of development within the western one fourth. The western center of the tract, along Kingston Pike, remains residential and, with the inclusion of two golf courses, urban recreational areas.

North of Kingston Pike, between Campbell Station Road and Watt Road, the area is almost entirely residential. Between Kingston Pike and the Norfolk Southern Railroad track, the area remained fairly rural until the 1990's when residential development began creeping inward. The southern portion of the tract, the area between the railroad and the Tennessee River, experienced the most dramatic increase in residential development after the late 1990's. Over a nine year period, eighteen subdivisions and more than twelve-hundred homes were completed or were under development in the area.

Growth throughout the tract has been strong. Between 1990 and 2000, the population increased nearly fifty-six percent, from nine-thousand five-hundred and eighty-one to fifteen-thousand five-hundred and sixty-seven. Housing units grew at an even faster sixty-seven percent, from three-thousand five-hundred and nineteen in 1990 to five-thousand eight-hundred and seventy-eight in 2000.

While the overall growth in the tract was sufficient to justify splitting it in the 2000 census, the African-American population remained low. In pure numbers, it increased from one-hundred and thirty residents in 1990 to two-hundred and sixty residents in 2000. Both numbers, however, remained under two percent of the total population for the tract.

2.3.3 North Knox County (1990 Census Tract 63000)

Census Tract 006300 is located in the northern portion of Knox County (Figure 2.12). It is bordered to the west by Interstate 75 and to the north by Anderson County. The population within the tract is growing. From 1980 to 1990 it grew by slightly over eleven percent, from four-thousand five-hundred and seventy-three to five-thousand and eighty. Between 1990 and 2000, growth accelerated to over twenty percent as the population increased from five-thousand and eighty to six-thousand one-hundred and seventy. In the same period, 1990 to 2000, housing units in the tract increased even faster at over thirty-two and a half percent from one-thousand eight-hundred and eighty-two to two-thousand four-hundred and ninety-five. Racial statistics for the tract can be misleading since, between 1990 and 2000, the African-American population increased by an amazing one-hundred and twenty-five percent. The reality, however, is that the actual number of African-American residents in the tract only increased from four in 1990 to nine in 2000. This makes the tract one of the least diverse, in terms of racial make-up, tracts in Knox County.

The tract consists of a series of heavily wooded ridges and clear-cut valleys, many of which are working farms, punctuated by widely spaced residences. The southern portion of the tract has the most intensive residential development though most of it is actually spill over growth from the Hall's Crossroad community to the south.

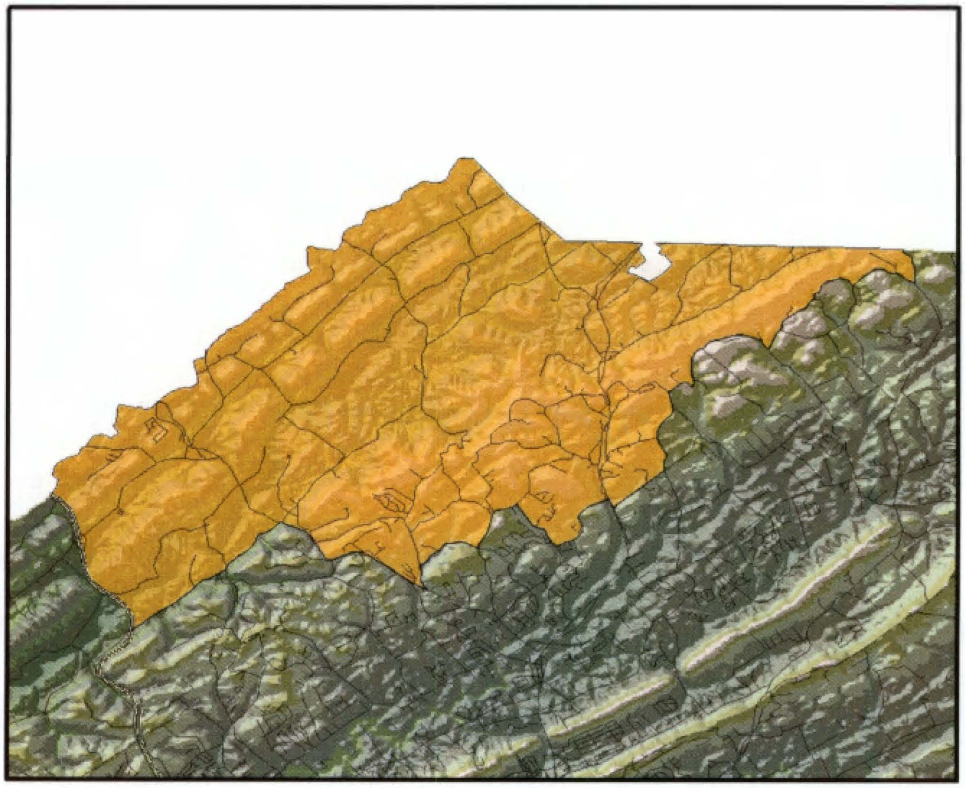


Figure 2.12 North Knox County (Census Tract 006300)

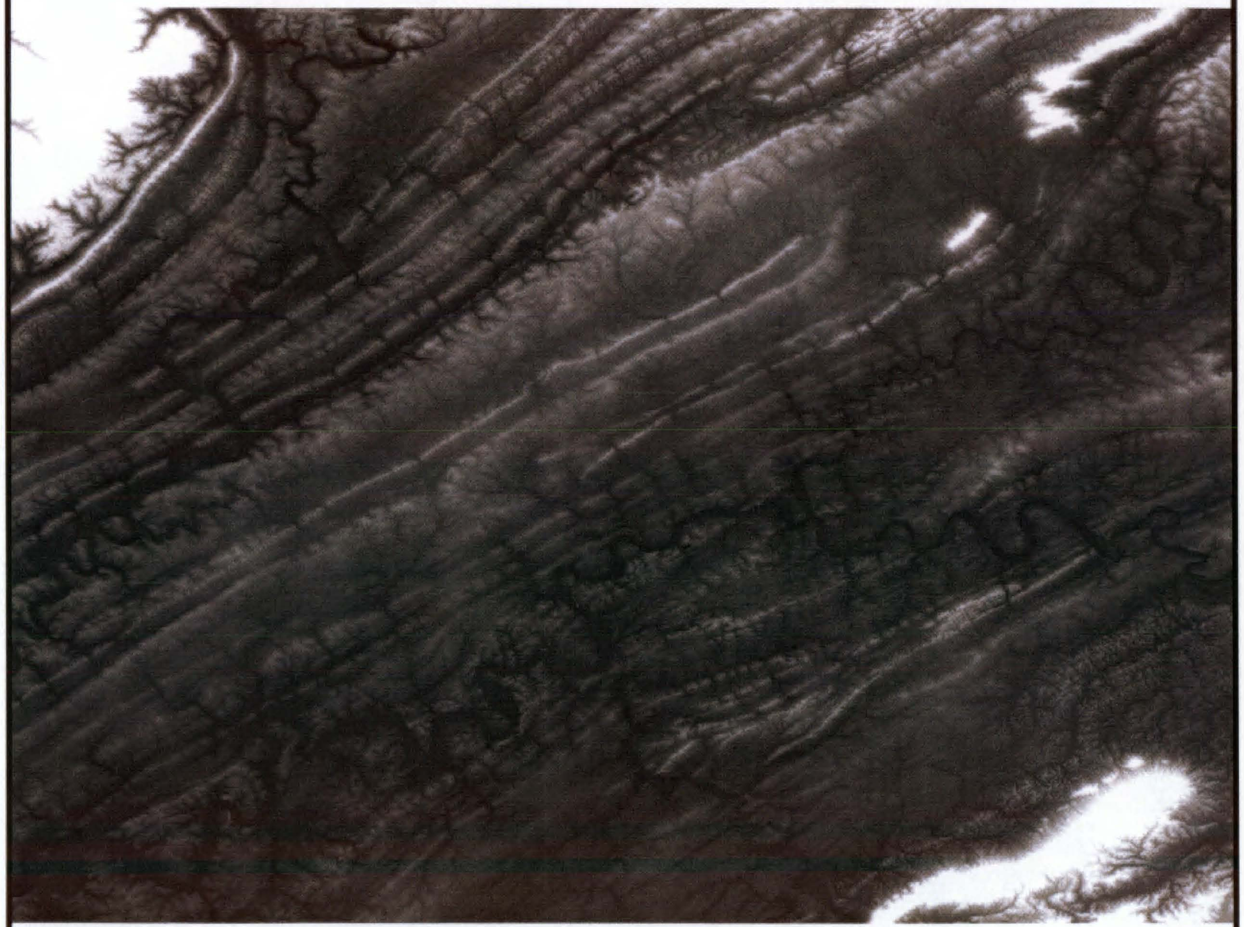
CHAPTER III

STUDY AREA MAPS AND PHYSICAL GEOGRAPHY

3.1 DEM Map of Study Area

Tennessee is one of the more unique southeastern states in that it is both land-locked and has a tremendous amount of diversity in elevation and landscape. So much so, that for many years the state is officially known as "The Three States of Tennessee." From the flat lands of western Tennessee's 300 foot elevation the terrain builds across the rolling hills of central Tennessee's 600 foot elevation before leveling out at approximately 2,000 feet above sea level atop the Cumberland Plateau. The eastern portion of the state begins at the plateau and drops quickly 1,000 feet into a 75 mile-wide valley region called the Ridge and Valley Province before climbing and terminating at 6,643 feet above sea level in the Great Smokey Mountains of the Blue Ridge Province. The "floor" of the Great Valley, as the eastern part of the Ridge and Valley Province is known, is not flat but comprised of a series of parallel ridges and valleys that run diagonally across multiple states from Pennsylvania to Alabama. Knox County is located near the center of the Ridge and Valley province in East Tennessee.

A DEM (Digital Elevation Model) map with its Metadata contains a considerable amount of information that is relevant to this study. Downloaded from the internet at http://seamless.usgs.gov and opened in ESRI's Arc Map, the map has a "stretched" symbology of grayscale coloring (Figure 3.1). Stretched, as used in the Arc Map Program, refers to a color representation that transitions from one shade to another, based on the attributes of the map, without breaking those distinctions into groups or categories.



Source: http://seamless.usgs.gov

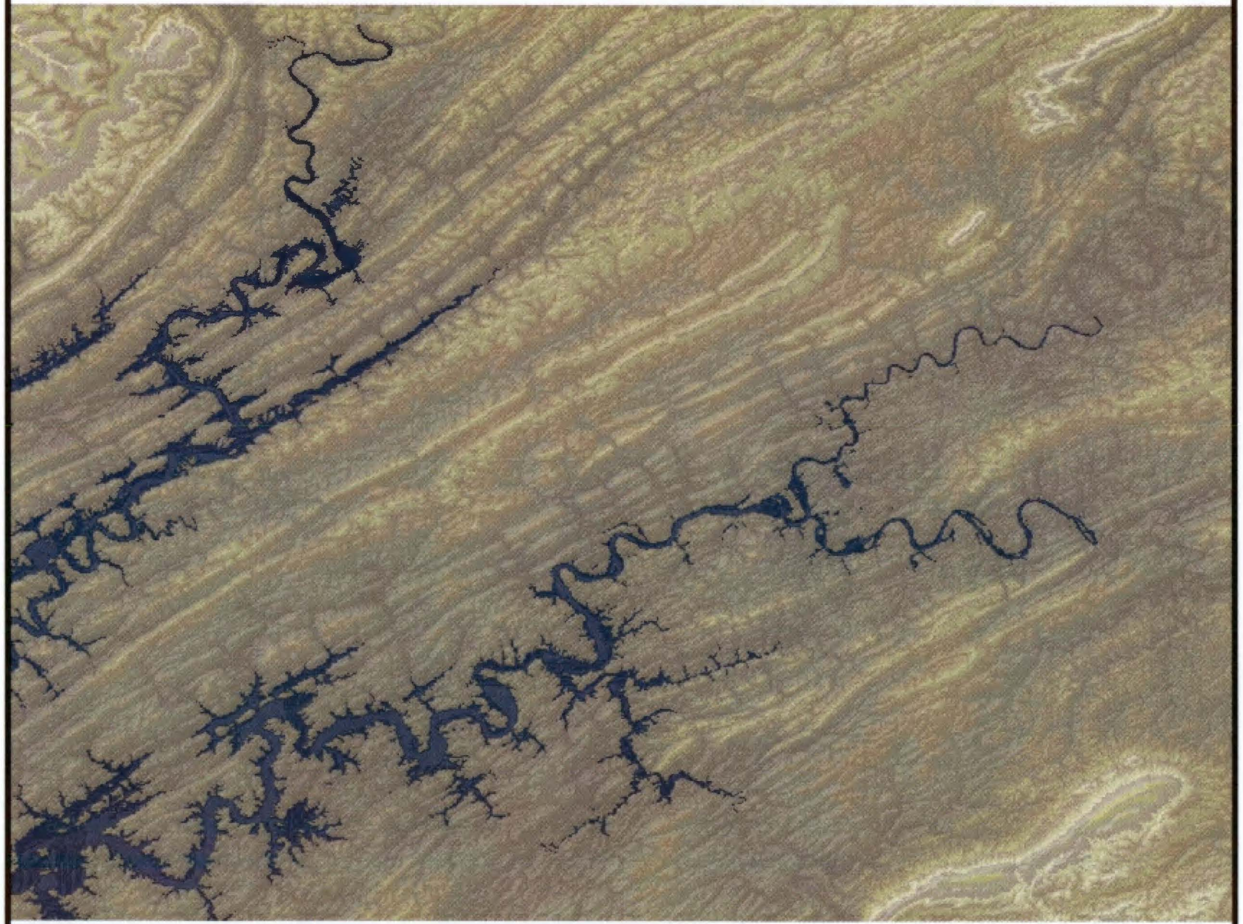
Figure 3.1 DEM (ned_53650690)

In the downloaded version of the map, the darkest colors represent the lowest elevation levels and the lightest represent the highest elevation levels.

To improve the visual impact of the map, I added colors (False Coloring) and a process in which a "false sun" is used to create shade on the opposite side (Hill Shade) to emphasize the elevation changes within the Arc Map document. In the false coloring process, colors are chosen by the map maker and are not based on any actual spatial research. The map maker chooses color symbology and the number of categories to be used. My background map includes 20 categories of false coloring, using 12 colors, and the Hill Shade effect (Figure 3.2). Like the downloaded DEM, the false colored map retains the darkest colors to represent the lowest elevations and the lightest colors to represent the areas with the highest elevation. The greatest benefit to the observer of this type of map is the distinction it presents between water and dry land. A secondary advantage is the greater depiction of elevation differences.

3.2 Terrain Influenced Land Use Change

Terrain plays a major role in influencing land use change but it should not be confused with the concept of environmental determinism. The mountains, ridges, valleys, rivers, lakes and all other surface undulations provide varying degrees of resistance and attraction to settlement and urbanization. Because of the topography found throughout the Ridge and Valley province, the two most influential terrain features on land use change are water and slope.



Source: http://seamless.usgs.gov

Figure 3.2 DEM (False Colored)

The water influence in Knox County is attributable to the Holston, French Broad, and Tennessee Rivers and the TVA reservoirs associated with them. The Holston and French Broad dissect the southeastern portion of the county before uniting east of Knoxville. The Tennessee River which is formed by the juncture of the other rivers continues in a southwestern direction before turning south and becoming the county boundary between Knox and Blount Counties. All have served not only as paths for the movement of goods and people but also as barriers to movement and settlement since before the Europeans first reached the area. Native Americans, and early Europeans, addressed this barrier through the use of boats, rafts and in certain locations by simply fording the river. Even though commercial ferries, powered boats and bridges have greatly reduced the inherent risk involved in river crossings, the resistance to development and urban growth has remained a problem for the area south of the Tennessee River known as South Knoxville.

While the rivers provide a very tangible resistance to movement and expansion, the Ridge and Valley province, because of its very nature, creates its own barriers in slopes and steep ridges. Sedimentary rocks, in the sub-surface of the Appalachian Uplands were folded under intense tectonic plate pressure. The rocks folded into parallel long, steep sided ridges and valleys so that the undulations of the Ridge and Valley province dominate the landscape (McKnight 2001). It is the most prevalent terrain feature and the one that has the greatest impact on development and urban growth. Within Knox County, the slope generated by this series of ridges ranges from zero degrees (flat), within parts of the valley floors, to more than fifty degrees within a two-hundred meter distance. Variations in slope are divided into five distinct categories, using the "Natural Brakes" feature of the Arc Map program. The Freehand Program was used to create a diagram of the categories based on degrees of slope covered by each (Figure 3.3). The colors depicted in the "Slope in Degrees" chart, Dark Green, Bright Green, Yellow Green, Tan and White, are approximations of those used in the "Slope (Knox County)" map. In an age of highly complex building practices, slope itself does not prevent urbanization. Slope does, however, increase the difficulty and expense involved at every step of the process. The added expense and difficulty applies not only for the developer but the municipality involved in providing roads, water, sewer, and electrical power, as well as for the end use consumer where driveways are steep, yards are characterized as hillsides, and building plans include steps or below ground features. A raster based map, converted to vector based polygons at the two-hundred meter grid scale, highlights the parallel nature and steepness of the ridges as well as the general lack of flat land within the valleys (Figure 3.4).

