THE ADVANTAGE OF MAPPING GENTRIFICATION WITH GEOGRAPHIC INFORMATION SYSTEMS: COMPARISONS OF THREE NEW YORK CITY NEIGHBORHOODS, 1980 - PRESENT

By

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Abstract

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Chung Chang

Adviser: Professor John E. Seley

This dissertation adopts a Geographic Information Systems (GIS) approach to map gentrification. It explores the combination of GIS and publicly available data as a new research tool to investigate gentrification at the Census Tract level within three New York City neighborhoods (Park Slope, Williamsburg and the Lower East Side). Results are compared to contemporary gentrification studies to argue the advantages of utilizing this methodology.

Since the term "gentrification" was coined (Glass, 1964), scholars with different research methods have produced a considerable body of literature. However, debates on causes and effects persist. While disciplinary differences could be the reasons for disagreement, another explanation is the various study geographical scales that can range from a single property to an entire city. This dissertation argues neighborhoods are the suitable spatial scale to study gentrification. Three neighborhoods are defined with selected Census Tracts. Rather than

aggregating these selected Census Tracts into a single neighborhood, the gentrification maps were created by connecting socio-economic status indicators from Census Surveys to each Census Tract. This approach demonstrates the different degrees of gentrification within these three neighborhoods. Data from 1980, 1990, 2000 and 2010 Census Surveys are used for cross-sectional and longitudinal comparisons. The advantages of this design are: first, the cross-sectional maps demonstrate the different degrees of gentrification within the neighborhoods at a given time. Second, the longitudinal maps show where gentrification moved and expanded through time. Third, as the surrounding Census Tracts outside the defined neighborhoods are also mapped, the "spillover effect" is also examined. Fourth, the clearly defined geographical boundaries of neighborhoods ensure exact comparisons with other researchers and future studies. These gentrification maps revealed that the gentrification of these neighborhoods has been spatially uneven. Certain areas were gentrified first and subsequent gentrification anchored these initial sections. Further, gentrification did not spread equally or endlessly. There were several factors that either facilitated or impeded the expansion of gentrification, and these factors usually worked in tandem with each other. In summary, the gentrification maps in this study provided an enhanced understanding of the spatial-temporal patterns of gentrification in these three neighborhoods.

Acknowledgements

It has been an extra-long journey to reach this destination, and it feels like a life-time ago when I was a very young man making the announcement to my family, back in Taiwan, that I would go to the United States for graduate study. I would not be where I am today without my unfazed parents. My mother's unconditional support and unyielding confidence in me keep me going through not only this lengthy expedition but all the challenges in my life. My father's financial assistance made it possible for me to transport myself across the globe and plunge into this abyss. You could have said no. Thank you!

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> Darling, I am telling you, not asking you. Next time you think you have a brilliant idea, just put it in a memo!

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Chapter One : Introduction

This dissertation adopts a Geographic Information Systems (GIS) approach to analyze gentrification of three New York City neighborhoods with publicly available data from 1980 to the present. The three neighborhoods are: Park Slope and Williamsburg in Brooklyn, and the Lower East Side in Manhattan.

This introductory chapter serves as a map to navigate the structure of this study. The goals of this study are to: 1) explore the combination of GIS and publicly available data to establish a new research tool to map gentrification longitudinally over three decades; 2) use these gentrification maps to examine contemporary gentrification theories; and 3) to conclude with an argument regarding the advantages of using a GIS approach to visualizing and mapping gentrification.

1-1 A Missing Link of Gentrification Research

At the time of this dissertation, in the second decade of the twenty-first century, “gentrification” is no longer a new and exotic word for academics or for the public. In fact, the term “gentrification” is nearly fifty years old as Ruth Glass first coined it in 1964. For a concept of this vintage with a vast and ever growing body of literature, it is surprising that scholars continue to debate the causes and effects of gentrification.

One of the explanations for these ongoing debates is the fact that gentrification has been studied in a wide variety of research disciplines, including: geography, urban planning, sociology and

environmental psychology, to name a few. It is not surprising, therefore, to encounter such disagreements because the inherent differences among these various disciplines would lead researchers to focus on various and distinctive aspects of gentrification, and these disciplines can lead to incompatible conclusion and theories. While it is beyond the scope of this dissertation to fully reconcile inter-disciplinary disagreements, this study does focus on one fundamental aspect of gentrification through a spatial analysis of the process. This particular approach with the use of GIS graphically represents the extent and progress of gentrification to help clarify the changes in the environment. I will also address how GIS mapping works as an applied research tool and as a method of representing spatial and temporal patterns of gentrification at various scales.

Gentrification is, by Ruth Glass's definition, a class contest and struggle over a given space. In general, researchers have in general agreed on this principal idea, regardless of their various disciplinary affiliations. However, the scales of space selected for such studies range widely from a single property site to those of an entire city. This vast range makes comparisons among the results quite difficult and sometimes impossible. To further complicate this matter sometimes the study sites are not even geographically well and clearly defined. This lack of a clearly defined space for studying gentrification often leads to confusion as not all place names have well-defined boundaries. While some places are defined by their municipal administration such as a city or a county, neighborhoods, on the other hand, are often loosely defined and are subject to residents' experiences. Nevertheless, neighborhoods are often used as the spatial units for gentrification (and other community) studies, which sometimes leads to confusion when they are not clearly defined and left to residents' personal experiences.

1-2 Gentrification Re-examined through a GIS Mapping Approach

Through a literature review on contemporary gentrification research and their chosen scales of space, this dissertation will explain why neighborhoods are the suitable scale of space to study gentrification. While some researchers have based their gentrification studies and theories on neighborhoods, most treat neighborhoods as individual entities and overlook the intra-neighborhood differences. The use of maps to show the locations and geographic overages is sometimes missing. The lack of maps in many research reports leaves the locations and more importantly, the geographical coverage to the readers' personal experiences, memories and imaginations. While the latter provide deep and rich narratives of how spaces are lived and represented, they also increase the potential of conflicting interpretations.

Some researchers have included maps to depict the locations of their study sites, but these maps often fall under the categories of "figures" and served only as static displays. A handful of gentrification researchers (Hackworth, 2000; Ley, 1996; Smith and DeFilippis, 1999) have employed mapping as a limited component of their research tools. However, in general, gentrification researchers have yet to use GIS maps and mapping as integral components of their studies and publications. This is a "missing link" in gentrification research, especially because recent innovations in GIS make it a powerful tool for any study that has a "location" component.

The evolution of the field of GIS can be traced back several decades and has developed in conjunction with the advancements in computer mapping, and contributions from various

academic institutions, government agencies, and private technology industries. Unfortunately, the attitudes toward and evaluations of this once very new technology were not always favorable. For example, Smith (1992a) criticized GIS as "a return of the very worst sort of positivism, a more naïve empiricism". Ironically Smith would subsequently use GIS to analyze the spatial patterns of dis-investment and re-investment in Manhattan's Lower East Side. (Smith and DeFilippis, 1999). Additionally, the renowned geographer Mark Monmonier (1996, 2nd edition) took a more lighthearted critical tone when he wrote "*How to Lie with Maps*" and showcased how maps have been misused, intentionally or otherwise, by scholars, politicians, and mass media.

Within the environmental psychology community, studies of behavioral mapping (Ittelson, Rivlin, and Proshansky, 1976) and mental mapping (Lynch, 1980; Milgram, 1976) can be traced back to pioneering scholars but the adaptation of GIS as a research tool has been sporadic with only a handful of dissertations using GIS as one of the research tools.

This dissertation aims to address this oversight. If gentrification researchers recognize the strength of mapping gentrification using a GIS approach and then adopt mapping as one of their key research methods, not only will they better understand and demonstrate the spatial and temporal components as they relate to gentrification but also the results will be more compatible for interdisciplinary comparisons. Environmental psychologists might have a tendency to rely on qualitative research methods, but GIS should not be mislabeled as a quantitative-orientated tool. As this dissertation will demonstrate, while individual gentrification maps are based on quantitative data, overall gentrification is a complex phenomenon. It requires examination

through a series of gentrification maps to analyze the spatial and temporal patterns of gentrification. This approach should, in turn, contribute to the broader understanding of gentrification.

1-3 A Map of the Dissertation

To demonstrate these advantages of applying a GIS approach to the study of gentrification, this dissertation begins with a review some gentrification studies that inspire the research design and the development of GIS. The dissertation then proceeds with the GIS mapping of the gentrification of three New York City neighborhoods and then conclude with a discussion chapter. Below are the chapters of this dissertation with brief explanations of their contents:

Chapter One: Introduction: A Map of the Dissertation

Chapter Two: Literature Review: Gentrification Research and Theoretical Debate since 1980

Chapter Three: Literature Review: GIS and its use in Social Sciences

Chapter Four: Research Design and Methods

Chapter Five: Park Slope

Chapter Six: Lower East Side

Chapter Seven: Williamsburg

Chapter Eight: Conclusion and Discussion

The Literature Review is divided into two chapters. Chapter Two focuses on gentrification research, studies, and theoretical debates since 1980 while Chapter Three focuses on GIS and its application in Social Sciences.

The focus of Chapter Two is on various gentrification studies published since 1980, it begins with an examination and deconstruction of the now classical definition by Ruth Glass in 1964. The discussion then follows the time frames established by the three-wave gentrification theory of Hackworth and Smith (2001) that divides New York City gentrification into "three waves." This dissertation focuses on the third wave. David Ley's (1996) arguments on the role the new middle class plays in the remaking of the central city will also be addressed.

After establishing the specific time frame for my study, the discussion will look at two opposing sides of gentrification scholarship: those who focus on the "production" of gentrification and those who focus on the "consumption" of gentrification. The more recent and expanded views of gentrification such as "new-built" gentrification (Davidson and Lees, 2005) and "super-gentrification" (Lees, 2003) will also be discussed. The debate on the overall effect of gentrification, namely displacement (Slater, 2010) or replacement (Hamnett, 2009) will also be reviewed.

While examining the various aspects of gentrification theoretical debates, special attention is directed to whether their research methodologies include maps, and if so whether the maps as tools and results effectively support the proposed theories and arguments. Lessons learned from this review will serve as reference for the development of the research methods incorporated to this dissertation.

Chapter Three is a second part of the literature review and discusses the development of GIS used by social studies researchers who focus on urban issues. The review examines how some of

the concepts in paper maps became the principles of GIS design. Other developments that led to the full materialization of GIS such as the Census Bureau's contributions to devise digital street networks and compiling survey data are also addressed. Raster imagery acquisition and interpretation are not employed by this dissertation and are far beyond its scope although they are crucial components of GIS data and methodology. Therefore, both of these topics will only be briefly discussed. Lastly, an examination of some existing gentrification maps will be used as examples to discuss various strengths and weakness as research design and methodology.

Chapter Four details the research design and methods that are employed to answer the research questions: What are the advantages of mapping gentrification with GIS, and what additional insights do the gentrification maps in this study provide? This chapter explains why specific New York City neighborhoods were selected as the study units and how these units are defined. The particular geographical coverage for the study neighborhood, however, will be explained in detail in each chapter dealing with the individual neighborhoods.

Once the neighborhoods are defined, the dissertation focuses on the two series of maps that are used to examine the gentrification factors observed in each of the three neighborhoods: the physical environments and the social environments. Although the research design is predominantly descriptive, what separates this dissertation from existing gentrification research is that the descriptions are based primarily on gentrification maps and GIS as visual tools. These gentrification maps are supplemented with charts and brief descriptions to facilitate the analysis of these maps. In other words, this study augments the body of work on gentrification because it

relies mainly on the applications of GIS maps as opposed to the majority of existing research that simply include maps supplements.

The two series of maps are based on publicly available data sets based for land use patterns and social economic status. The main reasons for this decision are cost and to facilitate comparative studies. Although private-sourced data sets may offer unique insights into gentrification within a particular neighborhood, such data-sets risk being uniquely narrow and can lead to a case-study that is only available, valid, and applicable to a particular location at a specific time. In contrast, this dissertation groups three case studies, and one goal is to explore whether publicly available data-sets can produce reliable and valid gentrification maps. If this goal is proved, then this research design can be readily applicable to other American cities and possibly other countries that possess similar census and land-use surveys.

The first series of maps reflecting land use patterns are based on the 2011 version of MapPLUTO (Primary Land Use Tax Lot Output) released by the New York City Department of City Planning (DCP). This data-set, renewed and released annually, records various attributes of each and every tax lot in New York City. Several variables from MapPLUTO are extracted and mapped including: 1) primary zoning; 2) building age; and, 3) building height. In addition, historical zoning maps, available on-line at the DCP website, are downloaded and included for comparisons.

The second series of maps reflecting socio-economic status are based on: 1) selected variables from the United State Census Surveys from 1980 to 2010; and, 2) supplements from the 2005-

2009 ACS (American Community Survey). The following variables are extracted or calculated from the Census Surveys: 1) the demographic maps with total populations; and, 2) the percentages of selected ethnic and age groups (within the total population); 3) housing maps that record the total housing units as well as the percentage of vacant and the rental units; 4) socio-economic status maps that include median household income, median gross rent, and educational attainments. Details of these gentrification maps are thoroughly explained in the methodology and design chapter. In brief, for each of the maps based on Census Surveys the values are either extracted or calculated from the four consecutive Census Surveys from 1980 through 2010. For each Census Tract a bar chart based on the data from the four Census Surveys is created and embedded into the gentrification maps to examine the spatial and temporal patterns.

By examining these embedded bar charts cross-sectionally (i.e. at a particular time of a specific Census year) and longitudinally (i.e. between Census Surveys), these gentrification maps provide a better spatial understanding of the degree and extent of gentrification experienced within these neighborhoods.

Chapters Five, Six and Seven each focuses on a single neighborhood: Park Slope, the Lower East Side, and Williamsburg. Each chapter begins with a clearly defined map illustrating the location and parameters of the study neighborhood. A brief local history is also provided leading to the starting decade of this study, i.e. 1980. The gentrification maps described in the methodology and design chapter are the primary focus of these three chapters and allow us to examine the gentrification of each neighborhood, using a GIS approach.

Chapter Eight: Conclusion and Discussion is divided into two sections. The first section summarizes the findings from the gentrification maps and provides a comparison analysis of these maps. For example, what are the similarities and differences in the gentrification of these three neighborhoods? The second section seeks to determine whether these gentrification maps provide additional insight into the gentrification experienced by these three neighborhoods and whether this information may in fact have been overlooked by gentrification studies that did not use GIS mapping as an integral research tool. Which gentrification maps in this study are more effectively depicting the gentrification and might serve as reference for further studies. Although this study does not intend to be a review of map design and GIS software, problems and issues encounters during the production of these maps will also be addressed.

Chapter Two : Literature Review - Gentrification Research and Theoretical Debate

Almost half a century after the term "gentrification" was coined by Ruth Glass (1964) the research and debates continue with respect to its causes and effects (Lees, Slater and Wyly, 2007; 2010). This literature review focuses on gentrification research and theoretical debates since 1980. There are two main reasons for this focus. The first consideration is primarily theoretical because this dissertation adopts the "Three Wave Gentrification Theory" of Hackworth and Smith (2001) and focuses on the most recent "wave" of gentrification which began in the 1990s. By starting the study in 1980 this dissertation will establish a base-line that examines the effects of the third wave of gentrification with subsequent Census surveys. Also, by focusing on the most recent research and debates, the issues they raise and subsequent discussions are more relevant to both the current state and future developments of gentrification.

The second reason for this focus is based on methodological considerations. For example, publicly available data sets that map gentrification at the U.S. Census Tract level are more readily available beginning with the 1980 Census (InfoShare, 2000). This study's gentrification maps use the same variables extracted from four consecutive Census surveys from 1980 through 2010 and examine the temporal changes of selected demographic, socio-economic and housing characteristics. These gentrification maps are explained in greater detail in Chapter Four that describes my research design and methods.

This chapter starts with deconstructing the classical definition of gentrification by Ruth Glass (1964). It then uses the time frames set by Hackworth and Smith's "Three Wave Gentrification Theory" (2001) and discusses the opposing sides of research which emphasizes either the production (Smith, 1996) or consumption (Ley, 1996) of gentrification space and the factors that lead to gentrification. More recent developments in gentrification research such as "super-gentrification" (Lees, 2003) and debates on "displacement" (Freeman and Braconi, 2004; Newman and Wyly, 2006) are also reviewed in this chapter.

In reviewing gentrification research special attention is given to examining if, and when how maps and mapping are used. Lessons learned from this literature review are used to develop the research methods for this dissertation.

2-1 The Classical Definition of Gentrification

In the Introduction *London: Aspects of Change*, Ruth Glass (1964) coined the term "gentrification" to describe a phenomenon she observed as follows:

> One by one, many of the working class quarters of London have been invaded by the middle classes – upper and lower. Shabby, modest mews and cottages – two rooms up and two down – have been taken over, when their lease have expired, and have become elegant, expensive residents. Larger Victorians houses, downgraded in an earlier or recent period- which were used as lodging houses or were otherwise in multiple occupation – have been upgraded once again.

With this short paragraph, Glass outlined several conditions and requirements for gentrification:

1. It is not a singular but multiple occurrences.
2. It is an urban phenomenon.
3. It is a process that involves class transition from working class to various level or middle classes. This clause leads to the use of social status indicators such as income and education in this study to approximate gentrification.
4. The physical structures involved have experienced dis-investment and then re-investment.

While these circumstances focus on the process of gentrification, Glass also noted the effects as she continues:

> Nowadays many of these houses are being sub-divided into costly flats of houselets (in terms of the new real estate Jargon). The current social status and value of such dwellings are frequently in inverse relations their size, and in any case enormously inflated by comparison with previous levels in their neighbourhoods. Once this 'gentrification' starts in a district, it goes on rapidly until all or most of the original working class occupiers are displaced, and the whole social character of the district is changed (pp. xviii to xix).

While the first half of this excerpt deals with the process as outlined in item number 3 above, in the second half, Glass further charts a few more elements of gentrification:

5. The process is directional from working class to middle class.

6. Although not explained explicitly, Glass concluded that the phenomenon advanced quickly.

7. More importantly and often overlooked by later studies is that Glass has pointed out the effect of gentrification: the displacement of the original residents and the consequent transformation of a neighborhood.

In the following sections, I will review the studies and the debates between the production and the consumption sides of gentrification, as well as the debates between whether gentrification leads to displacement or succession. However, prior to examining these opposing sides of gentrification theories, I will review of the Three Wave Gentrification Theory of Hackworth and Smith (2001) as it sets the temporal focus of this dissertation.

2-2 The Three Wave Gentrification Theory

Using three New York City neighborhoods, namely, Clinton in Manhattan, DUMBO (Down Under Manhattan Bridge Overpass) in Brooklyn, and Hunters Point in Queens, as examples and focusing on the changing role the government plays in urban environment development, Hackworth and Smith (2001) examined pre-2000 data and theorized the evolution of gentrification into three waves; the first wave dated prior to the economic recession of 1973. This first wave was sporadic, localized and funded by the public sector as a means to counter dis-investment in inner city areas. Jackson (1987) documented the country's suburbanization in the post W.W.II years, the general migration trends were towards suburbs and a movement away

from the inner cities. The gentrification of urban neighborhoods was therefore often considered as an alternative to suburban migration. Researchers speculated that these new urban gentrifiers might be those individuals and families who came to inner cities to study or work and chose to settle down, or minorities who moved to the suburbs initially but then decided to return to inner cities.

The second wave of gentrification began in the late 1970s, is exemplified in New York City with the loft conversions in SoHo (Zukin, 1982, 1987) and the Lower East Side (Smith and DeFilippis, 1999) and was characterized by the integration of economic and cultural factors. After the first wave, gentrification became a viable housing option especially for those who would spend sweat equity to refurbish properties that had fallen into despair or to convert spaces not originally designed for residential use. Generally, gentrifiers of this second wave were more involved in the transformation of the buildings as one of the many reasons for their decision of where to reside. By selecting less mainstream locations and investing their own labor into those properties, these individuals fulfilled their housing needs more economically and with less capital. However, sometimes these "DIY" ("Do-It-Yourself") gentrifiers confronted the unexpected effects of gentrification. While these individuals selected a particular neighborhood for its less desirable location and poorer housing conditions, by improving the neighborhood through sweat equity the same neighborhood could become more attractive to more affluent people who might become competitors in the local housing market. While property owners have the option to sell and cash out their investment when the value of properties in a particular neighborhoods appreciates, renters could face rapidly rising rent and/or be displaced or resort to doubling up to remain in the same neighborhood that they helped resurrect. In New York City

where a considerable proportion of residents are renters, this negative economic effect of gentrification is especially and deeply evident.

The third wave of gentrification began in the early 1990s. This is a new phase of gentrification where economic factors overshadow cultural aspects. Hackworth and Smith (2001) argued that in New York City the third wave of gentrification is especially distinct from previous two waves in the following focuses: first, as earlier gentrification had spread through the central part of the city, namely the Borough of Manhattan, this latest wave of gentrification expanded beyond Manhattan into the other Boroughs. This new wave of financial investment and gentrification is now exhibited in neighborhoods previously considered not gentrifiable such as those located outside Manhattan. Second, as gentrification is no longer a new concept and practice, individual gentrifiers are often replaced by real estate developers and investment speculators who initiate the process of gentrification at a much larger scale. Third, as larger scale gentrification takes place, effective resistance to gentrification from local residents becomes difficult. Real estate developers not only have substantial resources to defeat competition from individual property buyers, developers often work together with local government officials and form corporate-government partnerships to carry out their projects.

In contrast to the first wave of gentrification when government-assisted gentrification was regarded as a counter-measure to the continuation of inner city decay and whose objective was to help those individuals willing to stabilize inner city neighborhoods, the private sector-led corporate-government partnership of the third wave of gentrification is an active tactic for the latest trend in urban policy. Smith (2002) noticed the dropping of “gentrification” and replacing

it with other terminologies with a positive spin such as “urban renaissance” at the 1999 U.K. Department of Environment, Transportation and the Regions decree as a sign of legitimizing gentrification. Gentrification has overcome its former urban abnormality status and instead has become an urban administration strategy.

Hackworth and Smith argued that there are several explanations for this new, active government involvement. First is the declining federal financial assistance that presses local governments to be self-sufficient. Local governments and municipalities now have to devise strategies and implement policies to maximize profits from their land-holdings. Gentrification not only can restore but also increases property values. Gentrification also attracts and accommodates more affluent residents. Both of these factors can translate into higher government revenue (via taxation) for local governments to operate.

Second, individuals with less capital might not be able to manage the economic risk of investing in a property that is not adjacent to a well established area. Corporate-government partnerships, on the other hand, have both the financial means and governmental support to venture into less desirable neighborhoods. It is likely that individual gentrifiers could not compete with these larger actors. Rather they become consumers of the wholesale gentrification that is led by these corporate-government partnerships. The emergence of these power alliances in the creation of gentrification properties on a larger scale is often at the expense of existing residents and small business owners who face either dramatically rising rents or eviction through eminent domain.

Third, Hackworth and Smith considered the larger economic-political mode in recent years. They argued that the shift toward post-Keynesian governance makes protection for the working class more easily challenged (Hackworth and Smith, 2001, p. 464). But the U.K. government is not alone in its reticence to use a potentially charged word such as gentrification and opts instead to use the term urban renaissance. A U.S. government publication has also accepted gentrification as a possible method to not only overturn inner-city dis-investment, but also as a new way of achieving urban development (Lees, 2000; U.S. Department of Housing and Urban Development, 1999; Wyly & Hammel, 1999). On a more local level, in a report issued by the New York City Department of City Planning (1985) that studied the state of Park Slope and the Upper West Side it was simply titled "Private Reinvestment & Neighborhood Change". Throughout the entire 129-page document the word "gentrification" was not used at all. This omission is especially telling of how the City regards what had been happening in these two neighborhoods. The class-evoking term "gentrification" was avoided altogether. As world cities like New York and London shift their job markets from labor/manufacturing to service industries, it is apparent that their respective focus and vocabulary of the housing policies also shift accordingly.

Leaving the public policy debate for now and focusing on the academic front, Hackworth and Smith are not the first researchers to propose a business-oriented urban environment management and to situate gentrification in a broader urban economic consideration. A decade before their Three Wave Gentrification Theory, Harvey (1989) argued that in the period of late capitalism, urban governance would shift from "Managerialism to Entrepreneurialism" to attract fluid international capital into competing metropolises. The goal of these entrepreneur local

governments was to create an environment that would draw investment from large corporations. While this leads to numerous implications for both local commercial business and residential construction, Hackworth and Smith are the first researchers to explicitly link gentrification to the idea of corporate-government partnership.

Although beyond the scope of this study, local commercial business expansion goes hand-in-hand with a transformation in residential development in a neighborhood. Fitch (1993) and Mollenkopf (1983) focus on the commercial property construction in New York City and the economic polarization of the modern metropolis. The local government's focus to attract business often leads to speculative office construction to house corporations which do not always easily find prospective tenants. Some construction even halted midway due to the lack of prospective tenants (Wall Street Journal, July 25, 2012). Nevertheless, cities continue to employ large-scale urban development projects that often compete for the limited available space for housing. In turn, the slow growth of available housing units fails to meet an increasing population; this imbalance impacts the real estate markets.

Canadian geographer David Ley contrasts this economy-centered argument and considers the urban restructuring by a newly emerged middle class, remaking the central city (Ley, 1986, 1996). The next section will review the opposing sides of gentrification theories and their respective explanations.

2-3 Gentrification Theories: Production vs. Consumption

A more common literature review of gentrification theories is based on the production vs. consumption dichotomy of the leading cause of gentrification (Lees, Slater, & Wyly, 2007, 2010). Lees, Slater and Wyly purposely use the word "sides" in referring to these two opposing arguments as they believe the combative nature of the debate sometimes distracts the attention that should be focused on the research and not the debate itself. Other researchers have attempted to adopt a combined perspective, and argue both sides should be considered together to complement and not act as exclusive to each other in the study of gentrification (Lees, 1994a, 1994b).

These opposing theoretical sides explain gentrification from either the production of gentrifiable properties, as opposed to the consumption by the people who occupy gentrified spaces. The "production" gentrification theory, of which Neil Smith is considered the leading proponent, states that the production of gentrifiable properties is the requirement for gentrification and should be the focus for gentrification research. Among his many publications, Smith's perspective is explicitly summarized in an early, though seminal journal article titled "*Toward a Theory of Gentrification: A Back to the City Movement by Capital not People*" (Smith, 1979). In this article Smith lays out the "Rent Gap" concept which serves as the backbone of his subsequent gentrification studies as well other researchers who adhere to his theory.

In the production gentrification theory, the people who consume these properties are simply

pursuing or following the flow of capital in the built environment and as such, they are the consequences and not the cause of gentrification (Smith, 1979, 1986, 1992b). This argument has its roots in the Chicago School's concentric circle urban development theory (Burgess, 1925) which states that as cities expand, those who can afford to choose where to live opt for more luxurious and spacious single houses and move away from crowded inner cities. This process led to the rapid growth of suburbs in post World War II years as Jackson (1985) documents in *Crabgrass Frontier: The Suburbanization of the United States*. Left behind from this exodus were inner-cities with older, smaller and often devalued housing stock that were occupied by those yet to make the leap to the suburbs. In the most severe cases, properties were dis-invested to the point where owners abandoned their properties as the rental income could not match the property maintenance and income taxes (Marcuse, 1986).

In his Rent Gap theory (or the late revised Value Gap theory) Neil Smith argues that when the difference between the current property value in inner cities has fallen below its potential, a gap is created. In the rental housing market this is the Rent Gap: the difference between the rent which property owners could have charged and the real rent they actually receive from current tenants; in extreme cases the properties remain unoccupied. The Value Gap argument expands this reasoning to go beyond the rental market and includes the potential sale of these properties.

At the other "side" of gentrification research is the "consumption" gentrification theory, led by Canadian geographer David Ley. In contrast to Smith's focus on the capital flow in urban settings, Ley argues that gentrification is driven by "middle class resettlement in the inner city" (Ley, 1986. p521). Ley summarizes four explanations for gentrification:

1. Demographic Changes due to the post World War II baby boom: The surge in the population created a higher demand for housing units and drove people into a previously unfamiliar market, namely, the inner cities. The reduction in household size and the change of household types (as people married later in their lives and a rising divorce rate) also contributed to the higher demand for housing units. An expansion of urban areas employment opportunities led to a preference to reside closer to their jobs.

2. Housing Market Dynamics: rising housing costs throughout the suburbs in the 1970s led people to look for alternatives. Ley, however, cautions researchers about this thesis because like the aforementioned demographic change proposal, this factor over-emphasizes the role of the first-time and/or younger population who is seeking housing. Ley also warns that this particular viewpoint treats inner-city revitalization as "temporary or at best cyclical" (p. 523). In other words, once they have saved up enough capital, they would move away and leave the urban properties to the next wave of first-time home buyers. Also under this category, Ley criticizes Smith's rent gap proposal, which he considers over-identifying the supply (gentrifiable properties) rather than the demand (people seeking housing). Ley argues if economic consideration was the leading/driving force for gentrification, then we should observe gentrification clusters at locations that experience huge dis-investment. Instead, gentrification happens in transitioning neighborhoods which are close to well-established locations or have other urban amenities that make them susceptible to gentrification. Ley does recognize that his reason is based on the study of Canadian cities and might not be completely comparable to U.S. metropolitan areas. Nevertheless, the fact that there are high-priced new condominiums

in inner-cities in Canada indicates that affordability is not the only contributing factor for certain groups of individuals who wish to live in an urban environment.

3. The Value of Urban Amenity: Ley focuses on "the culture of consumption" as he identifies a set of values with an urban life-style, such as the smaller household and DINKS (i.e. Dual Income, No Kids) that have disposable income and are more likely to be gentrifiers. The urban amenities not found in the suburbs range widely and Ley cites early gentrification studies that identify artists (Jackson, 1985), gay communities (Castells, 1983) and other "countercultural life-styles" (p.524) that are more likely to be urban gentrifiers. Also, consumption can aim at the physical environment itself because older inner-city housing stocks provide an aesthetically distinctive and appealing landscape compared to that of the suburbs. This thesis can also be found in some studies that link gentrification to urban historical preservation and the pursuit of "authenticity" especially linking gentrification to brownstone restoration in Brooklyn and elsewhere (Osman, 2012). Ley also recognizes that "the creation of a high-amenity central city landscape has been vigorously promoted by many city administrations through the 1970s" (p. 524). Although he also cautions that such initiatives, though necessary, are not sufficient to attract gentrifiers.

4. The Economy Base: Ley discussed a post-industrial metropolitan economy reflecting a job market shifting from blue-collar to white-collar employment opportunities in urban areas. This accounts for the growing number of jobs and their concentrations in urban areas, as well as the job market shift that leads to a new middle class and a "downtown

workforce" (p. 525). All of these factors can lead to a pool of prospective gentrifiers who wish to reside near their employment.

The debate on the cause(s) of gentrification is ongoing. In more recent years both Daivd Ley and Neil Smith have shifted their research to focus on larger social issues such as immigration and globalization respectively (Ley, 2010; Smith, 2002, 2005). Their earlier journal articles and books (both published in 1996) remain influential and are the foundations for gentrification research today.

2-4 Mapping for Gentrification Studies and Environmental Psychology

For a subject matter that is inherently spatial, it is a wonder that not all gentrification studies use maps. For those researchers that do use maps, there are two types of usages: some researchers use maps only as static displays to indicate the locations and study areas, and other researchers incorporate specific measurements into the maps to illustrate various conditions of the study area. The existing examples of incorporating maps, mapping and GIS in gentrification research, generally follow the theoretical debate of the causes of gentrification. The "production" gentrification side focuses on the capital investment into the physical environment, whereas the "consumption" gentrification side focuses on the people.

For example, in their study of gentrification in Harlem, Schaffer and Smith (1986) include the maps in Figure 2-1 below. The map on the left illustrates the Borough of Manhattan with the area

known as Central Harlem highlighted. The map on the right illustrates areas with an above-average increase in per capita income (1970-1980). This map does not differentiate the various degrees of how much above-average the per capita income is in this area, and does not describe the conditions of the non-highlighted area; specifically, do they still have increasing per capita income but it is below-average, or perhaps they have the same or decreasing per capital income.

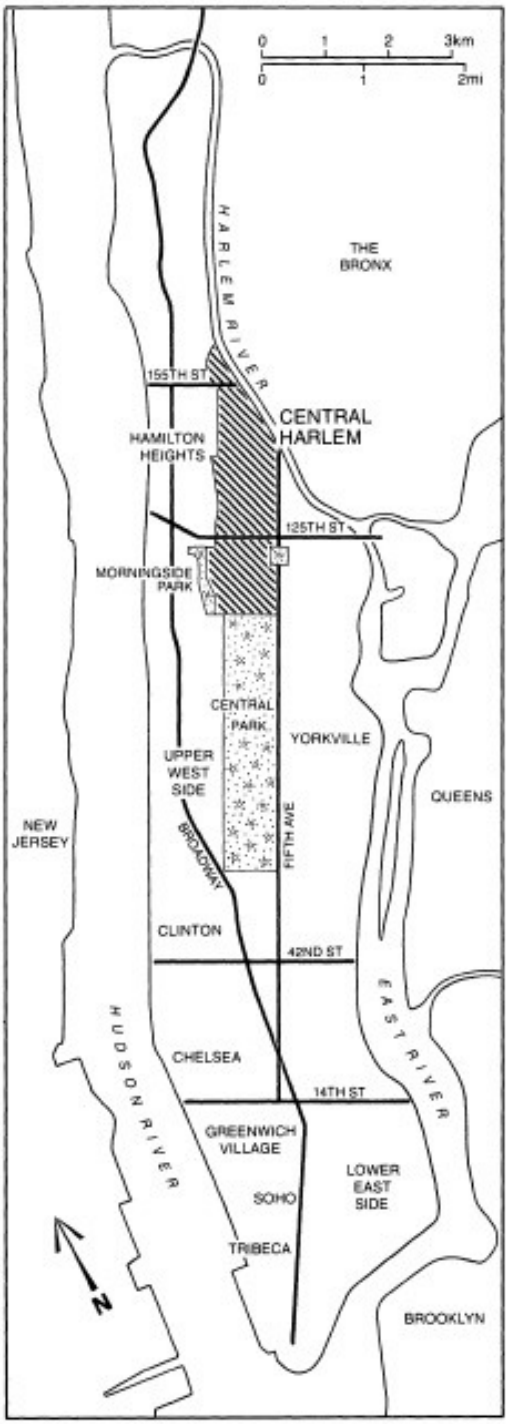


Figure 1. Manhattan and Central Harlem.

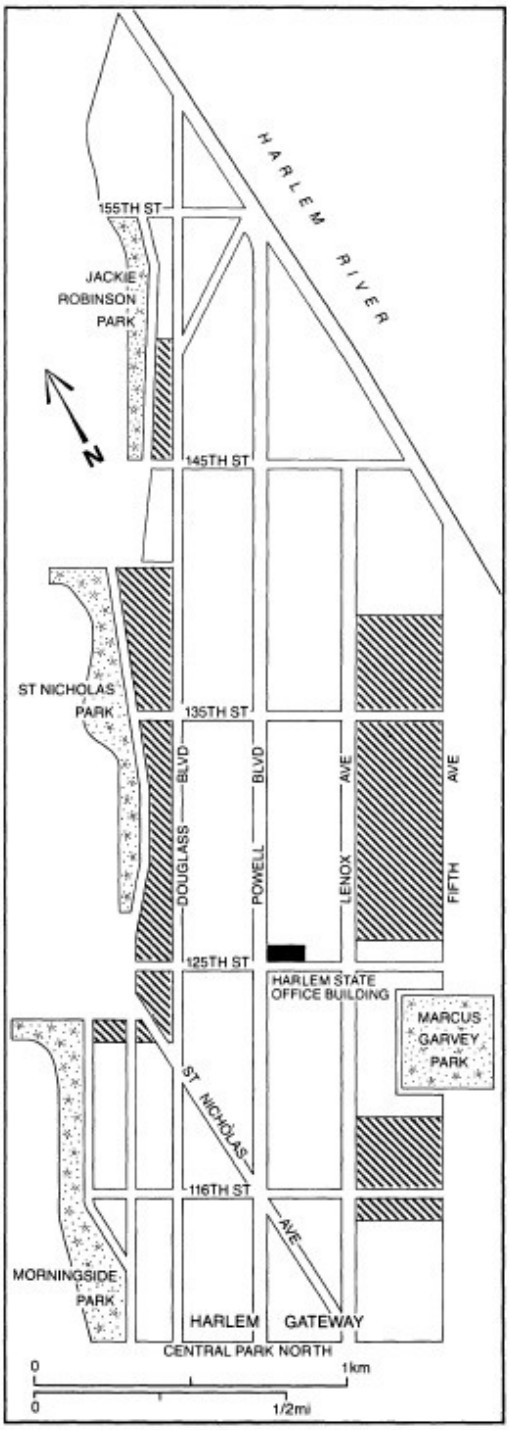


Figure 2. Above-average increase in per capita income, 1970–80.

Figure 2-1. Maps extracted from Schaffer and Smith (1986) The Gentrification of Harlem? Page 351 and page 354: location of Central Harlem and above-average increase in per capital income.

Figure 2-1. Maps extracted from Schaffer and Smith (1986) The Gentrification of Harlem? Page 351 and page 354: location of Central Harlem and above-average increase in per capital income.

The maps and mapping technique that follow the fundamental argument of the production side of gentrification theory are illustrated by Smith and DeFilippis (1999) when they mapped the dis-investment and re-investment of the Lower East Side from the mid-1970s to the mid-1980s (Smith, 1991, 1996; Smith and DeFilippis 1999). Using New York City's property assessment records, these researchers mapped both the advancement of tax arrears (dis-investment) and the pay-back (re-investment) on these tax arrears. With these maps, Smith and DeFilippis were able to provide a spatially-precise argument that gentrification was advancing approximately east-bound in the Lower East Side. These maps possess the spatial and temporal precision not found in other gentrification maps because they are based on actual annual records for each and every property.

It is important to note that while these maps are theoretically useful in explaining the Value Gap theory and are also methodologically innovative, this particular mapping technique has not been replicated elsewhere for the following reasons:

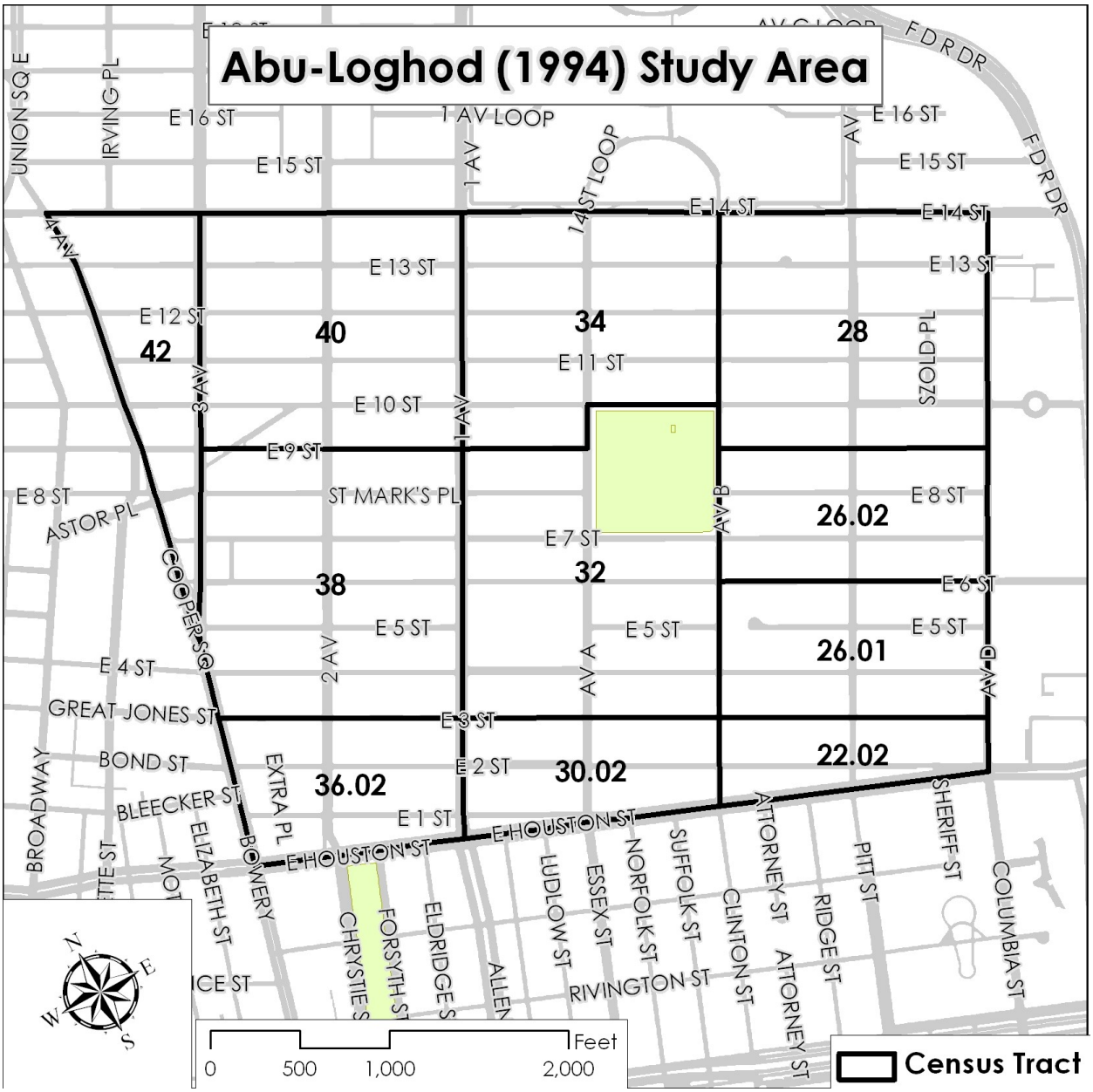
1. This data-set is unique to New York City and there is nothing comparable and available in other American cities. Not all municipalities respond to property owners with tax arrears in the same way. While New York City in circumstances may allow flexibility in receiving late property tax payments, hence providing a built-in buffer for some property owners and allow extra time for them to either submit payments or ultimately to forgo

ownership of their properties, other cities may have different regulations for property tax arrears.

2. A second and more theory-centered consideration, is the fact that this mapping design is only applicable when dis-investment is a factor in the process of gentrification. In other words, this particular mapping design can mainly capture the early stages of gentrification. However, as stated in the Super-gentrification theory (Lees, 2003) which will be reviewed later, not all gentrification is based on devalued properties. In fact, some neighborhoods may have not experienced dis-investment, but instead receive further capital investment (hence the term super-gentrification). In this scenario this particular mapping design would not successfully capture gentrification.

For the consumption side gentrification researchers, Census data-sets have been widely used to illustrate the rising socio-economic status which is linked to gentrification (Ley, 1992, 1996). Variables such as median household income, median gross rent, and college degrees among adult educational attainment have been used to illustrate gentrification. However, Census data-sets, although easy to obtain and comparable through time and space, are not completely perfect. The ten-year interval between Census Surveys can miss rapidly changing neighborhood conditions and housing market fluctuations. Nevertheless, the continuity and wide availability of Census data-sets sustain its usefulness for gentrification research and help document long-term trends either by applying traditional numeric statistical analysis or GIS for spatial analysis. For this reason, this study's design relies heavily on Census data-sets, but also supplements its data using analyses of the physical environments based on New York City's own tax lot data.

Despite its usefulness and standardization, not all researchers use Census data-sets the same way. For example, some aggregate several Census Tracts to form a single neighborhood as a study site (Hackworth, 2000; Lees, 2003). Other researchers retain the distinctive measurements from individual Census Tracts such the as the study of the Lower East Side by Abu-Lughod (1994). While the aggregated Census Tracts design yields summarizing figures for inter-neighborhood comparisons, by retaining individual Census Tract intact and then making comparisons among them, can provide a better understanding of the intra-neighborhood differences. Although Abu-Lughod does not use GIS, her research design does provide an in-depth understanding of the spatial patterns of gentrification of the Lower East Side by clearly defining her study area using Census Tracts. Map 2-1 below replicates her selection of Census Tracts to form her study site with GIS (Abu-Lughod, 1994, P. 31).



Map 2-1. Census Tracts in Abu-Loghod's Study Area (1994).

The slightly counter-clockwise rotation of Manhattan makes the avenues and streets look as if they form a grid that points at True North. The inserted compass at the lower left corner of the map indicates the degrees of rotation. Following this slight alteration, Abu-Lughod separates the Census Tracts into three strata:

1. The Western stratum which includes the Census Tracts west of First Avenue (Census Tracts 36.02, 38, 40 and 42);
2. The Middle stratum which includes Census Tracts between First Avenue and Avenue B (Census Tracts 30.02, 32 and 34);
3. The Eastern stratum includes the Census Tracts west of Avenue B (Census Tracts 22.02, 26.01, 26.02 and 28).

Abu-Lughod then presents specific socio-economic and demographic data from the 1980 and 1990 Census Surveys in table format that coincide with the spatial arrangements of these three strata. She also lists them individually at the Census Tract level to illustrate the differences within each individual stratum. With this presentation she discusses the different degrees of change at the stratum-level (which represents a third of her study area) and at all twelve Census Tract levels.

The design of this study is based on Abu-Lughod's approach and takes this approach a step further. Using GIS, variables that indicate gentrification from four Census Surveys (1980 through 2010) for each Census Tract are converted into bar charts and embedded directly into the gentrification maps. Due to the multiple Census Tracts incorporated into a single map, these embedded bar charts are proportionally compressed. These gentrification maps are accompanied by separate bar charts to clearly differentiate the differences represented by the four Census Survey years. The design of these gentrification maps will be explained in more details in Chapter Four - Research Design and Methods.

Distinctive from the dichotomous and confrontational “Production vs. Consumption” sides of gentrification theories, two prior Environmental Psychology dissertations (Justa, 1984; O’Hanlon 1982) adopted a more comprehensive approach to study Park Slope in Brooklyn, which is also a neighborhood in my study. Although Justa and O’Hanlon used Park Slope as a case study, they also studied the neighborhood in the larger context of New York City.

O’Hanlon (1982) reviewed historical changes of New York City since 1786. He documented the establishment and development of Park Slope since 1850 when the area was first used as farm land and in the following decades being developed for industrial and residential purposes. He especially focused on the real estate market of Park Slope since 1965 and used archival research and interviews to provide an in-depth account of the deterioration, abandonment and also seemingly contradictory conversions of old buildings for upper income families in the high rent areas within Park Slope.

Justa (1984) adopted a longitudinal approach and studied twenty community organizations in Park Slope for eight years. She examined the differences among these organizations and how they represented residents of different class in the changing neighborhood. While some community organizations attempted to attract investment and resettlement of new residents to the neighborhood, others focused on protecting the rights of minority and lower-income residents from being displaced.

Although Justa and O’Hanlon did not use GIS as their research method, they both included maps and manual mapping in their dissertations. Justa used paper maps and manually drew the

boundaries of Park Slope. She divided the neighborhood into four parts and aggregated the Census Tracts within each part to tabulate their housing and demographic trends from 1950 to 1970 (Justa, 1984, pp. 117-121). O'Hanlon did not aggregated Census Tracts and listed the numbers of apartments and median contract rent into each Census Tract on a map (O'Hanlon, 1982, p. 155). A replication of this particular mapping design but with total population data is included in the Park Slope chapter of this dissertation (Map 5-31).

Not all gentrification studies examine intra-neighborhood differences. In the next section I will review Loretta Lees' "Super-gentrification" study based on Brooklyn Heights. This review articulates two considerations: on the theoretical front, "Super-gentrification" challenges the classic production side of gentrification theory and argues a neighborhood can be further gentrified after experiencing initial gentrification; and on the research method side it discusses how maps are used in this Brooklyn Heights case study and how this in turn has influenced my research design.

2-5 "Super-gentrification" of Brooklyn Heights

Using a mixed research methodology of personal interviews and a statistical analysis of Census data-sets (1970 to 2000) Lees studied the Brooklyn Heights neighborhood and proposed a new concept that she named "Super-gentrification". She defined "Super-gentrification" as "the transformation of already gentrified, prosperous and solidly upper-middle-class neighborhoods into much more exclusive and expensive enclaves" (Lees, 2003, p. 2487). While this study can be reviewed as a case study of a specific neighborhood, within a larger context this study propels

gentrification researchers to reevaluate both production and consumption sides of established gentrification theories. Challenging the production side, Super-gentrification defies the Rent Gap (or Value Gap) concept, because gentrification seems to keep progressing even after a neighborhood has already been gentrified. Challenging the consumption side Super-gentrification also defies the idea that the middle-class remake inner cities, because an even more affluent group of people are involved in further gentrifying the same neighborhood.

As stated previously, Lees used mixed a research methodology that provided an in-depth account of the rapid ownership transfer of a single property due to the accelerating gentrification from the middle-class to the affluent. She also analyzed data from the four consecutive Census Surveys to provide a more comprehensive neighborhood profile. In one of the interviews, Lees recorded an account of an early gentrifier who came to Brooklyn Heights in 1962:

> At the time we had very limited resources so we had to find something that was reasonably inexpensive and at the time we felt we had to buy something north of Joralemon Street because of the nature of below Joralemon Street which was very heavily rental units to Hispanics, mostly Puerto Rican rooming houses. But because price was a big factor for us we ended up buying south of Joralemon Street anyway, and the property was quite small (interview with D, August 2002). (Lees, 2003, p. 2488).

Lees did not further pursue intra-neighborhood differences (as Abu-Lughod did in her research) but instead aggregated four Census Tracts to form her study site. She included some maps in her study like earlier gentrification researchers. Figure 2-2 below shows the extracted map (Lees,

2003, p. 2493). Similar to Schaffer and Smith (1986), this map shows the general location of Brooklyn Heights and its location in relation to City Hall and Wall Street across the river in Manhattan. In contrast to Schaffer and Smith who used shading in their map to indicate their study site, Lees's map does not provide this information and does not include the names of nearby neighborhoods so that readers who are unfamiliar with the area can better gauge the size of Brooklyn Heights. Two pages after this map in Lees's publication she provided a detailed map that illustrates the Brooklyn Heights Historic District with street boundaries (reproduced below in Figure 2-3).

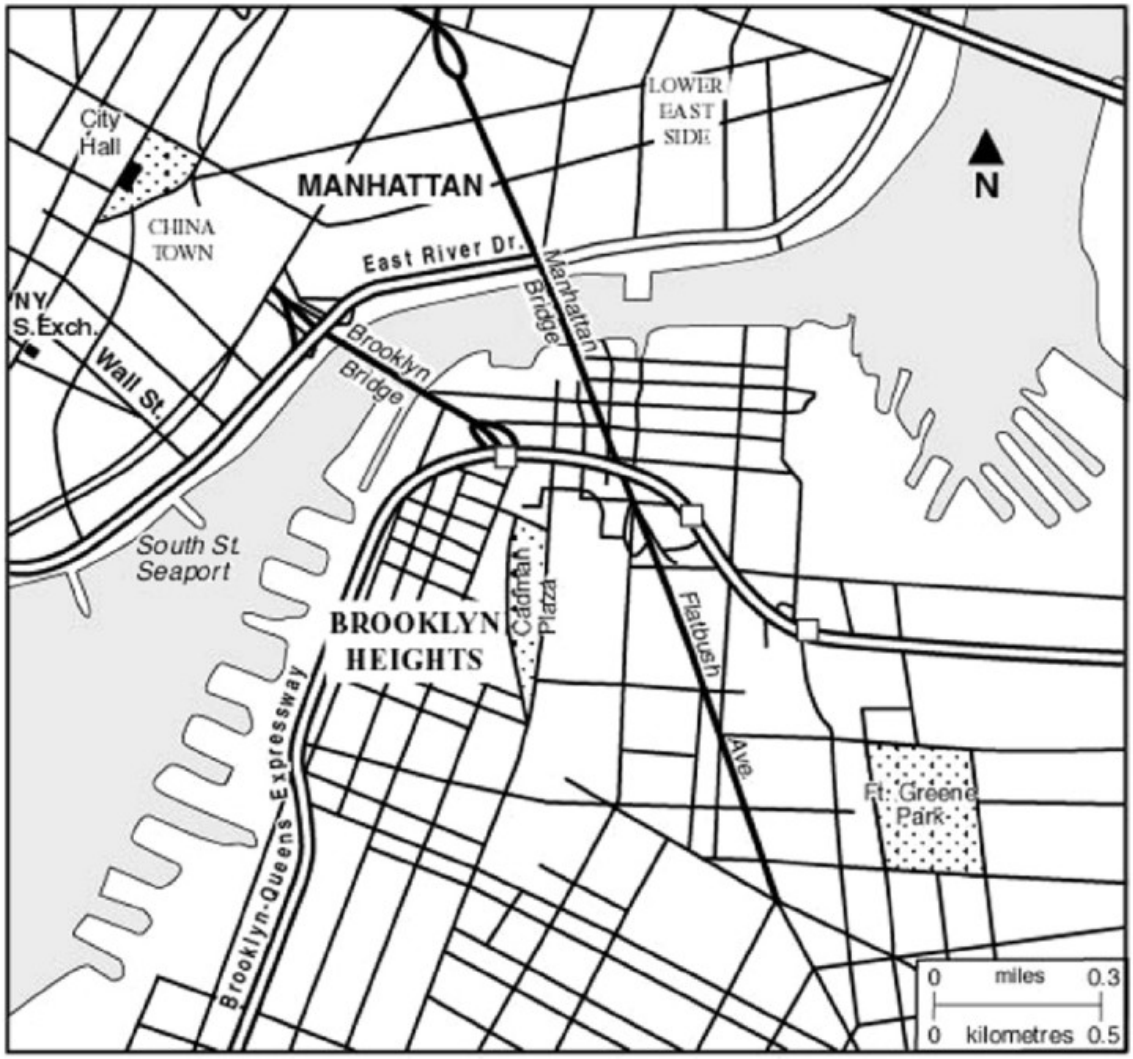


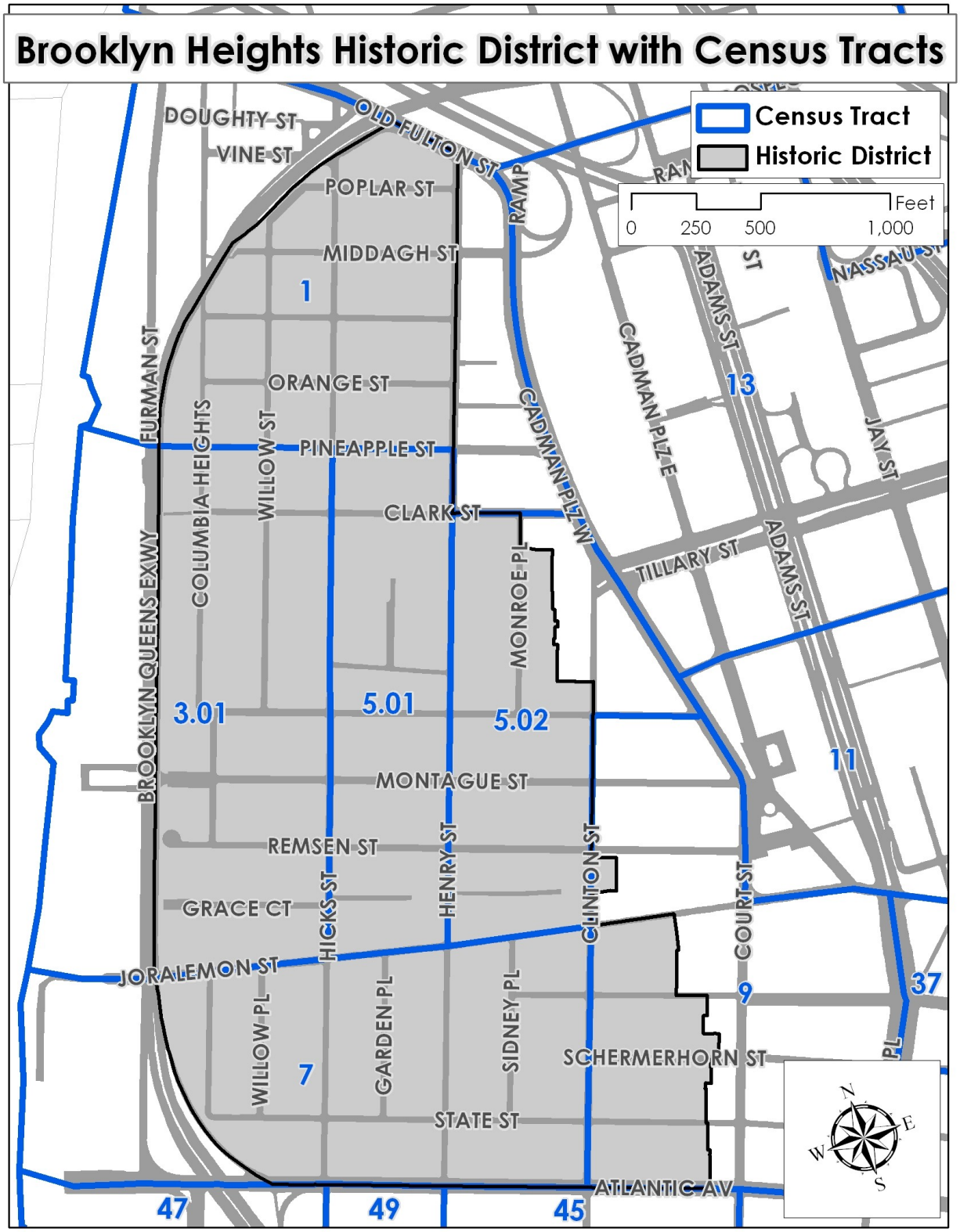
Figure 2. Brooklyn Heights and surrounds.

Figure 2-2. "Brooklyn Heights and surrounds" (Lees, 2003, p. 2493).

Figure 4. Brooklyn Heights Historic District.

Figure 2-3. "Brooklyn Heights Historic District" (Lees, 2003, p. 2495).

While the map in Figure 2-3 shows not only the detailed streets within but also the district's boundaries, it is somewhat misleading because the Brooklyn Heights Historic District does not completely correspond to the four Census Tracts (1, 3.01, 5 and 7) that Lees used to profile her study site. For example, Census Tract 5 was split into two Census Tracts for the 2010 Census Survey. In Map 2-2 below, the Brooklyn Heights Historic District is shown with the Census Tracts in bold blue lines. Therefore, we can readily identify the south-east corner of the Historic District is beyond the Census Tract coverage. If Lees had followed Abu-Lughod's methodology and instead used individual Census Tract data, then she could have tested whether her interviewee subject's perception regarding the differences within the neighborhood adjacent to Joralemon Street was accurate.



Map 2-2. Brooklyn Heights Historic District with Census Tracts.

2-6 Measuring Displacement

If after almost a half century of research, the causes of gentrification are still being debated, then it is probably to be expected that displacement (an effect of gentrification as stated by Ruth Glass) is likewise being contested among researchers. Using New York City's Housing Survey, which was based on data at the Community District level, Freeman and Braconi (2004a & 2004b) concluded that the displacement effect is not as serious as other researchers have argued. In fact, according to their calculations, mobility in gentrifying neighborhoods is actually lower than other neighborhoods and this observation seems to lead the conclusion that gentrification leads to the stability of a neighborhood. However, Newman and Wyly (2006) disagreed with this conclusion, and using the same data-sets with slightly different calculations they reached different conclusions to challenge the findings of Freeman and Braconi. Among the critiques they raised, two are especially related to the design of the present study:

1. In New York City there are fifty-nine Community Districts that represent distinctive spatial units of the City's Housing Survey. In a highly dense city such as New York City, each Community District can easily contain several distinctive neighborhoods with different demographic and socio-economic characteristics. Although no official neighborhood boundaries are provided by the New York City Department of City Planning, the Department's publications state that there are hundreds of neighborhoods in New York City. Freeman and Braconi did not consider residents that move within a Community District as being displaced, when one views the relatively large areas that a single Community District may cover, their assumption is rather weak. It is possible that displaced residents manage to find more economical housing in a different or nearby

neighborhood that is still located in the same Community District, or they may "double-up" to reside in the same neighborhood to stay close to their work, public school, transportation, social support network, etc. None of these scenarios are discussed in Freeman and Braconi's classification of displacement. As my study will show through the use of gentrification mapping based on individual Census Tract data (a smaller geographic unit), even within a single neighborhood the socio-economic conditions can vary considerably. The larger Community Districts that contain several neighborhoods can easily include a wider range of housing stock and rental opportunities. In other words, while Freeman and Braconi's conclusion is based solely on Community Districts as the acceptable study units, I find it questionable to leap to their conclusion without further research the daily experiences of those individuals who face the pressures of displacement in a gentrifying neighborhood.

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2. Newman and Wyly's second critique that challenges Freeman and Bracon's conclusion is focused on the temporal consideration. Newman and Wyly argue that the time-frame used by Freeman and Braconi was too late to identify the displacement in certain areas. In other words, by the time Freeman and Braconi initiated their study, gentrification could have had taken effect and displacement had already occurred and perhaps even peaked. In this scenario, Newman and Wyly suggest that what Freeman and Braconi observed, were Community Districts that had settled through the climax of displacement. Those who were displaced had already left; those who managed to remain had the means to hold on to their residence. In other words, what Freeman and Braconi measured, were stabilizing

or already stabilized Community Districts and, naturally, the displacement effects would be less severe than expected.

While my study aims to map gentrification and not displacement, several approximate indicators are explored and included in the gentrification maps, such as: minority ethnic groups including Black, Chinese, and Hispanic populations, as well as the percentages of people without high school diplomas. By mapping these seemingly non-gentrification measurements, my study can illustrate how these groups change in response to the more general gentrification indicators, such as rising income or populations with college degrees (or above) within the same neighborhood. However, none of these variables can be considered as measurements of displacement, as those who were displaced remain elusive and difficult to capture. The maps that are principal in my study are based on these additional variables in order to provide counter measures in the ongoing study of gentrification, and to examine how the compositions (i.e. ethnic diversity and educational attainments) of a particular neighborhood changes throughout the study period. It is my goal to provide multiple measurements of neighborhood changes using GIS to examine the intra-neighborhood differences. The details of these gentrification maps and their design will be elaborated in Chapter Four: Research Design and Methods.

Chapter Three : Literature Review – Geographic Information Systems

As with the literature review describing gentrification theories and debates, this chapter reviews only portions of GIS literature. A comprehensive review of the GIS literature is beyond the scope of this dissertation because GIS as a tool is used in many disciplines and industries. This literature review will begin with the definition of GIS and then introduce some GIS fundamental principles. I will also discuss the role of the U.S. Census Bureau in developing a computerized street network that digitized our living environment, and also their Decennial Surveys that provide demographic, socio-economic and housing data-sets for mapping. Concerns and critiques of this GIS tool and technology are also addressed.

3-1 What is GIS?

As the definition of gentrification leads to the lengthy and ongoing debate on its causes and effects, similarly defining GIS (Geographic Information Systems) is also a complicated matter. According to the United States Geological Survey (USGS) (2007), GIS is defined as:

> A computer system capable of capturing, storing, analyzing, and displaying geographically referenced information; that is, data identified according to location.

However, this information technology centered definition only begins to tell the whole story. Maguire (1991) expanded this definition and added an additional dimension, namely, "geographically oriented computer technology, integrated systems used in substantive

applications, and more recently a new discipline." In other words, GIS is not only the spatial data, the software and hardware that acquire, store, and display these data, it is also the discipline itself (or the various fields of disciplines) that analyzes these data. Goodchild (1992) also emphasizes both dimensions (as a branch of information technology and as a discipline) and uses GISc which stands for Geographic Information Science to better reflect this expanded definition. In this study, as I explore and use GIS primarily as a research tool, I will use the term GIS instead of GISc.

3-2 Who "Invented" GIS?

Roger Tomlinson, a geographer from England who moved to Canada in 1957, is often referred to as the "father of GIS" for his work in 1966 with the Canada Geographic Information Systems (CGIS) (Coppock & Rhind, 1991; Urban and Regional Information Systems Association, n,d,). This marks the first appearance of the term "geographic information systems." At the time Tomlinson was working for a survey company that was undertaking a forest survey in East Africa. The company was tasked to review all available maps of the area to find possible locations for new plantations. The estimated cost to carry out this project manually was so high that the proposal was rejected. Tomlinson argued that if a computer system could be developed that would automate the time-consuming and labor-intensive survey and review process the resulting cost could be more reasonable. He then developed a digital methodology, but no computer technology companies were interested in further advancing it.

A chance encounter with Lee Pratt, of the Canadian Department of Agriculture which at the time was implementing a Canada Land Inventory (CLI), led Tomlinson's idea to materialize. Pratt not only supported Tomlinson's proposal, but in fact, invited him to direct its development within

the Canadian Agricultural Rehabilitation and Development Administration (ARDA). The result of this partnership was that paper maps were scanned and digitized, and topological coding of boundaries was developed. Once the digitization of maps was completed, the sorting and spatial querying to examine the land use using computer systems became automatic.

Not everyone agrees that Tomlinson "invented" GIS and is the "father" of GIS. Rogers (n.d.) bestows the title to Ian McHarg, who himself did not use computers, but nevertheless developed the underlying principles of GIS. McHarg (1969) believed the environment could be separated into different layers, with each layer depicting a specific theme. For example, to find out potential areas for new development, themes that would affect the feasibility are identified: slope, drainage, vegetation, etc. Each layer depicts one theme and each theme is then graded by its degree of impact on new construction. Specifically, light slope will be illustrated as light gray and deep slope illustrated as black which indicates an area not suitable and costly for new development. By combining all the layers the darkest areas (i.e. deep slope and bad drainage) will illustrate the least favorable and costly sites for development and the lightest areas as the best candidates. McHarg also applied this system to map human ecology, such as physical disease (i.e. heart disease, tuberculosis, diabetes, etc.) and social disease (i.e. homicide, suicide, drug addiction, etc.).

This layered system is the fundamental basis for GIS, which can be regarded as an extension of McHarg's prior work with information technology. But GIS does not just replicate McHarg's work with computers. GIS goes several steps further. After a layer is geo-referenced, defined as the process to assign coordinates to its coverage based on a selected projection, the result is a

built-in grid used for locating objects on each layer. GIS users can then conduct spatial queries such as proximity analysis that identifies how many other objects are within a particular object. Furthermore, spatial queries can be conducted across various layers if they are geo-referenced to the same projection. As Tomlinson had proposed, spatial queries that are time-consuming and labor-intensive when performed manually could be automated using computers. Researchers could then further explore spatial relations within a layer or across various layers.

The field of GIS is not simply the use of computers to make maps, or to aimlessly explore data to find correlations between and among themes. As researchers dive into the world of GIS, they realize that although the software algorithm is important to carry out spatial analysis, as with all research, accurate and reliable data is the foundation of their studies. Spatial analyses can only go so far as the quality of the underlying data affords. For researchers that study U.S. demographic and socio-economic changes, the Census Bureau's Decennial Surveys provide just that.

3-3 U.S. Census Bureau

The U.S. Census Bureau actually plays a twofold role in the field GIS. The Decennial Surveys provide a comprehensive and continuing collection of demographic and socio-economic status data, which are not only important to GIS users who map these variables, but also to non-GIS statistical analysis. The Census Bureau's second contribution to the development of GIS is the creation of TIGER (i.e. Topologically Integrated Geographic Encoding and Referencing). TIGER includes a digitized street database for geo-coding, the procedure to convert a text street address into a spatially-correct dot on a map. This method was originally designed to calculate

the return rate of the Census Surveys. It also includes boundaries files for identifying geographic units, such as: Census Tracts and other physical features.

Prior to GIS, Census data had been used primarily as straight statistical analysis with numbers as visualizing the data onto maps, like traditional cartography, could be labor intensive. The capability of GIS to link data-sets to geographic features and to assign various colors to represent the intensity of such data greatly enhanced the process to create thematic maps. The development of TIGER reached a significant breakthrough for the 1990 Census Survey. While the entire U.S. territory was "covered" with Census Tracts since Census was introduced, it was only in the 1990 Census Survey that the data was linked, i.e. geo-coded or avail in geographic form. As a result, since the 1990 Census the Census Bureau has issued its survey results in both traditional statistics and as an atlas, and to illustrate demographic and socio-economic characteristics (Brewer, 2001; Brewer and Suchan, 2001).

Gentrification research relies on Census Survey data to illustrate the changes in demographic composition, housing characteristics, and socio-economic status. Researchers began to include maps and mapping in their publications prior to 1990 (Schaffer and Smith, 1986) when urban areas were first mapped using Census Tracts. Some of these studies were discussed in the previous chapter. As discussed previously, unfortunately not all gentrification researchers use GIS maps and mapping. They have yet to take full advantage of what GIS can do to visualize and present data effectively.

3-4 GIS vs. Computer Mapping

While Foresman (1998) considered GIS to be the latest major advancement in mapping, what separates GIS from traditional cartography is its employment of computers that automate previous time-consuming procedures (Robinson, 1982). Automation also enables GIS users to experiment with various settings applied to the same data to produce variations in the maps. The use of computers also enables GIS users to review the different visualization and select which they consider the most effective way to present data. While these features could be considered advantages of using GIS, at the same time, they introduce a user's subjectivity in mapping. While GIS affords experienced cartographers to swiftly create maps, new users of GIS can be easily overwhelmed by the multiple options provided by GIS desktop software and may use default settings which are not always the best option. GIS might have made computer map-making easy, but ultimately it is the expertise and experience of its users that make accurate maps, but always the question is "accurate" for what.

Subjectivity in map-making is not new in the field of cartography. Critical map-reading requires readers to consider what data is presented and how it is presented. It also requires them to consider what is omitted. GIS might have facilitated the process of map-making but also opened the floodgates for non-cartographers to make maps, and expanded the possibility of map manipulations. These manipulations are especially important when reviewing GIS applications and their results. Critics of GIS have focused their attention on these issues which I will discuss further in the following sections.

Geographers have expressed ambivalent feelings about those researchers who engaged in spatial

analysis without professional cartography training and knowledge in geography. At times geographers offer their assistance (Monmonier, 1993; MacEachren, 2004) and sometimes they worry about "bad" mapping practices that range from producing amateur, ineffective maps to the deliberate abuse of GIS for political propaganda (Monmonier, 1996). Nevertheless, GIS is a powerful tool that can reveal and analyze spatial patterns that might be missed by traditional numeric statistical analysis (Goodchild & Janelle, 2004). This particular capability is especially crucial for those researchers who consider space as an active variable of study and not just a dormant background factor.

3-5 Critics of GIS

GIS is not without its critics. Smith (1992) criticized that while the academics were engaged in the theoretical "war" of whether, and where, GIS should be situated in an academic setting, a critical discussion of the military use of GIS was virtually absent. As valid as this argument is, how effective the academics can penetrate the military black box and gain knowledge of military GIS applications is questionable. This does not mean, however, that military use of GIS is completely unknown to the civilian world. Global Positioning System (GPS), developed by the U.S. Department of Defense and deployed in the First Gulf War is now widely used for non-military purpose in navigation, tracking vehicles, and wild fires, etc. (Monmonier, 1997, 2004).

A potential offensive use of GIS is the particular but ever-growing commercial use of GIS to monitor prospective customers. Parallel to law enforcement organizations, same as the police department's monitor crime, modern corporations collect data about their current customers to

actively seek prospective ones (Clarke, 1988). This is called geodemographics, consumer-behavior studies based on locational profiling (Goss 1995a, 1995b). The presumption has its roots in the Chicago School's view, namely, that people with similar socio-economic status live in close proximity and that such geographically-clustered homogenous groups consume alike (Weiss, 1988). Hence, by analyzing data from existing consumers, corporations profile: what sort of communities and which products or services sell. The next step for these corporations is to apply such profiles to identify locations with similar socio-economic status characteristics and to open a new branch in this location, or to bombard the target communities with solicitations through direct mailings.

Such commercial surveillance is based on data that Clarke (1988) terms "dataveillance" is rapidly increasing and invading into people's daily life. Having originated with data collected by Census Surveys, geodemographics now use data sources that range widely from consumer surveys, replied guarantee cards, social media, credit reports, to newly-relocated residents address lists sold by post offices, to name only a few. Previously these data were separate pieces of information and difficult to consolidate for meaningful analysis. With GIS they are linked through location and each community is profiled for its consumer powers, behaviors and tendencies. The location of one's residence is always a part of one's identity, but under geodemogrphics it also indicates one's consumer tendencies and in turn a commodity itself pursued by corporations. In the practice of geodemographics neighborhoods have been catalogued and subjected to selected promotion by corporations.

GIS in essence is a tool. It is the users who decide the purpose and results of for applying this tool. In the next section I will review how the New York City Police Department (NYPD) uses GIS to monitor crime patterns.

3-6 NYPD CompStat and Crime Mapping

The computerized statistics (CompStat) employed by NYPD is a managerial tool that its creator claims to be have been inspired by observing how a restaurant owner checked up dining customers to see if they were served properly by the wait staff (Maple, 1999). Increasing crime incidents in a particular police precinct is considered an important indicator of a precinct commander's job performance, so the inventor of CompStat reasoned this technology might be extended to a larger realm.

During a 28-day period, six types of crime incidents (i.e. murder, rape, robbery, felony assault, burglary, grand larceny, and grand larceny auto) are tabulated, geo-coded and mapped. Each week a CompStat meeting is held at NYPD headquarters and the commanders of precincts take turns to make presentations on their crime-fighting tactics, while the audience (upper management and other precinct commanders) observe projected maps and question the results. In additions to precinct commanders being accountable for their performance, CompStat also helps NYPD to identify geographical concentrations of crime which could cross precinct boundaries and be unnoticed within individual precinct records. This intelligence is then used to dispatch patrols more effectively to target specific crime hot-spots.

CompStat is not without its critics. Mass media reports based on retired personnel and whistle-blowers have indicated that due to mounting pressures to achieve performance improvements, some precincts have downgraded their crime own reports (Eterno & Silverman 2012; Rashbaum, 2010; Rayman, 2010). For example, values of stolen goods are reduced to below $1,000. This change transforms a burglary incident into a misdemeanor which is not recorded by CompStat. Other than the issue of data accuracy and reliability, it should also be noted that CompStat itself records only crime incidents and does not include how many crimes have been solved; one of CompStat's shortcomings.

Although CompStat provides the public a window to determine if the crime incidents in their neighborhood is declining, academic researchers are ambivalent about such quasi-military control over an urban environment (Davis 1992; Body-Gendrot, 2000). The use of CompStat also raises concerns about individual privacy (Wartell & McEwen, 2001). While visitors can use it to avoid crime hot spots, local residents might feel stigmatized by living near crime hot-spots. While the effectiveness and implications of CompStat can use more critical examinations, it has gained such popularity that a federally-sponsored manual of using GIS to fight crime has been made available to all who are interested (Harries, 1999).

Not all police departments map crime the same way. NYPD CompStat only releases weekly statistics aggregated at the precinct level, while other cities have progressed to display real-time and detailed crime locations. For example, the online crime mapping of San Francisco Police Department shows the exact locations of crime incidents and allows viewers to manipulate the screen display by selecting crime types and dates (San Francisco Police Department, no date).

(See Figure 3-1 below). Different crime incidents at the same location are mapped with a black shield with numbers and viewers can click on the icon to view detailed information about each incident.

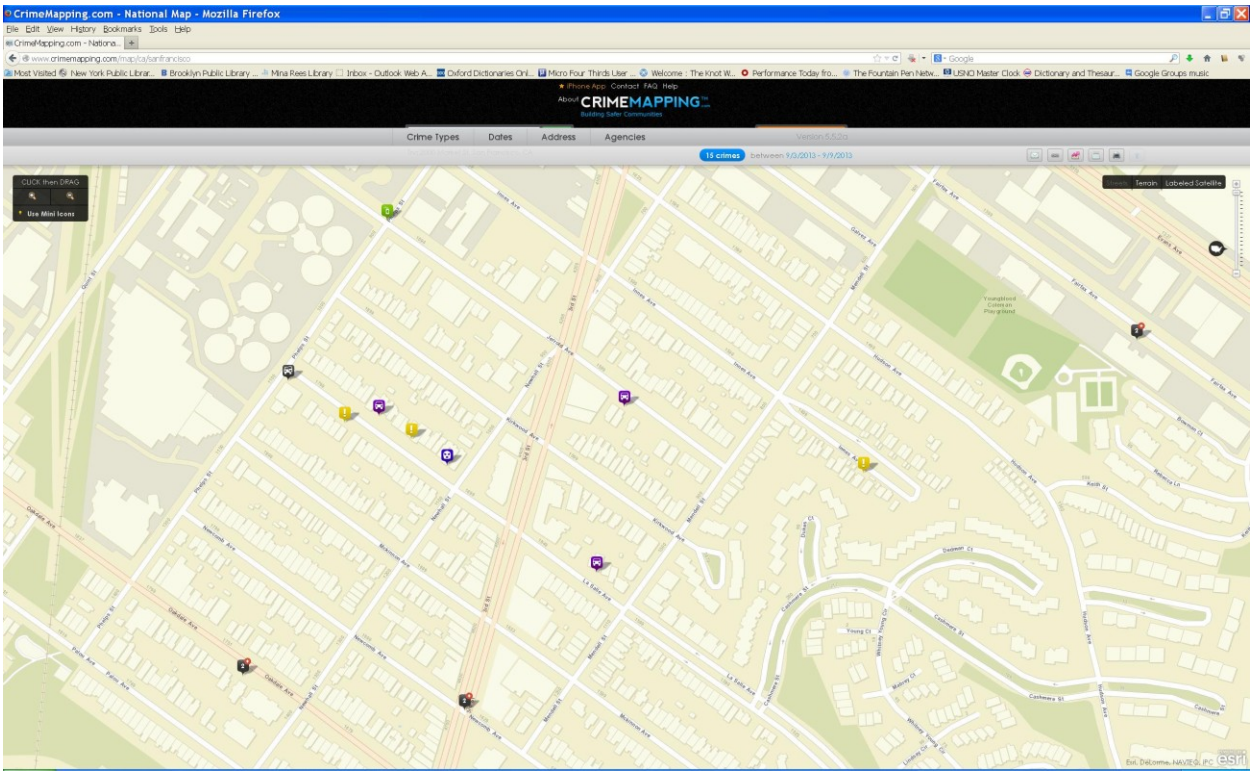


Figure 3-1. Screenshot of San Francisco Police Department CRIMEMAPPING showing incidents from September 3 to 9, 2013 in the Bayview neighborhood.

GIS is not only being used by the police to map crime in various precincts, GIS can also be used to map the recent controversial "stop-and-frisk" practice by NYPD that has been criticized for targeting selected neighborhoods and possible racial profiling (Stoudt, 2013; Stoudt, Fine and Fox, 2012). As argued above, GIS is a tool and its applications can have various implications.

3-7 Conclusion

GIS has come a long way from its early days when its function was initially to simply replace paper maps. Like many modern inventions associated with information technology, GIS can have unforeseen and complicated implications. While it might be beyond the immediate intent of GIS users and application developers to anticipate all possible implications, a critical and cautious evaluation process should be included in the development of every GIS project. With that in mind, in the next chapter I will lay out my plan to create gentrification maps using GIS to document the changes from 1980 to 2000 of three New York City neighborhoods. The results will illustrate the gentrification of these neighborhoods and to review the gentrification theories discussed in the previous chapter.

Chapter Four : Research Design and Methods

> …prose has a sequential, linear structure that can be painfully insufficient for discussing places, regions, and spatial relations.
>
> Monmonier (1993, p. ix)

As Monmonier argues in the preface of his *Mapping It Out: Expository Cartography for the Humanities and Social Sciences*, words and actually numbers as well, are inadequate to describe a spatial phenomenon. Geographers and urban researchers have long been using maps and mapping to supplement their writings and statistical analyses. This study will go a step further and elevate maps to the forefront and argue the advantages of maps (produced by GIS) to enhance the study of gentrification.

To avoid developing a "one-off" methodology, maps presented in this study are produced with publicly available data-sets associated with gentrification and produced with GIS. Although a desktop GIS computer program is used to produce the gentrification maps for this dissertation, no proprietary features are involved in the making of these maps. A discussion about the GIS software itself will be discussed in Section 4-7. These gentrification maps will lead the descriptions and discussions of the various changes recorded in the three study neighborhoods. Bar charts and pie charts illustrate trends and proportions are also produced in conjunction with the gentrification maps. These gentrification maps not only illustrate what has changed and the

amount of change, but most importantly, the location of these changes and also if there is a spatial pattern associated with these changes.

4-1 The Research Design

The research design of this study is mainly descriptive. However, it is not in the traditional sense a descriptive research that includes narratives and statistics to account for "what is going on" (de Vaus, 2001, p. 1). While words and numbers are employed for this study, maps employing publicly available data produced with GIS are the primary method to describe the gentrification process in the three neighborhoods. Maps from existing gentrification studies and those publications from government documents are also used and subsequently compared to the gentrification maps I produced for this dissertation.

Regardless of the ongoing debates over the causes and effects of gentrification that were discussed in the previous literature review chapter, researchers have continuously used Census data to show the conditions and changes of demographic, socio-economic and housing characteristics of the neighborhoods they studied (Lees, 2003; Ley, 1996; Marcuse, 1986; Smith, 1986). Although there is no universal agreement about the variables from the Decennial Census Survey that might reveal gentrification, specific variables such as: income, rent and higher educational attainments have been repeatedly used to account for gentrification. The particular variables used for this dissertation are detailed later in this chapter.

As an exploratory inquiry on GIS as a research tool, certain gentrification maps produced for this study are compared with non-GIS-produced maps. These comparisons are achieved by placing

traditional paper maps together with the gentrification maps produced for this study to illustrate the advantages of the GIS-produced maps. The focus of this study, however, is to examine how and what additional insights the gentrification maps produced by GIS can provide. There are various and numerous data-sets that could be used to indicate gentrification. The first selection criterion for this study is that the data are publicly available to ensure that other and/or future researchers can also have access to the data to produce comparative studies. The second selection criterion is the fact that the data-set is not explicitly exclusive to New York City. To fulfill these selection criteria, the United States Decennial Census Surveys are selected to map the demographic, housing, and socio-economic status associated with gentrification. The use of Census Survey data ensures that at least comparable gentrification studies can be conducted in the same manner in various other neighborhoods throughout the United States, or potentially other countries that conduct similar census surveys. Using Census Survey data also ensures that the results from this study can be linked to results from future Census Surveys. In this regard the design is expandable and replicable in both space and time.

The other data-set used in this study to map the physical environments of the selected neighborhoods was acquired from the New York City's Department of City Planning. While this is obviously New York City data, other municipal agencies maintain similar and comparable data-sets. Three variables from City Planning's data-set that are common among other public agencies with regard to land use in their agency's jurisdiction are: primary zoning, age of the existing structures, and number of floors for each tax lot.

Private and commercially available data-sets wrer explicitly avoided for the present study. The main reasons for this decision are potential cost and exclusiveness to space and time. In contrast, the United States Census survey data are free and publicly available. The survey is administered every ten years which ensures its continuity in time. The survey is also administered for the entire nation and is therefore not exclusive to a specific location. In contrast, not all private and/or commercial data-sets meet these standards, which often render them to be either time or location exclusive, leading the research based on them to also be exclusive in time and space.

Although this study focuses on three New York City neighborhoods, it is designed not to be just another typical case study with limited applicability to other neighborhoods. While the knowledge we learn from the gentrification maps in the following chapter might be focused on the three neighborhoods, the research design can be replicated easily in other U.S. cities, and used for comparative studies by other researchers or community activists.

The following sections lay out the specifics of the data sets and how they were used to develop the gentrification maps. They are divided into two groups based on the attributes they use to "describe" gentrification:

> Group A: maps for the physical environment, such as zoning and various features of the existing structures;
>
> Group B: maps for the social environment, such as demographic and socio-economic status of the residents.

Although the design of the maps and figures in this study aims to demonstrate the uneven intra-neighborhood conditions, the sequences of the maps in the chapter for each neighborhood are identical to facilitate the inter-neighborhood comparisons. The map titles include a numerical convention. The first number corresponds to the chapter number: “5” for Park Slope, “6” for the Lower East Side and “7” for Williamsburg. The second number after the hyphen records the sequence. For example, Map 5-6 is the base map for Park Slope that illustrates its Core and Environs Census Tracts; Map 6-6 is the base map for the Lower East Side; and Map 7-6 is the base map for Williamsburg.

Before detailing these two groups of gentrification maps, I will explain how the neighborhood is defined for this study.