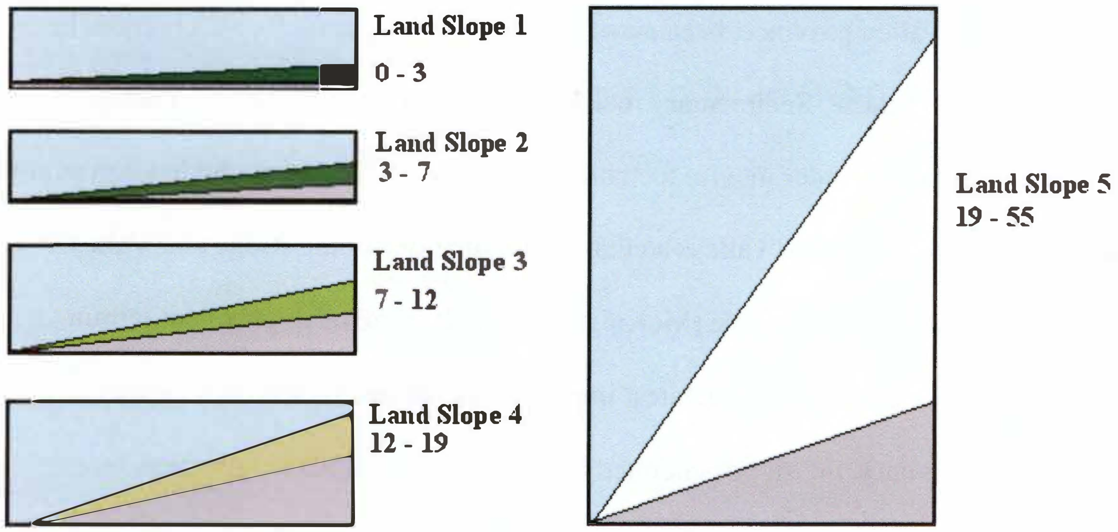


Figure 3.3 Slope in Degrees

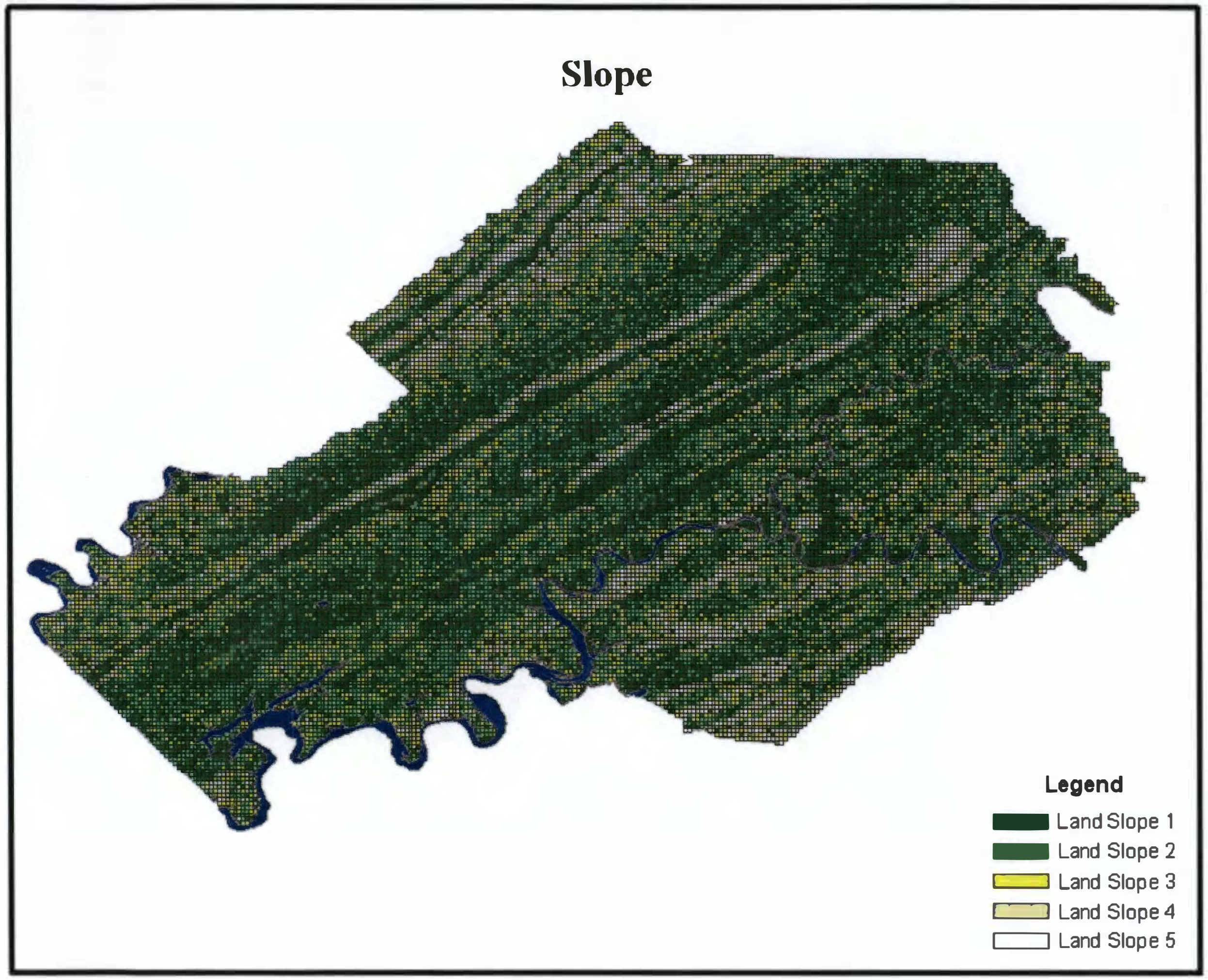


Figure 3.4 Knox County Slope

3.3 Creating the Grid Overlay.

The map used in all spatial analysis within this research consists of the base map and grid overlay. I considered four different sized grid overlays: five-hundred meter, two-hundred meter, one-hundred meter and thirty meter. The thirty meter and one-hundred meter grids were rejected because the return included too many cells to effectively manage. The five-hundred meter grid was rejected because there was too great a loss in detail. The two-hundred meter grid was chosen as the basis for the project because it is a small enough measurement to provide the necessary detail yet it is large enough to return a workable (26,825) number of cells. Building this grid overlay is a multi-step process in the ESRI ArcMap program that is detailed below:

1. NLCD raster data (at 30 meter resolution) was downloaded from the EPA website for the years 1992 and 2001 (Figure 3.5).
2. I chose the 1992 data to be converted to points. This conversion process places one point in the center of each of the 1,705,987 NLCD raster cells (Figure 3.6).
3. These points are then converted back to raster. The option is available to select the size of the raster cells. Based on Knoxville's Latitude of 35^{o} 49' N, one degree of Longitude is equitant to 56.0895... miles or 90.2673... kilometers. Since I am using a two-hundred meter grid, the multiplier for the raster cell size is 0.00221564 (Figure 3.7).

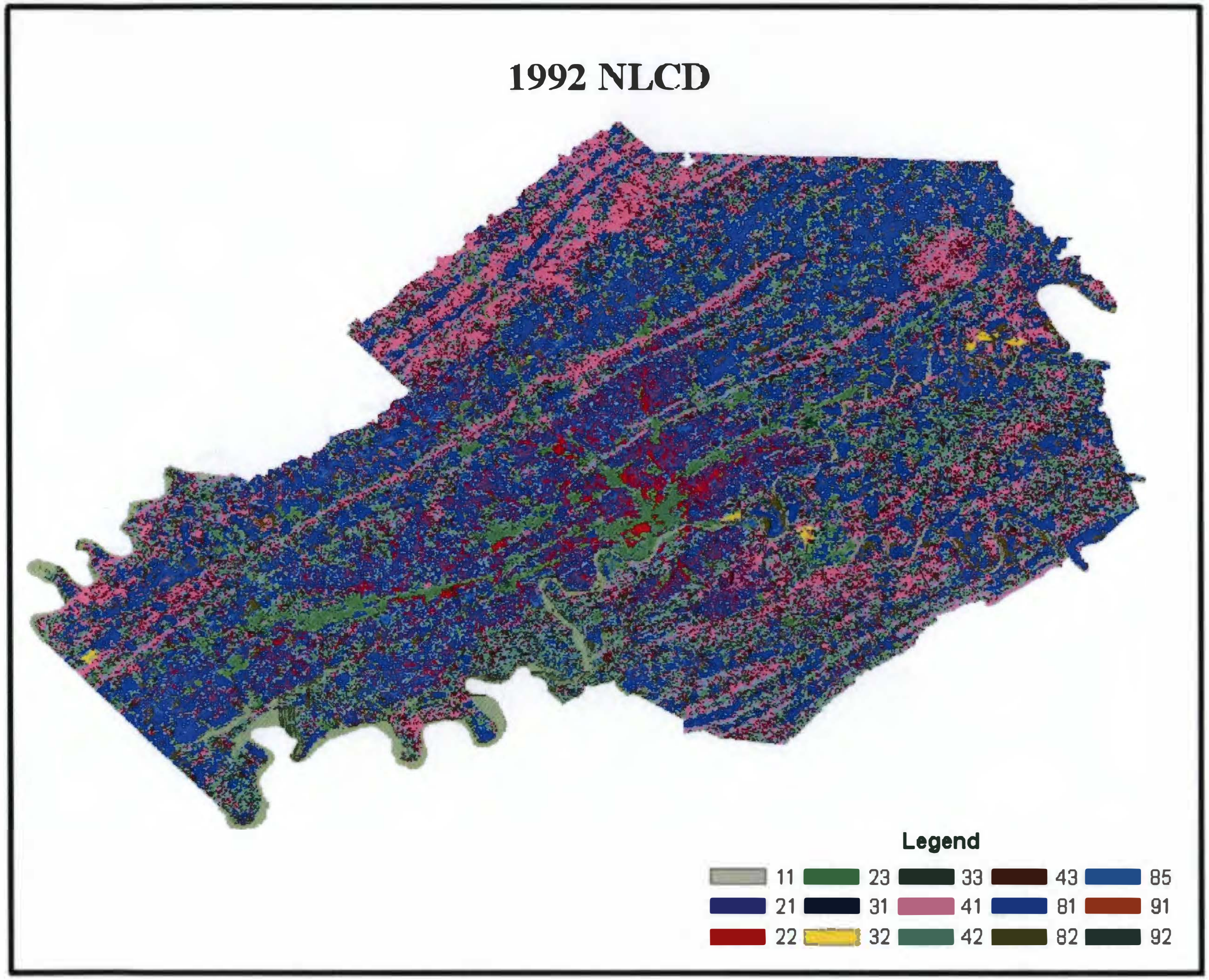


Figure 3.5 Knox County (1992 NLCD Raster)

Figure 3.6 Raster Point Set (Detail)

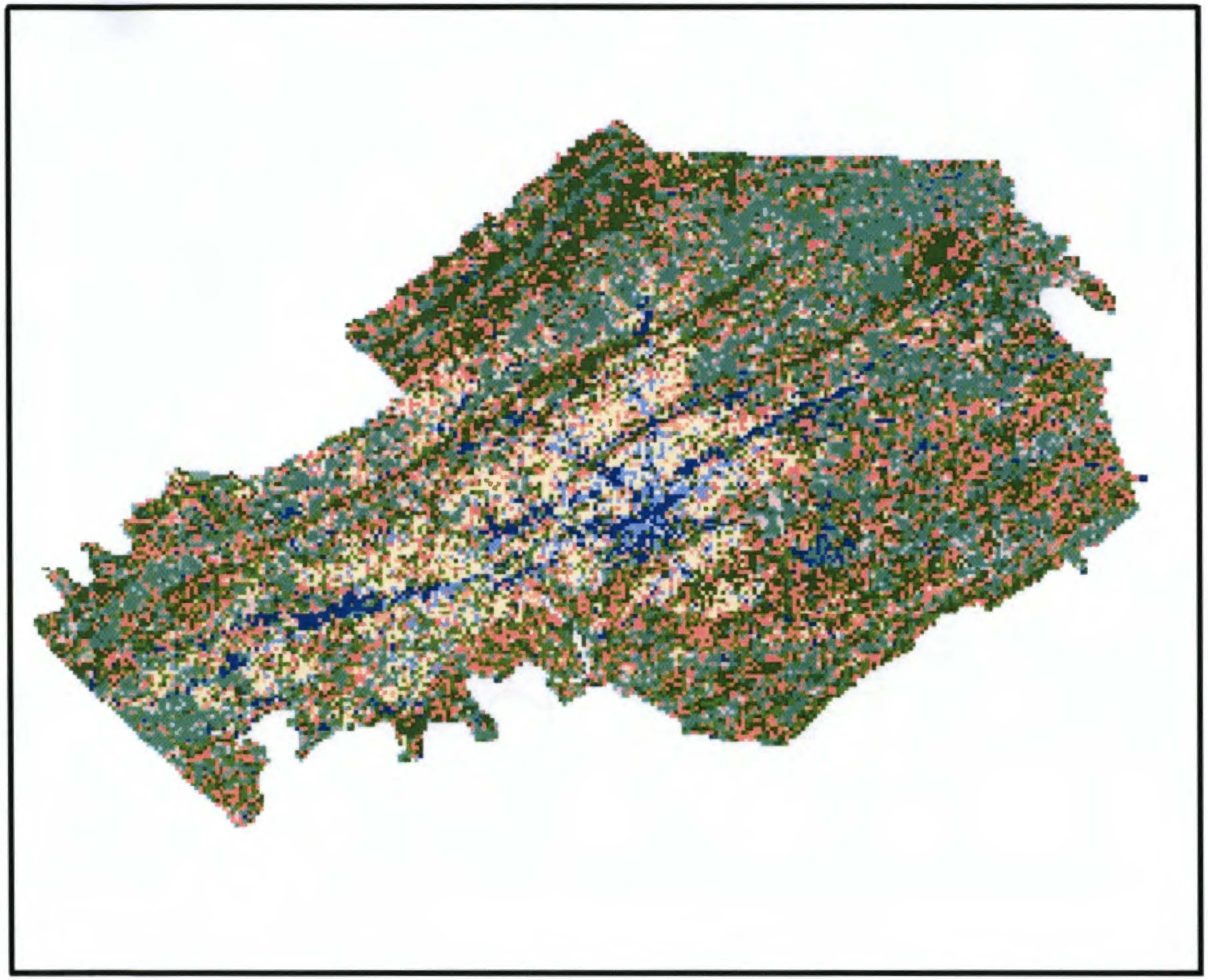


Figure 3.7 200 Meter Raster Set

4. In order to establish center points for each of these cells, I again converted the raster cells to points. This returns 26,825 points which can be geographically located using an X-Y (Latitude – Longitude) coordinate system.

5. These points are converted back to raster using the same cell size.

6. This raster layer is then converted to polygons (turning off the simplify polygon option). This returns a layer of 26,825 individual polygons.

7. Using the display option, I turned off the "fill" color. This returns 26,825 "outline" squares which, for the purpose of this study, serves as the grid overlay (Figures 3.8 and Figure 3.11).

Figure 3.8 200 Meter Grid (Detail)

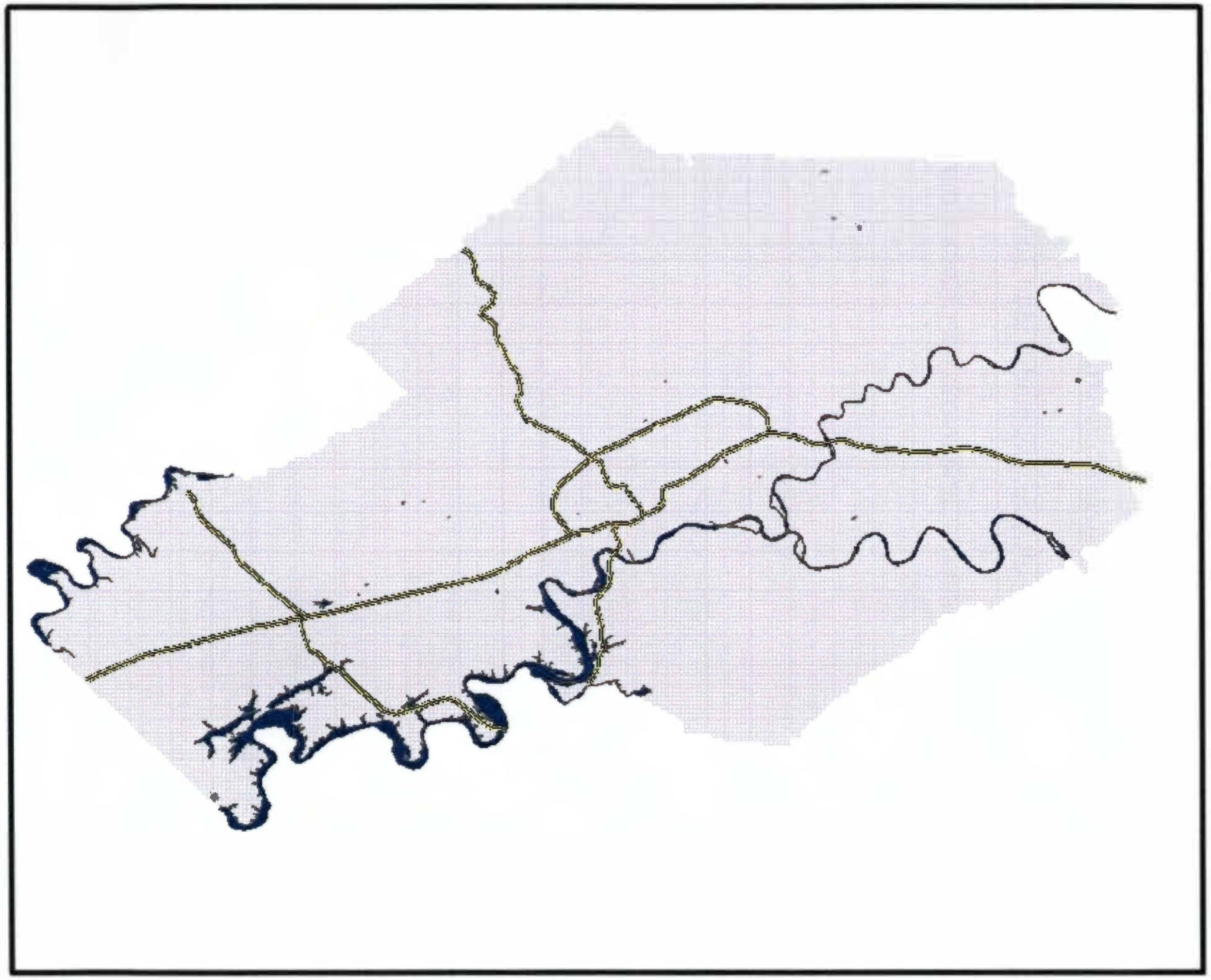


Figure 3.9 200 Meter Grid Overlay

To summarize, my data collection for spatial analysis began with a DEM (Digital Elevation Model) that I modified with false coloring and hill shading. Next I created a grid overlay using 1992 year NLCD (National Land Cover Data). I chose an optimal grid cell size of 200 meters. To achieve this size, I converted 30 meter cells from raster to points, then back to raster where the cell size was modified to 200 meters. The result is a layer of 26,825 polygons that serves as the grid overlay for Knox County.

CHAPTER IV

RESEARCH DESIGN

4.1 Culturally Driven Settlement Patterns

Urbanization can take many forms. It can be the central business district's concrete, asphalt and multi-story buildings or the pockets of multi-acre manufacturing and distribution establishments clustered in an industrial park, but it can also be the sprawling sea of residential, specialty and commercial developments that collectively create the suburban landscape.

Since the late 1980's, Knox County's urbanization has been driven by residential and specialized development. Between 1997 and 2002 manufacturing, wholesale trade and, to a lesser degree retail trade have all experienced an erosion of their physical presence within the county while professional / scientific / technical services and health care / social assistance businesses have increased (Table 4.1). The new commercial development at Turkey Creek will reverse, at least for the short term, the five percent drop in retail businesses, but the decline in manufacturing and wholesale trade seem to only reinforce the changing economic base. Combining this specialized growth with the population and residential growth, especially in the Southwest and Northwest Sectors of Knoxville / Knox County, provides the basis for this urbanization study.

While it is possible to differentiate types of urbanization within the parameters of the NLCD information, this thesis operates under the assumption that an urban area is urbanized. As long as the minimum land cover criteria, approximately thirty percent

Table 4.1 Knox County Economic Sector Data

NAICS		1997		2002	
		Businesses	Employees	Businesses	Employees
31 - 33	Manufacturing	493	20,782	458	17,136
42	Wholesale trade	950	12,580	865	12,508
44 - 45	Retail trade	1,946	28,344	1,856	29,589
51	Information			224	5,851
53	Real estate & rental	464	2,822	480	2,912
54	Professional & Tech.	937	8,000	1,206	11,331
56	Admin. & Support	444	14,818	558	18,246
61	Educational Services	43	243	67	620
62	Healthcare & Social	925	10,391	1,147	27,214
71	Arts & Entertainment	113	1,274	143	2,140
72	Accom. & Food Serv.	769	17,252	774	18,869
81	Other Services	669	4,539	816	5,675
		7753	121,045	8594	152,091

Data Source: U.S. Census

man-made, is met, the spatial area will simply be considered urban. The factors that contribute to residential urbanization are varied. In this thesis, I use historic elements, racial elements, and economic elements as the basis for determining the desirability of one area over another for the developer and the home buyer.

4.1.1 Historic Elements of Population Settlement

The population of Knox County has been growing since before Hoyt's study was published. Over the last seventy years (1930 - 2000) it has grown over one-hundred and forty-five percent or about two percent per year. This increase slowed considerably between 1980 and 1990 before rebounding again in the next ten years (Table 4.2).

Table 4.2 Knoxville / Knox County Population Changes 1930 - 2000

Year	Population	Change	City	Change	County	Change
1930	155,902	N / A	N / A	N / A	N / A	N / A
1940	178,468	14.47%	111,600	N / A	66,868	N / A
1950	223,007	24.96%	124,769	11.80%	98,238	46.87%
1960	250,523	12.34%	111,827	-10.37%	138,696	41.18%
1970	276,293	10.29%	174,587	56.12%	101,706	-26.67%
1980	319,694	15.71%	175,030	0.25%	144,664	42.24%
1990	335,749	5.02%	253,864	45.04%	81,885	-43.40%
2000	382,032	13.79%	274,736	8.22%	107,296	31.03%

Source: U.S. Census

While a direct comparison in population figures within the city is impossible, due to the changing political boundaries, certain trends are recognizable. Between 1950 and 1960, the City of Knoxville actually lost population while Knox County's population, outside the city limits, grew at over forty percent. In response to this, the city embarked on a series of annexations which between 1960 and 1970 increased the city's population by over fifty percent and reduced the resident count outside the city limits by more than twenty-five percent. This process was repeated between 1980 and 1990, though not at the scale indicated in the table since the definition of "city" changed in the U.S. Census categories.

A second trend is evident in the inconsistent and non-linear change within the individual sectors (Table 4.3). The Central Core Sector actually lost population between 1980 and 1990, then again lost population between 1990 and 2000. The Southeast Sector followed suit and lost population between 1980 and 1990 but was able to regain some growth between 1990 and 2000, though not to 1980 levels.

Table 4.3 Population Growth by Sector

Sector	1980	1990		2000	
Central Core	88,993	78,759	-11.50%	73,640	-6.50%
Northeast	67,818	71,201	4.99%	82,928	16.47%
Southeast	45,125	41,597	-7.82%	44,253	6.39%
Southwest	45,985	59,812	30.07%	76,773	28.36%
Northwest	71,773	84,380	17.57%	104,438	23.77%
Totals	319,694	335,749	5.02%	382,032	13.79%

Source: U.S. Census

Hoyt projected that growth would occur in a westward and, to a lesser degree, northward direction. Residents seeking to escape the stigmatism associated with "downwind" soot, ash and inherent low property values proved these projections correct. The Northeast Sector experienced moderate (4.99%) growth from 1980 to 1990 and stronger growth between 1990 and 2000 while the western portion of the county, Southwest Sector and Northwest Sector, gained more in population than the county as a whole.

Public perception is not the only element supporting the westward expansion projected by Hoyt. Government decisions were made to locate marginally desirable facilities as the Knox County jail, public housing projects and the now defunct "Knox County Farmer's Market" in the eastern portion of the county. The latter was planned as a market for truck farmers to sell produce directly to the consumers yet was perceived as a venue aimed directly at those unable to afford the costlier grocery store products. This kind of thinking simply reinforced the already existing perception that the eastern side of the county was poor and would always be that way.

4.1.2 Racial Elements of Settlement

While this paper makes no comment on the social or ethical issues inherent in forced, voluntary or chosen segregation, it is an issue that plays a major role in not only settlement patterns but also in the growth of development. Since one of the premises of this research is that urbanization is a non-reversible condition, a shift of population from one specific area to another within the study area in effect doubles the amount of land that has been developed.

From the period just after the Civil War until the Civil Rights Movement of the 1960's, African-American residents of Knoxville were restricted in the areas in which they could settle. This was, of course, not an issue that was limited to the Knoxville area but one that did have a major impact on the city's development and urbanization. The relocation of residents from the shanty-town abodes in east Knoxville to government housing projects along Magnolia Avenue was but one step in the changing social demographic of Knoxville's Central Core Sector. A second, and perhaps more important, step was the reaction of the existing residents.

While it has been thoroughly researched elsewhere, "White Flight" is the simplest and most accurate way to describe the exodus of white residents from the Central Core Sector of Knoxville. While no longer as viable a condition as it once was, having primarily occurred from the mid 1960's until the mid 1980's, "White Flight" continues in the northeastern portion of the Central Core Sector.

While growing in absolute numbers, Knox County's African-American population fell from fifteen and a half percent in 1934 to about eight and a half percent in 1970. From 1980 until 2000, Knox County's African-American population has held steady at between eight and a half and nine percent. This racial mix is not evenly distributed. In 1990 over seventy-six percent of the African-American residents lived within the Central Core Sector pushing its African-American percentage to over twenty-eight and a half percent. Despite a slight decline in the number of African-American residents within the Central Core Sector by 2000, the percentage actually increased to slightly over thirty percent as the overall population fell at an even faster rate.

It is not the intent of this paper to imply that homes in predominantly African-American communities have inherently lower values than those in other communities yet the reality is that housing values, which are driven mainly by supply and demand principles, decrease or stagnate in any area in which the population is declining. This reduction or stagnation in home values is a self perpetuating condition which continues until the public perception changes and the lack of undeveloped land available elsewhere creates a second, or sometimes third, generational value to the land itself. This condition is evident in areas where homes are purchased for the sole purpose of being torn down to make room for "new" development and in areas undergoing refurbishing as part of a gentrification process.

Because there still remains ample land in Knox County to support an expansive form of urbanization, re-development has met with only moderate success. Other than urban renewal projects, most of the second generation development is urbanization, in the form of subdivisions, of more widely spaced rural and semi-rural residences.

4.1.3 Home Values

Home values, for the purpose of this thesis are based on the median value, as established by the Census Bureau. This value is then applied to all homes in the tract. In 1990 the median home value in Knox County was sixty-three thousand nine-hundred dollars (Figure 4.1). By 2000, the median home value had jumped over fifty percent to ninety-eight thousand five-hundred dollars (Figure 4.2). Thirty-two of the 2000 census tracts had median home values below this mark (Table 4.4). While not an exact science, since homes of various values are located within each tract, this method of comparison presents trends in home values.

Overall the number of tracts and the percentage of tracts with median home values above the county average increased in 2000. The Southwest Sector had the greatest concentration of above average home values in 1990 with eight of the top fifteen tracts. This disparity increased even more by 2000 when six of the top seven tracts, in terms of home values, were located in the Southwest Sector.

While wealth was still concentrated in the Southwest Sector, pockets of wealth appeared in every sector by 2000. The Northwest Sector, Northeast Sector and Southeast sector all enjoyed considerable gains in home values due in part to the decrease in developable land in the Southwest Sector. A secondary contributing factor to the increased home values, especially in the Northwest and Northeast Sectors, has been a reduction in the stigmatism associated with living in a less desirable part of the county. This single factor has increased not only the home values but the desirability of land within the sectors for future development.