4-2 Defining the Neighborhoods

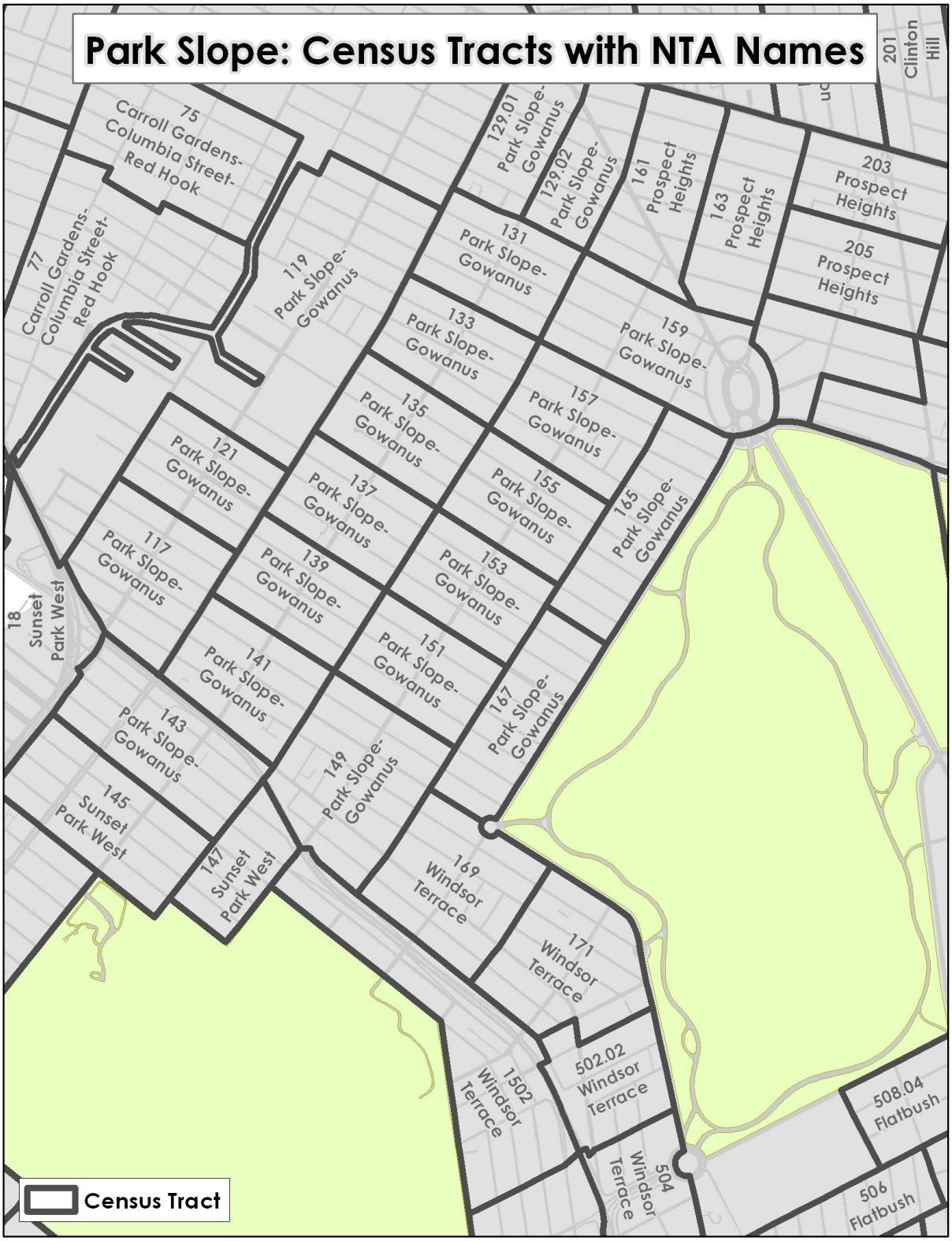
There are no officially defined geographical boundaries for the hundreds of neighborhoods in New York City. Although on the Department of City Planning’s website there is a page titled “New York: A City of Neighborhoods” (DCP, 2010a), the “neighborhood map” reflects the fifty-nine Community Districts as the background together with multiple neighborhood names appearing at their approximate locations (DCP, 2010b). Below in Figure 4-1 is a clipped section of this map illustrating Brooklyn Community District 6 (i.e. blue region with the black number 6) that appears to contain five different neighborhoods, namely: Cobble Hill, Carroll Gardens, Red Hook, Gowanus and Park Slope.

Figure 4-1. Clipped DCP Neighborhood Map showing Brooklyn Community District 6 and neighborhoods (DCP, 2010b).

From this map (in Figure 4-1) readers can view the spatial relations among the five neighborhoods; Gowanus is on the west side of Park Slope and Cobble Hill is north of Carroll Gardens. However, no boundaries are provided and dividing lines are left to the imagination, knowledge and experience of the reader. The lack of boundary lines also prevents the reader who is unfamiliar with these neighborhoods to attempt to gauge the size of each neighborhood and how its definition changes over years.

The Department of City Planning (DCP) has devised "Neighborhood Tabulation Areas" (NTAs) and assigns each Census Tract in the City with a NTA name. As New York City neighborhoods are bigger than a single Census Tract, a NTA name are shared across several Census Tracts. These designations serve as the basis to define and draw the neighborhood boundaries for this study. Contemporary gentrification studies were also consulted when I selected the Census Tracts that form the three neighborhoods for this study. DCP itself recognizes that the NTAs are

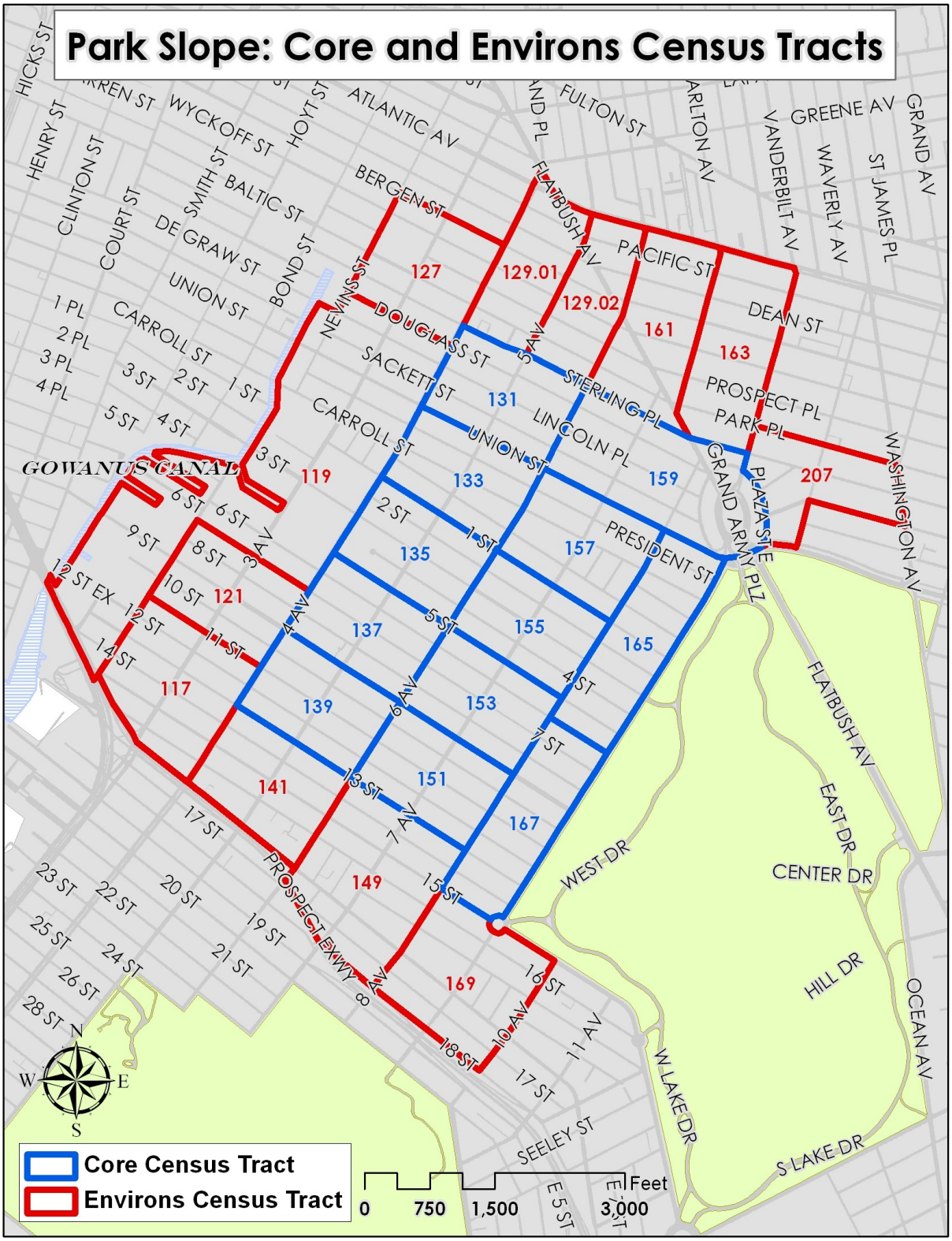
“aggregations of Census Tracts that are subsets of New York City's fifty-five Public Use Microdata Areas (PUMAs). Primarily due to these constraints, NTA boundaries and their associated names may not definitively represent neighborhoods” (DCP, 2010c). While this disclaimer seems to reaffirm the City’s reluctance to draw official boundary lines among its neighborhoods, it does provide a starting point for conceptualizing a definition for this study. In the future, but outside the scope of this study, DCP’s NTAs might one day become the basis to study the evolution of neighborhoods in New York City. Map 4-1 below illustrates that the Census Tracts in the Park Slope neighborhood are actually classified as “Park Slope-Gowanus”; again demonstrating the uncertain boundaries of New York City neighborhoods.



Map 4-1. Census Tracts in Park Slope vicinity labeled with both Census Tract number and NTA name assigned by DCP.

At the beginning of each of the three neighborhood chapters that follow, contemporary gentrification researchers' publications are consulted to help draw the boundaries of these neighborhoods. Census Tracts that are approximately within these boundaries are selected to form and represent these neighborhoods. Because these selected Census Tracts likely do not correspond to the neighborhood boundaries, this study devises a scheme using Core and Environs Census Tracts: Those Census Tracts that fall within the commonly agreed boundaries are designated as the "Core" Census Tracts (i.e. blue outline) while the immediate surrounding Census Tracts are designated as the "Environs" Census Tracts (i.e. red outline).

Map 4-2 below serves as an example for Park Slope. The full details regarding the selection process are discussed in the Park Slope chapter (Chapter 5). For now, it is important to note that some Census Tracts in Map 4-1 are labeled "Park Slope - Gowanus" but as Map 4-2 illustrates some falls into the "Environs" area and not the "Core" area. Census Tract 129.02 is an example. With this scheme even though the selected Census Tracts might not completely conform to the general neighborhood boundaries, it is the combined coverage of both the Core and Environs Census Tracts that should include not only these neighborhoods but also some of the surrounding city blocks. The gentrification maps based on this scheme may illustrate not only the selected neighborhood but also examine whether there is gentrification spillover into nearby areas or contrast with these nearby areas.



Map 4-2. Park Slope: Core and Environs Census Tracts.

In addition, unlike certain gentrification studies that aggregate selected Census Tracts to form a single geographic entity (Lees, 2003), this study adapts the research design of two prior Environmental Psychology dissertations (Justa, 1984; O'Hanlon 1982) and Abu-Lughod (1994), which maintains the Census Tracts as separate and links the selected variables from Census Surveys to each Census Tract. This design will reveal the intra-neighborhood differences and can be used to examine how gentrification moves and spreads over time. With the use of GIS software, this process requires some effort, but much is easier than the manual effort employed by earlier gentrification researchers.

A few Census Surveys selected variables and their values that span three decades are also charted to supplement these maps. The identical bar charts depicting these selected variables are embedded into these maps, having the advantage to reveal previously overlooked spatial patterns. Because the embedded bar charts are small due to the limited space available, I have added accompanying bar charts so that it is easier for the readers to examine trends. The maps from the aforementioned three studies are extracted or reproduced to demonstrate the advantages of GIS-produced gentrification maps.

A summary of the design, reasons and advantages of the design for this study are listed below:

1. Although the neighborhoods formed by the Core Census Tracts might not be an exact fit with the street boundaries, by not dividing the Census Tracts, the integrity of the data collected at the Census Tract level is maintained.

2. Even though Census Tracts might be re-drawn, they are generally stable and this stability will afford future researchers to carry out direct comparisons.

3. If other researchers do not agree with the selected Core Census Tracts to coincide with their own definition of a particular neighborhood, the inclusion of Environs Census Tracts allows them to easily add and subtract Census Tracts to conform to their preferred area covered and to compare the results from this study albeit with some key discrepancies that might throw of the comparisons.

4. By linking the selected variables from the Census Surveys to each Census Tract, the gentrification maps show how, at a particular time of the Census Survey, each Census Tract is characterized by different values. This step shows the intra-neighborhood differences cross-sectionally for each Census Survey that is used in this study. The longitudinal gentrification maps, which link the same selected variable to the Census Tracts, show the chronological changes from the four Census Surveys.

Before detailing the data sources and variables used to make the gentrification maps, I will introduce and describe the formats of the gentrification maps: following the convention of cartography, north is at the top of the maps; compasses with arrows pointing and indicating directions are inserted in the maps, illustrating the locations of each neighborhood and their relation to New York City. All the maps in this dissertation follow this rule; therefore compasses are omitted in subsequent maps.

It is important to note that the map scales of the three neighborhoods are different from each other. For instance, each neighborhood is zoomed in to the extent that they fill a full page to maximize the clarity and readability of the embedded bar charts showing the chronological trends during the study period. A scale bar of 3000-ft has been inserted into each neighborhood's definition maps (see Map 4-2 above with selected Core and Environs Census Tracts for Park Slope). These scale bars are omitted in subsequent maps because each neighborhood's gentrification maps in each individual chapter retain the same scale. The table below summarizes the different geographical scales for each of the three neighborhood maps:

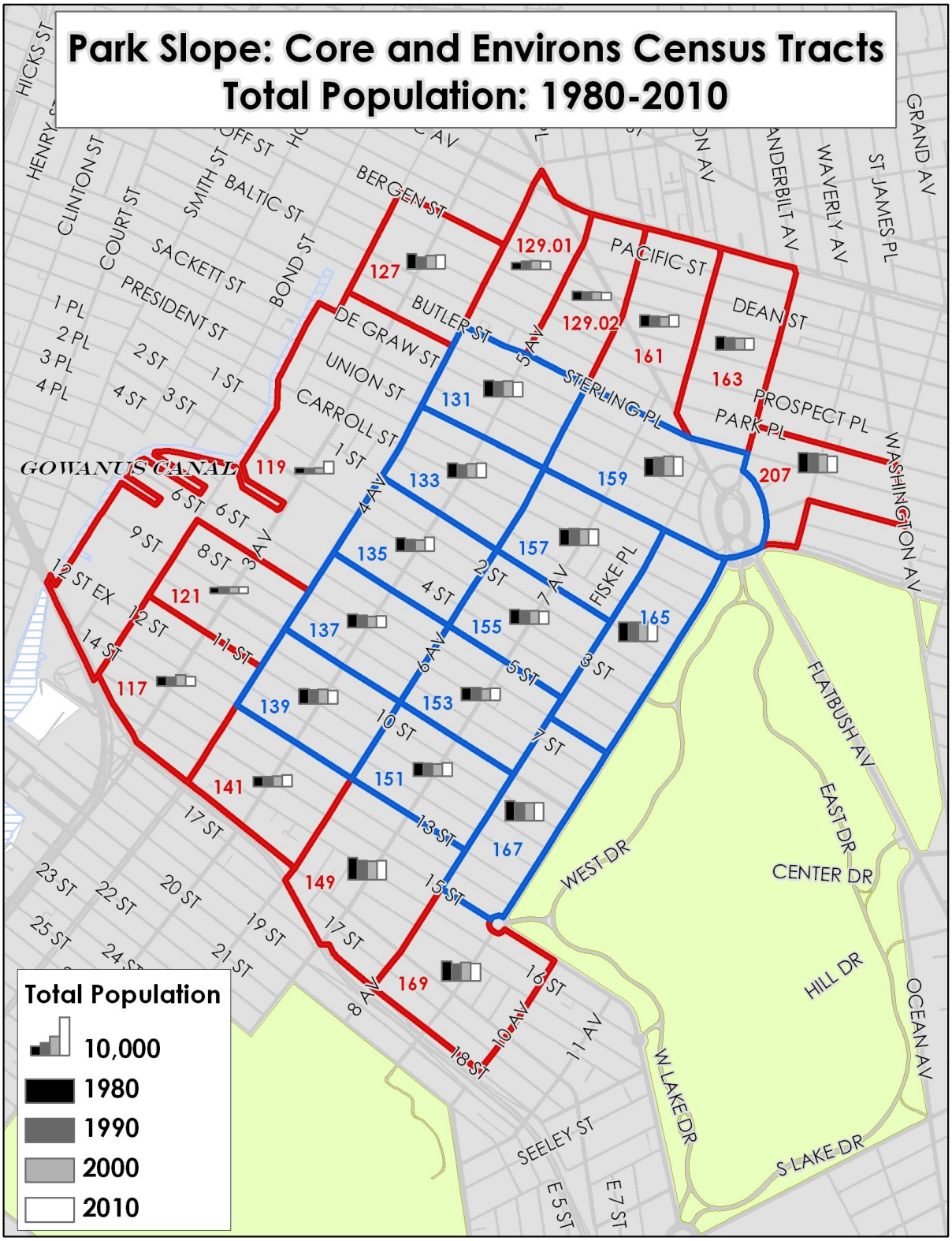
Neighborhood	**Map Scale**	**Numbers of feet represented by one inch on the paper map**
Park Slope	**1:16,000**	**1333.3**
Lower East Side	**1:17,500**	**1458.3**
Williamsburg	**1:14,000**	**1166.7**

Table 4-1. Geographic scale used for the three neighborhood maps.

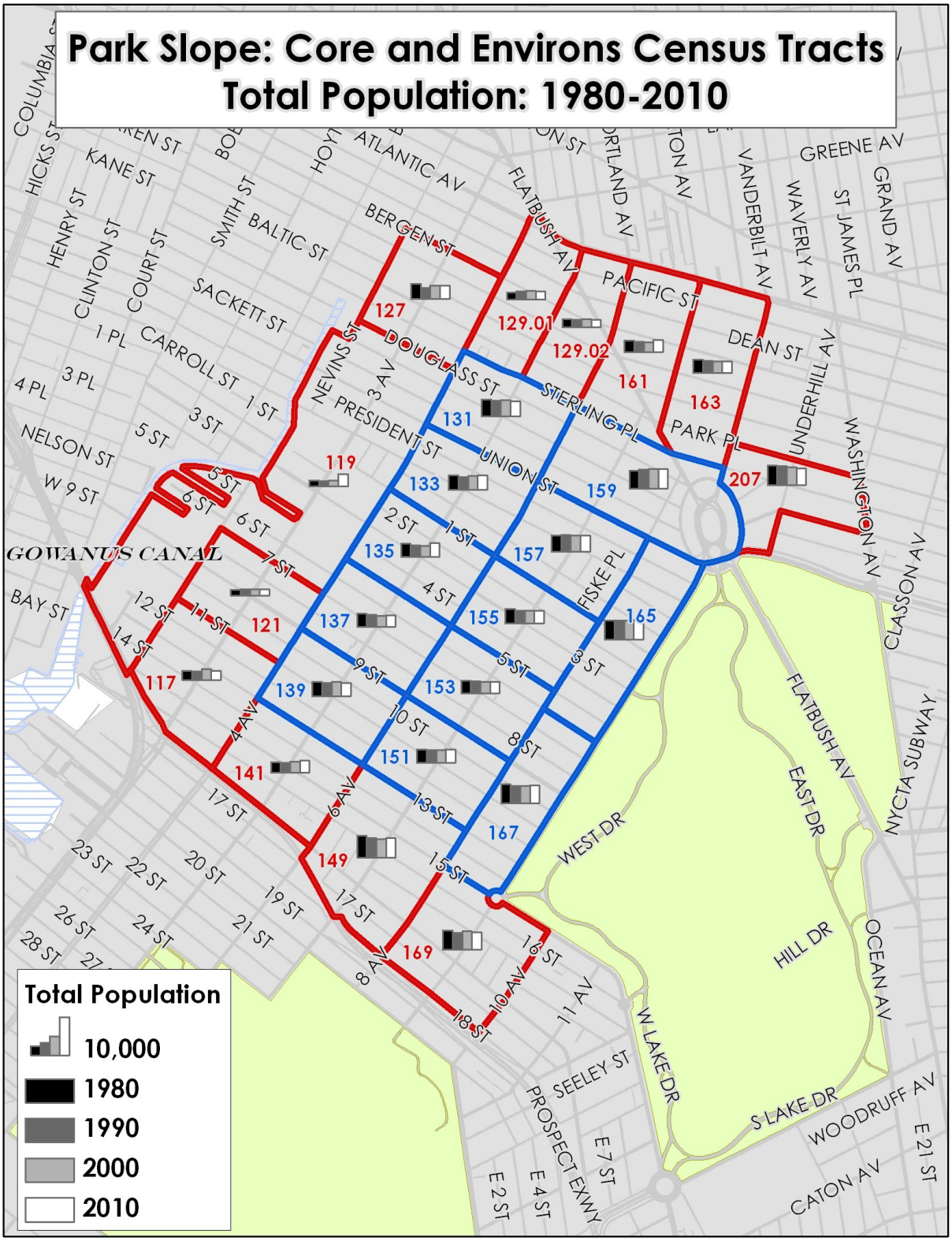
The scheme to use a single map scale for all three neighborhoods was considered so that the maps from all three neighborhoods are comparable. As Table 4-1 above shows, the values of the map scales for Park Slope and the Lower East Side that fill a page are close. In fact, the difference between maps with 1:16,000 and 1:17,500 scales is not very noticeable. Two maps of Park Slope (Map 4-3 and Map 4-4 below) show the Park Slope population at the Census Tract levels and two map scales: Map 4-3 with 1:16.000 scale; Map 4-4 with 1:17,500 scale. As these maps demonstrate, they do not look very different. Were this study to only involved mapping

Park Slope and the Lower East Side, these area maps would both be using the 1:17,500 scale, so they can be comparable.

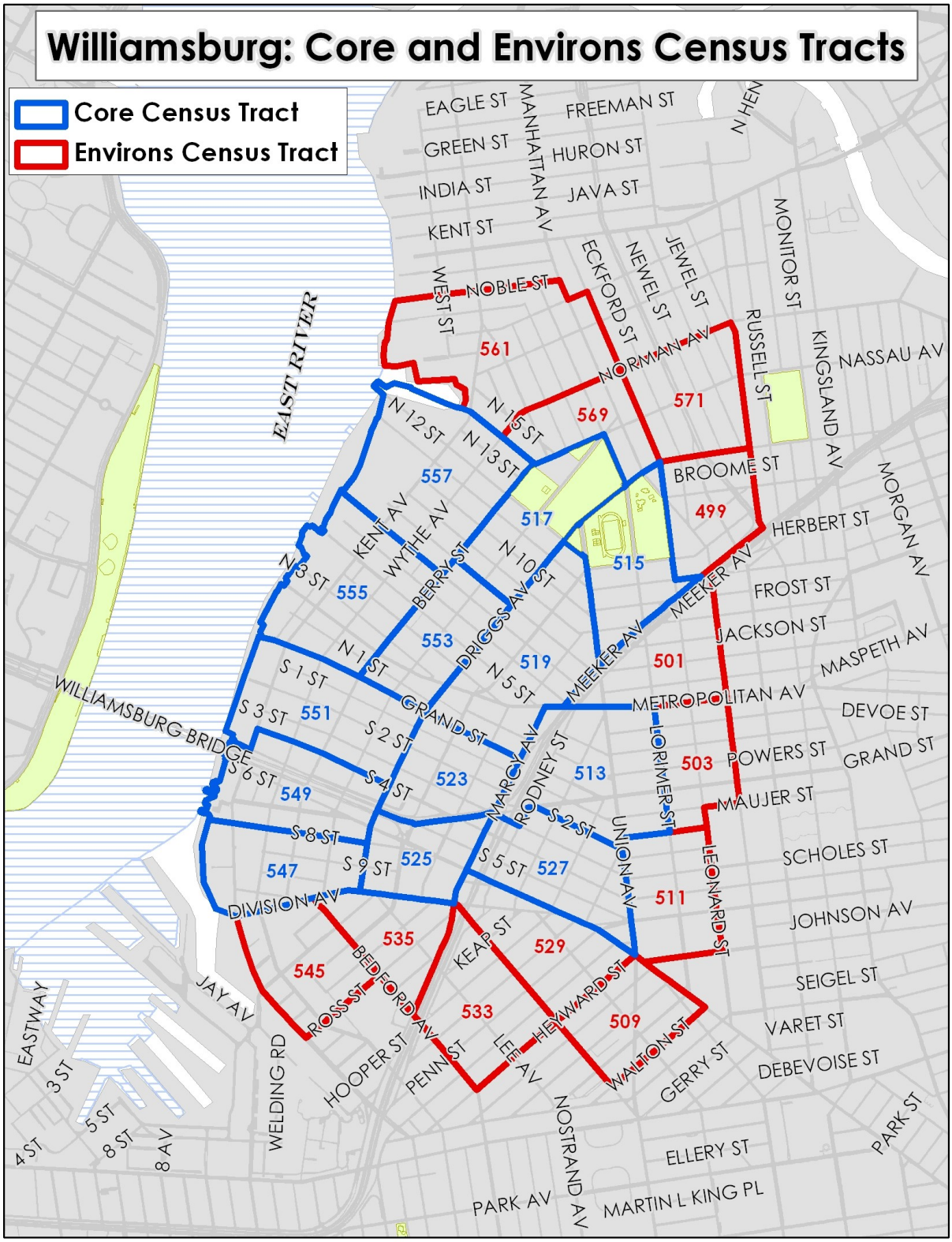
The rationale to use different map scales is the fact that Williamsburg, as defined by this study, is noticeably smaller than is the Lower East Side. The Core areas of these two neighborhoods are 1.04 and 1.64 square Miles respectively. If a single map scale is used for all three neighborhoods, it would be necessary to accommodate the largest neighborhood, and that would be the 1:17,500 map scale. If this scale were applied to Williamsburg, the maps would cover surrounding areas that are not included in this study. Map 4-5, further below, represents the Williamsburg base map using the 1: 17,500 scale. While this seems possibly an aesthetic consideration, the problem with this map scale is that the size of the Census Tracts in Williamsburg are smaller and cannot accommodate the embedded bar charts. For example, Map 4-6 shows the percentages of the White population in Williamsburg. As some Williamsburg Census Tracts are predominantly White, some of the taller bars would extrude into the adjacent Census Tracts. Map 4-7 is the same map using the 1:14,000 scale and even at this level some taller bars are still extruding into adjacent Census Tracts. To avoid these extruding bar charts, and increase the clarity of these embedded bar charts, my priority is to maximize the neighborhoods.



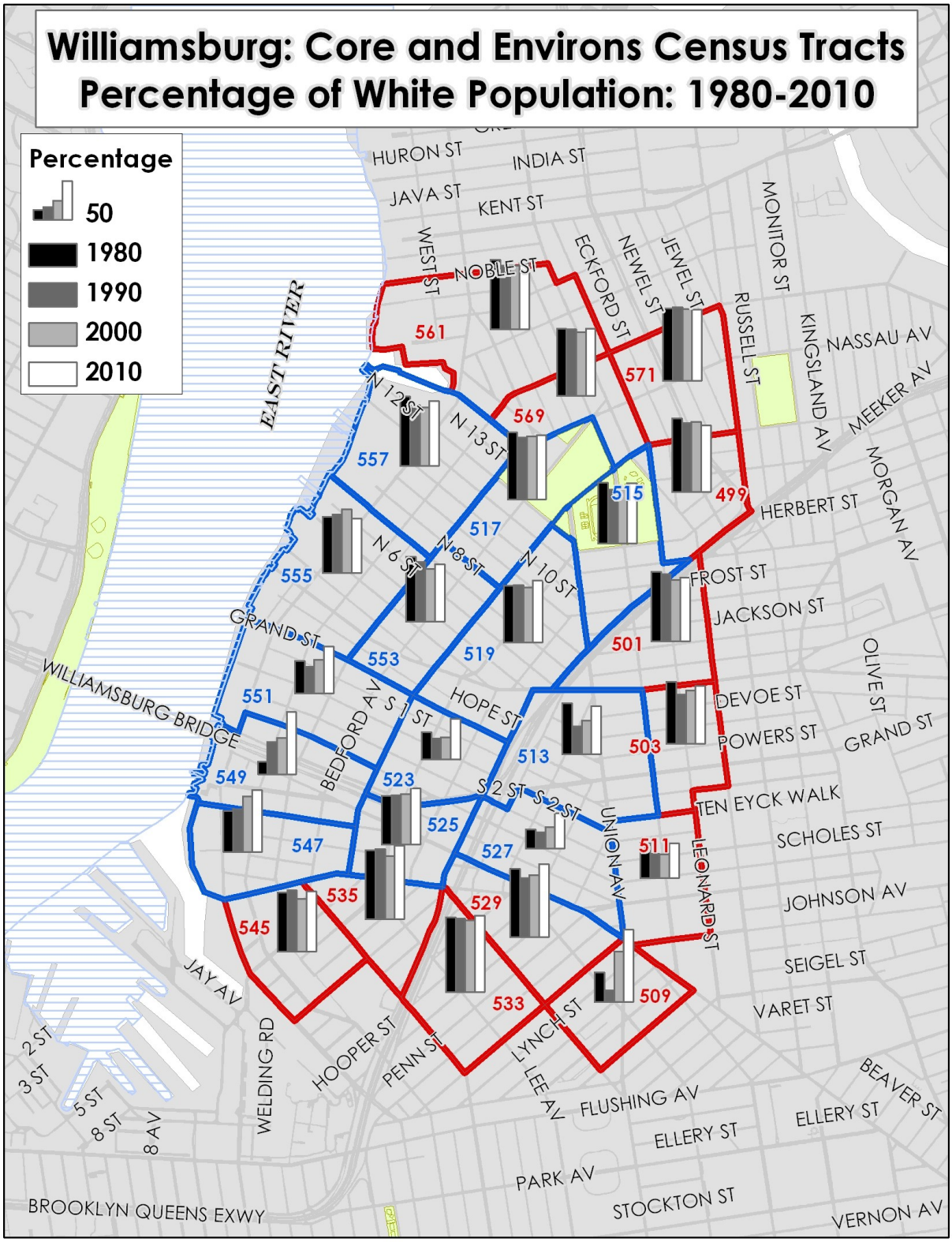
Map 4-3. Population Map of Park Slope with 1:16,000 scale.



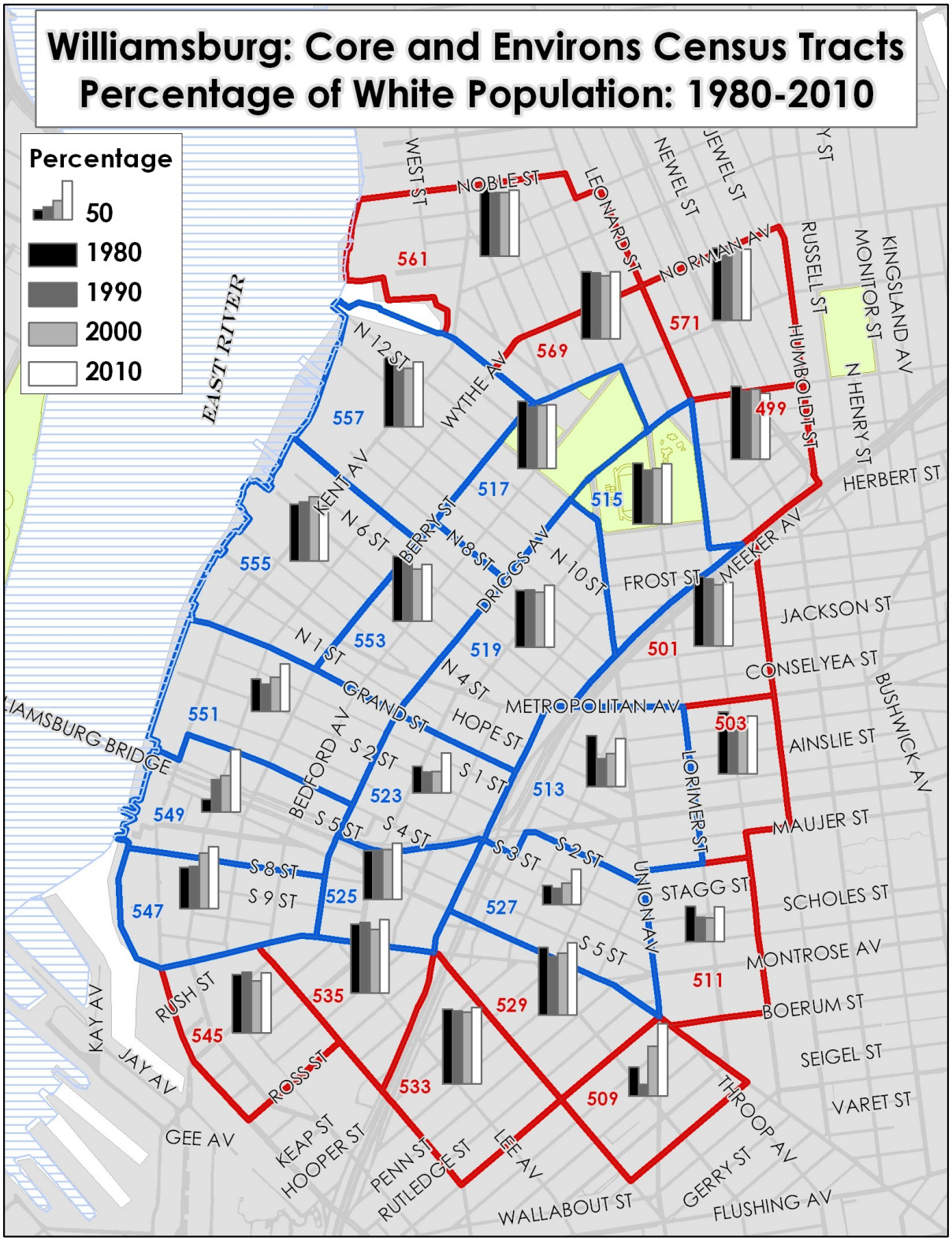
Map 4-4. Population Map of Park Slope with 1:17,500 scale.



Map 4-5. Population Map of Williamsburg with 1:17,500 scale.



Map 4-6. Percentage of White Population in Williamsburg with 1:17,500 scale.



Map 4-7. Percentage of White Population in Williamsburg with 1:14,000 scale.

The bar charts embedded into each Census Tract illustrate the temporal changes based on the values of the four study years (1980, 1990, 2000 and 2010) and are extracted from either Decennial Census Surveys and/or American Community Survey (ACS) when the variables are no longer available in the 2010 Census. The bar charts use different representation schemes as the characteristics and the range of values vary from each other. For example, some are based on the exact numbers directly extracted from the data sources; others are calculated as percentage figures. The details of these different bar chart schemes are detailed after the Data Source section of this chapter.

4-3 Data Sources for the Gentrification Maps

There are three major publicly available data sources used for the creation of the gentrification maps in this study:

A. The New York City Department of City Planning - BYTES of the BIG APPLE.

http://www.nyc.gov/html/dcp/html/bytes/applbyte.shtml

This data source provides the data sets of MapPLUTO and LION:

MapPLUTO is a GIS data-set that originated from the New York City Department of Finance's Digital Tax Map with extra attributes added by the Department of City Planning (DCP, 2011a). The acronym PLUTO stands for “The Primary Land Use Tax Lot Output”. It records three types of data for each tax lot, namely, lot characteristics, building characteristics and the political/administrative district into which a particular tax lot falls. Details of the exact attributes used for this study are documented in the following pages.

The acronym LION stands for "Linear Integrated Ordered Network" and is a single line street network data used to label street names in gentrification maps.

B. The New York City Department of Information Technology & Telecommunications' NYCMap

http://www.nyc.gov/html/doitt/html/citywide/gis_downloads.shtml

Various GIS layers from NYCMap such as the roadbed, hydrography and open space are used to serve as the background of the gentrification maps. Data from this source are used for the background maps.

C. The demographic, socio-economic and housing data originate from the United States Census Bureau's Decennial Surveys and American Community Survey. They are available from the following websites:

Census Bureau:

http://www.census.gov/#

Infoshare:

http://infoshare.org/main/public.aspx

National Historic Geographic Information System:

https://www.nhgis.org/

4-4 Gentrification Maps Group A: The Physical Environment

This group is comprised of three series of maps that depict the physical conditions of the neighborhoods: primary zoning, building age and building heights. The physical environment maps are produced with GIS for this study and are based on the MapPLUTO 2011 release that includes the data from 2010 and coincides with the latest Census Survey used for mapping the social environment. Historical Zoning Maps are downloaded from the Department of City Planning website. These Zoning Maps provide snapshots of land use patterns that approximately correspond to the three earlier Decennial Census Survey years (i.e. 1980, 1990 and 2000).

The three series of physical environment maps, custom-made for this study, are all based on the smallest spatial unit derived from MapPLUTO, which is a single tax lot. In each series, the selected tax lots are highlighted in dark gray for contrast against the un-selected tax lots which are light gray.

The first group in this category is the Zoning Maps. These Zoning Maps show the three primary zoning districts (i.e. residential, commercial and manufacturing). Historical Zoning Maps are selected and downloaded from the Department of City Planning website. These Zoning Maps show the land-use patterns at the approximate time corresponding to the three earlier decennial Census surveys (1980, 1990 and 2000). The current zoning maps are based on the 2011 release of MapPLUTO.

The second group maps the "Year of Construction" of the existing structure in each tax lot in the study neighborhoods. The third group maps "Number of Floors" of the existing structure in each tax lot. These maps, combined with the Zoning Maps, provide an understanding of the characteristics of the physical environment as they illuminate: the land use patterns (by zoning), whether the buildings are predominantly older or newer construction, and if the neighborhoods are largely comprised of short or tall buildings.

Recent rezoning proposals for each study neighborhood are also reviewed. Both the existing and proposed Zoning Maps are downloaded and included in this section for the purpose of discussing the possible effects on the future state of the physical environment and a possible link to current and future gentrification.

4-4.1 Zoning

New York City is divided into three Zoning Districts: residential (R), commercial (C), and manufacturing (M) (DCP, 2011b). These designations assign the legal use for each tax lot. The residential lots are reserved for housing units. The commercial lots are for reserved business activities such as offices, shops and restaurants. The manufacturing lots are reserved for factories and infrastructure such as power stations and airports. Each district is further divided into sub-categories and each sub-category with its own particular land use regulations and restrictions.

In general, these districts are exclusive to each other, although under circumstances they are overlaid onto each other. For example, specific tax lots are zoned as commercial with a residential overlay. Tax lots like this are regularly found along commercial strips in a residential

neighborhood. Buildings on these lots have shops on the ground (and/or second) floor with upper floors designated for residential use.

Historical Zoning Maps that correspond to the year of the Decennial Census Surveys that are used for the social environment gentrification maps are downloaded from the Department of City Planning by (DCP, 2013). These historical Zoning Maps are to be compared with Zoning Maps produced using GIS in this study (DCP, 2011c). In contrast to the downloaded historical Zoning Maps that include all Zoning Districts and overlays in a single sheet of maps, the Zoning Maps developed for this study focus only on the three primary zoning categories (i.e. residential, commercial and manufacturing) at the tax lot level for each neighborhood.

These GIS-generated Zoning Maps for each neighborhood are developed with each primary Zoning District highlighted as black tax lots, in contrast to the other tax lots in identical gray color. These maps illustrate the current land use patterns of the neighborhoods such as where people live, where people shop and work and where are the factories or other industrial activities. While the Zoning Maps produced in this scheme are intended to simplify the complex zoning applied to New York City (as observed in the single-sheet Zoning Maps), this study's GIS-generated Zoning Maps are distinctive from each other and provide a quick and easy visualization of the primary land use within each neighborhood.

4-4.2 Building Age Maps

Each existing structure on the New York City's tax lots are recorded with the year when construction was completed. However, because MapPLUTO is a fairly recent data-set, a portion

of the construction completion years especially for the older buildings are estimated and identified with a marker. Despite this uncertainty related to older buildings' records of completion year, it does not extensively affect this study because the purpose of this series of maps is to provide a general idea of the age of the existing structures. A secondary purpose of this series of maps is to examine whether post-1980 construction, corresponding to the U.S. Census Surveys, are clustered around specific areas within the three study neighborhoods.

It should be noted that this series of maps is not intended to analyze the construction booms and wanes experienced by each neighborhood. MapPLUTO only records existing structures; demolished buildings are subsequently replaced by newly constructed ones and are overwritten on MapPLUTO; MapPLUTO therefore cannot inform if there were waves of demolition and construction in the past. Again, the purpose of this series of maps is to illustrate (as of 2010) the approximate ages of existing buildings as well as the locations of any new buildings. For these two purposes, the MapPLUTO year built data is aggregated into the following un-equal interval groups: Pre-1940, 1940-1959, 1960-1979, 1980-1989, 1990-1999, 2000-present. The first three groups are intended to establish the locations of the existing buildings built before the time period of this study. The last three groups are aggregated with smaller intervals each reflecting a single decade that corresponds with the time-frame of the Census Surveys used in this study. These three groups are used to examine whether there is new construction in these neighborhoods and if so, whether they cluster within these neighborhoods. Similar to the method used to produce the Zoning Maps, six maps (one for each group) are developed for each neighborhood highlight as black tax lots against the other tax lots as gray.

4-4.3 Building Height

This series of maps is based on the MapPLUTO's data identifying number of floors. It should be noted that not all floors are built with the exact same height. Shops and factories might have a lower number of floors, but each floor might be taller in dimension than an ordinary residential floor. Older buildings might have taller individual floors than do newly constructed buildings, or vice versa. At times, within the same building the ground floor might be taller than are the upper floors to accommodate shared space. In other words, mapping building heights using the number of floors from MapPLUTO' data an inexact process of approximation. Nevertheless, the purpose of this series of maps is to illustrate the general physical characteristics of the three study neighborhoods to determine which grouping of floors has a greater visual presence. This will allow those who are unfamiliar with these neighborhoods to create better mental images of neighborhood characteristics.

These maps provide another visualization to describe of the physical characteristics of the neighborhoods such as: whether the buildings are generally short, or tall, and whether each group clusters at specific areas of the neighborhoods. Data are aggregated into the following groups: 0, 1 to 2, 3 to 4, 5 to 6, 7 to 12 and over 12. These categories, when co-examined with the Zoning Maps, approximately correspond to the following building types:

0 floor: no structure

1 to 2-floor: short houses, factories, shops

3 to 4-floor: taller houses, brownstones

5 to 6-floor: walk-up apartment buildings

7 to 12-floor: taller apartment buildings

over 12-floor: high-rise buildings

Following the methodology from the previous sections, tax lots in each group are highlighted as black and the other tax lots are highlighted as gray. Six maps reflecting different groups of the number of floors in each building are developed for each neighborhood.

4-5 Gentrification Maps Group B: The Social Environment

This group of gentrification maps is based on the publicly-available data sets originated from the U.S. Census Bureau. These data sets are also available from other non-profit websites such as InfoShare and National Historical Geographic Information Systems. The data from four Decennial Census Surveys from 1980 through 2010 are the variables used in this group of gentrification maps. Results from the American Community Survey (ACS) are also used to fill in the variables not available from Census 2010 as it was a short-form only survey. From 1940 to 2000, two types of questionnaires were used for the Decennial Census Surveys: a “short form” with basic questions such as: age, sex, race, and Hispanic origin, and a “long form” which was only administered to about one in every six households with additional questions regarding socio-economic and housing characteristics.

Census 2010 was implemented as a “short-form” survey as the “long form” was replaced by the American Community Survey (ACS). ACS is designed to be a rolling and sampled assessment as opposed to the once-every-ten-year Census Survey. Although this initiative enables the Census Bureau to release shorter interval estimates, it is not a direct substitute for the previously used long form. As the data from the Census 2010 is short-form only, variables only available from the older Census Survey’ long form were extracted from ACS data for longitudinal comparisons. This is the first time researchers conducting longitudinal studies were affected by comparing the results from the Decennial Census Surveys with the ACS, the effects of this research design are yet to be examined and discussed by future scholars. On the other hand, as the long form has been disbanded, this comparison is the only available approach to carry out longitudinal studies at the current time and will be useful going forward. Both the Census Bureau and DCP have approved researchers to compare Census 2000 with recent ACS but advise users to approach with caution (DCP, 2012; U.S. Census Bureau, 2012a).

As described above, this study uses data from four Decennial Census Surveys (together with ACS data when the selected variables were only available from long form Census Surveys). The initial year, the 1980 Census Survey, serves as the benchmark for selecting the variables to create the gentrification maps. Newer variables devised and only available in more recent Census Surveys are excluded from this study to maintain the continuity of the maps with the 1980 data. In the following pages the selected variables from the Census Survey are listed and explained.

In each other neighborhood chapter, before presenting the gentrification maps, bar charts with the values from New York City, the Five Boroughs and the study neighborhood’s Core and

Environs areas are listed to illustrate the general trend. For example, variables from the "straight count" categories such as the total population have three separate bar charts as the numbers from New York City and the Five Boroughs are much greater than those from the neighborhoods and a single bar chart cannot accommodate all of them while clearly show the differences among the four Census Surveys. The first bar chart illustrates the population of New York City and the Five Boroughs. The second bar chart illustrates the "aggregated" neighborhood population (with the values from the Core and Environs combined). The third bar chart lists the population of the Core and Environs areas of a neighborhood separately.

For the variables from the "percentage" categories such as the percentage of the White population (of the total population) all the figures are listed in a single bar chart as all their values range from zero to one hundred (percent). The values from the Core and Environs are listed separately to provide a general trend illustration before the detailed gentrification maps which are based on Census Tract level data.

I made every effort to use a single bar chart scale for this study whenever possible. However, due to the wide ranges of figures it is simply not possible to use a single scale for every map and chart so that they are clearly legible. Other than the variable differences between the "straight count" and the "percentage" types, within each of these two types of variables there are also wide ranges. For example, the total population at the Census Tract level can be in the thousands. The median household income, on the other hand, can reach tens of thousands. Even among the "percentage" category, the range could be so wide that the scale has to be adjusted to accommodate them. For example, in the housing condition maps, the percentage of renter-

occupied units is generally much greater than that of the vacant units. Although I made some compromises to minimize using different scales, it simply cannot be avoided totally. While efforts are made to make as many maps as comparable as possible, readers are advised to check the representational bar chart in the map legend before making comparisons among different maps in this study.

Values of each selected variable is sequenced and attached to the corresponding Census Tract using GIS software with a color coding scheme for bar charts as indicated in the map legend. The map legend is generally located at the corner of a map to ensure it does not obscure the neighborhood Census Tracts and embedded bar charts.

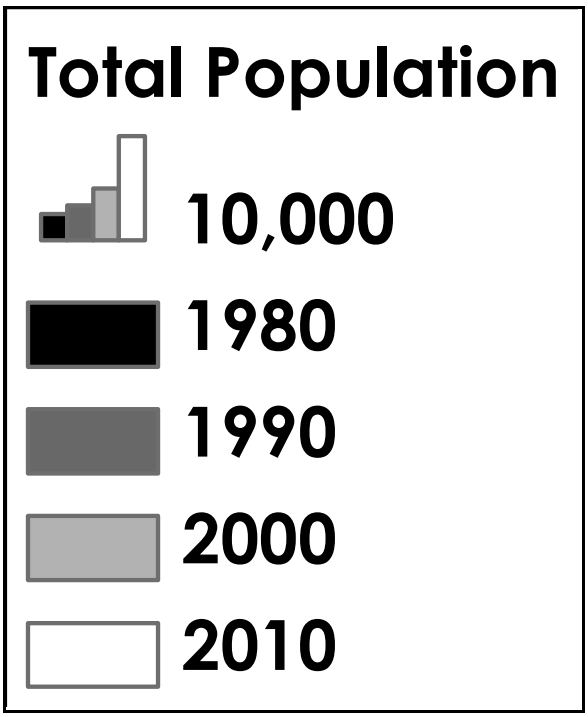


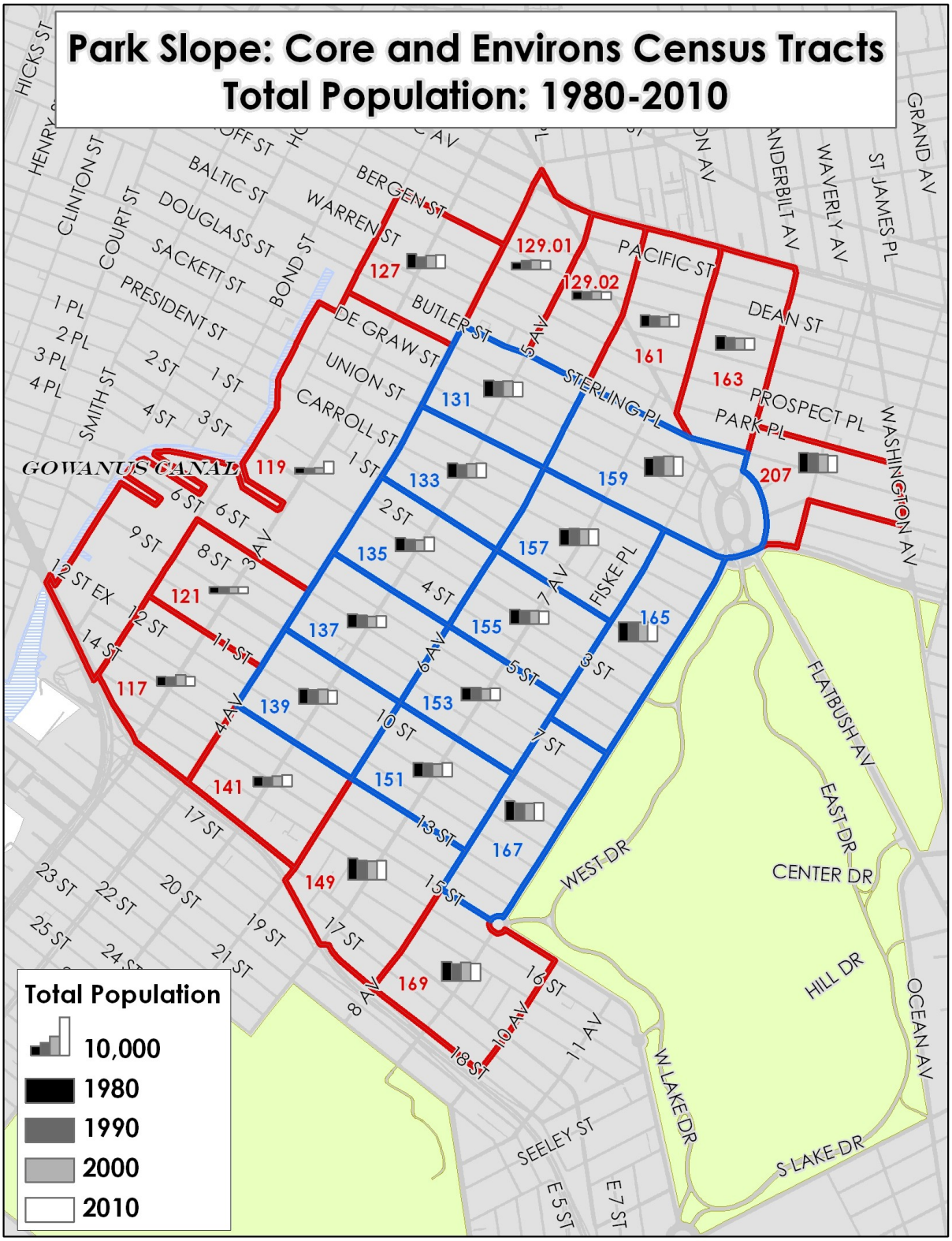
Figure 4-2. Sample Map Legend of the Gentrification Maps.

In this sample map legend (Figure 4-2 above) the top line “Total Population” states the values depicted by the map. The bar chart below the top line (“Total Population”) is automatically generated by the GIS software to provide reference heights and illustrate how the height of each bar represents the value of the variable (i.e. total population in this example). The most crucial bar in this example is the white bar on the far right, whose height represents 10,000 as indicated in the legend; the three bars to its left indicate 50%, 33% and 25% of the white bar (representing the total population of 5,000; 3,333; and 2,500 respectively).

If the map is based on percentages, this scheme remains valid, i.e. the number in the legend illustrates the value of the first right bar. The next three bars from right to left represent 50%, 33% and 25%, respectively, of the value the first right bar represents.

The four rectangles below the representation bar chart illustrate the years symbolized on the map: the color black for the year 1980, the color dark gray for the year 1990, the color light gray for the year 2000, and the color white for the year 2010. The map of the total population for each Census Tract in Park Slope is included here to illustrate this arrangement, (See Map 4-8). As mentioned in the previous discussion, the space encompassing each Census Tract on the map is limited and therefore the embedded bar charts are compressed to fit into the map. Nevertheless, they correspond to the representation bar chart in each map legend. To provide a clearer view to the readers, two bar charts i.e. grouped by their locations of Core vs. the Environs are included after the map as a supplement. These bar charts are sequenced by their Census Tract numbers which do not always bear any particular spatial relation. These bar charts are also included to demonstrate the reason maps with embedded bar charts are more helpful because these maps can

reveal whether spatial patterns exist among the figures. To facilitate comparisons among the Census Tracts from the Core and Environs area of a neighborhood, these two groups of bar charts are arranged to be displayed on the same page: the Core Census Tracts at the top half of the page and the Environs Census Tracts at the bottom. To maximize the available space on a single page, these bar charts are only titled with captions. In the case of the Lower East Side because the number of the Census Tract in its Core area is greater than those in the Environs (29 vs. 11) the horizontal dimension of the bar chart for the Core area are compressed. The vertical dimension is retained so the values can be compared directly to those in the Environs.



Map 4-8. Total Population of each Census Tract of Park Slope.

For straight count variables such as total population, no adjustment is made and they are mapped straight from the original downloaded data-sets. Monetary variables, such as income and rent, adjustments are made using the Consumer Price Index (CPI) Inflation Calculator from the U.S. Bureau of Labor Statistics (U. S. Department of Labor, no date). Values from pre-2010 Census Surveys are calculated to be directly comparable to the data from Census 2010. Other than the longitudinal comparisons using four Census Surveys from 1980 through 2010, assessments are also made against the corresponding values from the Borough the study neighborhood is located. The following variables are used to create this group of gentrification maps for the social environment.

4-5.1 Total Population

The term "total population" does not indicate the in-migration or the out-migration patterns in an area. Total population simply records the total number of population from each Census Tract at the time when the Census Survey was conducted. Nevertheless, this map shows the growth or decline of total population for each Census Tract during the study period. It also provides a quick visual comparison of the total population of one Census Tract to another.

4-5.2 Selected Ethnic Groups

As mentioned above, this study is based on the 1980 Census and the data available from that particular survey are used as the benchmark for this series of maps. In the 1980 Census Survey, there are fifteen groups listed in the race item, namely: White, Black, American Indian, Eskimo, Aleut, Chinese, Filipino, Japanese, Asian Indian, Korean, Vietnamese, Hawaiian, Samoan,

Guamanian and Other. This study maps only the White, Black and Chinese populations as the other racial groups do not have a considerable presence in the three study neighborhoods. In fact, the racial category "Chinese" is included in this study only because part of the Chinatown in Manhattan is included in the definition of the Lower East Side. While there are not many Chinese people living in Park Slope or Williamsburg, the Chinese are also mapped to provide a contrast that further highlights the concentration of the Chinese population in certain areas of the Lower East Side. In this series of maps, each racial group is calculated as a percentage of the total population for each Decennial Census Survey. They are sequenced from 1980 through 2010 to illustrate the rise or decline of their presence at the Census Tract level.

The Hispanic population by the Census Bureau's definition is a binary categorization. Respondents indicate that they are either "Not Hispanic or Latino" or "Hispanic or Latino" (U.S. Census Bureau, 2007). Under either category respondents can then further identify themselves with a particular race option from any of those listed in 4-5.2. For this study, the percentage of the Hispanic population of the total population is mapped of each selected Census Tract.

4-5.3 Selected Age Groups

This study does not intend to be a comprehensive demographic inquiry, but it does seek to examine whether certain age groups have a strong presence in the three study neighborhoods. The following three age groups from the total population are mapped:

Age Under 5: Certain early gentrification studies have characterized gentrification neighborhoods with DINKs (Double Income, No Kids). To examine if this argument still holds validity, the spatial distribution of new born infants and toddlers are examined using this map.

Age 22-29: Williamsburg, Brooklyn is one of the three study neighborhoods that has experienced with an influx of young artists and college students who can no longer afford residing in the Lower East Side (Bahrampour, 2004). This series of maps examines the spatial distribution of young adults in this age group.

Age 65 and Over: At the other end of the age spectrum is the senior citizens group. This series of maps examines whether this particular group maintains their presence in these three neighborhoods during the study period.

4-5.4 Housing Tenure Conditions: Total Housing Unit, Percentage of Renters and Percentage of Vacant Units

There is a variable from the Census long form known as “Tenure” (H7); the comparable variable from ACS is B25003 (U.S. Census Bureau, 2012b). This series of maps will illustrate the types of housing tenure within these three study neighborhoods.

4-5.5 Median Household Income (In the Past 12 Months)

The 1980 through 2000 values are from the U.S. Decennial Census Surveys; the 2010 data is from the 2005-2009 American Community Survey, 5-year averages.

4-5.6 Median Gross Rent

This study will focus on the changing rental market and document the rising (or falling) cost of rent for the three study neighborhoods. The data sources are from Census Surveys 1980, 1990 and 2000 and an estimate for 2010 from ACS 2005-2009, 5-year averages.

4-5.7 Educational Attainment

This section contains two maps: the first includes individuals with College (or above) Degree; the second includes individuals without a High School Diploma. The Census Survey only asks respondents older than 25 to indicate their highest educational attainment. This study calculates the percentage figures by dividing the head counts from the Census Surveys in the total population. The mathematical formula allows this study to focus on gentrification as it is represented by the general concentrations of these two groups of people and does not focus on the educational attainment among the adults.

While previous researchers have recorded a rising number of people with College (or above) Degree as an indicator of gentrification, this study adds the group of people lacking a High School Diploma. A comprehensive examination of gentrification should pay close attention to both ends of educational attainments and observe whether their presence is affected by gentrification.

4-6 The Embedded Bar Charts in the Gentrification Maps

While it is favorable to use a uniform bar chart representation throughout a study to allow for direct comparisons, due to the different nature and various ranges of the variables used in this study it is regrettably not possible to use a uniformed bar chart continuously across maps. Nevertheless, every effort has been made to minimize the numbers of representation schemes used in this study. Another consideration is to use the same representation scheme for the same variable in all three study neighborhoods so that they can be compared directly to each other. For example, the bar chart representation reflecting the percentages of the White population (of the total population) is the same bar chart scheme used for all three study neighborhoods. With this arrangement, at least the same theme map from all three study neighborhoods can be directly compared.

In general, there are three types of variables used in the social environment gentrification maps, namely: straight counting numbers, proportional percentages and comparison percentages.

1. Straight counting maps use the values directly as they are recorded in the Census Surveys. Variables such as: total population, annual median household income and monthly median gross rent are examples of this type of data. Due to the various ranges involving these variables, different schemes have to be adapted. For example, the tallest bar in the map legend for the total population represents 10,000. While this scheme works for all total population maps in the three study neighborhoods, the top value for the annual median

household income requires another scheme as the values are much greater; in fact, it is tenfold greater (i.e.100,000).

2. Proportional percentages are the calculated values derived from a selected sample group within a population. Examples of this type of variables are: the percentage of White population (of the total population), the percentage of renter-occupied housing units (of all housing units), the percentage of people without a high school diploma (of the total population). These percentages indicate proportions of a specific universe and do not exceed 100%.

3. Proportional percentages are the results of comparing the proportional percentage to the average of a Borough and place the figures in a larger context. As a result, comparison percentages can exceed 100%, or reach below zero if they lag behind the Borough's figures. Although it might seem logical to use the citywide figures as the baseline for the comparison, New York City is a large and complex metropolis and its figures can sometimes be guided and skewed by the extremes on both ends of the distribution. The figures from the two respective Boroughs (i.e. Brooklyn and Manhattan) where the three study neighborhoods are located provide a broader geographical context but retain a certain local framework for study.

4-7 GIS Software

While the design of this study aims to discuss the advantages of using GIS to map gentrification, there are two GIS related issues which are not addressed in this study. The first is a review of currently available GIS software; the second is the creation of a step-by-step instruction book for the gentrification maps in this study.

There are numerous GIS software programs on the market at the time of this study and this study does not serve as a product assessment. These companies have copyrighted and trademarked their products and possess different designs and interfaces and compete against each other in the marketplace. However, the gentrification maps developed in this study do not employ any particular proprietary procedures. In other words, any available GIS software program should be able to produce similar maps for comparison or for follow-up studies.

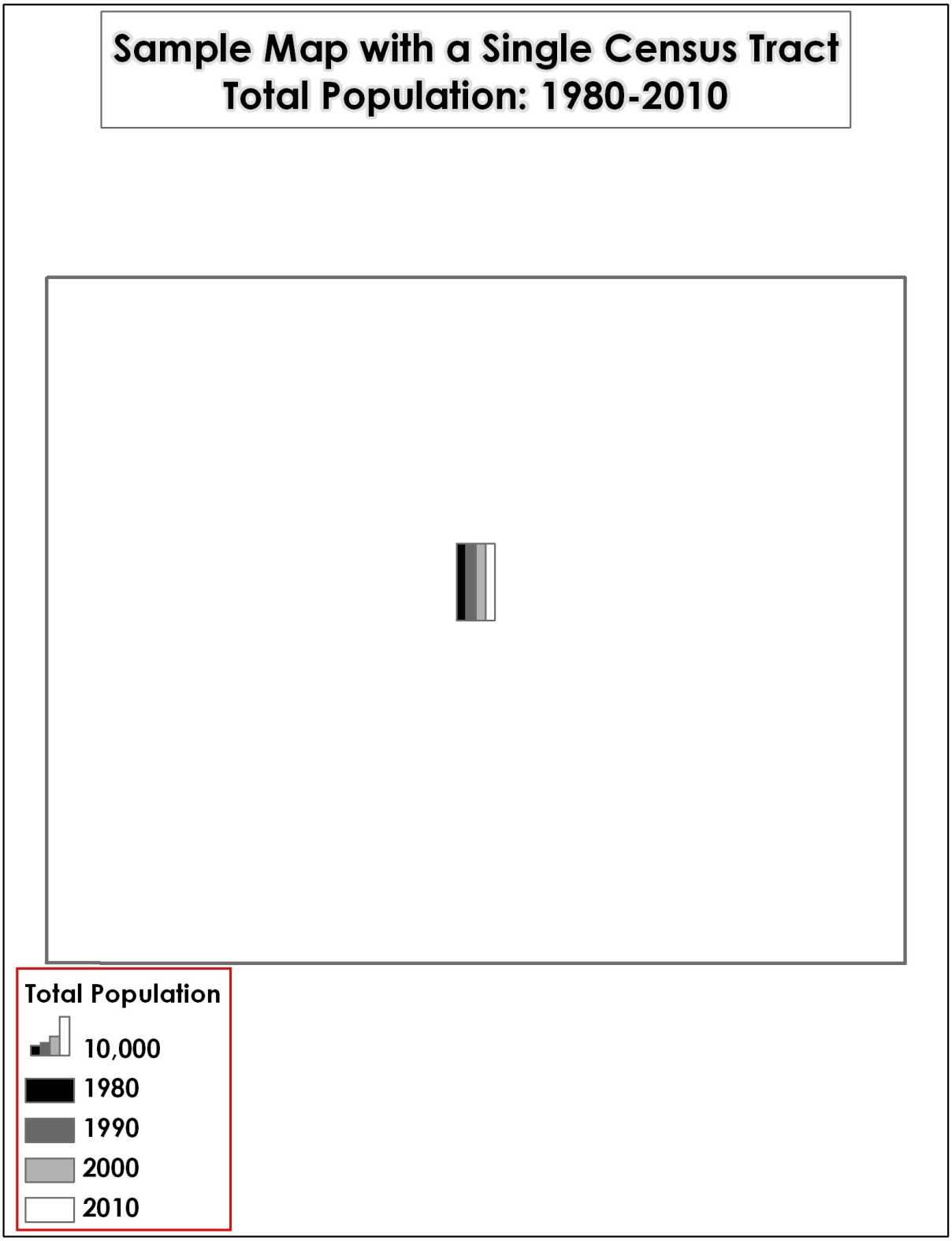
Desktop GIS software programs for personal computers, like other software, are being updated with new releases regularly. While some updates simply streamline steps to accomplish the same goal or add new functions, at times a new version is considerably different from a previous release. A step-by-step instruction book will be out-of-date in a short period of time. Again, the gentrification maps in this study do not employ any particular proprietary procedures. Those who wish to replicate these maps should be able to do so after taking a course to familiarize themselves with the software program of their choice. The resulting layouts might appear slightly different due to the unique design from each individual software company, but the embedded bar charts function is common to all GIS software programs.

This is not to say, however, that this study does not reflect upon the particular software used to create the maps. While the maps in this study do not employ particularly complex procedures to produce, the amount of effort and time spent on creating the maps in the study has been considerable and the results not always ideal. To streamline the content and structure of this chapter, the discussions below only focus on the mapping elements crucial to this study.

For this study GIS is a tool for creating maps, and like all tools it has its strengths and also limitations. The maps in this study are created with ArcMap – ArcInfo 10, released by the Environmental Systems Research Institute, Inc. (Esri), located in Redlands, California. Certain aspects of the map formats in this research are due to the design of ArcMap. For example, in the social environment gentrification maps section, SES indicators are mapped by converting the values into a bar-chart at the Census Tract level with the following color scheme to represent the Census Survey years as follows: black: 1980; dark gray: 1990; light gray: 2000; white: 2010. The bar charts are then displayed, via the GIS software, inside each Census Tract of each of the three study neighborhoods. By examining the trends of each bar chart, spatial patterns within the neighborhood might be revealed.

For the purposes of illustration, consider a singe rectangular-shape Census Tract with a total population of 20,000 in all four Census Survey (1980, 1990, 2000, and 2010). With the color scheme specified above, ArcMap generates a map with a legend displayed below (See Map 4-9). In the map legend, indicated as a small red-outlined rectangle in the lower left corner, a representational bar chart is generated by the GIS software to provide a reference for the values listed in the bar charts that is inserted into the Census Tracts. The color scheme is also included

to indicate the Census Survey year each color represents. This legend is enlarged as Figure 4-3 and is included after Map 4-9 for further discussion.



Map 4-9. Sample Map with 20,000 Population in a Single Census Tract for Four Census Survey Years, 1980 through 2010.

As the sample Census Tract has a fictitious total population of 20,000 through the four Census Survey years, the bar chart shows four bars with the same height that follows the color scheme included in the lower part of the map legend (See Figure 4-3 below): black for 1980, dark gray for 1990, light gray for 2000, and white for 2010.

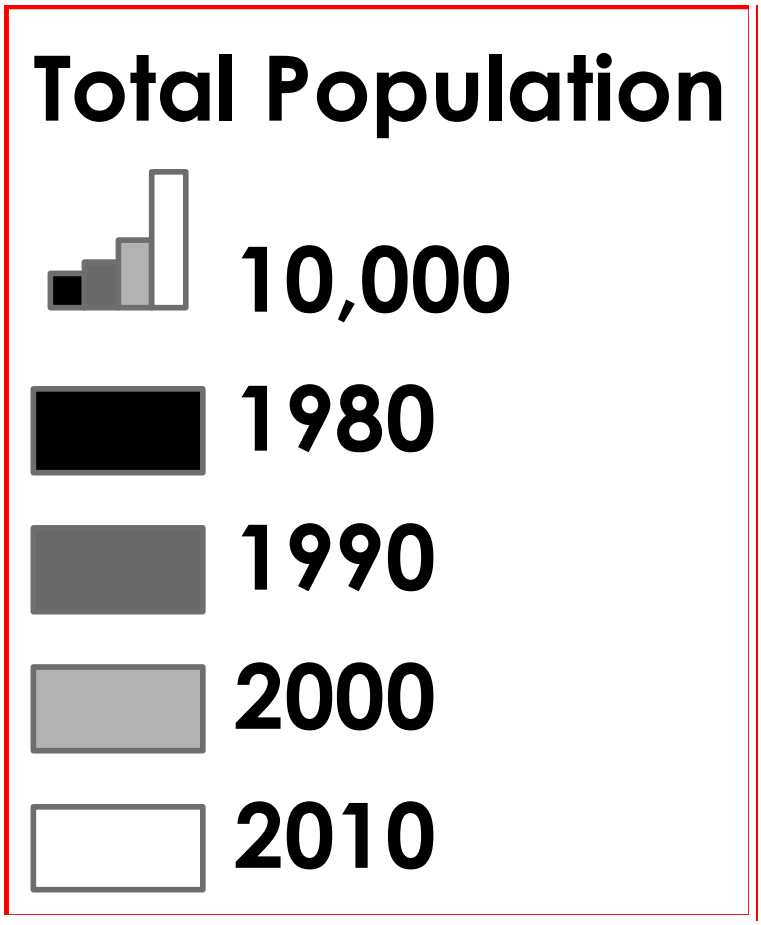


Figure 4-3. Enlarged Map Legend with Representational bar chart and color scheme for four Census Survey years.

On top of this color scheme is a program-generated representational bar chart with the number value 10,000 on its right. This representational bar chart is generated by ArcMap 10 with the following steps:

1. ArcMap 10 examines the ranges of the variables and select the highest value.

2. ArcMap 10 then takes approximately half of the highest value, labels it (i.e. 10,000 in this case) and uses it as the tallest bar located at the far right in the representational bar chart.

3. ArcMap 10 then generates lower "steps" (bars) that represent lower values to the left with the following formula: 50% of the tallest bar, 33% of the tallest bar and then 25% of the tallest bar.

4. In other words, converting this representational bar chart for this scheme into actual values would be, from the right to left: 10,000 (white bar, labeled), 5,000 (light gray bar), 3,333 (dark gray bar), and 2,500 (black bar on the far left).

An ArcMap 10 user can specify a value from 1 to 200 to adjust the overall size of the bar charts. However, the formula for generating the bars in the representational bar chart is fixed. In ArcMap 10 there is no option available for the program user to fine-tune the lower steps. There is also no way to label them individually, except to manually inserting each value number in each map.

Another limitation with this automatically generated representational bar chart is the possible interpretation of a trend it may imply. A novice mapping student may review the legend, misinterpreted the color coding as individual years, and conclude that there is a rising trend. In the fictitious map above, while there are no additional steps required because the population for

the four Census Survey years are precisely the same (i.e. 20,000), ArcMap 10 will generate a representational bar chart with a misleading increasing trend.

The ratios of the representational bar chart are also fixed by the ArcMap 10 software program and no options are available for the program users to modify them. While one may prefer to use a straight and constant 50% "stepping-down" scheme (i.e. 50%, 25% and 12.5%) or a less steep decreasing trend at a constant two-thirds "stepping-down" (i.e. 67%, 44% and 30%), none of these schemes are available to customize the map legend.

Due to these restrictions of the software used, the maps created for this study are not always the easiest to understand. Nevertheless, as all the maps are created with the same program they share the same limitations and the format of the representational bar chart in the map legend is generated the same way. As this study uses bar charts extensively to demonstrate the trends associated with each Census Tract, the formula for the representational bar charts in the map legends is integral to interpret and understand the values represented in the bar charts. In summary, the tallest bar on the far-right is approximately half of the highest value in the map and it is labeled accordingly. The three "stepping down" bars to its right (and from right to left) follow the formula of 50%, 33% and 25% of the tallest bar. These three "stepping down" bars are not labeled.

Map formats and designs are cartographic topics that are beyond the scope of this study. However, the above discussion describes the role of the representational bar charts that appear in the map legends. The representational bar charts in the map legends are integral in reading and

understanding the gentrification maps developed for the three study neighborhoods in the following chapters. It is for this reason the representational bar chart are discussed in detail in this research design chapter to provide context for the discussion in the next chapters that deal with the gentrification maps of the three study neighborhoods.

Chapter Five : Park Slope

Park Slope, a neighborhood in Brooklyn, has been gathering some buzz in the past few years. In the 2007 January/February issue of *Natural Home & Garden* it was selected as one of America's "10 Best Eco-Neighborhoods" (Romer, 2007). It was also selected by the American Planning Association as one of the "10 Great Neighborhoods in America" for its "architectural and historical features" (American Planning Association, 2012). The photographs in Figure 5-1 show the various styles of late-nineteenth century buildings in Park Slope. More recently, in 2010, *New York Magazine* rated Park Slope number one in its "The Best Places to Live in NYC" feature (Silver, 2010).

Regardless of how this number one ranking was calculated by its pseudo-scientific "livability calculator", not all New Yorkers agree with this finding. For instance, there are mocking terms such as "Teat Lounge" in a novel that satirizes some of the new mothers who nurse at a local tea/coffee house called Tea Lounge (Kurutz, 2009). There is also the term "Puke Slope," and John Mollenkopf, Director of Center for Urban Research at City University of New York, explains arises largely from the fact that "people who are well-housed are the envy of others" (Harris, 2008).

Figure 5-1. Typical Buildings in Park Slope.

But the current residents of Park Slope are not just well-housed, there is a distinctive lifestyle in this neighborhood. For example, the photograph in Figure 5-2, taken at the intersection of 7th Avenue and 5th Street, provides a glimpse of life in Park Slope.

Figure 5-2. Park Slope 7th Ave. and 5th St., February, 2010.

"COMING SOON" as the board states in bold letters, not just a regular bakery, but one that will offer "Artisan Bread," and not fast food but "slow roasted," indicating the extra effort invested in the cooking labor and production; and not just common chicken but "organic" chicken. If the advertised products have not painted an image of up-scale consumption, then the nanny and baby

in the photograph add yet another sign of the lifestyle in Park Slope, i.e., a White baby cared for by a minority nanny.

Park Slope was not always this posh. In this chapter I will document the changes experienced in Park Slope, since 1980, using gentrification maps. As previously stated in the research design chapter, the design of the gentrification maps will illustrate the uneven development during the last three decades. Before I begin examining the gentrification of Park Slope, I will first define the geographic coverage of Park Slope for this study.

5-1 Defining the Park Slope Neighborhood

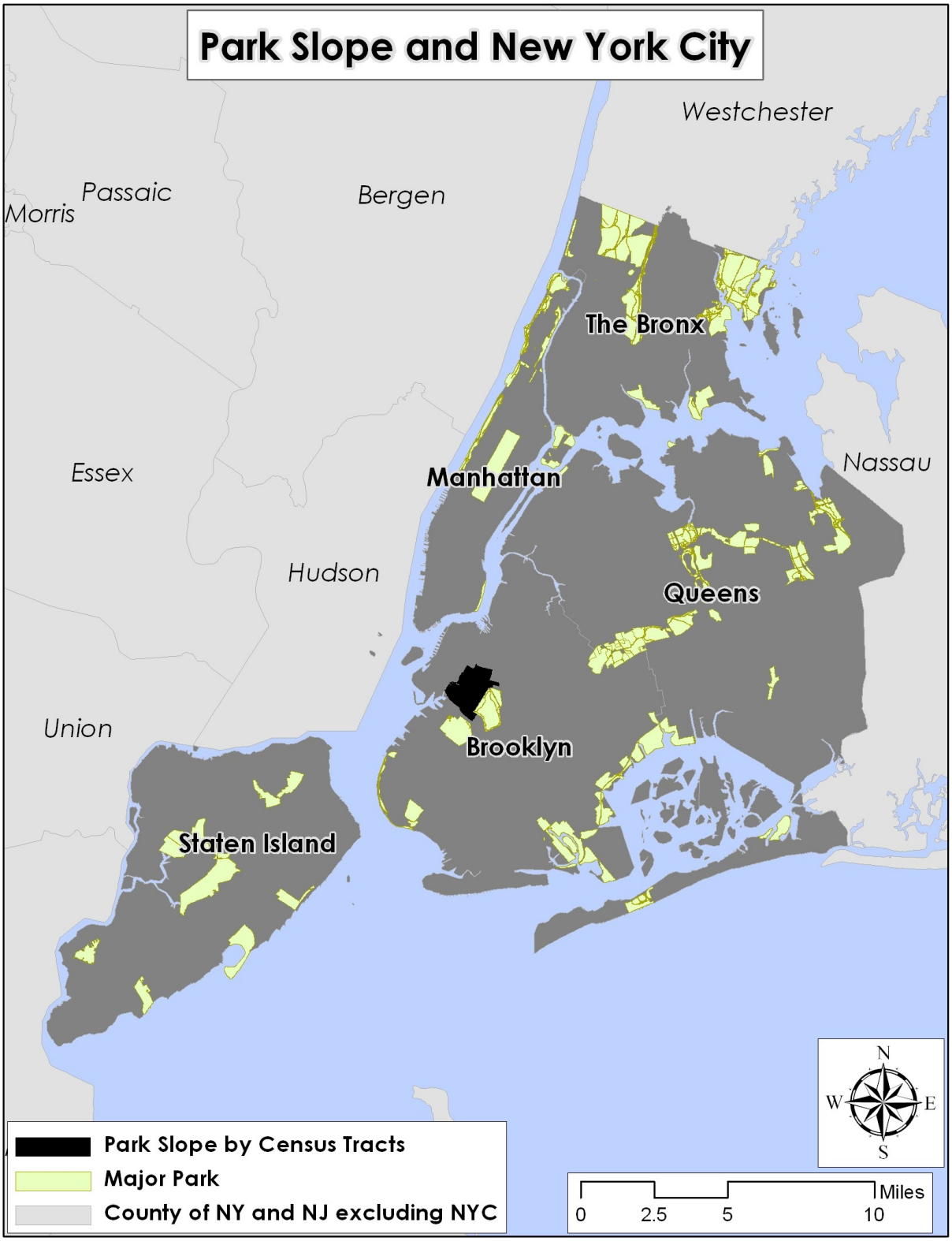
Park Slope is located in Northwestern Brooklyn, which is Kings County, as indicated by the black shaded area in Map 5-1 below.

Researchers (Brooklyn Historical Society, 2008; Justa, 1984; Lees, Slater and Wyly, 2008; O'Hanlon, 1982; Slater, 2003) agree that the following streets form the boundaries of Park Slope: Flatbush Avenue on the North, Prospect Park West on the East (facing the western boundary of Prospect Park), 4th Avenue on the West and 15th Street on the South (flush with Prospect Park Southwest). Map 5-2 below highlights these streets with dark brown lines to show this geographic coverage.

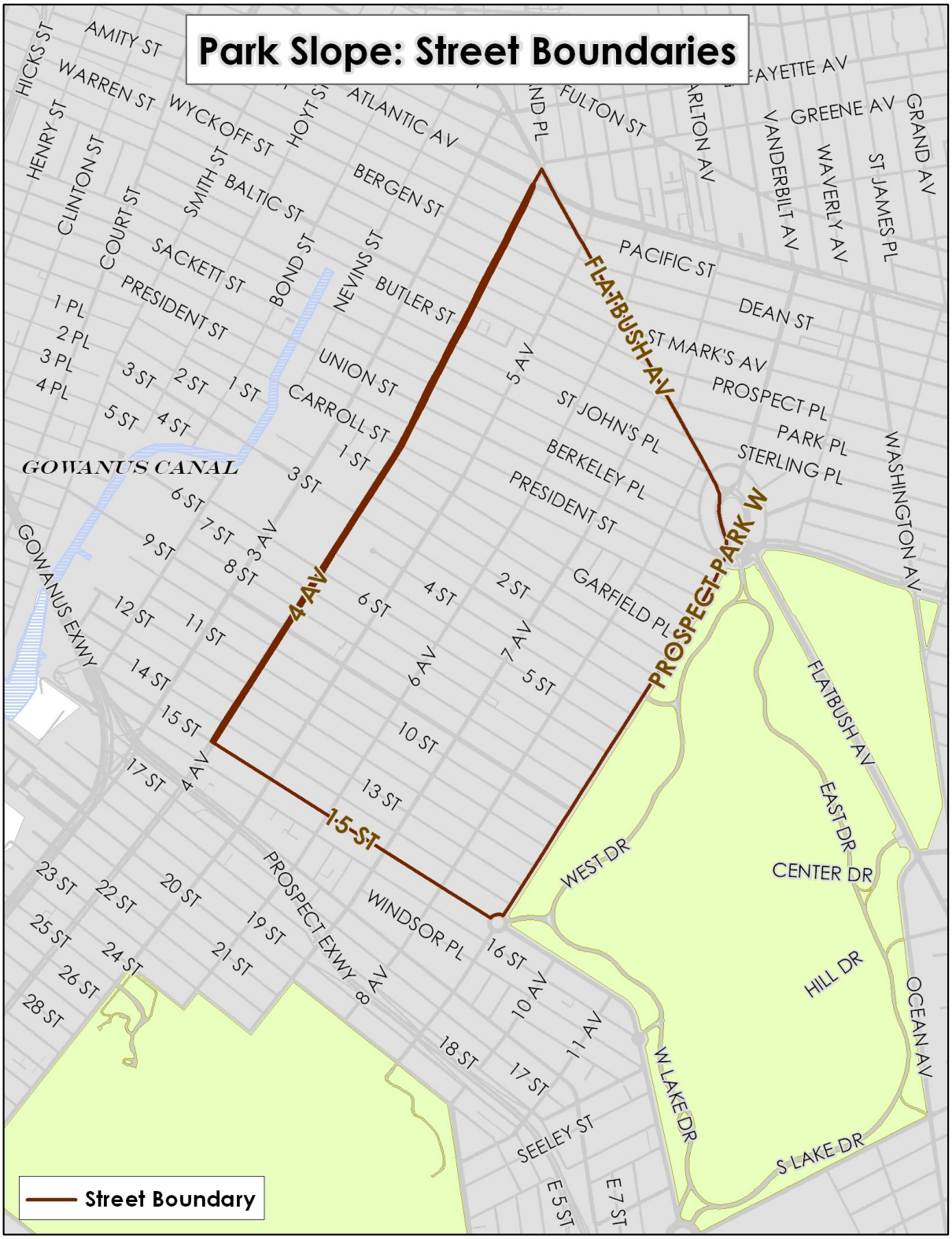
As the design of this study relies on Census Survey data, Census Tracts were selected to form the neighborhood. As mentioned previously in the research design chapter, Census Tracts do not always exactly coincide with neighborhood boundaries. In fact, there is no official neighborhood

boundary for Park Slope. The most notable discrepancies in Park Slope are on the Northern part where Flatbush Avenue diagonally cuts through three Census Tracts, namely, 129.01, 129.02 and 161. Following the guidelines established by the research design, Census Tracts completely within the street boundaries (Brooklyn Historical Society, 2008; Justa, 1984; Lees, Slater and Wyly, 2008; O'Hanlon, 1982; Slater, 2003) are designated as the "Core" Census Tracts (outlined in blue) whereas the immediate surrounding Census Tracts are designated as the "Environs" Census Tracts (outlined in red). Maps 5-3 through 5-5 illustrate all of these selections and designations. Map 5-6 illustrates only the Core (outlined in blue) and Environs (outlined in red) Census Tracts and serves as the base map for Park Slope in this study. With this inclusive approach (to incorporate surrounding Census Tracts) both the aforementioned street boundaries as well as areas adjacent to Park Slope are included in the gentrification map coverage to examine possible spillover effects.

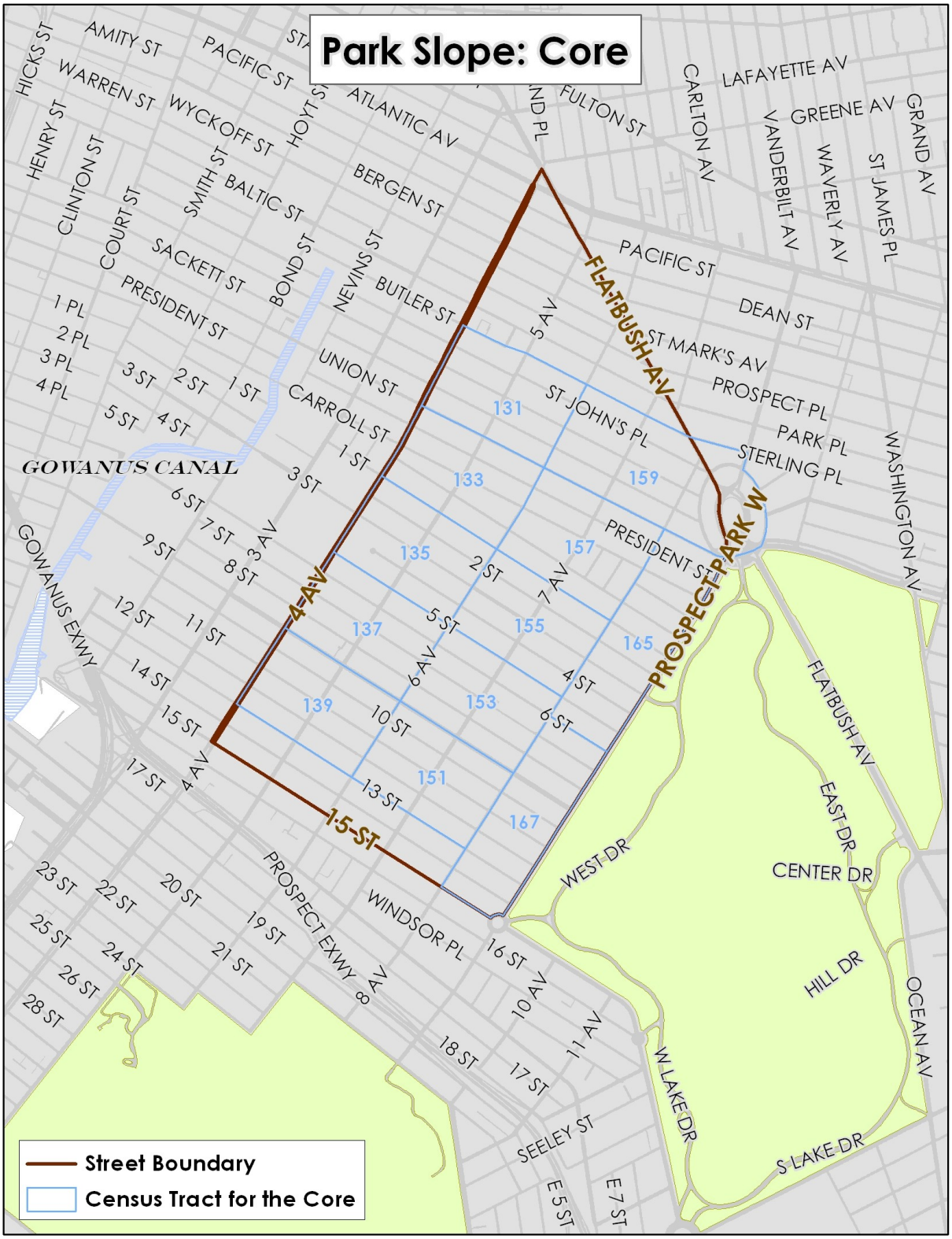
This definition, displayed in Map 5-6, is different from two prior Environmental Psychology Program dissertations (Justa, 1984; O'Hanlon, 1982). Both dissertations focus on Park Slope itself and exclude all Census Tracts west of 4th Avenue (i.e., 117, 119, 121 and 127). Census Tracts 129.01, 129.02 and 163 are partially included in their definition of Park Slope with areas north of Flatbush Avenue excluded. South of Flatbush Avenue, they include the three Environs Census Tracts cited in this study (i.e. 141, 149 and 169) but exclude a portion of Census Tract 169 so that the eastern boundary is aligned with the western boundary of Prospect Park.



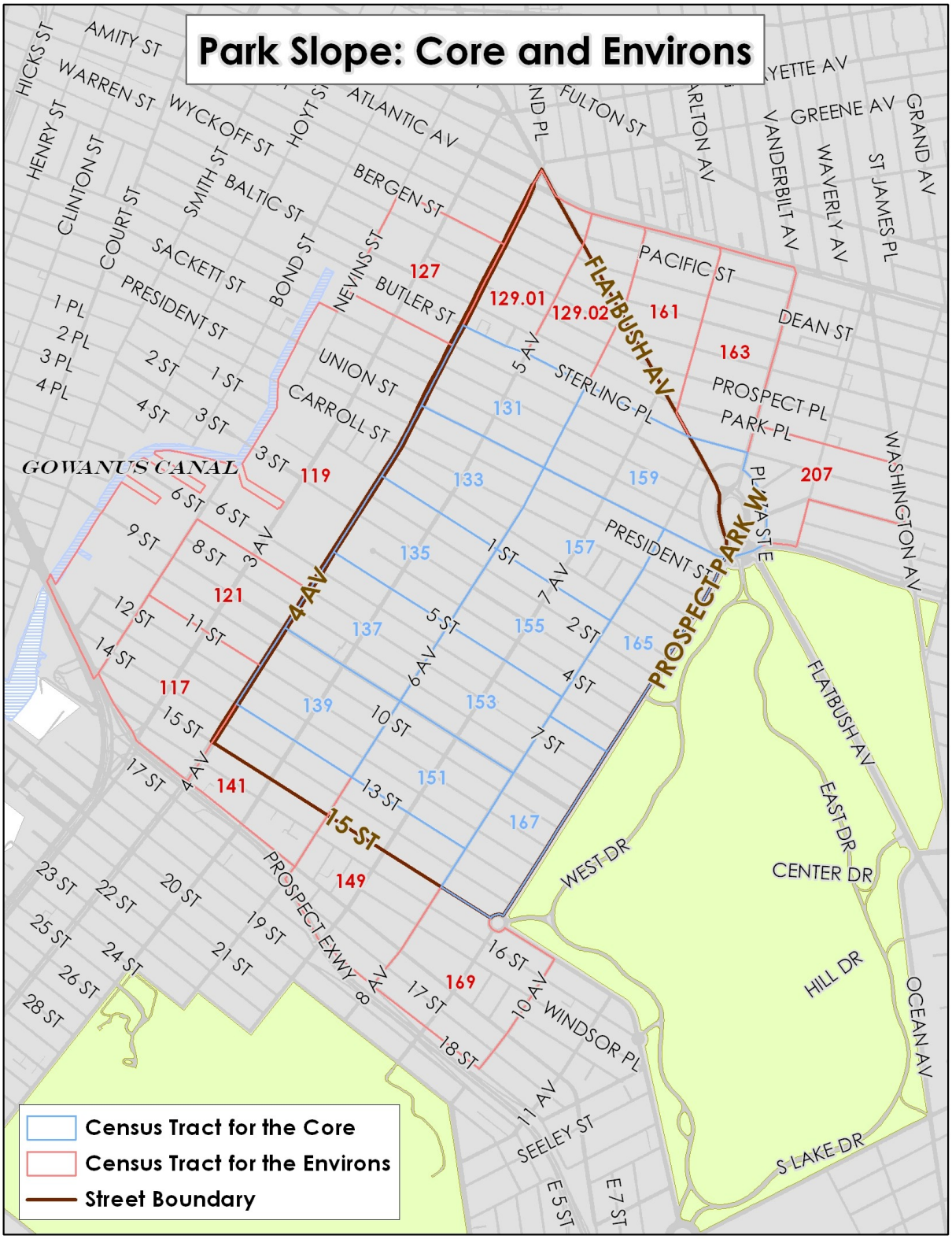
Map 5-1. Park Slope and New York City.



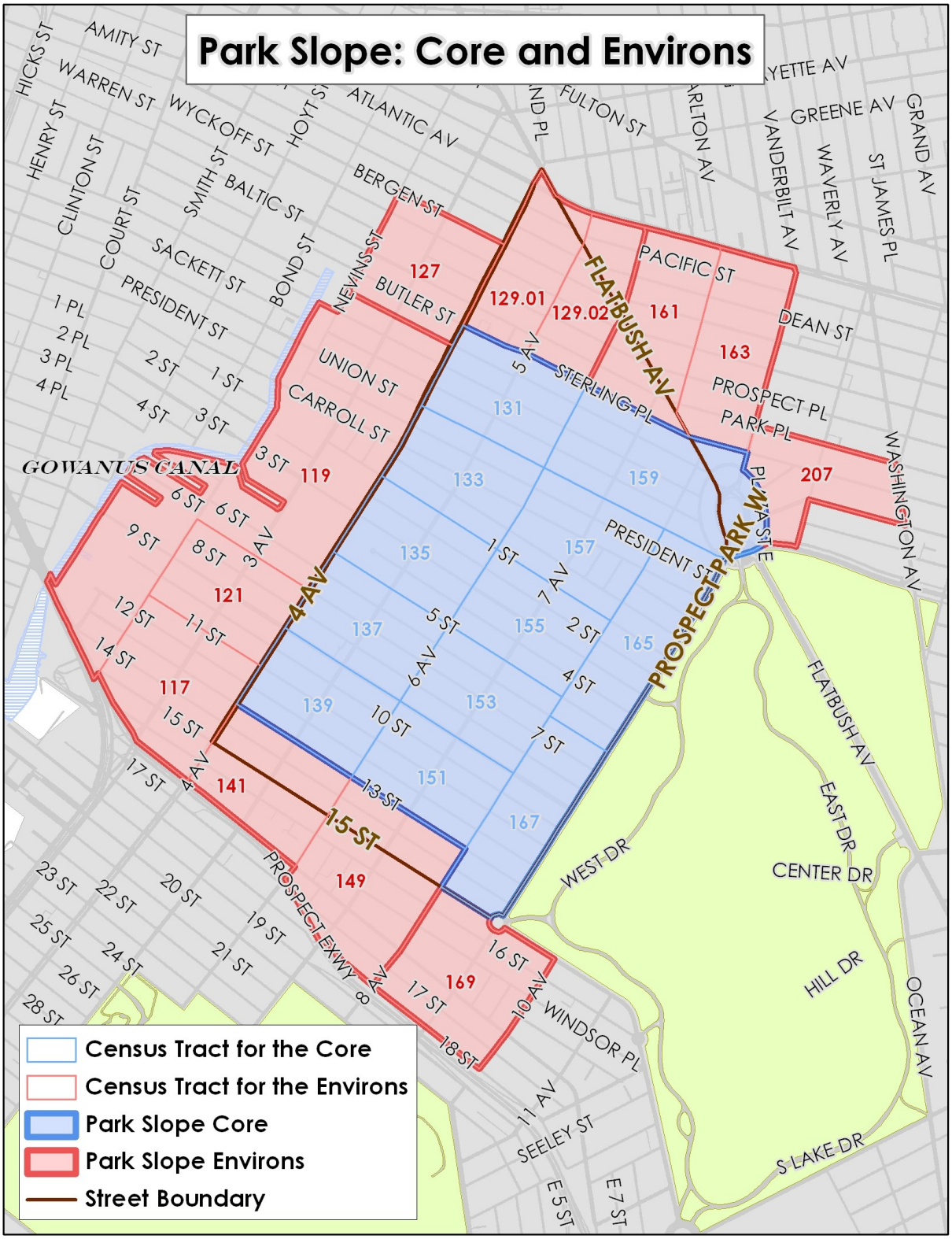
Map 5-2. Park Slope: Street Boundaries.



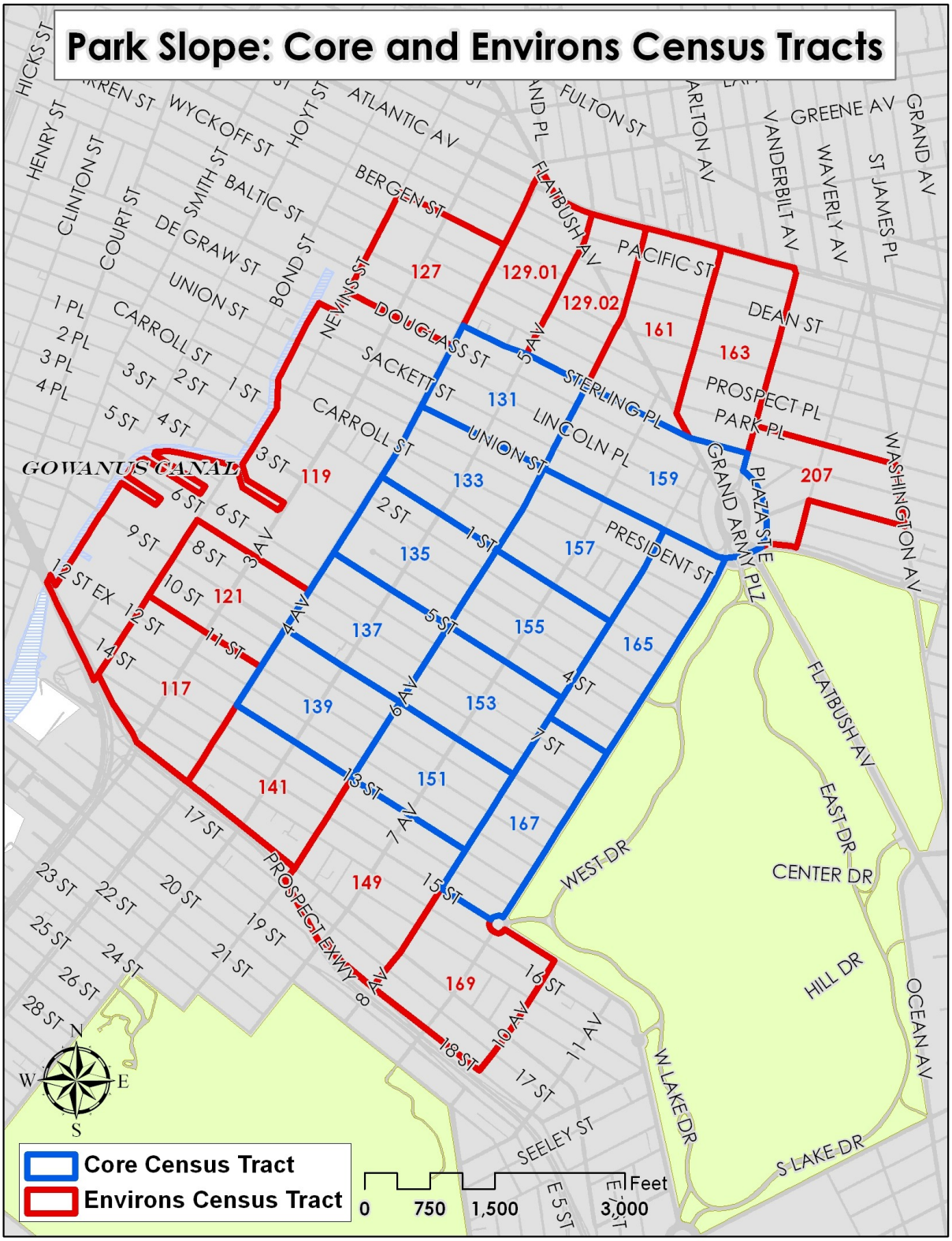
Map 5-3. Park Slope: Core with Census Tracts.



Map 5-4. Park Slope: Core and Environs with Census Tracts.



Map 5-5. Park Slope: Core and Environs with Census Tracts.



Map 5-6. Park Slope: Core and Environs Census Tracts.

Despite these discrepancies between previous researchers and this study in defining Park Slope, the results of this study are still be comparable to the two prior Environmental Psychology dissertations. As stated in the research design chapter, by not aggregating the Census Tracts into a singular study area, it is possible to custom select the Census Tracts in the Core and Environs areas to form a "Park Slope" that fits the definition of the two prior Environmental Psychology dissertations. The non-aggregation design also affords this study to examine the intra-neighborhood differences at the Census Tract level. Further, by preserving the geographic integrity of each Census Tract no manipulation of data is required. For example, when a Census Tract is only partially included in a study the usual solution is to calculate the "partial" total population by multiply the reported total population to the percentage of the Census Tract area that is included in the study. The formula presumes residents are evenly distributed spatially throughout a Census Tract which is not always the case. As a result, using partial Census Tracts (and proportioned data) introduces errors into the final analysis. Contemporary and future researchers that do not agree with the particular definition of this dissertation may add and/or subtract certain Census Tracts to formulate a new study area. Comparisons are possible based on common Census Tracts, provided that future researchers do not aggregate Census Tracts in their research design.

5-2 A Brief History of Park Slope

The name of the neighborhood "Park Slope" references Prospect Park and the slope of the land which rises up from the low-laying Gowanus Canal to the hills inside the park. The development of Park Slope as a prominent residential neighborhood accelerated around the completion of the Brooklyn Bridge in 1883. The Brooklyn Bridge made commuting to Lower Manhattan easier and

allowed people to move farther into previously less developed areas of Brooklyn. Anchoring the newly-constructed Prospect Park (1866-73), stately mansions and brownstones were constructed along Prospect Park West and adjacent blocks, while modest brick and wood frame row houses were built on the West and South sides of Park Slope closer to the industrial Gowanus Canal area for servants and workers.

Park Slope was established as a suburban residential neighborhood as Brooklyn was a City itself. When Brooklyn was consolidated to become part of New York City, Park Slope would soon experience the effects of additional suburbanization in the early 1900s. Residents moved farther to the (then) suburb of Flatbush. In the following decades while the areas closest to Prospect Park retained their high(-rent) status, urban planners began to consider the rest of the neighborhood a "slum" as 75% of the housing stock was represented by rooming houses with absentee landlords (Lees, Slater and Wyly, 2008. p. 21). Hamill (2008) who bought a house on Prospect Park West in 1970 provides an alternative though anecdotal explanation:

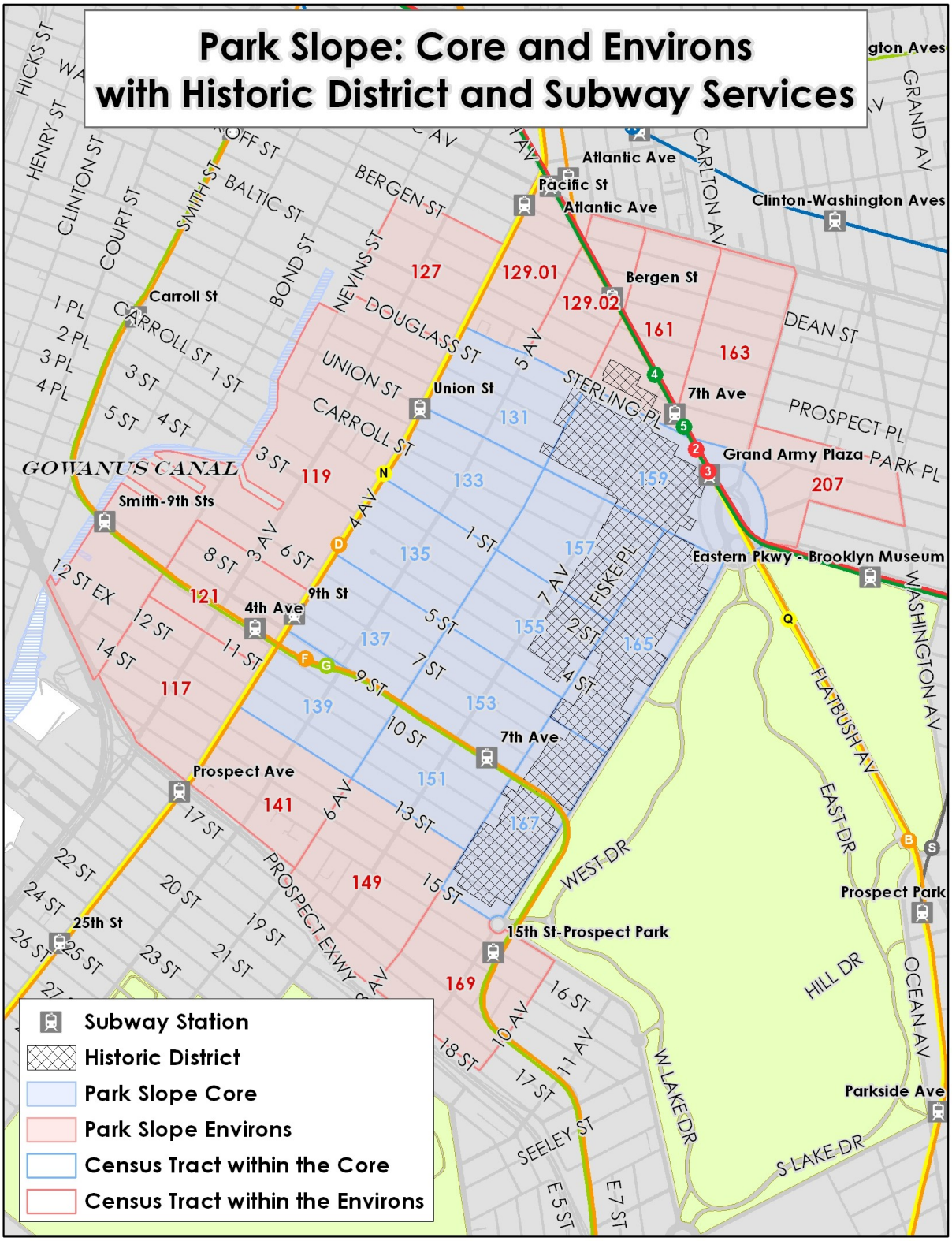
> Many of the older houses were owned by women who had outlived their husbands. They had fixed incomes, Social Security and pensions, and were forced to mutilate the houses in order to live. The long wide floors were often chopped into furnished rooms for single men (and a few women). (Hamill, 2008).

With the construction of the Brooklyn Queens Expressway (BQE), the Long Island Expressway (LIE) in the mid-twentieth century and the opening of the Verrazano Bridge in 1965 which connects Brooklyn to Staten Island, established residents continued to move away from Park

Slope. Around this time, federal mortgage programs that focused on suburban home ownership also contributed to suburbanization. During New York City's fiscal crisis in the mid-1970s, property disinvestment and residential abandonment took place. It was during this time that gentrifiers began to move into Park Slope. Local civic groups and neighborhood associations worked together to stop this area from further urban decay and to preserve the area. For example, the Park Slope Betterment Committee was established in 1966 and purchased properties to advertise them to residents of Brooklyn Heights, Greenwich Village and the West Side of Manhattan (Brownstone Revival Coalition, 2003). The Park Slope Civic Council launched a movement to establish Park Slope Historic District in 1973 and strongly opposed a New York City Department of Transportation plan to convert 6th and 7th Avenues into one-way "speedways" (Park Slope Civic Council, no date). Map 5-7 below illustrates the Park Slope Historic District (see hatched-line pattern) which is located around the Upper/North Park Slope.

The resurgence of Park Slope because of these local civil groups drew the attention of New York City government such that, in 1985 a report was released by the New York City Department of City Planning, citing Park Slope as one of two neighborhoods (the other being the Upper West Side of Manhattan) that experienced private re-investment (DCP, 1985). It is in the context of this history that I will present my study on the gentrification of Park Slope.

Park Slope is well served by subway services as Map 5-7 below illustrates: Subways 2, 3, 4, 5, B and Q operate along Flatbush Avenue; D and R on 4th Ave; and F and G on 15th Street. To highlight the color-coded subway lines, the color schemes for the Park Slope Core and Environs are muted in this map.



Map 5-7. Park Slope: Core and Environs Census Tracts with Historic District and Subway Services.

5-3 Park Slope: The Physical Environment

This section focuses on the physical environment of Park Slope, starting with "Zoning" and then structural characteristics such as building age and building heights. Although all past and present zoning maps are publicly available from the DCP website, this study uses only those coinciding approximately with the Census Survey years from 1980 through 2000. The 2010 zoning maps are created with GIS using the 2011 release of MapPLUTO and the latest NYCMap data-sets. This approach illustrates land use pattern changes over time and also the different designs of downloaded maps from a city agency and custom-made maps created by GIS users. The differences between the map contents and designs are discussed.

5-3.1 Zoning Maps

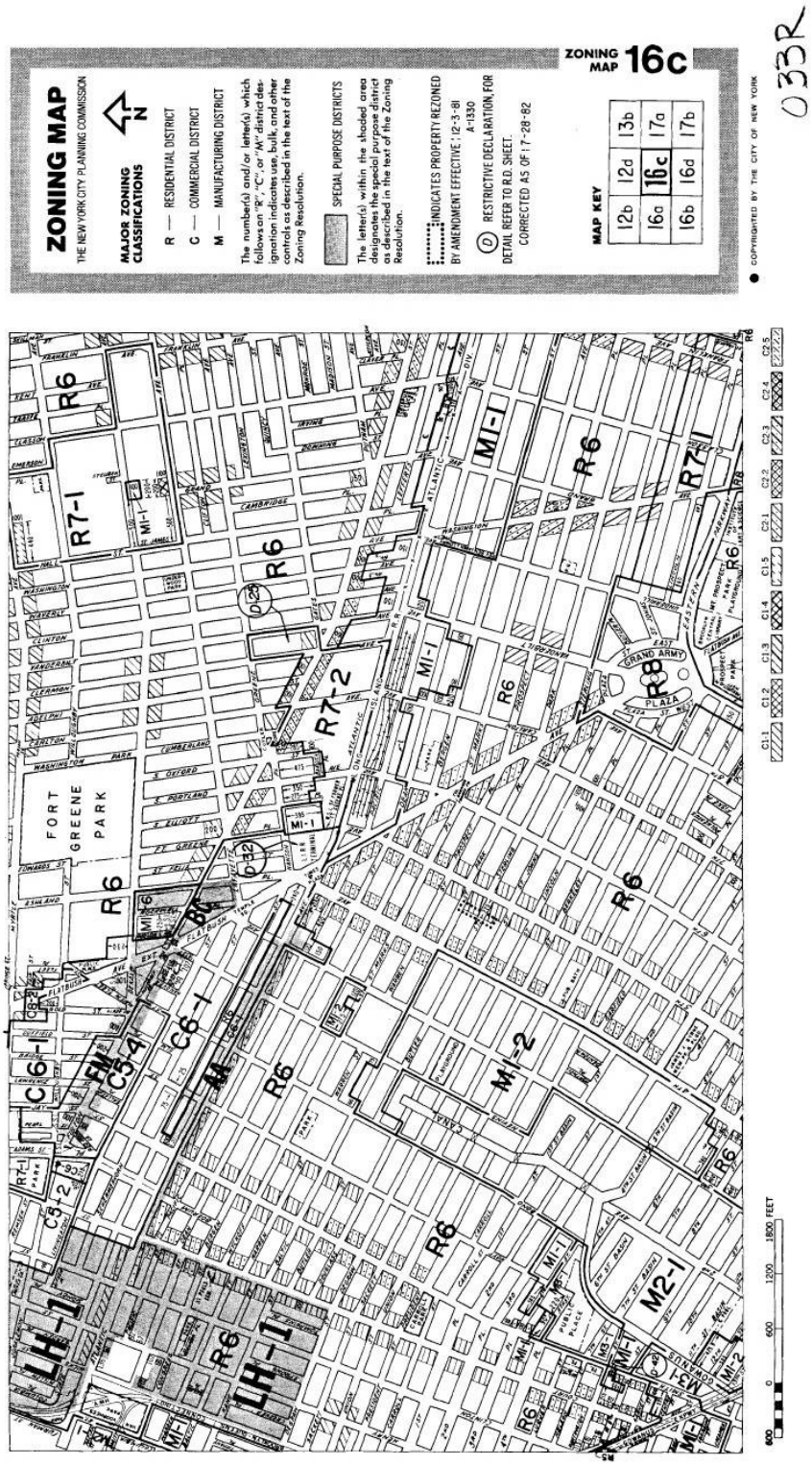
In the following pages are the Historical Zoning Maps downloaded from the DCP website for the Park Slope area from the early 1980s through the early 2000s. These maps were catalogued using an arbitrary grid layered on New York City created by DCP; Park Slope is divided into two pages of maps. It should be noted that these Historical Zoning Maps correspond approximately to the early three Decennial Census Surveys (1980, 1990 and 2000). DCP only releases updated zoning maps when rezoning is approved.

It should also be noted that these scanned paper Historical Zoning Maps condense all three zoning districts and their sub-categories into a single map. While the sub-categories of the commercial districts are differentiated by various patterns listed at the bottom of each map, the sub-categories of residential and manufacturing districts are labeled directly on the maps. This all-in-one design has made these maps appear visually busy, cluttered and confusing because all

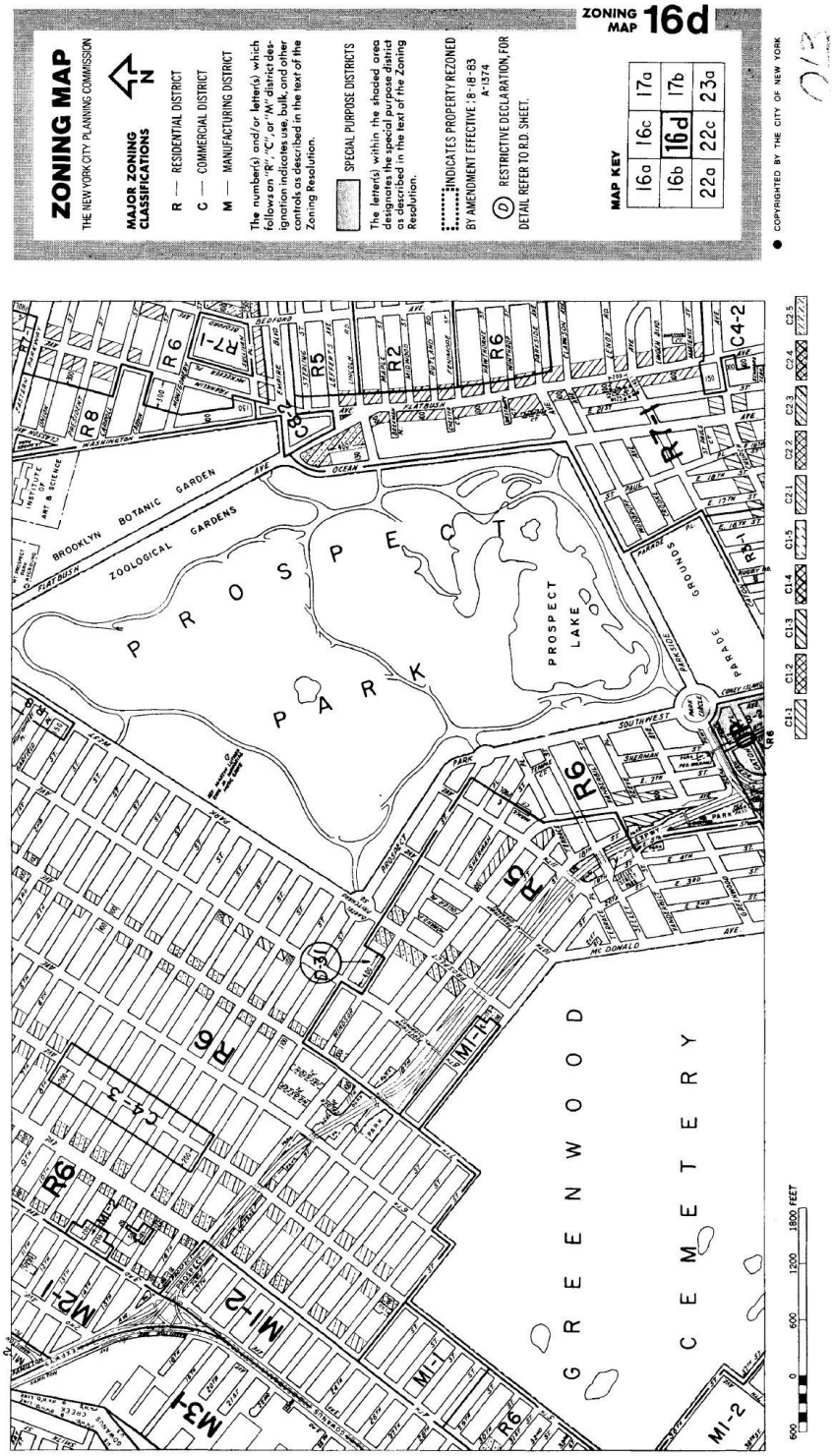
the zoning information is presented in a single map. Following these Historical Zoning Maps are the 2010 zoning maps produced using GIS, that contrast the differences between these two map designs.

The Historical Zoning Maps are static displays of all the zoning information. Once they are completed they cannot be altered or simplified and cannot illustrate the spatial distribution of the three major zoning districts separately. The purpose of including Historical Zoning Maps is to provide a basic and important historical perspective and background knowledge of the locations of the three distinctive zoning districts. Individuals who are unfamiliar with Park Slope can develop a mental map of the land use patterns after reviewing these zoning maps. These downloaded Historical Zoning Maps do not allow manipulation of data; readers must mentally process all the information displayed on the maps in order to grasp the land use patterns. In contrast, the benefits of GIS are that it allows its users to query specific features and present these features as the users see fit. For this study, simplified zoning maps illustrating the spatial distribution of the three primary zoning districts are created using GIS. Each zoning map provides a prominent theme and readers should find it easier to grasp the primary feature of each GIS zoning map.

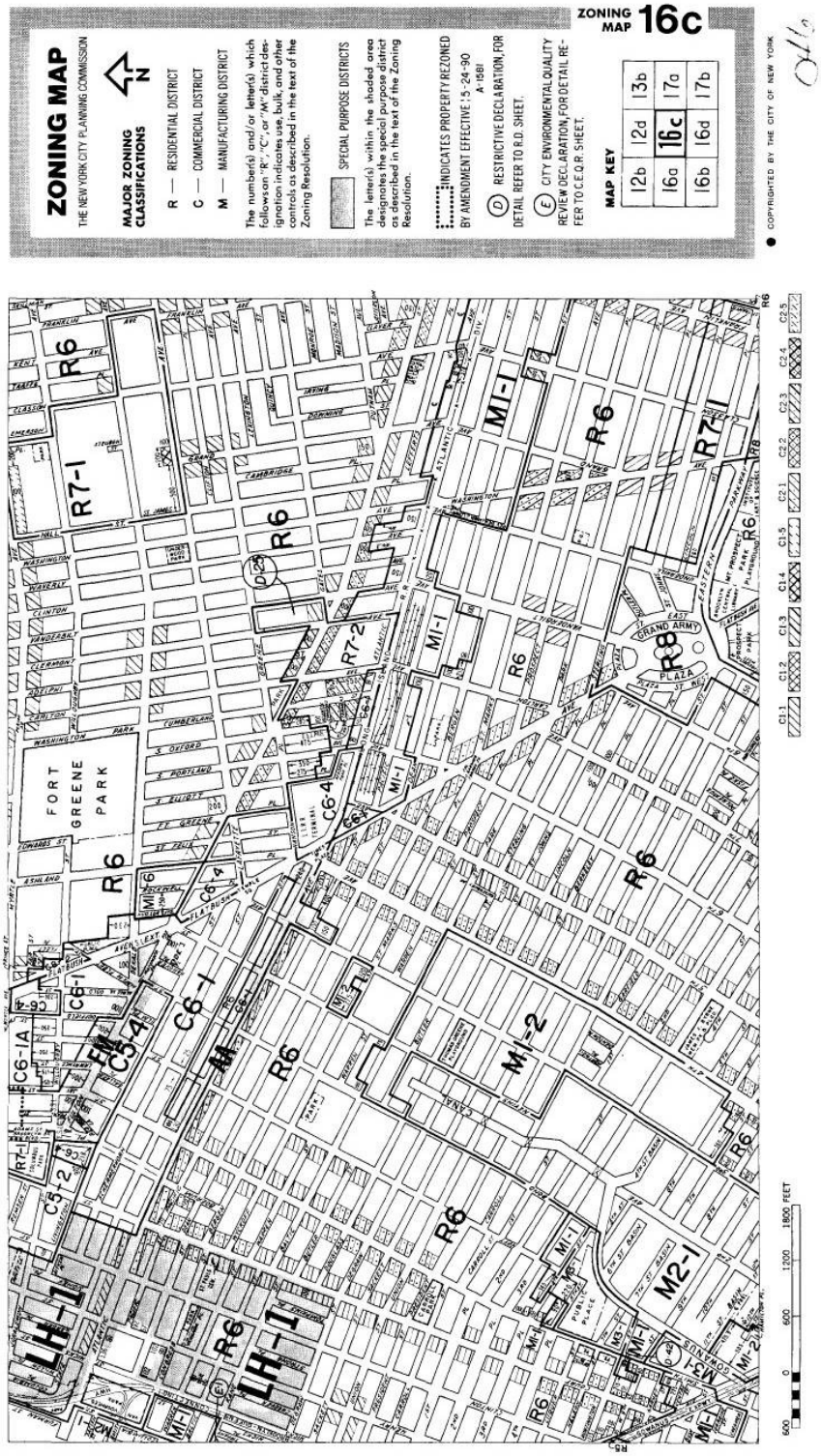
The Historical Zoning Maps on the following pages correspond approximately to the Census Survey years: Map 5-8 and Map 5-9 represent 1983; Map 5-10 and Map 5-11 represent 1990; Map 5-12 and Map 5-13 represent 2001 and 2003 (DCP, 2013).



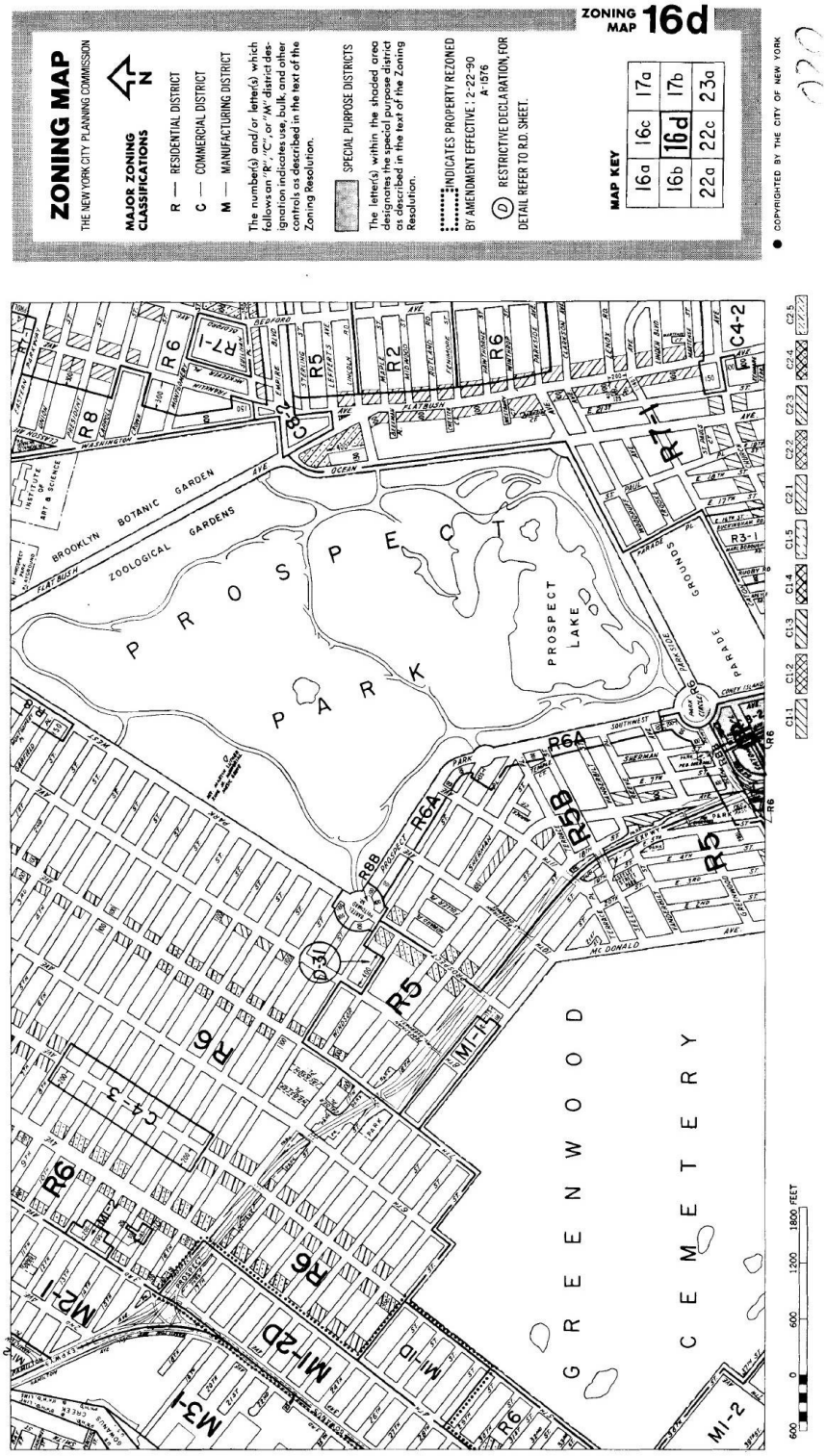
Map 5-8. Historical Zoning Map 16C - 1982.



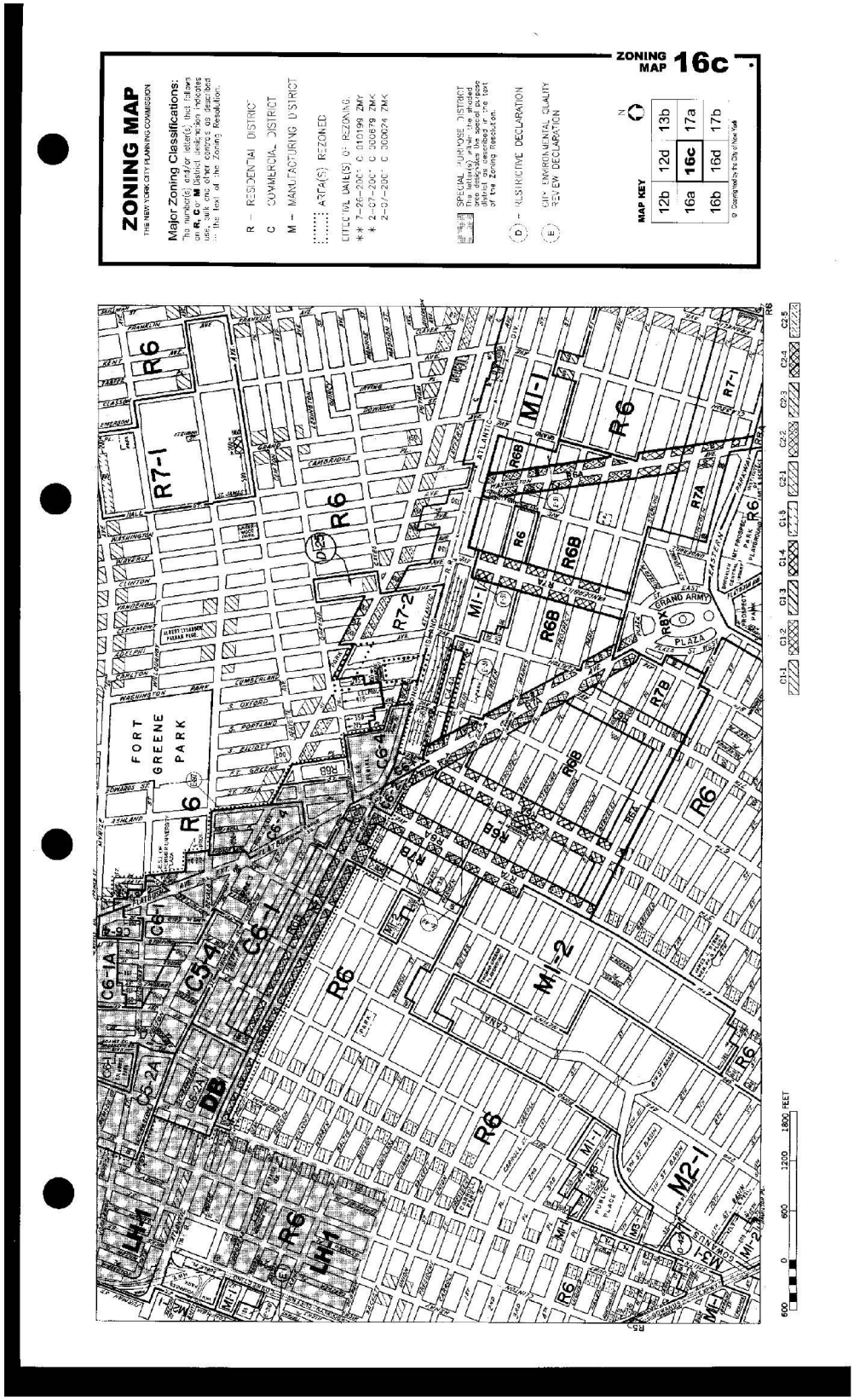
Map 5-9. Historical Zoning Map 16D - 1983.



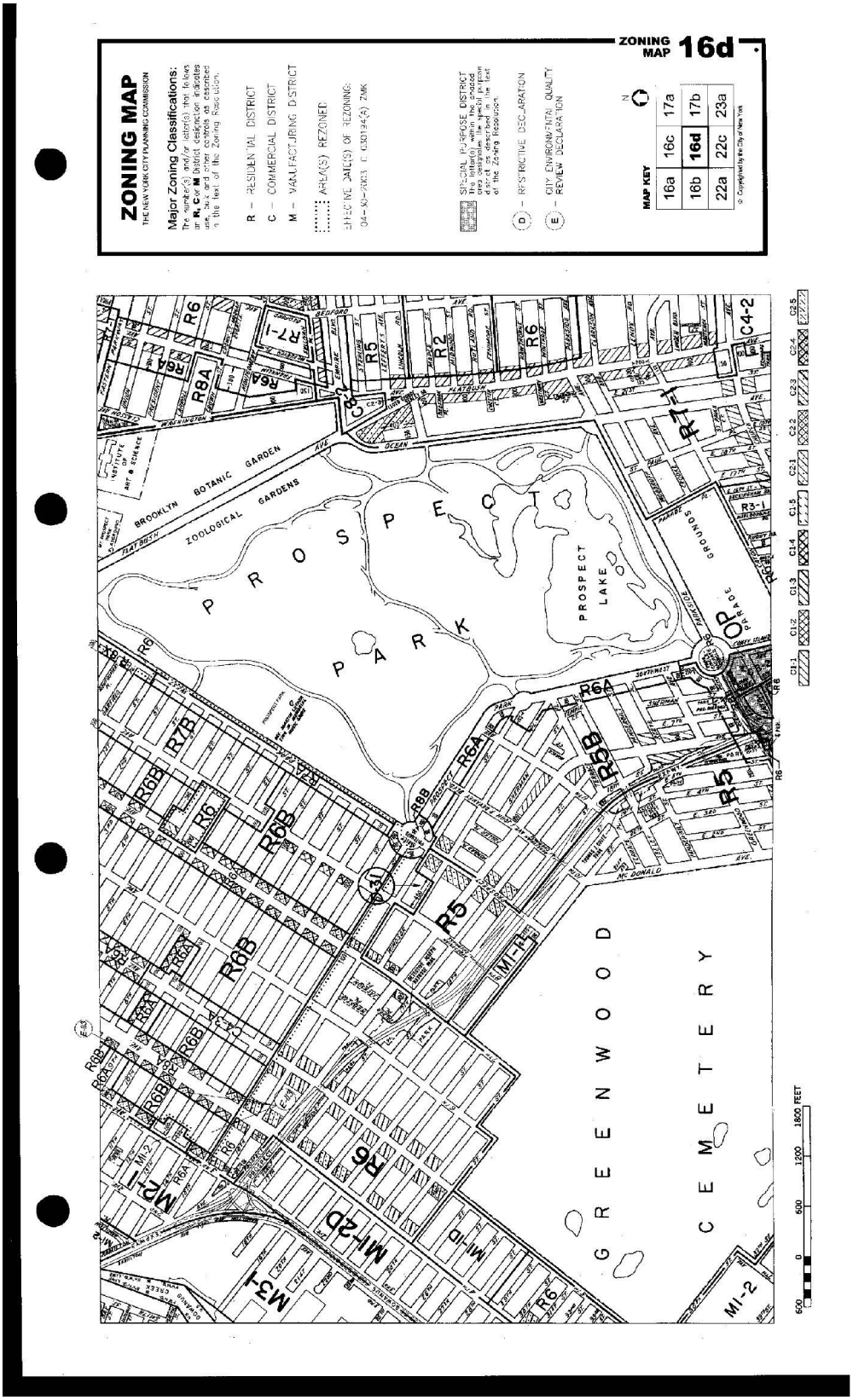
Map 5-10. Historical Zoning Map 16D - 1990.



Map 5-11. Historical Zoning Map 16C - 1990.



Map 5-12. Historical Zoning Map 16D - 2001.



Map 5-13. Historical Zoning Map 16D – 2003.

The following are three zoning maps (See Map 5-14 through Map 5-16) based on the 2011 release of the MapPLUTO data-set, that reflect 2010 land use condition. In addition, there are two pie charts that represent Park Slope Core and Environs (See Figure 5-3 and Figure 5-4) that are based on the three primary zoning districts (i.e. residential, commercial and manufacturing) and park land. The percentages are calculated by the area of tax lots in each category. The percentages are not based on the number of tax lots in each zoning district because not all tax lots are of equal size. These two pie charts reveal the different land use patterns between these two areas: the residential tax lots represent the major category for both areas, but in the Core the percentage is noticeably higher (i.e. 79% vs. 45%); the commercial tax lots represent approximately the same proportions in both the Core and Environs (i.e. 20% vs. 17%); the manufacturing tax lots percentages illustrate how the Core and Environs areas are different from each other: there is no manufacturing tax lot in the Core area but in the Environs the manufacturing tax lots represent 36% of the tax lot area.

A special note should be pointed out for the park land proportions of the Core and Environs in the pie charts (Figure 5-3 and Figure 5-4). While they seem extremely low and similar for the Core and Environs (i.e 1% vs. 2 %), in reality the access to park land for the residents of the Core and Environs is very different: one side of the Core area is adjacent to Prospect Park that is not included in this calculation of the pie chart because Prospect Park is located outside the definition of the Core area. Residents of the Environs, on the other hand, generally need to pass through the Core to reach Prospect Park. Although several Environs Census Tracts are located next to the Gowanus Canal, the tax lots on both sides of the Canal are zoned for manufacturing and the Canal itself is highly polluted and a Superfund site (U.S. Environment Protection

Agency, Region 2, 2010). (see Map 5-16 below). The residents of the Environs need to travel more to reach for park lands. However, as the gentrification maps in this chapter will demonstrate, this area is also being gentrified.

While these two pie charts summarize and contrast the different land use proportions for the Park Slope Core and Environs, they cannot provide the locations of these different zoning districts. This feature is one of the advantages maps possess over non-spatial pie charts. With regard to the creation of the GIS zoning maps: using a query that selects all tax lots primarily zoned for residential produces a residential zoned tax lots map (See Map 5-14). While this map does not reveal the finer distinctions within the residential district, readers unfamiliar with Park Slope can quickly grasp the fact that Park Slope is predominantly residential. There are gaps along some avenues and a portion of the Environs Census Tracts west of 4th Avenue. Subsequent maps that focus on commercial and manufacturing districts will provide more detail and reveal their locations.

The commercial zoning map (See Map 5-15) clearly illustrates where shops and offices are located in Park Slope. These are mostly located along the avenues with the exception of Prospect Park West, 8th and 6th Avenues, which are residential. This pattern of commercial tax lots located along selected avenues can also be found in neighboring areas in all directions.

Map 5-16 illustrates the manufacturing zoned tax lots. It is noted, again, that there are no manufacturing zoned tax lots within the Core or in the Southern Environs Census Tracts. On the Northern Environs Census Tracts along Atlantic Avenue is the Atlantic Yards Development currently underway. This major development site includes a new sports arena, shops and high-rise residential buildings. The first residential building began construction in early 2012 (Atlantic Yards, no date). The entire project's comprehensive impact on the area is yet to be fully reviewed.

These simplified GIS zoning maps provide readers with a much quicker understanding of land use patterns in Park Slope than do the Historical Zoning Maps in the previous pages. Although these GIS generated zoning maps separate each zoning district into a single map, it should be clear to readers that Park Slope is mostly residential; the commercial district is located along specific wider avenues; and manufacturing tax lots are located outside the Core and clustered around the Gowanus Canal.

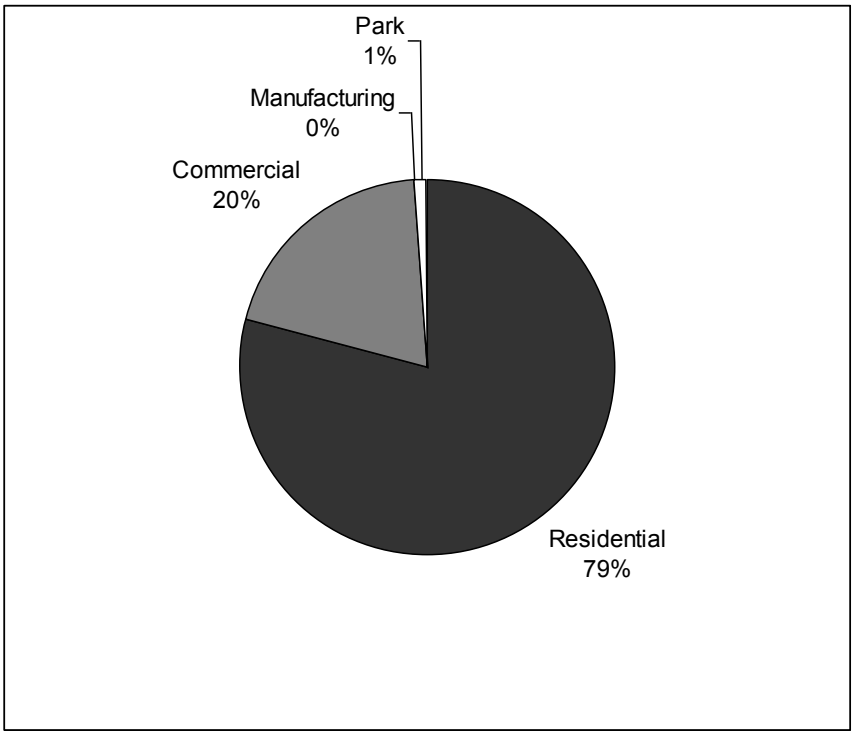


Figure 5-3. Percentages of Different Zoning Districts in Park Slope - Core by Tax Lot Area.

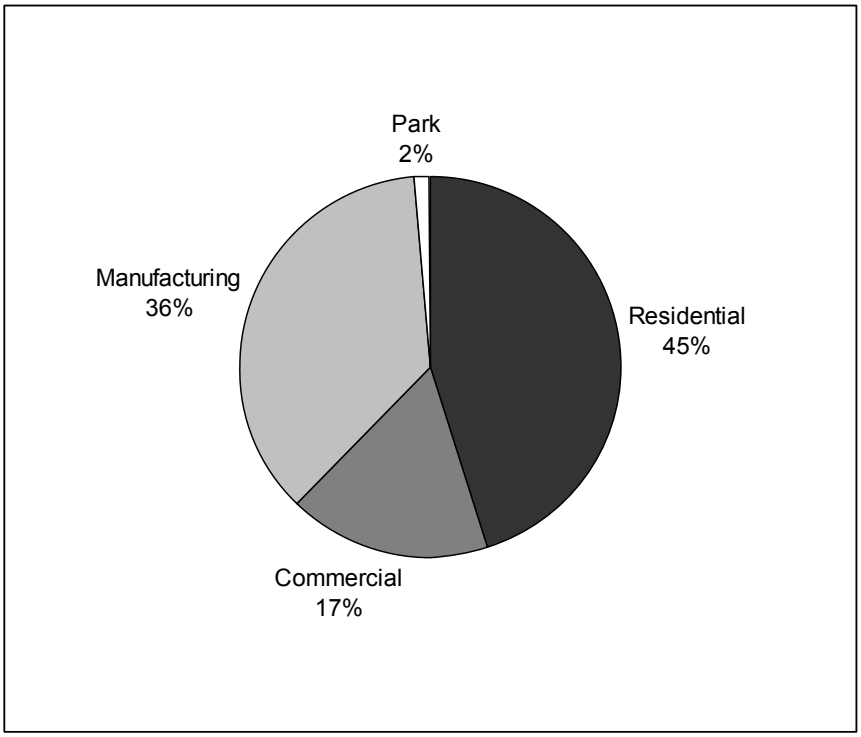
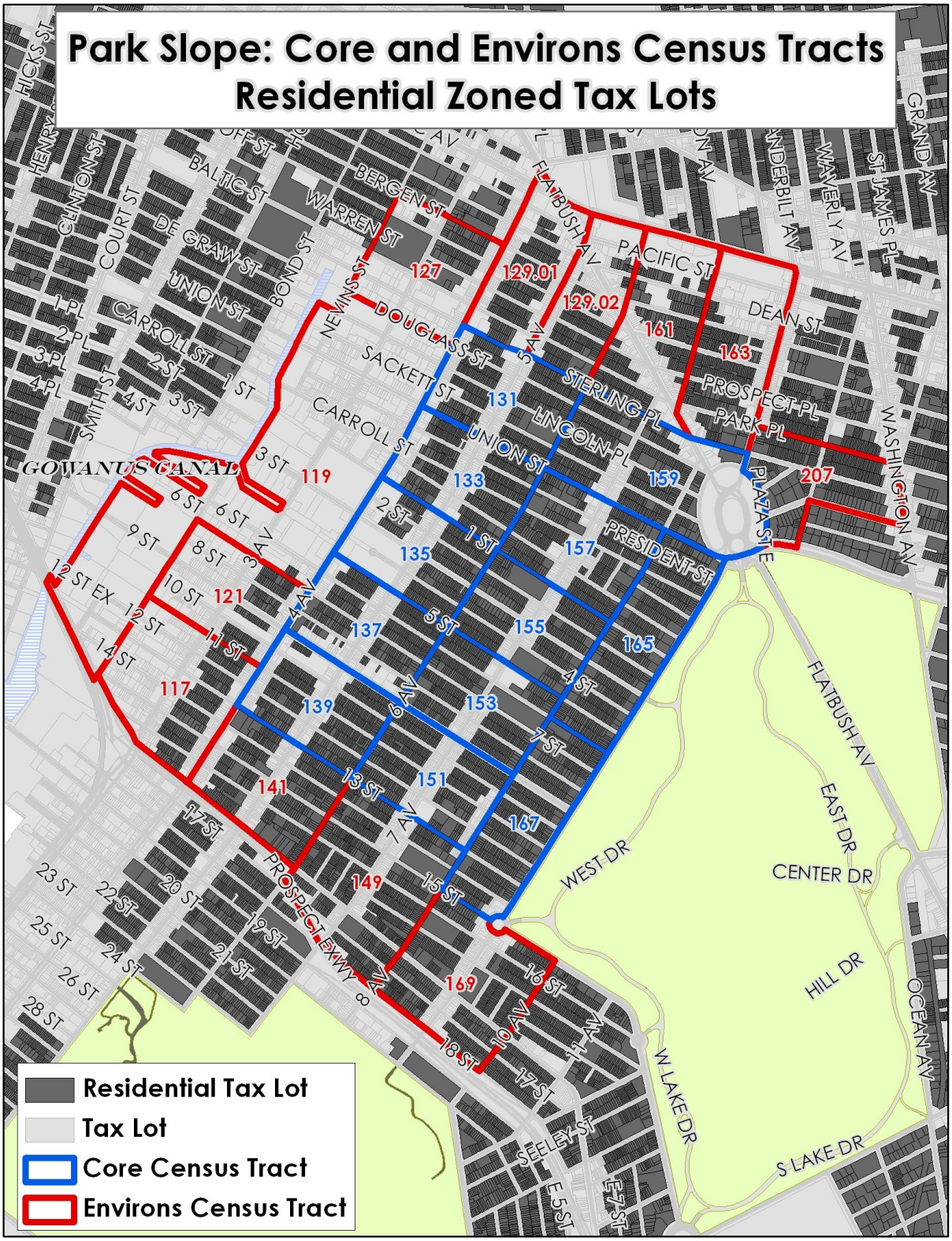
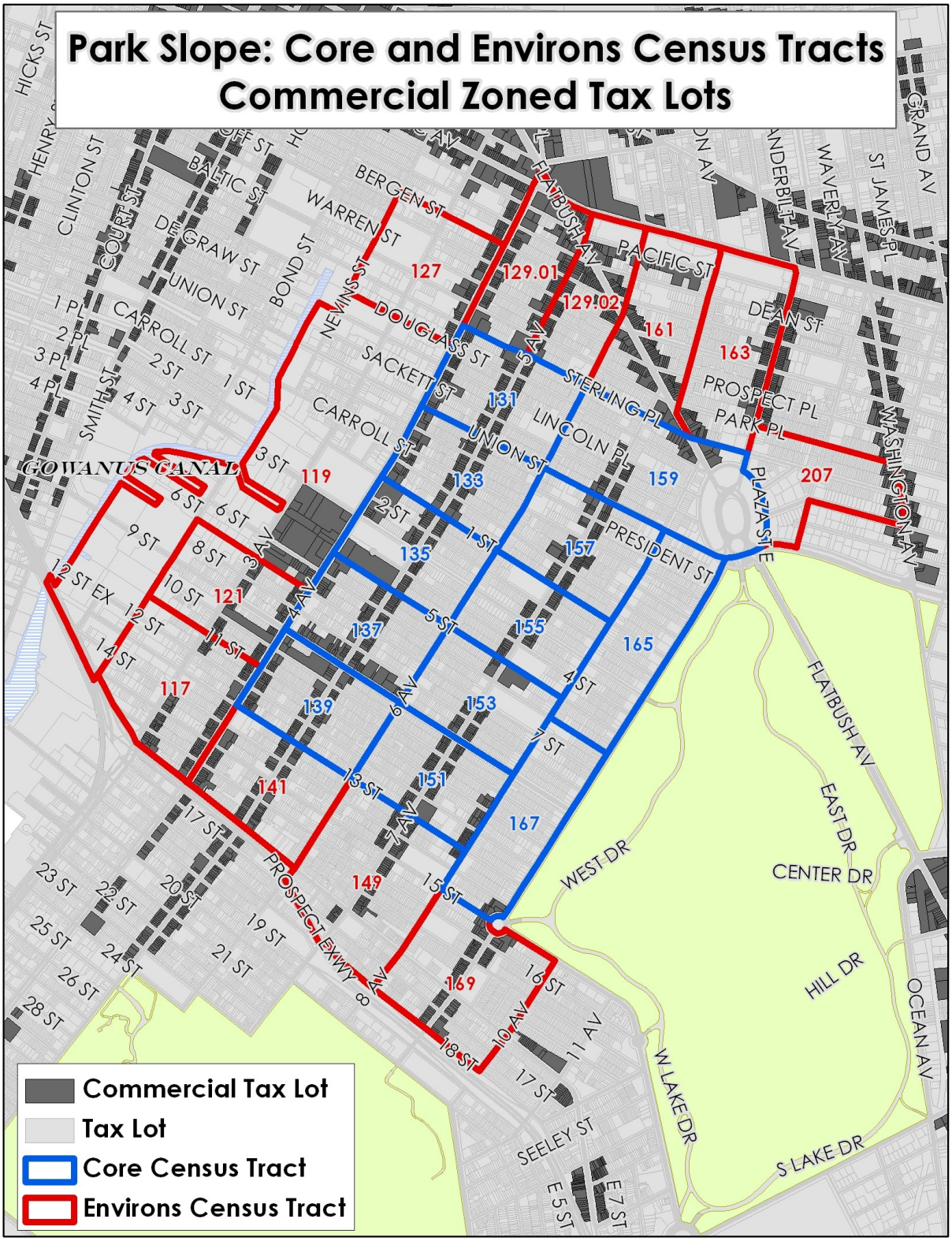


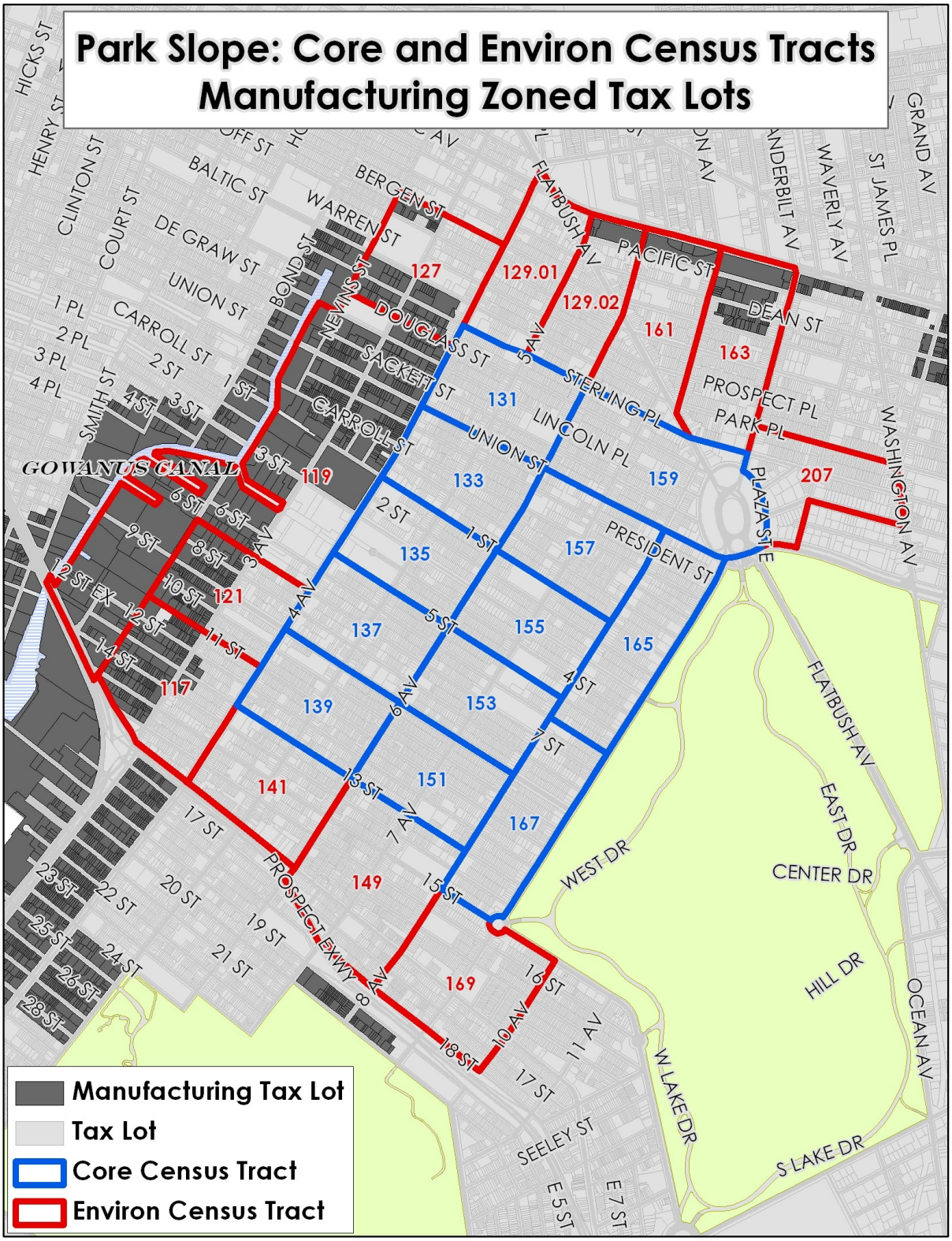
Figure 5-4. Percentages of Different Zoning Districts in Park Slope - Environs by Tax Lot Area.



Map 5-14. Residential Zoned Tax Lots in Park Slope, 2010.



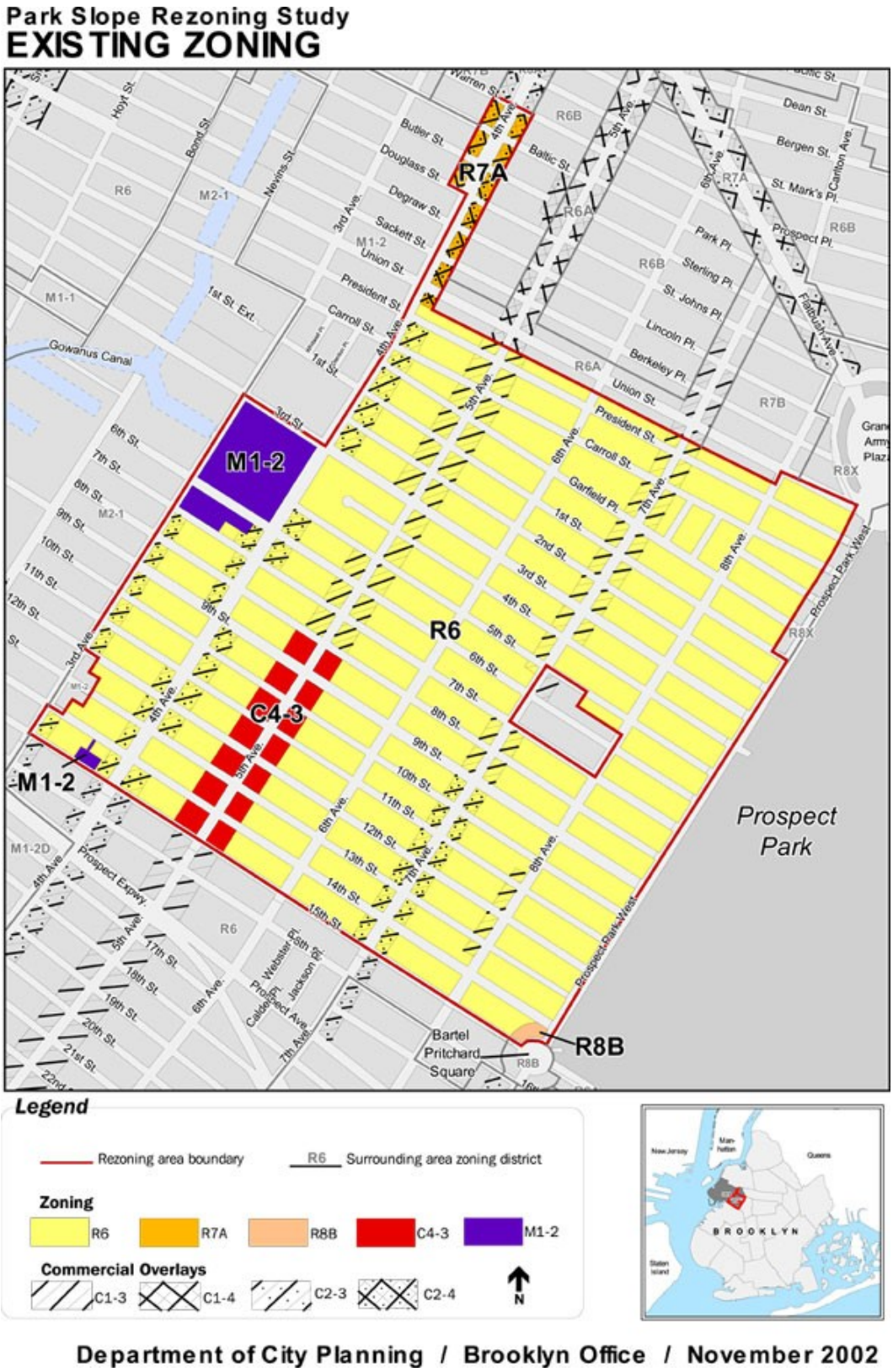
Map 5-15. Commercial Zoned Tax Lots in Park Slope, 2010.



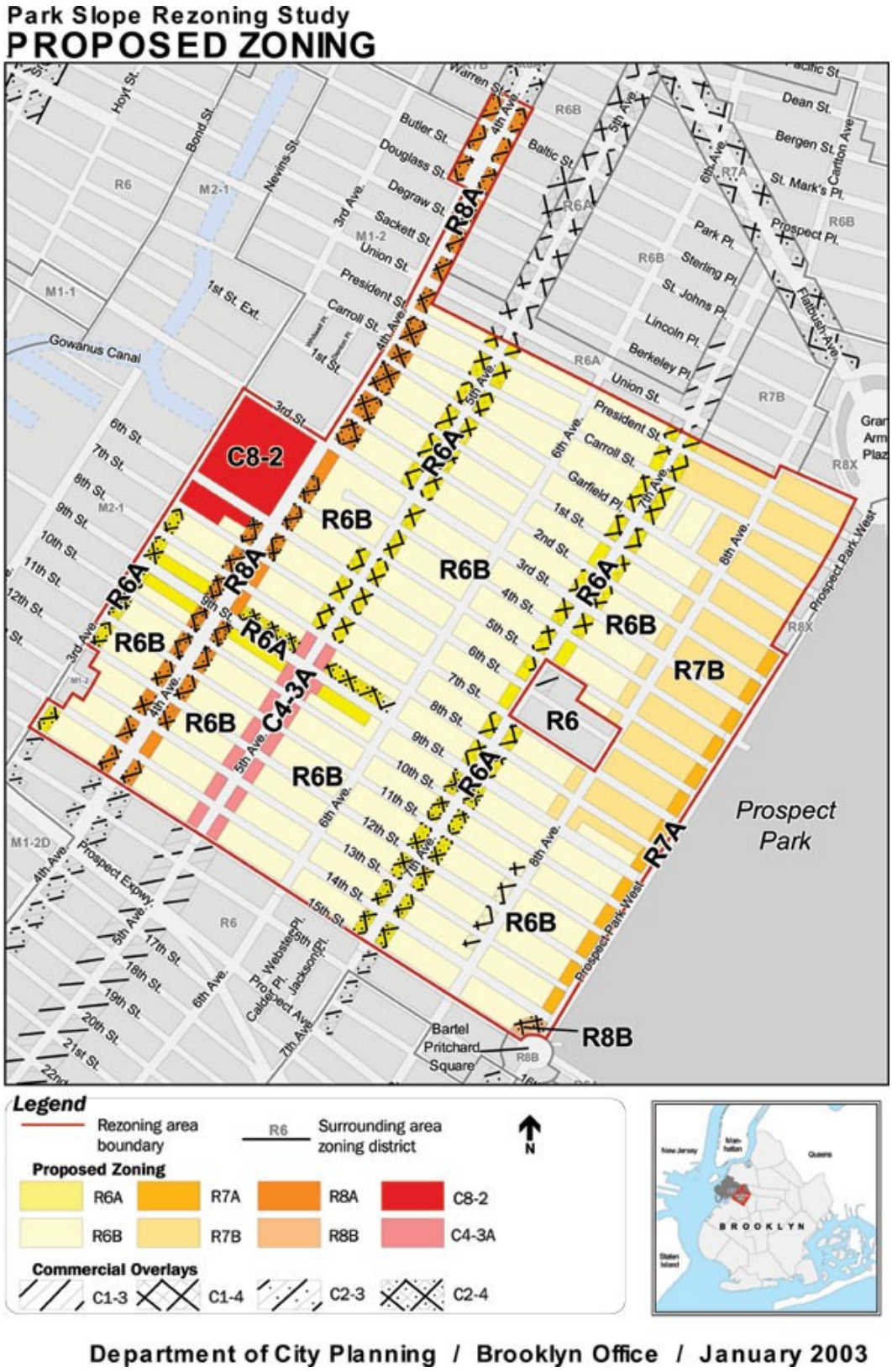
Map 5-16. Manufacturing Zoned Tax Lots in Park Slope, 2010.

Remarkably, since 1980 and through the subsequent decades, the land uses in Park Slope have not experienced major changes. The only exception is the rezoning approved in 2003 (DCP, 2002a). The following two maps from DCP website compare the pre-2003 zoning and the proposed zoning. According to the DCP proposal: "The goals of the rezoning are to preserve the historic scale of the brownstone neighborhoods, and provide increased opportunities for residential and commercial development on Fourth Avenue" (DCP, 2002b).

A noticeable zoning change (See Map 5-17 and Map 5-18) from manufacturing (indicated in purple) to commercial (indicated in red) is located at a large city block between 3rd and 6th Streets, and 4th and 3rd Avenues. This city block was purchased by the Whole Foods Market Company; the construction of the supermarket commenced in the spring 2012. When construction is completed, this will be the first Whole Foods store in Brooklyn (Robbins, 2012a). How this major land use change and especially how this large supermarket will influence future gentrification in the area remain to be seen. At the time of this dissertation (i.e. late 2012), a second Whole Foods Market location is planned for Williamsburg (Robbins, 2012b).



Map 5-17. Existing Zoning as of 2002 (DCP, 2002c).



Map 5-18. Proposed and Approved Zoning Change (DCP, 2002d).

5-3.2 Building Age

The age of its buildings marks Park Slope as an old neighborhood. As Figure 5-5 illustrates, the existing structures for the Core and Environs were mostly constructed before 1940. Moreover, the structures within the Park Slope Historic District are skewed toward an even earlier period, namely, at the end of the nineteenth century and early twentieth Century (New York City Landmark Preservation Commission, 1973). Among the existing structures, less than 10% were built in the time periods included in this study (1980 - present). Within the Core the figures remain low, while in the Environs there is a slight increase in the post-2000 period. The maps in the following pages (See Map 5-19 through Map 5-24) focus and highlight different time period. The post-2000 construction clusters toward the West side of the Core Census Tracts, likely the result from the 2003 DCP rezoning. It is noteworthy that since 1940, among the Eastern Census Tracts there have been only a small number of “in-fill” new construction.

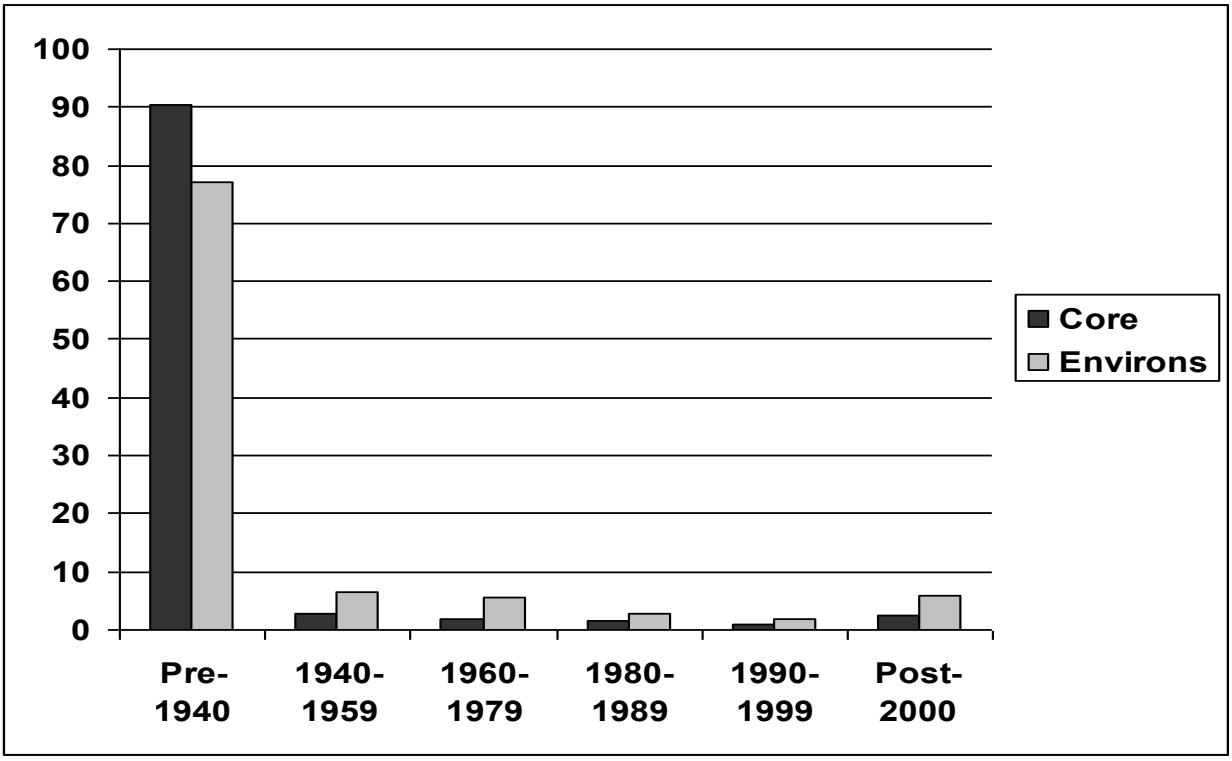
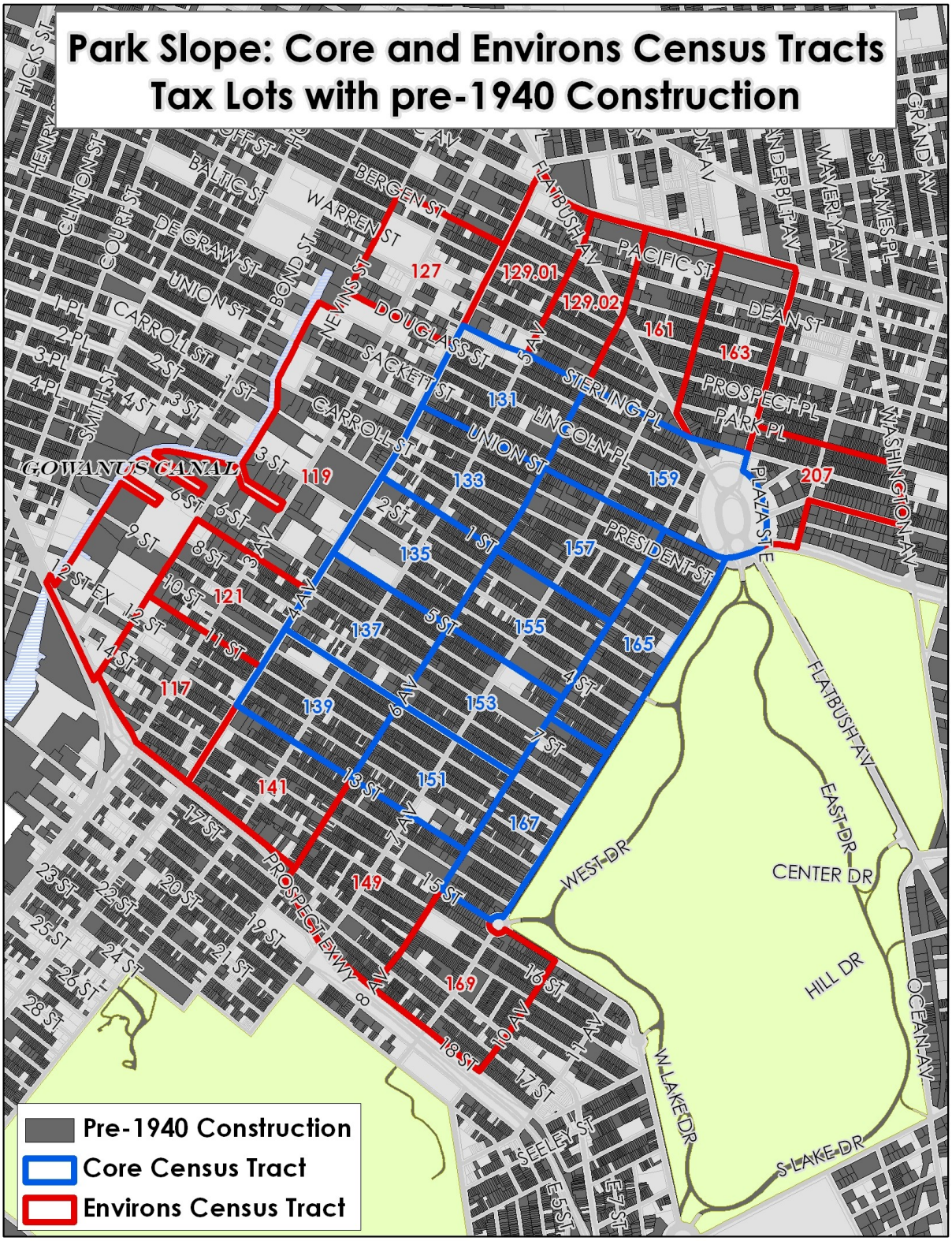
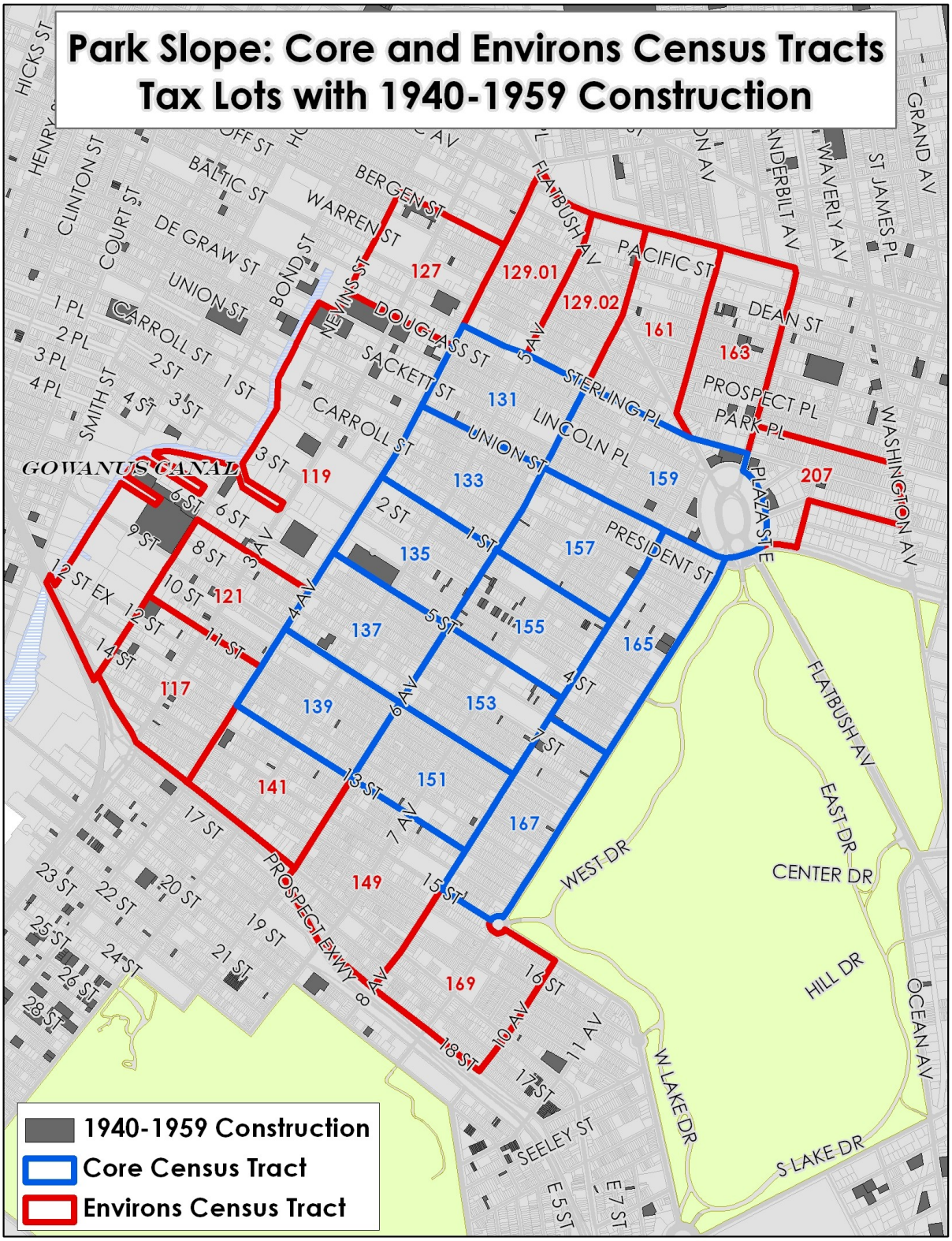


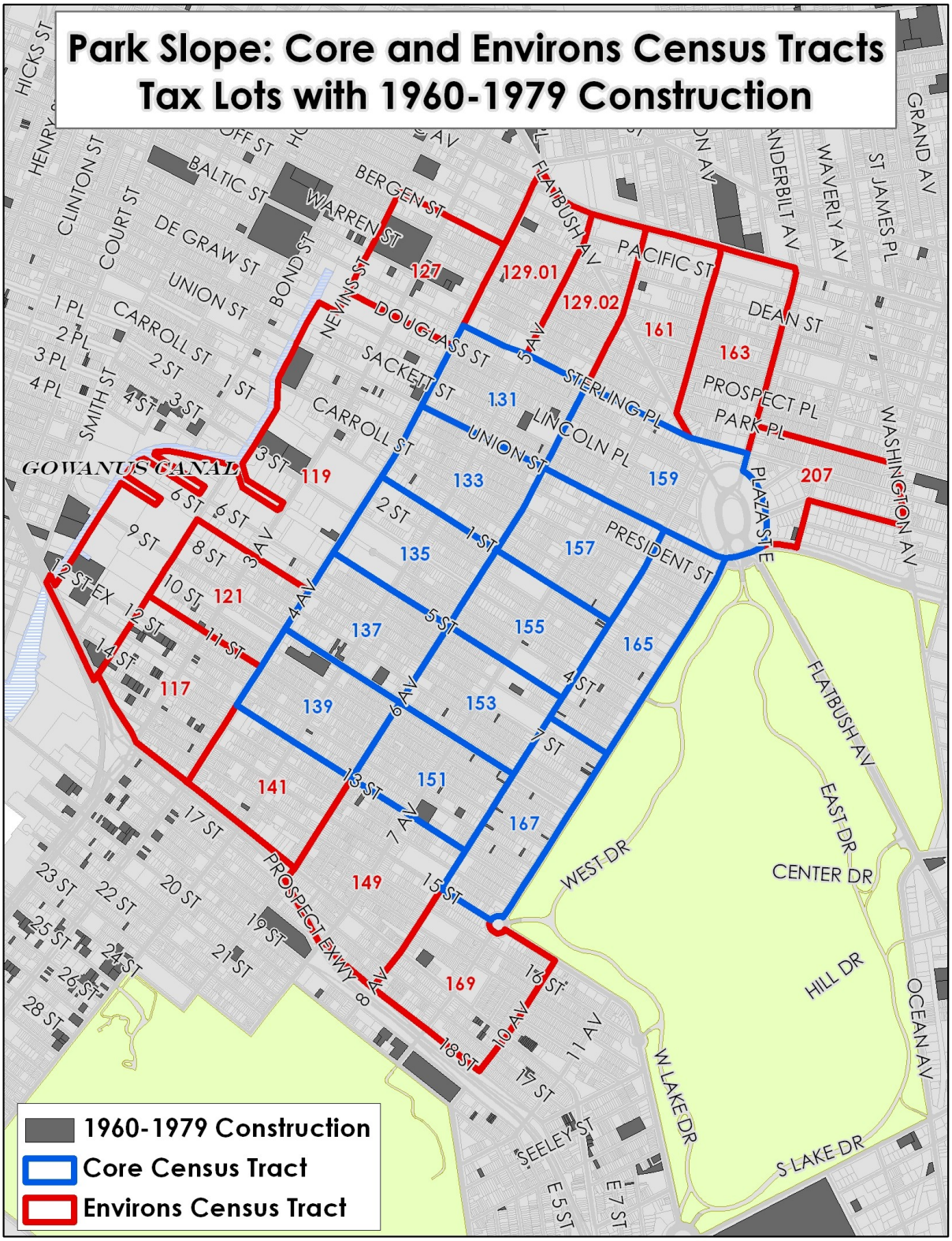
Figure 5-5. Percentage of Building Age, by Tax Lot Area, Park Slope - Core vs. Environs, 2010.