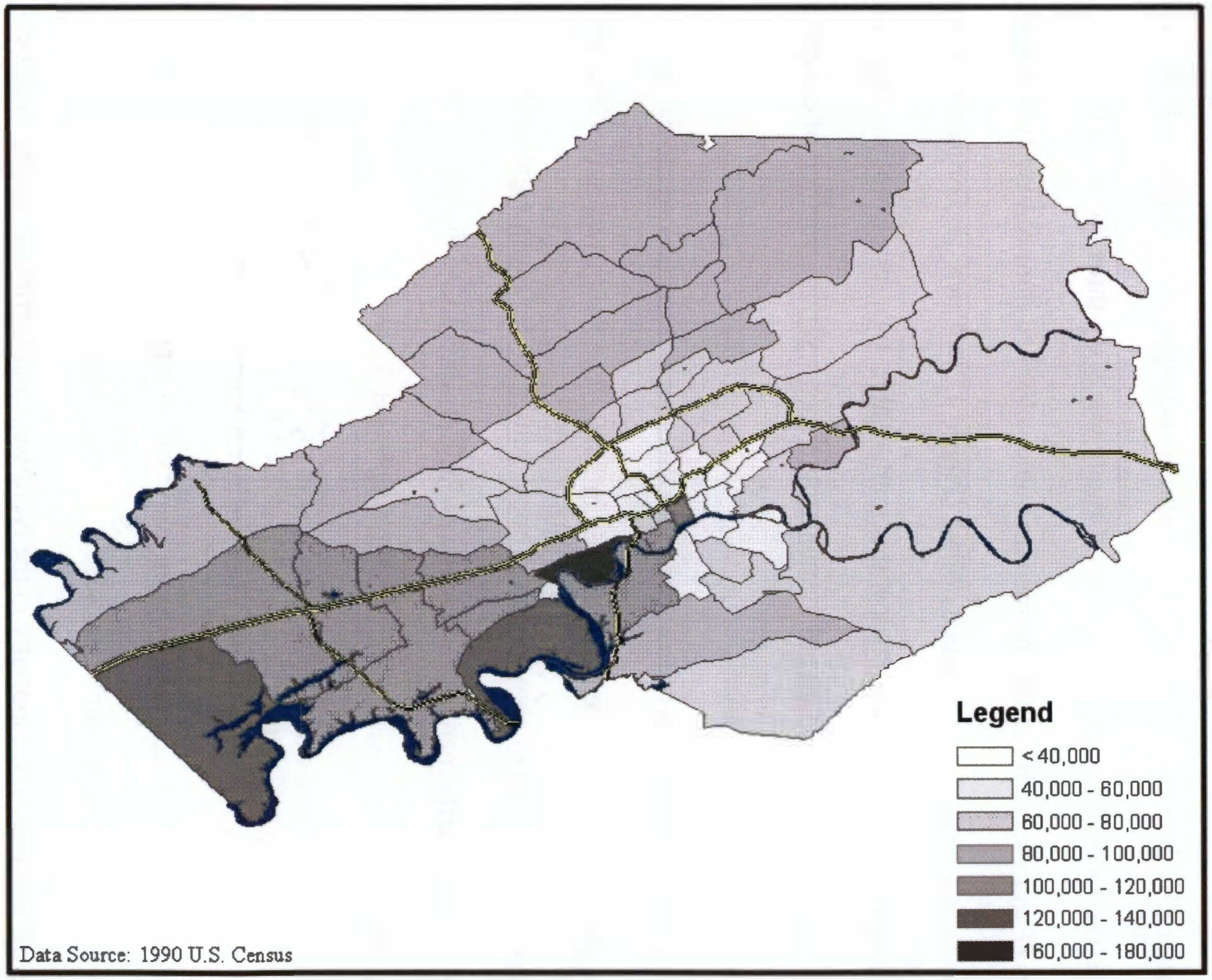


Figure 4.1 1990 Home Values

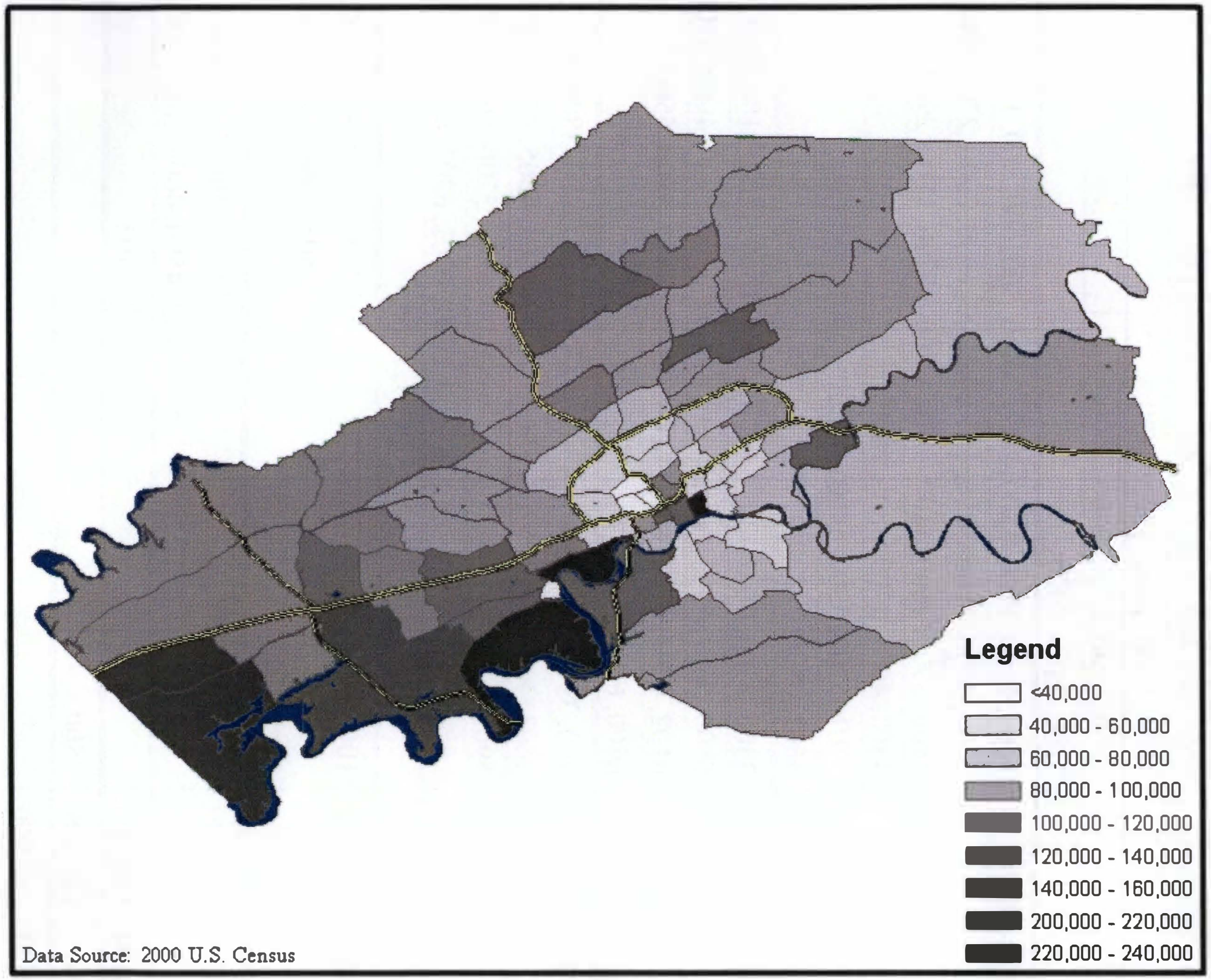


Figure 4.2 2000 Home Values

Table 4.4 Home Values by Census Tract

	1990 Census Tracts	2000 Census Tracts
20,000 - 40,000	200, 300, 400, 500, 600, 800, 1200, 1300, 1400, 1500, 1700, 1900, 2000, 2200, 2400, 2600, 2700, 2800, 2900	1200, 1300, 1400
40,000 - 60,000	1000, 1100, 1600, 1800, 2100, 2300, 3000, 3100, 3200, 3400, 3800, 3900, 4000, 4100, 4200, 4300, 4601, 4700, 4800, 5000, 5201, 5202, 5300, 5400, 5500, 5602, 6500	400, 500, 600, 800, 1500, 1700, 1900, 2000, 2200, 2400, 2600, 2700, 2800, 2900
60,000 - 80,000	3300, 3700, 4602, 4900, 5100, 5600, 5601, 5902, 6000, 6101, 6102, 6201, 6202, 6203, 6204, 6300, 6400	900, 1600, 1800, 2100, 2300, 3000, 3200, 3400, 4000, 4100, 5202, 5400, 5500, 6500
80,000 - 100,000	900, 3500, 4401, 4402, 4500, 4603, 4604, 5702, 5703, 5801, 5901,	300, 1000, 3100, 3800, 4200, 4300, 4601, 4605, 4700, 4800, 5000, 5201, 5300, 5601, 5602, 6101, 6102, 6203, 6204, 6300, 6400,
100,000 - 120,000	100,	200, 3700, 4603, 4606, 4900, 5704, 5803, 5804, 5901, 5902, 6000, 6202
120,000 - 140,000	5701, 5802	100, 1100, 3300, 3500, 4401, 4402, 4500, 4604, 5100, 6201
140,000 - 160,000		5703, 5705
160,000 - 180,000	2500,	
180,000 - 200,000		
200,000 - 220,000		5805, 5806
220,000 - 240,000		700, 2500, 5701

Data Source: U.S. Census (1990, 2000)

4.1.4 Commercial Retail Development

In addition to the "Home Values" mentioned in section 4.1.3 the "Proximity to Primary Commercial Development" and "Proximity to Secondary Commercial Development" are economic elements that also affect settlement patterns. To determine values for these elements I considered "Shopping Malls" and similarly sized developments to be "Primary" and Wall-Mart, K-Mart and Target stores to be "Secondary Commercial Developments."

Knoxville Center (formally East Town Mall) and West Town Mall were the only two Primary Commercial Developments present during the early part of the 1990's. In the period since 2000, Turkey Creek, in far west Knox County has grown into a Primary Commercial Development and will be considered as such in the future growth projections. The presence of a national department store and multiple national specialty retail stores out weigh the fact that both a Wall-Mart and Target are located within the development.

Since the late 1990's Secondary Commercial Developments have seen their share of changes as well. Wall-Mart opened a store near Knoxville Center and has announced plans to close one store after approval and completion of a larger store in the Halls community. K-Mart, due to a corporate down-sizing, closed their store in Farragut. Target in (July 2006) closed their store in Fountain City and opened a new store closer to Knoxville Center (Figure 4.3).

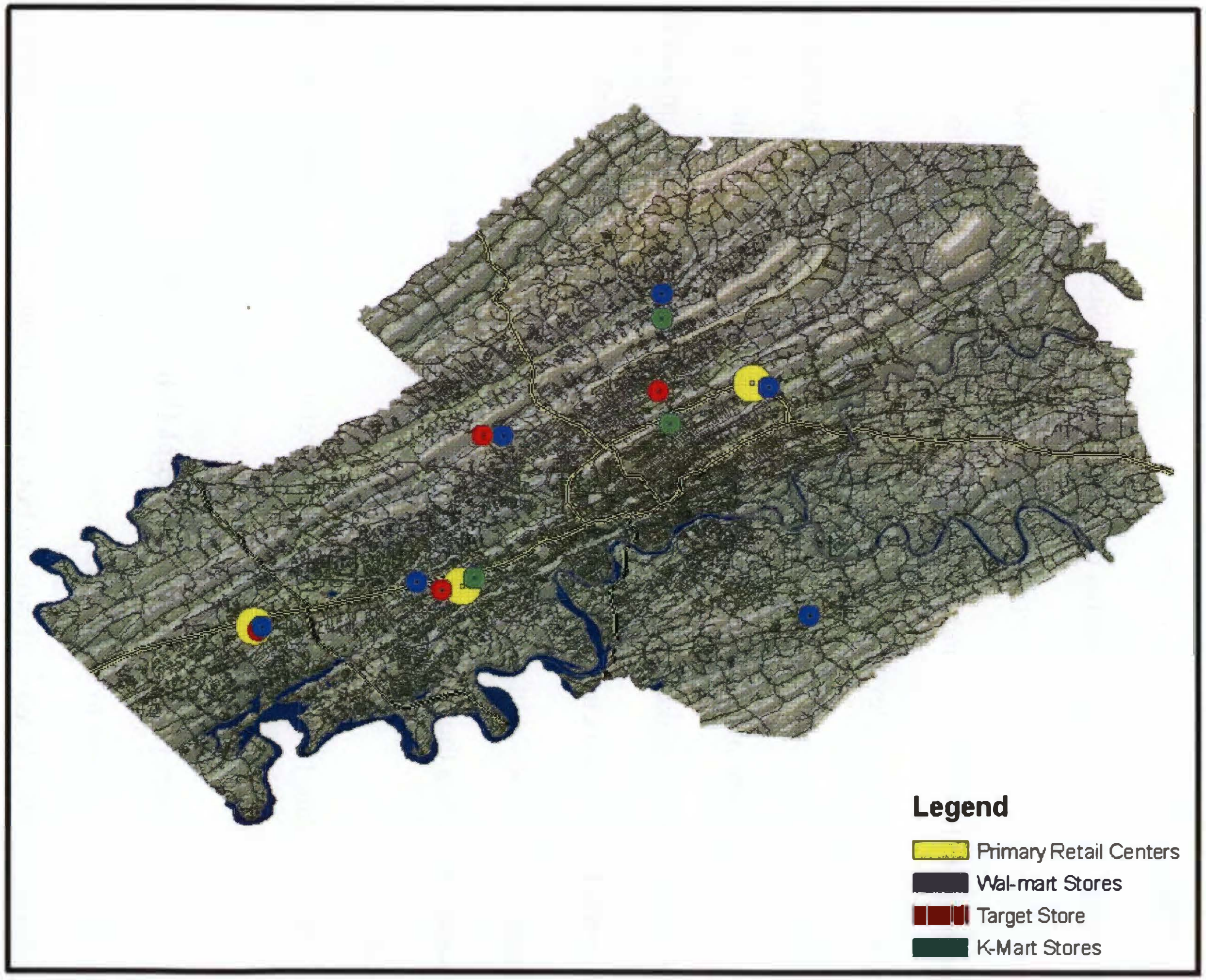


Figure 4.3 Post 2000 Retail Centers

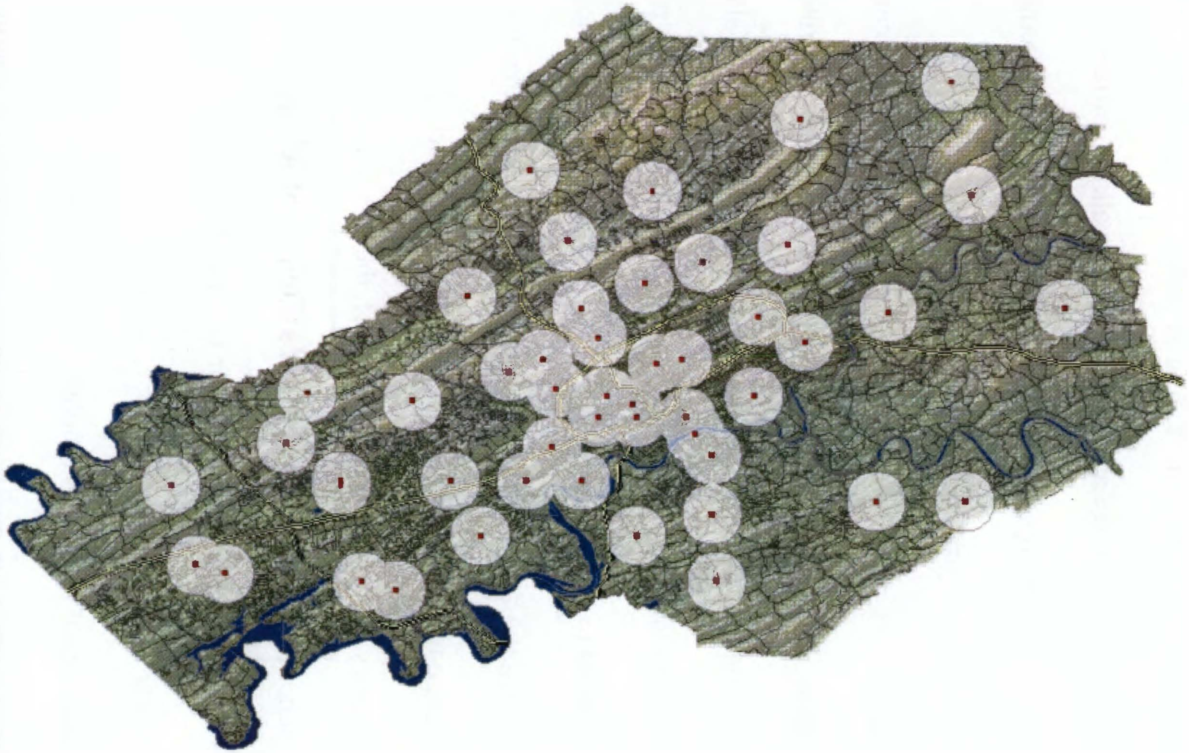
4.1.5 Proximity to Schools

The proximity to a school is one of the oldest criteria by which settlement potential is measured. Knowing that the student or parent was expected to provide the transportation to and from school, usually in the form of walking, proximity was often an essential consideration when shopping for a new home. This placed a premium on housing values that was directly relational to the home's location.

Currently eighty-four schools serve over fifty-three thousand students in the Knox County School System. Forty-nine of these schools are elementary / intermediate schools, fourteen are middle schools and twelve are highs schools. Sixty-six percent of the students in the Knox County School System qualify, based on age and proximity to the school they are zoned to attend, for publicly funded transportation. The other thirty-three percent live within the "parental responsibility zone" meaning that it is the parents' responsibility to arrange transportation to and from the school each day.

At the elementary / intermediate school level, there is still an emphasis on the community based schoolhouse as evidenced by the number of schools and locations. This also provides a greater range of choices for families wishing to locate within close proximity to a school (Figure 4.4).

At the middle school level, less emphasis is placed on locating the building within a particular community and more emphasis is placed on establishing a more centralized location. As to be expected with the lower number of schools, fewer choices in the housing market are available to families wishing to locate within close proximity to a middle school. Choosing a particular school, however, is still a viable option since large (and often irregularly shaped) zones are used to divide the students attending one school



Data Source: Knox County Board Of Education

Figure 4.4 Elementary and Intermediate Schools

from those attending another. This trend toward centralization is even more evident in the zones for the Knox County high schools (Figure 4.5).

Within this thesis, school locations and quality of schools are considered as variables in projecting urban growth. For the school location aspect of the variable, proximity to a school, based on the one mile "zone of parental responsibility," is the standard by which influence is considered. Since there are more elementary / intermediate schools within the county, they account for the majority of the school location influence. The entire zone for each high school will also be considered based on its ranking in percentage of students qualifying for Tennessee's Hope scholarship. Under these guidelines, desirability of a school zone is considered highest for the area with the highest percentage of graduating students that have maintained a 3.0 GPA (grade point average) out of 4.0 possible or have scored at least a 19 on their ACT (Table 4.5).

Table 4.5 High School Hope Scholarship Rankings

High School	Rank	Scholarship Percent
Bearden	1	70%
Halls	2	62%
West	3	58%
Farragut	4	56%
Karns	5	53%
Powell	6	49%
Carter	7	44%
South-Doyle	8	37%
Central, Austin-East and Fulton	9	33%
Gibbs	12	29%

Source: Knoxville News Sentinel

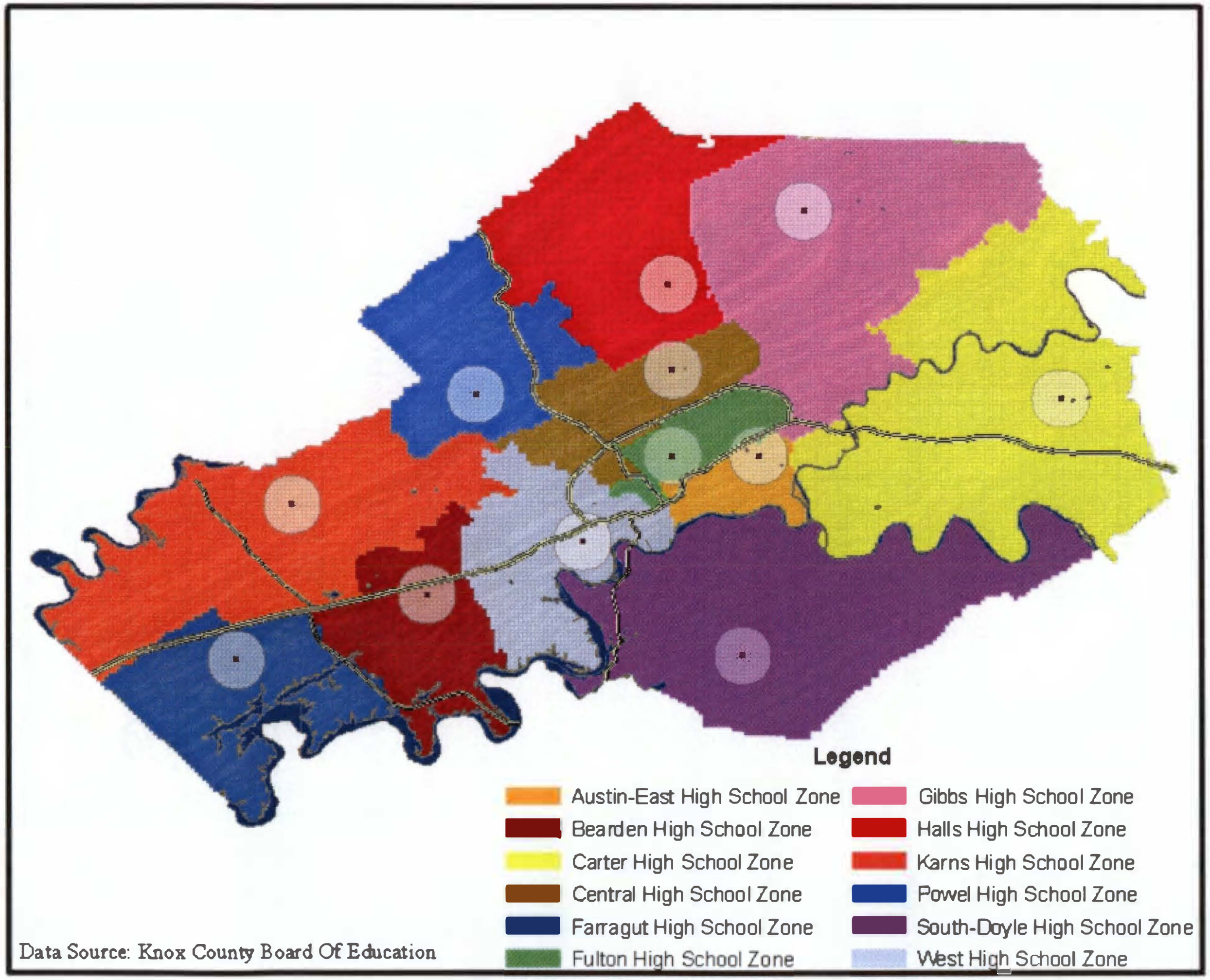


Figure 4.5 High School Zones

To summarize Chapter IV, I have chosen to examine culturally driven elements of the Knoxville / Knox County area. Among these are: Changes in business patterns reflected by the number of businesses and numbers of employees in 1997 and 2002; population changes between 1930 and 2000; population growth by sector in 1980, 1990, and 2000; racial patterns; home values by census tract in 1990 and 2000; economic elements in commercial retail development; and proximity to schools as factors that influence settlement choices in the residential sector.

CHAPTER V

MODELING URBAN GROWTH

Three types of models are used in the study to examine historical urban growth and to project future land use change. The rule based model is the simplest because it denotes the amount of growth to be expected based on the population growth. The statistical analysis identifies the variables that have the greatest amount of impact on determining growth patterns. The GIS model, as used in this study, combines elements of the other two models into a single cohesive unit.