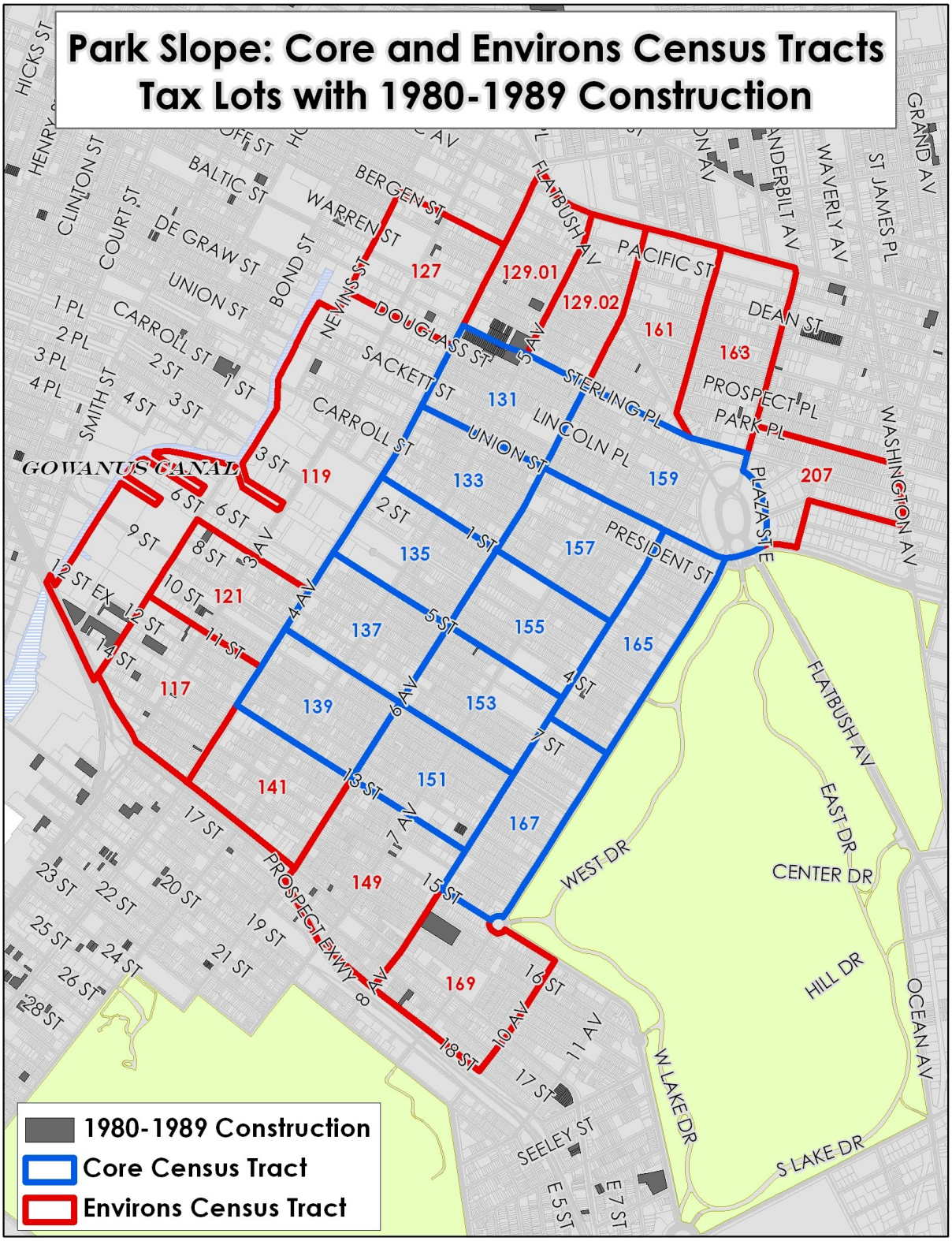
Map 5-19. Park Slope Tax Lots with pre-1940 Construction.



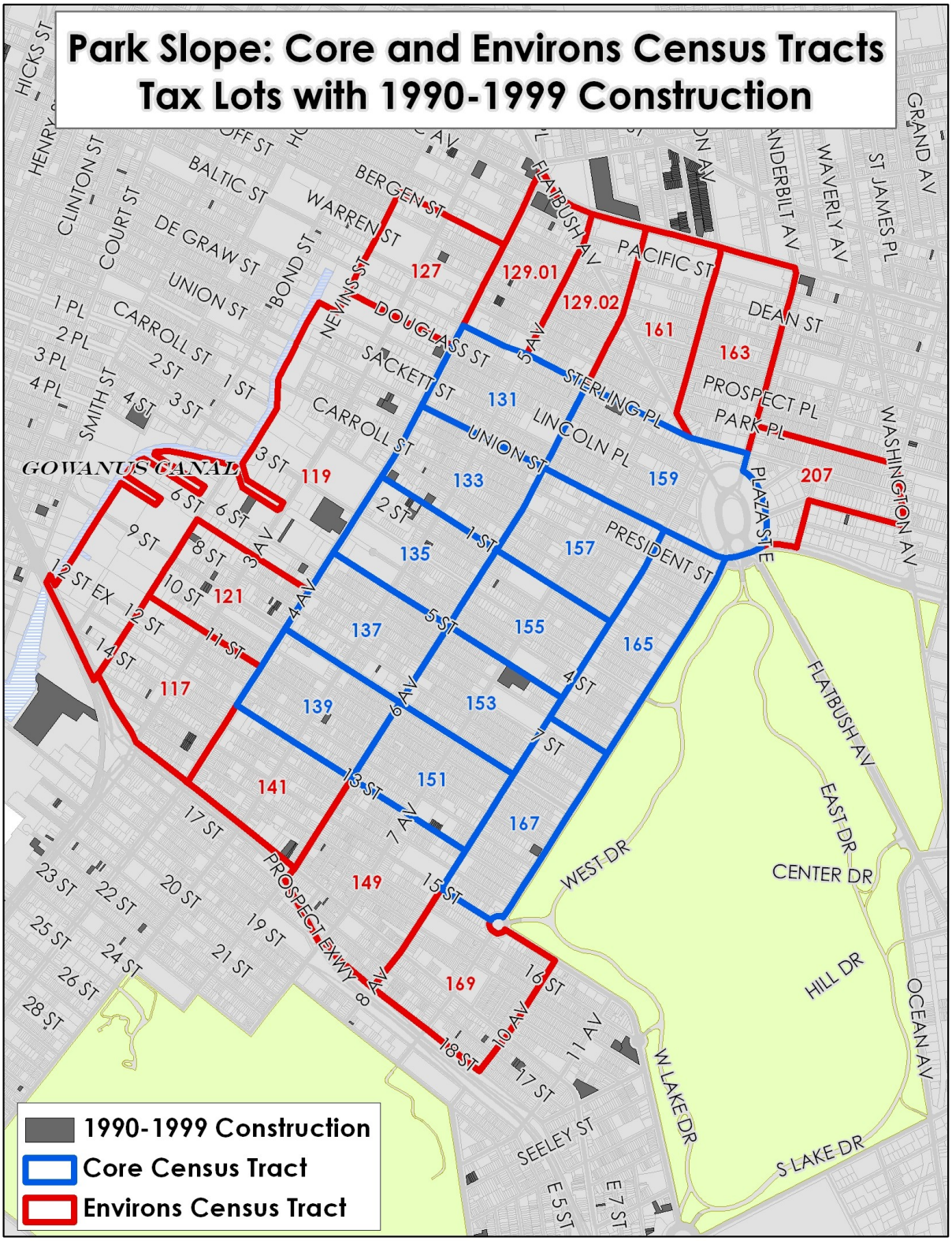
Map 5-20. Park Slope Tax Lots with 1940 - 1959 Construction.



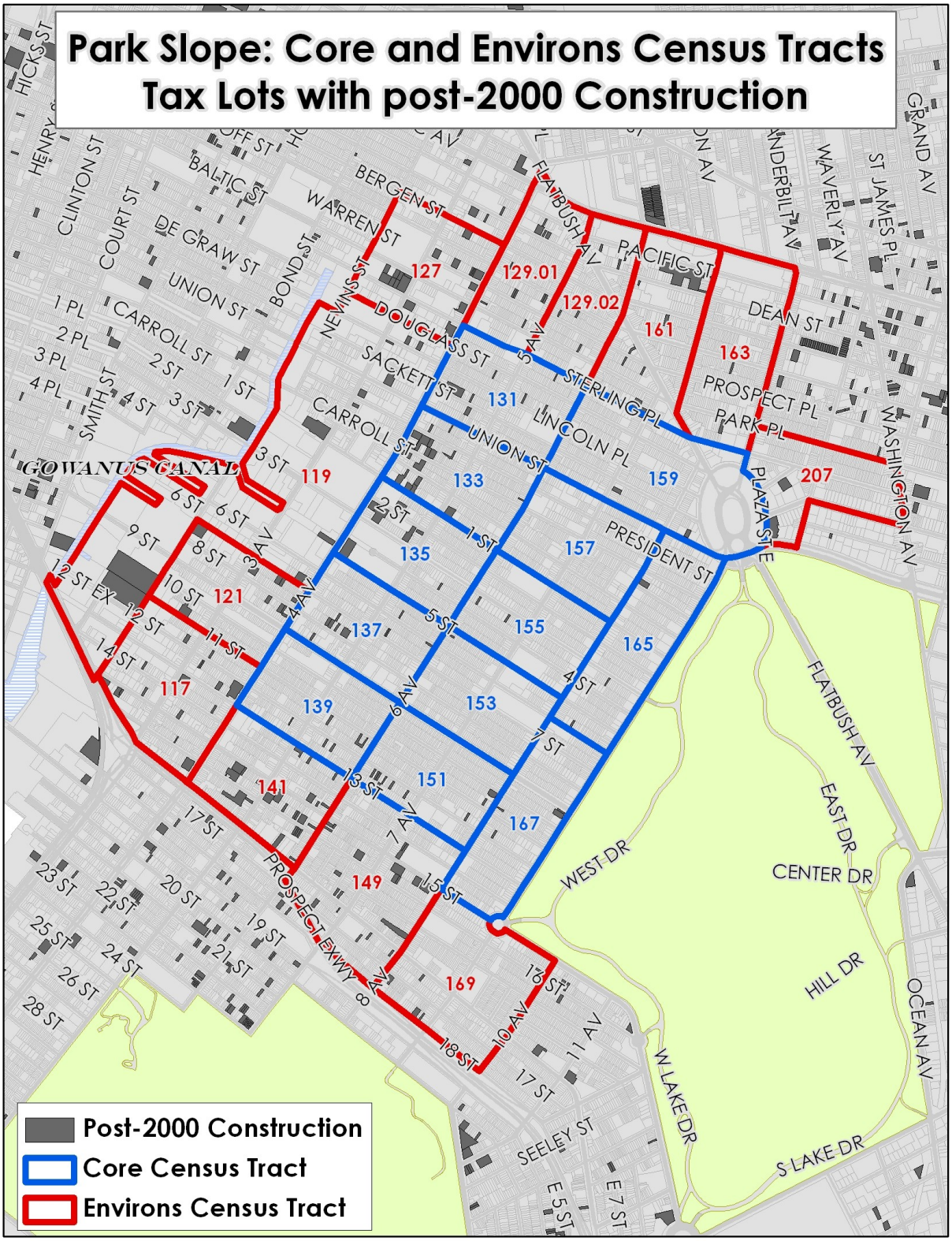
Map 5-21. Park Slope Tax Lots with 1960 - 1979 Construction.



Map 5-22. Park Slope Tax Lots with 1980 - 1989 Construction.



Map 5-23. Park Slope Tax Lots with 1990 - 1999 Construction.



Map 5-24. Park Slope Tax Lots with post-2000 Construction.

5-3.3 Building Height

Maps 5-25 through 5-30 depict another dimension of the physical environment, namely, building heights. These maps are based on the "number of floors" attribute from the MapPLUTO data-set to approximate the building heights. The categories are:

0 floor: no structure (See Map 5-25)

1 to 2-floor: short houses, factories, shops (See Map 5-26)

3 to 4-floor: taller houses, brownstones (See Map 5-27)

5 to 6-floor: walk-up apartment buildings (See Map 5-28)

7 to 12-floor: taller apartment building (See Map 5-29)

over 12-floor: high-rise buildings (See Map 5-30)

Figure 5-6 below compares the Core and Environs and illustrates the similarities and differences between these two areas. The tax lots in the Core are predominantly 3 to 4-floor structures. The Environs is "flatter" with the 1 to 2-floor category being the majority, although it is followed by the 3 to 4-floor category. Neither the Core nor the Environs has many tax lots with greater than 5-floor structures.

This series of maps illustrate that the majority of buildings in Park Slope are in the category of 3 to 4-floor, followed by the category of 1 to 2-floor which are located toward the Western and Southern areas of the neighborhood. The distribution of the 1 to 2-floors category actually extends beyond the defined Environs Census Tracts. The spatial distributions of 5 to 6-floor and 7 to 12-floor buildings appear scattered.

The category of tax lots with no structure cluster in the Northern end of the area and taller buildings (7 to 12-floor) are scattered around the area. Map 5-30 illustrates tax lots with over 12-floor buildings. These high-rise buildings are rare in Park Slope. They are only ten such buildings in the Core and two in the Environ areas. The high-rise buildings inside the Core cluster around the North-east corner along Prospect Park West and around Grand Army Plaza. The remaining three high-rise buildings are scattered. Most Census Tracts lack a single building in the high-rise category. In summary, Park Slope is a neighborhood characterized by low rise buildings, most no more than four floors.

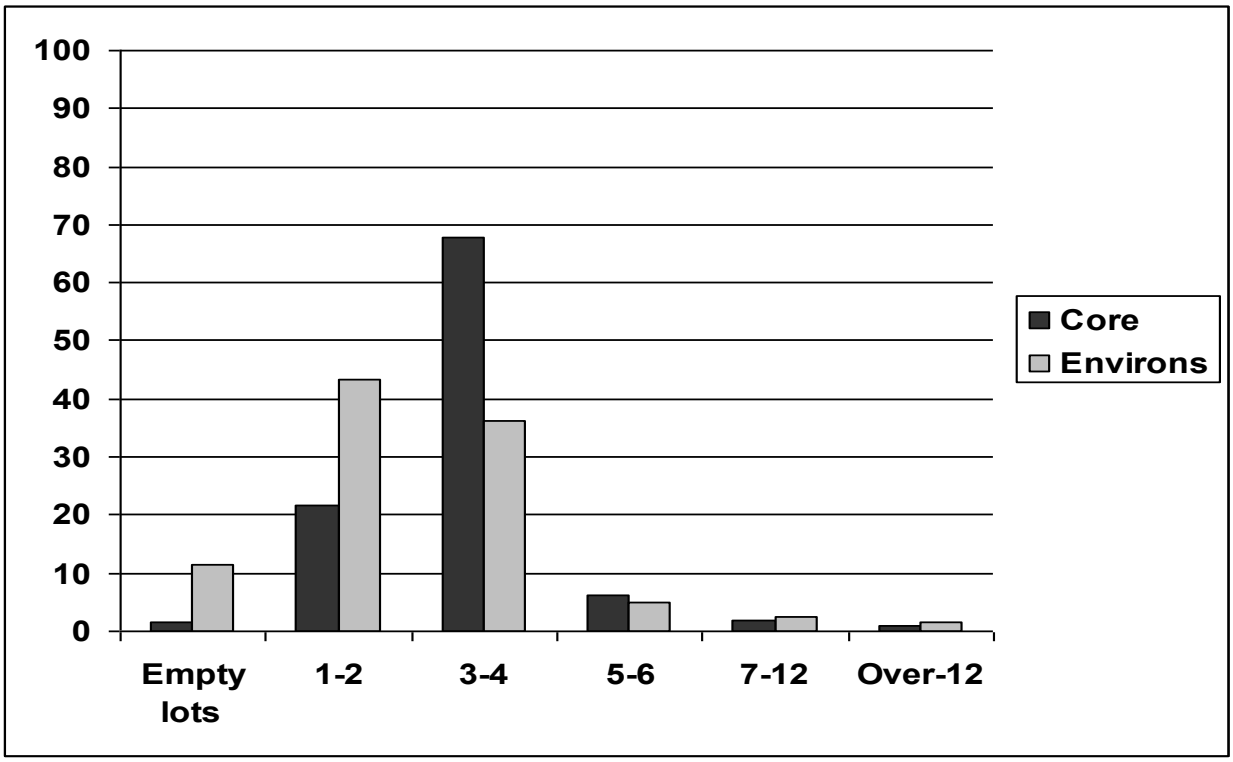
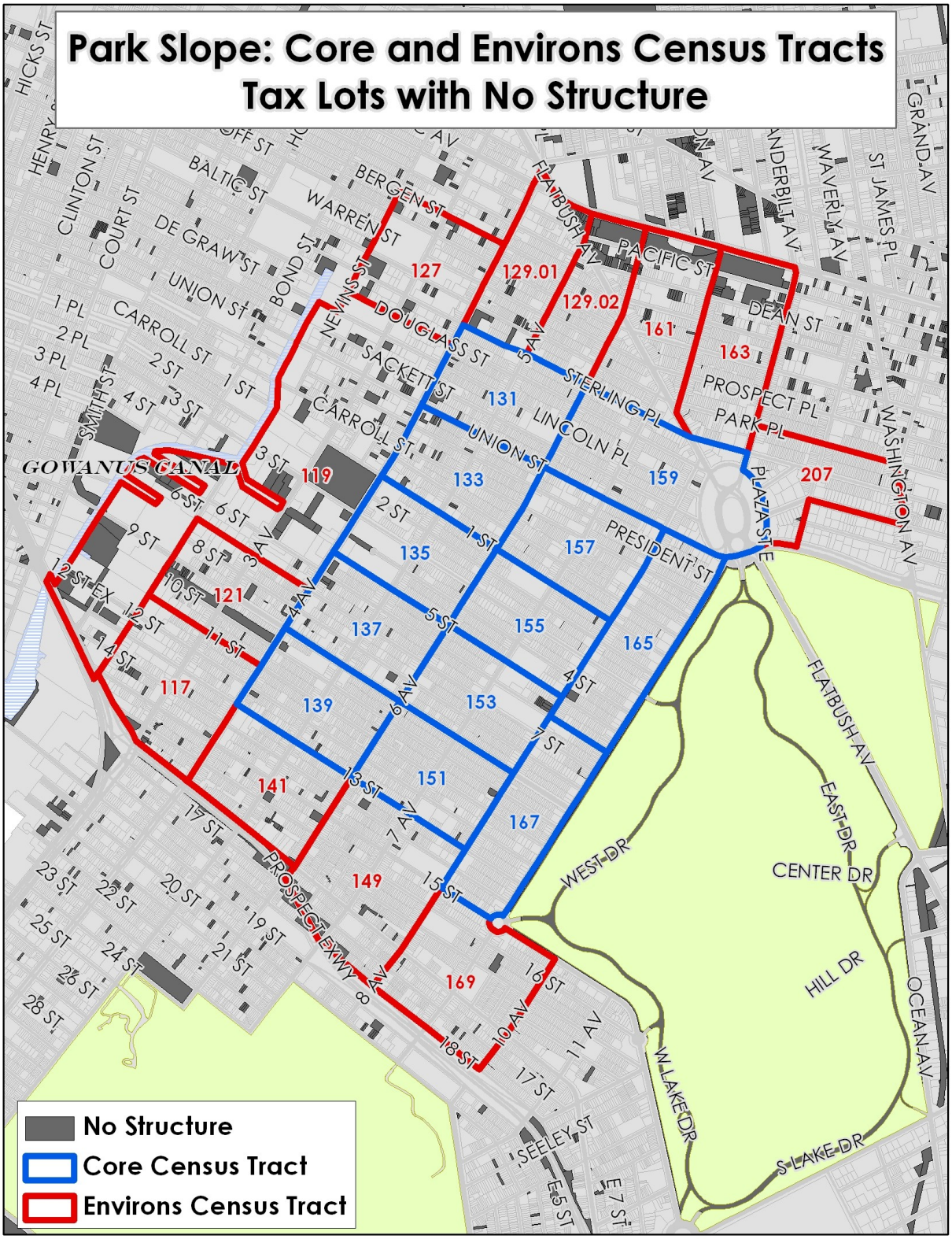
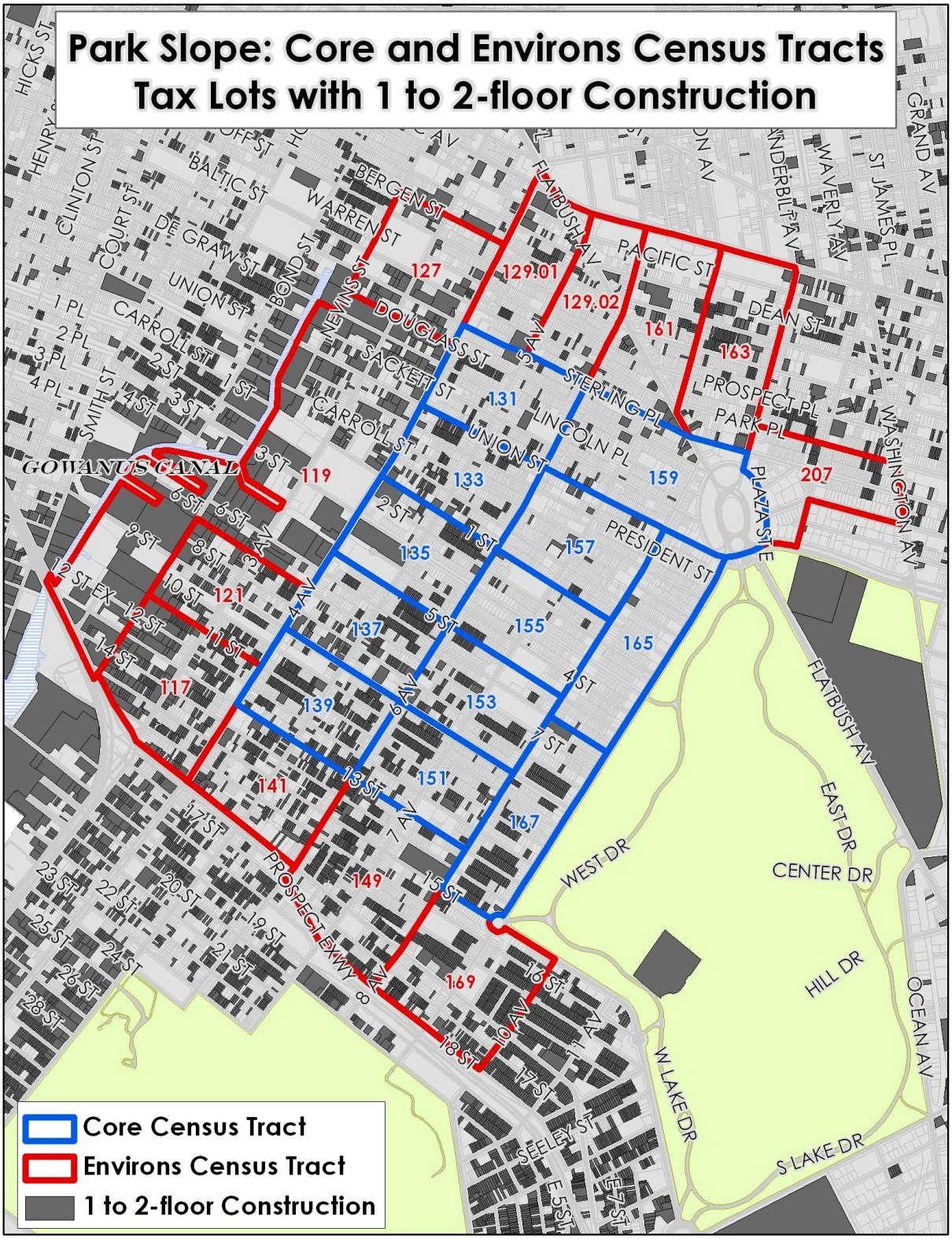


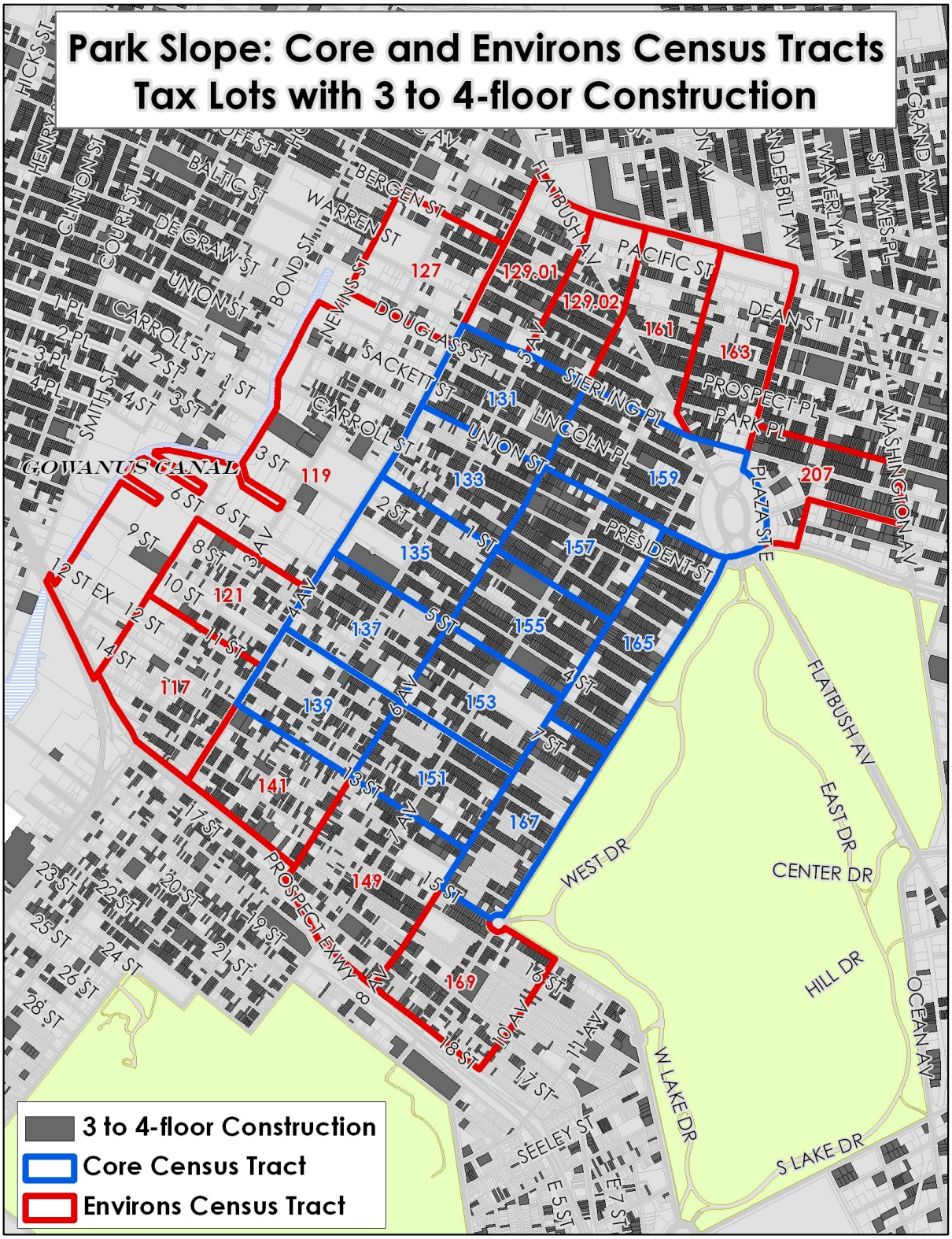
Figure 5-6. Percentage of Building Floor category by Tax Lot Area, Park Slope - Core vs. Environs, 2010.



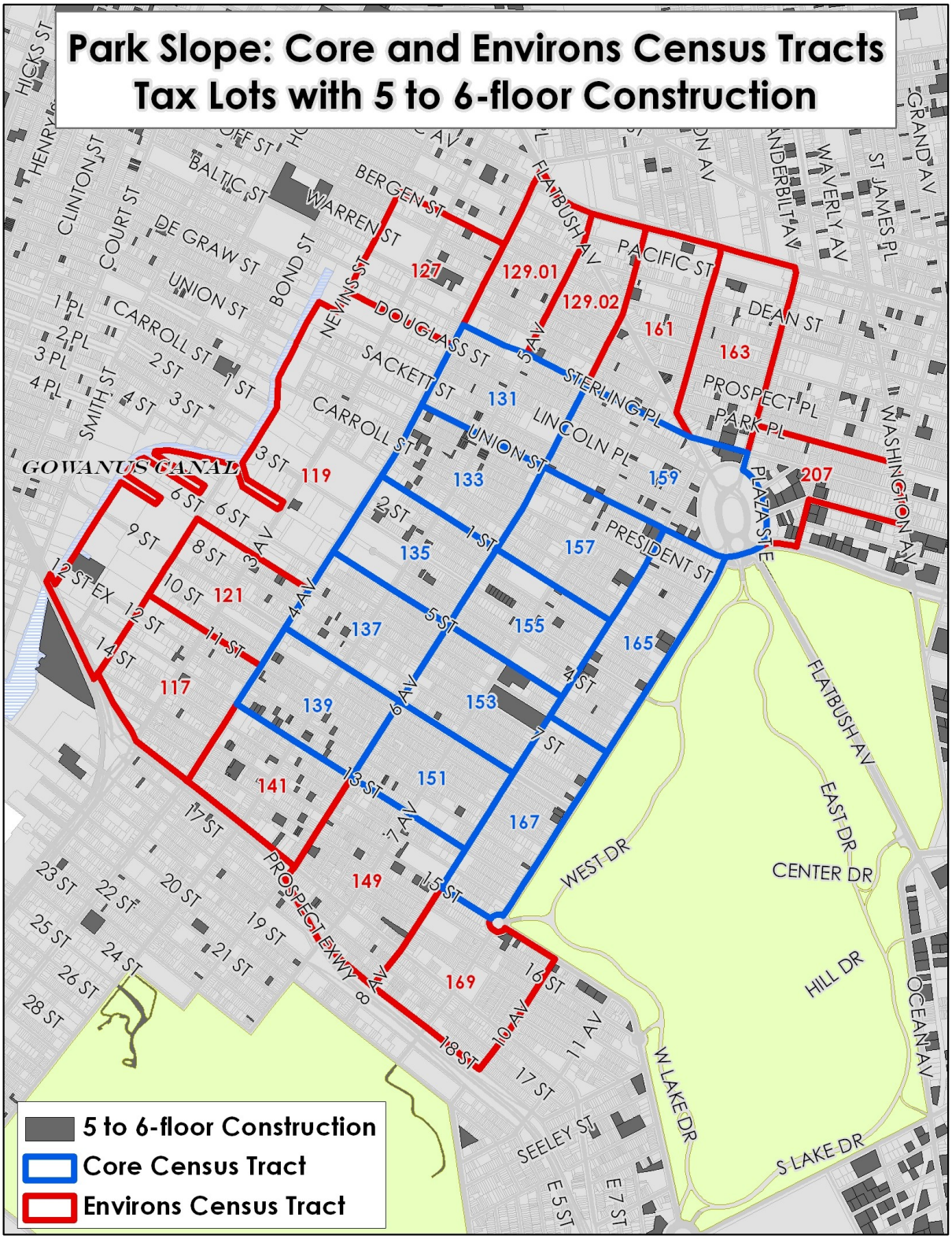
Map 5-25. Park Slope Tax Lots with No Structure.



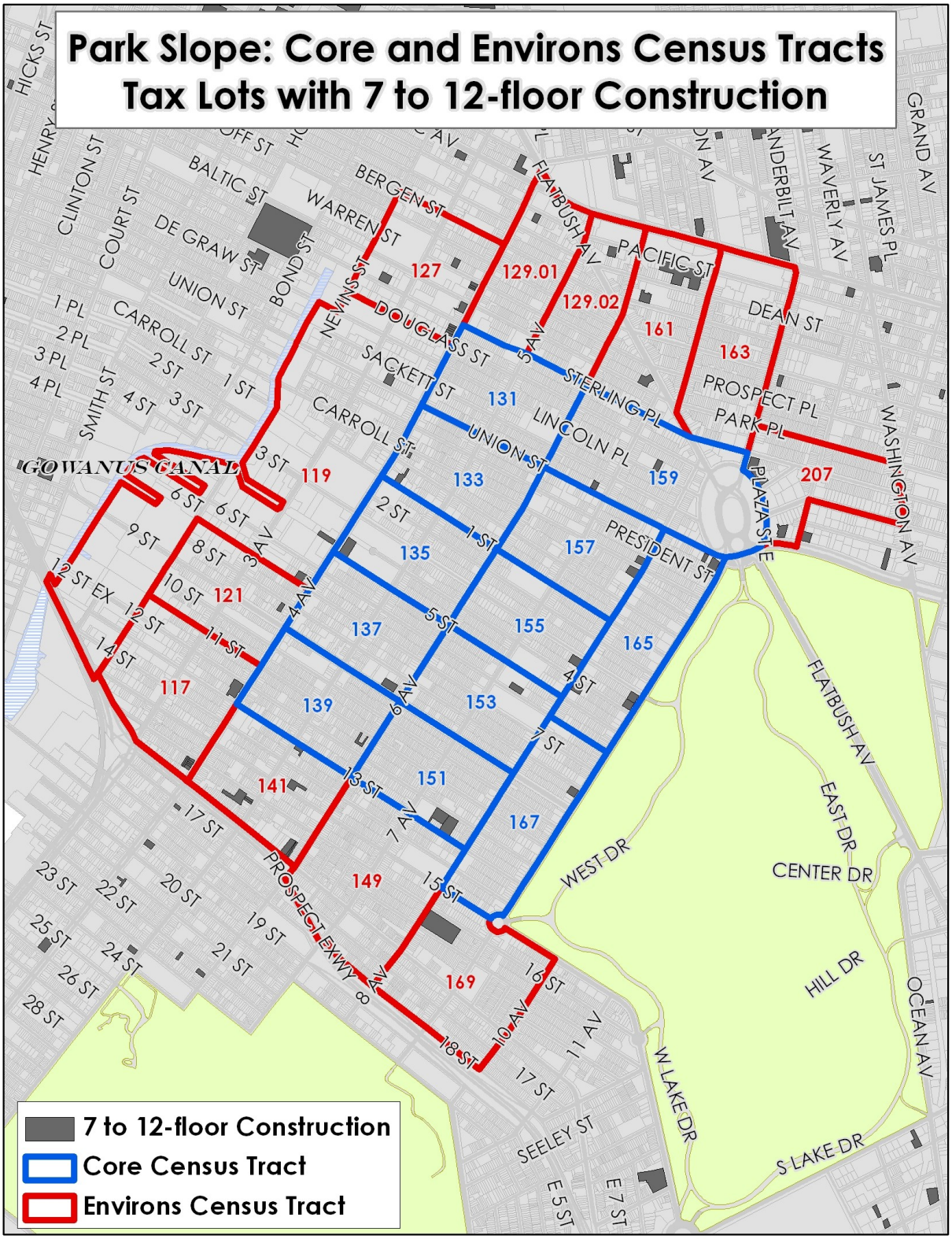
Map 5-26. Park Slope Tax Lots with 1 to 2-floor Construction.



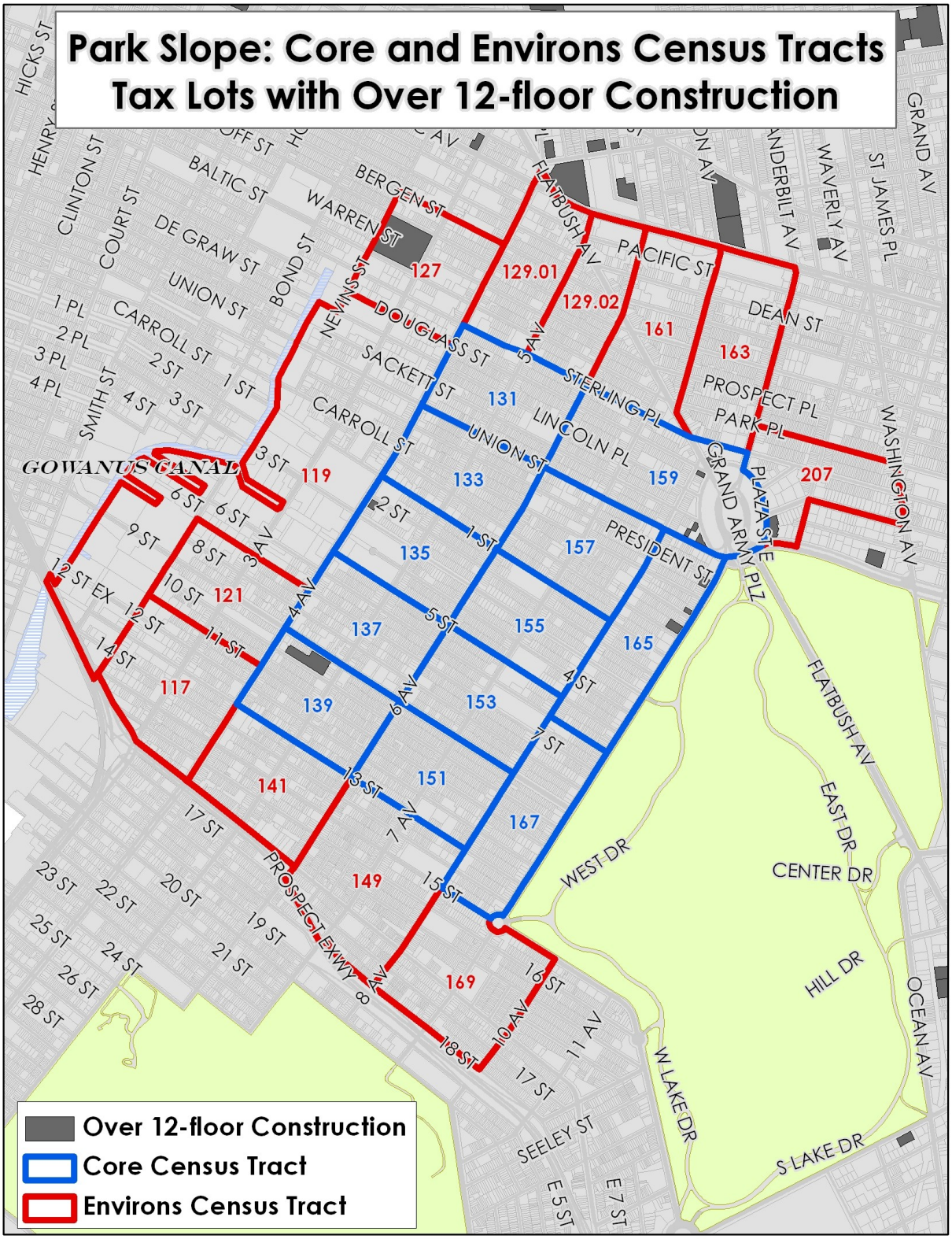
Map 5-27. Park Slope Tax Lots with 3 to 4-floor Construction.



Map 5-28. Park Slope Tax Lots with 5 to 6-floor Construction.



Map 5-29. Park Slope Tax Lots with 7 to 12-floor Construction.



Map 5-30. Park Slope Tax Lots with Over 12-floor Construction.

5-4 Park Slope: The Social Environment

5-4.1 Total Population

Between 1980 through 2010 New York City and each of the Five Boroughs have experienced a slow but steady increase in population. Figure 5-7 below illustrates that among the Five Boroughs, Brooklyn is consistently the most populated.

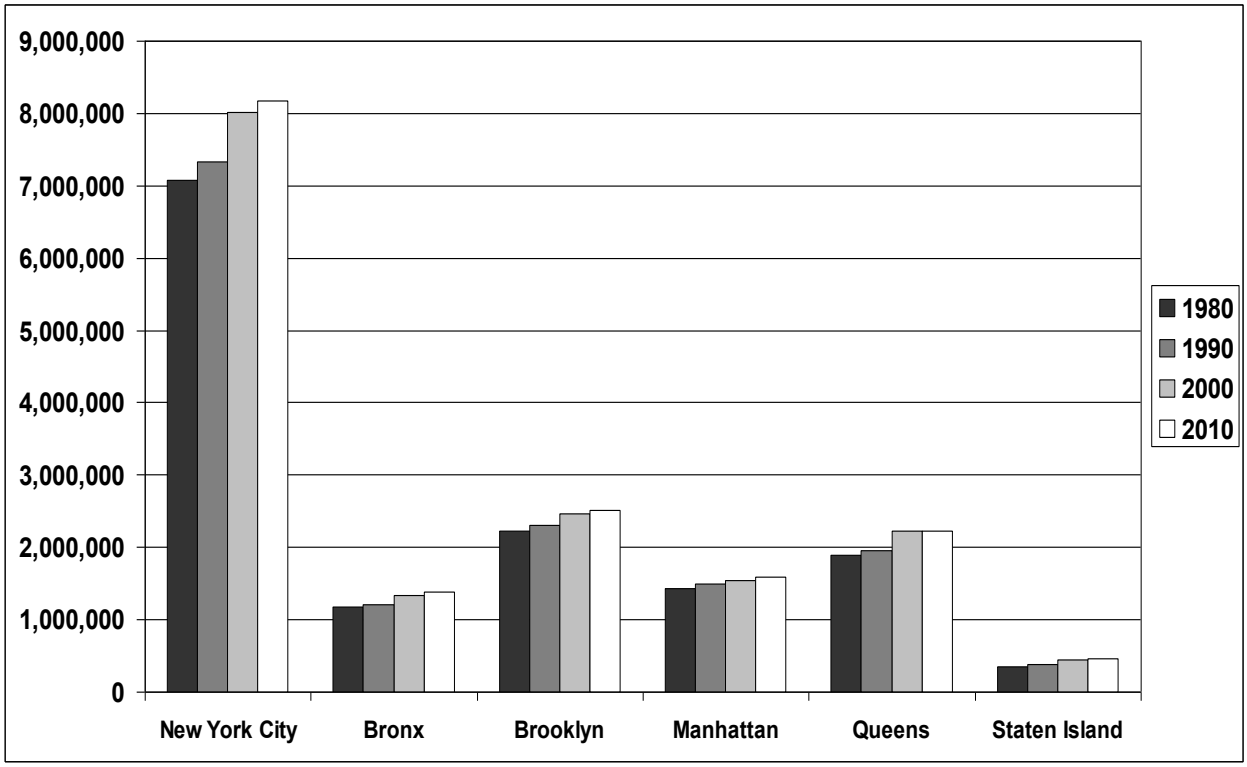


Figure 5-7. Total Populations of New York City and the Five Boroughs, 1980 - 2010.

A common practice to illustrate neighborhood changes is to aggregate several Census Tracts to form a study area and then tabulate the values chronologically (Lees, 2003). This approach provides readers with the necessary information but it also requires some effort to understand the

trends over the study period. Readers must read through all the values and then compare them to decide whether there is a trend or a peak at a particular time. A bar chart that is labeled with raw data such as the one below (Figure 5-8) improves this approach because it illustrates a trend graphically and provides a quicker visual comprehension and at the same time retains the exact numbers for precise comparisons.

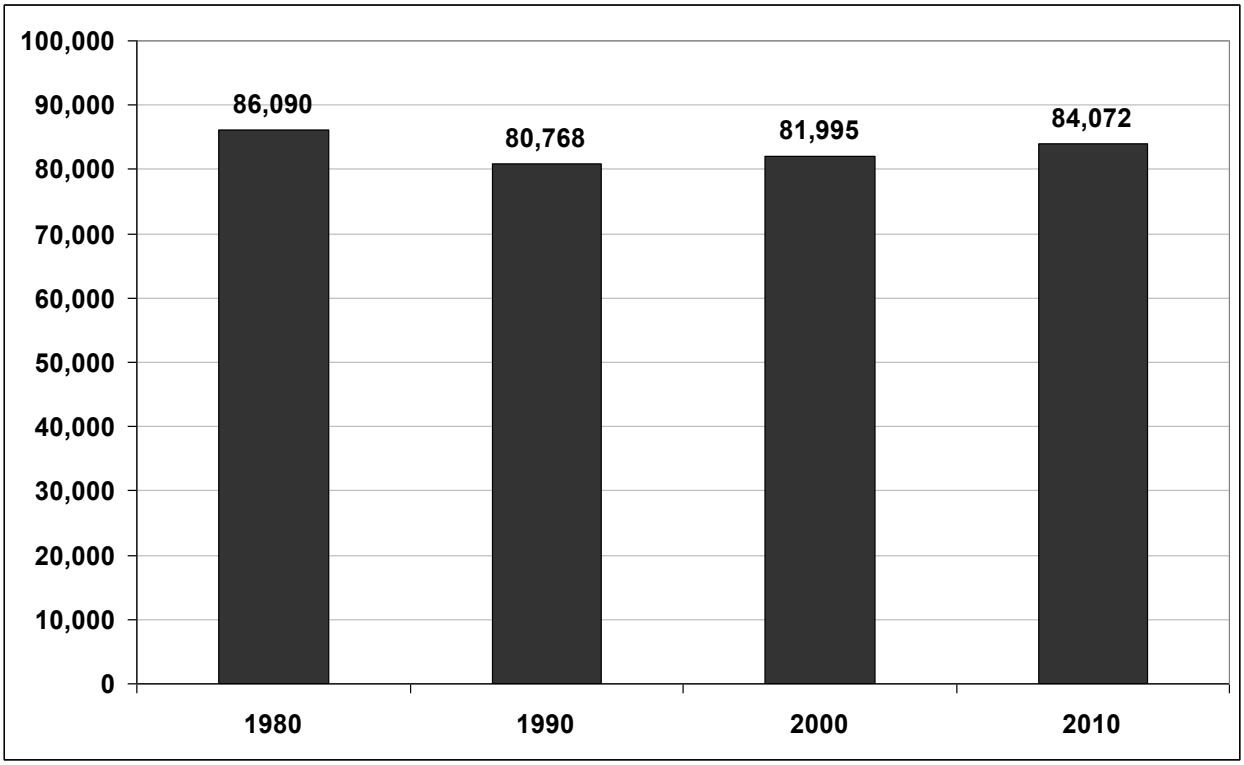


Figure 5-8. Total Population of Park Slope, 1980 - 2010.

While this alternative approach provides a quick reference with regard to the total population of the entire study area, it does not include the variations within the neighborhood. Even this study's design that assigns Census Tracts as either Core or Environs, this two-category method only adds a slightly more information. In Figure 5-9 below the Core and the Environs Census

Tracts are aggregated into two groups and illustrate a similar pattern, namely, both had the greatest numbers back 1980. In 1990 both the Core and the Environs Census Tracts experienced a decrease in population. In fact, in 1990 the Environs reached the lowest point throughout the study period. Subsequent Census Survey years experienced gains in population, however the numbers have yet to reach the peak reported in 1980. For the Core, the population decreased from 1980 through 2000 and only in the year 2010 did it increase slightly. Similarly, the Core has yet to reach the peak reported in 1980.

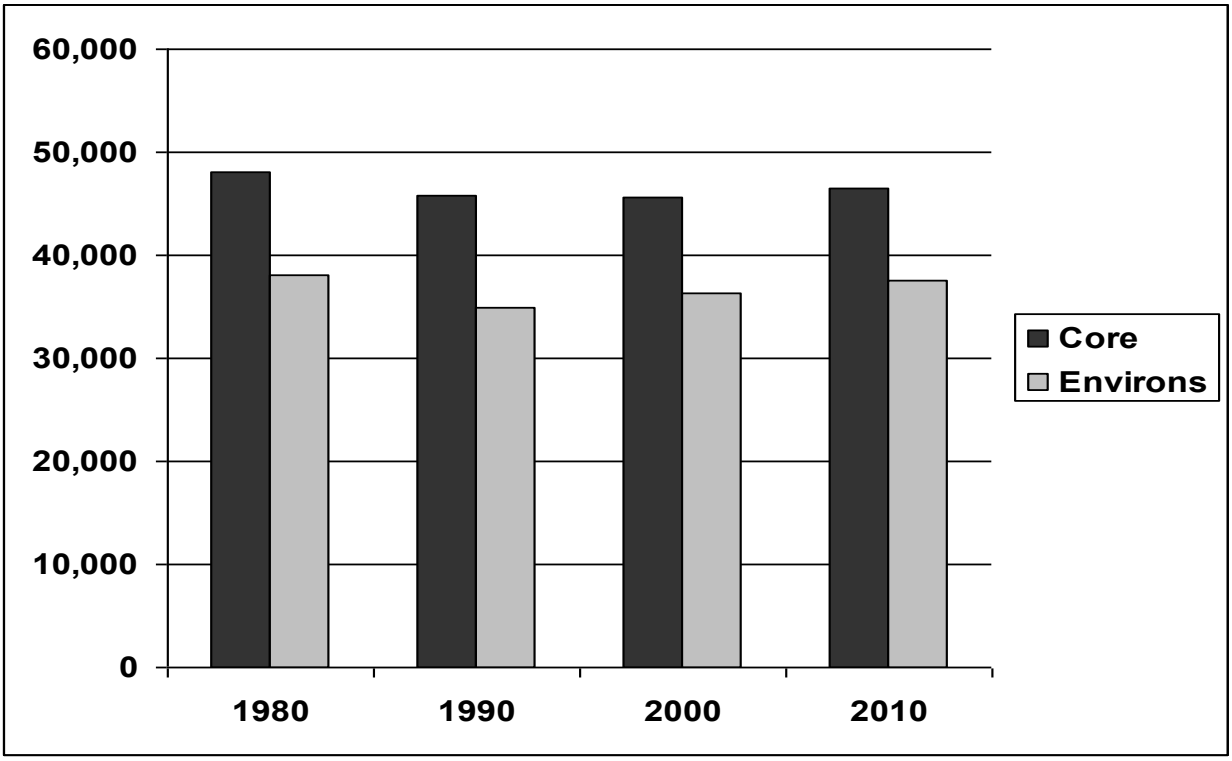


Figure 5-9. Total Population of Park Slope - Core vs. Environs, 1980 - 2010.

Before delving further into the next and smaller geographic unit, namely, the Census Tracts, a discussion of what has been revealed from these two simple bar charts is necessary. The total

population counts from Census Surveys do not reveal in-migration or out-migration. Nevertheless, if both the Core and the Environs Census Tracts experienced the largest populations in 1980, we can assume that the out-migration out-numbered the in-migration. And even as the total population increased from 1980 through 2010, it is noted that the overall population has yet to reach the peak that it was in 1980. If Park Slope residents and visitors believe that the neighborhood seems to be getting crowded in recent decades, the belief is only partially true, when factoring in that the 1980 level has yet to be exceeded.

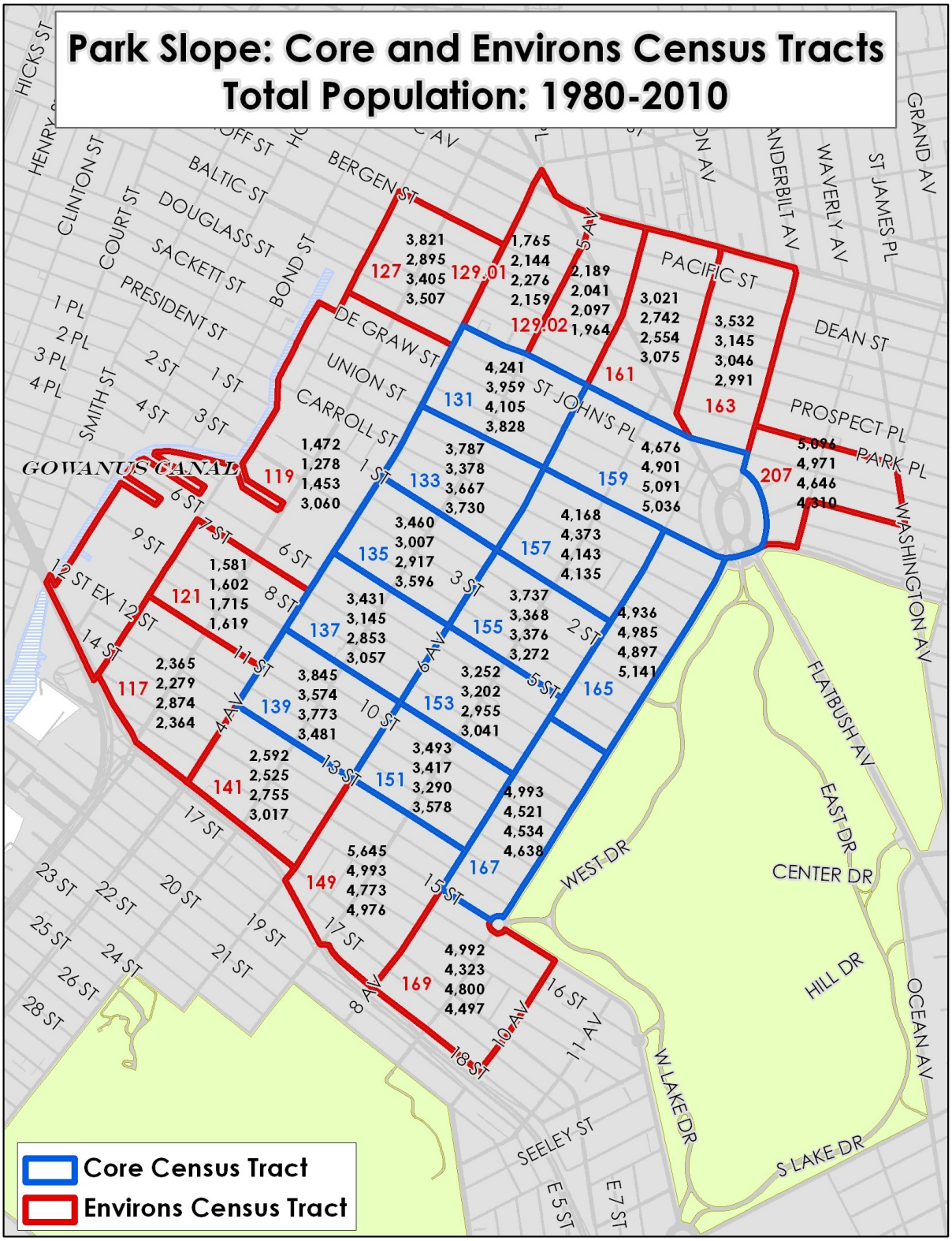
When the total population is listed by each Census Tract, this would provide more detailed information. However, the resulting matrix requires a considerable effort to process (Table 5-1). Even with the additional data for which Census Tracts are categorized (as either Core or Environs) this does not benefit readers to better comprehend population trends of the study area. In fact, this approach is probably more confusing than the two figures described above, that at the very least provide the reader with a quick grasp of how the populations of the Core and Environs Census Tracts have changed over time. Furthermore, in Table 5-1, the spatial relationships among the Census Tracts are not conveyed. Perhaps, this is one reason that researchers have simply aggregated Census Tracts to form a single study area.

O'Hanlon (1982) realized this shortcoming, specifically that there are missing spatial relationships among Census Tracts and his solution was to insert all the numbers into the respective Census Tracts on a single map such as the Map 5-31 reproduced below. While the automation enabled by using GIS facilitates the process of creating this map, readers must review all the numbers first to determine the trend of each Census Tract, and then decide whether

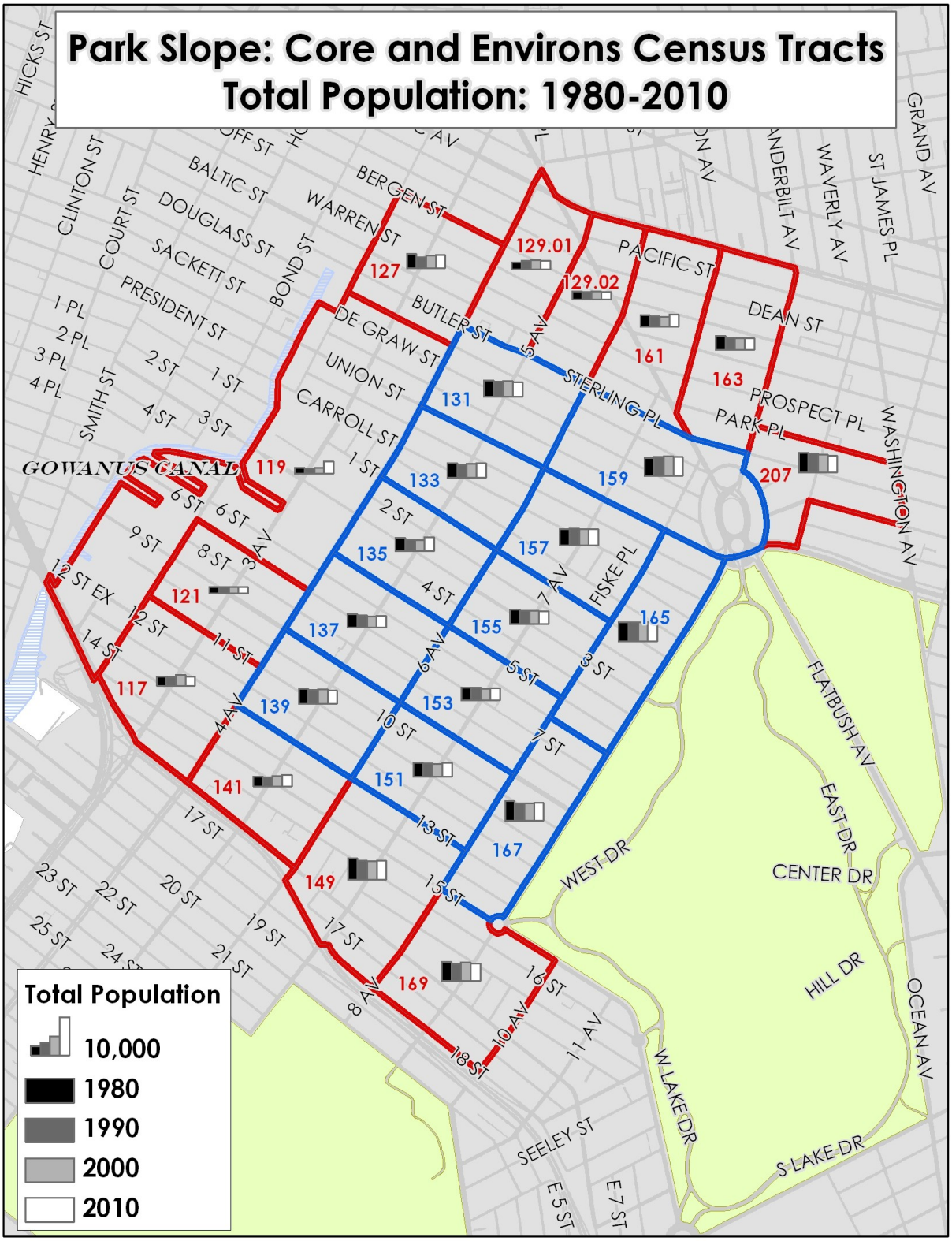
certain clusters of Census Tracts share the same trend. In contrast, creating individual bar charts for each Census Tract, and then placing these bar charts within each corresponding Census Tract, enables readers to decipher the trend more easily and additionally to conclude whether there is a spatial pattern involving a cluster of Census Tracts that may share the same trend (Map 5-32). This embedded bar chart approach focuses more attention on the spatial distribution of relative changes in data sets, but also presents limitations. For example, the space of each Census Tract is limited and the bar charts must be compressed so they can be embedded into the maps. If the figures from the four Census Surveys are similar to each other, it can be difficult to readily determine any difference. To accommodate this limitation, individual bar charts for the Census Tracts are grouped by Core and Environs and are created to supplement the maps.

Census Tract	Area	Census 1980	Census 1990	Census 2000	Census 2010
117	Environs	2,365	2,279	2,874	2,364
119	Environs	1,472	1,278	1,453	3,060
121	Environs	1,581	1,602	1,715	1,619
127	Environs	3,821	2,895	3,405	3,507
129.01	Environs	1,765	2,144	2,276	2,159
129.02	Environs	2,189	2,041	2,097	1,964
131	Core	4,241	3,959	4,105	3,828
133	Core	3,787	3,378	3,667	3,730
135	Core	3,460	3,007	2,917	3,596
137	Core	3,431	3,145	2,853	3,057
139	Core	3,845	3,574	3,773	3,481
141	Environs	2,592	2,525	2,755	3,017
149	Environs	5,645	4,993	4,773	4,976
151	Core	3,493	3,417	3,290	3,578
153	Core	3,252	3,202	2,955	3,041
155	Core	3,737	3,368	3,376	3,272
157	Core	4,168	4,373	4,143	4,135
159	Core	4,676	4,901	5,091	5,036
161	Environs	3,021	2,742	2,554	3,075
163	Environs	3,532	3,145	3,046	2,991
165	Core	4,936	4,985	4,897	5,141
167	Core	4,993	4,521	4,534	4,638
169	Environs	4,992	4,323	4,800	4,497
207	Environs	5,096	4,971	4,646	4,310
Total Population		86,090	80,768	81,995	84,072

Table 5-1. Total Population of Park Slope - Core and Environs by Census Tracts, 1980 - 2010.



Map 5-31. Park Slope, Total Populations in Numbers by Census Tract, 1980 - 2010.



Map 5-32. Park Slope, Total Populations in Bar Charts by Census Tract, 1980 - 2010.

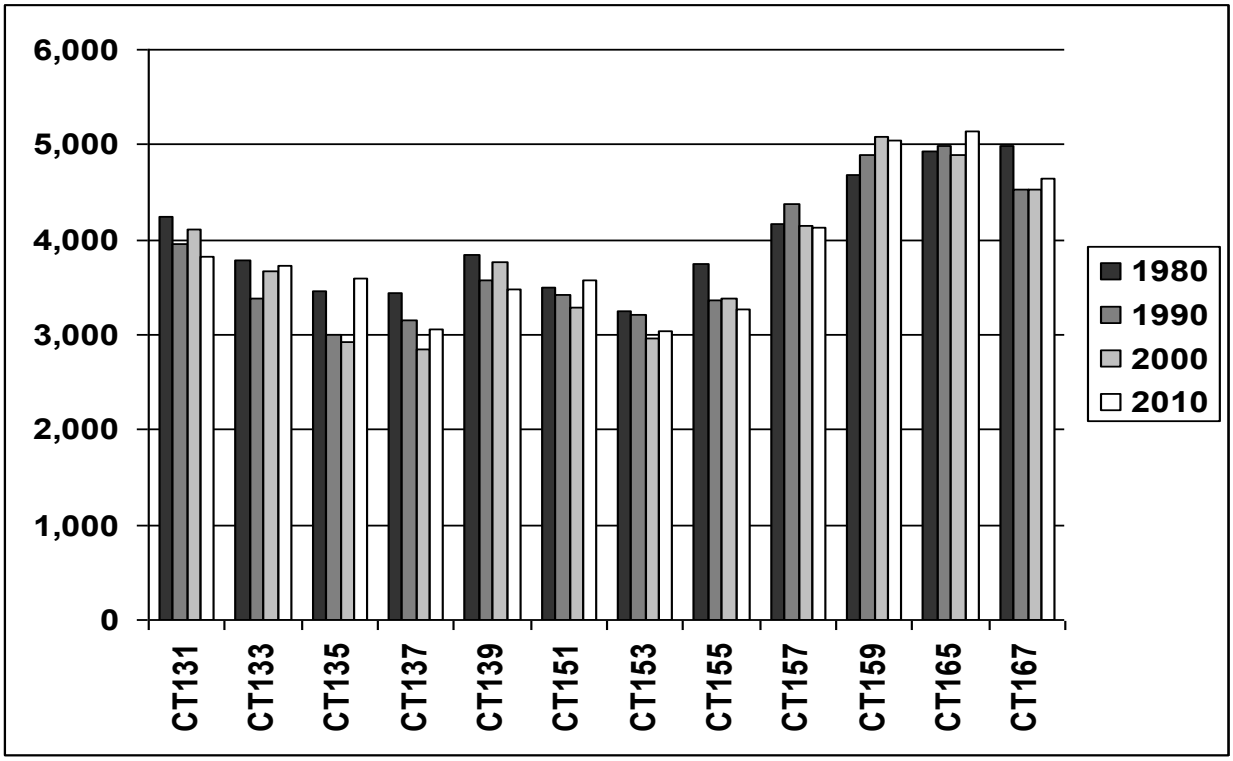


Figure 5-10. Total Population of Census Tracts, Park Slope - Core, 1980 - 2010.

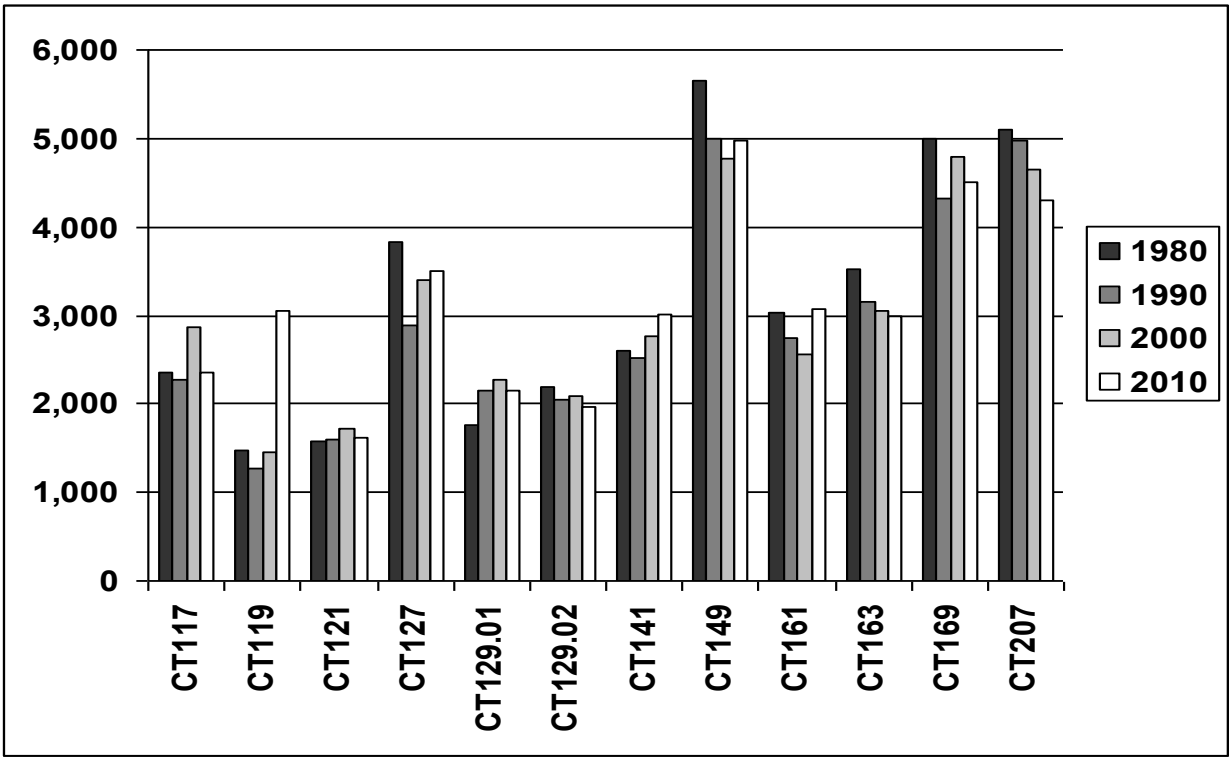


Figure 5-11. Total Population of Census Tracts, Park Slope - Environs, 1980 - 2010.

For example, Map 5-32, Figure 5-10 and Figure 5-11 illustrate the figures and trends. Although there are not many variations among the four Census Surveys, Map 5-32 provides additional information that is not readily revealed by the numerical matrix in Table 5-1:

1. The Census Tracts in the Core area are generally more populated, which is not surprising considering the area is predominantly zoned for residential use.

2. Two Environs Census Tracts in the South (149 and 169), as well as Census Tract 207 in the North-east are more populated and each maintains a population in the 4000s or 5000s range. These values are higher than are the West corridor Core Census Tracts.

3. Other Environs Census Tracts are less populated. This observation is especially represented by three Census Tracts adjacent to the Gowanus Canal where most tax lots are zoned for manufacturing use.

The initial gentrification map produced for this study and the variable used, proves beneficial as a visualization tool that describes a basic demographic condition, such as the exact locations within Park Slope that experience an increase in population.

5-4.2 Selected Ethnic Group Maps

In this series of maps, selected ethnic groups (White, Black, Chinese and Hispanic-origin) are mapped by their percentages of the total population within each Census Tract. The four percentage figures calculated from the Census Survey years (1980, 1990, 2000 and 2010) are plotted as a bar chart and embedded into each Census Tract in the maps. The bar chart sizes for these percentages are standardized so these ethnic group maps can be directly compared to each other.

5-4.2a Percentage of the White Population

Figure 5-12 below illustrates, between 1980 and 2010 there were different trends among New York City and the Five Boroughs for the percentage of the White population. New York City itself experienced decreasing percentages of the White population and this trend is shared by the Bronx, Queens and Staten Island. In contrast, Brooklyn and Manhattan, after experiencing decreased percentages of the White population from 1980 and 2000, had an increase between 2000 and 2010. However, neither Brooklyn nor Manhattan has reached the high percentages of Whites reported in the 1980 Census Survey.

The Core Census Tracts in Park Slope reverse the New York City trend. Although the figures are approximately equal in 1990 and 2000, between 1980 and 2010 there were increasing percentages of White population. The Environs experienced a dip in 2000, but in 2010 the highest point was reported among the four Census Surveys. While the bar charts in Figure 5-12 illustrate the opposite trend and slight differences between the Core and the Environs areas, Map 5-33 below reveals more detailed spatial patterns at the Census Tract level.

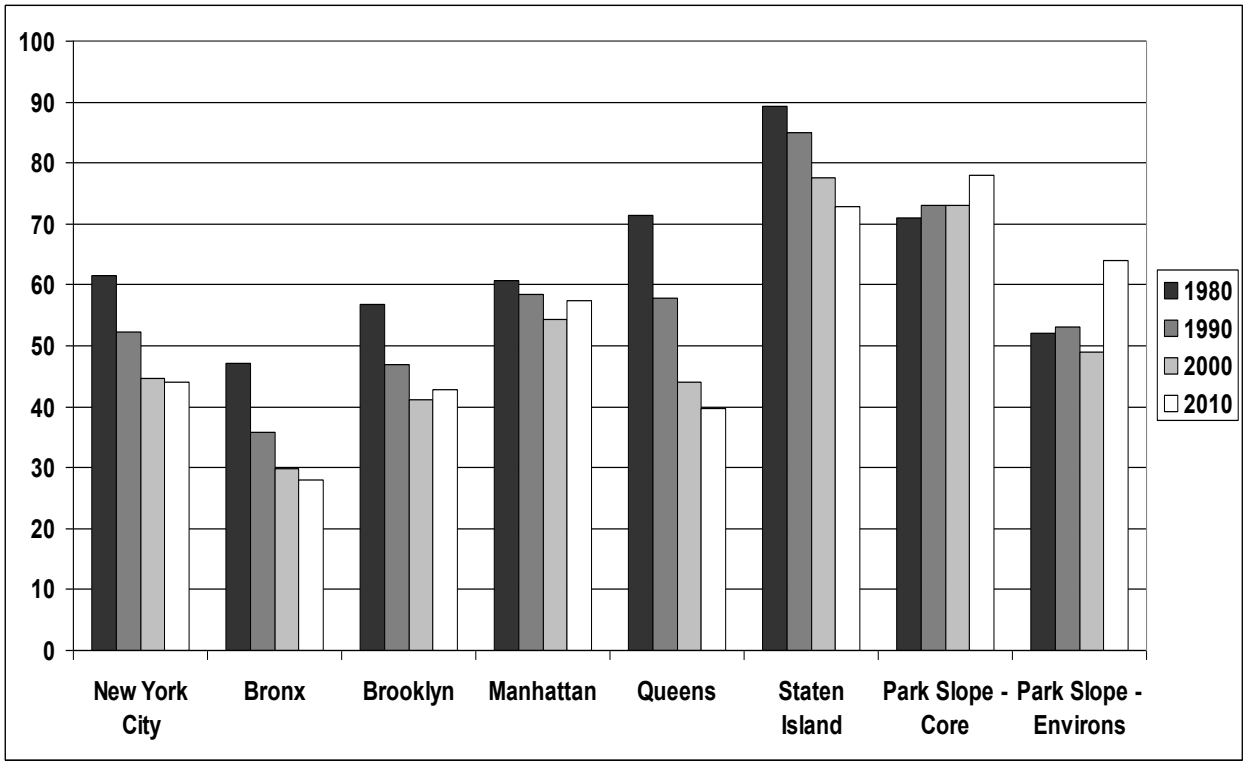
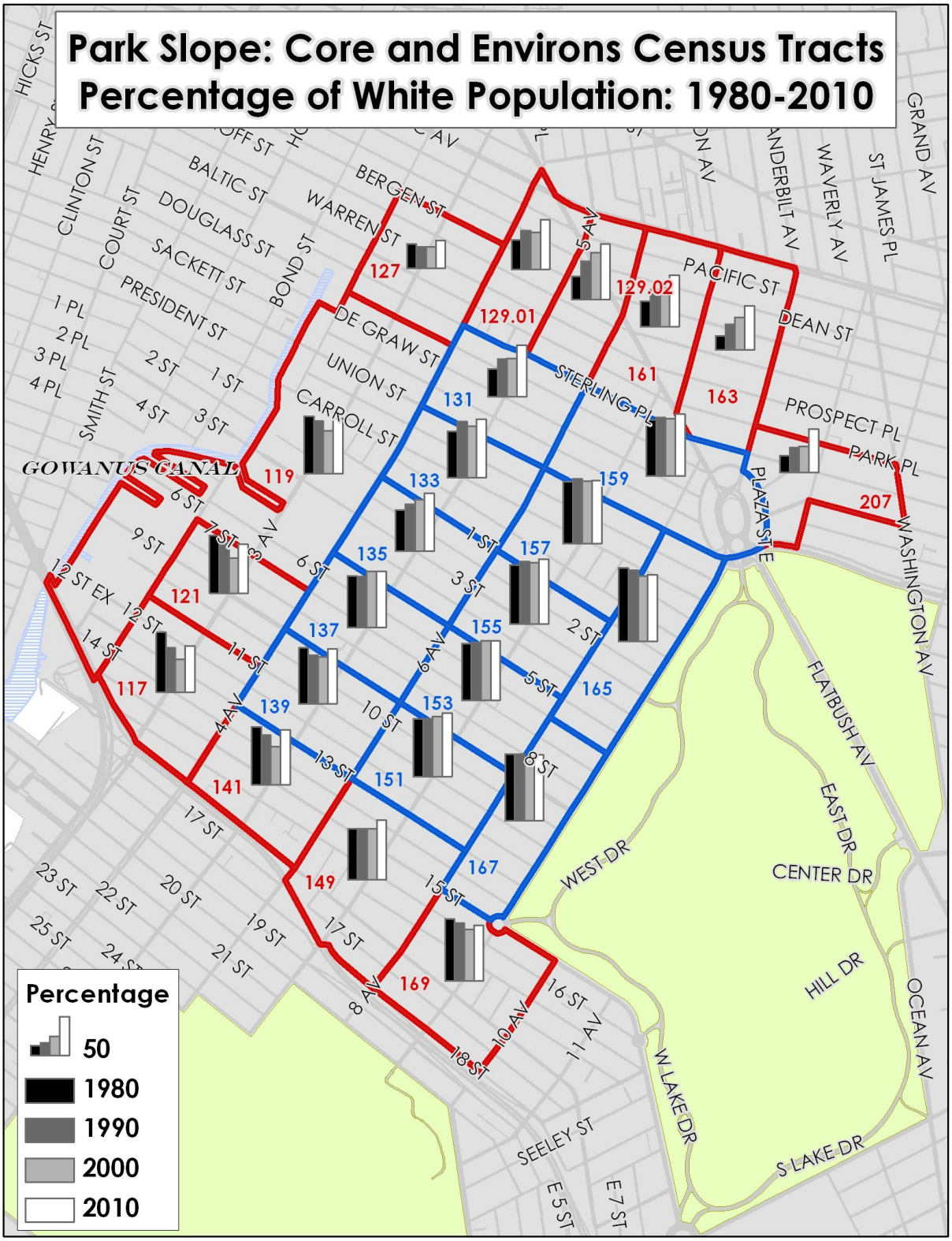


Figure 5-12. Percentage of the White Population in New York City, the Five Boroughs and Park Slope - Core and Environs, 1980 - 2010.



Map 5-33. Park Slope, Percentage of White Population by Census Tract, 1980 - 2010.

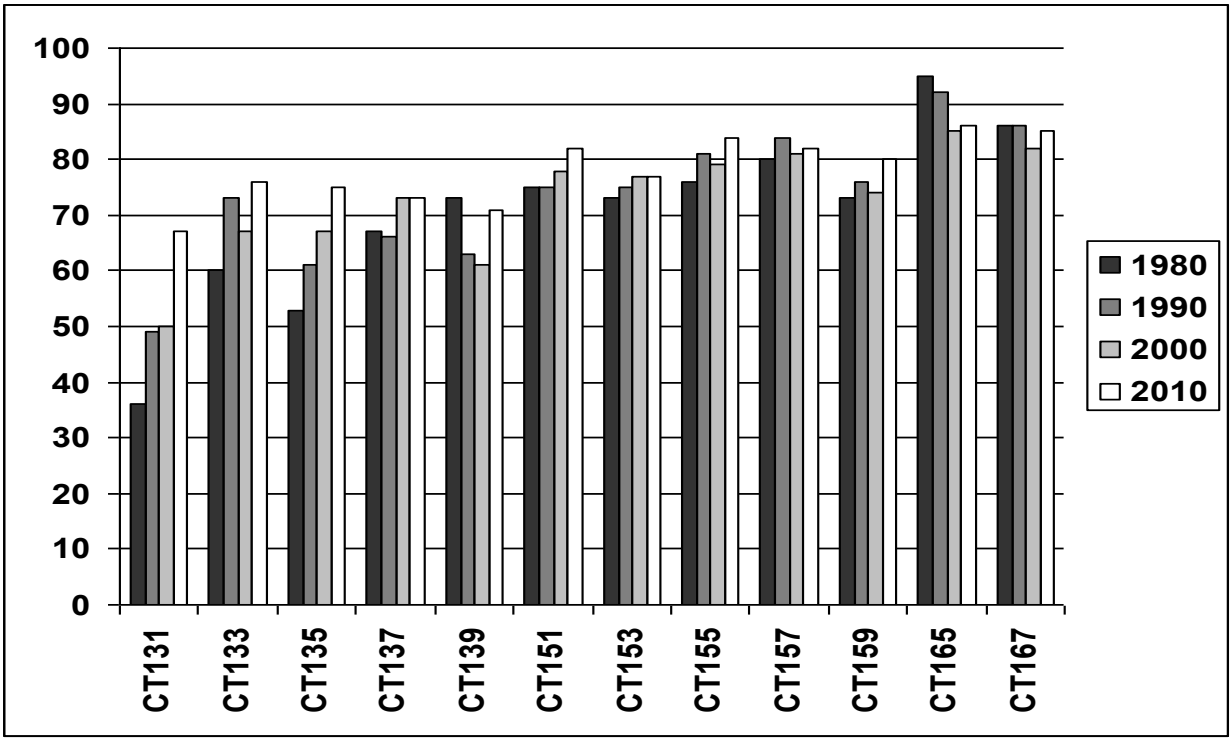


Figure 5-13. Percentage of the White Population in Park Slope - Core by Census Tract, 1980 - 2010.