5.1 Rule-Based Model

Over the last seventy years Knox County has experienced a population growth of approximately two percent per year. Between 1980 and 1990 this growth slowed to approximately five percent before rebounding to nearly fourteen percent between 1990 and 2000. Since this figure seems more in line with the historical growth pattern than the unusually low figure noted in the previous decade, it is the one that was used in the study.

During roughly the same period, 1992 through 2001, the urbanized area, as categorized by the NLCD information, grew by nearly seventy-five percent. This equates to an urban growth rate of slightly over eight and one quarter percent per year. These numbers, accepting that all of the data is correct, imply that for every one percent increase in population there is a corresponding increase in the urbanized spatial area of roughly six percent. Following the example presented in The Strom Thurmond Institute's study of urban growth in the Charleston South Carolina area where a little over six to one ratio, observed over a twenty-one year period, was adjusted to a five to one ratio for predicting future growth, a slightly more conservative ratio of five percent growth in urbanized area per one percent growth in population is also used in this study.

The resulting growth projections, based on the lowest of three population growth projections commissioned by the Knoxville / Knox County Metropolitan Planning Commission, is included in Table 5.1. It is important to note that the urbanization data for the years of 1992 and 2001 are derived from the NLCD data used as the basis of this study. It is also important to note that the relatively large jump noted within the table between 1992 and 2001 is more the result of a long period of growth than any type of abnormally. One last note about the table is in reference to the population estimate for the year 2001. The actual 2000 census population count was compared to the projected 2005 population and a simple compound growth formula was used to predict a result.

Table 5.1 Urban Grids

Year	Population	% Growth	Grids	x 5	Grids Urban
1992	N / A	N / A			3,212
2001	386,512	N / A		2,399	5,611
2005	404,965	4.69	263	1,315	6,926
2010	426,181	5.24	363	1,815	8,741
2015	443,471	4.06	355	1,775	10,516
2020	459,599	3.64	382	1,910	12,426
2025	473,532	3.03	377	1,885	14,311
2030	484,701	2.36	337	1,685	15,996

Source of Population Growth Estimates: December 2001 MPC Technical Report Series.

5.2 Statistical Regression Analysis

To determine the statistical significance that various social and physical factors had on the urbanization, a linear regression analysis incorporating multiple variables was ran using SPSS software in a "Stepwise" methodology. This analysis generated a return of approximately 0.95, meaning that ninety-five percent of the urban growth between 1992 and 2001 occurred in grids identified through the variables chosen (Appendix). Ninety-four point nine percent of the growth occurred in cells identified by the **Proximity to Urban** variable while all other variables combined returned only two one-tenths of one percent.

5.3 GIS (Geographic Information System) Based Model

A total of eleven variables are used to designate the areas of Knox County that are most likely to experience a land use change to urban. Some, **Home Values**, **Proximity to Primary** and **Secondary Commercial Centers**, **School Ranking** and **Proximity to Schools**, relate closely to cultural and economic influences. Other variables, **Proximity to Existing Urban**, **Proximity to Major Roads**, **Proximity to Roads** and **Proximity to Major Urban Nodes** (defined as limited access highway interchanges) are strictly spatial location driven. **Existing Land Cover**, based on the ground cover in place in 1992 and **Slope**, directly related to terrain within the study area are considered physical elements.

The variables as identified by the stepwise statistical model and the methodology by which they are applied to this study are detailed below.

Proximity to Urban, as noted, was the variable that had the single greatest impact on the spatial location of the land use change. To identify the cells located within specified distances from the existing urban areas, buffers were created at two-hundred meter intervals extending outward from the 1992 urban areas (Table 5.2). Eighteen-hundred meters was chosen as the maximum distance of influence because over ninety-nine percent of the actual 2001 urbanization occurred within that distance.

Proximity to Roads was determined by buffering the Census Bureau Tiger File roads to a distance of one-hundred meters. All grids with their centers within that buffer were assigned a value of five.

Proximity to Urban Node was ranked as the next most important determinant. Here the goal was to allow an adequate distance from the actual interchange point to include the expected build-up of restaurants, hotels, fuel stations etc. typically found at interstate exits. Grids more than one-thousand meters from the interchange point received no added value. Grids within one-thousand meters from the interchange point received a value of five and those within five-hundred meters received a value of ten.

Table 5.2 Proximity to Urban and Values

Dist. From Urban	Number of Growth Cells of 2,399	Percent of Growth	Values
Urban			20
200 Meters	1,653	68.90	18
400 Meters	1,999	83.33	16
600 Meters	2,058	85.79	14
800 Meters	2,211	92.16	12
1,000 Meters	2,293	95.58	10
1,200 Meters	2,326	96.96	8
1,400 Meters	2,346	97.79	6
1,600 Meters	2,365	98.58	4
1,800 Meters	2,377	99.08	2
> 1,800 Meters	22	< 1	0

Proximity to Secondary Commercial was determined to be the fourth most important influence on urban growth. The grids surrounding these (K-Mart, Target, and Wal-Mart) points were assigned values based on spatial distances of one mile, two miles and three miles. The values were zero for distances greater than three miles, one for distances between two and three miles, two for distances between one mile and two miles and three for distances of less than one mile.

Existing Land Cover is the highest ranking of the two "physical" elements. Based on the categories chosen, land cover plays a pivotal role in identifying areas that have low to moderate development usage and are therefore most susceptible to change. Because this portion of the study considers the factors that promote or provide the least amount of resistance to urbanization, I ignored the existing urbanized areas and considered only the non-urbanized usage areas from the NLCD classification schemes. Forest, consisting of class 41 (deciduous), 42 (evergreen) and 43 (mixed) are all combined into a single category. This category accounted for nearly fifty-four percent of the county's land cover in 1992 and received a value of three. Class 81 (pasture / hay) accounted for slightly over twenty-five percent of the county's land cover in 1992 and received a value of two. Classes 85 (urban / recreational grasses) and 82 (row crops) were the other major non-urban land cover categories. Each covered slightly less than three percent of the county's land surface in 1992 and received a value of one. When combined with the existing urbanized land cover, these categories accounted for approximately ninety-eight percent of Knox County's land use in 1992, the other land cover categories were considered to have little, if any, effect on urban growth.

School Rankings is the sixth most important influence on urbanization. While only contributing a small amount of influence (one half of one percent), the fact that it is a factor at all re-emphasizes that there is some level of consideration for school zoning involved in the desirability level for spatial areas. The values for school rankings are based on the percentage of graduating seniors that qualify for the Tennessee Lottery funded Hope Scholarship as compared to the overall fifty-one percent of Knox County seniors that are offered the scholarships. There are twelve high schools within the county and ten levels of desirability which coincide with the school's actual rankings. Three of the top four schools in the rankings, Bearden, West and Farragut, are located in the Southwest Sector of the county. They receive values of four, two and one respectively based on the percent above the county median they scored. Karns and Powell, located in the Northwest Sector, and finish fifth and sixth in the rankings. They each receive no added desirability value since they are within five percent of the county average. Halls, Carter and Gibbs High Schools are located in the Northeast Sector. Halls receives an added value of three for its second place ranking while Carter and Gibbs each receive no added desirability value. South-Doyle is the only high school located in the Southeast Sector. It also receives no value. All three of the high schools located within the Central Core Sector finished below the county average and received no added desirability value. The entire high school zone that is associated with the individual high schools receives the same desirability value.

Slope is the second of the "physical" elements to have some influence on urbanization. Despite the fact that it, as a category, only added three-tenths of one percent to the overall statistical model, a little over forty-seven percent of the urban growth between 1992 and 2001 occurred in the area designated in Chapter III as slope one. Another thirty-six percent of the growth occurred in the areas designated as slope two and slightly over thirteen percent was added in the areas designated as slope three.

Proximity to Major Roads is actually a subset of the Proximity to Roads category in that it is also derived from the Census Bureau's Tiger files. The major two differences are the types of roads and the buffers added to them. Major roads are those designated as either major thoroughfares (Kingston Pike, Ashville Highway, Broadway / Maynardville Pike, etc.) or major connector roads (Northshore Drive, Oak Ridge Highway, etc.). Most of these roads are either completely or at least partially three or more lanes. Buffers in this category are established at three-hundred, two-hundred and one-hundred meters with assigned values of one, two and three respectively.

Proximity to Schools, as noted in Chapter IV, is designated as the areas within one mile of a public school. While the map in Chapter IV showed only the elementary and intermediate schools, the actual category includes all middle and high schools as well. The grids with their centers within the one mile buffers of the schools receive a value of one while those outside the buffer receive no added value.

Home Values are a direct reflection of the median home value within a given tract. Census tracts with approximate home values at or below the county's median home value for a particular year are considered to have no added value. Tracts above that level, based on Hoyt's theory and observations, are considered to be more desirable and receive added values based on their categorical standings (Table 5.3). The amount of added value is based on the dollar amount above the median value in twenty-thousand dollar increments.

Table 5.3 Home Values

Home Values	1990	2000
	Value	Value
<40,000	0	0
40,000 - 60,000	0	0
60,000 - 80,000	1	0
80,000 - 100,000	2	0
100,000 - 120,000	3	1
120,000 - 140,000	4	2
140,000 - 160,000	*	3
160,000 - 180,000	6	*
180,000 - 200,000	*	*
200,000 - 220,000	*	6
220,000 - 240,000	*	7

* Denotes that No Tracts had this median value

5.4 Growth Model

The growth model used in the study is constructed in the "model builder" portion of the Arc-GIS program. This program allows the user to apply a series of criteria in a specific order to a chosen input and receive a repeatable output. The model created for this study is based on a logical progression of elimination in which grids are selected as most likely to become urbanized because of their fit to the criteria used.

The major portion of the growth model, and the portion which remains constant throughout the study, is the lower portion in the diagram which starts with all grids within the study area as the input (Figure 5.1).

This input is divided into five areas based on the five sectors identified earlier. These five grid sub-sets are then reduced by the distance of influence based on the desirability of the sector. The levels of desirability have been determined by comparing the overall percentage of population growth, urban growth, and average home values during the period between 1990 and 2000. The Central Core sector has experienced the lowest amount of change and therefore has the strength to influence only the areas adjacent (within 200 meters) to its existing urbanized footprint. The Southwest Sector has the highest growth level and is therefore able to influence land a greater distance from the existing urbanized areas. In the case of this study, that influence is considered to extend up to 1,000 meters. The other three; the Northwest Sector, the Northeast Sector and the Southeast Sector are assigned levels of influence at varying distances between the two.

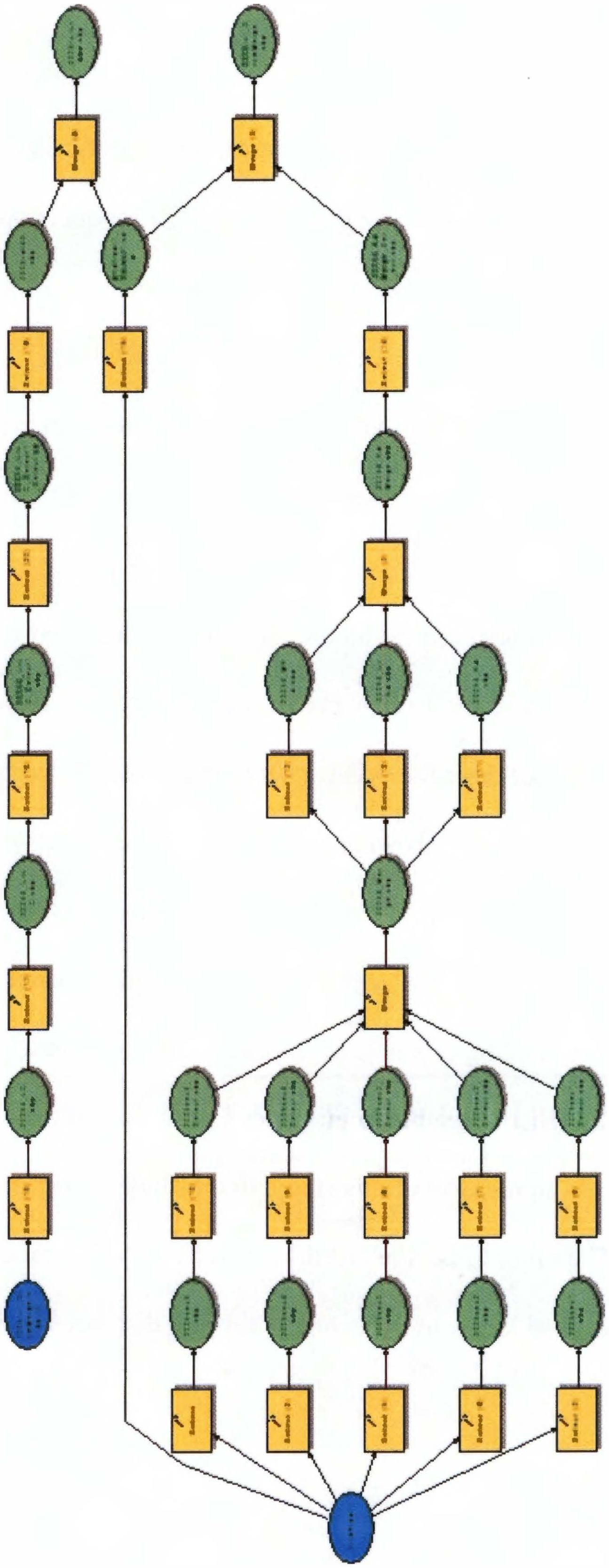


Figure 5.1 Urban Growth Model

These levels of desirability are carried forward to all future growth projections (Table 5.4). Considerations are next made for the proximity to roads, major roads and urban nodes, and lastly a consideration is made for the terrain (slope) that exists in those areas. The final part of the main portion merges all cells in the original input that were considered urban. This portion of the model returns a gross number of cells that have the highest potential to become urban.

The second portion of the model, the upper portion in the diagram, is the variable level used to reduce the potential growth area to the net number of grids projected to actually become urbanized (based on the rule based model previously discussed in section 5.1).

The first step in this portion of the model is the consideration of the existing land use. This is followed by a reduction in the potential growth area based on the manually selected non-build able grids (major parks, wetlands, etc.) and the grids with their centers within twenty feet of existing roads (this is done to reduce the occurrence of false returns). The last two steps of the secondary portion of the growth model include the

Table 5.4 Distance of Influence

Sector	Rank	Distance (in Meters)
Southwest	1	1,000
Northwest	2	800
Northeast	3	600
Southeast	4	400
Core	5	200

variables. The first of which includes the potential to reduce the distance of influence for the two fastest growing sectors to 600 meters from their original 1,000 and 800 meters respectively (the other sectors remain the same at 600, 400, and 200 meters). The second variable step, and the one that changes with each model, includes the provision to select the grids that have a total value equal or above the number necessary to return the closest number of grids to those projected by the rule based model. Again the grids categorized as urban in the original input, are merged into the final projection.

CHAPTER VI

PROJECTIONS

For the purpose of this study, the 1992 and 2001 NLCD classifications and the maps derived from them are accepted as correct. To simplify the projection maps, all layers except the streets, interstates / divided highways, water, grid overlay and existing urban have been turned off.

6.1 1992 Urban

The 1992 map (Figure 6.1), compiled from NLCD data, illustrates the urbanized area of Knox County as determined by the NLCD classifications of 21, 22 and 23. These three-thousand two-hundred and twelve grids, classified as urban, represent nearly fifty square miles of urbanized land use.

The Central Core's forty six percent urbanization level (742 grids out of 1,628) represents the highest concentration of said land use within the county. Of note is the open area in the southeastern portion of the sector (owned by the State of Tennessee) and the buffer located south of the I-640 bypass in the north.