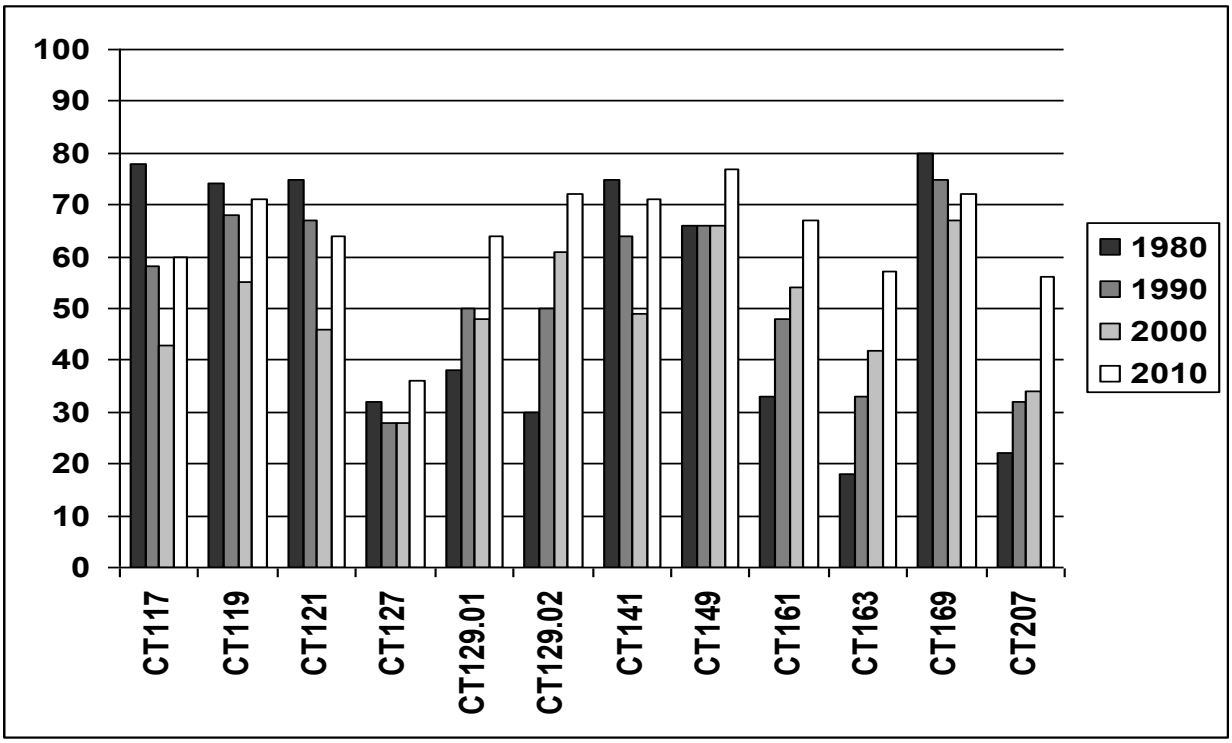


Figure 5-14. Percentage of the White Population in Park Slope - Environs by Census Tract, 1980 - 2010.

With Map 5-33, Figure 5-13 and Figure 5-14 we conclude overall that the Park Slope population is predominantly White, but the map provides more information beyond the aggregated Core vs. Environs bar charts:

1. The Census Tracts in the Northern Environs (excluding the northwest 127) show clear increasing percentages of the White population since 1980. In fact, Census Tract 131 of the Core shares the same pattern.

2. In the Core area there are slight variations across the years but in general the percentages of the White population remain high.

3. While the Western Environs Census Tracts (119, 121, and 117) share the pattern with the overall Environs (slight decrease in 2000, then an increase in 2010) the five Environs Census Tracts on the North show a steady increase in the percentages of Whites from 1980 to 2010.

5-4.2b Percentage of the Black Population

The percentages of the Black population from 1980 through 2010 are more complex than the pattern of the White population. For New York City as a whole, the percentage of the Black population peaks in 1990, then continues decreasing for the next two Census Survey years.

Both Brooklyn and the Bronx have consistently higher percentages of Black population than Manhattan, Queens and Staten Island. While these percentages also peak in 1990 as in New York

City itself, the Bronx had a slight increase in 2010, while Brooklyn shows a general decreasing trend of the Black population since 1990. Over the years, Staten Island shows a constant increase in percentages of the Black population, although this Borough possesses the lowest percentage of Blacks overall.

In Park Slope, the Environs consistently have approximately twice the percentage of Black population compared to the Core. Both have decreasing percentages from 1980 to 2010 and also have consistently lower percentages than the Borough of Brooklyn.

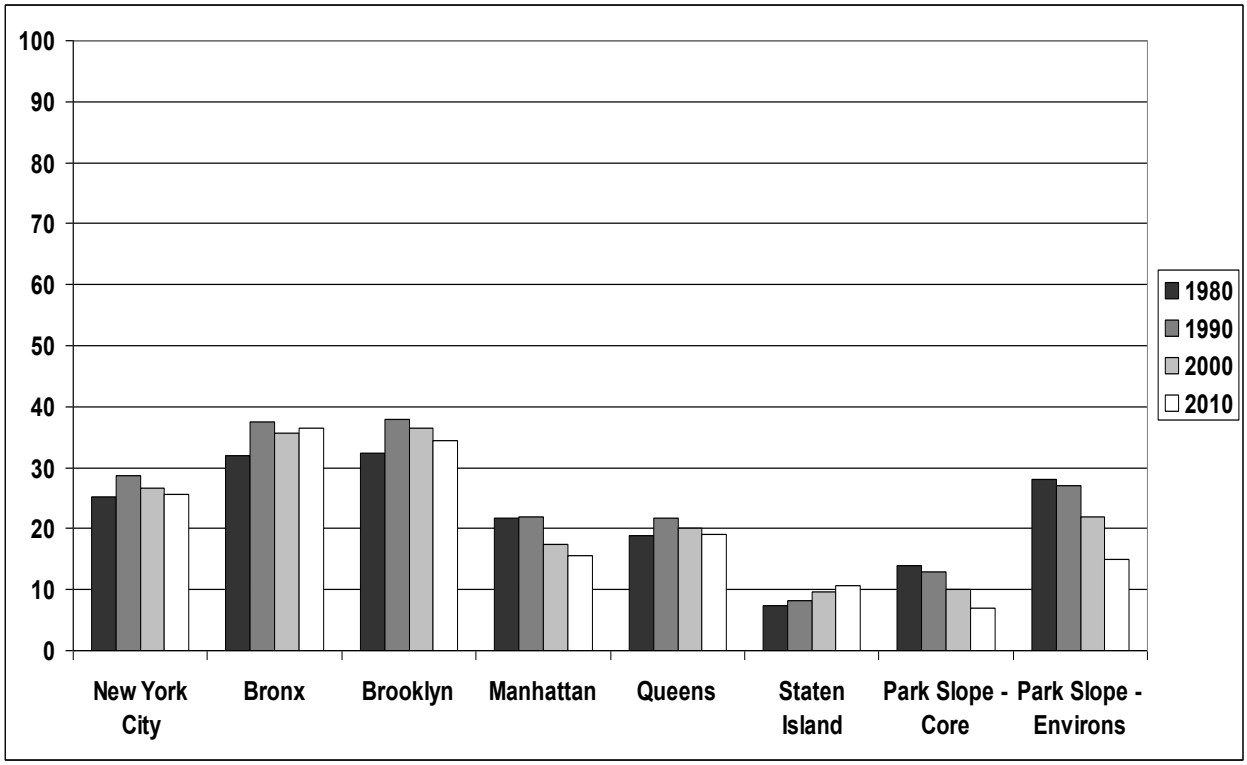
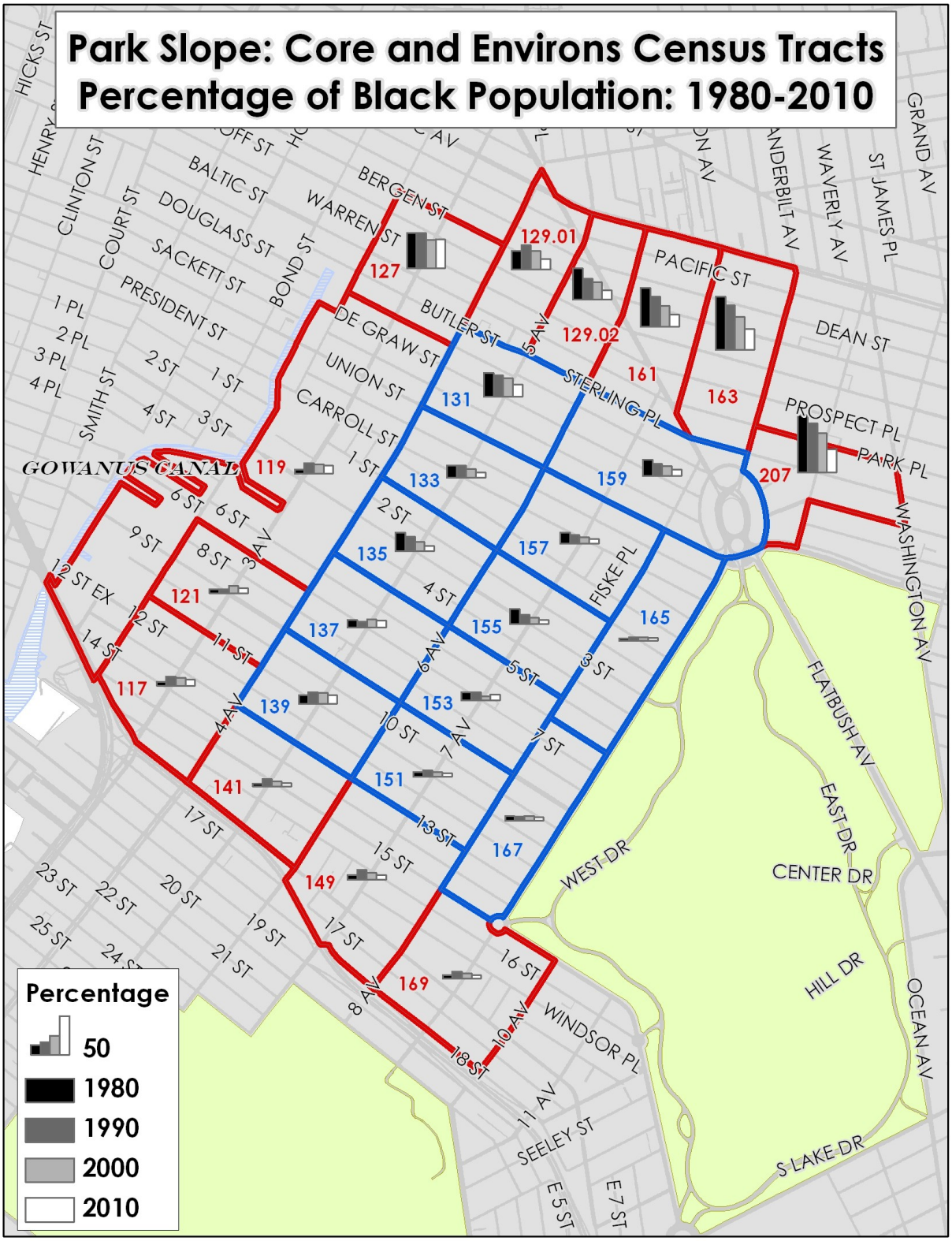


Figure 5-15. Percentage of the Black Population in New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.



Map 5-34. Park Slope, Percentage of Black Population by Census Tract, 1980 - 2010.

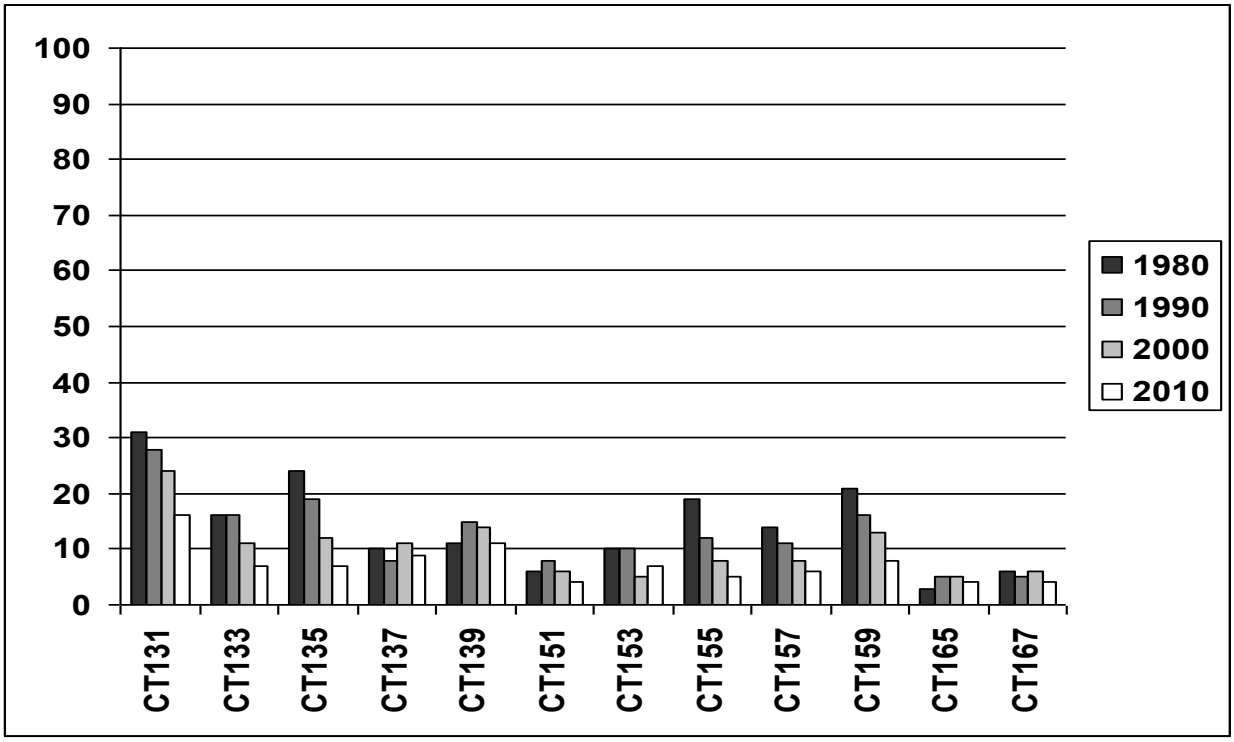


Figure 5-16. Percentage of the Black Population in Park Slope - Core by Census Tract, 1980 - 2010.

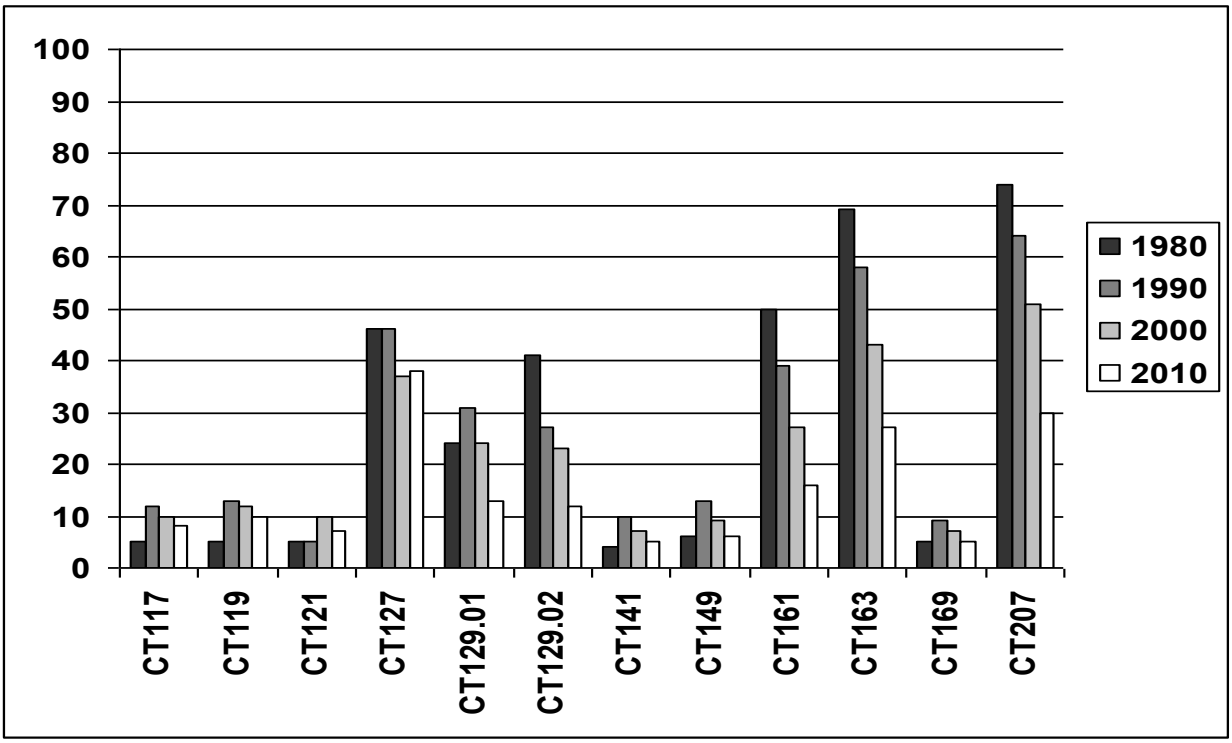


Figure 5-17. Percentage of the Black Population in Park Slope - Environs by Census Tract, 1980 - 2010.

As Map 5-33 demonstrates the high percentages of the White population in the Park Slope area, it should not be a surprise to see the low percentages of the Black population and the other ethnic groups. Map 5-34 reveals additional spatial patterns not evident by Figure 5-16 and Figure 5-17:

1. The two Core Census Tracts adjacent to Prospect Park (165 and 167) experienced a consistently low Black population through the years. The same is observed for the Southern and Western Environs Census Tracts.

2. Within the Core, and especially on the North-west corner, the percentage of the Black population decreased during the study period.

3. Most noticeable, and corresponding to the increase of the White population in the Northern Environs Census Tracts, is the decrease of the Black population percentage in the North Environs Census Tracts. Although ethnic composition should be combined with other socio-economic status variables to consider the advancement of gentrification, at this point it should be noted that these Census Tracts (165 and 167) experience more White in-migration and more Black out-migration than do the other Census Tracts that have more stable figures.

5-4.2c Percentage of the Chinese Population

Park Slope is not nearby the few neighborhoods that are known as the Chinatowns throughout New York City. It may therefore seem pointless to chart the percentages of the Chinese population in Park Slope. On the contrary, doing this exercise serves two purposes: the first is to

establish how low the percentage of the Chinese population is, and the second is to facilitate comparisons with the remaining Brooklyn neighborhoods and also with the Lower East Side which includes a portion of the Chinatown which is expanding in Lower Manhattan. To clearly illustrate the low percentages of the Chinese population, the scale of Figure 5-18 has been enlarged; the highest value on the Y-axis is 10, rather than 100.

Between 1980 and 2010, New York City as a whole experienced a steady increase in the percentages of the Chinese population. With the exception of the Bronx which has consistently less than 1%, and Manhattan that appears to have stalled in its growth, the other three Boroughs have experienced the same increasing trend (with the Borough of Queens having the highest figure). Although both Park Slope Core and Environs show a slight increase, from 2000 through 2010 the percentages remain at the same level (i.e. at 2% and 3% respectively). Map 5-35 below does not provide more detailed information because the values are consistently too low.

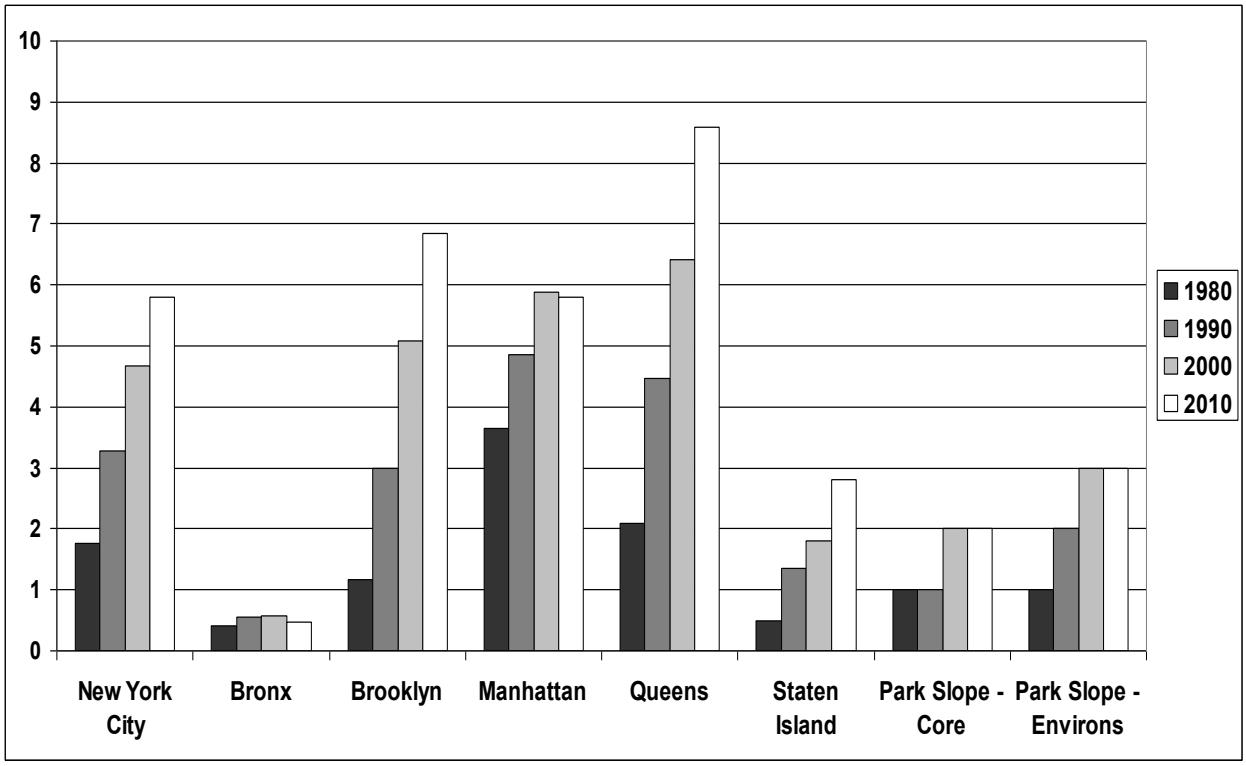
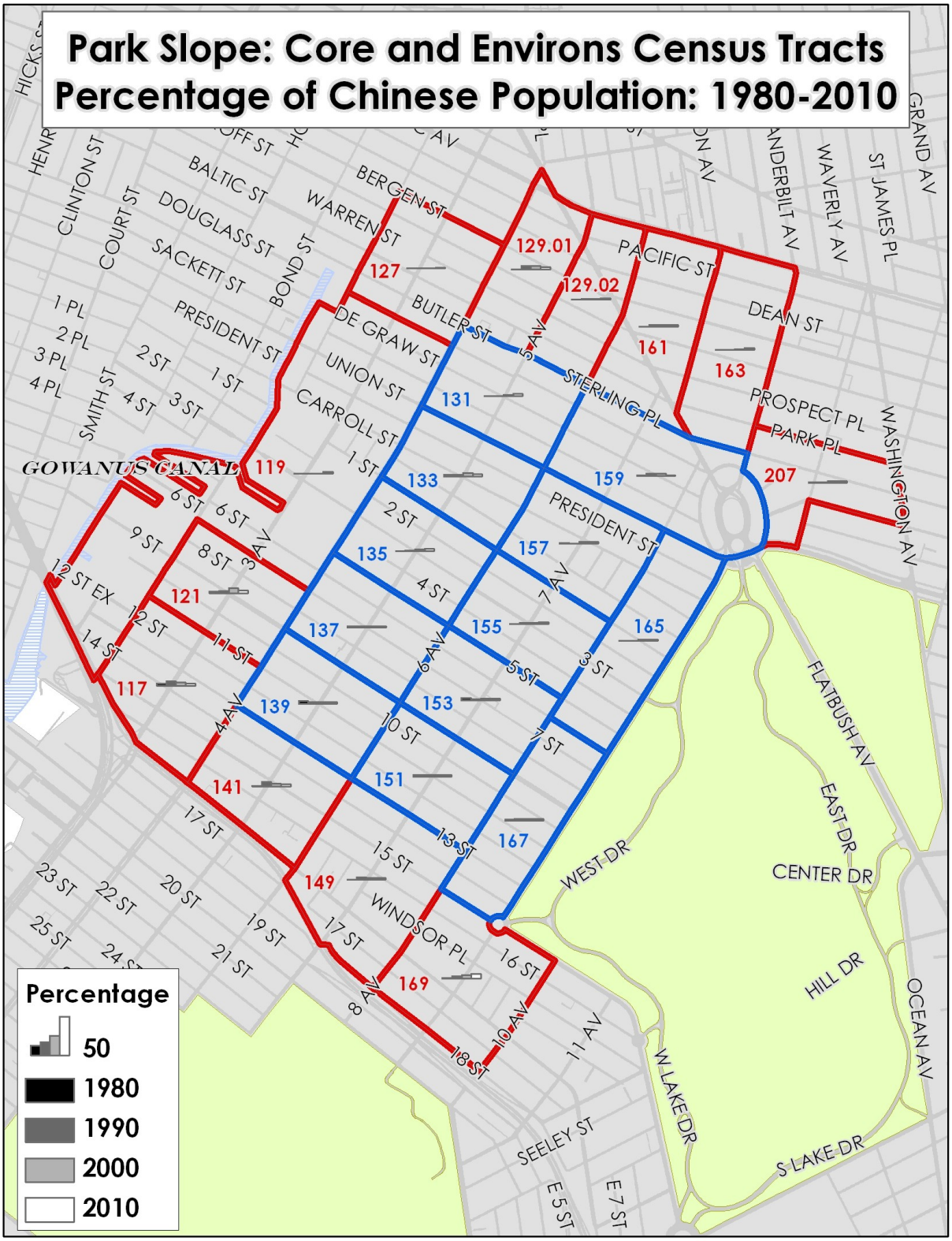


Figure 5-18. Percentage of the Chinese Population in New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.



Map 5-35. Park Slope, Percentage of Chinese Population by Census Tract, 1980 - 2010.

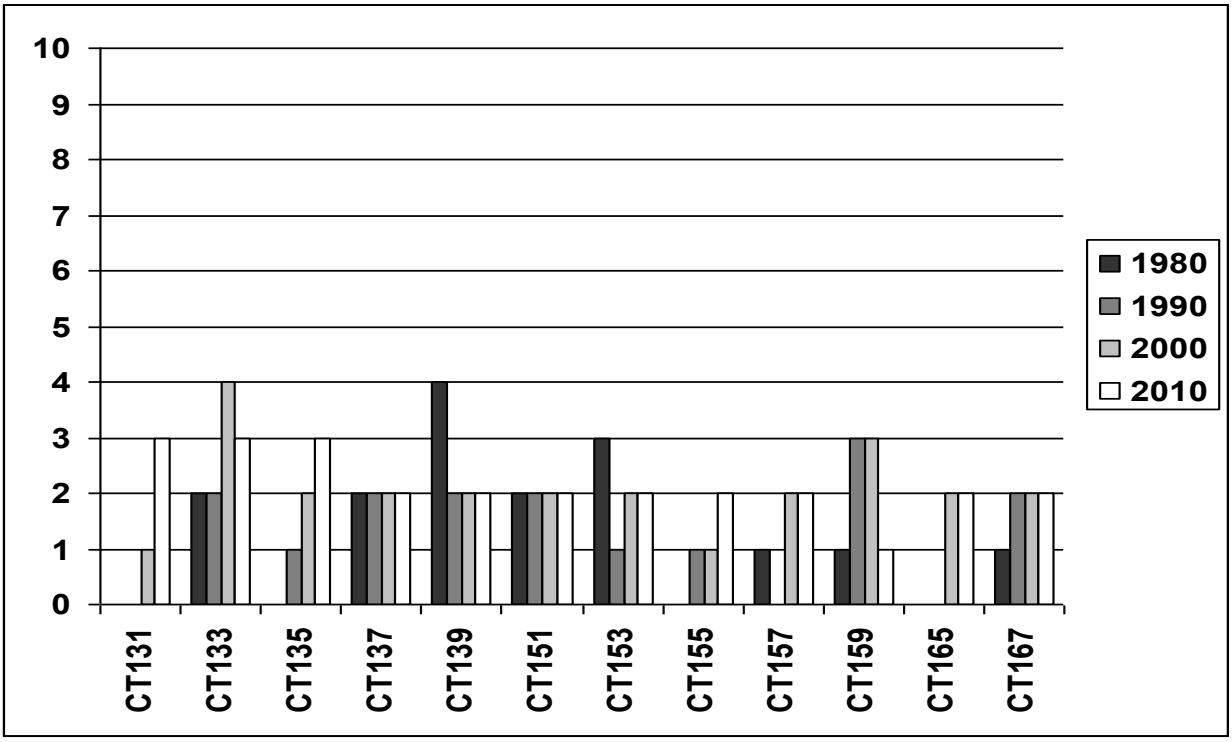


Figure 5-19. Percentage of the Chinese Population in Park Slope - Core by Census Tract, 1980 - 2010.

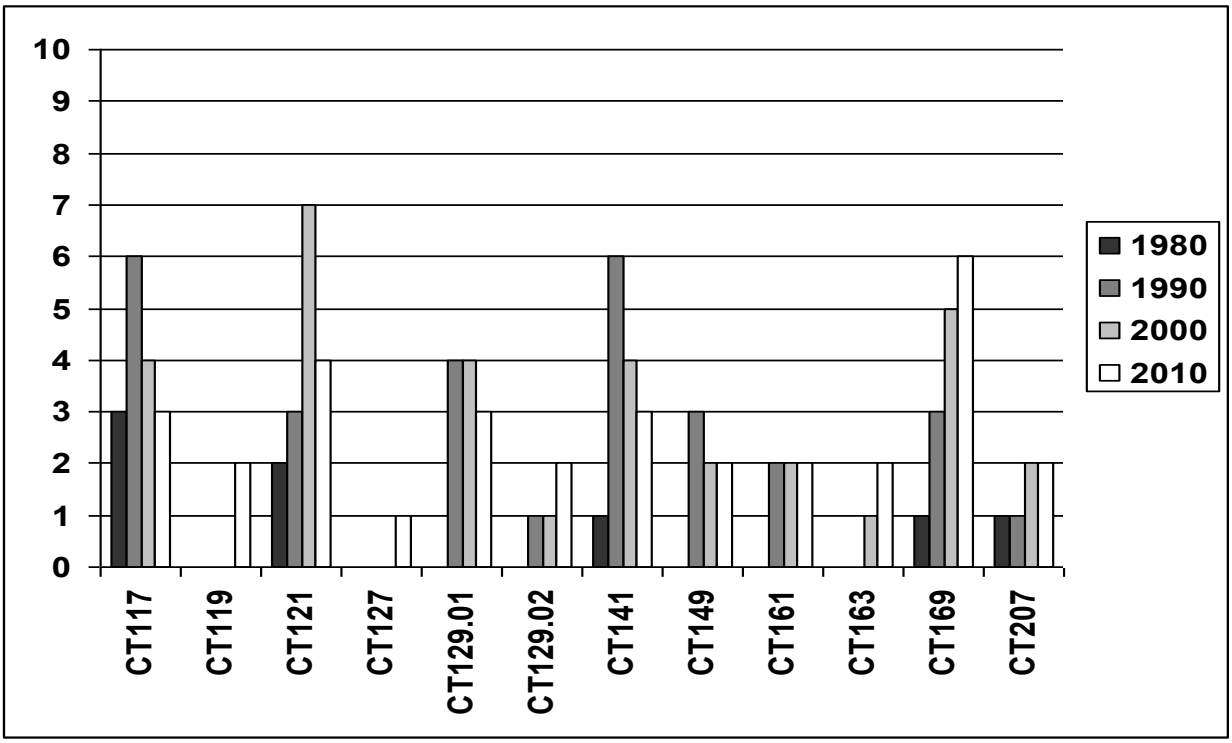


Figure 5-20. Percentage of the Chinese Population in Park Slope - Environs by Census Tract, 1980 - 2010.

5-4.2d Percentage of the Hispanic-origin Population

The percentage summarized in the Hispanic-origin population bar charts and map must be interpreted with caution. While the previous three ethnic groups (White, Black and Chinese) are exclusive of one another, the Census Bureau's definition of Hispanic-origin is a binary option applicable to all ethnic groups. In other words, the entire population is divided into either Hispanic-origin or non Hispanic-origin. In general, New York City and its Five Boroughs experienced increasing percentages of Hispanics between 1980 and 2010. During the same time period, the Bronx, Queens, and Staten Island experience more noticeable increases. However, the Bronx remains the Borough with the highest percentages throughout the study years. In contrast, Park Slope Core and Environs experienced decreasing percentages throughout the study period.

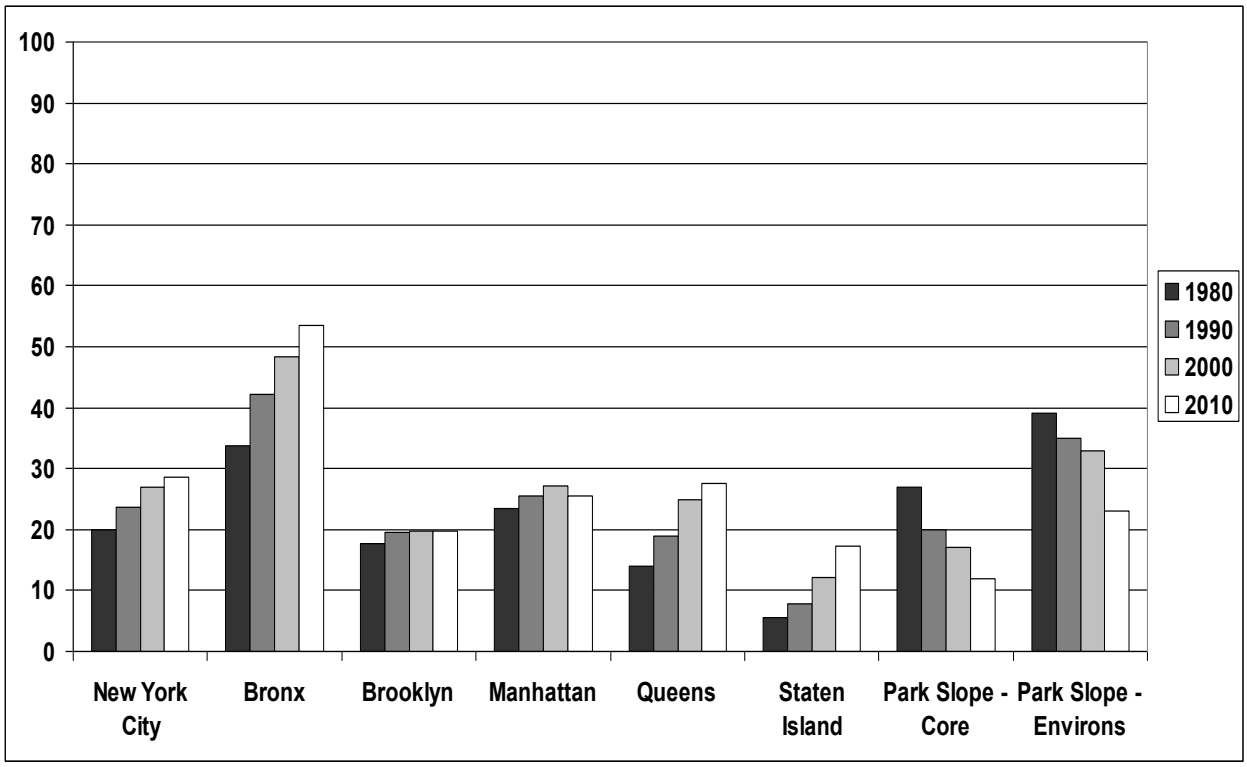
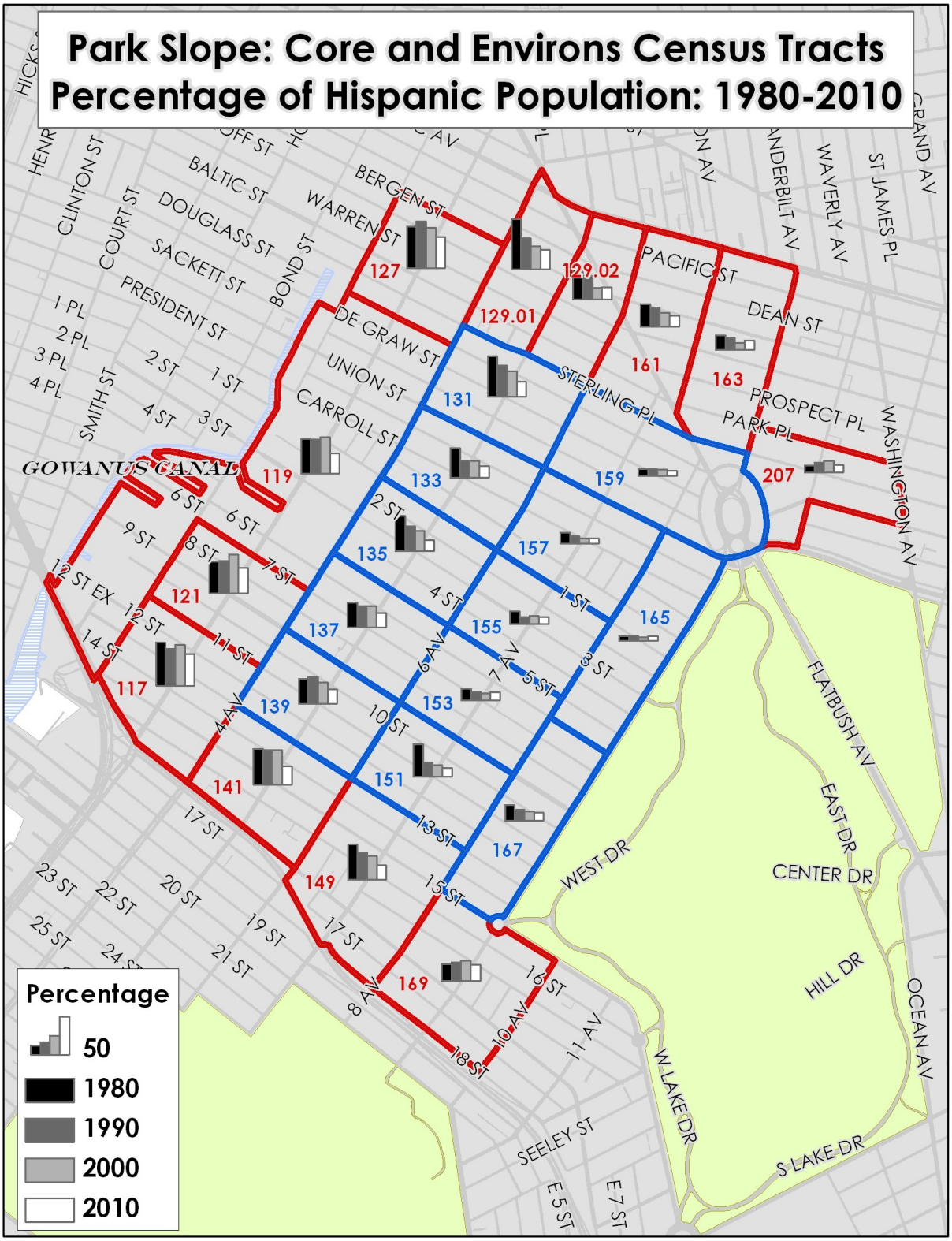


Figure 5-21. Percentage of the Hispanic Population in New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.



Map 5-36. Park Slope, Percentage of Hispanic Population by Census Tract, 1980 - 2010.

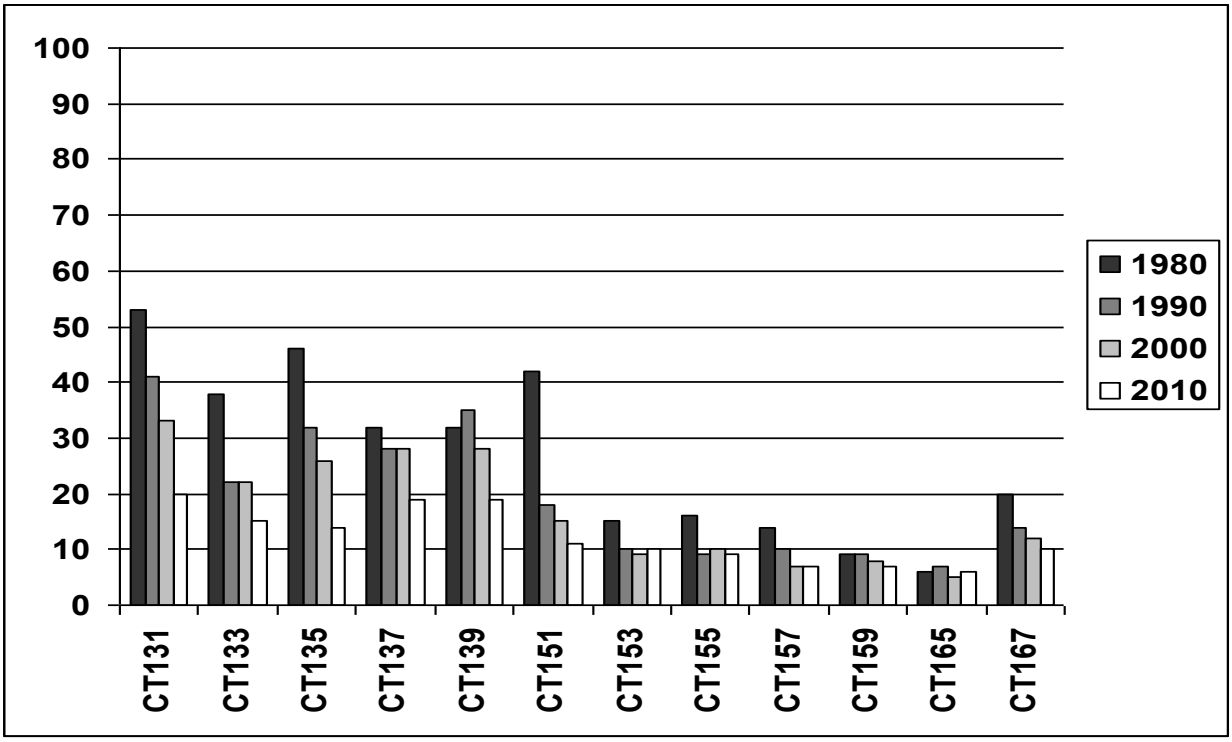


Figure 5-22. Percentage of the Hispanic Population in Park Slope - Core by Census Tract, 1980 - 2010.

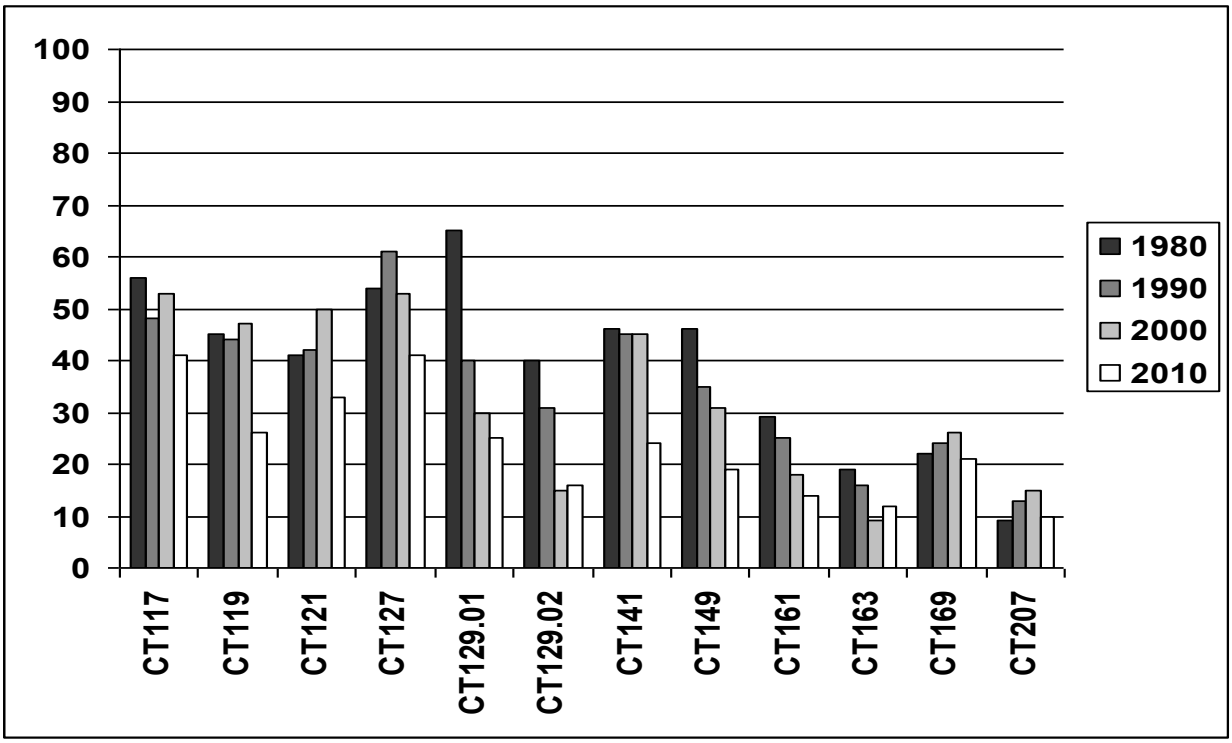


Figure 5-23. Percentage of the Hispanic Population in Park Slope - Environs by Census Tract, 1980 - 2010.

If this study continues to adopt the previous research's design to aggregate Census Tracts into a single site, or to aggregate Census Tracts into the Park Slope Core and Environs, then the aforementioned observation ends the description of the Hispanic population in the area. On the other hand, when each Census Tract is linked to its corresponding data and then mapped, this alternative research design reveals at least two additional spatial patterns that are observed:

1. The Census Tracts of the Core area closer to Prospect Park had lower percentages of the Hispanic population than the Environs Census Tracts. In fact, this observation is also valid with Census Tract 207 (which is adjacent to Prospect Park and part of the Environs).

2. Over the study period, the decrease in percentage of the Hispanic population is most noticeable for the Census Tracts in the North-western Core (Census Tracts 131, 133 and 135). This decrease trend is also observed in Census Tract 151 located in the South-east Core. The same observation can also be applied to the Census Tracts in the Northern Environs area. However, as the map indicates, even the comparatively high figure (41% in 2010) of Census Tract 127 has been decreasing since 1990.

3. Another Census Tract that still has a considerable percentage of the Hispanic population is Census Tract 117 located at the South-west Environs. It reports a fluctuating pattern throughout the study period but overall is experiencing a decrease in Hispanic population (from 56% in 1980 to 41% in 2010).

5-4.3 Selected Age Group Maps

In the following pages, the percentages of three age groups are mapped as follows: “Age Under 5”, “Age 22-29” and “Age 65 and Over”. The scale of the bar charts embedded within the maps is standardized so that the maps can be directly compared to each other. The scales of the bar charts in the figures, on the other hand, are sometimes enlarged (with the range from 1 to 10 instead of 1 to 100) to facilitate the comparisons of the lower-values.

5-4.3a Age Under 5

Figure 5-24 below illustrates the percentages of Age Under 5 from 1980 and 2010. Despite the fluctuations reflected in the four Census Surveys, overall the variations are within 1% to 2%. Manhattan remains the Borough with the lowest rate of children age under 5, while the Bronx reports the highest. The Park Slope Core maintains a steady percentage of this age group between 1980 through 2000, with a 1% increase in 2010. The Park Slope Environs have a more unique trend in that it has a relatively high 8% in 1980 and then drops to 7% in the next Census Survey in 1990. It then drops to 5% in the next Census Survey in 2000 but gains 1% in 2010 and reaches 6% (which is 1% lower than the Core). Neither the Park Slope Core and Environs surpasses the rate of the Borough of Brooklyn at 7% in 2010. Because the figures are consistently less than 10%, the scale of Figure 5-24 is enlarged similar to those used in the bar charts for the Chinese population (Figure 5-18, Figure 5-19 and Figure 5-20), with the highest value on the Y-axis as 10.

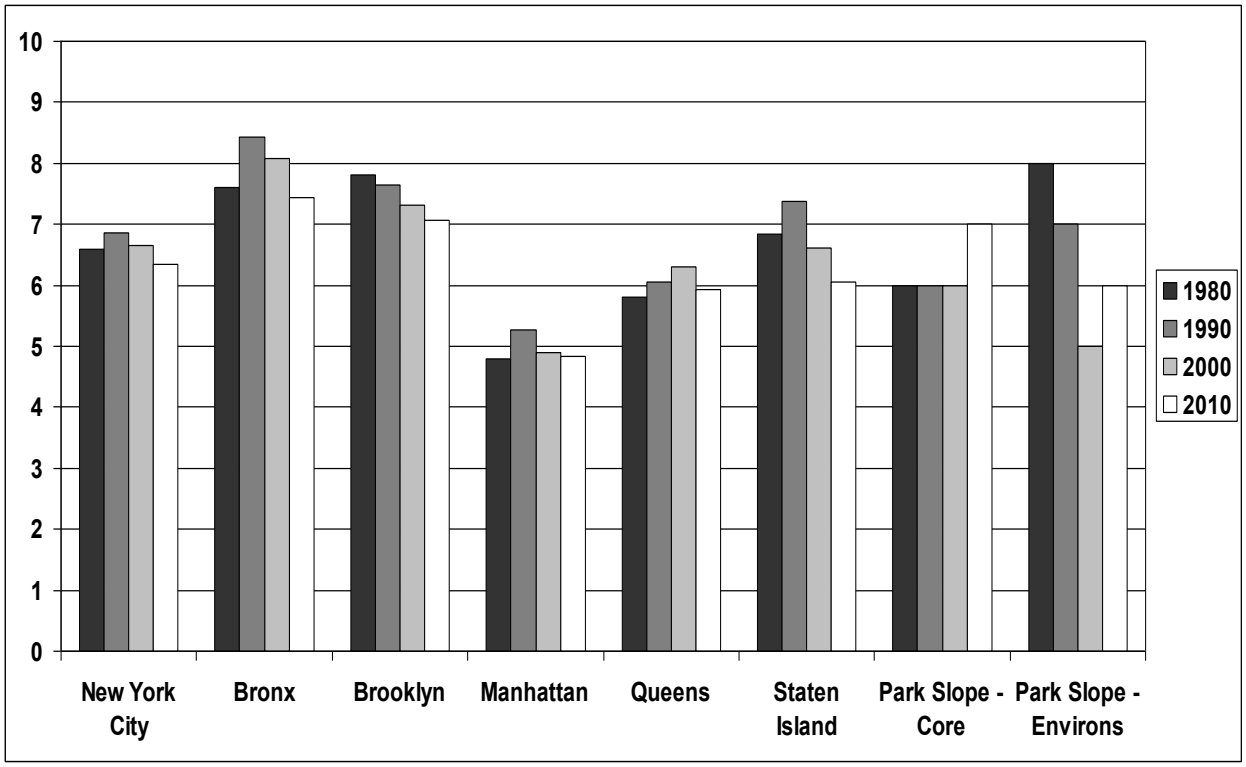
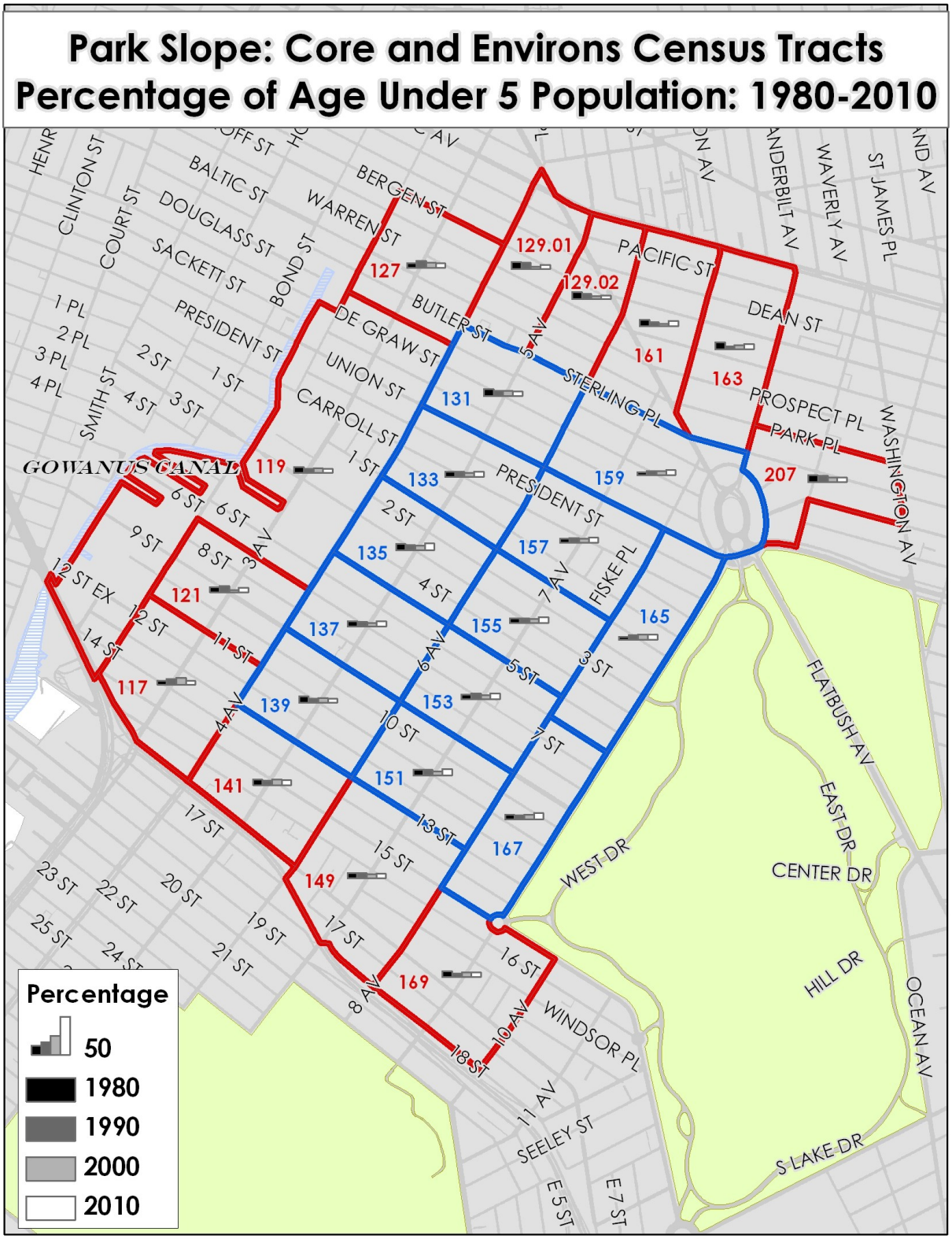


Figure 5-24. Percentage of the Age Under 5 Population in New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980-2010.



Map 5-37. Park Slope, Percentage of Age Under 5 Population by Census Tract, 1980-2010.

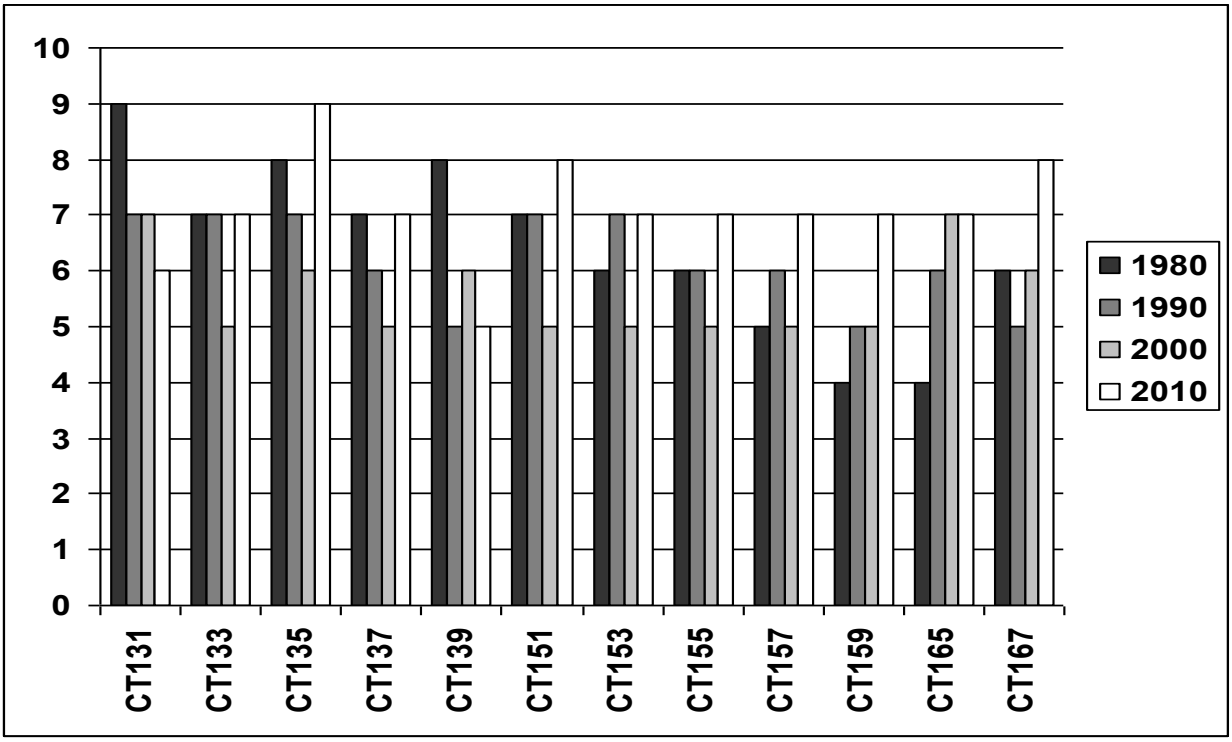


Figure 5-25. Percentage of the Age Under 5 Population in Park Slope - Core by Census Tract, 1980 – 2010.

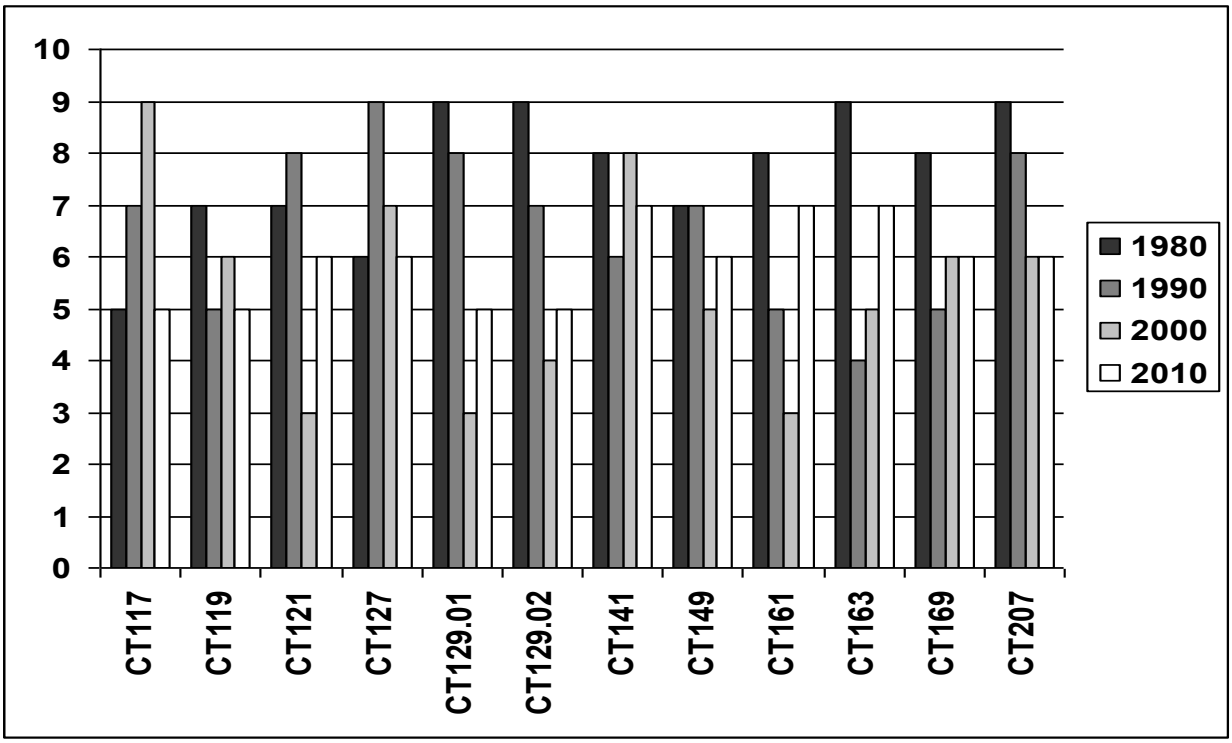


Figure 5-26. Percentage of the Age Under 5 Population in Park Slope - Environs by Census Tract, 1980 - 2010.

In recent years, the abundance of baby strollers and their theft in Park Slope have become popular stories in the mass-media. A *New York Times* reporter went so far as to state "in Park Slope, the Brooklyn neighborhood that probably has the highest stroller-per-capita ratio in New York City" (Keh, 2009). While the percentage for the Age under 5 population in Park Slope map (See Map 5-37 above) cannot disapprove this conjecture (because Census Surveys do not collect data about stroller ownership) the map does reveal that the overall percentage of the Age under 5 population has not changed much from 1980 to 2010. In fact, the percentages have remained so low that it is difficult to discern the differences through the years using this map. Figure 5-24 demonstrates that the Park Slope Core and Environs both have experienced 1% increase between 2000 and 2010; Figure 5-25 and Figure 5-26 show some individual Census Tracts have experienced as much as a 3% increase during the same ten-year time.

5-4.3b Age 22-29

Figure 5-27 below shows the percentages of the Age 22-29 group. For New York City and its Five Boroughs there does not seem to be a clear increasing or decreasing trend. The exception is the Borough of Staten Island which experienced a noticeable drop in 2000 and then remains about the same for 2010. In Park Slope, the Core has the same figure from 1980 though 2000 then decreases in 2010. The Environs illustrate a different trend, from 1980 through 2000 it has an increasing in the percentage of Age 22-29, and then in 2010 a slight drop in this age group.

Map 5-38 below illustrates the slight variations of these percentages throughout the study period although nothing particularly different from the general trend. A closer examination reveals that in the Northern Core near Prospect Park (Census Tracts 159, 157 and 155) and those adjacent to

Prospect Park (Census Tracts 165 and 167) show slight decreases in this age group. The opposite, a slight increasing trend is found in the Core on the South-west corner (i.e. Census Tract 139).

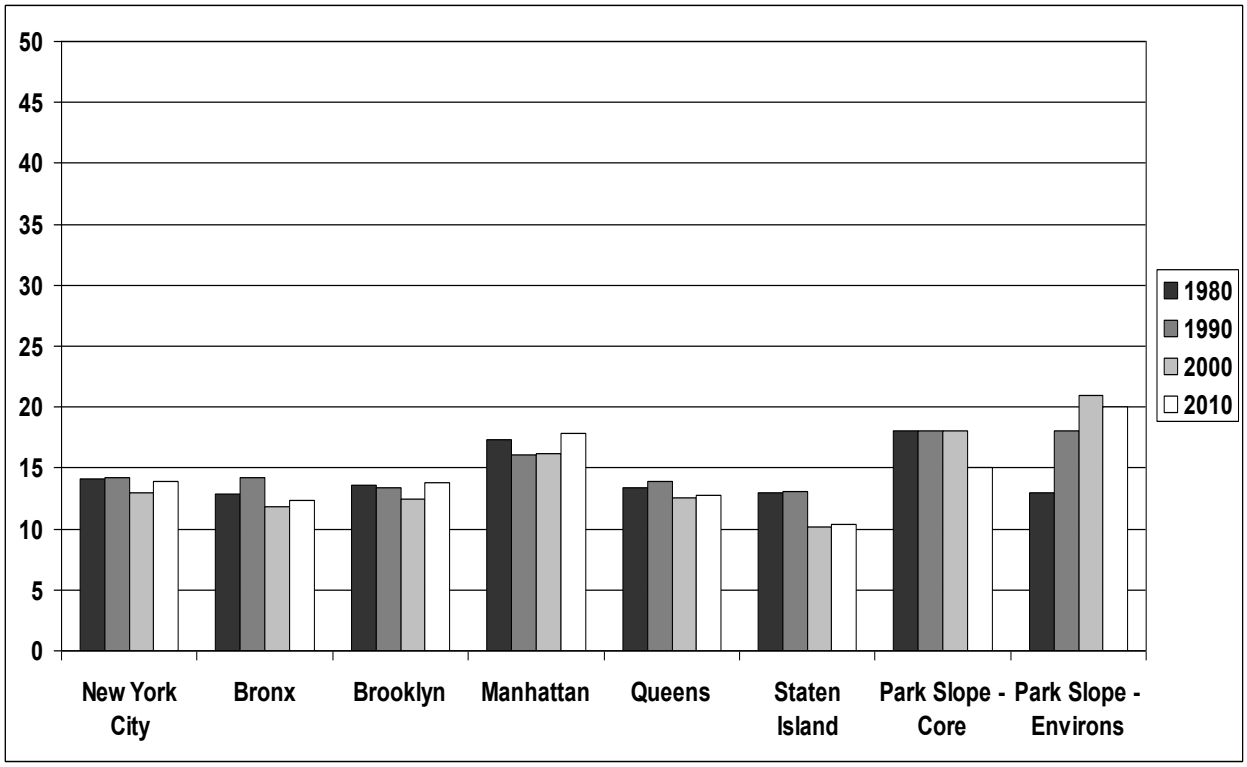
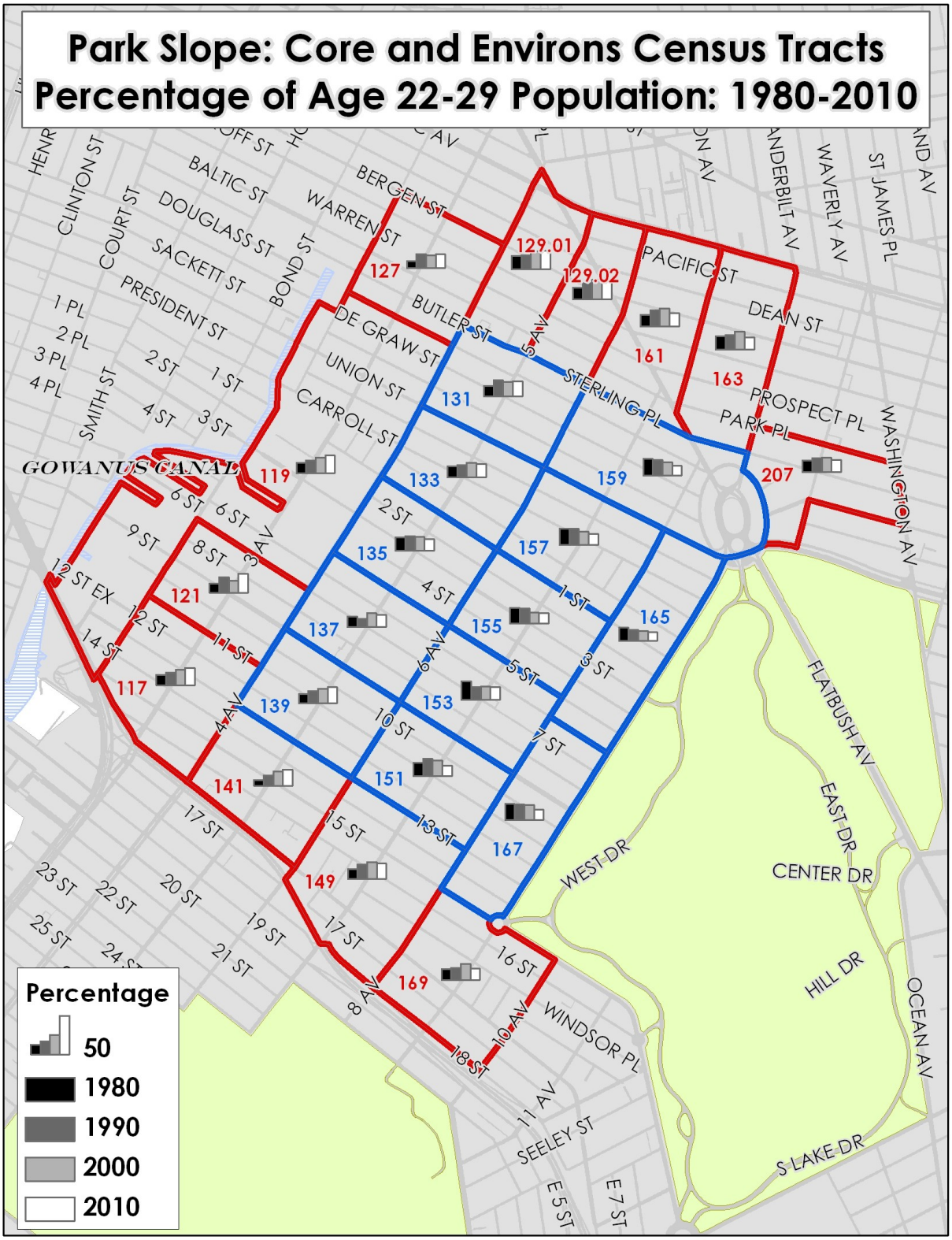


Figure 5-27. Percentage of the Age 22-29 Population in New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.



Map 5-38. Park Slope, Percentage of Age 22 - 29 Population by Census Tract, 1980-2010.

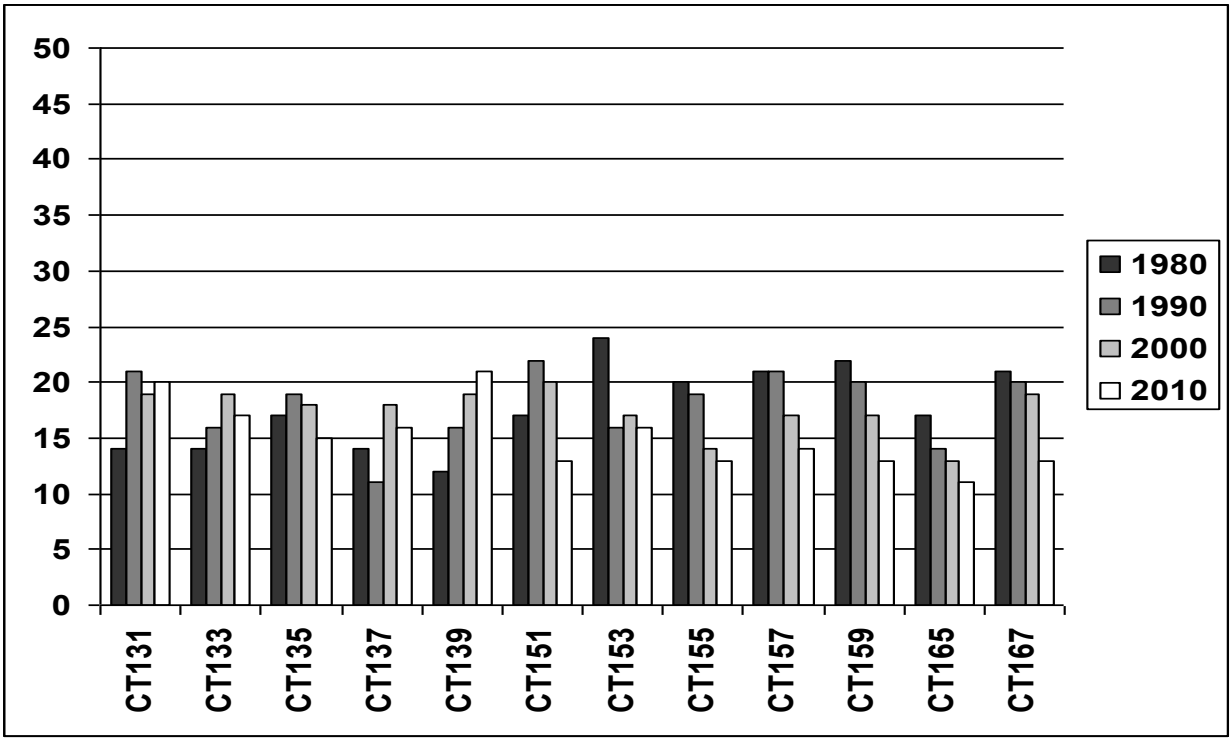


Figure 5-28. Percentage of the Age 22-29 Population in Park Slope - Core by Census Tract, 1980 - 2010.

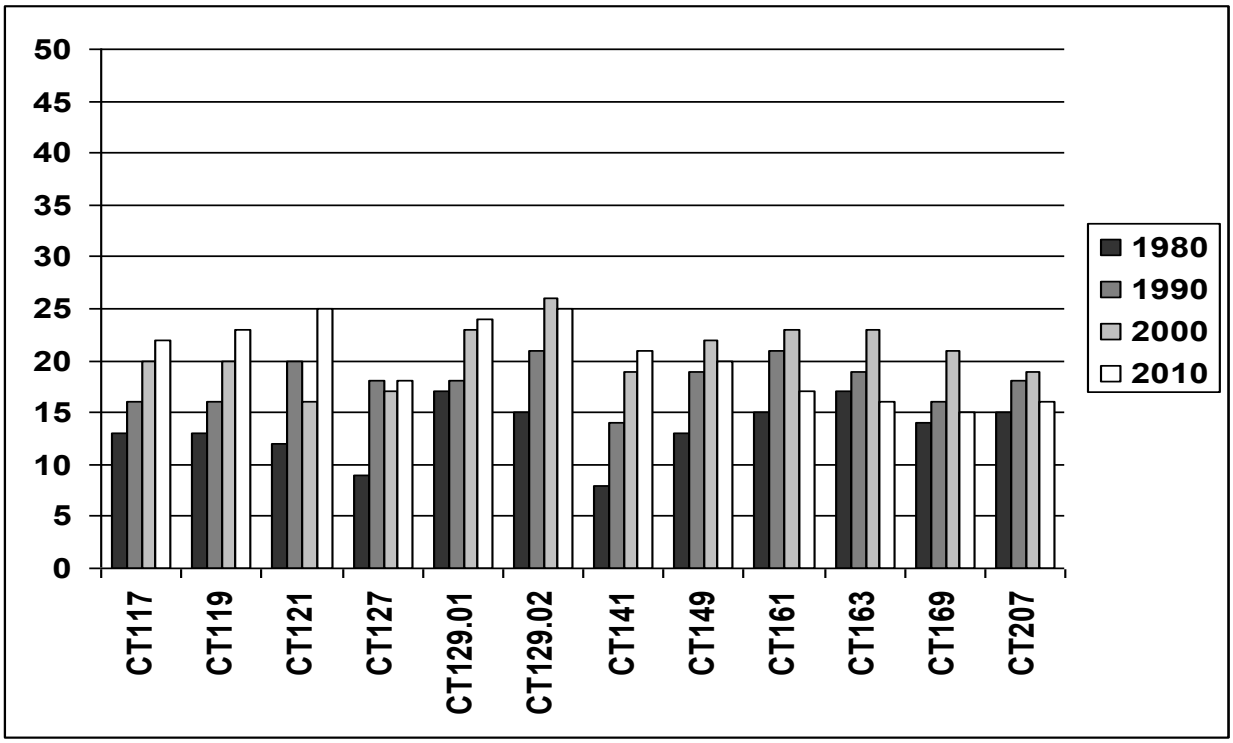


Figure 5-29. Percentage of the Age 22-29 Population in Park Slope - Environs by Census Tract, 1980- 2010.

5-4.3c Age 65 and Over

In Figure 5-30 below, a decreasing trend of the Age 65 and Over group is observed in Staten Island in 2000 and 2010. The other Boroughs and New York City overall, however, show fluctuating percentages in this age group from 1980 to 2010 with the Borough of Manhattan reports higher percentages. The Park Slope Core has percentages higher than the Borough of Brooklyn through the study period despite the lowered percentage in 2010. The Environs also reports a lowered percentage in 2010 although it is still higher than the Borough of Brooklyn and New York City.

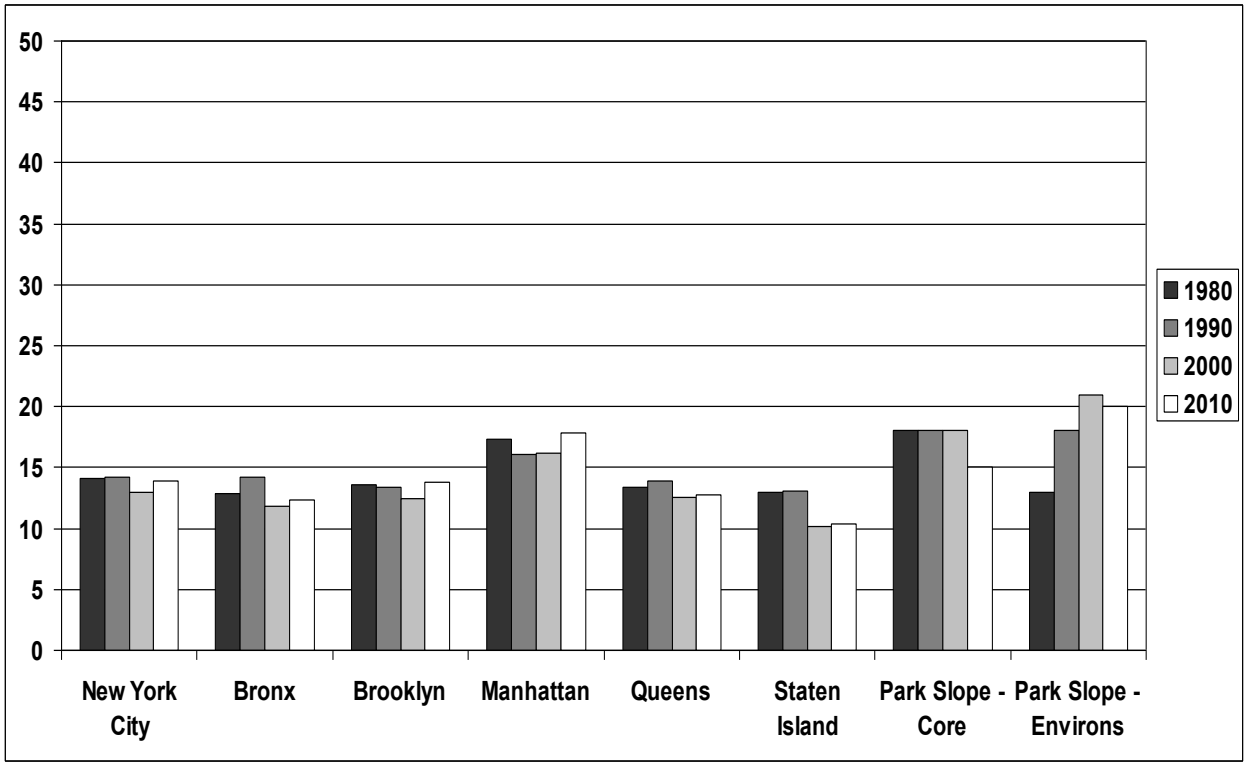
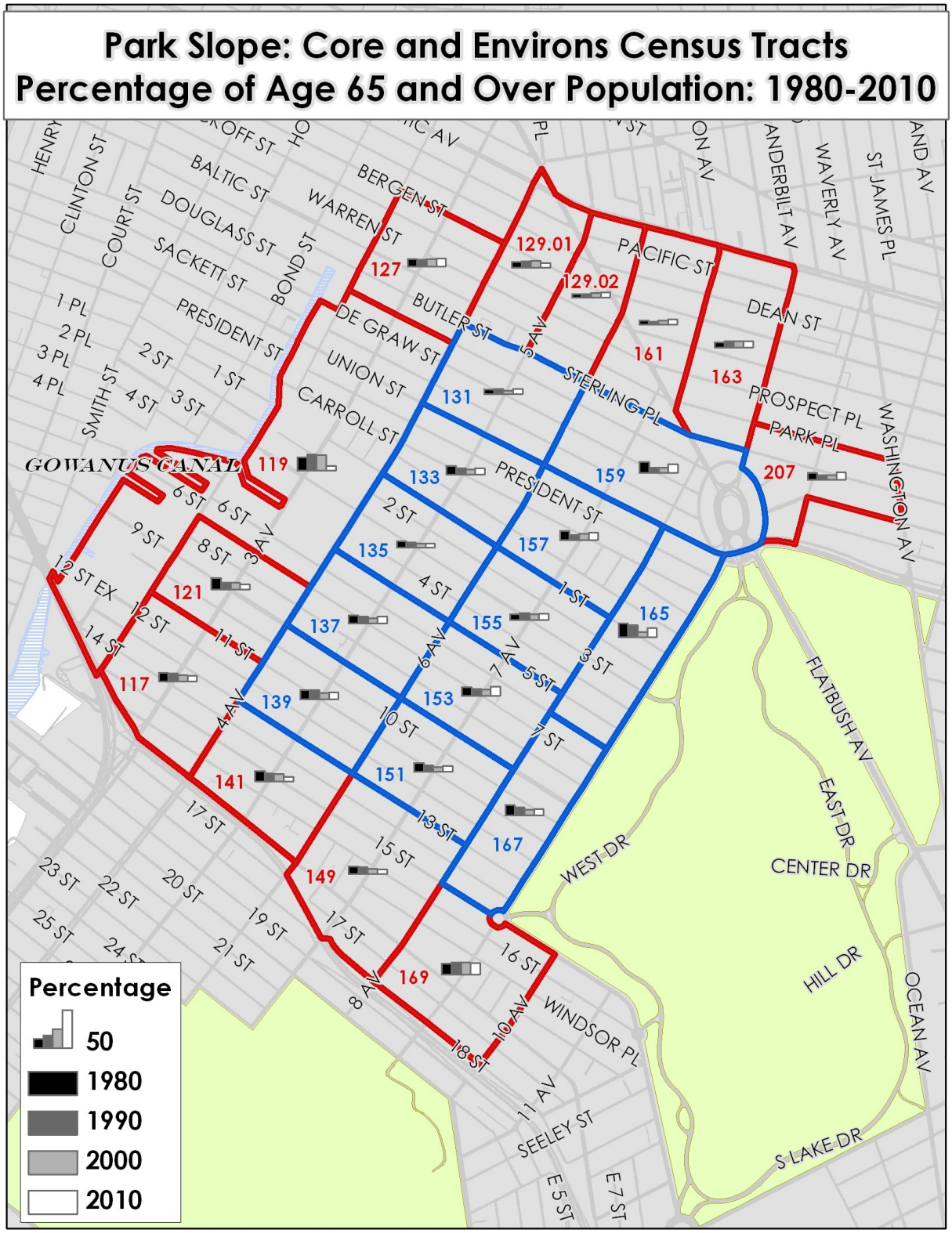


Figure 5-30. Percentage of the Age 65 and Over Population in New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.



Map 5-39. Park Slope, Percentage of Age 65 and Over Population by Census Tract, 1980-2010.