The Northeast Sector with its six percent urbanization (623 grids out of 10,033) is one of the least urbanized sectors in Knox County. Even within this otherwise nun-urban sector, a fairly concentrated amount of urbanized land from the Fountain City area (east

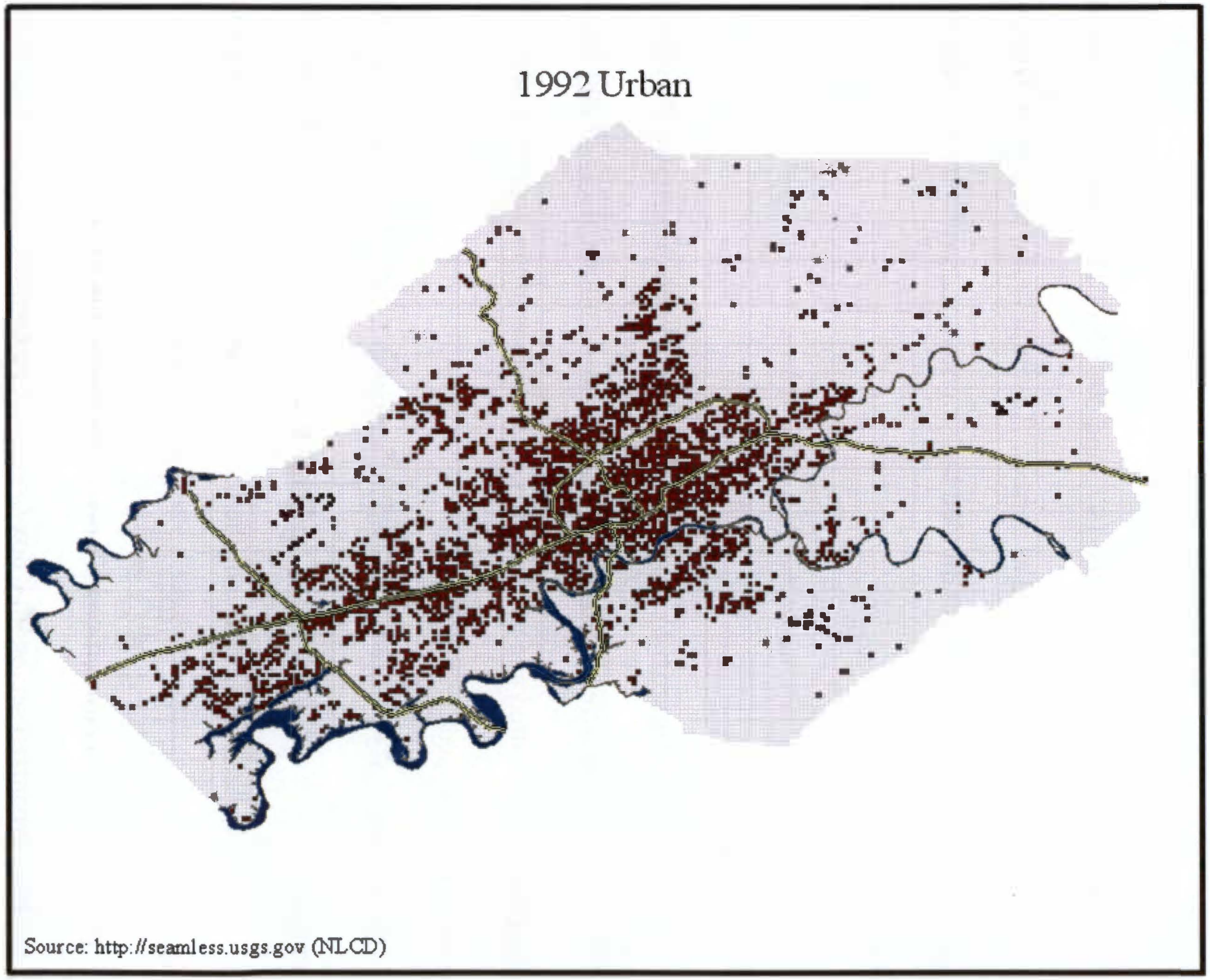


Figure 6.1 1992 Urban

and west of Broadway) westward to I-75. A secondary cluster is located further out Broadway in the Halls Crossroads community.

The Southeast Sector includes nearly six and one half percent urbanization (371 grids out of 5,741) nearly all of which is located on either side of Chapman Highway or within the Forks of the River Industrial Park.

The Southwest Sector has an eighteen percent urbanization level (631 grids out of 3,467). Most are spread between the Central Core Sector and Ebenezer (east and west) and Northshore and I-40 (north and south). A secondary grouping is located in the Farragut area.

The Northwest Sector has an urbanized level of about fourteen percent (845 grids out of 5,949), most of which are either in the Powell community or between I-75 and Pellissippi Parkway.

6.2 2001 Urban

The 2001 map (Figure 6.2), drawn from later NLCD information, shows a leap in urbanization as the 3,212 grids considered urban in 1992 expanded to 5,611 grids considered urban. Remembering that the time frame elapsing between the two maps is nearly twice that depicted in subsequent maps, the growth from 49.61 square miles of urbanized ground cover to 86.66 square miles is not beyond reason.

The Central Core Sector, the most urbanized of all the sectors, experienced a growth rate of nearly thirty-three percent. This growth was attributed mainly to infill throughout the sector.

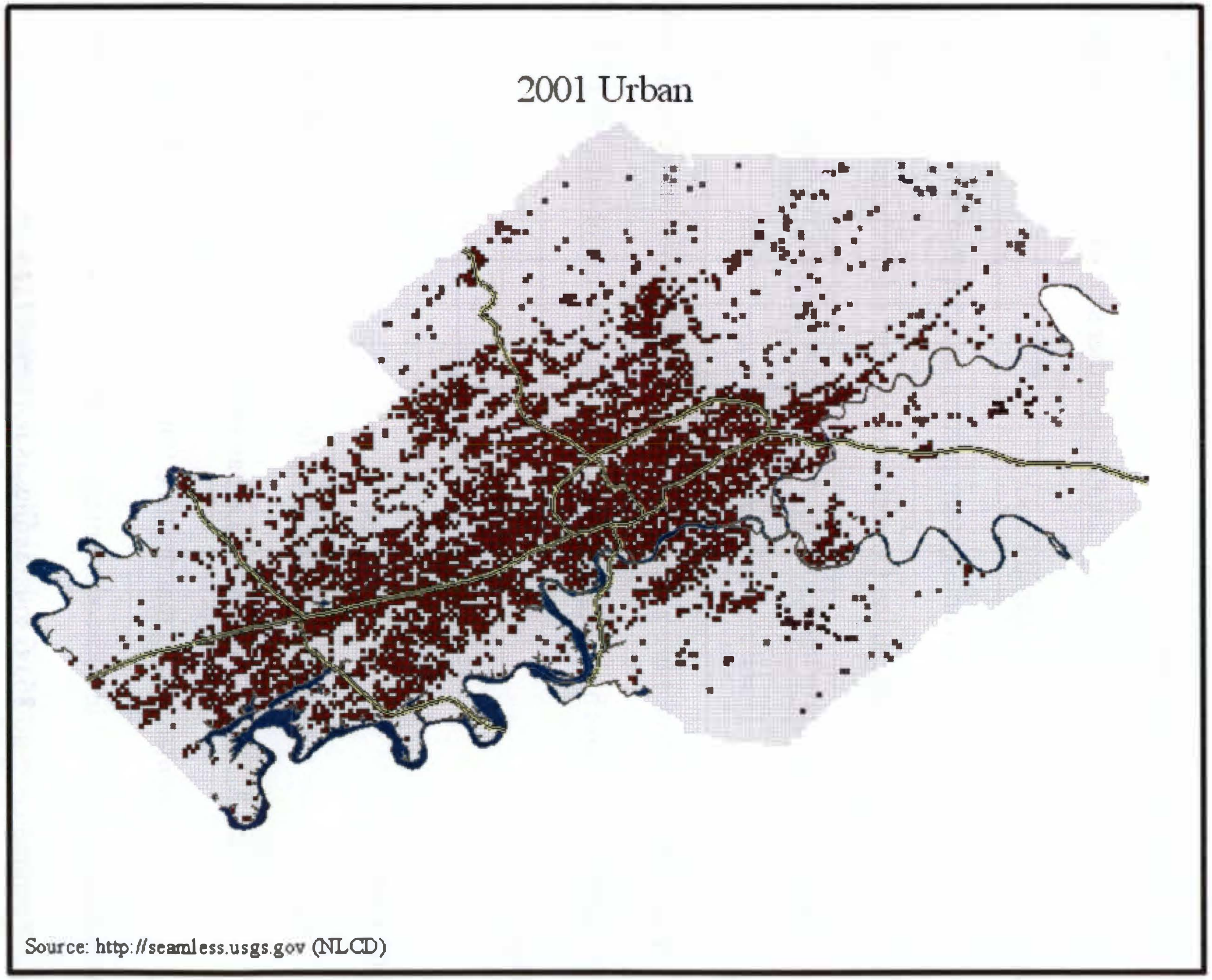


Figure 6.2 2001 Urban

The Northeast Sector grew at a more impressive rate of eighty-seven percent. Here the growth was attributed to infill in the Fountain City and Hall's Crossroads communities and growth along Ashville Highway and Rutledge Pike.

The Southeast Sector experienced the lowest amount of growth during the period at thirty percent. The amount that did occur was primarily within the Forks of the River Industrial Park or along Chapman Highway.

The Southwest Sector doubled the number of urbanized grids during the nine year period. A major expansion in the Farragut area combined with high levels of infill between Northshore Drive and Kingston Pike account for most of this growth.

The Northwest Sector also doubled the number of urban grids within it. High amounts of infill from the Powell community to just west of Pellissippi Parkway (especially along the Middlebrook Pike corridor) fueled the growth.

6.3 2005 Urban

The 2005 map (Figure 6.3) is the first of the projected growth maps. There is an increase from 86.66 square miles of urbanized land use to the nearly 107 square miles. Of interest are the unique growth patterns developing within different parts of the county. In both the Southwest Sector and Central Core Sector, growth patterns are being shaped by the availability of land. In the Northwest Sector and in much of the Northeast Sector, growth patterns are being influenced by the terrain (as evidenced by the distinctive ridge lines visible). In the eastern portion of the Northeast Sector, and to a lesser degree in the Southeast Sector, urban growth seems most dependent on the location of the major roads.

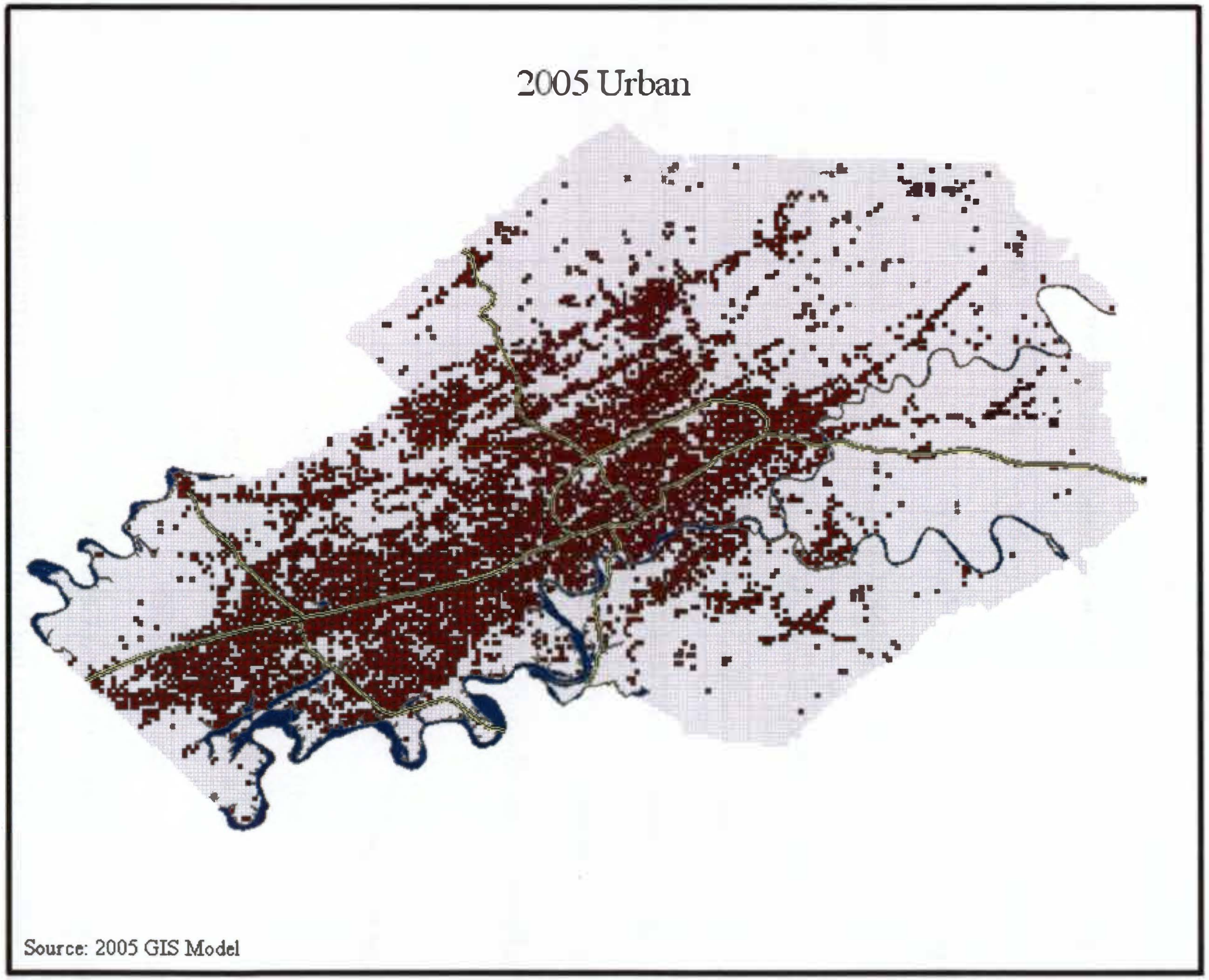


Figure 6.3 2005 Urban

The Central Core Sector's growth is expected to slow to five percent. This modest increase still would push the overall percentage of urbanized land cover to nearly sixty-four percent. The growth is limited to infill.

The Northeast Sector has a projected growth of thirty-two percent. While the second highest growth rate by sector, it only pushes the sector to a little over fifteen percent urbanized because of the sheer volume of area in the sector. Most of the changes are expected to occur within the Hall's community and along the major roads.

The Southeast Sector is expected to grow at a fairly low sixteen percent. Growth within the Lake Forest community as well as expanding development along Chapman Highway at John Severe and Tipton Station seem to fuel the change.

The Southwest Sector is expected to have the highest rate of growth at thirty-seven percent. It is also the second sector to reach the fifty percent urbanized level as the area north of Northshore Drive from Farragut to the Central Core Sector continues to fill.

The Northwest Sector Grows by a modest twenty percent reaching a total urbanized area of thirty-five percent, nearly all of which is attributable to infill.

6.4 2010 Urban

The 2010 map (Figure 6.4) projects a further increase to 134.99 square miles. This pushes the overall percentage of Knox County considered urbanized to thirty-two percent. The unique development patterns noticeable in 2005 (the ridgelines and major road influences) are strengthened even more in 2010.

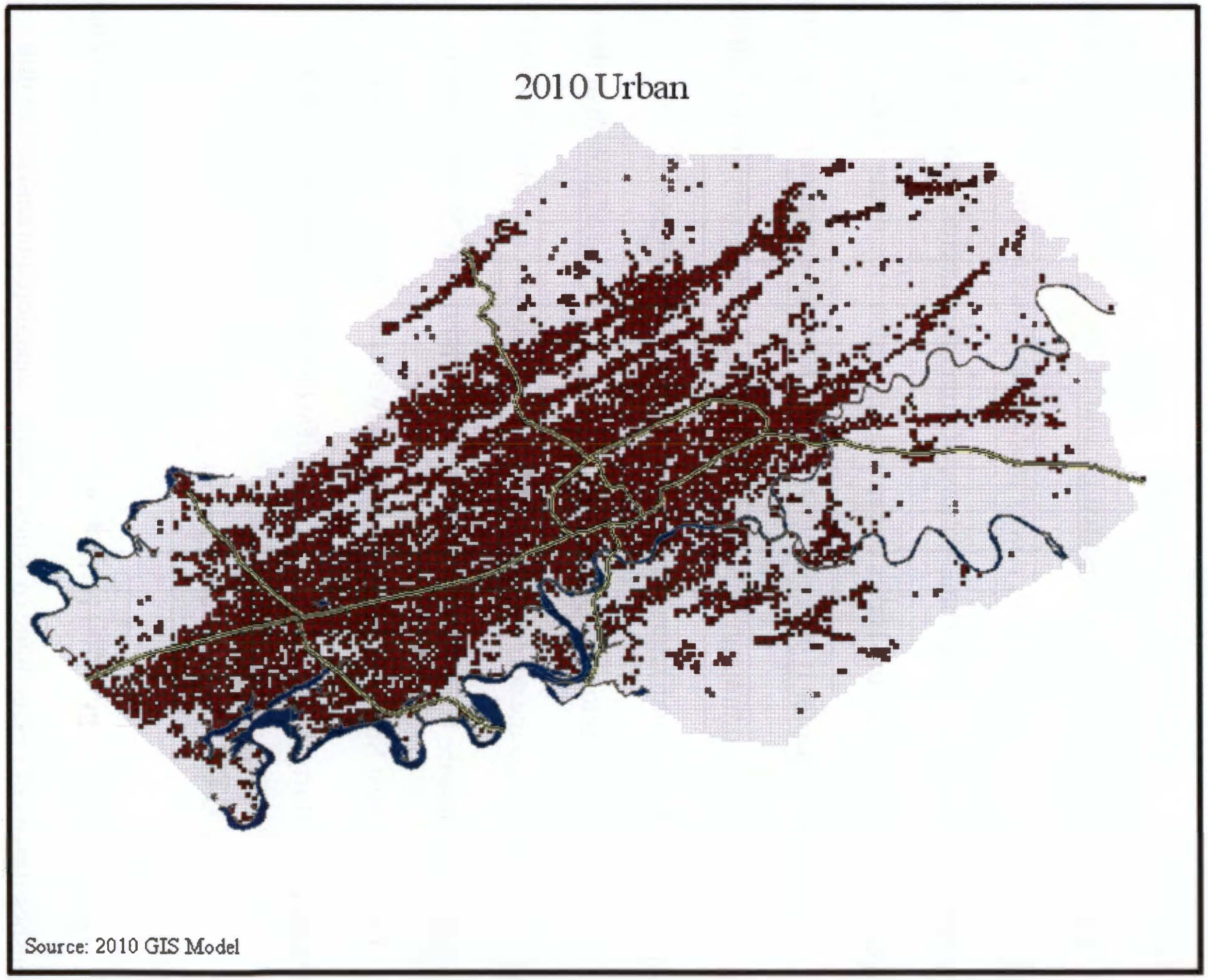


Figure 6.4 2010 Urban

The Central Core Sector is projected to increase by another five percent, bringing the total urbanized area to nearly sixty-seven percent. Infill continues to be the driving force within the sector.