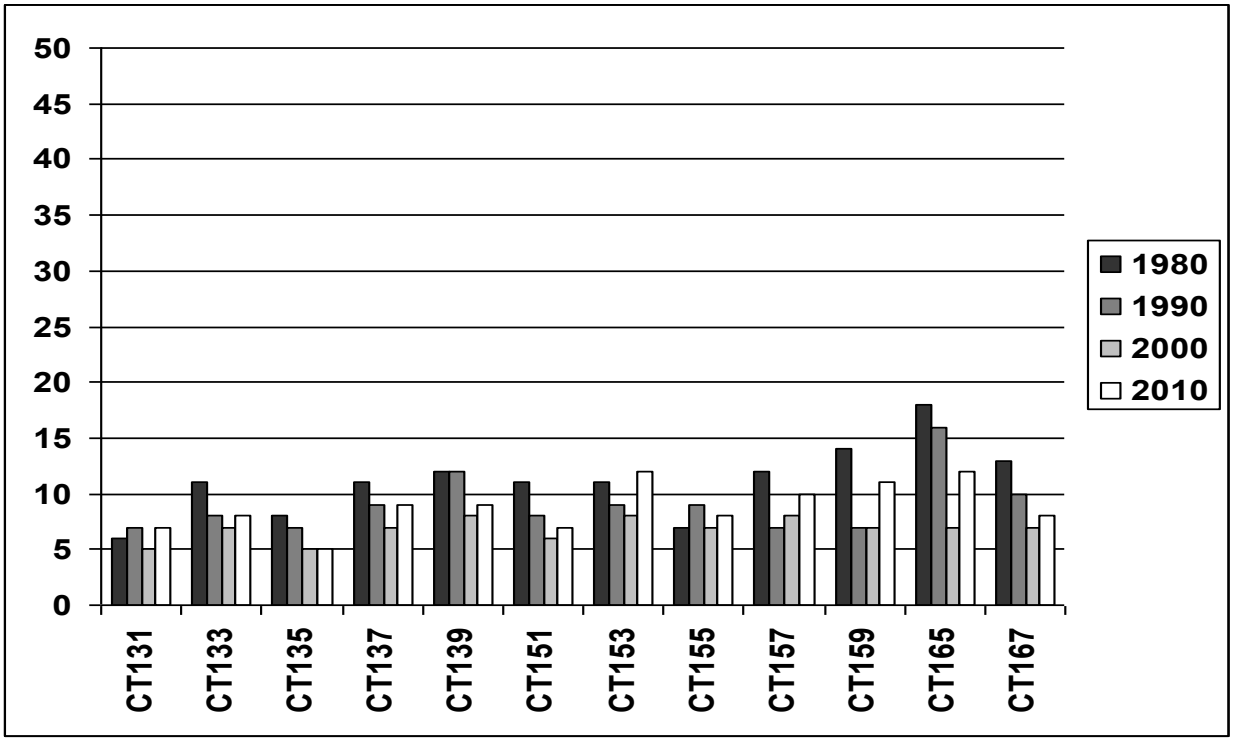


Figure 5-31. Percentage of the Age 65 and Over Population in Park Slope - Core by Census Tract, 1980 - 2010.

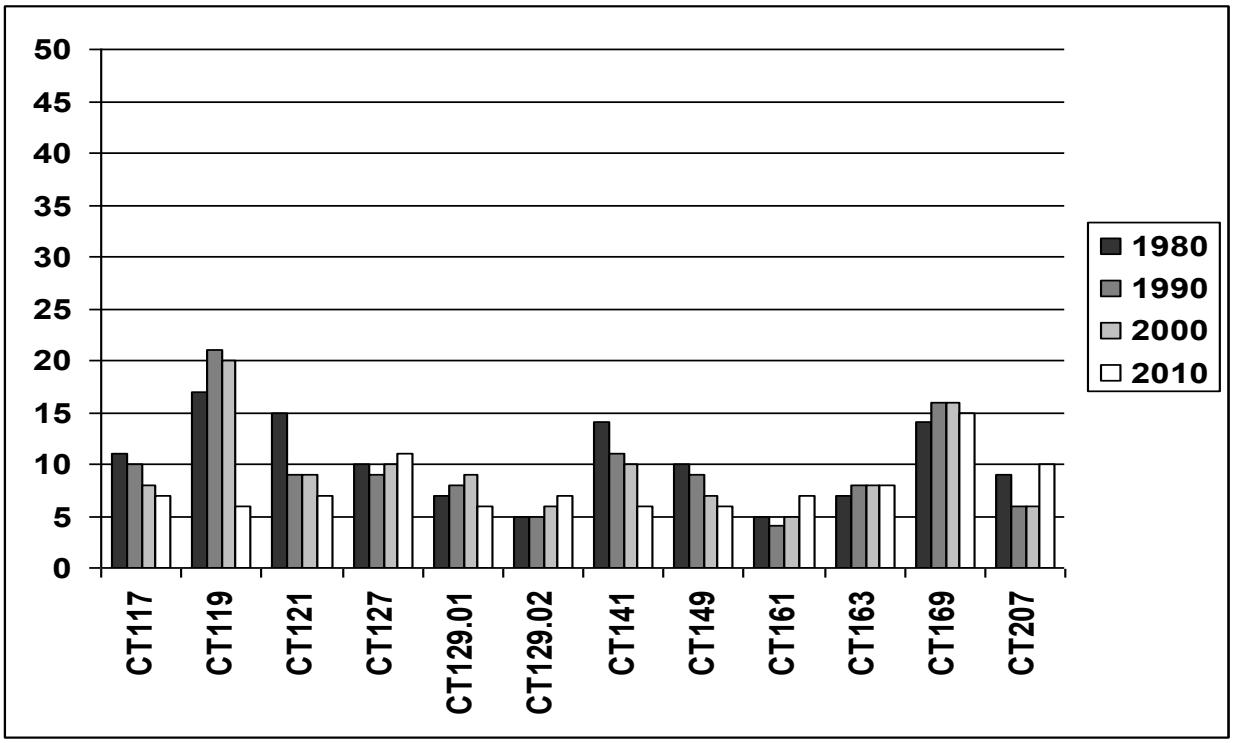


Figure 5-32. Percentage of the Age 65 and Over Population in Park Slope - Environs by Census Tract, 1980 - 2010.

A noticeable change in the Age 65 and Over population in Park Slope is observed in the Census Tract 119 that is located at the Eastern Environs. Between 1980 and 2000 this area had higher percentages, but in 2010 the percentage drops dramatically. The three Core Census Tracts adjacent to Prospect Park (159, 165 and 167) also have slightly higher percentages in 1980; over time they decrease until 2010 when the figures increase again, although they still do not reach the highest value reflected in the 1980 Census.

5-4.4 Housing Conditions

In this series of maps, three housing conditions of each Census Tract are mapped, namely, the total housing units, the percentage of vacant housing units and the percentage of renter-occupied housing units.

5-4.4a Total Housing Units

The overall trend reflects increasing numbers of housing units in New York City and its Five Boroughs, with Brooklyn being the Borough with the most housing units and Staten Island with the least housing units.

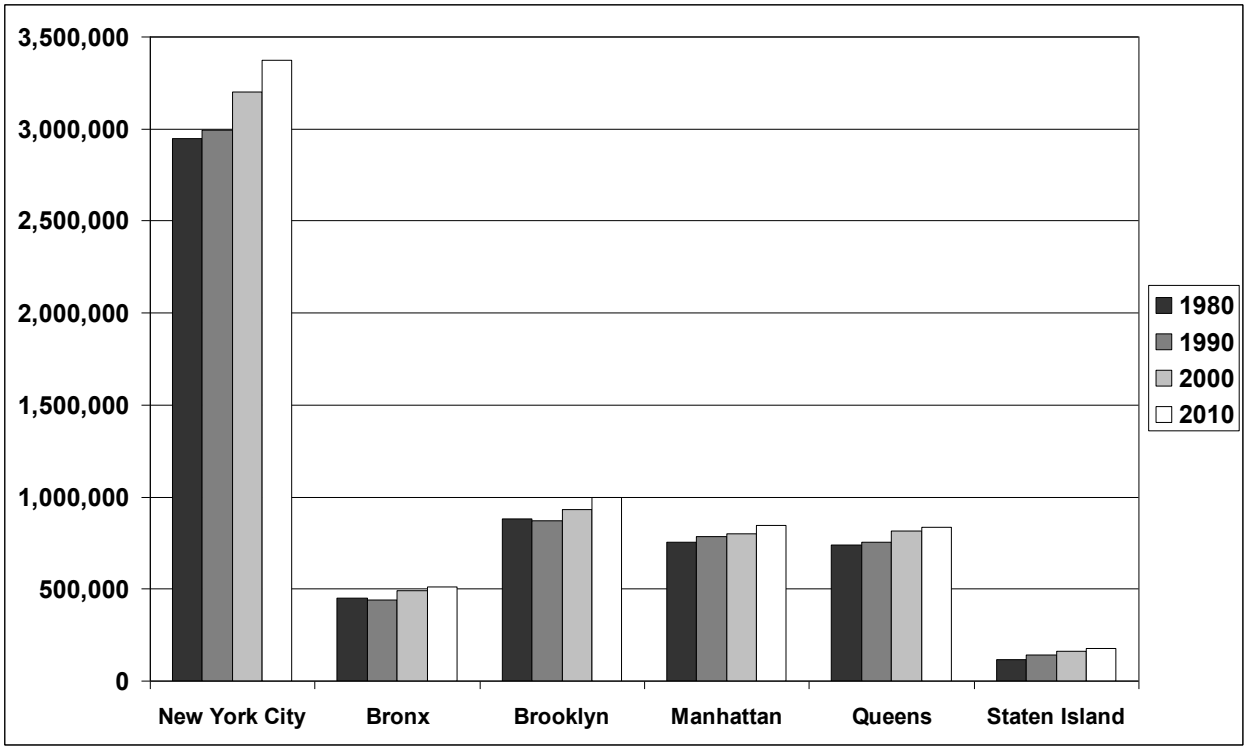


Figure 5-33. Numbers of Total Housing Units in New York City and the Five Boroughs, 1980 - 2010.

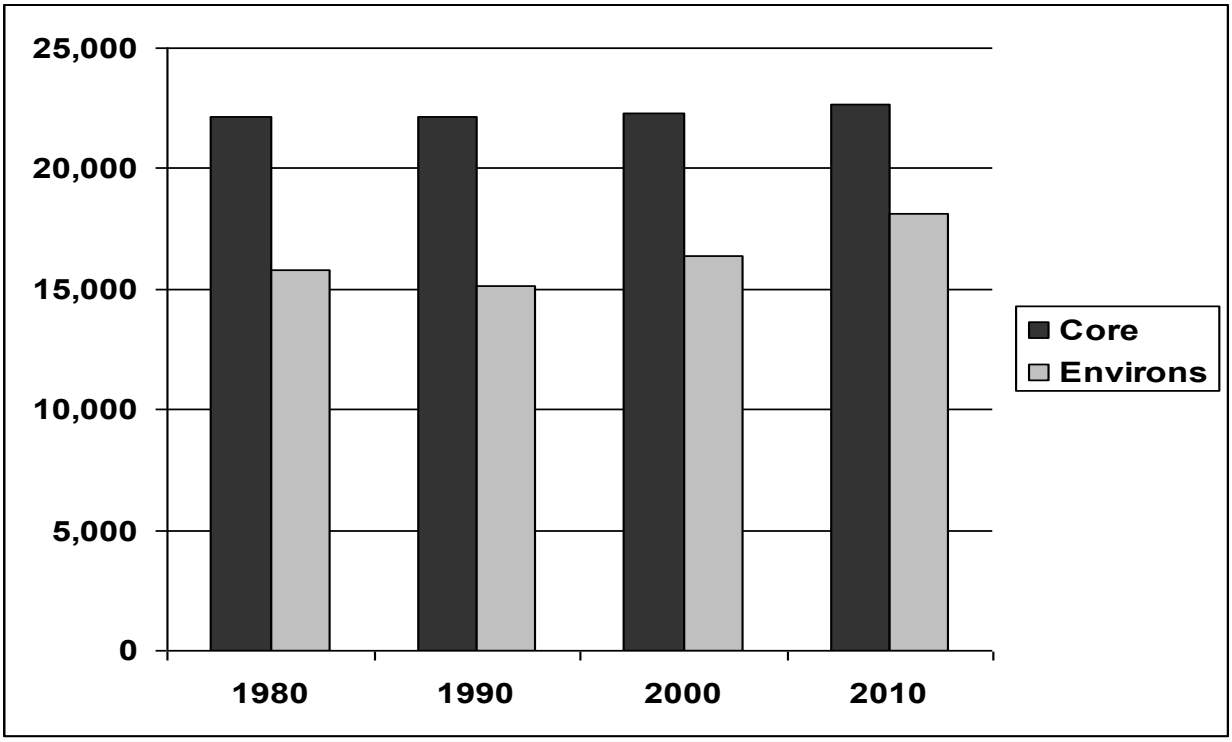
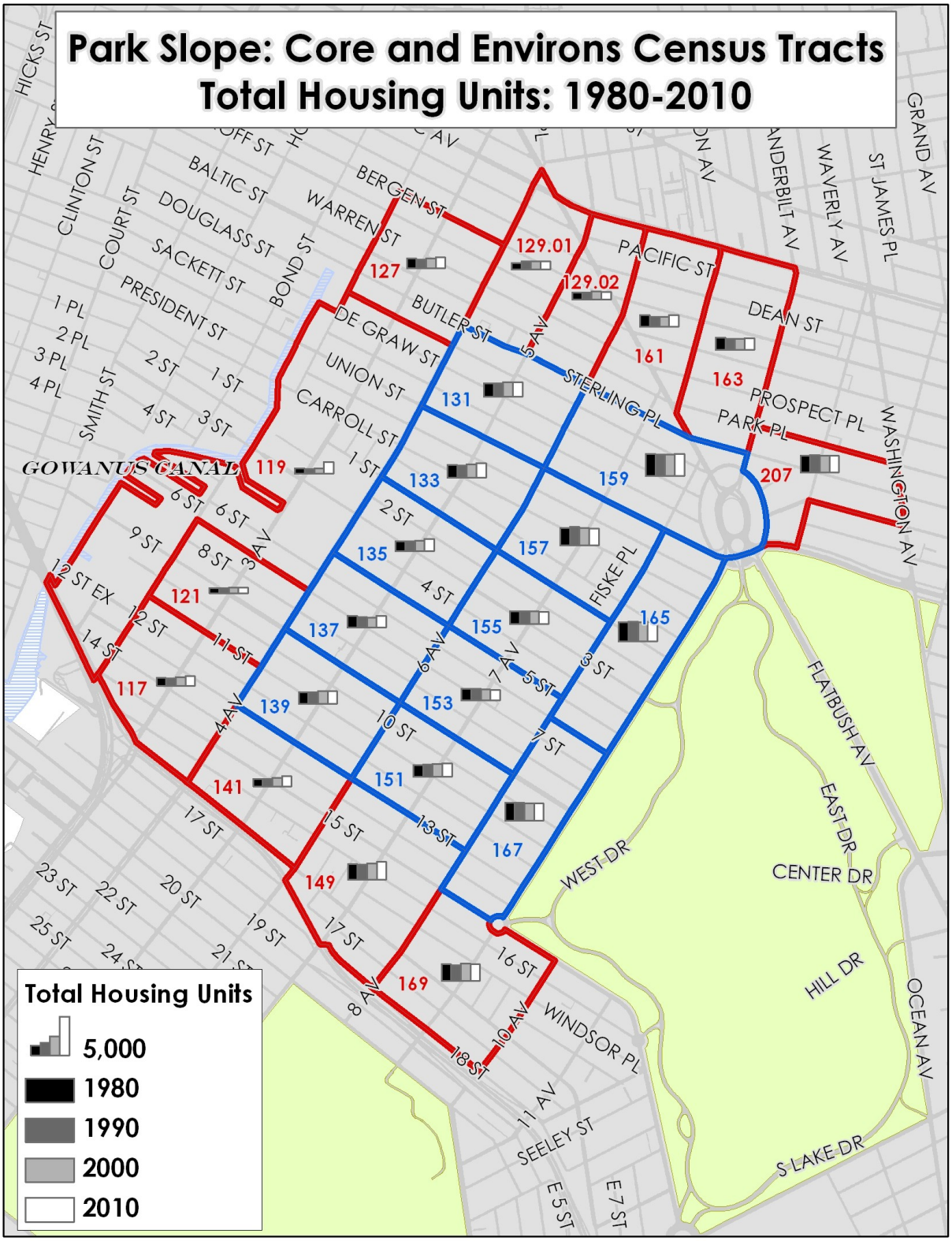


Figure 5-34. Numbers of Total Housing Units in Park Slope - Core vs. Environs, 1980 - 2010.



Map 5-40. Total Housing Units in Park Slope by Census Tract, 1980 - 2010.

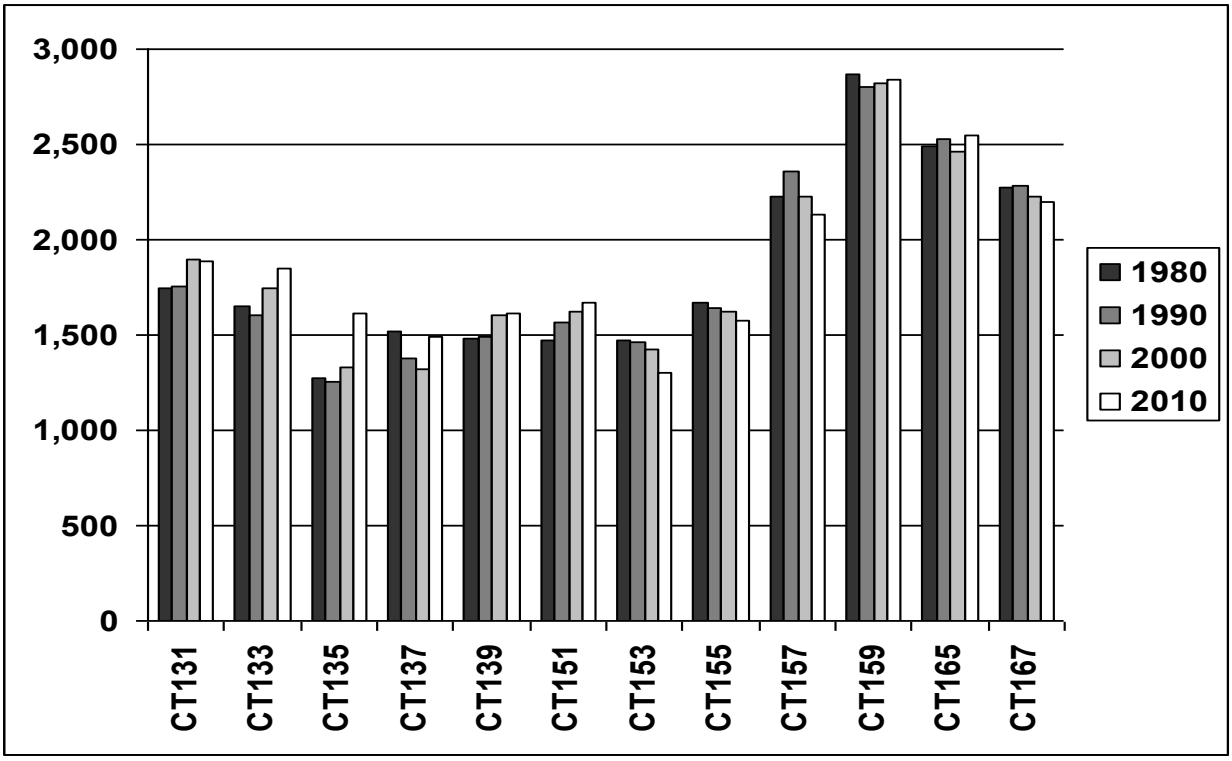


Figure 5-35. Total Housing Units in Park Slope - Core by Census Tract, 1980 - 2010.

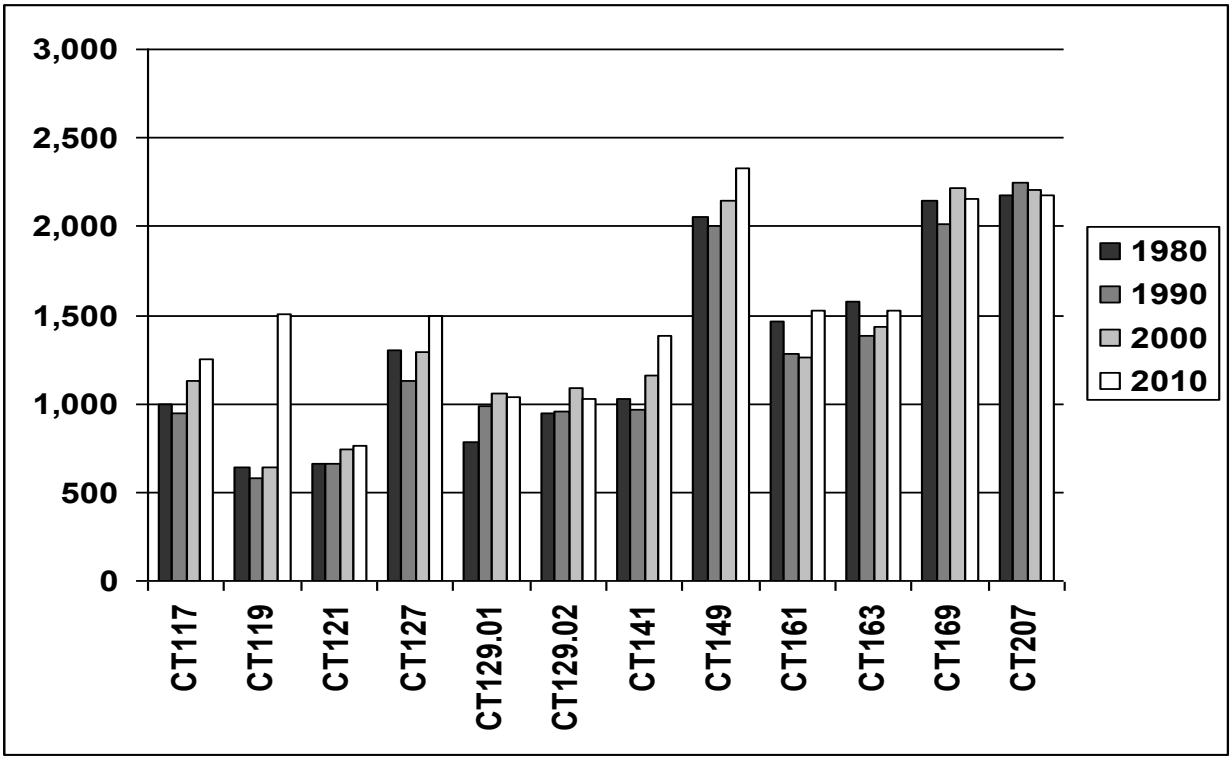


Figure 5-36. Total Housing Units in Park Slope - Environs by Census Tract, 1980 - 2010.

As was previously established using the physical environment maps, despite recent rezoning and sporadic new construction, overall there was no noticeable change in the total number of housing units in Park Slope. The only exception is Census Tract 119 which experienced a slight increase between 2000 and 2010. As of 2010 the three Western Environs Census Tracts were still predominantly zoned for manufacturing (See Map 5-16 Manufacturing Zoned Tax Lots) and had fewer housing units when compared to those adjacent or close to Prospect Park.

5-4.4b Percentage of Vacant Housing Units

Figure 5-37 below reveals that it was only in Park Slope Environs in 1980 that the vacant housing rate reached 10%. All the other Census Tracts throughout the years had less than 10%. In fact, some are even below 5%. New York City had a fairly consistent rate below 6% until 2010 when it peaked at almost 8%. Brooklyn and Queens also shared this pattern with the highest figures in 2010; the Bronx had a dip in 1990 but maintained the same level for both 2000 and 2010. Due to the consistent low percentages, Figure 5-37 uses the enlarged scale with the top value on the Y-axis at 10%.

In Park Slope, during the two early Census Surveys both the Core and the Environs experienced higher vacancy rates than did New York City and the Borough of Brooklyn. In 2000, the figures dipped and in the Core it dropped below New York City and Brooklyn, while in the Environs it was slightly higher than New York City and Brooklyn. The vacancy rate for both the Core and the Environs rose again in 2010, although it did not reach the peak reported in early years.

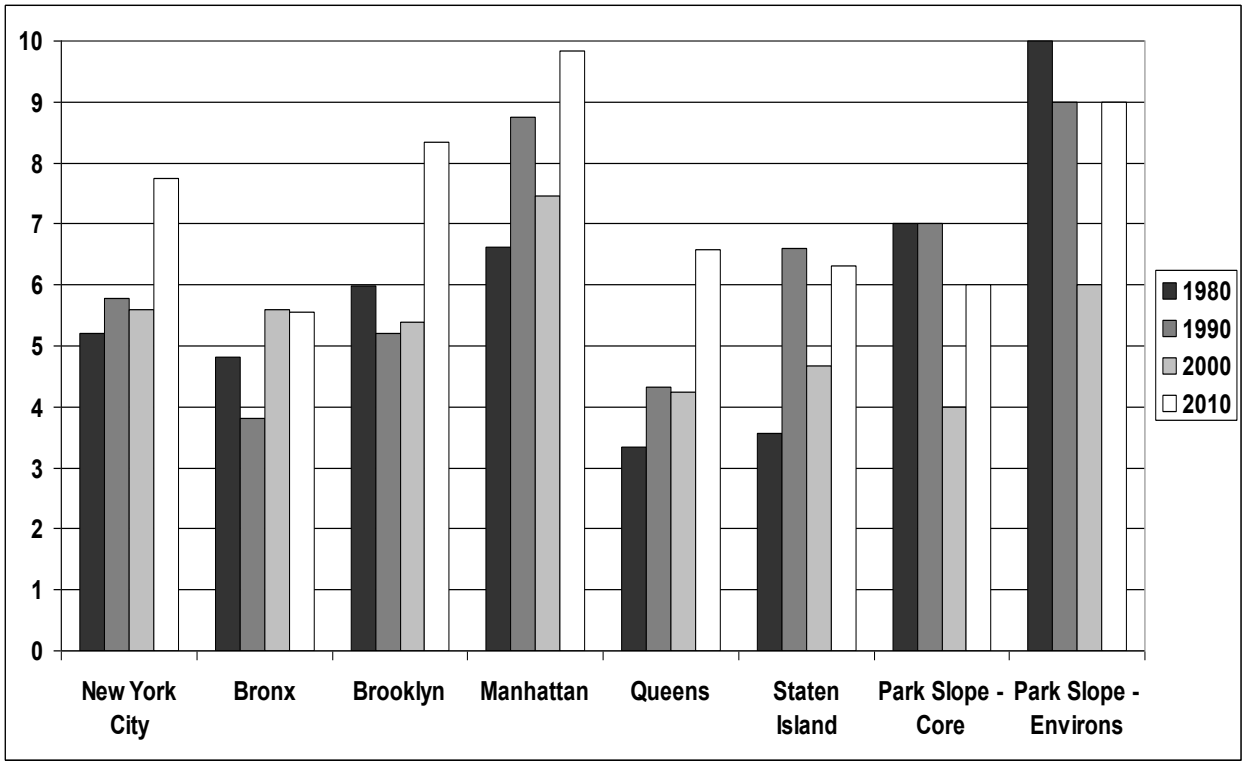
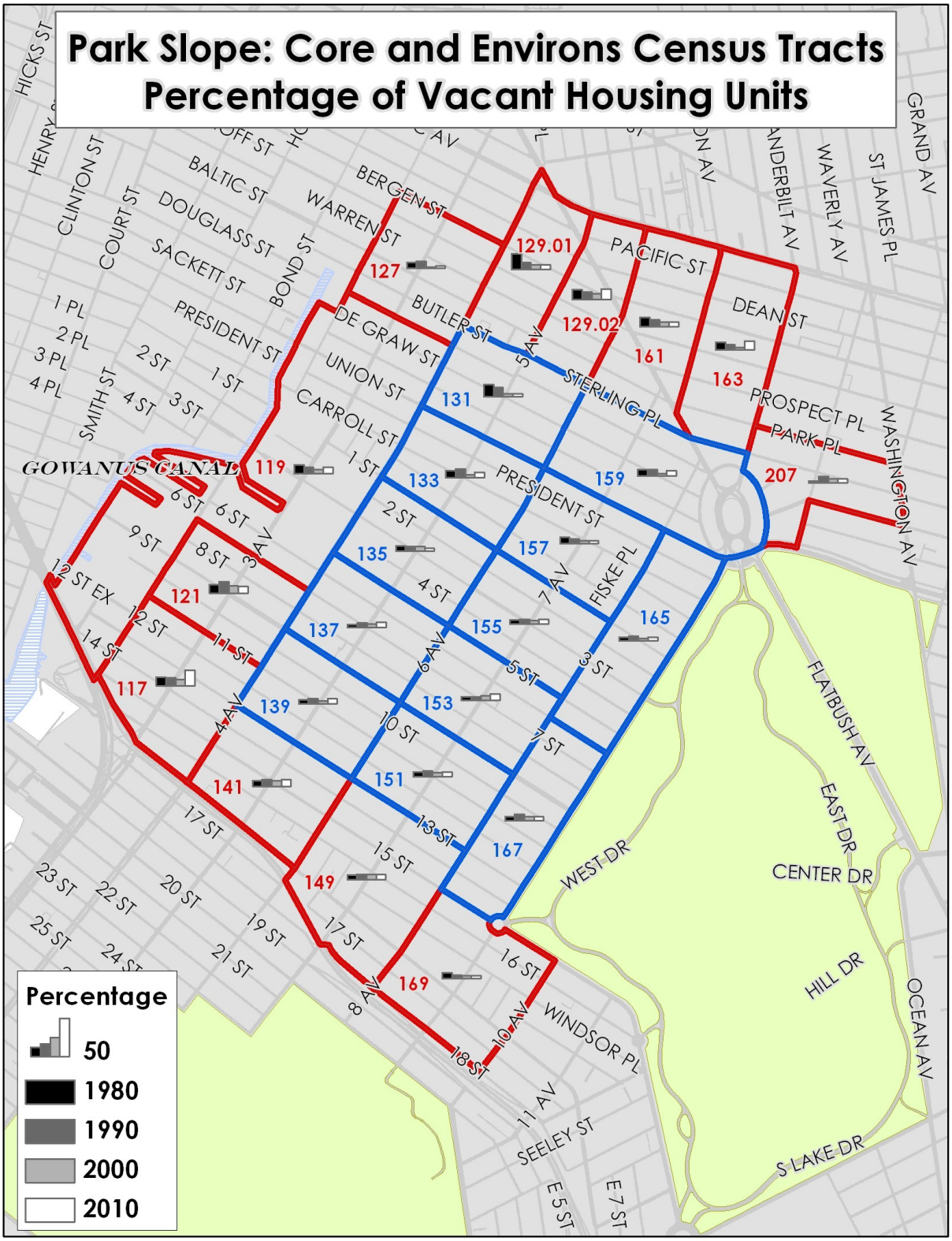


Figure 5-37. Percentage of Vacant Housing Units in New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.

Map 5-41, Figure 38 and Figure 5-39 below depicts the percentages of vacant housing units in Park Slope. Of all the Census Tracts in the Core, the two at the North-west corner (Census Tracts 131 and 133) had higher percentages in 1980 and 1990 but then dropped to single digits in more recent years. The highest vacancy housing percentage for 2010 is to be found at the South-west Environs Census Tract (117) which reaches 20%; adjacent Census Tracts all had less than 10% rates.



Map 5-41. Park Slope, Percentage of Vacant Housing Units by Census Tract, 1980 - 2010.

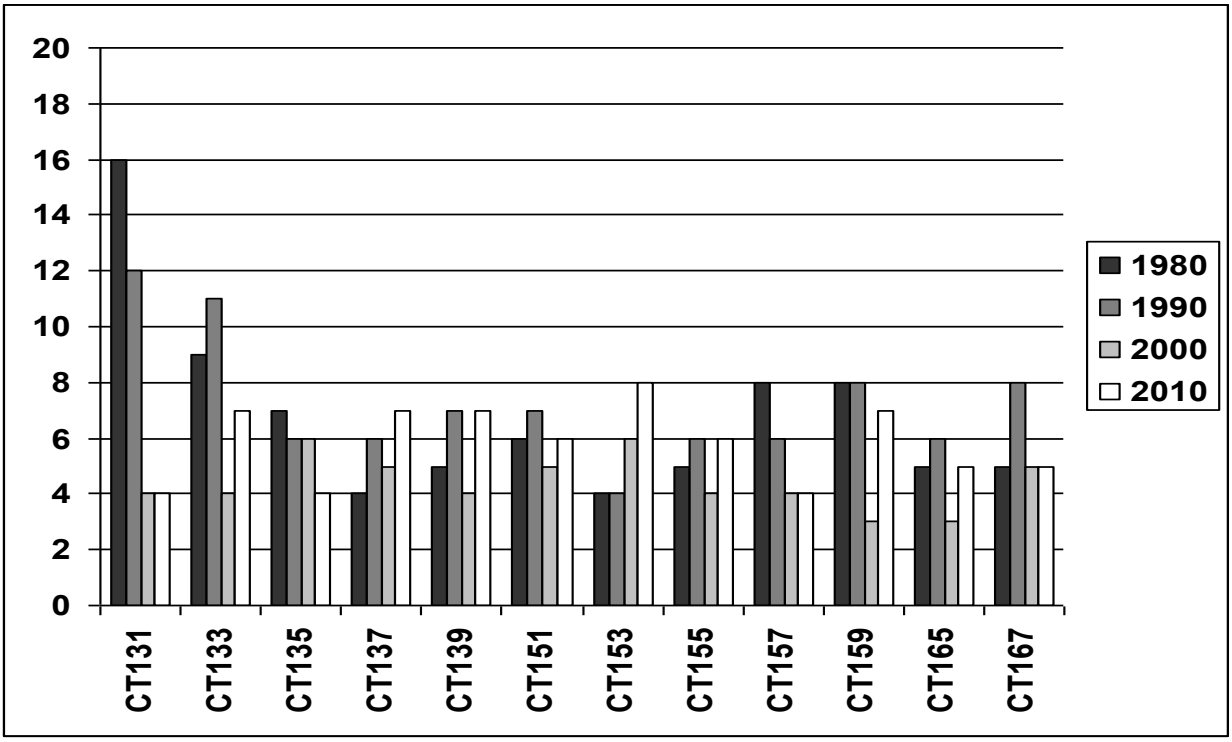


Figure 5-38. Percentage of Vacant Housing Units in Park Slope - Core by Census Tract, 1980 - 2010.

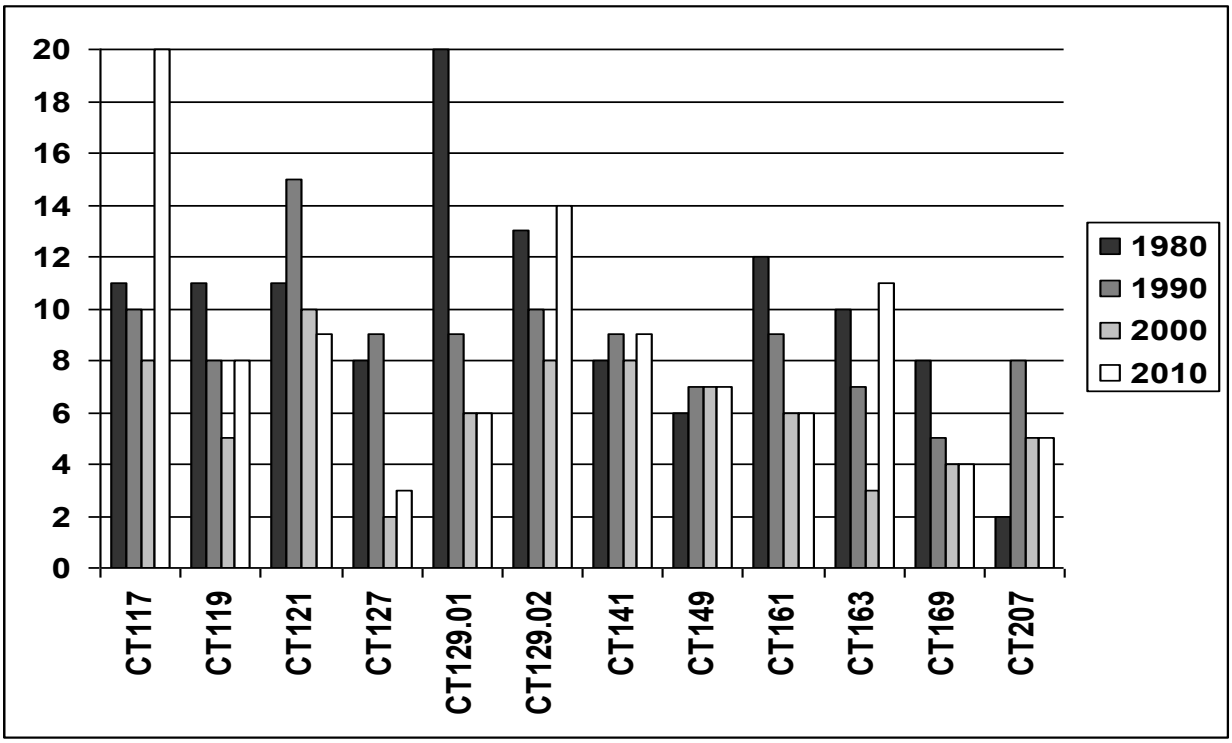


Figure 5-39. Percentage of Vacant Housing Units in Park Slope - Environs by Census Tract, 1980 - 2010.

5-4.4c Percentage of Renter-Occupied Housing Units

Renter-occupied units remain the majority of housing categories in New York City; four out of five the Boroughs (except Staten Island) between 1980 and 2010 experienced steady decreasing percentages of renter-occupied housing units (Figure 5-40, below). This trend is also observed with a noticeable drop in Manhattan between 1980 and 1990. Staten Island is the Borough with the lowest rates, consistently below 40%, followed by Queens, which maintains a rate of renter-occupied housing units between 50% and 60%. In the Park Slope Core, the percentages generally decrease over time and between 1990 and 2000 it remained unchanged. The Park Slope Environs reveals a "zigzag" pattern that drops, rises, and then drops again throughout the study period. (See Figure 41 and Figure 42 below).

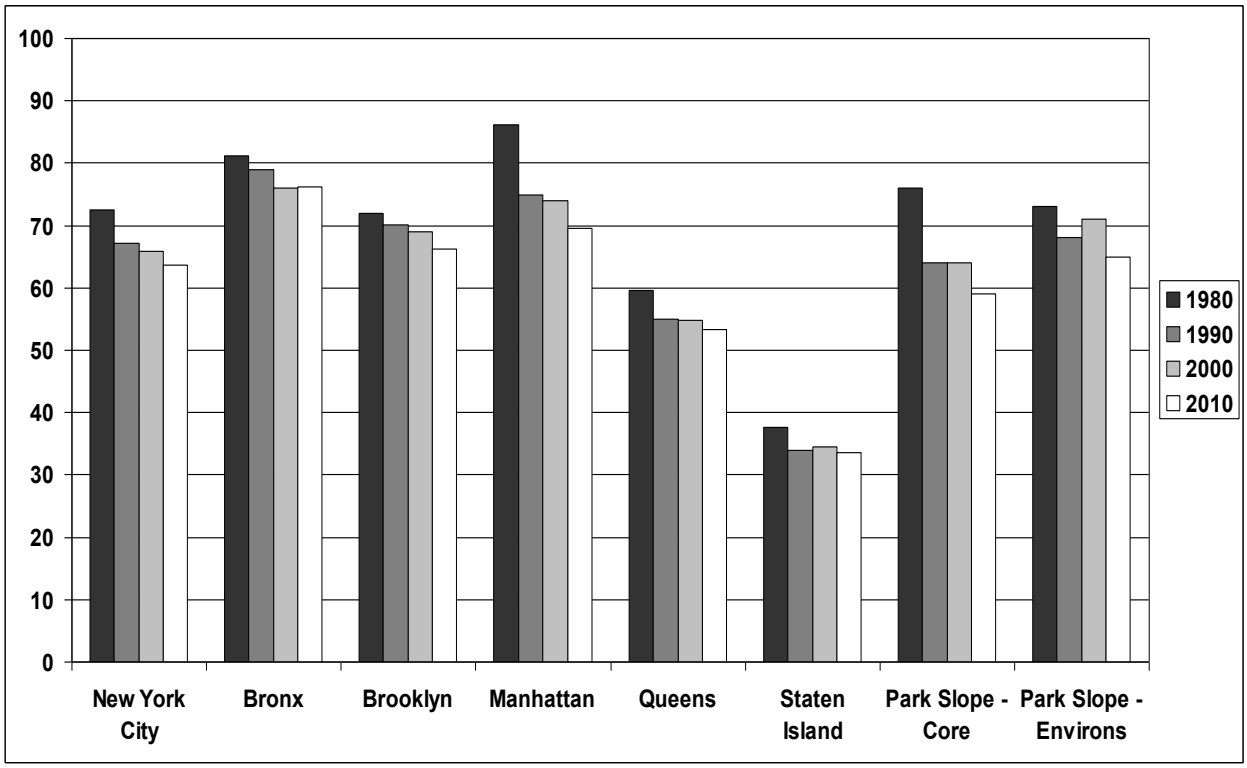
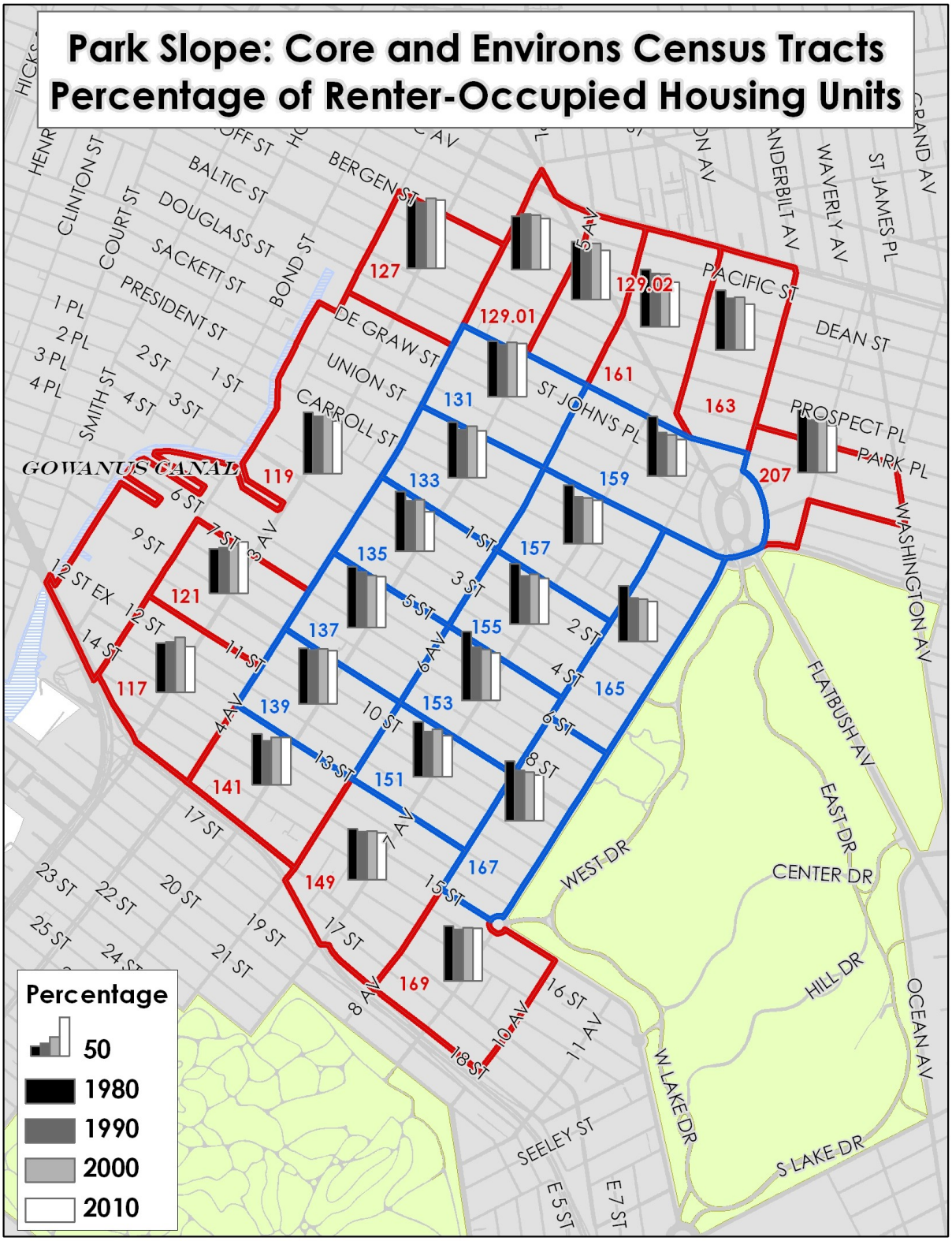


Figure 5-40. Percentage of Renter-Occupied Housing Units in New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.



Map 5-42. Park Slope, Percentage of Renter-Occupied Housing Units by Census Tract, 1980 - 2010.

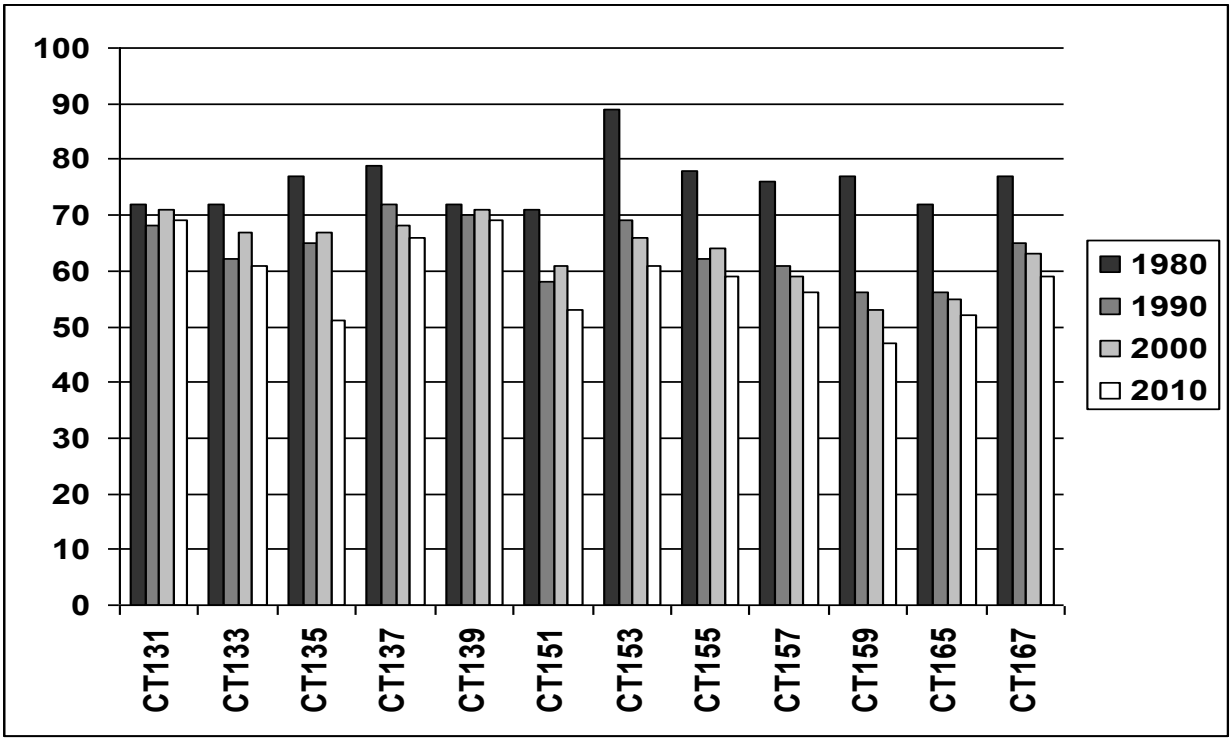


Figure 5-41. Percentage of Renter-Occupied Housing Units in Park Slope - Core by Census Tract, 1980 - 2010.

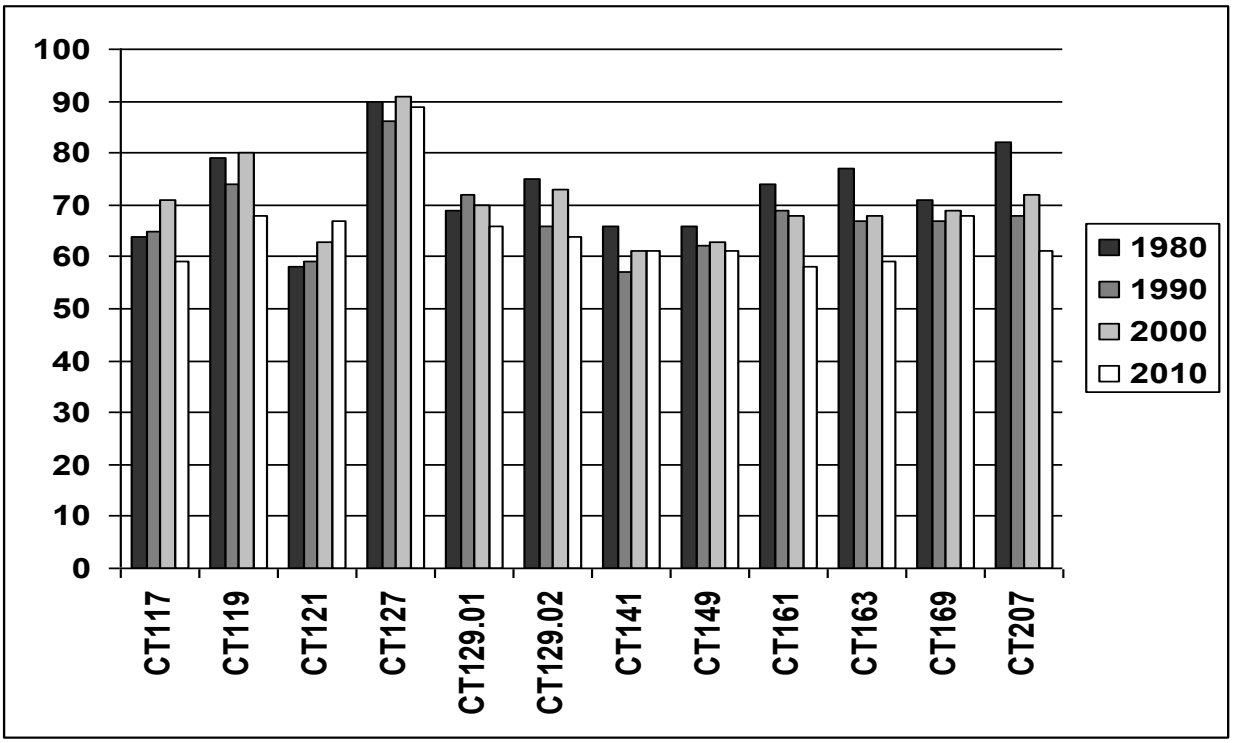


Figure 5-42. Percentage of Renter-Occupied Housing Units in Park Slope - Environs by Census Tract, 1980 - 2010.

At first glance, the overall trend for renter-occupied housing units in Park Slope decreases throughout the years, especially for the Census Tracts in the Eastern portion (closer to Prospect Park). Within the Core and on the West side, the middle three Census Tracts (i.e. 133, 135 and 137) also share this trend. The remaining two Core Census Tracts at the Upper North-west and Lower South-west corners also reflect a decrease, but at a lower rate.

Within the Environs Census Tracts, the decreasing trend for renter-occupied housing units is also observed in the North-western Census Tracts (207, 163 and 161). The Northern-west Census Tracts 129.01 and 129.02 have slightly decreasing rates. However, the North-west Census Tract 127 does not share this pattern of decreasing renter-occupied housing but instead maintains a relatively high rate. Other Environs Census Tracts also demonstrate slightly decreasing rates than those observed in the Core; the only exception is Census Tract 121. One can speculate that the new building construction that began in 2000 in this area may target the market for home owners. (See Map 5-24).

5-4.5 Median Household Income

The median household incomes from 1980 through 2000 are inflation-adjusted and directly comparable to those of 2010. Figure 5-43 below illustrates the median household income for New York City between 1980 and 2010 which peaked at 1990. The economic recession in the early 1990s and subsequent years clearly had an effect, as represented by the figures of 2000 and 2010, though slightly increasing, do not reach the height exhibited in 1990. This pattern is also observed in Brooklyn, Queens and Staten Island. In the Bronx, the 2010 median household income figure is even lower than it was in 2000, which indicates a continuing decline. Manhattan

appears to be the only Borough that shows economic recovery, when the 2010 figure exceeds that of 1990. Staten Island remains the Borough with the highest median household income through all four Census Surveys; followed by Manhattan, Queens, Brooklyn and finally the Bronx.

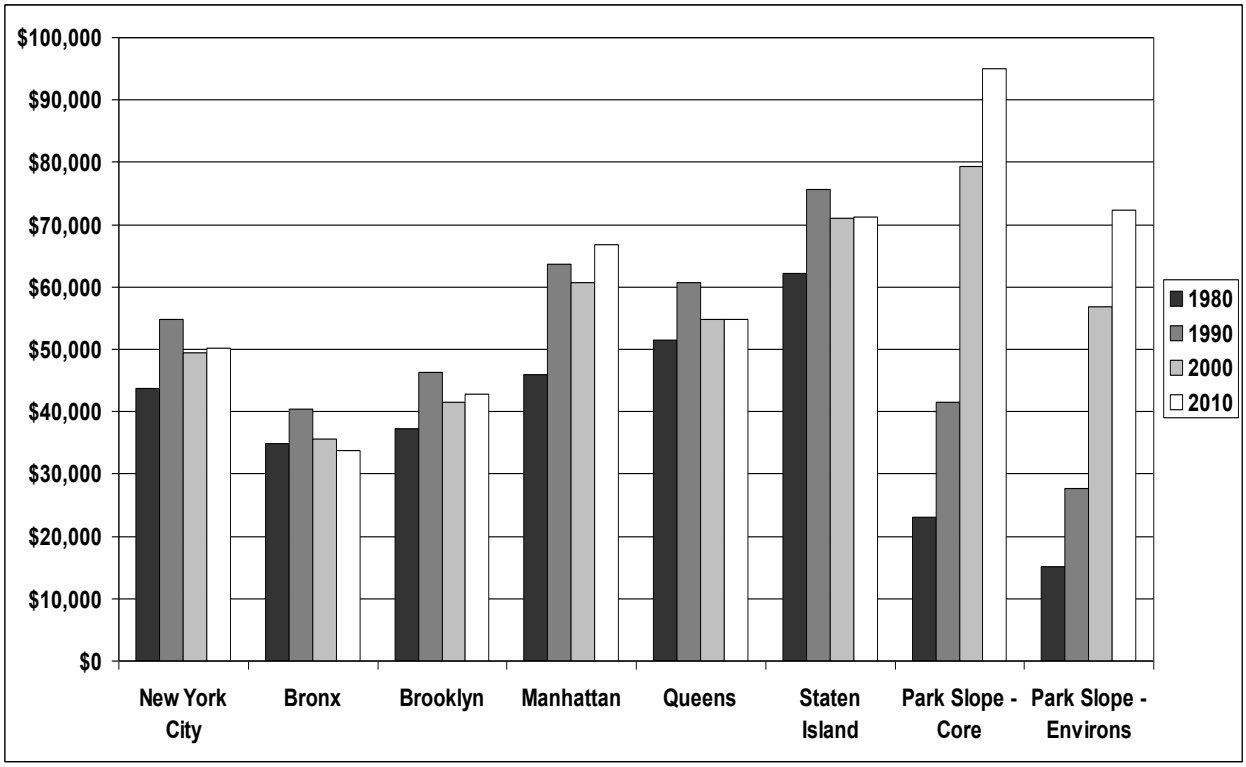
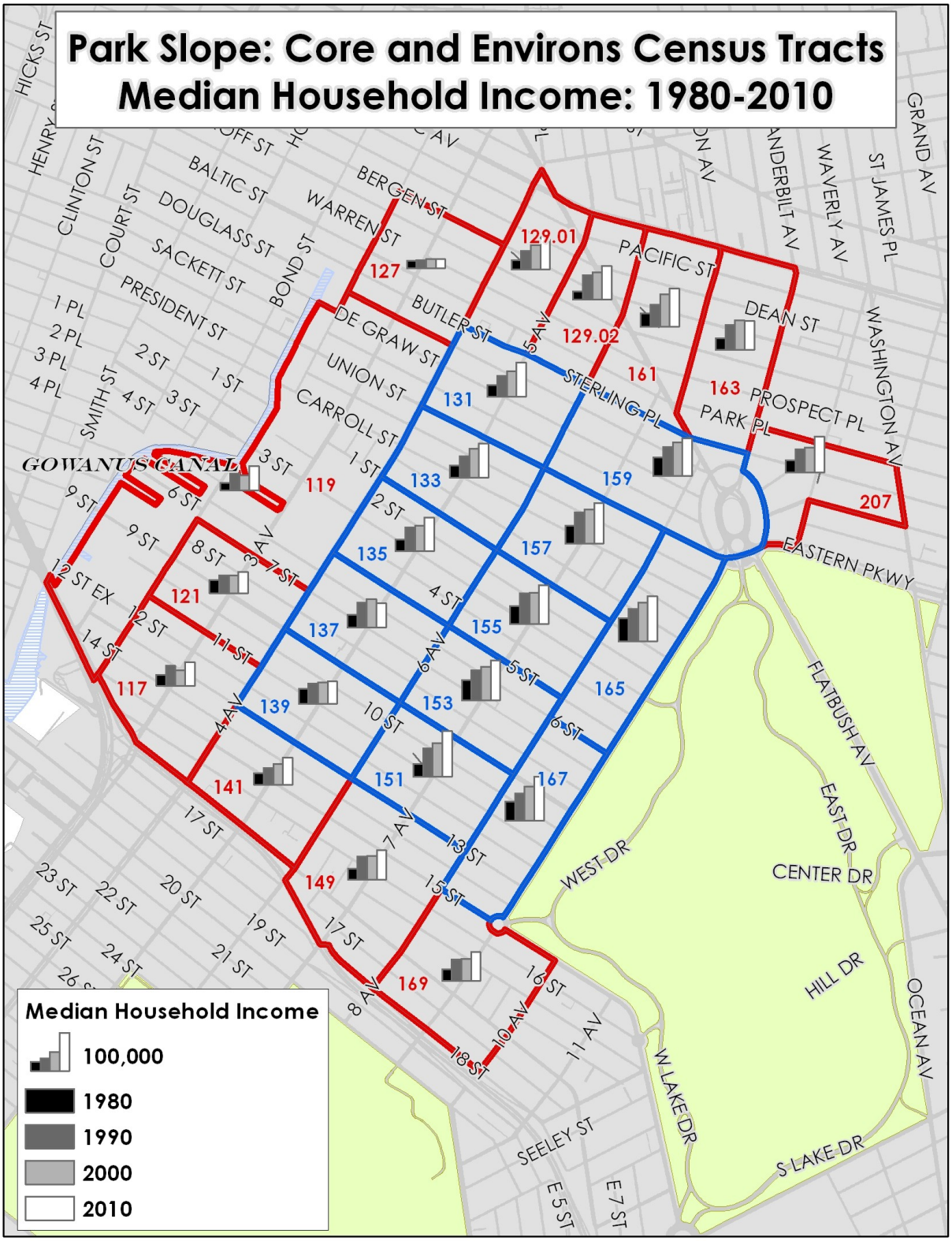


Figure 5-43. Median Household Income, New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.

Park Slope Core and Environs illustrate a trend of a continuous increase in median household income between 1980 and 2010. Considering the general trends at the Borough level, the increasing rates in both the Core and Environs are rather striking. In 1980, both the Core and Environs figures are lower than those of New York City and Brooklyn; by 1990, despite considerable increases, both the Core and Environs remain behind those of the City and the

Borough. The reverse is observed in 2000 when both the Core and Environs exceed the Borough and the City, with the Core higher than the Environs. This pattern and increasing trend is repeated in 2010. It should also be noted that both the 2010 median household income of the Core and the Environs are more than four times those of their own 1980 figures. Map 5-43, Figure 5-44 and Figure 5-45 below illustrate median household income at the Census Tract level in Park Slope and illustrate the intra-neighborhood differences.



Map 5-43. Park Slope, Median Household Income by Census Tract, 1980-2010.

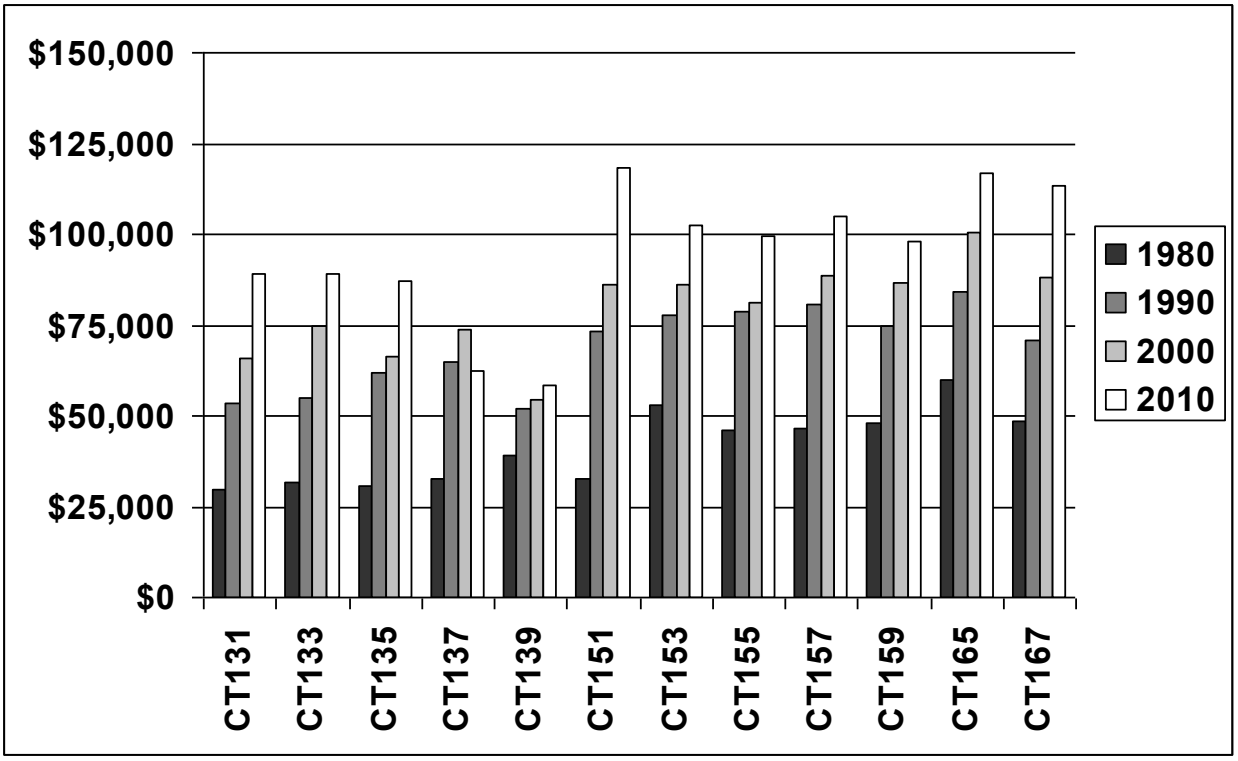


Figure 5-44. Median Household Income in Park Slope - Core by Census Tract, 1980 - 2010.

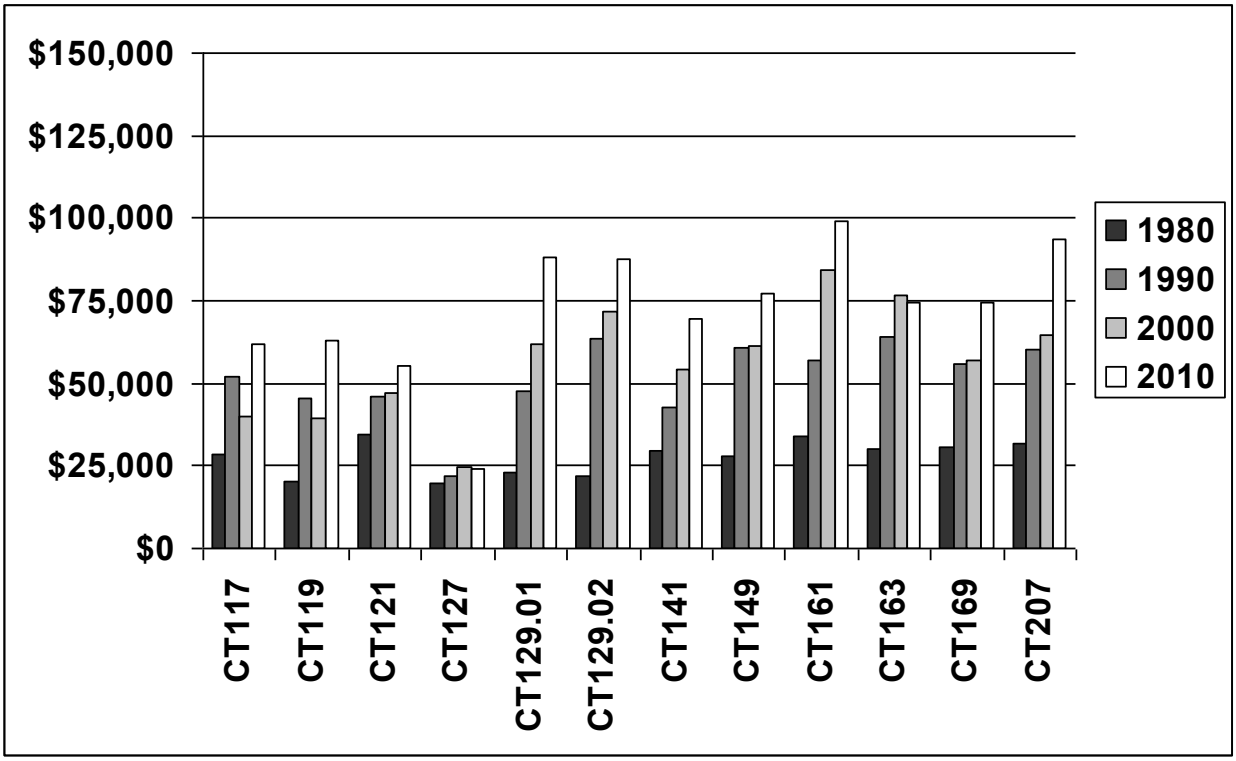


Figure 5-45. Median Household Income in Park Slope - Environs by Census Tract, 1980 - 2010.

The general rising trend for both the Park Slope Core and Environs is observed in most of the Census Tracts. The only exception for the Core is Census Tract 137 which peaked in 2000. The intra-neighborhood differences that are revealed by the map include:

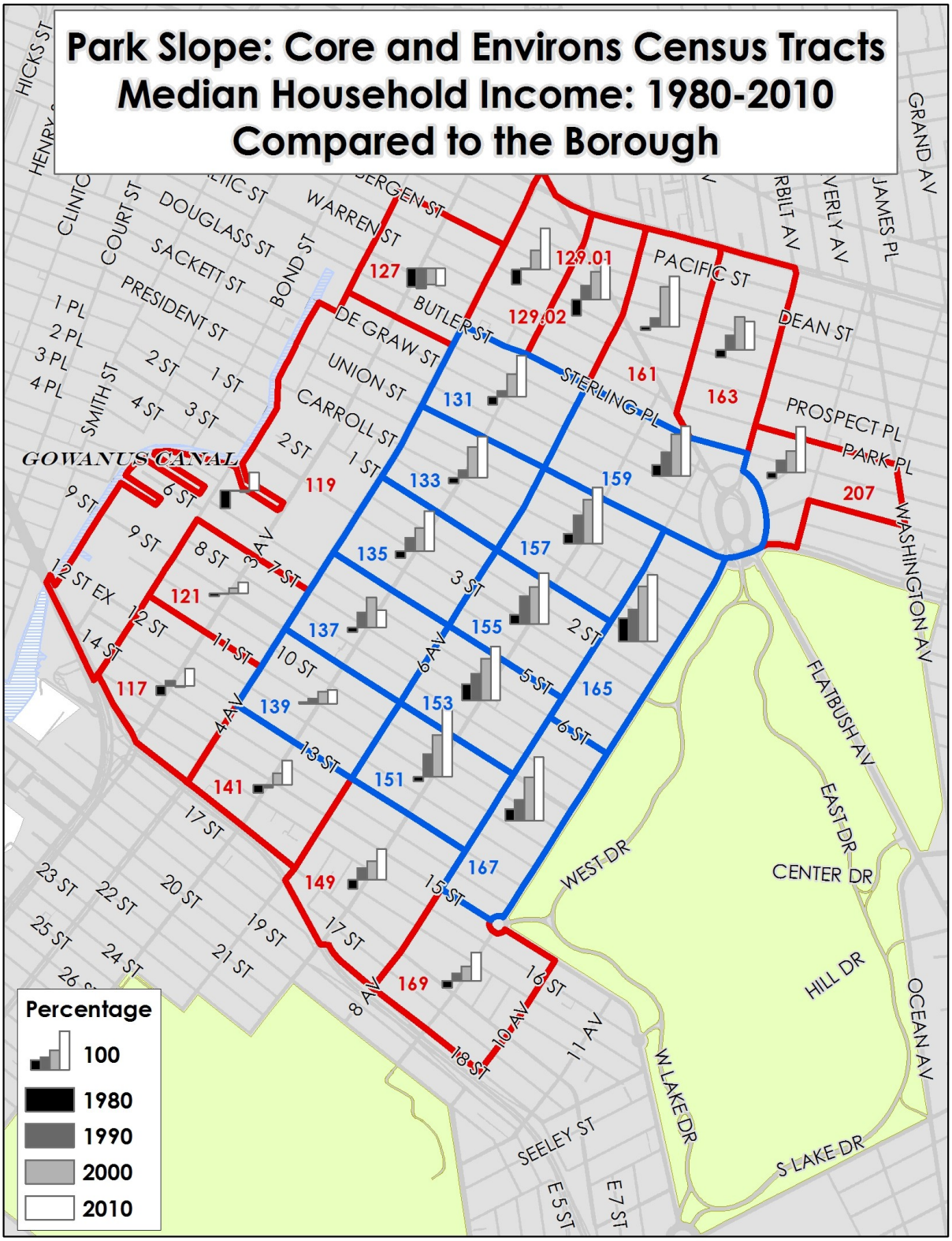
1. Through the four Census Survey years, the Core Census Tracts closer to Prospect Park have higher median household incomes. These are followed by the remaining Census Tracts within the Core, and ultimately by those Census Tracts in the Environs.

2. In general, the increases between 2000 and 2010 are the most noticeable. The only exception is Census Tract 127 at the North-west corner, which peaked in 2000. Its 2010 figure is slightly lower than that of 2000, and through the study period has had much lower figures than do all the other Census Tracts.

3. The most striking pattern is the considerable increase in median household incomes between 1980 and 2010 in the area. With the exception of Census Tract 127, the 2010 median household income for all Census Tracks are three to four times of what they were reported in 1980. This sharp increasing trend is not observed in any Borough-level figures.

Map 5-44 below summarizes these median household income increases within a larger context and compares each Census Tract's figure with the Borough using each respective Census Survey year. This map reveals additional insights into the gentrification of Park Slope. The pattern of increasing median household income is evident for a majority of the Census Tracts in Park

Slope. It also becomes clear that not all Census Tracts in the area have always experienced incomes higher than the Borough itself. Figure 5-46 and Figure 5-47 below illustrate the differences by the Core and Environs at the Census Tract level.



Map 5-44. Park Slope, Median Household Income Compared to the Borough by Census Tract, 1980 - 2010.

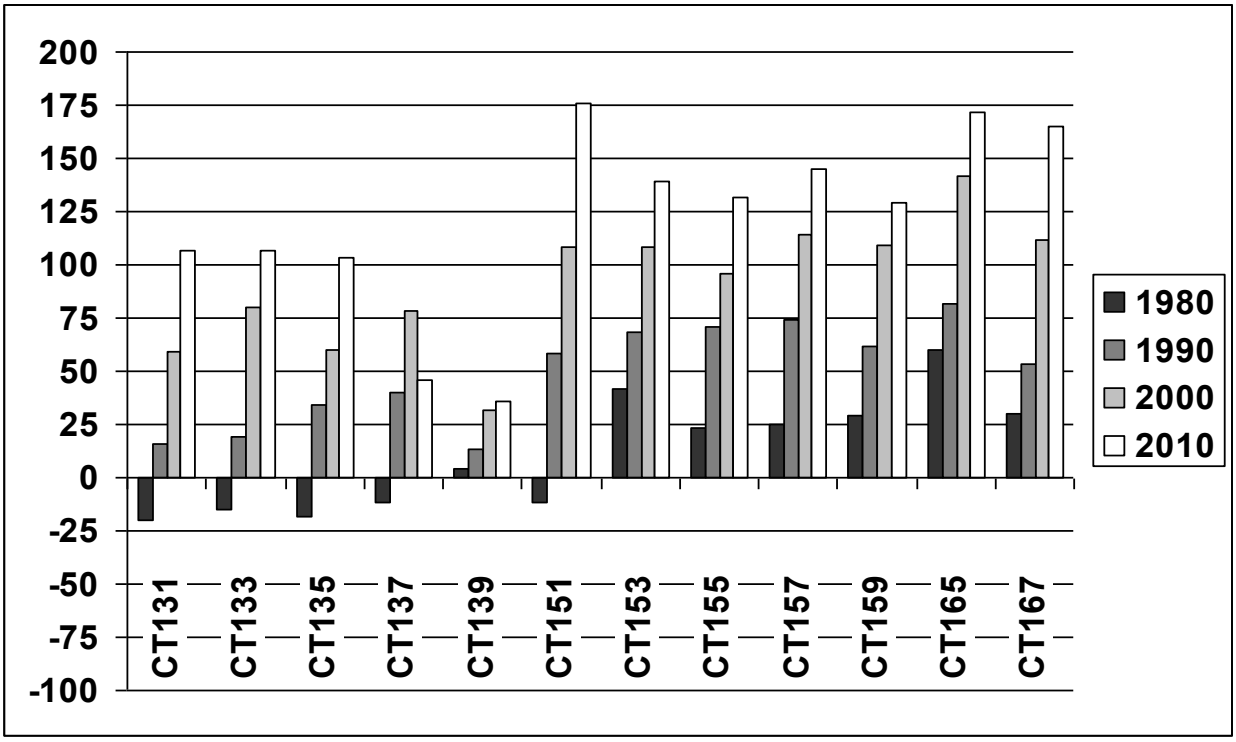


Figure 5-46. Percentage of Median Household Income Compared to the Borough by Census Tract, Park Slope - Core, 1980 - 2010.

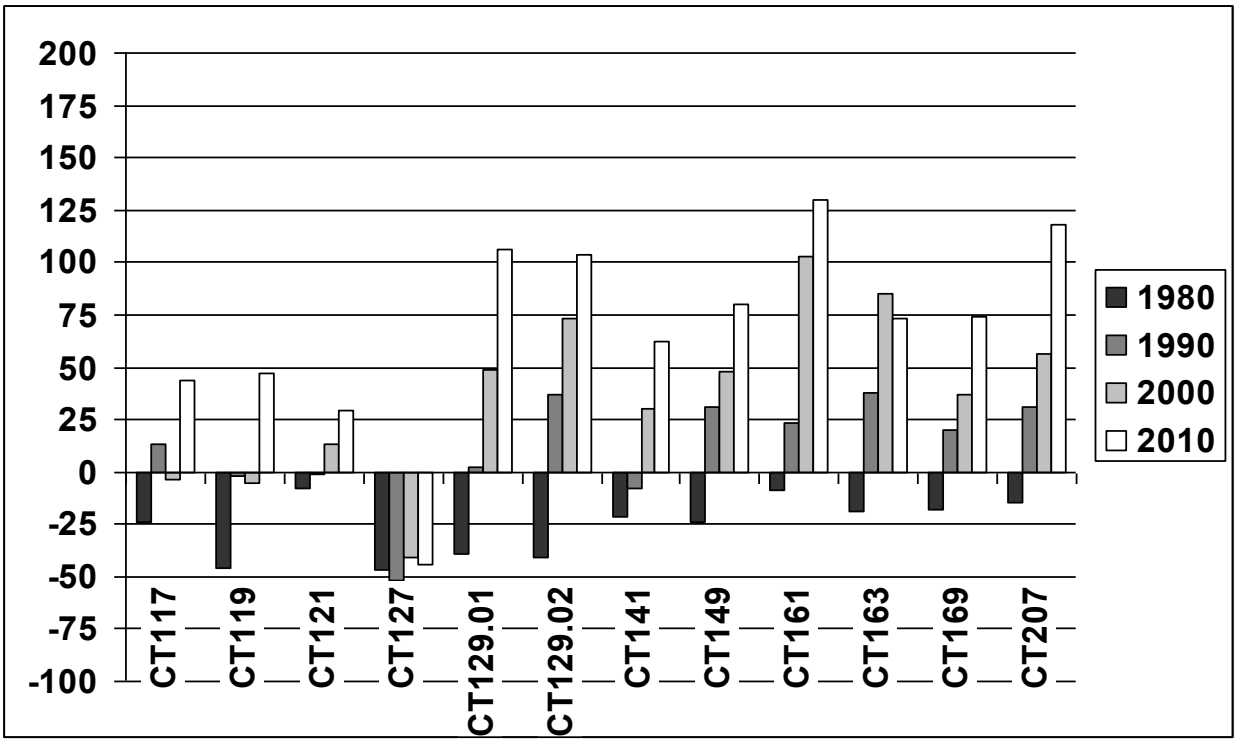


Figure 5-47. Percentage of Median Household Income Compared to the Borough by Census Tract, Park Slope - Environs, 1980 - 2010.

At the starting point of this study in 1980, Census Tracts in the Core adjacent to (i.e. 159, 165 and 167) and close to (i.e. 157, 155, and 153) Prospect Park had median household incomes higher than the Borough itself. Census Tract 139 of the Core, located further away from Prospect Park, also shares this pattern although its figure was only slightly higher than the Borough.

In 1990, the Census Tracts with above-the-Borough median household income expands into the North, South, and West. All Census Tracts in the Core area are in this category. In 2000, the increasing trend mostly remains with the exception of Census Tract 117 located at the South-west corner, which initially surpassed the Borough in 1990 and then fell below the Borough in 2000. Census Tract 121 of the Environs also reported slightly higher than the Borough value. By 2010, with the exception of Census Tract 127 at the North-western corner, all Census Tracts report median household incomes higher than the Borough of Brooklyn itself.

Monmonier's argument that "…prose has a sequential, linear structure that can be painfully insufficient for discussing places, regions, and spatial relations (Monmonier, 1993) is evident in the previous discussion that one reads through sequenced descriptions to get a picture of how Census Tracts with above-the-Borough median household incomes expand from 1980 to 2010. However, even using Map 5-44 that shows bar charts that compare the median household income of Census Tracts to the Borough itself, a considerable effort is needed to visually identify the Census Tracts that "reverse" (changes from lower to higher than the Borough) at a given time, cite the location, and then compare them over a period of time to observe the spatial-temporal expansion.

One of the advantages of employing GIS is that it allows users to query and select features by either spatial or numerical clauses and then assign the results in various colors. In this particular case using median household incomes, if the Census Tracts are selected sequentially for the year they had exceeded the Borough itself and then displayed one after another, the expansion can be viewed as an animated map. The next section will describe a series of gentrification maps measuring median gross rent; the animated map is presented in the summary at the end of this chapter.

5-4.6 Median Gross Rent

Seemingly independent from fluctuations in median household income from 1980 through 2010 (See Figure 5-43), the median gross rent steadily increased throughout New York City and in every Borough. (See Figure 5-48 below). In general, the difference in median gross rent between 1990 and 2000 is less than that between 1980 and 1990 as well as between 2000 and 2010. This observation is perhaps a result of the overall decreasing median household income in 2000 as illustrated in Figure 5-43. This slight increase in median gross rent between 1990 and 2000 is also observed in the Park Slope Core and Environs. The bar charts in Figure 5-48 below illustrates that these differences are greater especially between 1980 and 1990 and also between 2000 and 2010, indicating the rising median gross rent was accelerating.

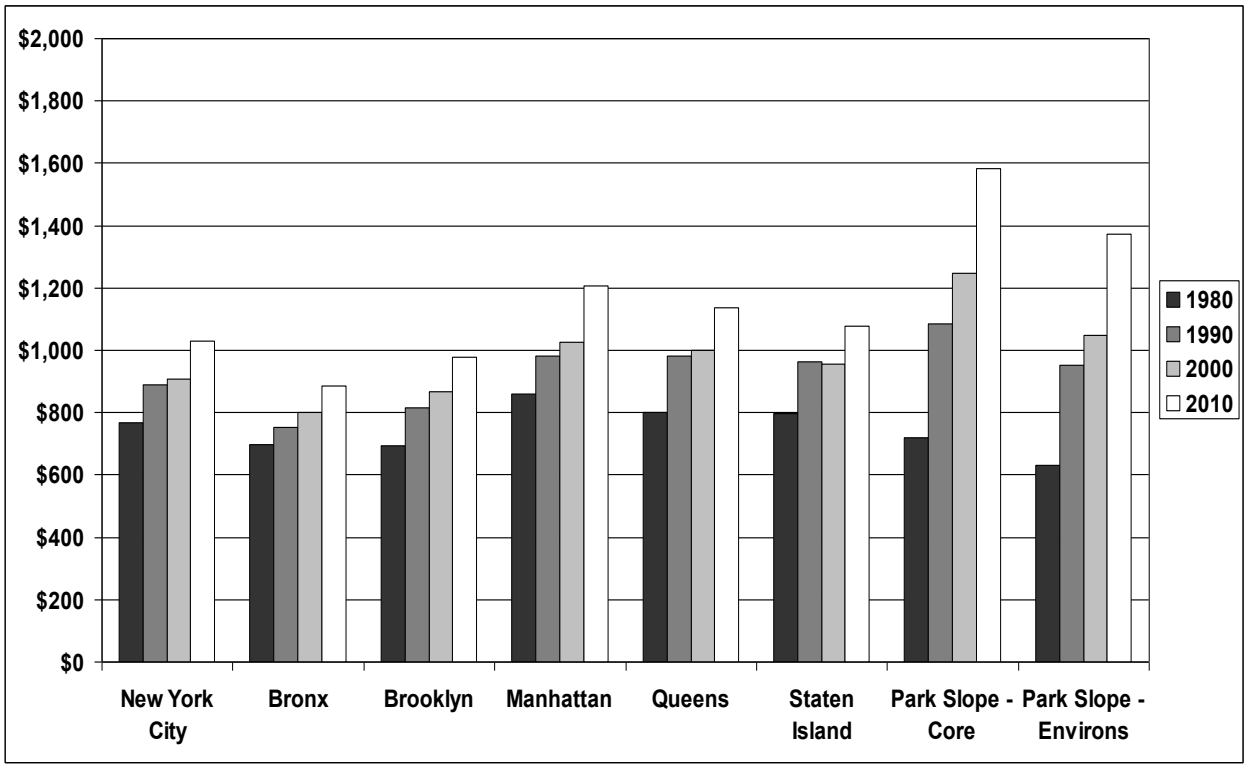


Figure 5-48. Median Gross Rent, New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.