The Northeast Sector is projected to have the largest increase at over forty-three percent. Because of the vast size of the sector, the overall level of urbanization remains low at twenty-two percent. High levels of growth are expected along Emory Road and Ashville Highway.

The Southeast Sector is expected to grow by thirty-six percent as the Lake Forest, John Severe, and Tipton Station areas continue to expand. Large areas of forested ridge and valley components restrict the overall urbanization level low at thirteen percent.

The Southwest Sector is projected to slow to fifteen percent growth. Here the lack of large tracts of developable land, other than in the most southwest part of Knox County, as evidenced by the sector's overall urbanization rate of fifty-seven percent, is the primary cause.

The Northwest Sector is expected to grow by thirty percent. Again this growth is expected to take place between Pellissippi Parkway and I-75 in the form of infill.

6.5 2015 Urban

By 2015 (Figure 6.5) the urbanized land use in Knox County is expected to reach 162.4 square miles. This twenty plus percent increase over the amount projected for 2010 is directly attributable to a shift in settlement patterns from the highly congested Central Core and western portions of the county to the more lightly developed Northeast and Southeast Sectors.

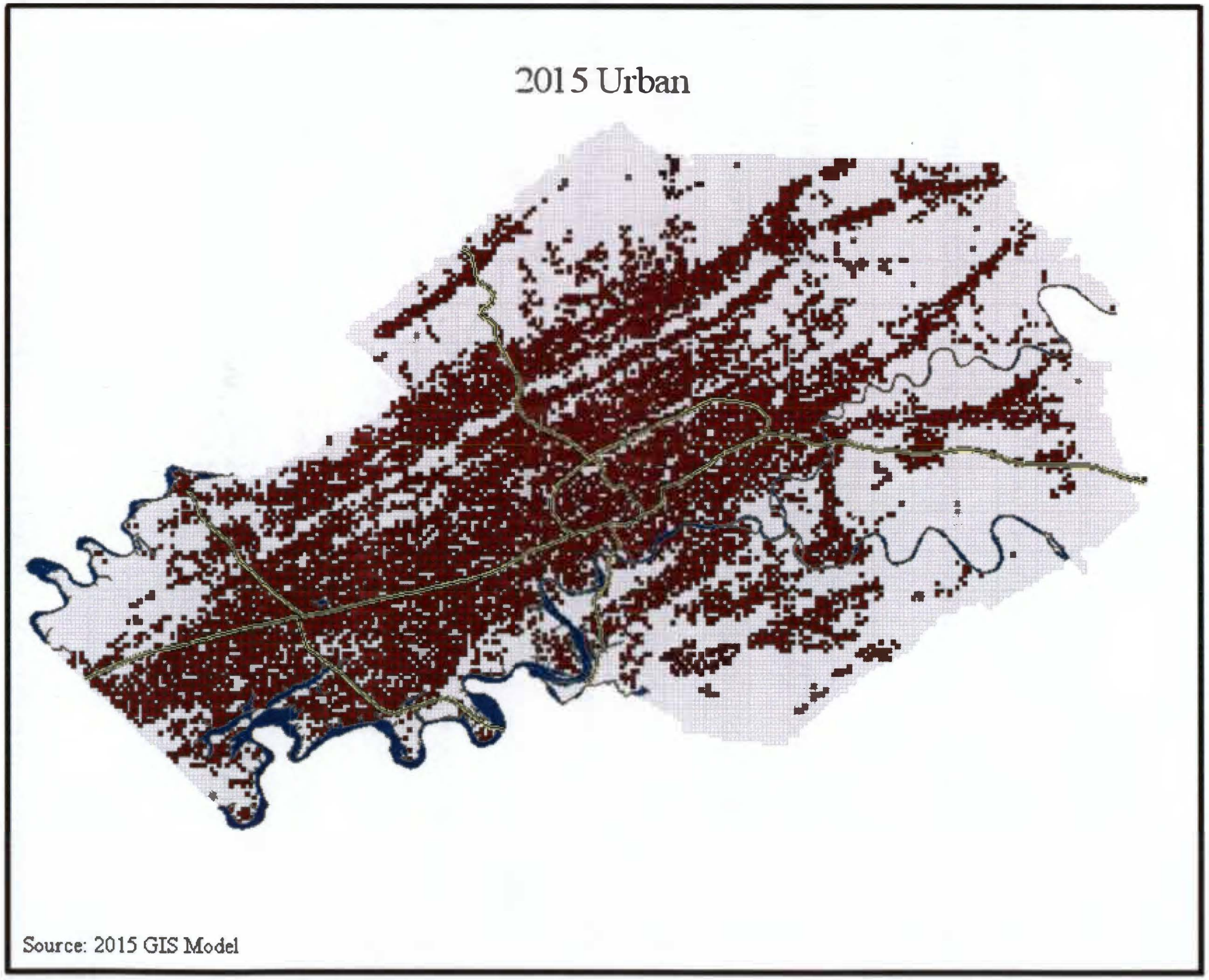


Figure 6.5 2015 Urban

The Central Core Sector is expected to grow by a nearly stagnant three percent. The sector still reaches an urbanized level of nearly seventy percent. As with previous projections, the growth is expected to occur as infill.

The Northeast Sector again is the beneficiary of the shift in settlement patterns as it is expected to grow at a rate of over forty-one percent. The area from I-75 to beyond Tazewell Pike is projected to become a nearly solid path of development.

The Southeast Sector is projected to have the greatest percentage gain at nearly fifty-six percent. Growth in this sector is expected to center on the three areas along Chapman Highway and in the area adjacent to the industrial park.

The Southwest Sector is expected to grow at a modest five percent yet still is enough to push the sector over sixty percent urbanized. Some infill and an expansion of the developed areas around the Farragut community account for most of the growth.

The Northwest Sector is projected to grow at eleven percent through residential development in the north central portion of the sector. This growth pushes the sector over the fifty percent urbanized threshold.

6.6 2020 Urban

The 2020 (Figure 6.6) projection marks the first time that the county reaches an urbanized level of over forty-five percent. It also marks the first time that growth into the eastern portion of the county expands appreciably beyond the areas bordering the major roads.

The Central Core Sector is expected to grow at a low five percent to an urbanized level of over seventy-two percent.

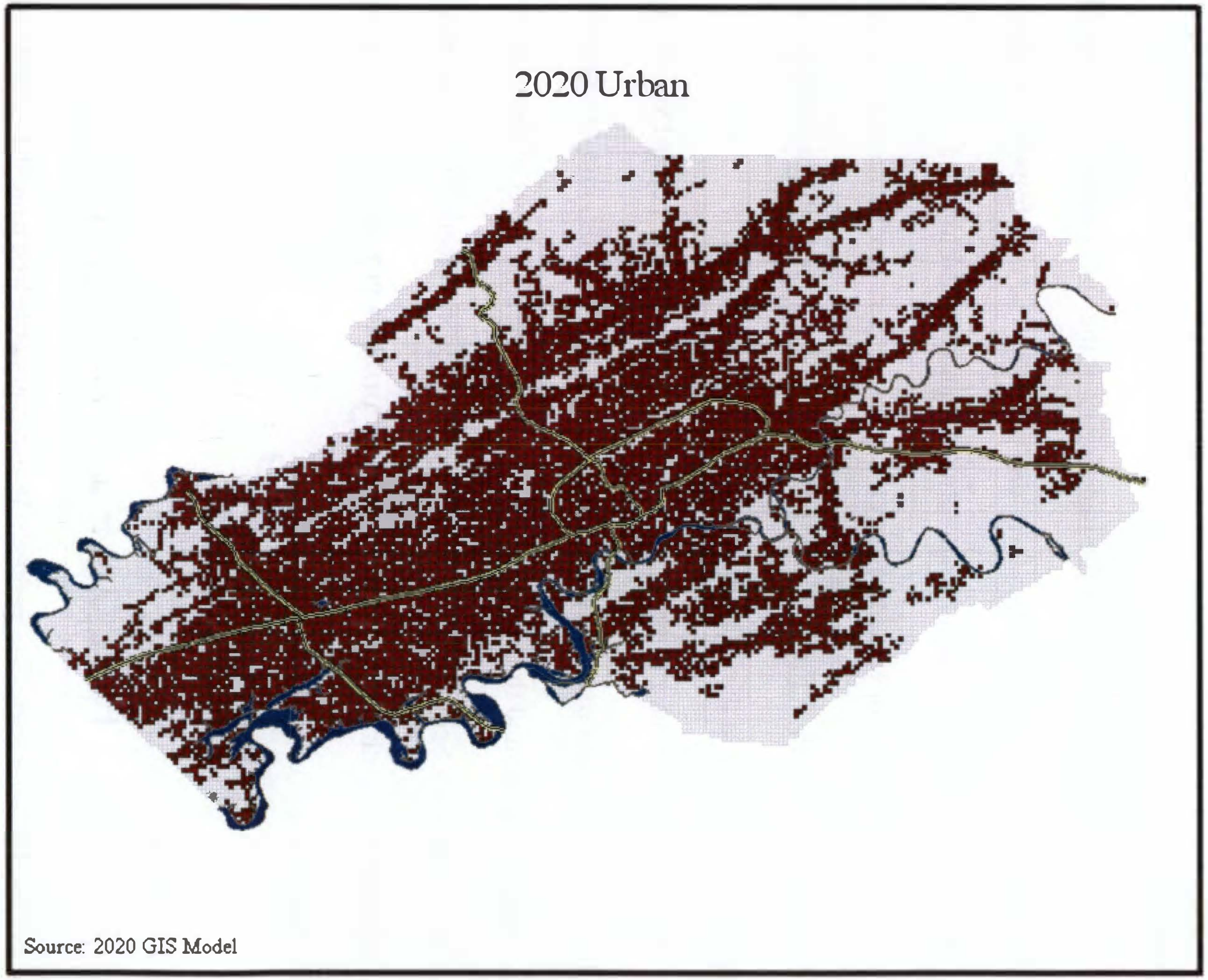


Figure 6.6 2020 Urban

The Northeast Sector is projected to grow by twenty-five percent but because of its large size is expected to remain below forty percent urbanized. Growth along the major roads is expected to expand into the surrounding countryside.

The Southeast Sector is again expected to generate to strongest growth at slightly over thirty-three percent. Some overlapping between the four growth zones is expected to become evident.

The Southwest Sector while expected to grow at a fairly low thirteen percent is projected to reach sixty-eight percent urbanized. Only scattered pockets escape the widespread urbanization.

The Northwest Sector also is projected to grow at a thirteen percent rate. The sector now, however, is expected to exceed fifty-six percent urbanized.

6.7 2025 Urban

The 2025 projection (Figure 6.7) marks the point at which Knox County surpasses the fifty percent urbanized level. Major portions of the county, as illustrated by the map, are expected to become solid pockets of urbanization.

The Central Core Sector is expected to reach a level of seventy-six percent urbanization with a growth of about four and one half percent.

The Northeast Sector is projected to grow by over twenty percent bringing its total urbanization to forty-seven percent.

The Southeast Sector is expected to grow again by the highest percentage at thirty-seven. This sector is, however, expected to remain the least urbanized at only thirty-eight percent.

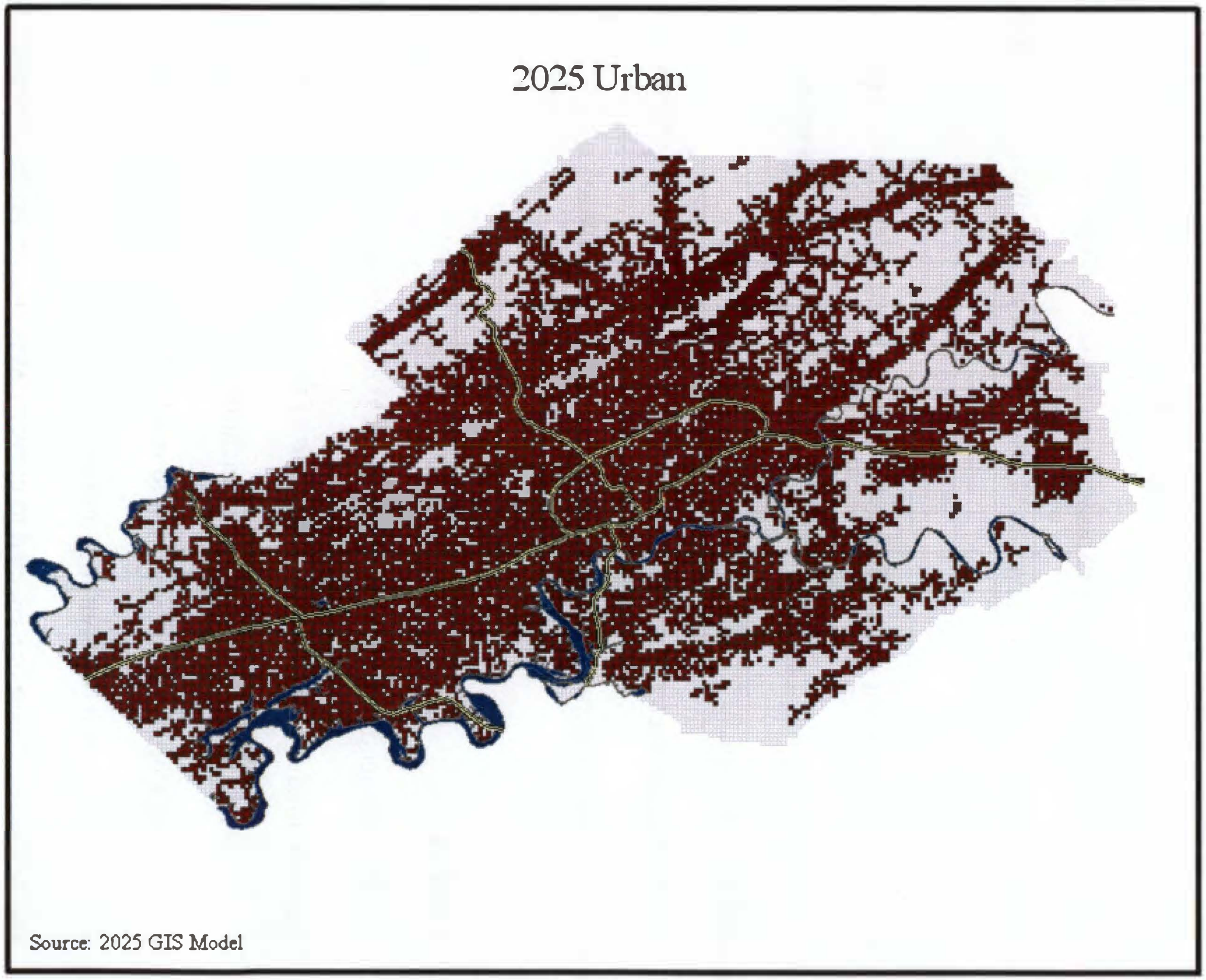


Figure 6.7 2025 Urban

The Southwest Sector is expected to grow at the same four and one half percent rate as the Central Core. It is also expected to reach an urbanized level of seventy-one percent.

The Northwest Sector is projected to reach an overall urbanized level of sixty-two percent with its over nine percent growth.

CHAPTER VII

CONCLUSIONS

This research assesses the potential changes in land-use within Knox County from 1993 to 2025. Using the GIS based growth model, which incorporates elements of both the statistical model and the rule based model, a seventy percent accuracy rate was achieved. This number is derived by comparing the projected location of urbanized grids in 2001 and the actual location of the urbanized grids classified by the NLCD information.

The urban projections provided by the growth model illustrate a county that will, within a single generation, transition from twelve percent urban in 1993 to over fifty percent urban by 2025. Based on the paper's use of Knox County's "low growth" population growth estimate and the fact that, according to the NLCD information, the urbanized level of land use had already reached nearly twenty-one percent by 2001, the estimate seems reasonable.

The single greatest weakness in the GIS based model, based on comparisons between projections and known urban growth patterns, was the inability of the program to anticipate the construction of roads and other access corridors. This weakness became evident in the 2025 projection (especially in the eastern portion of the county) and became so obvious in the 2030 projection that I felt that it was no longer reliable.

For the other projections, (2005, 2010, 2015 and to a lesser degree 2020) the resulting maps illustrate urban land use change that is both reasonable and probably fairly accurate.

The major contributing factors found in the changing of land use included not only the proximity to existing urbanized areas and readily available access in the form of roads, but the desirability as determined by location. Based on the statistical analysis and the results of the urban growth model, the hypothesis that land use change to urban is primarily driven by the proximity to existing urbanization within a specific spatial region mitigated only by the physical conditions of the existing landscape is acceptable.

While accepted that the NLCD data inherently contains errors such as under classifying urban areas in the 2001 data (based on personal knowledge of the Southwest Sector), it does, as evidenced by the seventy percent accuracy rate, seem to project acceptable trends and patterns if not individual grids. Therefore, I am confident that the NLCD information is sufficiently accurate to support the hypothesis that it can be used for GIS based growth model projections.

7.1 Future Research

The most obvious extension of this research is to catalog the natural elements of land use identified by the NLCD information. This would allow the researcher to compare and make projections concerning changes in the amount of forest, pasture and row crops within the county. From this data the researcher should be able to gage and project the short and long term affects of the destruction of "green" spaces.

A second avenue of research would entail use of the research to catalog and project the amount of impermeable surface within the county. This could provide base data of the potential storm water runoff and non-source point pollution risk that will face the governmental agencies within the area.

A third potential outgrowth of this research would be in municipal planning. The risk of under building utility service networks or schools could be minimized through the understanding of long term settlement and growth patterns.

BIBLIOGRAPHY

Allen, Jeffery and Kang Lu. Modeling and Prediction of Future Urban Growth in the Charleston Region of South Carolina: a GIS-based Integrated Approach. *Conservation Ecology* 8 (2): 2. [online] URL: http://consecol.org/vol8/iss2/art2

Brown, David L. and John M. Wardwell. 1980. *New Directions in Urban-Rural Migration: The population Turnaround in Rural America*. New York: Academic Press.

Fisher, Manfred M. and Yee Leung (eds). 2001. *GeoComputational Modelling: Techniques and Applications*. New York: Springer-Verlag Berlin Heidelberg.

Frey, William H. and Alden Speare Jr. 1988. *Regional and Metropolitan Growth and Decline in the United States*. New York: Russell Sage Foundation.

Gottdiener, Mark. 1985. *The Social Production of Urban Space*. Austin: University of Texas Press.

Harris, Roger. 29 August 2006. "Business park gets rezoning; suit likely." *Knoxville News Sentinel*.

Hester, David J. Modeling Albuquerque's Urban Growth. *USGS Middle Rio Grande Basin Study*. [Online] URL: http://rockyweb.cr.usgs.gov/mrgb/forcast.html.

Hoyt, Homer. Federal Housing Administration, 1939. *The Structure and Growth of Residential Neighborhoods in American Cities.* Washington DC: US Government Printing Office.

Jacobs, Jane. 1961 *The DEATH and LIFE of GREAT AMERICAN CITIES*. New York, NY: Vintage Books.

Jensen, John R. 2000. *Remote Sensing of the Environment: An Earth Resource Perspective*. Upper Saddle River, NJ: Prentice Hall.

Johnston, Robert A. and David R. Shabazian. January 2003. UPlan: A Versatile Urban Growth Model for Transportation Planning. Presented at Transportation Research Board Annual Meeting.

Kaplan, David H., James O. Wheeler and Steven R. Holloway. 2004. *Urban Geography.* York, PA: Malloy Lithographing.

Kivell, Philip. 1993. *Land and the City: Patterns and Processes of Urban Change.* New York: Routledge.

Knoxville / Knox County Metropolitan Planning Commission *Development in the 80's: A summary of Urban Activity in Knoxville and Knox County 1982 – 1989.* Knoxville: 1990.

Knoxville / Knox County Metropolitan Planning Commission *Knoxville Metropolitan Area Land Use Plan.* Knoxville: 1972.

Knoxville / Knox County Metropolitan Planning Commission *Knoxville / Knox County General Plan 2000.* Knoxville: 1984.

Lansing, John B. 1964. U.S. Department of Commerce. *The Propensity to Move.* Washington D.C.: U.S. Government Printing Office.

Lang, Robert E. 2003. *Edgeless Cities: exploring the elusive metropolis.* Washington D.C.: Brookings Institution Press.

Long, Larry E. *Migration and Residential Mobility in the United States.* New York: Russell Sage Foundation, 1988.

Liverman, Diana, [et al.], editors. 1998. *People and Pixels: Linking Remote Sensing and Social Science.* Washington D.C.: National Academy Press.

Maguire, David J., Michael Batty and Michael F. Goodchild eds. 2005. *GIS, spatial analysis, and modeling.* Redlands CA: ESRI Press.

Mellon, Ericka. 3 July 2006. "College funding unevenly allotted." *Knoxville News Sentinel.*

Ralston, Bruce. 2004. *GIS and Public Data.* Clifton Park NY: Delmar Learning.

Salant, Priscilla. 1990. *A Community Researcher's Guide to Rural Data.* Washington D.C.: Island Press.

U.S. Department of Commerce. *The Propensity to Move*. Washington D.C.: U.S. Government Printing Office. 1964.

U.S. Department of Commerce, Bureau of the Census, 1990. *Census of Population and Housing*. Washington DC: U.S. Government Printing Office.

U.S. Department of Commerce, Bureau of the Census, 2000. *Census of Population and Housing*. Washington DC: U.S. Government Printing Office.

U.S. Environmental Protection Agency. NLCD Classification Schemes (Level II). *Multi-Resolution Land Characteristics Consortium.* [Online] URL: http://www.epa.gov/mrlc/classification.html.

U.S. Environmental Protection Agency. 2002. *Urban Ecosystem Analysis Knox County, Tennessee*. Washington DC: U.S. Government Printing Office.

Wheeler, William B. 2005. *Knoxville, Tennessee: A Mountain City in the New South.* Knoxville TN: University of Tennessee Press.

APPENDIX

Stepwise Regression Analysis

Regression

Notes

Output Created		09-MAR-2007 09:42:39
Comments		
Input	Data	D:\sb550\growaaa.sav
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	25274
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on cases with no missing values for any variable used.
Syntax		REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOVA /CRITERIA=PIN(.05) POUT(.10) /NOORIGIN /DEPENDENT @2001Urb /METHOD=STEPWISE Prox_Urb Prox_MRd Prox_Rd Prox_PCom Proc_SCom Prox_UrbNd Prox_Sch Ex_LC Slope Home_Val Sch_Rank .
Resources	Elapsed Time	0:00:00.25
	Memory Required	6564 bytes
	Additional Memory Required for Residual Plots	0 bytes

Variables Entered/Removed(a)

Model	Variables Entered	Variables Removed	Method
1	Prox_Urb	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Prox_Rd	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
3	Home_Val	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
4	Prox_UrbNd	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
5	Ex_LC	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
6	Prox_MRd	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
7	Slope	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
8	Proo_SCom	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
9	Sch_Rank	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
10	Prox_Sch	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a Dependent Variable: 2001Urb

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.974(a)	.949	.949	.741
2	.974(b)	.950	.950	.735
3	.975(c)	.950	.950	.731
4	.975(d)	.950	.950	.729
5	.975(e)	.951	.951	.727
6	.975(f)	.951	.951	.726
7	.975(g)	.951	.951	.724
8	.975(h)	.951	.951	.724
9	.975(i)	.951	.951	.723
10	.975(j)	.951	.951	.723

a Predictors: (Constant), Prox_Urb
b Predictors: (Constant), Prox_Urb, Prox_Rd
c Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val
d Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd
e Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC
f Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd
g Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope
h Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope, Proc_SCom
i Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope, Proc_SCom, Sch_Rank
j Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope, Proc_SCom, Sch_Rank, Prox_Sch

ANOVA(k)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	256435.030	1	256435.030	467438.656	.000(a)
	Residual	13864.121	25272	.549		
	Total	270299.151	25273			
2	Regression	256664.012	2	128332.006	237847.092	.000(b)
	Residual	13635.139	25271	.540		
	Total	270299.151	25273			
3	Regression	256787.719	3	85595.906	160087.292	.000(c)
	Residual	13511.432	25270	.535		
	Total	270299.151	25273			
4	Regression	256871.452	4	64217.863	120848.784	.000(d)
	Residual	13427.700	25269	.531		
	Total	270299.151	25273			
5	Regression	256928.466	5	51385.693	97108.990	.000(e)
	Residual	13370.685	25268	.529		
	Total	270299.151	25273			
6	Regression	256993.494	6	42832.249	81337.015	.000(f)
	Residual	13305.657	25267	.527		
	Total	270299.151	25273			
7	Regression	257041.639	7	36720.234	69980.961	.000(g)
	Residual	13257.512	25266	.525		
	Total	270299.151	25273			
8	Regression	257073.373	8	32134.172	61385.413	.000(h)
	Residual	13225.778	25265	.523		
	Total	270299.151	25273			
9	Regression	257081.892	9	28564.655	54599.629	.000(i)
	Residual	13217.259	25264	.523		
	Total	270299.151	25273			
10	Regression	257087.202	10	25708.720	49158.483	.000(j)
	Residual	13211.949	25263	.523		
	Total	270299.151	25273			

a Predictors: (Constant), Prox_Urb
b Predictors: (Constant), Prox_Urb, Prox_Rd
c Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val
d Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd
e Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC
f Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd
g Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope
h Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope, Proc_SCom
i Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope, Proc_SCom, Sch_Rank
j Predictors: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope, Proc_SCom, Sch_Rank, Prox_Sch
k Dependent Variable: 2001Urb

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.144	.010		13.754	.000
	Prox_Urb	1.004	.001	.974	683.695	.000
2	(Constant)	.099	.011		9.326	.000
	Prox_Urb	.995	.002	.966	661.493	.000
	Prox_Rd	.200	.010	.031	20.601	.000
3	(Constant)	.059	.011		5.440	.000
	Prox_Urb	.993	.002	.963	661.727	.000
	Prox_Rd	.190	.010	.029	19.623	.000
	Home_Val	.065	.004	.022	15.211	.000
4	(Constant)	.067	.011		6.169	.000
	Prox_Urb	.989	.002	.959	637.471	.000
	Prox_Rd	.188	.010	.029	19.491	.000
	Home_Val	.064	.004	.021	14.885	.000
	Prox_Urb Nd	.099	.008	.018	12.663	.000
5	(Constant)	-.105	.020		-5.267	.000
	Prox_Urb	.996	.002	.966	590.447	.000
	Prox_Rd	.207	.010	.032	21.099	.000
	Home_Val	.062	.004	.020	14.498	.000
	Prox_Urb Nd	.102	.008	.019	12.902	.000
	Ex_LC	.039	.004	.017	10.380	.000
6	(Constant)	-.116	.020		-5.858	.000
	Prox_Urb	.995	.002	.965	588.439	.000
	Prox_Rd	.189	.010	.029	19.106	.000
	Home_Val	.063	.004	.021	14.707	.000
	Prox_Urb Nd	.100	.008	.018	12.664	.000
	Ex_LC	.042	.004	.018	11.116	.000
	Prox_MRd	.062	.006	.016	11.112	.000
7	(Constant)	-.236	.023		-10.101	.000
	Prox_Urb	.993	.002	.963	588.727	.000
	Prox_Rd	.177	.010	.027	17.831	.000
	Home_Val	.063	.004	.021	14.845	.000
	Prox_Urb Nd	.099	.008	.018	12.636	.000
	Ex_LC	.047	.004	.020	12.361	.000
	Prox_MRd	.057	.006	.015	10.184	.000
	Slope	.042	.004	.014	9.579	.000
8	(Constant)	-.248	.023		-10.585	.000
	Prox_Urb	.989	.002	.959	554.876	.000
	Prox_Rd	.171	.010	.026	17.136	.000
	Home_Val	.060	.004	.020	14.032	.000
	Prox_Urb Nd	.095	.008	.017	12.031	.000
	Ex_LC	.051	.004	.022	13.324	.000
	Prox_MRd	.056	.006	.015	10.078	.000
	Slope	.043	.004	.014	9.678	.000
	Proc_SCom	.032	.004	.012	7.786	.000
9	(Constant)	-.258	.024		-10.969	.000
	Prox_Urb	.989	.002	.959	554.922	.000
	Prox_Rd	.170	.010	.026	17.080	.000
	Home_Val	.050	.005	.017	10.247	.000
	Prox_Urb Nd	.095	.008	.017	12.082	.000
	Ex_LC	.051	.004	.022	13.520	.000
	Prox_MRd	.055	.006	.014	9.604	.000
	Slope	.044	.004	.015	9.983	.000
	Proc_SCom	.029	.004	.011	6.930	.000
	Sch_Rank	.014	.003	.007	4.036	.000
10	(Constant)	-.262	.024		-11.116	.000
	Prox_Urb	.988	.002	.958	542.799	.000
	Prox_Rd	.168	.010	.026	16.846	.000
	Home_Val	.052	.005	.017	10.473	.000
	Prox_Urb Nd	.096	.008	.017	12.164	.000
	Ex_LC	.053	.004	.023	13.801	.000
	Prox_MRd	.054	.006	.014	9.729	.000
	Slope	.044	.004	.015	9.942	.000
	Proc_SCom	.026	.004	.010	6.336	.000
	Sch_Rank	.013	.003	.006	3.915	.000
	Prox_Sch	.036	.011	.005	3.186	.001

a Dependent Variable: 2001Urb

Excluded Variables(k)

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	Prox_MRd	.020(a)	13.676	.000	.086	.964
	Prox_Rd	.031(a)	20.601	.000	.129	.910
	Prox_PCom	.012(a)	8.204	.000	.052	.914
	Proc_SCom	.017(a)	10.699	.000	.069	.795
	Prox_UrbNd	.019(a)	13.181	.000	.083	.951
	Prox_Sch	.007(a)	4.516	.000	.028	.856
	Ex_LC	.010(a)	6.505	.000	.041	.789
	Slope	.017(a)	11.896	.000	.075	.953
	Home_Val	.023(a)	16.446	.000	.103	.991
	Sch_Rank	.018(a)	12.697	.000	.080	.987
2	Prox_MRd	.015(b)	10.350	.000	.065	.936
	Prox_PCom	.009(b)	6.042	.000	.038	.903
	Proc_SCom	.014(b)	8.584	.000	.054	.784
	Prox_UrbNd	.019(b)	12.936	.000	.081	.951
	Prox_Sch	.004(b)	2.352	.019	.015	.846
	Ex_LC	.017(b)	10.474	.000	.066	.763
	Slope	.013(b)	8.717	.000	.055	.927
	Home_Val	.022(b)	15.211	.000	.095	.986
	Sch_Rank	.016(b)	11.378	.000	.071	.982
3	Prox_MRd	.015(c)	10.668	.000	.067	.935
	Prox_PCom	.008(c)	5.411	.000	.034	.901
	Proc_SCom	.012(c)	7.229	.000	.045	.777
	Prox_UrbNd	.018(c)	12.553	.000	.079	.950
	Prox_Sch	.005(c)	3.293	.001	.021	.843
	Ex_LC	.016(c)	9.944	.000	.062	.762
	Slope	.013(c)	9.039	.000	.057	.927
	Sch_Rank	.007(c)	4.468	.000	.028	.742
4	Prox_MRd	.015(d)	10.376	.000	.065	.934
	Prox_PCom	.007(d)	4.584	.000	.029	.897
	Proc_SCom	.010(d)	6.279	.000	.039	.772
	Prox_Sch	.005(d)	3.407	.001	.021	.843
	Ex_LC	.017(d)	10.380	.000	.065	.761
	Slope	.013(d)	8.916	.000	.056	.927
	Sch_Rank	.007(d)	4.419	.000	.028	.742
5	Prox_MRd	.016(e)	11.112	.000	.070	.930
	Prox_PCom	.009(e)	6.066	.000	.038	.880
	Proc_SCom	.013(e)	7.799	.000	.049	.768
	Prox_Sch	.008(e)	4.968	.000	.031	.825
	Slope	.015(e)	10.580	.000	.066	.907
	Sch_Rank	.008(e)	5.160	.000	.032	.739
6	Prox_PCom	.009(f)	5.861	.000	.037	.880
	Proc_SCom	.012(f)	7.663	.000	.048	.767
	Prox_Sch	.007(f)	4.663	.000	.029	.824
	Slope	.014(f)	9.579	.000	.060	.899
	Sch_Rank	.007(f)	4.540	.000	.029	.736
7	Prox_PCom	.009(g)	5.935	.000	.037	.880
	Proc_SCom	.012(g)	7.786	.000	.049	.767
	Prox_Sch	.007(g)	4.593	.000	.029	.824
	Sch_Rank	.009(g)	5.372	.000	.034	.731
8	Prox_PCom	.004(h)	2.624	.009	.017	.690
	Prox_Sch	.005(h)	3.333	.001	.021	.801
	Sch_Rank	.007(h)	4.035	.000	.025	.707
9	Prox_PCom	.003(i)	1.949	.051	.012	.669
	Prox_Sch	.005(i)	3.186	.001	.020	.800
10	Prox_PCom	.003(j)	1.612	.107	.010	.661

a Predictors in the Model: (Constant), Prox_Urb
b Predictors in the Model: (Constant), Prox_Urb, Prox_Rd
c Predictors in the Model: (Constant), Prox_Urb, Prox_Rd, Home_Val
d Predictors in the Model: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd
e Predictors in the Model: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC
f Predictors in the Model: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd
g Predictors in the Model: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope
h Predictors in the Model: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope, Proc_SCom
i Predictors in the Model: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope, Proc_SCom, Sch_Rank
j Predictors in the Model: (Constant), Prox_Urb, Prox_Rd, Home_Val, Prox_UrbNd, Ex_LC, Prox_MRd, Slope, Proc_SCom, Sch_Rank, Prox_Sch
k Dependent Variable: 2001Urb

VITA

Charles Steven Brown was born July 10, 1959 in Dayton, Tennessee. The third of four children for Earl and Betty Brown, he spent much of his childhood around his grandfather's dairy farm outside Dayton. After graduating from Tyner High School, near Chattanooga, he attended The University of Tennessee at Chattanooga for one semester before entering the workforce fulltime as a delivery driver for a tractor-trailer parts distributor. In 1984 he became the store manager for one of the Auto Zone locations in Chattanooga and in 1985 accepted a similar position in Memphis. In 1986 he returned to Chattanooga and the heavy parts business. In 1987 he was named branch manager of the Chattanooga location. Knoxville came into play in 1991 when he accepted a transfer as manager of the company's Knoxville location. A Major change occurred in late 1998 as the company made the decision the sell to an investment group. In the spring of 2000, he made the decision to return to college and in 2004 graduated from The University of Tennessee at Knoxville with honors.

As an undergraduate, his love of cultures and places drove him to seek a minor in Geography. A desire to teach at the college level pushed him to seek and obtain admission to the graduate program in Geography at Tennessee where he studied urban, rural and GIS aspects of the field.