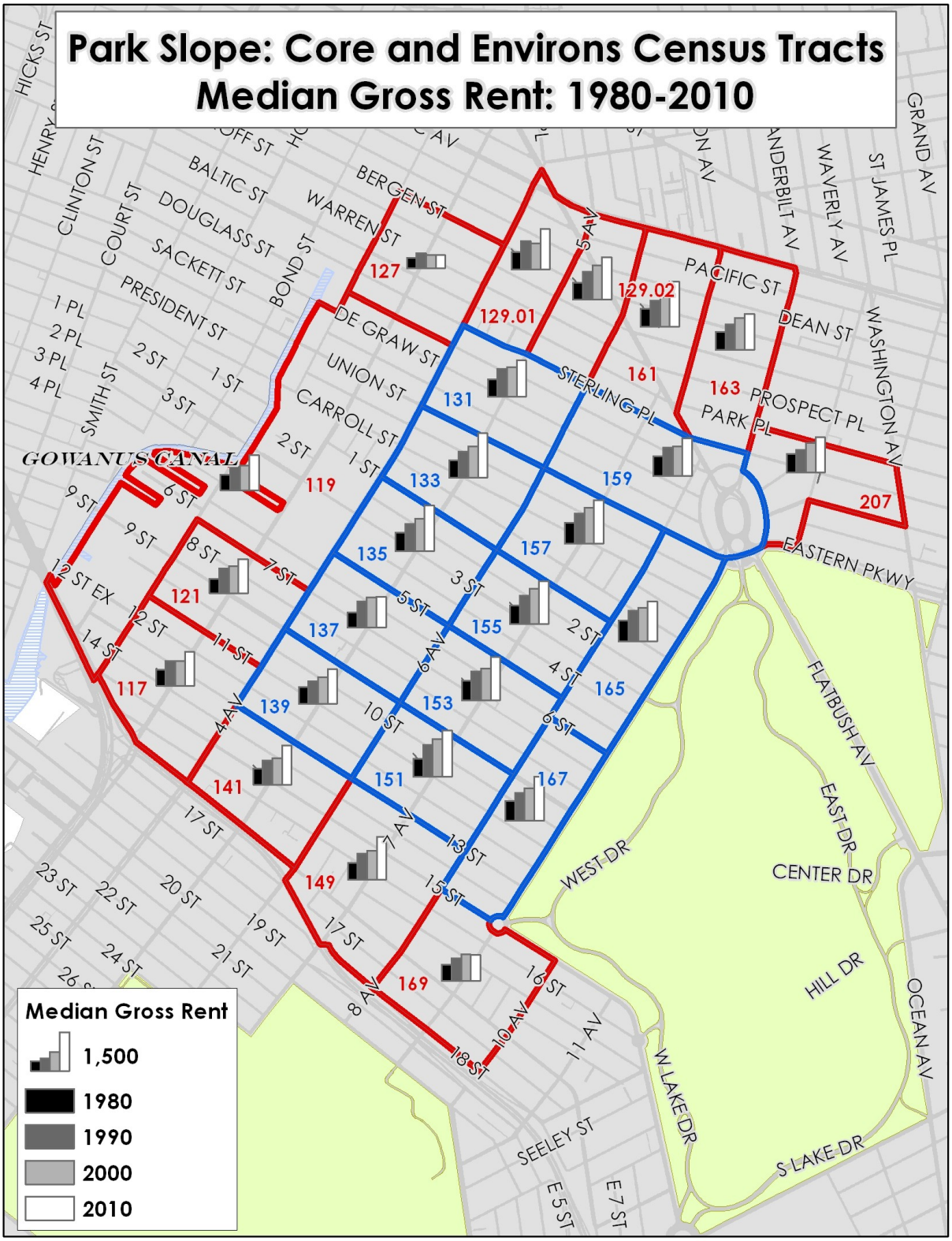
Map 5-45 below illustrates the median gross rent in Park Slope Core and Environs at the Census Tract level. At first glance, the median gross rent pattern is identical with that of the median household income: rising values as the time period progresses. Compared with the median household income map (Map 5-43), Map 5-45 shows that while most Census Tracts in Park Slope report higher incomes, these Census Tracts also report increasingly higher rents. It is possible that either the existing residents have obtained higher incomes or the newly relocated gentrifiers may be of a higher economic status, but both groups would be required to pay the higher housing cost to live in Park Slope. In addition, it is noteworthy that they are rapidly rising rents between 2000 and 2010 in most Census Tracts in the Core and also in the North, the Southwest, and the South Environs Census Tracts.

In contrast to the general rising income and rent across most Census Tracts is Census Tract 127 located at the far North-west corner. In Census Tract 127 rent peaked in 1990 and decreased in the following years; in 2000 and 2010 the figures are virtually identical (i.e. $522 and $517) while the remainder of Park Slope and the Borough of Brooklyn experienced increasing rents. Following the spatial patterns of the rapidly rising median household incomes in the area, and considering it is flanked by Census Tracts 119 and 129.01 that report considerably higher rents in 2010 (i.e. $1,383 and $1,563 respectively), it seems logical to predict that in future years gentrification will expand into this far North-west corner of Census Tract 127.

There is an explanation for why this particular Census Tract (i.e. 127) has not experienced increasing income and rising rent as did the other regions of the neighborhood; it is located at a considerable distance from Prospect Park and from other gentrified areas to experience spillover gentrification. Future gentrification trends in Park Slope may first occur in other areas that possess characteristics that are more attractive to immediate gentrification. For example, future gentrification may continue expanding north towards the Atlantic Yards Development, possibly expand west with the anticipated competition of the Whole Foods supermarket located between 3rd and 6th Streets.

Some researchers may argue that the rezoning along 4th Avenue together with the subsequent new construction in this area may change the characteristics of the Western area of Park Slope, it is important to note that rezoning for residential development on the Northern end of the 4th Avenue (specifically between Douglass and 3rd Streets) is only focused on the East side of 4th Avenue; the West side of 4th Avenue remains zoned for manufacturing. In other words, only the

Southern section of 4th Avenue has been rezoned from commercial to residential use on both sides of the street. Considering of all these factors, Census Tract 127 may avoid gentrification in the near future.



Map 5-45. Park Slope, Median Gross Rent by Census Tract, 1980 - 2010.

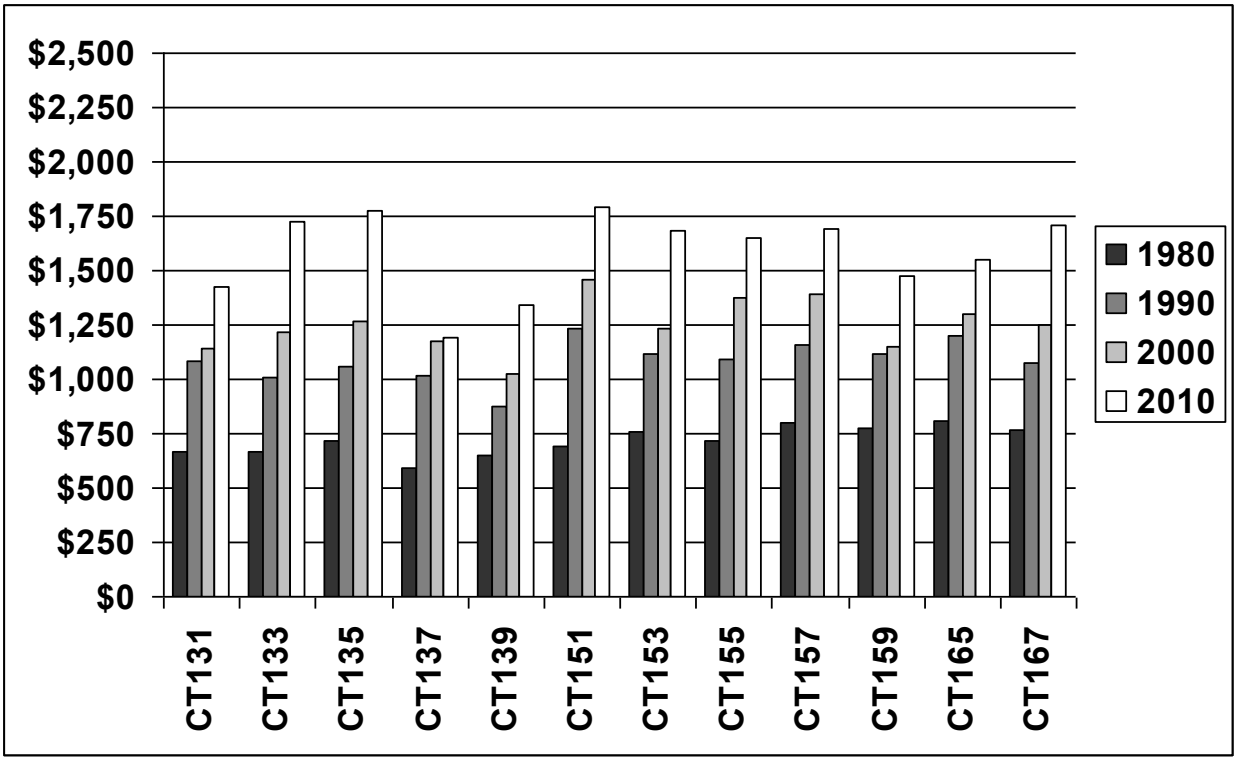


Figure 5-49. Median Gross Rent in Park Slope - Core by Census Tract, 1980 - 2010.

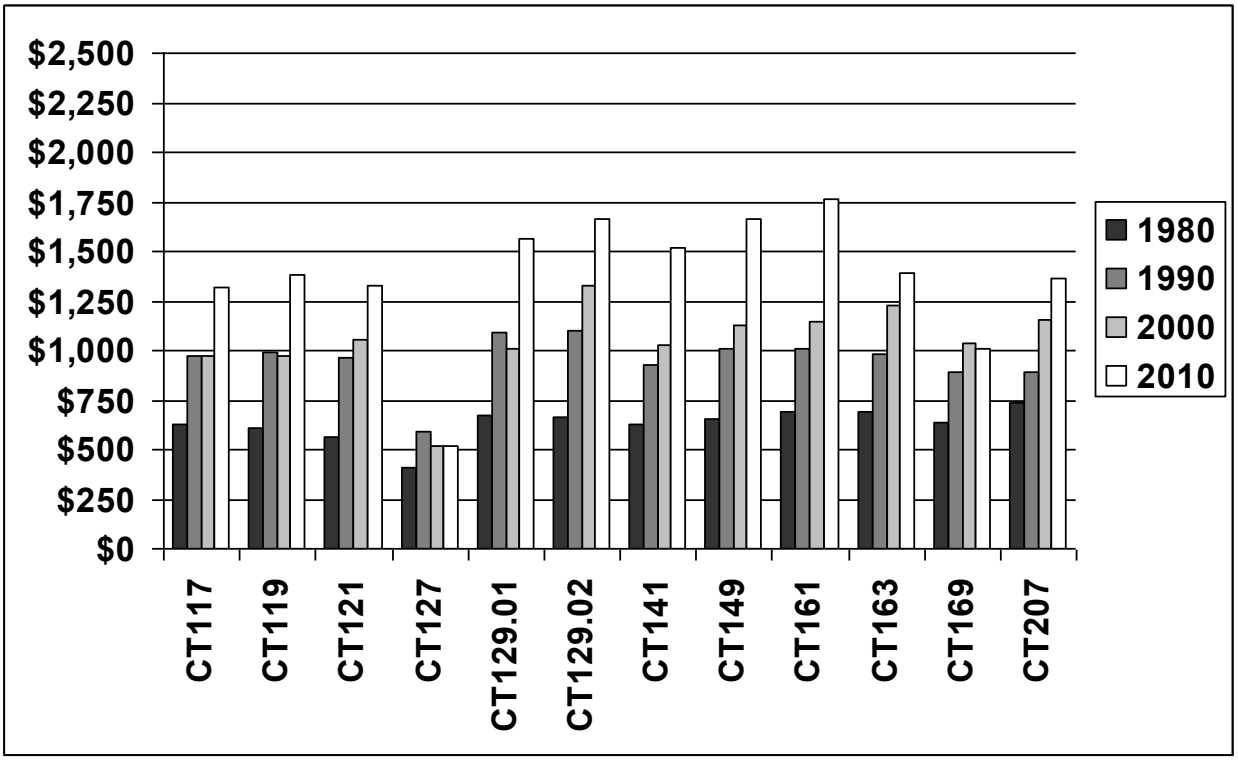


Figure 5-50. Median Gross Rent in Park Slope - Environs by Census Tract, 1980 - 2010.

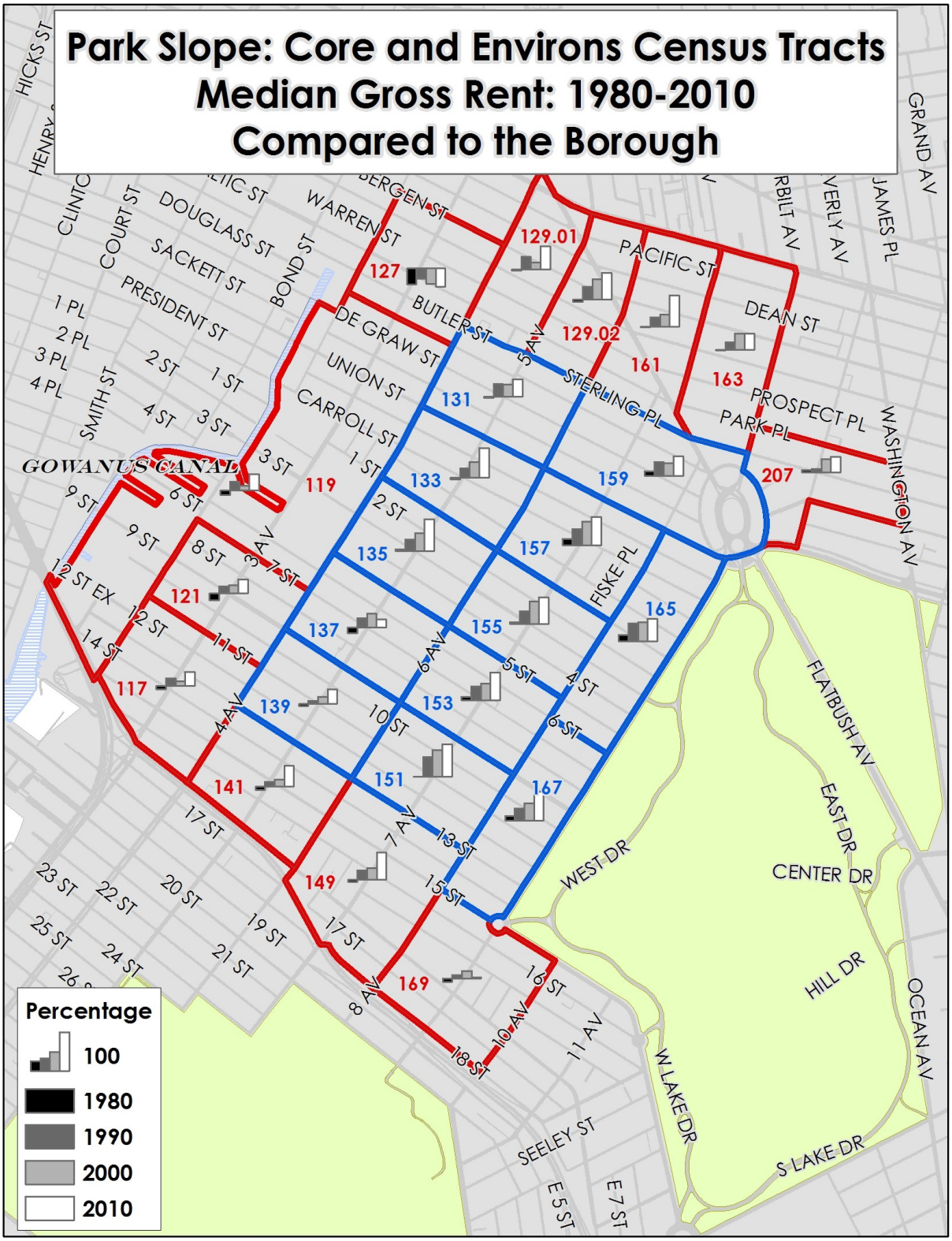
Map 5-46 below compares the median gross rent at the Census Tract level to the Borough as a whole and reveals some additional spatial patterns including:

1. In general, the reversal in the spatial-temporal expansion (from below to above-the-Borough) mirrors the pattern of reversal of the median household income.

2. In 1980, Census Tracts in the Core adjacent and nearby Prospect Park reported above-the-Borough rent; in 1990 and the following Census Survey years, all Census Tracts in the Core reported rents higher than the Borough.

3. For the Census Tracts in the Environs, there are various stages of development. In the North, earlier and accelerated increases are observed. Since 1990, the Environs Census Tracts North of the Core had rents higher than the Borough; the only exception is Census Tract 127 at the North-west corner that had rents reported below the Borough throughout the study period.

4. The Environs Census Tracts west of the Core had reported lower rents in 1980, and had reported above-the-Borough rents in 1990 and afterwards. This pattern continues with the Environs Census Tracts south of the Core, with the exception of the South-east Census Tract 169, which had experienced a slower increasing trend that actually peaked in 2000.



Map 5-46. Park Slope, Median Gross Rent Compared to the Borough by Census Tract, 1980 - 2010.

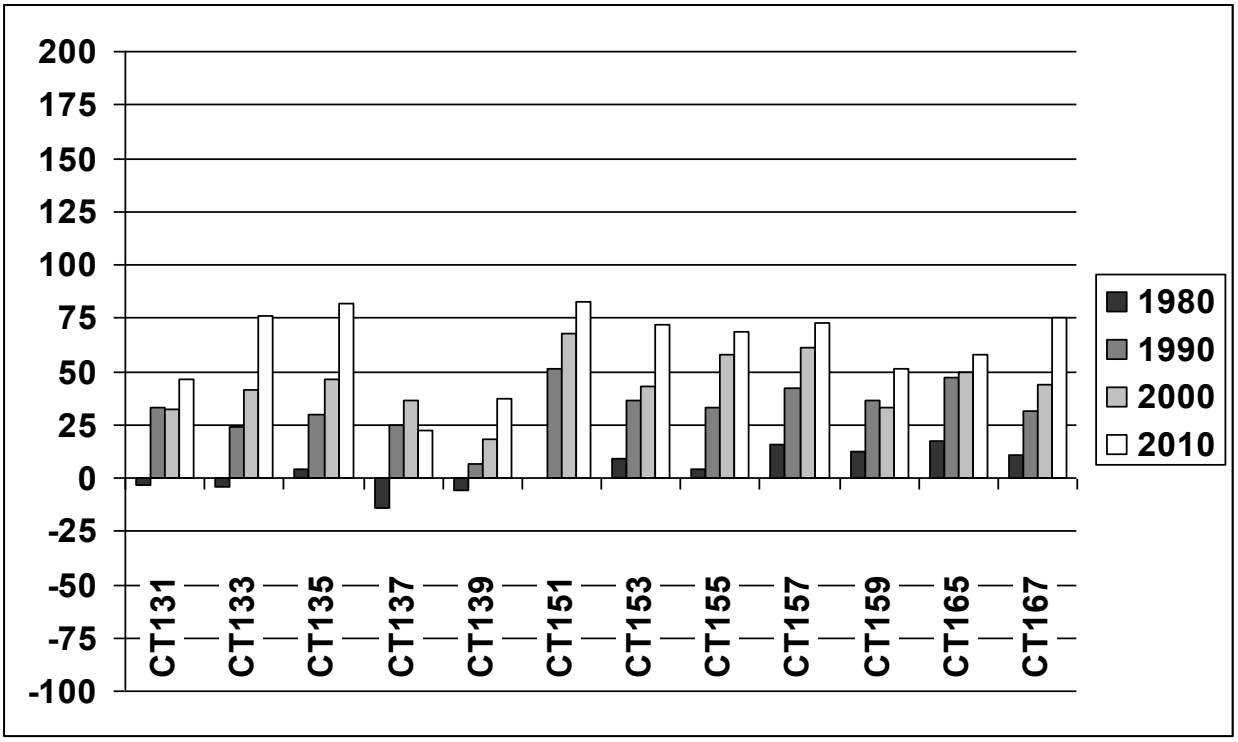


Figure 5-51. Percentage of Median Gross Rent Compared to the Borough by Census Tract, Park Slope - Core, 1980 - 2010.

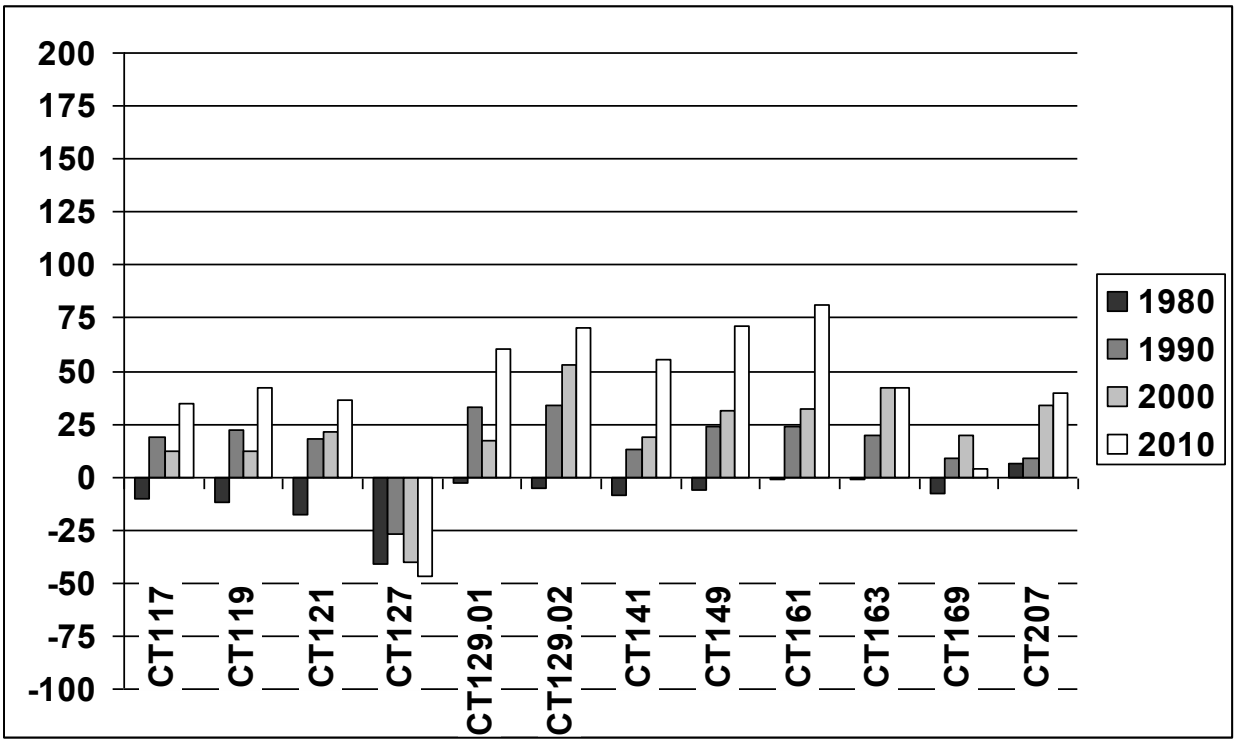


Figure 5-52. Percentage of Median Gross Rent Compared to the Borough by Census Tract, Park Slope - Environs, 1980 - 2010.

5-4.7 Educational Attainment

This section discusses the two ends of the spectrum of educational attainment, namely: those individuals with College (or Above) Degree (a commonly used research variable to indicate gentrification), and those individuals without a High School Diploma and examines the ways gentrification impacts the second group.

5-4.7a College (or Above) Degree

Figure 5-53 below illustrates the percentage of the population with College (or Above) Degree in New York City, the Five Boroughs and the Park Slope Core and Environs. All five Boroughs and the City itself have exhibited an increase in the percentage of people with College (or Above) Degree; Manhattan is the Borough with the highest figures. Among the four other Boroughs, Brooklyn, Queens and Staten Island share an increasing trend and report at approximately 20% in 2010; the Bronx ranks the lowest among the five Boroughs and reports approximately half the percentages when compared to the City as a whole throughout the study period.

The Park Slope Core and Environs both show considerable increases from 1980 through 2010. In 1980, the Core area already reported over 20% of the population with College (or Above) Degree (exceeding both the Borough and New York City). Over the next thirty years the Park Slope Core continued to increase and in 2010 reported nearly three fold when compared to the Borough's percentage.

The Environs, likewise exhibited a striking growth in the percentages of individuals with College (or Above) Degree. Beginning in 1980 there were only 6% reported, while the Borough reported

7%. By 1990 the Park Slope Environs exceeds the Borough and is two-fold when compared to the Borough at 20%. The increase slows down during the next decade and is less than the Core, but in 2010 it reports 44% which is 1% higher than Manhattan. This accelerated increase in population with higher education certainly supports the observation about the steady gentrification of the area. Map 5-47 below illustrates the percentages by Census Tract and in addition reveals intra-neighborhood differences.

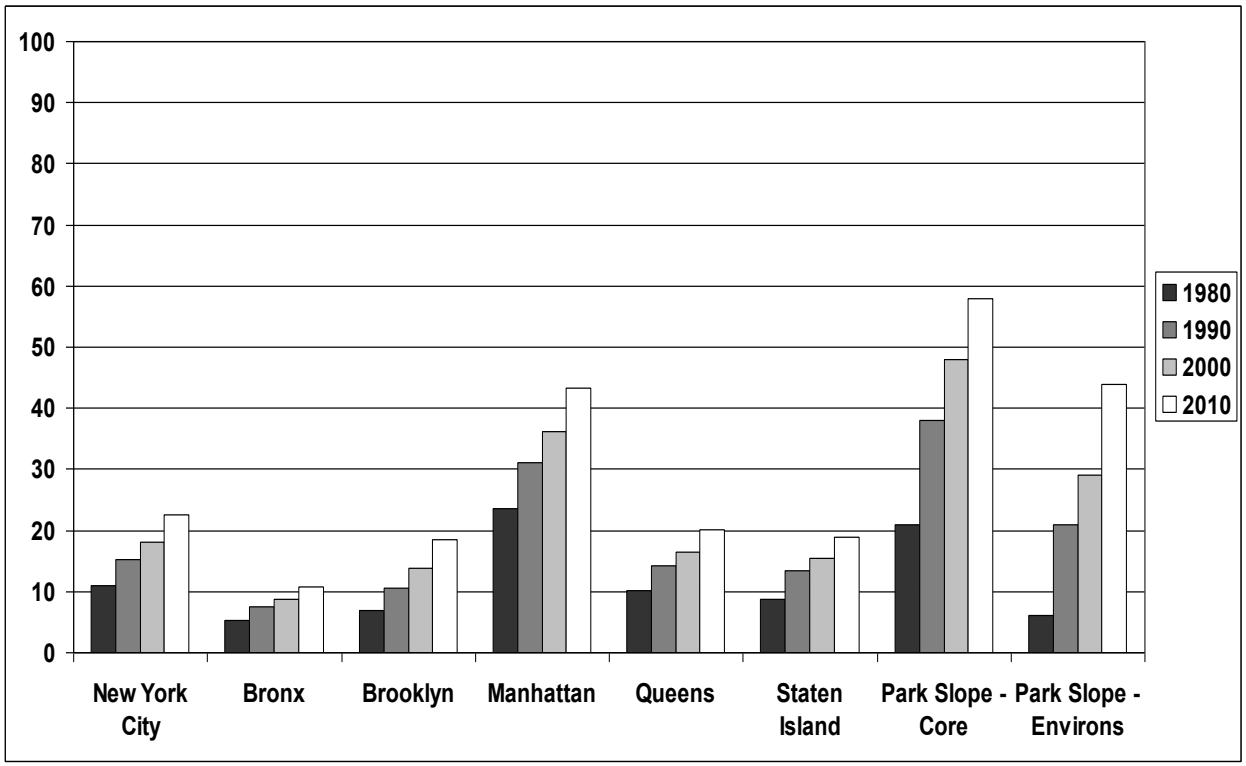
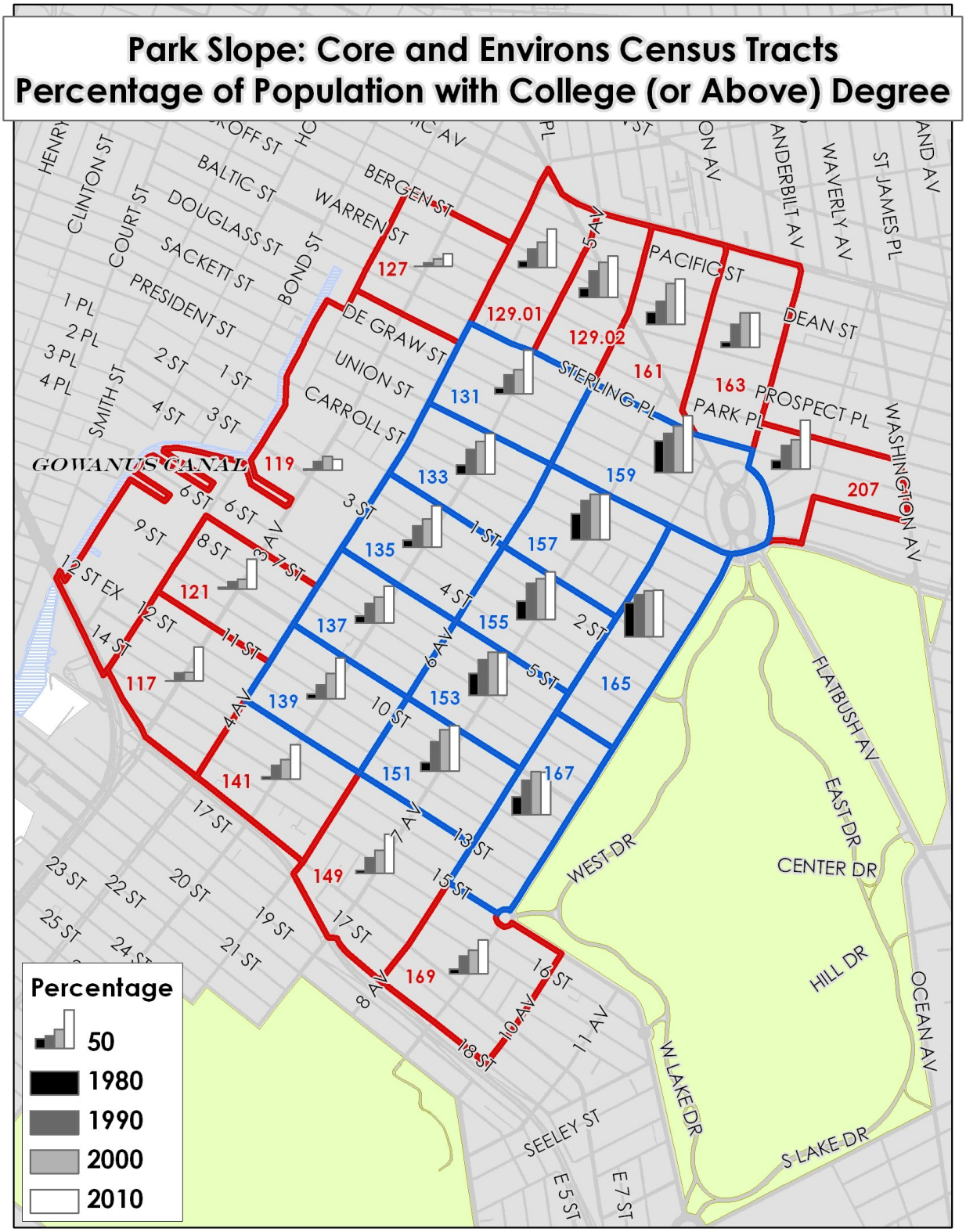


Figure 5-53. Percentage of the Population with College (or Above) Degree in New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.



Map 5-47. Park Slope, Percentage of Population with College (or Above) Degree by Census Tract, 1980 - 2010.

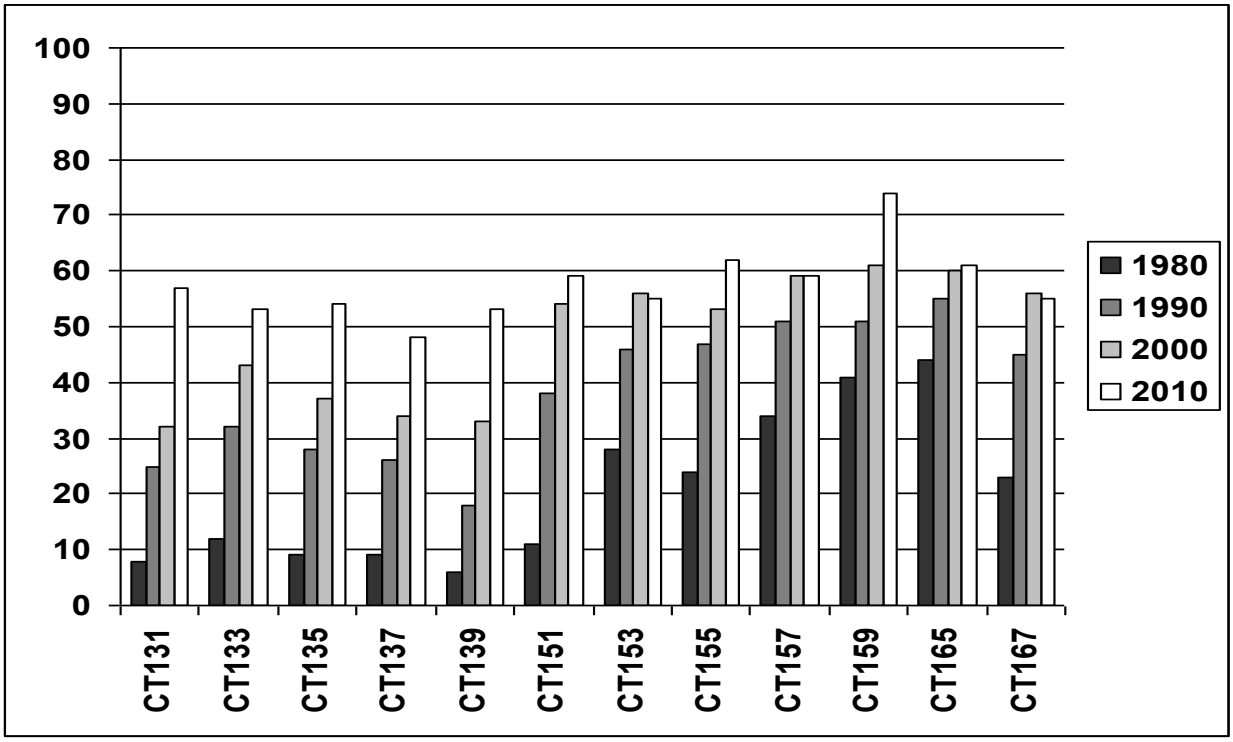


Figure 5-54. Percentage of the Population with College (or Above) Degree in Park Slope - Core by Census Tract, 1980 - 2010.

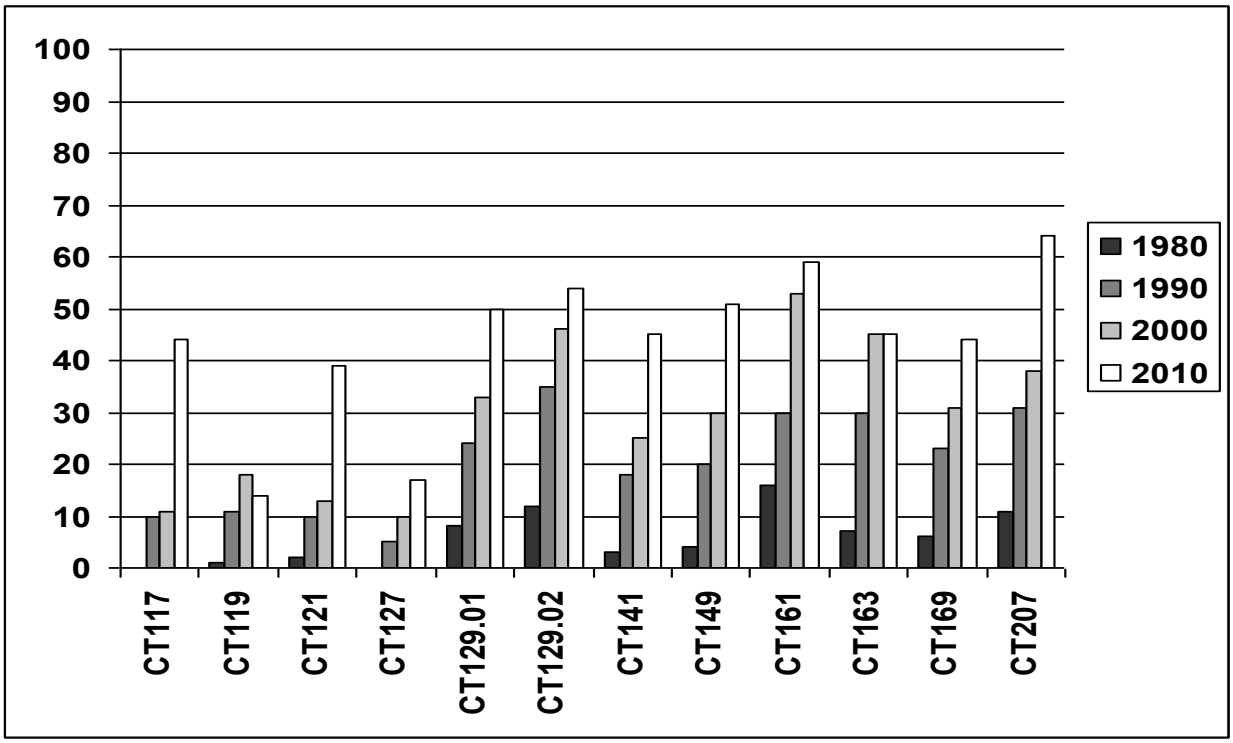


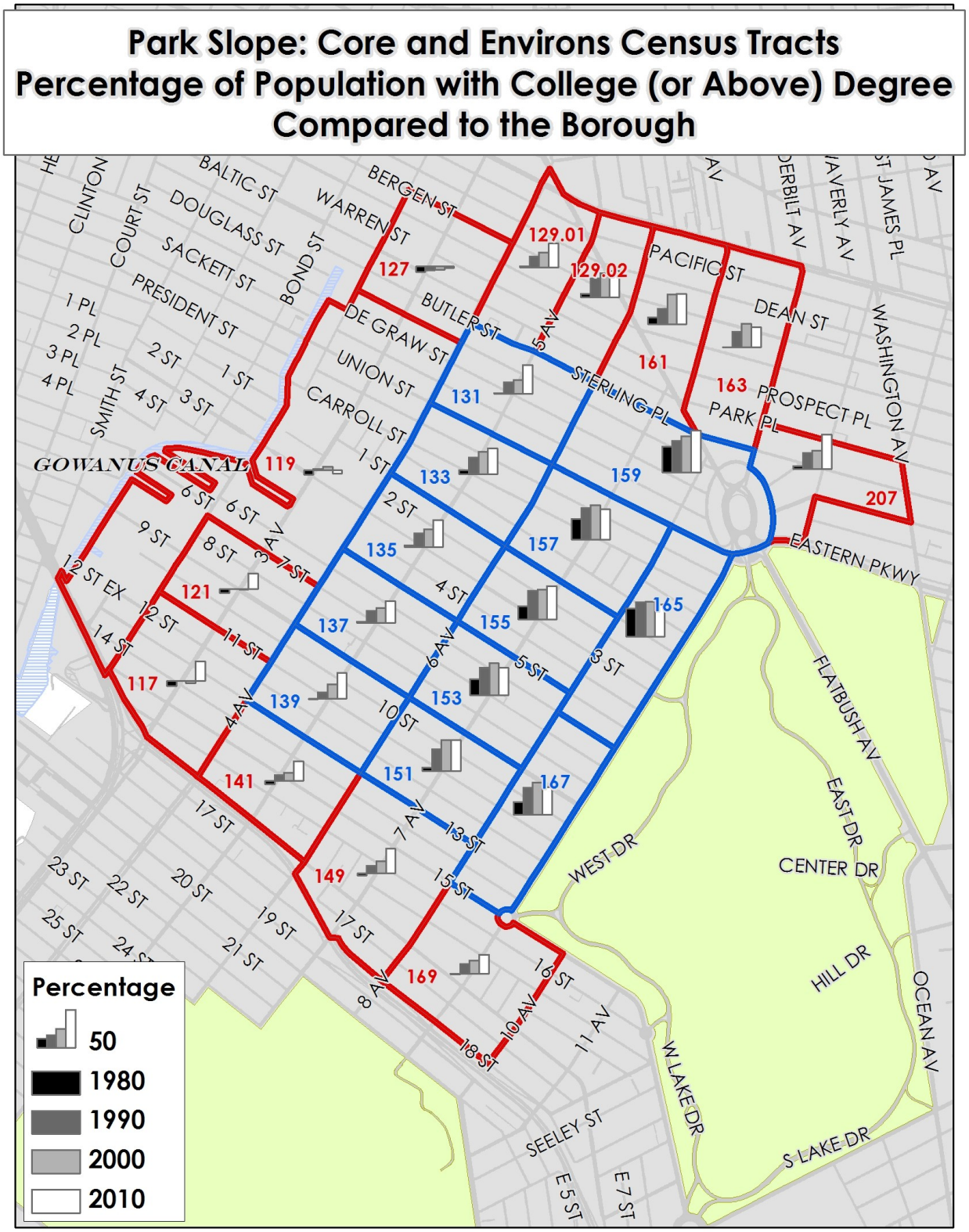
Figure 5-55. Percentage of the Population with College (or Above) Degree in Park Slope - Environs by Census Tract, 1980 - 2010.

The overall increasing percentage of the population with College (or Above) Degree is consistent throughout the study period. A few exceptions do exist, for instance: between 2000 and 2010, Census Tracts 153 and 167 both drop 1% to report 55%, which is still considerably higher than the Borough and approximately double what they were in 1980; Census Tract 119 experiences a 4% drop to 14%. Census Tract 127 increases from 10% in 2000 to 17% in 2010. The two Environs Census Tracts at the South-west corner (i.e. 121 and 117) experience considerable increases during this decade (perhaps a result of a spillover effect and the new construction in this area).

In general, the Core has higher figures when compared to the Environs. Census Tracts located on the North and adjacent to Prospect Park have higher values. This pattern has been previously reported for median household income. The aforementioned rapid increase in the Environs is not evenly distributed throughout all Census Tracts. Although the North, South and Southwest Environs Census Tracts report low initial figures, they all increase rapidly from 1980 through 2010. As noted, Census Tract 119 actually has a 4% decrease to 14%. Census Tract 127, despite a 7% increase, ends at 17%. Both Census Tracts 119 and 127 are not much lower than the Borough's 2010 figure of 19%, when compared with the rapid increases in other Census Tracts it is clear that gentrification of the Core has yet to expand into these areas.

Map 5-48 below further illustrates the uneven development and gentrification of the Park Slope Core and Environs using the Borough figures as a yardstick through the years. Within the Core, those adjacent or closer to Prospect Park are consistently higher than the Borough, and in general, maintain a growing trend. Those on the West and South-west report approximately the

same figures as the Borough in 1980, but in subsequent years they out-pace the Borough. This pattern is also observed for the North and South Environs Census Tracts.



Map 5-48. Park Slope, Percentage of Population with College (or Above) Degree, Compared to the Borough by Census Tract, 1980 - 2010.

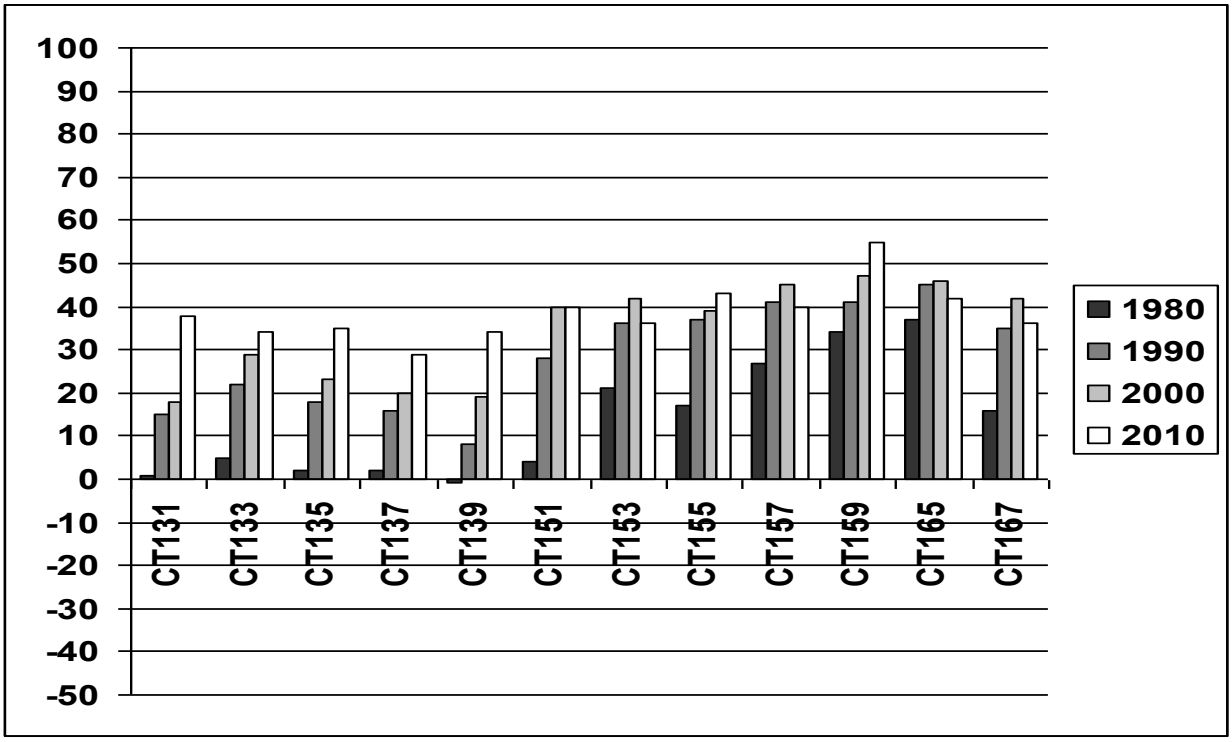


Figure 5-56. Percentage of the Population with College (or Above) Degree Compared to the Borough in Park Slope - Core by Census Tract, 1980 - 2010.

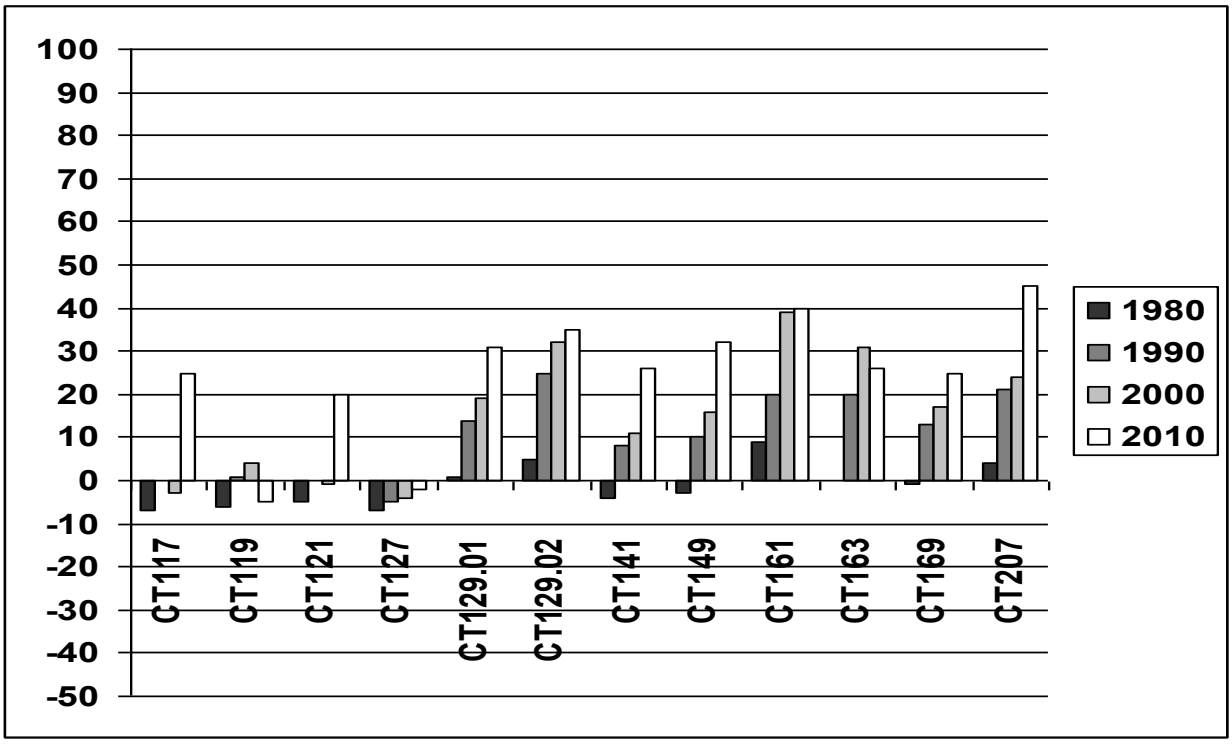


Figure 5-57. Percentage of the Population with College (or Above) Degree Compared to the Borough in Park Slope - Environs by Census Tract, 1980 - 2010.

The West Environs, as discussed in the previous section, has two distinctly different patterns that are especially evident between 2000 and 2010. While in general they remain about the same as the Borough as a whole, the Southern Census Tracts 121 and 117 show noticeable growth and North-west Census Tracts 127 and 119 remain slightly below the Borough. An important research question is whether the slower/stalled gentrification means that individuals without higher education manage to remain in this area? The following section examines the percentage of people without high school diplomas.

5-4.7b No High School Diploma

Figure 5-58 below illustrates the percentage of the individuals without a High School Diploma in New York City, the Five Boroughs and the Park Slope Core and Environs. Between 1980 and 2010, all of these areas report decreasing percentages of individuals without a High School Diploma. Among the Five Boroughs, the Bronx consistently reports the highest percentage and Staten Island reports the lowest.

Both the Park Slope Core and Environs have decreasing percentages in this category. Over the years the Environs have reported consistently higher figures. In 1980, the Core already was below the Borough, while the Environs were above the Borough. In 1990 the Environs advanced to surpass the Borough. Throughout the study period, a noticeable drop can be observed when comparing the 1980 and 1990 figures. In the more recent two Census Surveys, the Core reports the lowest percentage among all areas.

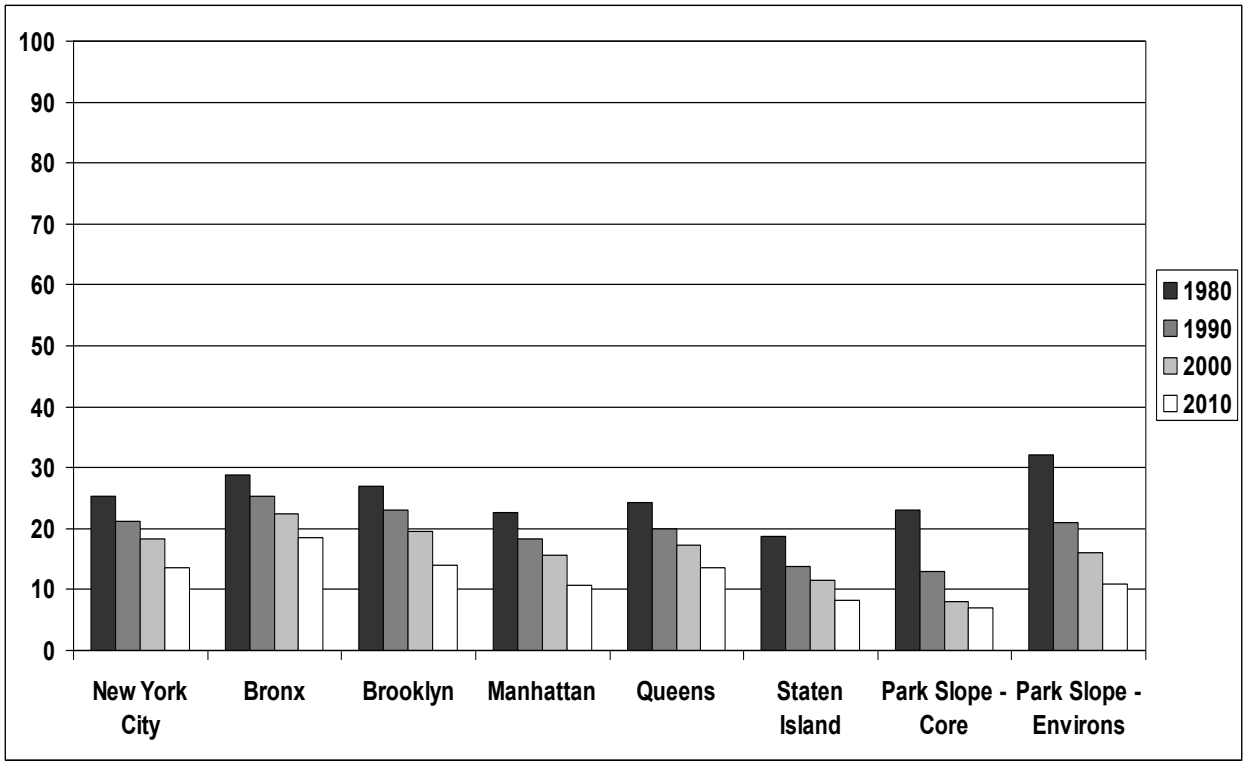
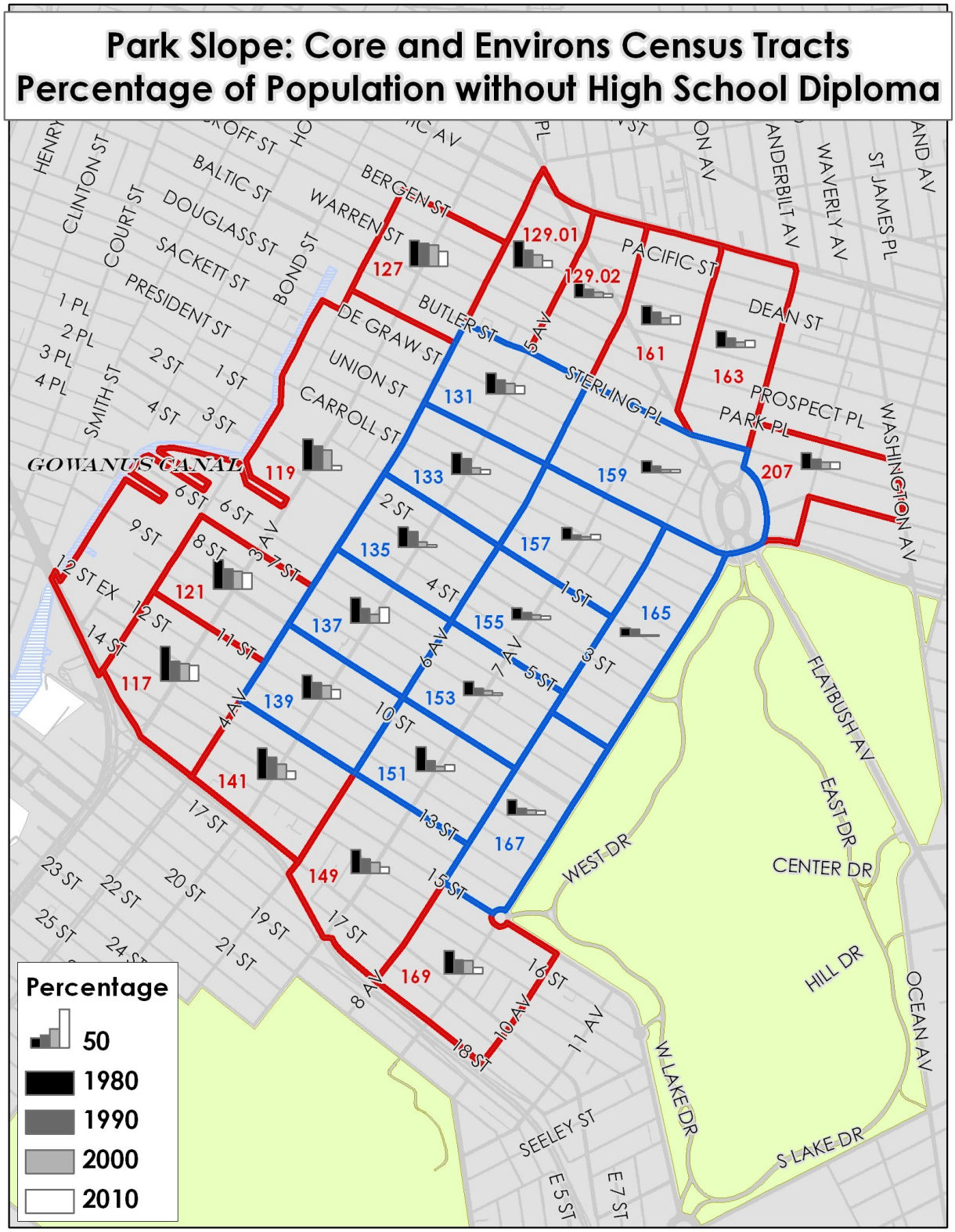


Figure 5-58. Percentage of the Population without a High School Diploma in New York City, the Five Boroughs and Park Slope - Core vs. Environs, 1980 - 2010.

Map 5-49 below illustrates the percentage of population without a High School Diploma for each Census Tract. This map reveals the variations during the study period and similar to the other gentrification indicators that were previously charted and mapped in this study, it reveals intra-neighborhood differences.

Within the Core, the Census Tracts adjacent and closer to Prospect Park report lower figures than those Census Tracts border 4th Avenue. As of 2010, with the exception for the North-west Census Tract 131 and the South-west Census Tract 137, the remaining Core Census Tracts report single-digit percentages. The Environs Census Tracts in the Northern and Southern areas report lower figures than do those on the West side. The single exception is Census Tract 119, which in

2010 reports a single-digit percentage. The North-west Census Tract 127 and South-west Census Tracts 122 and 117 report that approximately 20% of the population are without a High School Diploma.



Map 5-49. Park Slope, Percentage of Population without High School Diploma by Census Tract, 1980 - 2010.

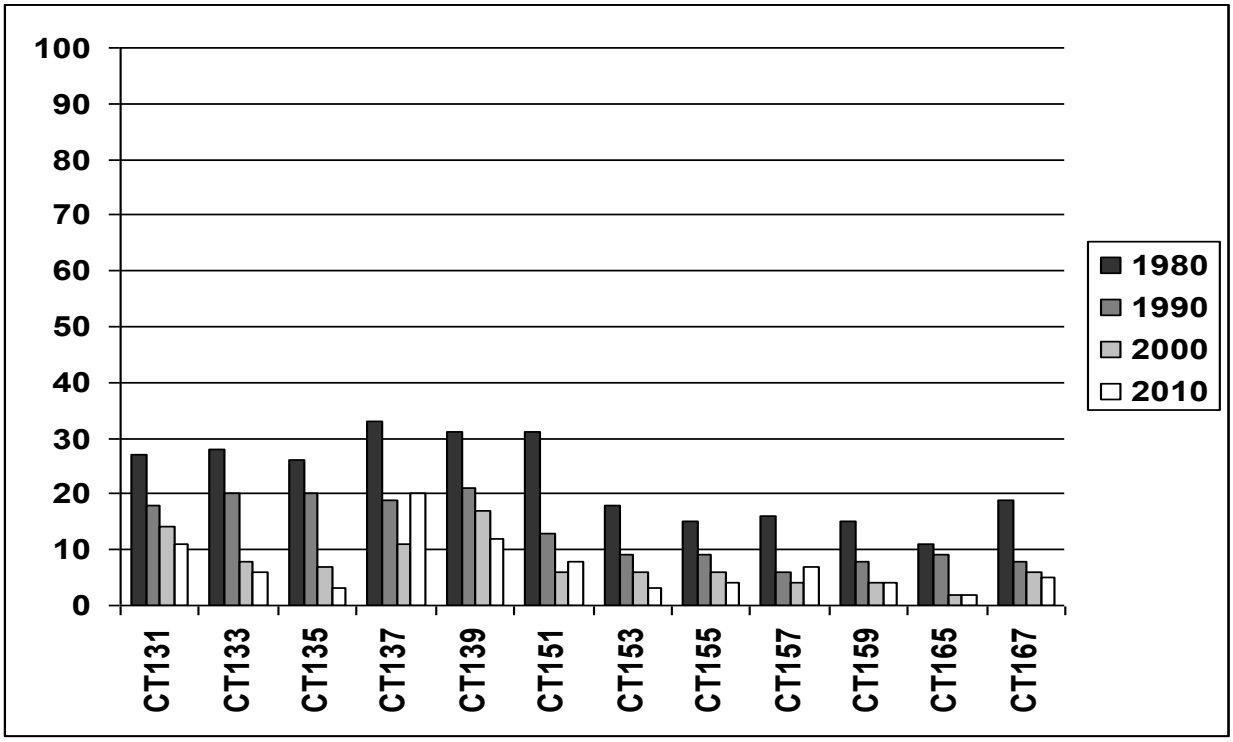


Figure 5-59. Percentage of the Population without a High School Diploma in Park Slope - Core, by Census Tract, 1980 - 2010.

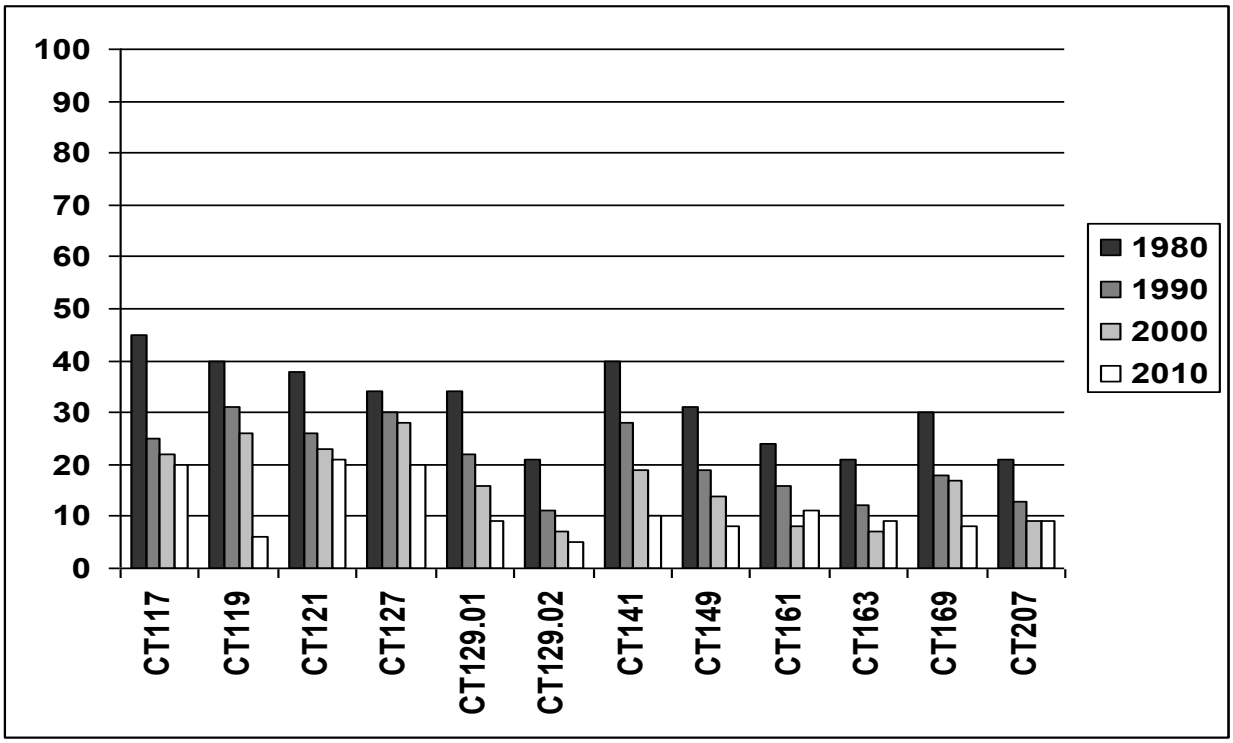
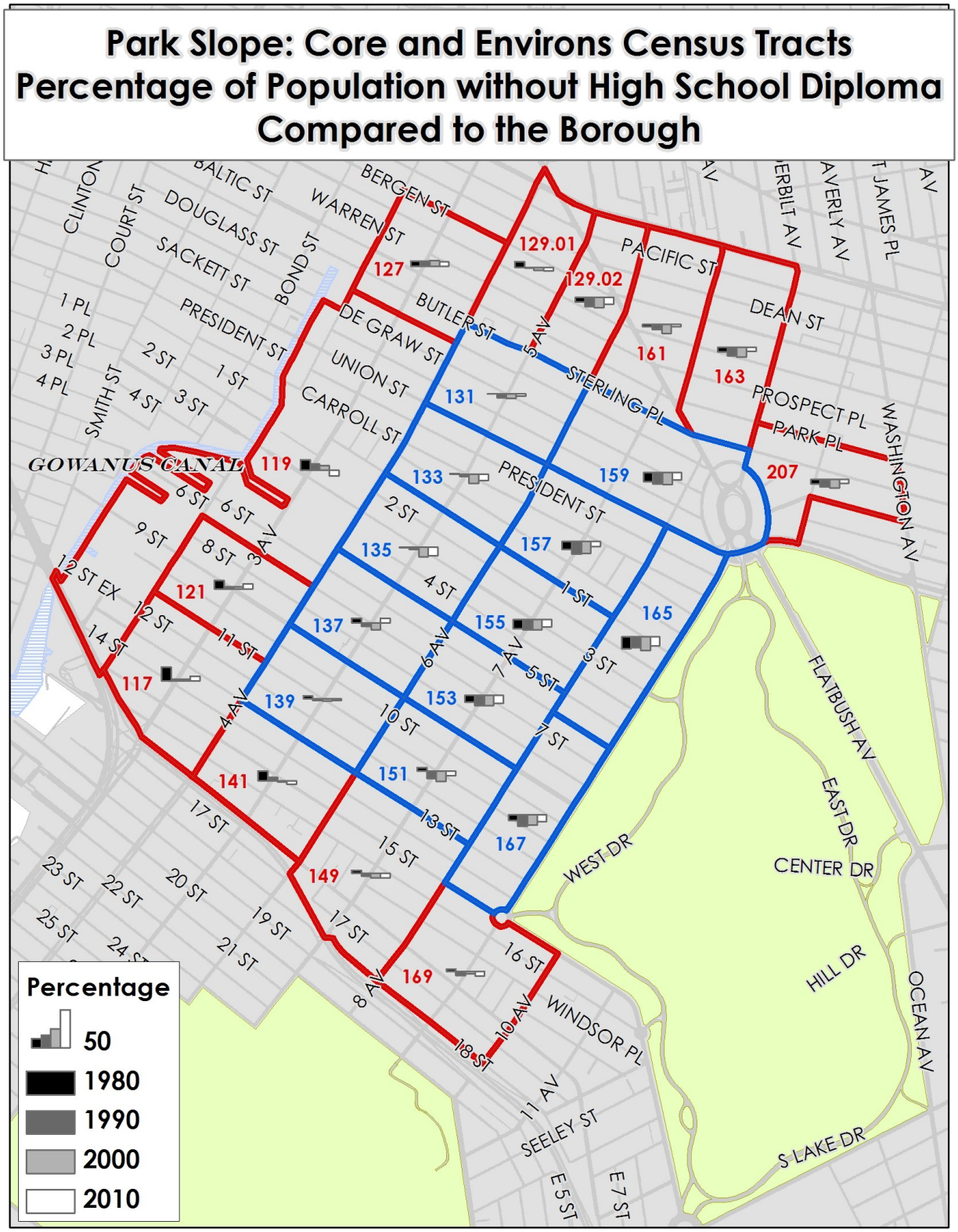


Figure 5-60. Percentage of the Population without a High School Diploma in Park Slope - Environs, by Census Tract, 1980 - 2010.

These spatial patterns are also observed on Map 5-50 that compares these figures to the entire Borough from 1980 through 2010. Those Core Census Tracts with lower figures are consistently below the Borough averages, while those with higher figures increase and surpass the Borough at the earlier stage of the study period from 1980 to 1990. In the Environs, the Northern Census Tracts are consistently below the Borough averages, with the exception of the North-west Census Tract 129.01, which reverses itself between 1980 and 1990. The Southern and Western Environs Census Tracts also reverse in 1990 or 2000. Three Environs Census Tracts remain above the Borough averages from 1980 through 2010, specifically: the North-west Census Tract 127 and the South-west Census Tracts 121 and 117.



Map 5-50. Park Slope, Percentage of Population without High School Diploma, Compared to the Borough by Census Tract, 1980 - 2010.

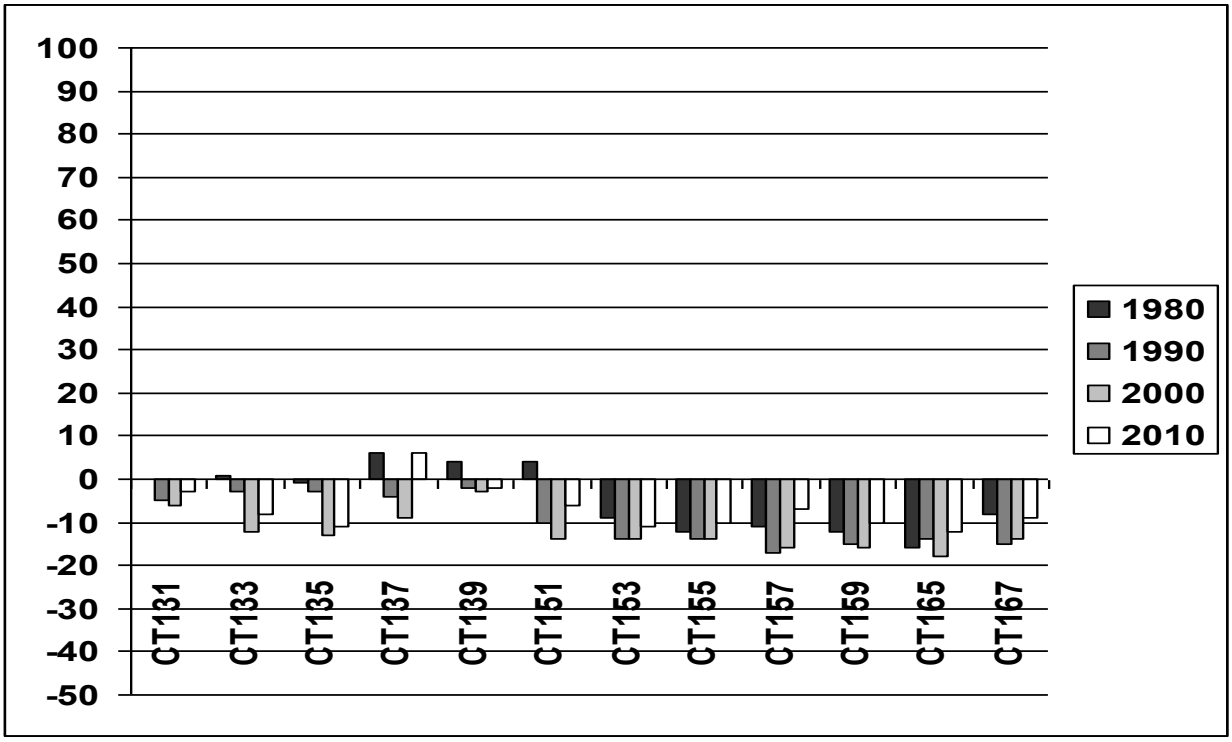


Figure 5-61. Percentage of the Population without a High School Diploma Compared to the Borough in Park Slope - Core by Census Tract, 1980-2010.

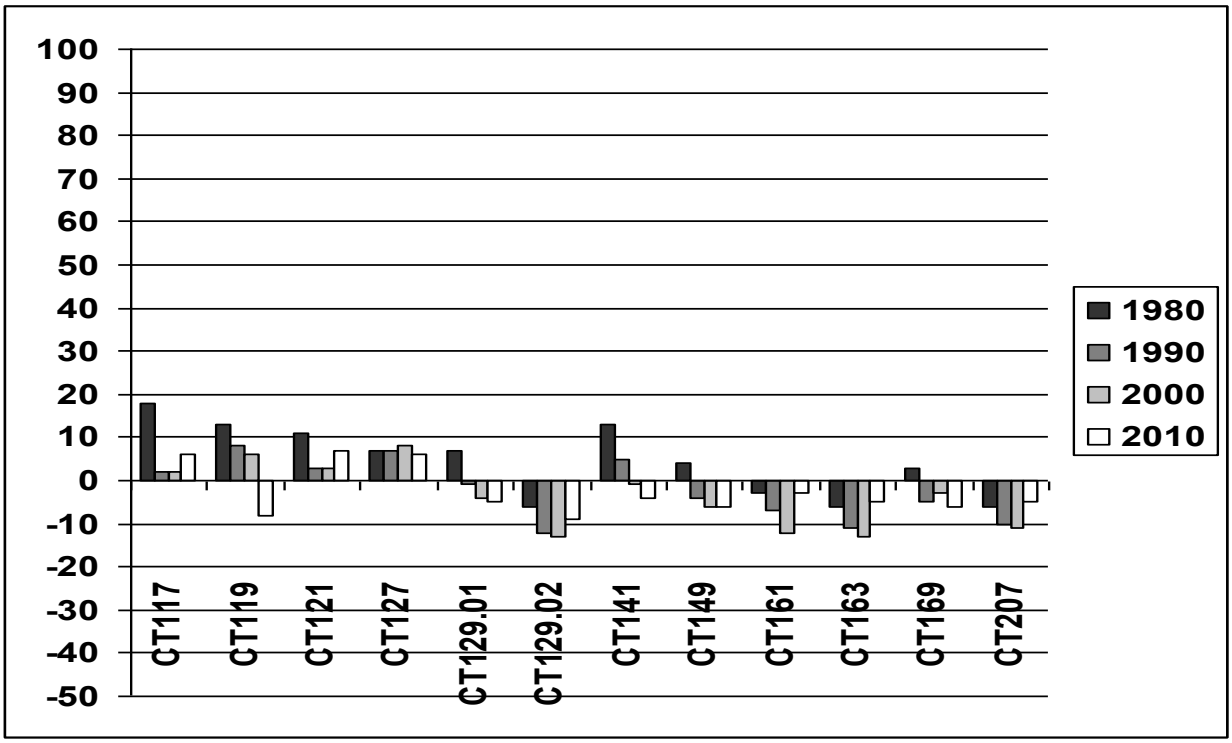


Figure 5-62. Percentage of the Population without a High School Diploma Compared to the Borough in Park Slope - Environs by Census Tract, 1980-2010.

5-5 Park Slope: Summary

Having produced more than forty maps to depict the physical, demographic and socio-economic conditions I hope to have accomplished the following goals.

The first goal is to clearly define a study area and to illustrate it with GIS maps. Gentrification and other community studies that rely solely on text to describe the boundaries of a neighborhood may be adequate for those readers who are familiar with a particular area and can easily conjure up a mental image but for those readers who are unfamiliar with an area the list of street names and landmarks that define a neighborhood is insufficient to describe the location and coverage of a study area. As far as New York City is concerned, neighborhoods are not officially defined and researchers who only include names of streets and landmarks to indicate study areas may leave the scope of the geography to the imagination of contemporary and future researchers. Whether the selected street boundaries are fixed or may change over time is another issue. However, the spatial uncertainty can be avoided if we are to offer a clear grasp of the "geography of gentrification" and to create comparable studies.

The second goal is to distinguish the intra-neighborhood differences through the study years by not aggregating the Census Tracts to form a singular study area. With the use of GIS as a map-making tool, this goal is accomplished using the maps in this chapter to clearly identify the conditions (i.e. physical, demographic and socio-economic) of gentrification and their various degrees throughout the study period. These maps illustrate a certain trend from east to west with greater spillover in the North than the South. The two farthest corners in the Northwest and Southwest have experienced the least gentrification. This micro-spatial analysis at the Census

Tract level should provide those readers that are not familiar with the area with a deeper understanding of the gentrification in Park Slope. It is also my hope that with the examples illustrated in this chapter that I have clearly demonstrated the advantages of using individual bar charts embedded in GIS maps rather than the traditional non-spatial Core-vs.-Environs bar charts.

In summary, the findings of physical environment of Park Slope include:

1. The tax lots in Park Slope are mostly zoned for residential use with shops lining portions of the wider avenues. There are no manufacturing zoned tax lots inside the Core Census Tracts; these only exist in the Environs Census Tracts and in particular nearby the Gowanus Canal.

2. The existing structures were mostly constructed before 1940. In subsequent decades and at the present time, there is new but limited construction. The heights of buildings in Park Slope are fairly low with most buildings not exceeding four stories; taller buildings are sporadically located in this study area.

3. These physical characteristics set the parameters of gentrification in the area. Prospect Park and the Prospect Park Historic District have served as prominent anchors for gentrification in the study area and the distance to Prospect Park serves an important role in subsequent gentrification.

4. Despite some rezoning in the area, the land use pattern has been fairly stable in the study area. One exception is the incoming Whole Foods supermarket that may attract gentrification to the Western area. The rezoning at the South-west corridor may lead to an increase in new construction that may cater to those individuals who are attracted to Park Slope, but cannot afford the rapidly rising housing costs near Prospect Park.

5. The long term effect of the most recent and ongoing Atlantic Yards development and its construction at the extreme North border of the Northern Environs Census Tracts remains to be fully evaluated. Although the Barclays Center opened in the fall of 2012, the timeline for completion of its expanded development has been a moving target (*New York Times*, 2013). Nevertheless, judging from the gentrification maps in this chapter, the gentrification of Park Slope has expanded more toward this direction than toward the South and West Environs Census Tracts.

In summary, the findings from the demographic gentrification maps of Park Slope include:

1. After the early decrease in 1990, Park Slope has been experiencing steady population growth, although it has yet to reach its highest number in 1980. While Park Slope is still predominantly White, there are differences among the Census Tracts; most notable is the increasing percentage of the White population in the Northern Environs Census Tracts.

2. The Black population has been clustered in the Northern Environs Census Tracts although corresponding to the rising percentage of the White population, the percentage of the Black population has decreased throughout the neighborhood.

3. The Chinese population has been consistently low in this neighborhood. The Hispanic-origin population clusters toward the Western Census Tracts although like the Black population it also has been decreasing over the years. Census Tracts adjacent and close to Prospect Park have lower percentages of Hispanic-origin population than those Census Tracts located in the North-west, West and South-west Environs.

4. Despite reports in the media, there is no notable percentage increase for the Age Under 5 group. The percentage of the Age 22-29 group is also fairly stable with a slight decrease nearby Prospect Park and a slight increase in other areas. The Age 65 and Over group also decreases nearby Prospect Park and in the Gowanus Canal area - adjacent to Census Tract 119, but overall their presence in the area is stable.

In summary, the housing conditions in Park Slope include:

The most noticeable change in housing conditions is the decreasing percentage of renter-occupied housing units both in the Core and the Northern Environs Census Tracts. If this trend continues, existing tenants and incoming rental housing unit seekers will face a more competitive housing market.

The socio-economic conditions of Park Slope can be described as follows:

1. The median household income, a commonly used gentrification indicator, shows a rapidly gentrified Park Slope, especially for the period between 2000 and 2010. In the larger context, comparing these increases to the Borough itself, the spatial pattern is especially revealing. For example, Census Tracts adjacent to and near Prospect Park are gentrified first and subsequently expand into other directions. These particular temporal-spatial patterns are examined in a series of maps after this summary section.

2. In the larger geographic areas of New York City and the Five Boroughs, the median gross rent consistently rises despite an income decrease between 1990 and 2000. Park Slope does not share this decrease but reports increasing median household incomes; the rising median gross rent and decreasing number of available rental units are likely to result in a more competitive rental market.

3. With regard to educational attainment, the trend follows that of an increase in median household income, namely, that the percentage of people with College (or Above) Degree increases over time and the area closer to Prospect Park has higher figures. At the other end of the spectrum, the percentage of individuals without a High School Diploma has a spatially reverse pattern, namely: Census Tracts with higher figures are located farther away from Prospect Park. Overall, the percentage of people without a High School Diploma decreases noticeably from 1980 through 2010.

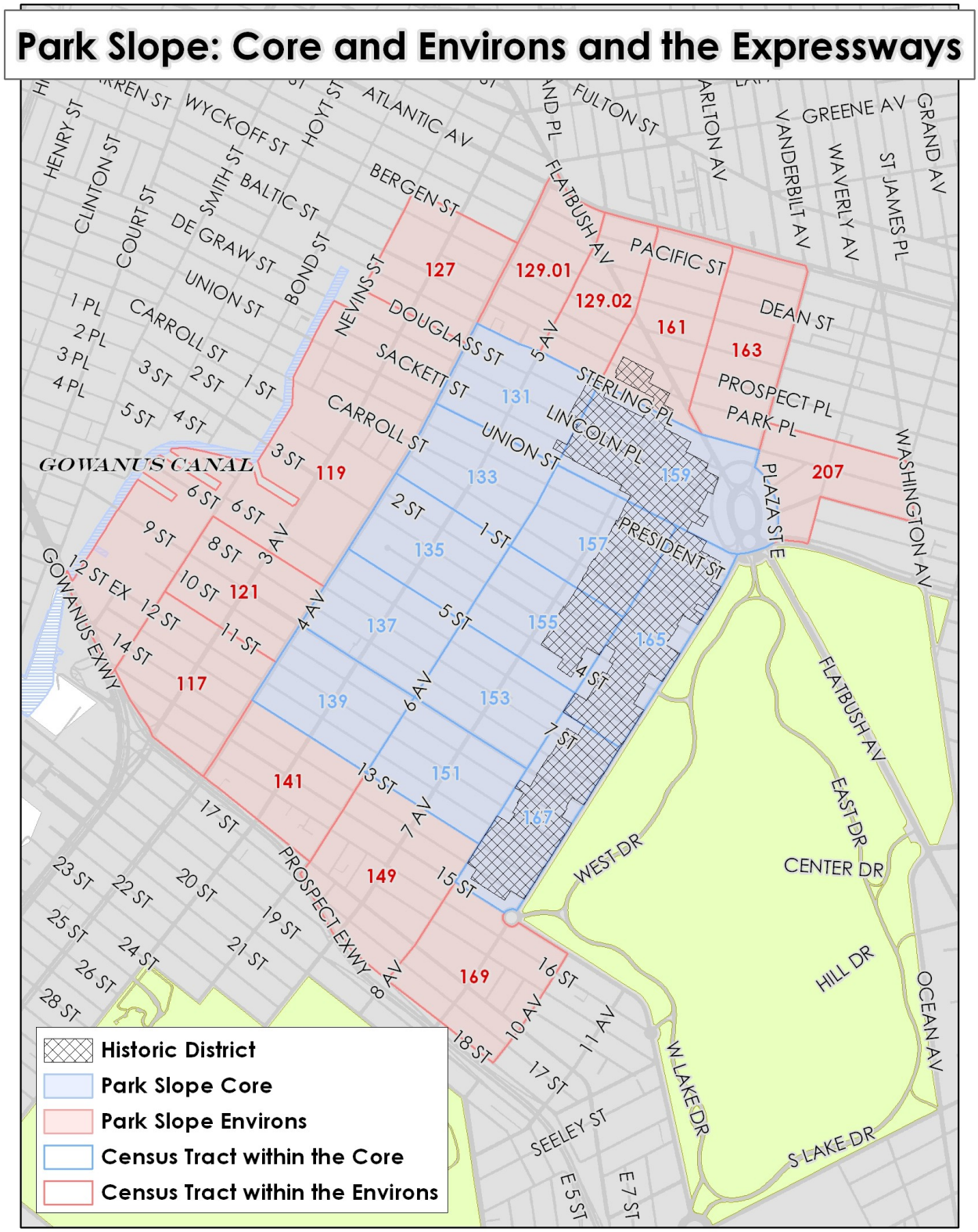
In summary, consistent with the historical development of Park Slope, the Census Tracts nearby Prospect Park have experienced gentrification first and accelerated especially when compared to the Borough as a whole. In more recent years, gentrification has expanded toward the Northern and Southern Environs Census Tracts; the exceptions are the Census Tracts at the North-west and South-west corners. Between these two corners, the South-west may also begin to experience gentrification due to the recent rezoning for residential development. However, the future projection of a possible spillover effect should be considered with caution; it would be unwise to assume that gentrification will continue without spatial limitations. If the Census Tracts adjacent to Prospect Park are the epicenter of gentrification in Park Slope, then one question to consider is how far could the gentrification expand once Prospect Park becomes beyond easily accessible?

On the North side, the Atlantic Yards is a significant factor. Whether the newly constructed sports stadium and accompanying commercial and residential development will affect the expanding gentrification beyond Park Slope remains to be seen. The advantages of using GIS and mapping to illustrate the study area is self-evident because GIS map can show the spatial relationships between Park Slope and this new cluster of major development taking place in downtown Brooklyn.

On the most Western side gentrification is at its early stage and ongoing. With the residential rezoning toward the South-west portion of 4th Avenue, it is reasonable to assume that the new construction and the expected Whole Foods supermarket may attract individuals wishing to reside in Park Slope but find it beyond their reach to live in this area. The highly contaminated

Gowanus Canal, designated a Superfund Site as of 2010 (U.S. Environmental Protection Agency, Region 2, 2010) and the nearby manufacturing zoned tax lots both present major obstacles not only to gentrification but to any residential development. In turn, these barriers may influence the spillover effect of gentrification toward other directions.

Other physical characteristics that may pose as barriers to gentrification are the Gowanus Expressway and Prospect Expressway located at the south border in the South Environs Census Tracts. (See Map 5-51 below). While Environs Census Tracts south of the Core show increasing incomes and rents in recent years, whether this spillover gentrification can continue across these two expressways remains to be seen.



Map 5-51. Park Slope and Gowanus Expressway and Prospect Expressway.

While the maps in this chapter illustrate the physical and social environment factors associated with gentrification, they have limitations. The growing presence of people with higher incomes and higher educational attainment may signal the emergence of "the gentry" but the gentrification maps based on Census Survey data cannot determine if this trend is a result of in-migration or if the existing population is doing better through the years. Such detailed information is only available through applying in-depth qualitative research methods, which is not the focus of this dissertation. Nevertheless, the gentrification maps in this chapter provide a spatial understanding of the changes experienced in Park Slope during the last three decades, using selected variables that represent the physical and social environments.

While gentrification cannot be represented by a single variable, comparing the median household income to the Borough as a whole provides a quick spatial-temporal reference to illustrate the ways gentrification moves and expands through the years. In the following discussion, at the end of this chapter on Park Slope, is a series of maps created with the query capability of GIS. These maps highlight areas fulfilling user specified criteria as when a particular Census Tract (or Tracts) changes from below to above the Borough medians. These maps are listed in temporally reverse sequence so when viewed by flipping the pages backwards from Map 5-56 to Map 5-52, the movement and spread of gentrification in Park Slope becomes evident.

In 1980, the Census Tracts adjacent and close to Prospect Park in the Core reported incomes higher than the Borough itself. In 1990, this pattern expanded and all the Census Tracts in the Core had reported incomes higher than the Borough. This pattern also spilled into the Environs

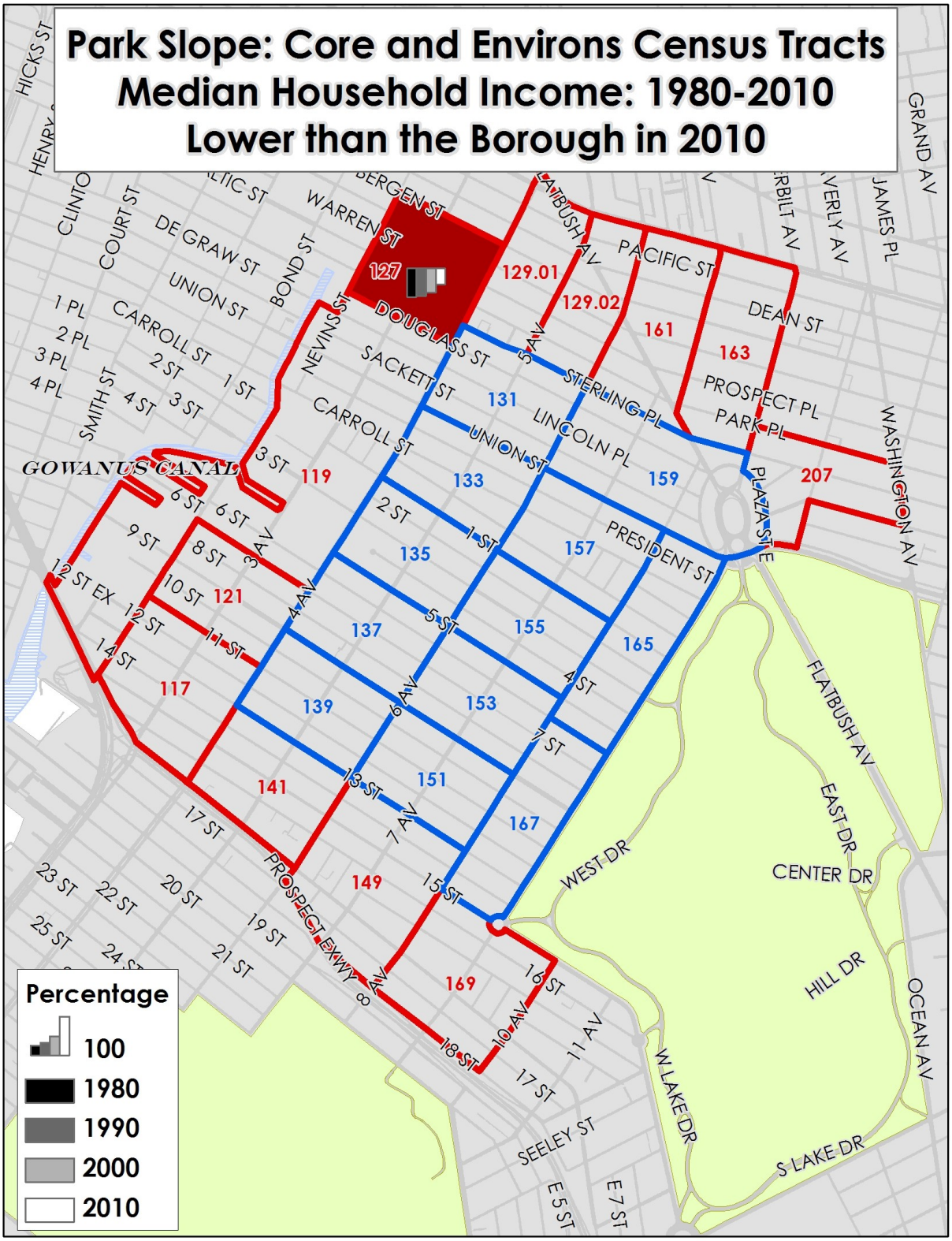
Census Tracts North and South of the Core area. In 2000, this expansion moved into two more Environs Census Tracts Southwest of the Core (i.e. Census Tract 121 and Census Tract 141).

It should be noted that Census Tract 117 at the South-west corner has a unique pattern. Its median household income was higher than the Borough in 1990 but slightly lower than the Borough in 2000. In 2010 it reported median household income higher than the Borough again. No other Census Tracts in the area share this fluctuating pattern; in general, once a Census Tract in Park Slope reports median household income higher than the Borough it stays higher than the Borough in the subsequent Census Survey years.

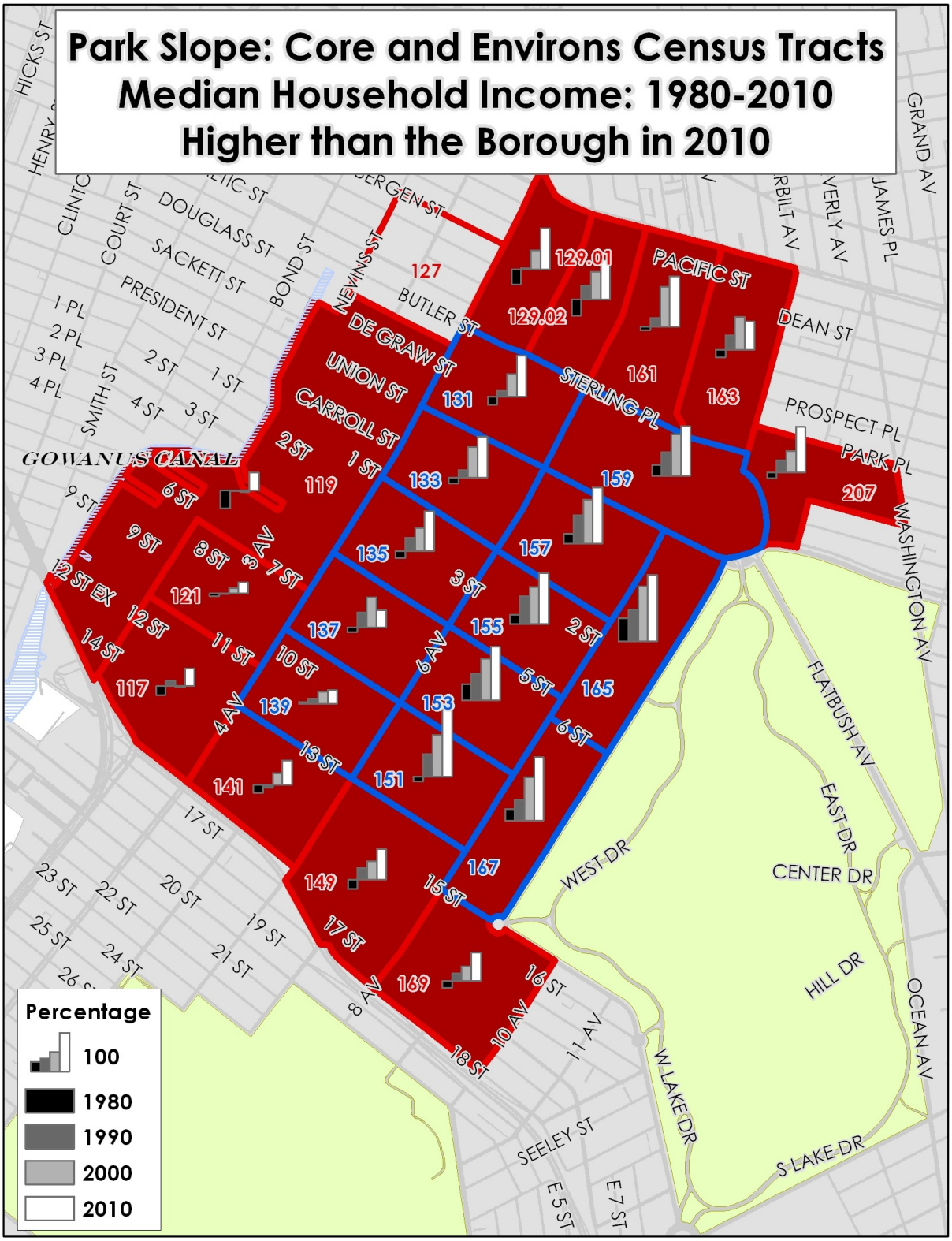
By 2010, nearly all Census Tracts in the Park Slope Core and Environs had median household incomes higher than the Borough with the exception of Census Tract 127 located at the North-west corner; and with the exception of Census Tract 117 which does not increase consistently. The other Census Tracts remain the higher-than-the-Borough pattern. It should be noted the changes (from lower to higher than the Borough) in the Park Slope Core and Environs only occurred in Census Tracts adjacent to each other (i.e. there is no “leapfrog”). These maps illustrate the advantage of mapping gentrification using GIS to reveal these relationships among the Census Tracts not available from bar charts.

It should be expressed that while this series of maps that are based on comparing the median household incomes to the Borough as a whole, and approximate a display of the spatial-temporal patterns of gentrification in the area, these maps only provide a representation of the gentrification more comprehensively mapped based on the selected variables included in this

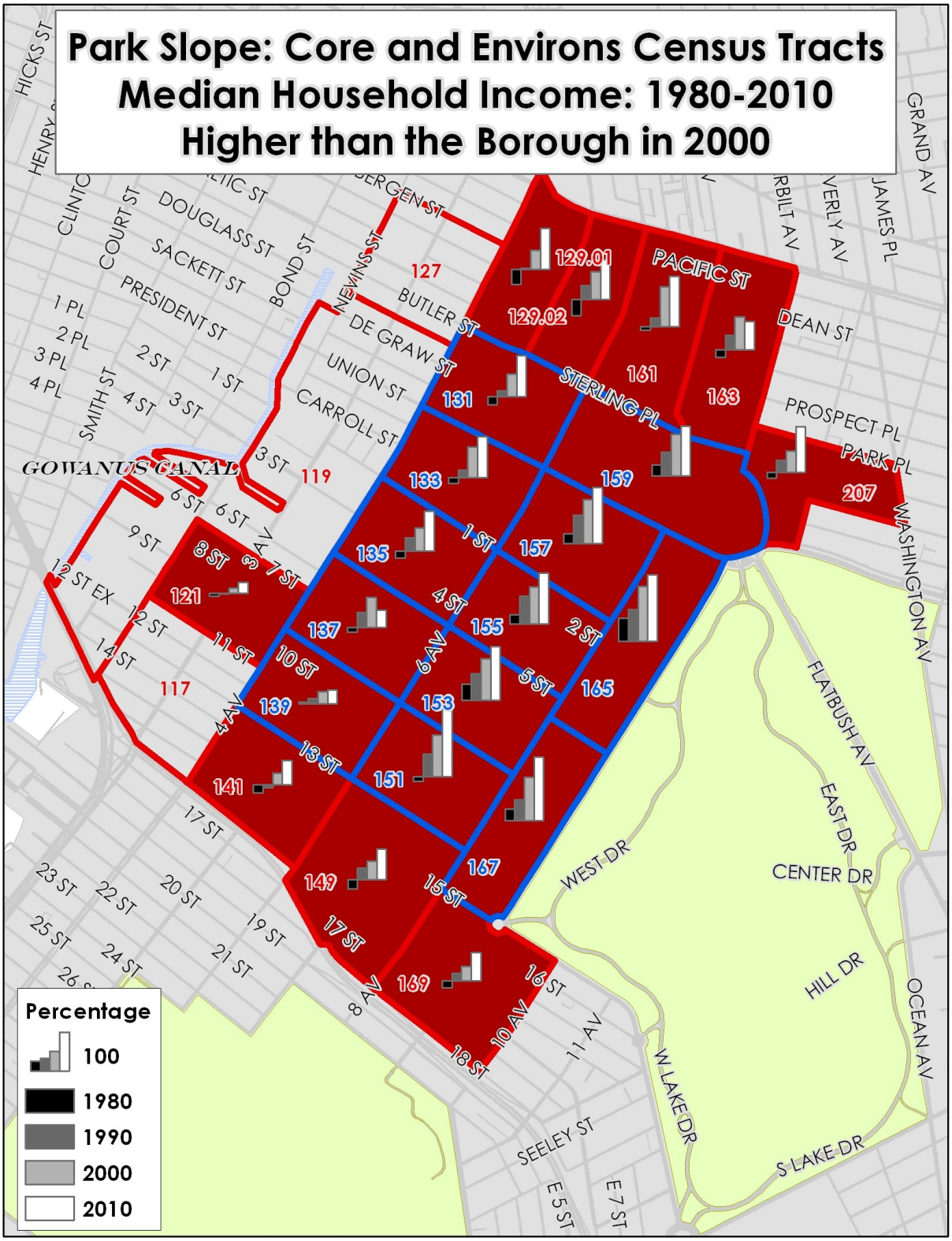
chapter. Gentrification in Park Slope will be further discussed in the final chapter of this dissertation. In the next two chapters, the gentrification of the Lower East Side and Williamsburg will be mapped following the methods and formats of this chapter on Park Slope.



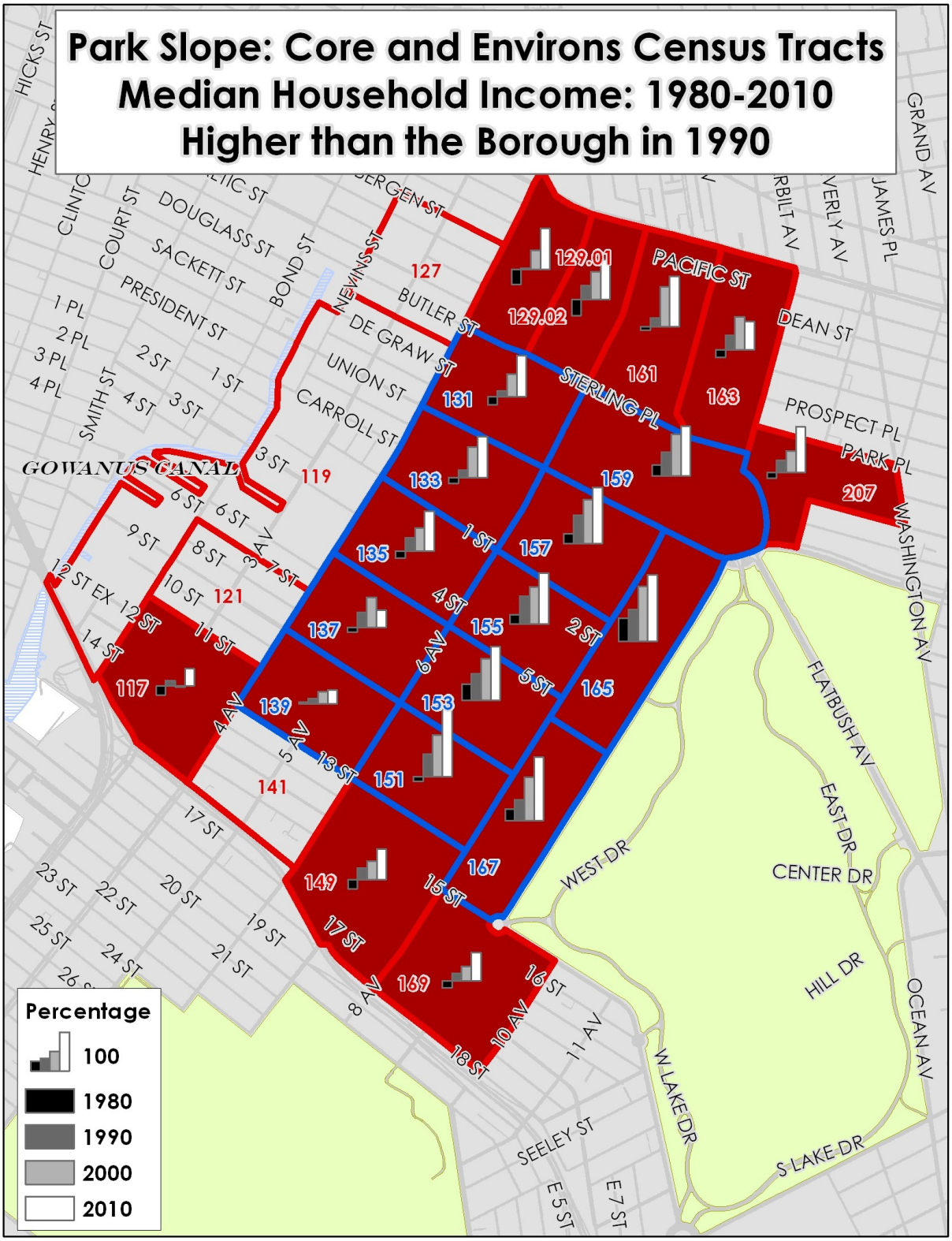
Map 5-52. Median Household Income Lower than the Borough in 2010.



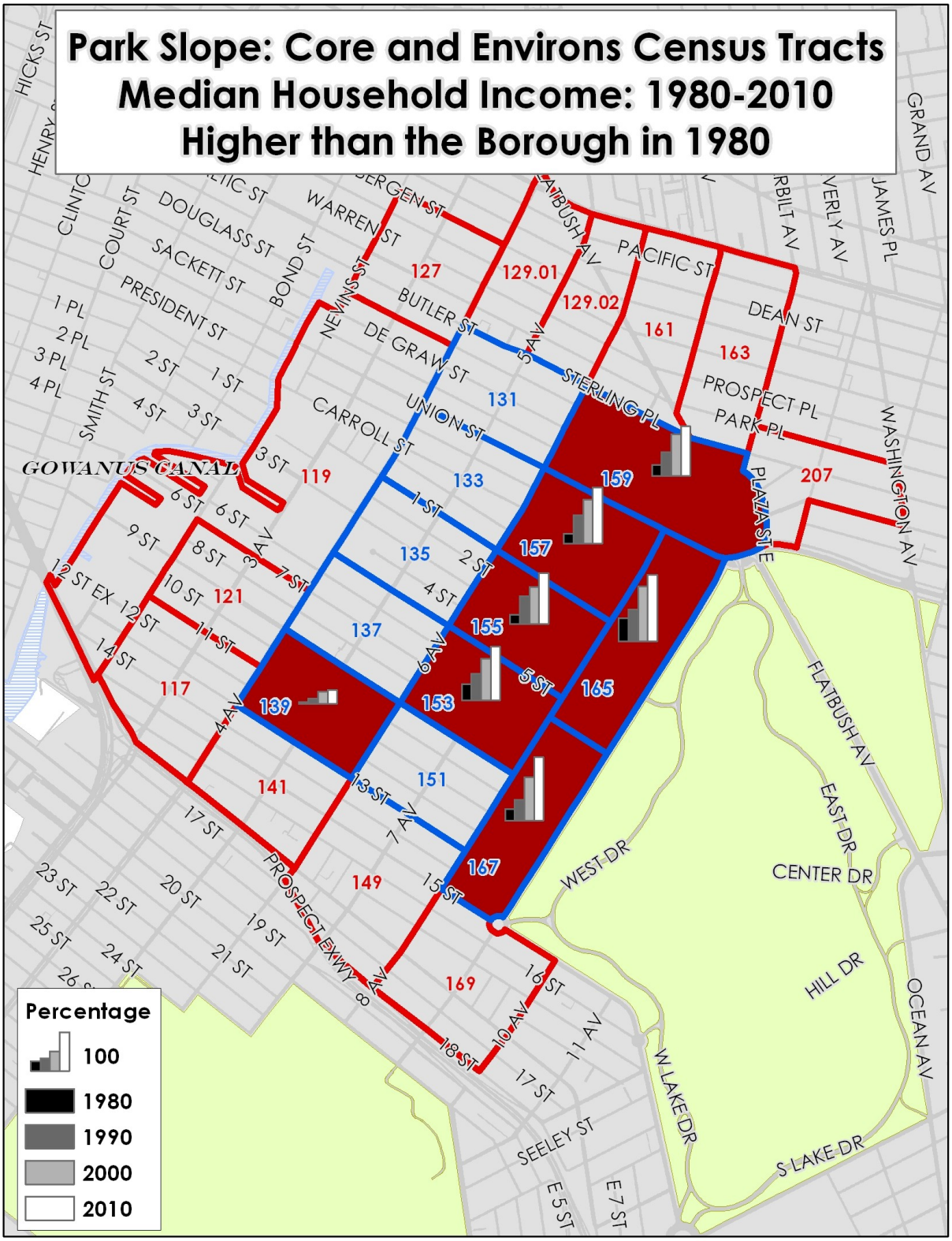
Map 5-53. Median Household Income Higher than the Borough in 2010.



Map 5-54. Median Household Income Higher than the Borough in 2000.



Map 5-55. Median Household Income Higher than the Borough in 1990.



Map 5-56. Median Household Income Higher than the Borough in 1980.

Chapter Six : Lower East Side

Located in South-eastern Manhattan (see Map 6-1 below), the Lower East Side has been a gateway for immigrants to New York City with waves of newcomers from various nationalities and ethnic backgrounds establishing their foothold in this area (Maffi, 1995). These days, immigrants are not the only residents in this neighborhood. Displaced residents from surrounding areas seeking affordable housing have relocated to the Lower East Side. Its proximity to both downtown and midtown office districts makes it an attractive alternative for those who work in Manhattan and do not wish to endure long commutes. However, being closer to business districts also makes the Lower East Side neighborhood susceptible and sensitive to the overall economic climate and fluctuations in Manhattan and New York City.

In the past few decades, the Lower East Side has experienced and been impacted by the cyclic nature of New York City's economy through property dis-investment and re-investment (Smith 1996). These economic fluctuations have resulted in considerable demographic and socio-economic shifts in the neighborhood. In addition to private properties, public housing projects occupy considerable space along the East River (see Map 6-7, further below). These diverse groups of residents have all chosen (or have little choice otherwise) to live in the Lower East Side, making it a "poster child" for contested urban space (Maffi, 1995; Smith, 1996).

Compared to Park Slope in discussed Chapter Five, the Lower East Side is more complex because of the aforementioned reasons and it is also a bigger and denser neighborhood. Its Core Census Tracts cover approximately 1.6 square miles which is about twice the area of the Park

Slope Core Census Tracts. In addition, it is more densely inhabited. The Census 2010 records its population about three and half times that of Park Slope (i.e. 160,743 and 46,533, respectively). Both the larger geographic coverage and the larger population have increased the diversity in the neighborhood and therefore the gentrification in the Lower East Side is much more complex.

Different waves of immigrants come and go, but the changes observed in the Lower East Side are not limited to its residents. The changes created by new construction in the Lower East Side are so dramatic that in 2008 it made the list of the "11 Most Endangered Historic Places" by the National Trust for Historic Preservation (2012). Figure 6-1 below illustrates some of the older buildings in the neighborhood. The photograph in the top row is Katz's Delicatessen, a Jewish restaurant located at the Southwest corner of East Houston Street and Ludlow Street. It has been in the neighborhood since 1888 and in this exact location since 1917 (Katz's Delicatessen, 2010). Its one-story structure is dwarfed by a new high-rise building just across the street, the Ludlow, a luxury rental apartment tower that stands over twenty-stories tall with floor-to-ceiling windows. In general, the streetscape of the Lower East Side is more likely to be associated with tenement houses which occupy many blocks in the neighborhood. (Bottom row of Figure 6-1). They are typically five or six-stories tall with their façades flush with the front line of the tax lots. They are also characterized with exterior fire escapes which were required by the Tenement House Act of 1867 and are visible in the photographs at the bottom of this page.

The photograph in Figure 6-2 illustrates new construction located at 51 Astor Place, opposite Cooper Union. The glass structure is designed by the famous architect Fumihiko Maki whose recent other designs in New York City include the expansion of the United Nation building in

midtown by the East River and the new Tower 4 at the World Trade Center site. Within the Lower East Side new and old building may located in close proximity.

Figure 6-1. New and old buildings in the Lower East Side.

Figure 6-2. New Building at 51 Astor Place designed by Fumihiko Maki.

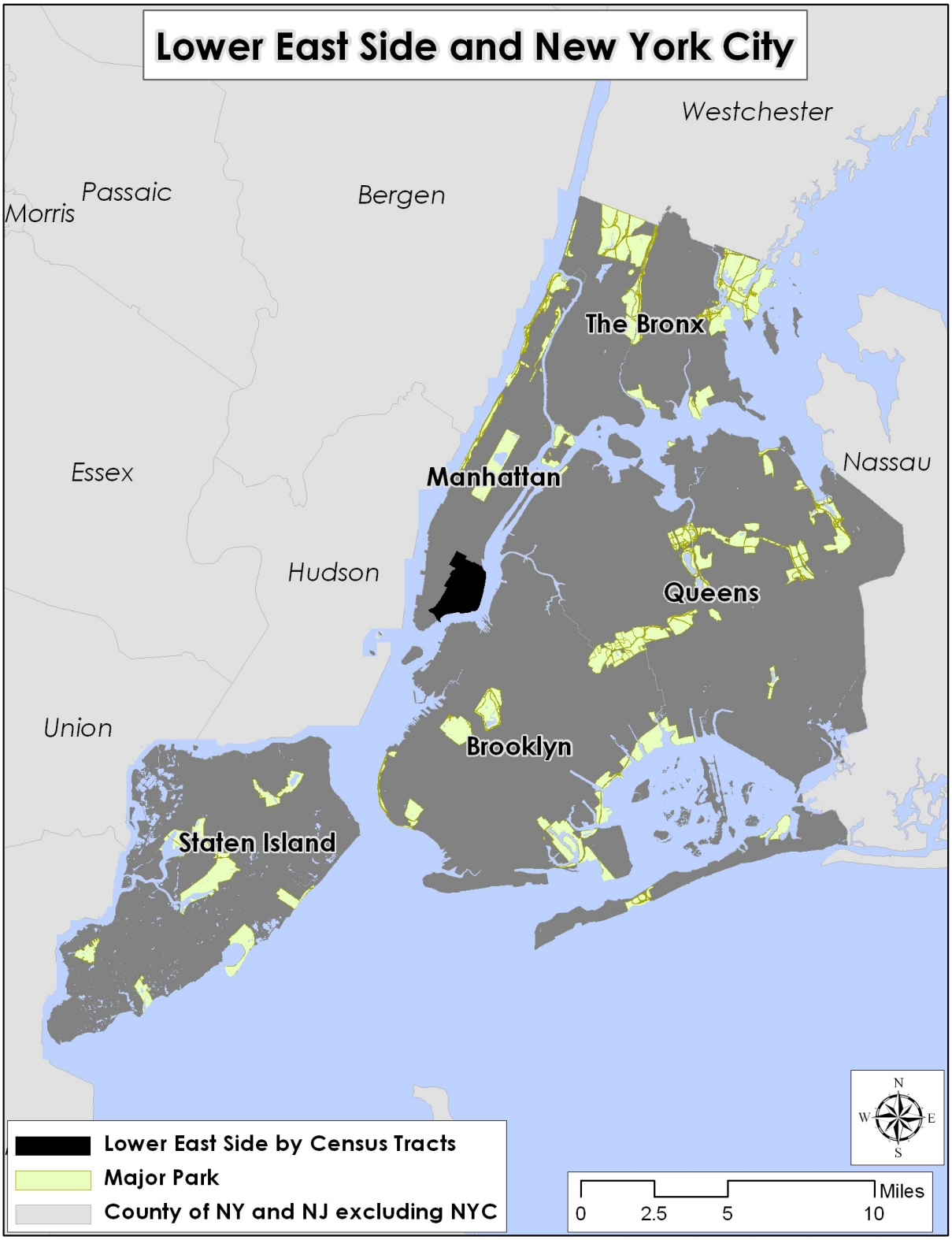
As mentioned in the closing remarks of the Park Slope chapter, a major advantage of the Census Tract level bar-charts that are embedded in the neighborhood gentrification maps (when compared to the aggregated Census Tracts design) is the ability to reveal the intra-neighborhood differences. This chapter will follow the structure of the Park Slope chapter and map the gentrification of the Lower East Side.

6-1 Defining the Lower East Side Neighborhood

The Lower East Side is located at the South-eastern portion of Manhattan (the New York County) as indicated in the black area in Map 6-1 below. Research corresponding to the time-frame of this study (Maffi, 1995; Smith, 1996) used the following streets to form the boundaries

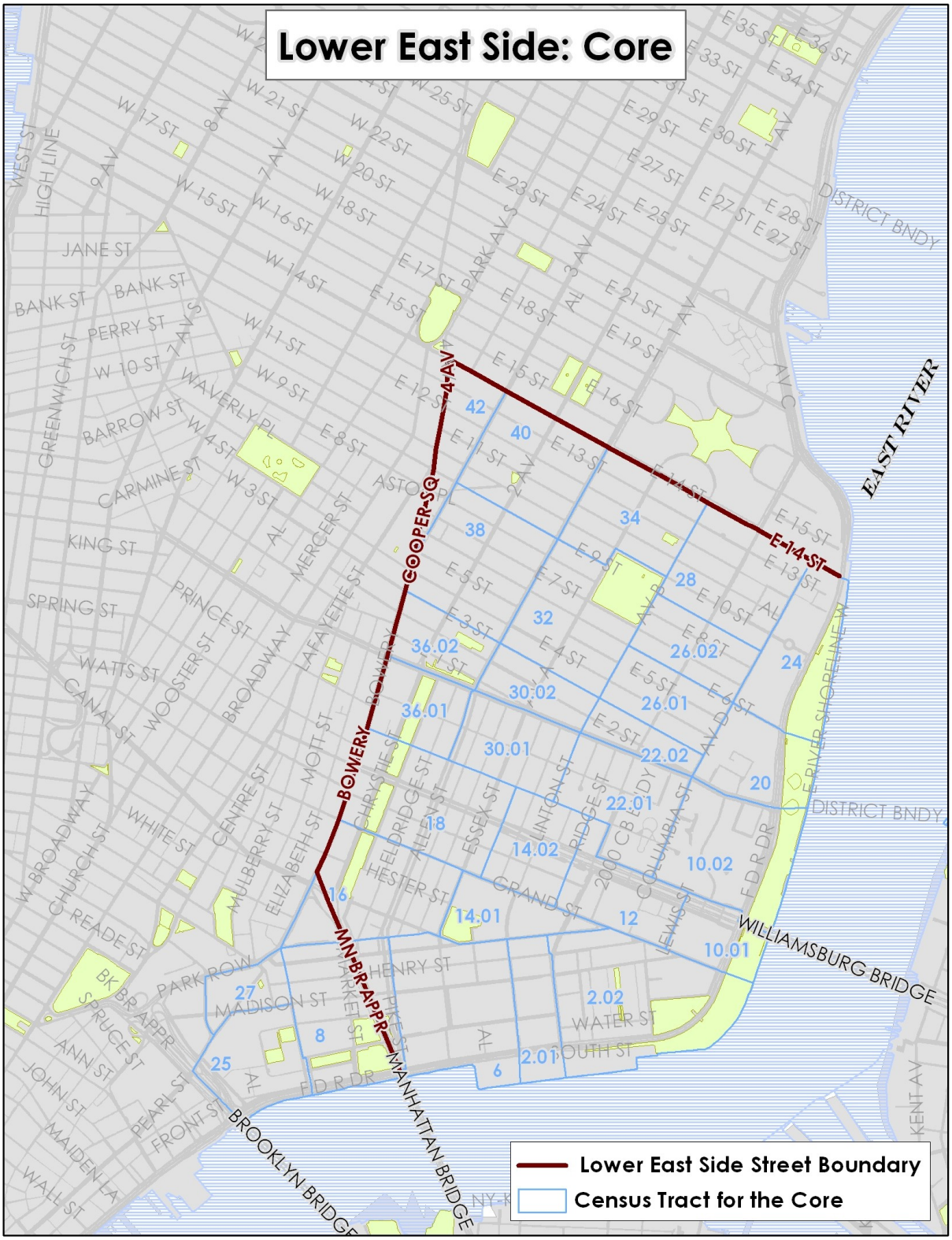
for the Lower East Side: namely, East 14th Street on the North, the East River on the East, Fourth Avenue and Bowery on the West, and the approaches to the Manhattan Bridge on the South. Map 6-2 further below highlights these streets with dark brown lines.

Following these street boundaries, the Core and Environs Census Tracts are selected for this study following the organization of the discussion in the Park Slope chapter. The Census Tracts inside these street boundaries form the Core, with the exception that in the Southern tip this study extends a few Census Tracts to reach the approach to the Brooklyn Bridge (see Map 6-3). The purpose of this expansion is to examine whether the gentrification in the Lower East Side affects the Chinatown in downtown Manhattan. The immediate Census Tracts surrounding the Core are selected to be the Environs (see Map 6-4). Map 6-5 illustrates the Core and the Environs with colors blue and red respectively to clearly illustrate these areas. To avoid these colors possibly obscuring the embedded bar charts within the Census Tracts, the base map (see Map 6-6) of the Lower East Side only shows the boundaries of the Census Tracts in their corresponding colors (i.e. blue for the Core; red for the Environs).

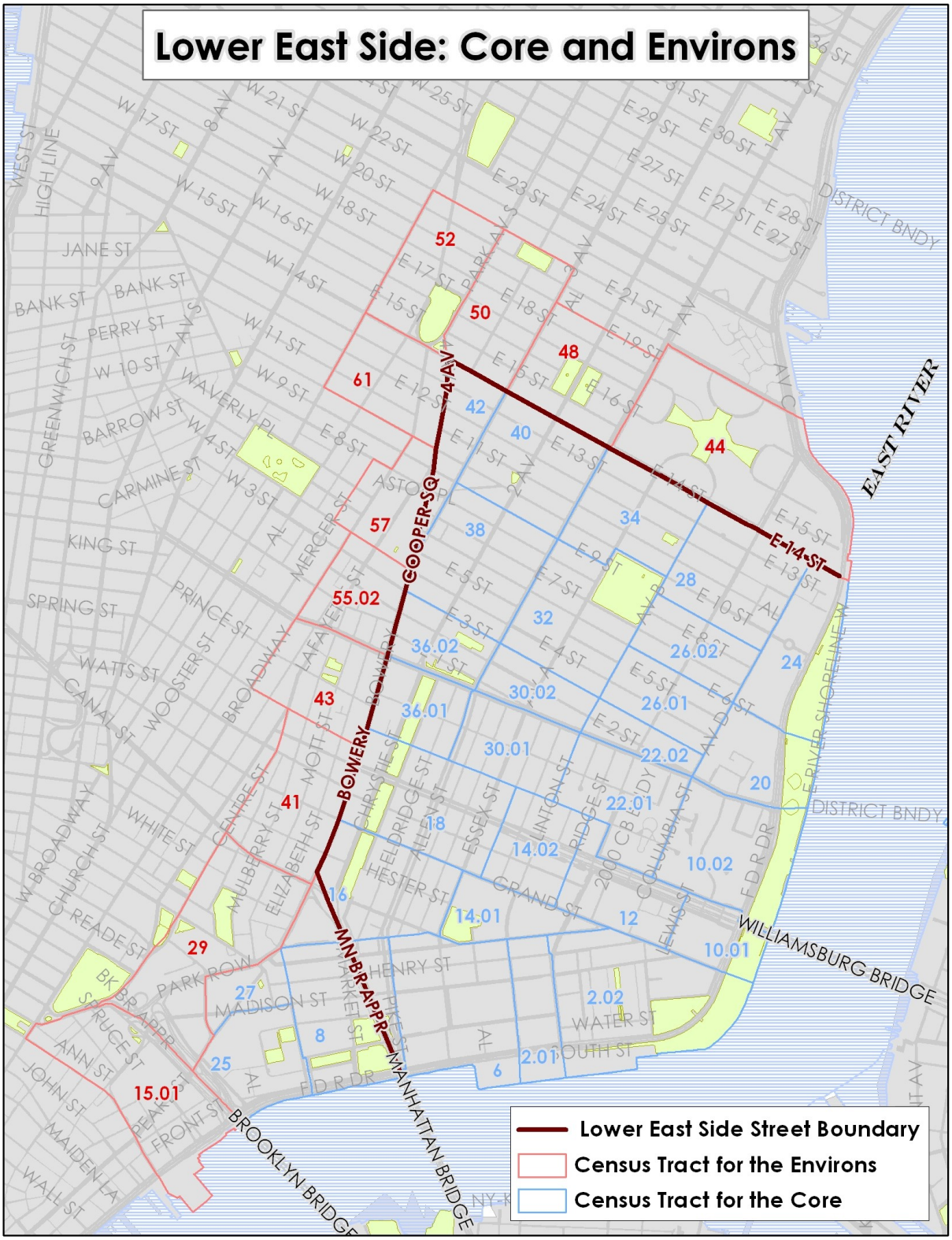


Map 6-1. The Lower East Side and New York City.

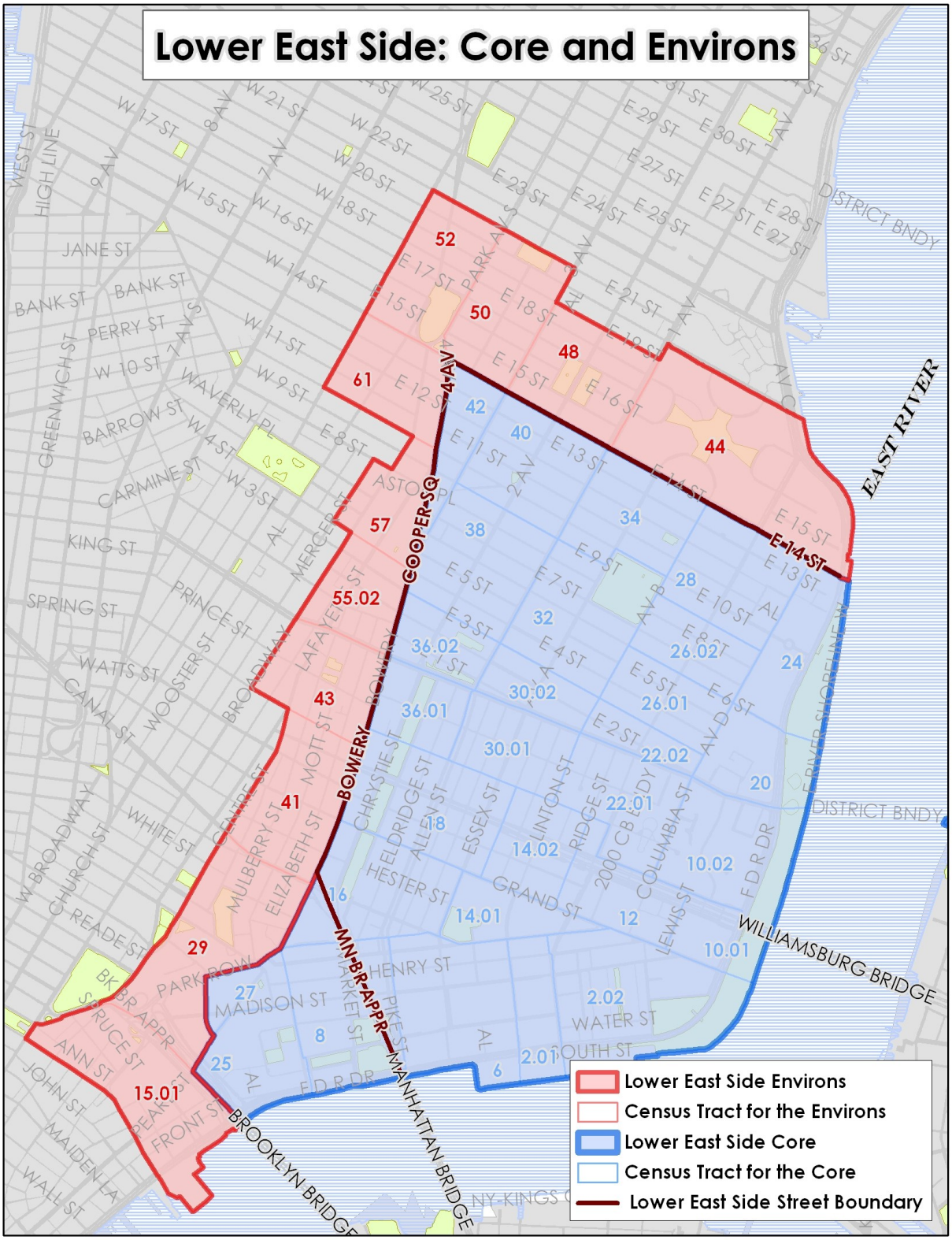
Map 6-2. Lower East Side: Street Boundaries.



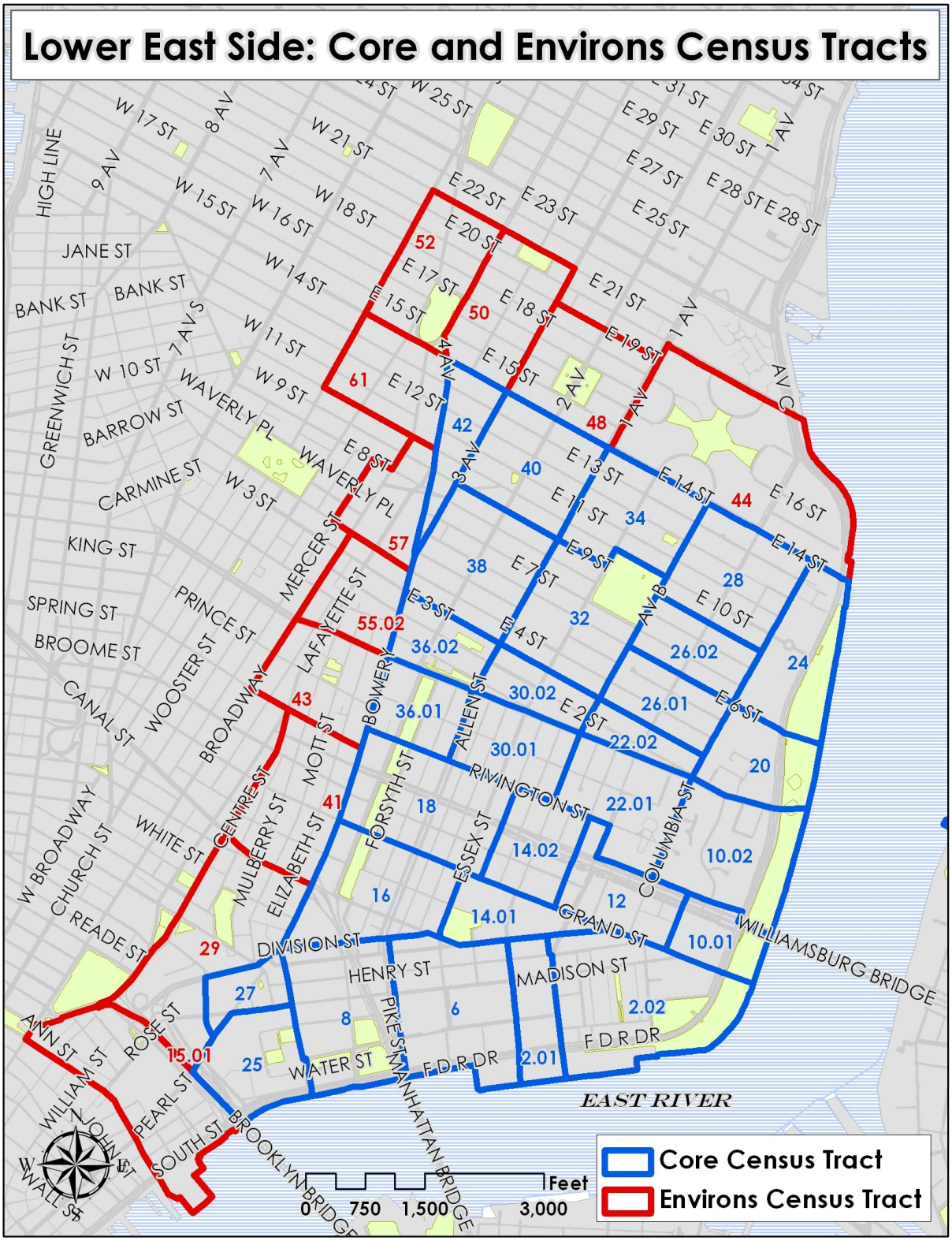
Map 6-3. Lower East Side: Core with Census Tracts.



Map 6-4. Lower East Side: Core and Environs, with Census Tracts.



Map 6-5. Lower East Side: Core and Environs, with Census Tracts.



Map 6-6. Lower East Side: Core and Environs Census Tracts.

Unlike Park Slope where the historic preservation district dominates some of its Core Census Tracts (see Map 5-7), within the Core Census Tracts of the Lower East Side there is only a very modest St. Mark's historic preservation district at the North western corner located within Census Tract 40 (see Map 6-7, below). However, among and beyond the Environs Census Tracts there are several historic preservation districts that encircle the perimeter of the Lower East Side. In Park Slope the historic preservation district is one of the leading factors for its gentrification. In the case of the Lower East Side, these outside historical preservation districts might have caused displaced residents to relocate to the Lower East Side.

6-2 A Brief History of the Lower East Side

Similar to Park Slope, the early development of the Lower East Side began initially as farm land. It was in the early nineteenth century that the area experienced its first influx of immigrants from Ireland. By the late nineteenth century, other immigrants groups such as: Italians, Jews from Eastern Europe, Russians, Romanians, Hungarians, Ukrainians, Slovaks, Greeks and Poles followed.

One of the largest ethnic enclaves was predominantly Jewish in the early twentieth century. For instance, 2nd Avenue between Houston and 14th Streets were occupied with Yiddish theaters and pushcart vendors also occupied the area, selling inexpensive merchandise. The rapid population growth led to the construction of tenement houses after 1850. Despite various reforms to improve the congested tenement house design, the area remained "a prototypical big-city slum" and continued to receive waves of immigrants through the years leading up to World War I

(Jackson, 1995; White & Willenaky, 2000). *How the Other Half Lives* (Riis, 1890/2011) describes and documents the living condition in these tenement houses.

In an effort to improve the housing conditions, the City's Housing Authority started building large-scale projects to replace tenement houses which the AIA Guide considered "over-compensation". While a typical tenement house occupies a 25 by 100 foot tax lot and houses ten to twelve families, these newer large-scale housing projects were intended to consolidate a considerable number of tax lots into a single bulky lot and then build multiple high-rises and free-standing apartment buildings.

After the Second World War, the Lower East Side became the first racially integrated section of New York City when blacks and Puerto Ricans moved there. The influx of a Spanish-speaking population led to the term Loisida, which is the phonetic spelling of the original name. The population integration was not limited to an ethnic component, rather, artists, writers and musicians also moved to the Lower East Side due to the cheaper cost of living and social tolerance.

By the 1960s most Jewish and Eastern European residents had moved out of the Lower East Side neighborhood. In the following decades, the Lower East Side experienced the despair of poverty, crime, drugs and abandonment from property owners because the rent could not cover the building's upkeep and property taxes. At the same time, the cheap housing attracted venturesome and speculative real estate re-investments (Smith, 1995). New waves of immigrants from Asia arrived after 1980 which helped to stabilize the neighborhood. Nevertheless, the friction and

conflicts among the diverse ethnic groups and people of different socio-economic backgrounds keep the space in the Lower East Side contested.

Map 6-7. The Lower East Side: Core and Environs Census Tracts with Historic District, Subway Services and Public Housing Projects.

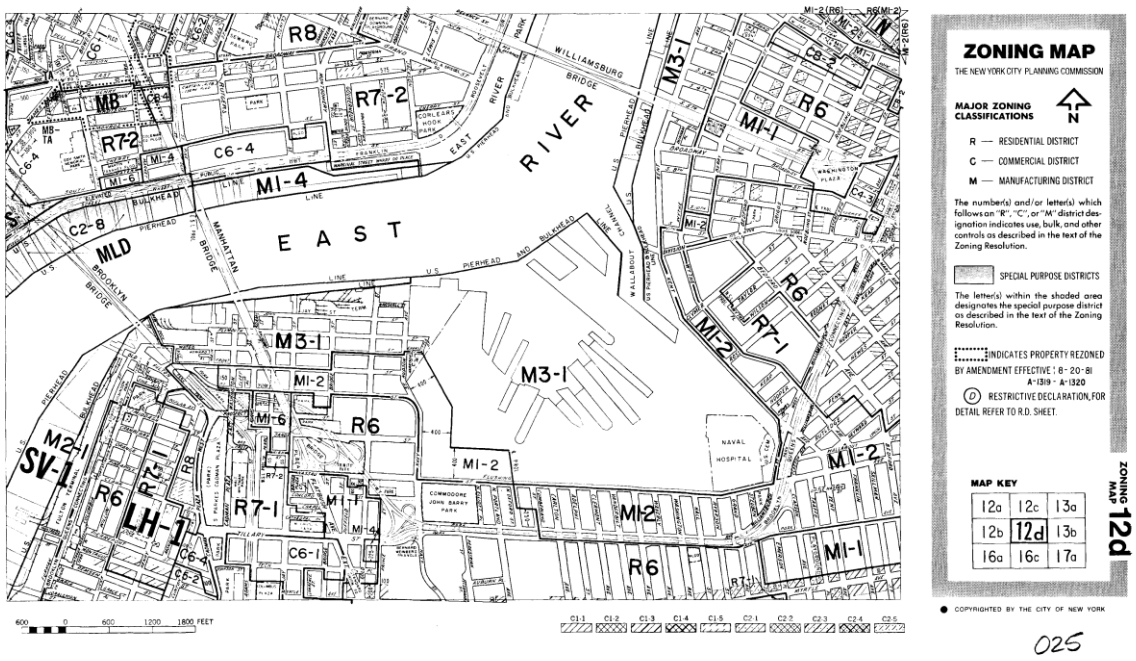
6-3 Lower East Side: The Physical Environment

Following the structure of the previous Park Slope chapter, this section maps the physical environment of the Lower East Side including: zoning, building age and building heights.

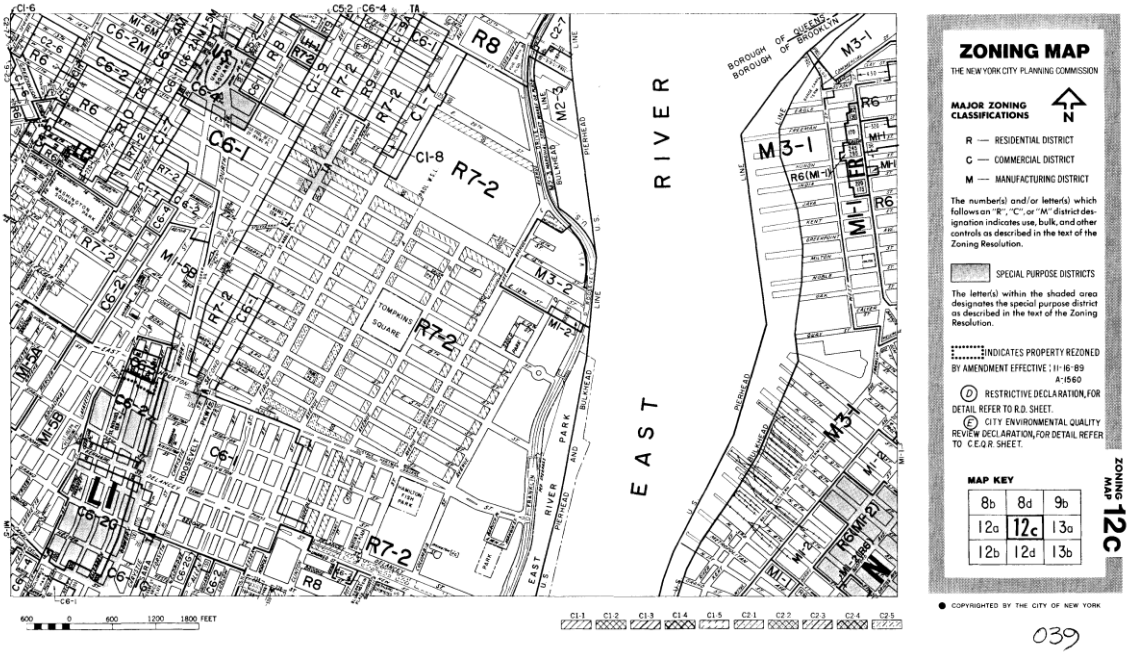
6-3.1 Zoning Maps

The Lower East Side defined by this study covers approximately two grid cells (i.e. 12c and 12d) in the DCP's zoning index map (DCP, 2011c). The Historical Zoning Maps that coincide with the Census Survey years 1980, 1990, 2000 and 2010 are extracted from the DCP website and attached below (see Map 6-8, Map 6-9, Map 6-10, Map 6-11 and Map 6-12) (DCP, 2013):

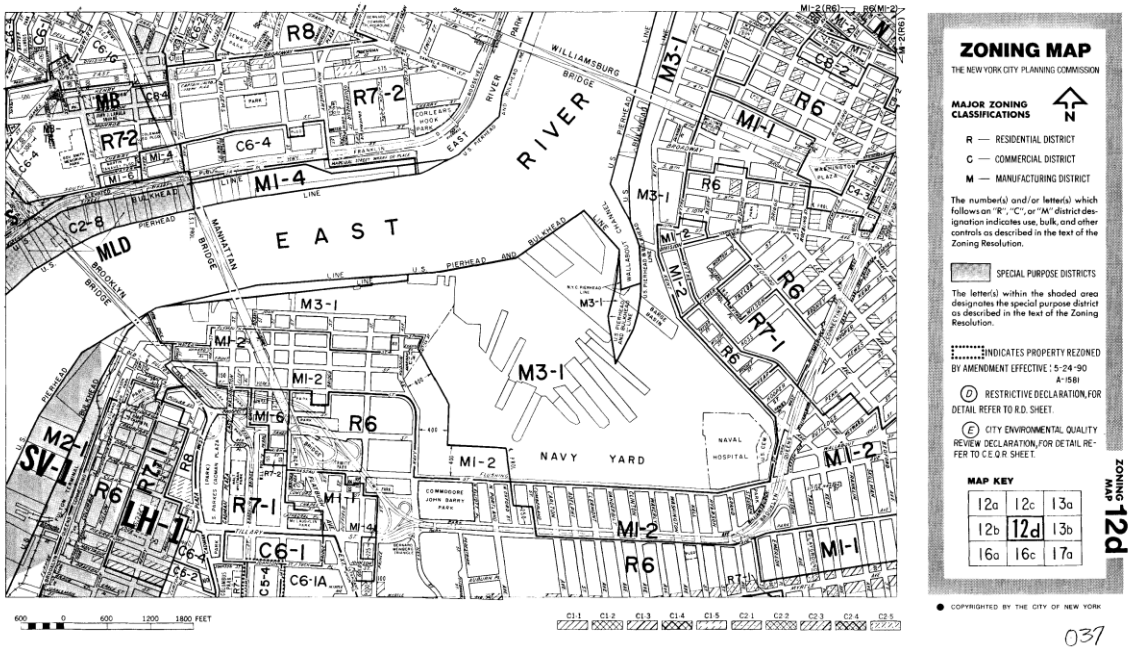
Map 6-8. Historical Zoning Maps 12c, 1981.



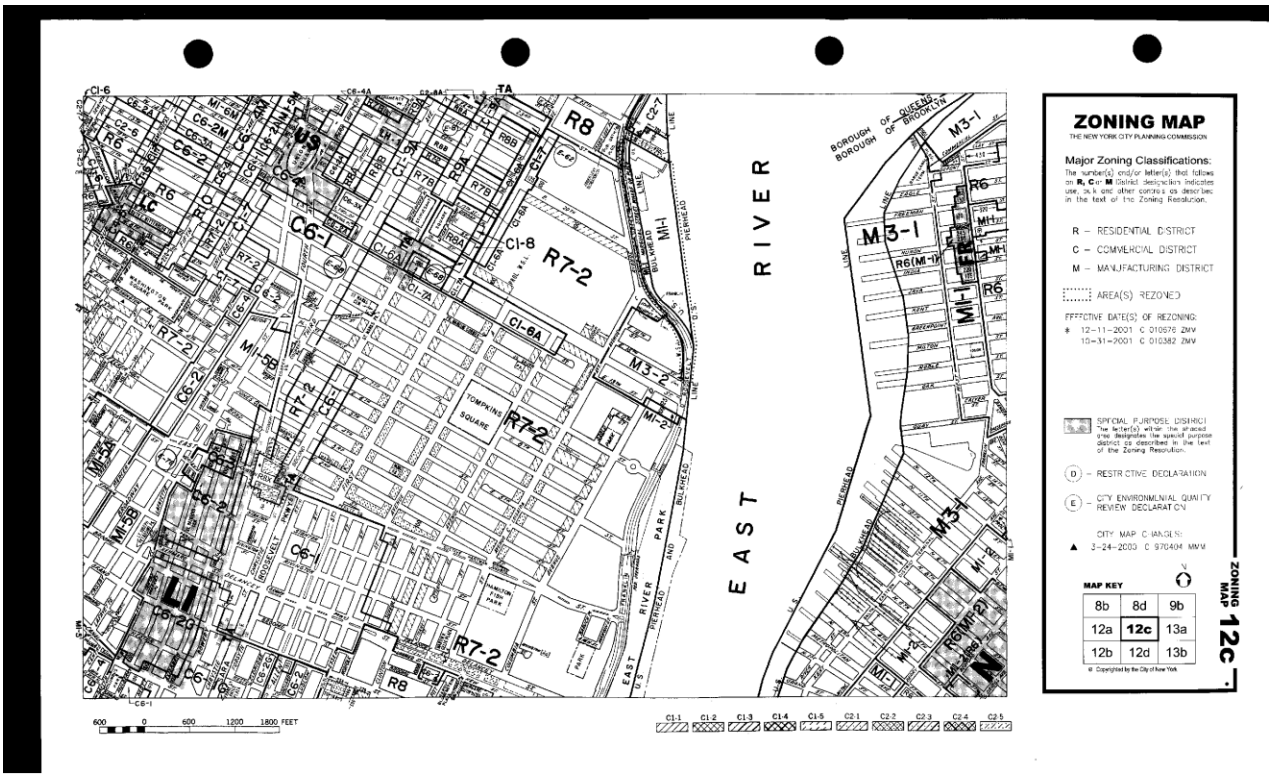
Map 6-9. Historical Zoning Maps 12d, 1981.



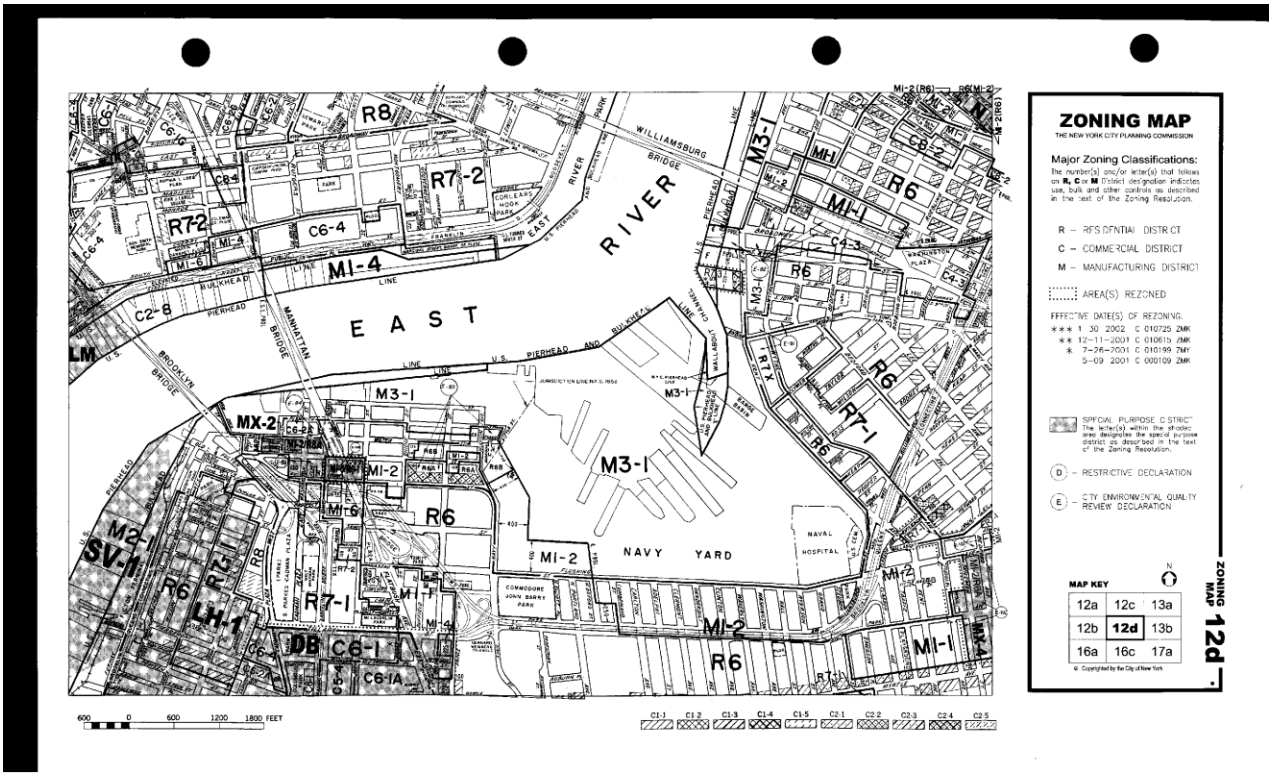
Map 6-10. Historical Zoning Map 12c, 1989.



Map 6-11. Historical Zoning Map 12d, 1990.



Map 6-12. Historical Zoning Map 12c, 2001.



Map 6-13. Historical Zoning Map 12d, 2001.

The zoning districts of the Lower East Side that coincide with the latest Census survey of 2010 are mapped by MapPLUTO 2011. Figures 6-3 and 6-4 below show the percentages of each zoning district by its tax lot area for the Core and Environs respectively. We can observe in the Core the residential and commercial districts have approximately the same percentages and combined together would account for 80% of its area. Manufacturing has only 4% and the rest 15% being used for park land.

The Environs have a distinctively different land use pattern, with only 11% of the lot area primarily zoned for residential use. Commercial lots are the majority there. The three zoning maps to follow (Maps 6-10, 6-11 and 6-12 for residential, commercial and manufacturing respectively) would show more details for the differences among the Census Tracts.

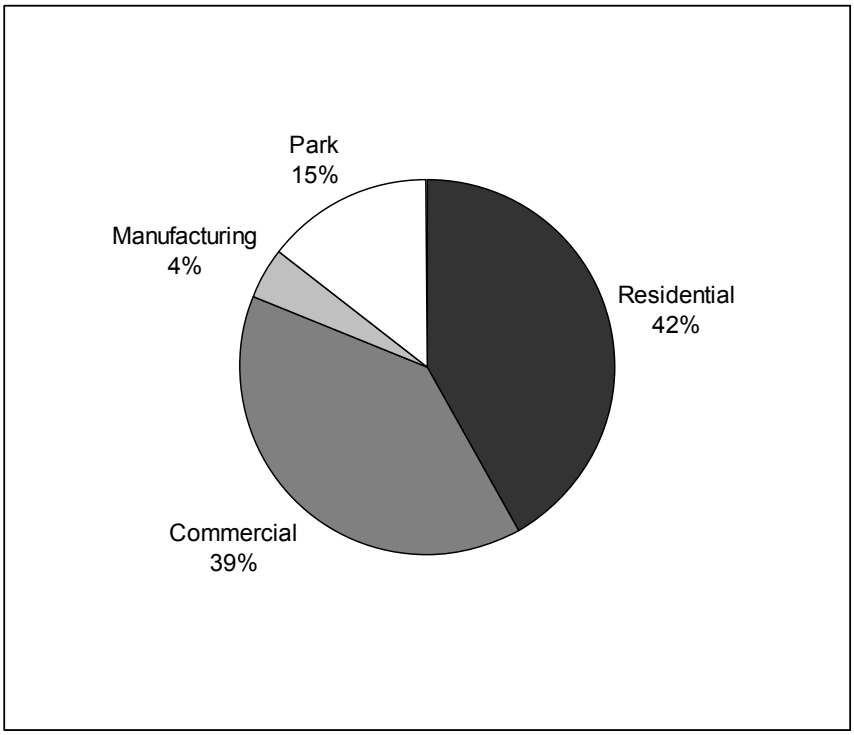


Figure 6-3. Percentages of Different Zoning Districts in the Lower East Side – Core.

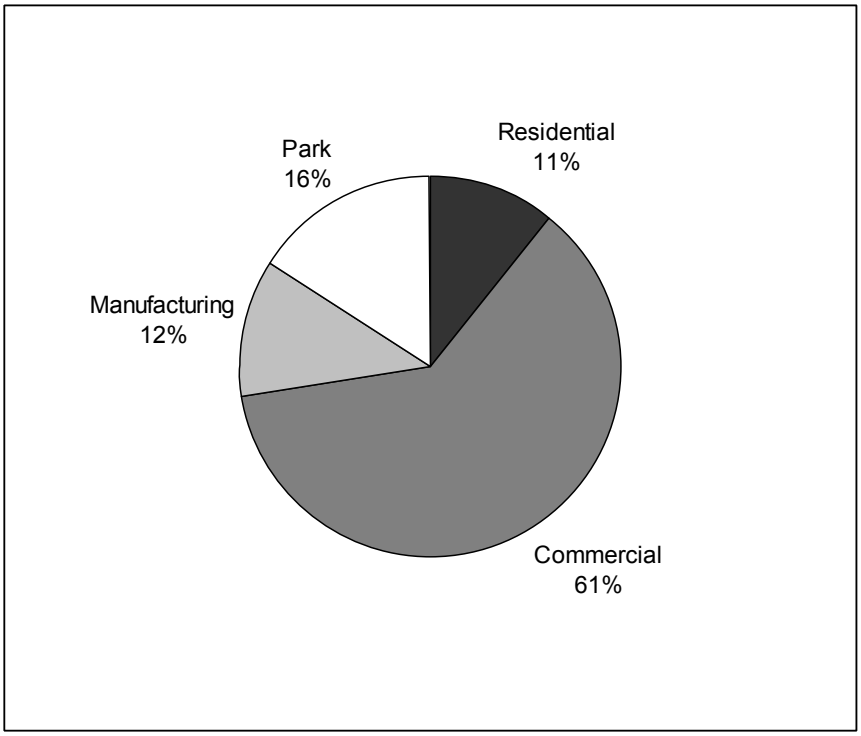


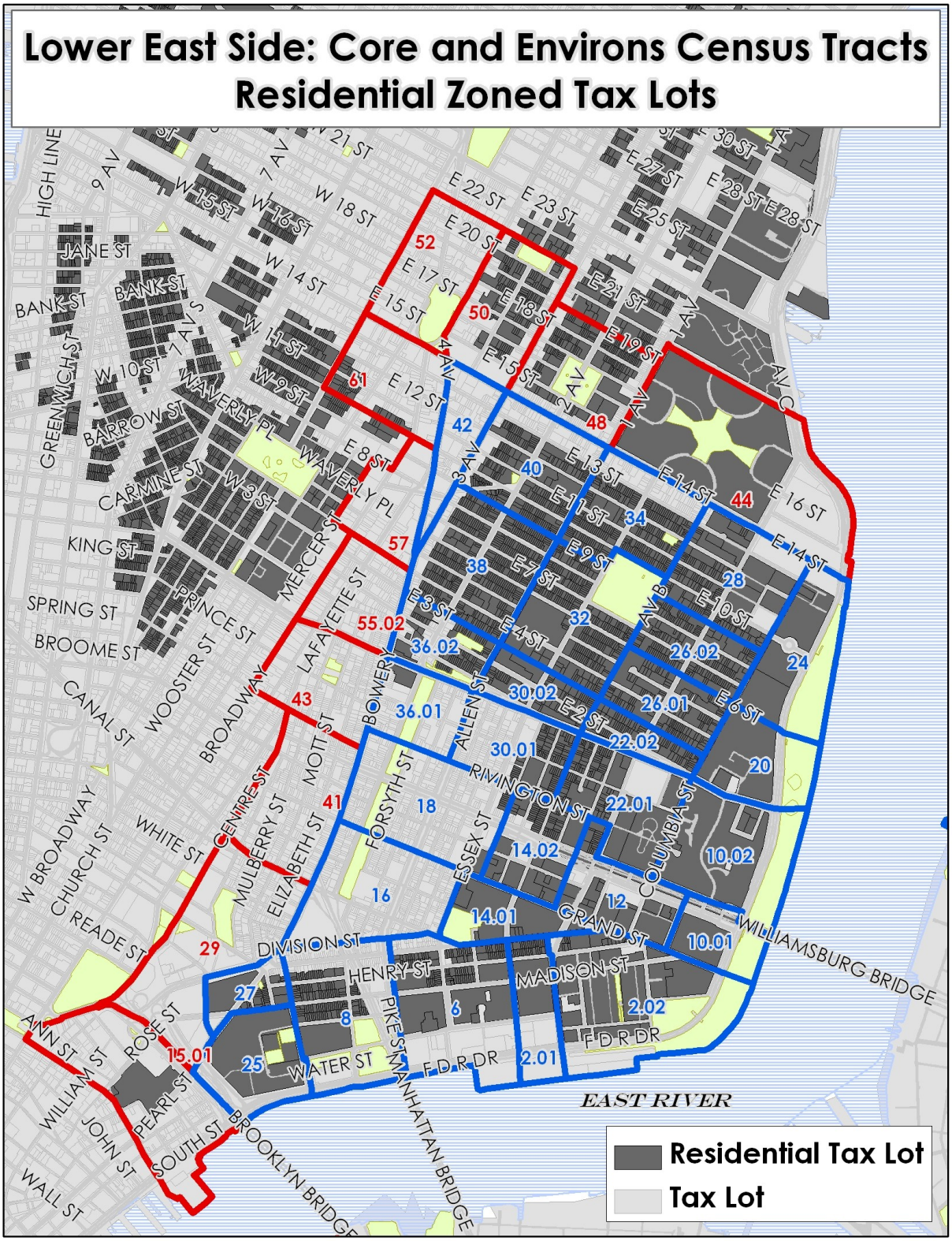
Figure 6-4. Percentages of Different Zoning Districts in the Lower East Side – Environs.

Map 6-14 below illustrates most Census Tracts in the Core area are occupied by residential tax lots; the exceptions are the four Census Tracts located in the middle-left portion of the neighborhood (i.e. 16, 18, 30.01 and 36.01) that are commercial tax lots (See Map 6-15). As mentioned in the previous Methodology Chapter, the zoning classifications in New York City are complex; therefore these zoning maps are based only on the primary zoning designation for each tax lot. Mixed use zoning is not uncommon and even within these four Census Tracts that are primarily zoned for commercial use, residential units remain and are generally located on the higher floors of a building, while lower floors are used for commercial activities. The population and housing maps in the following sections will illustrate that residents exist in these Census Tracts.

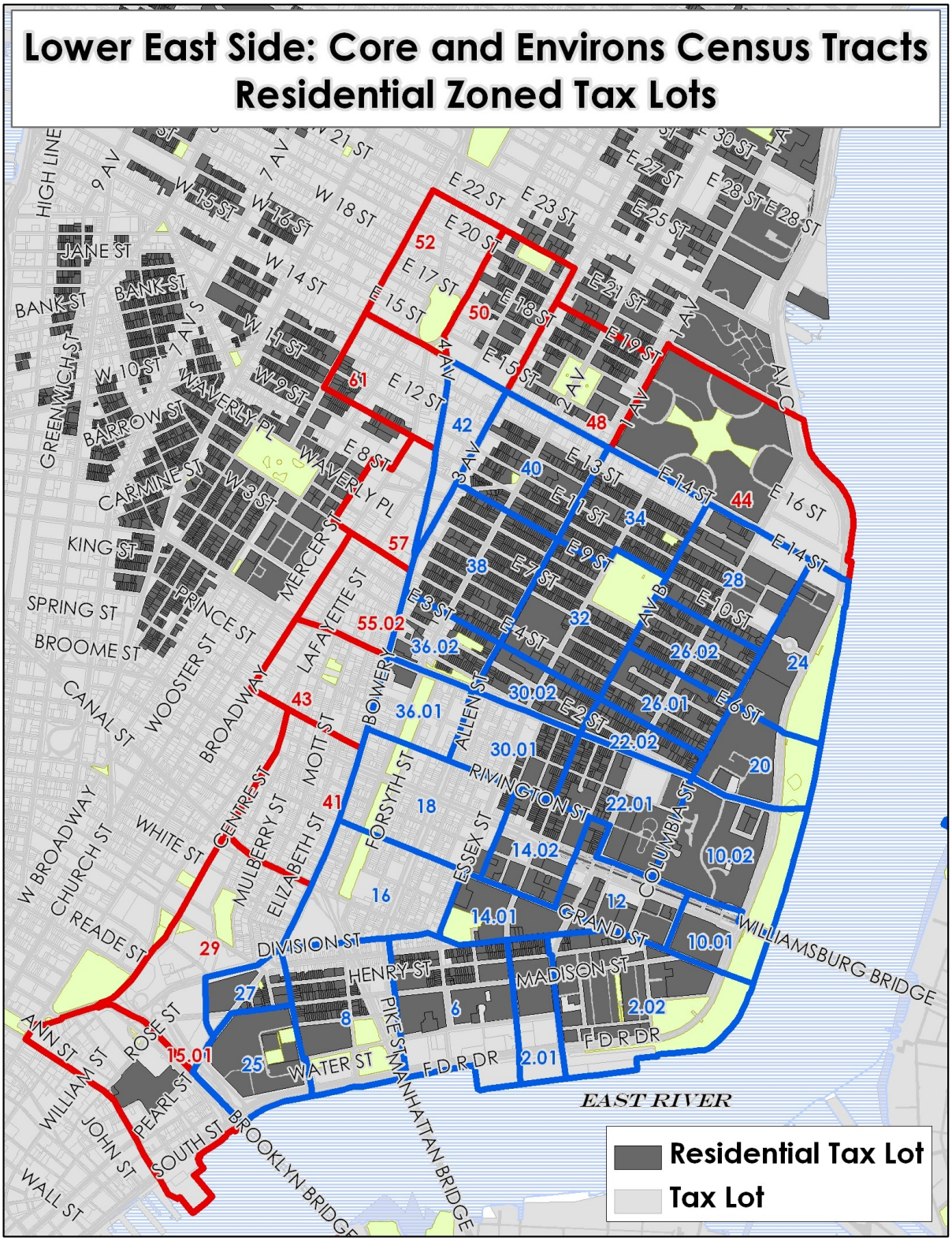
Only in the North and North-western Environs Census Tracts can the pattern that was observed in Park Slope can be found in the Lower East Side, namely, commercial tax lots along the wider avenues. The South-western Environs Census Tracts are dominated by commercial tax lots, indicating commercial land use in the downtown civic and office districts.

Manufacturing zoned tax lots are basically absent (i.e. 4%) from the Core Census Tracts in the Lower East Side (See Figure 6-3). The exceptions are in the North-western tip (Census Tract 52) and a few of the Western Environs Census Tracts. The handful of tax lots located at the North-eastern corner where East 14th Street intersects with the FDR Drive, are used by the Consolidated Edison, an electricity company, as a sub-station. Within the Census Tracts of the Environs, the manufacturing tax lots cluster in the North-west corner at Census Tract 52. The manufacturing tax lots can also be found to occupy the majority of Census Tract 57 and Census Tract 55.02 that

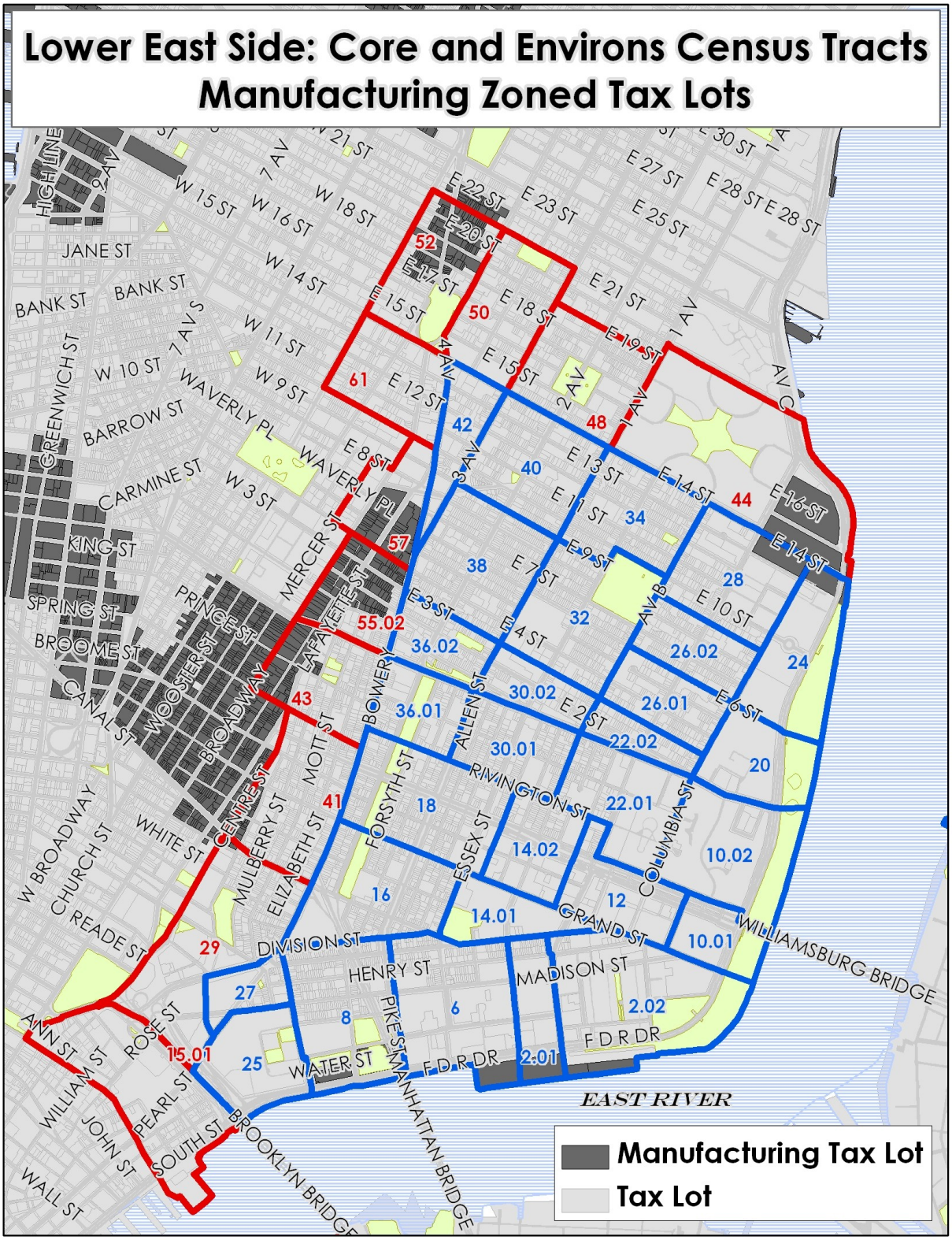
are located West of the Bowery. Census Tract 41 and Census Tract 43 also have a few manufacturing tax lots in the West side which are more associated with other manufacturing tax lots that are outside the Environs area and a significant industrial zone that remains in lower Manhattan (See Map 6-16 below).



Map 6-14. Residential Tax Lots in the Lower East Side, 2010.



Map 6-15. Commercial Tax Lots in the Lower East Side, 2010.

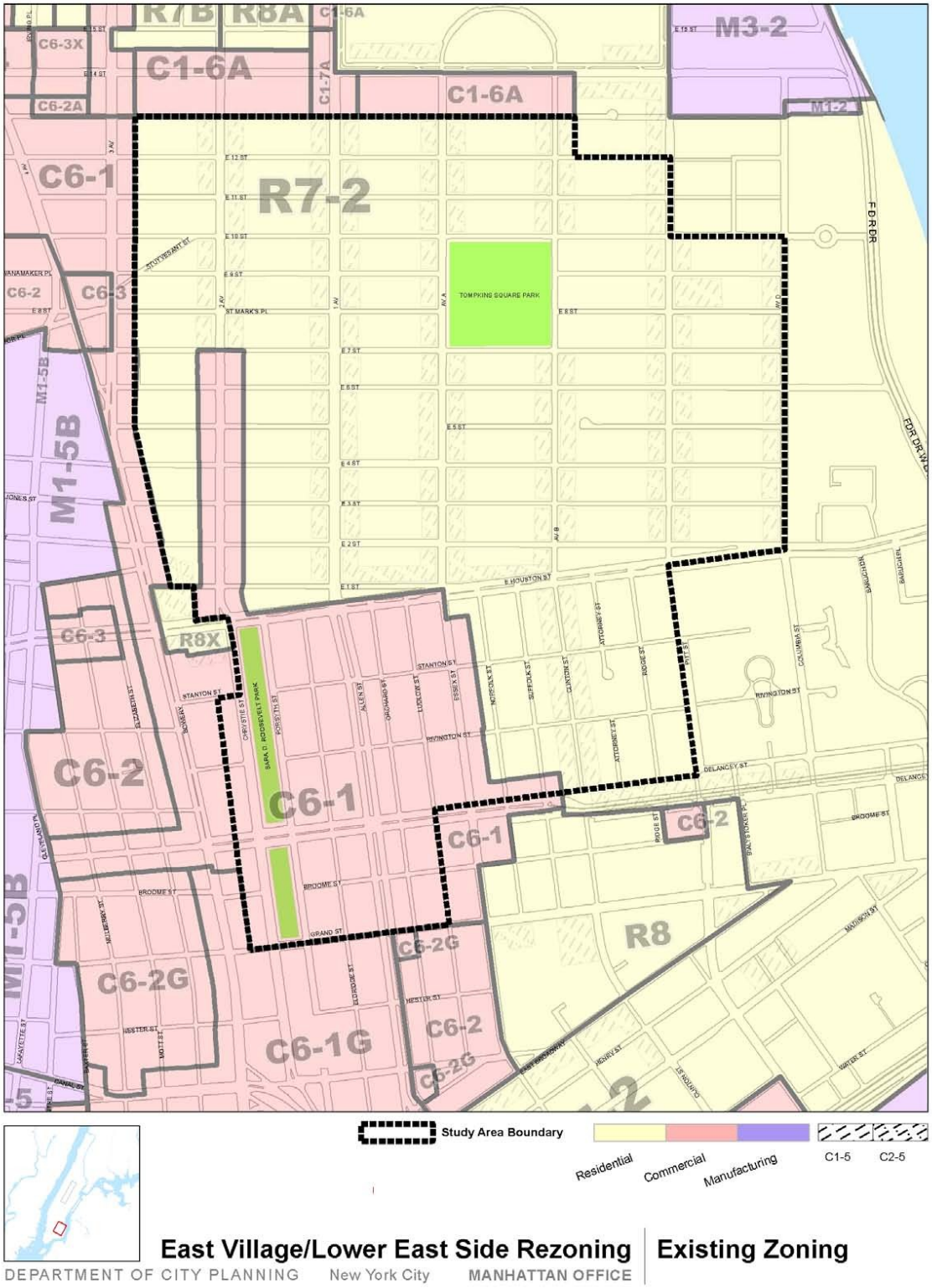


Map 6-16. Manufacturing Tax Lots in the Lower East Side, 2010.

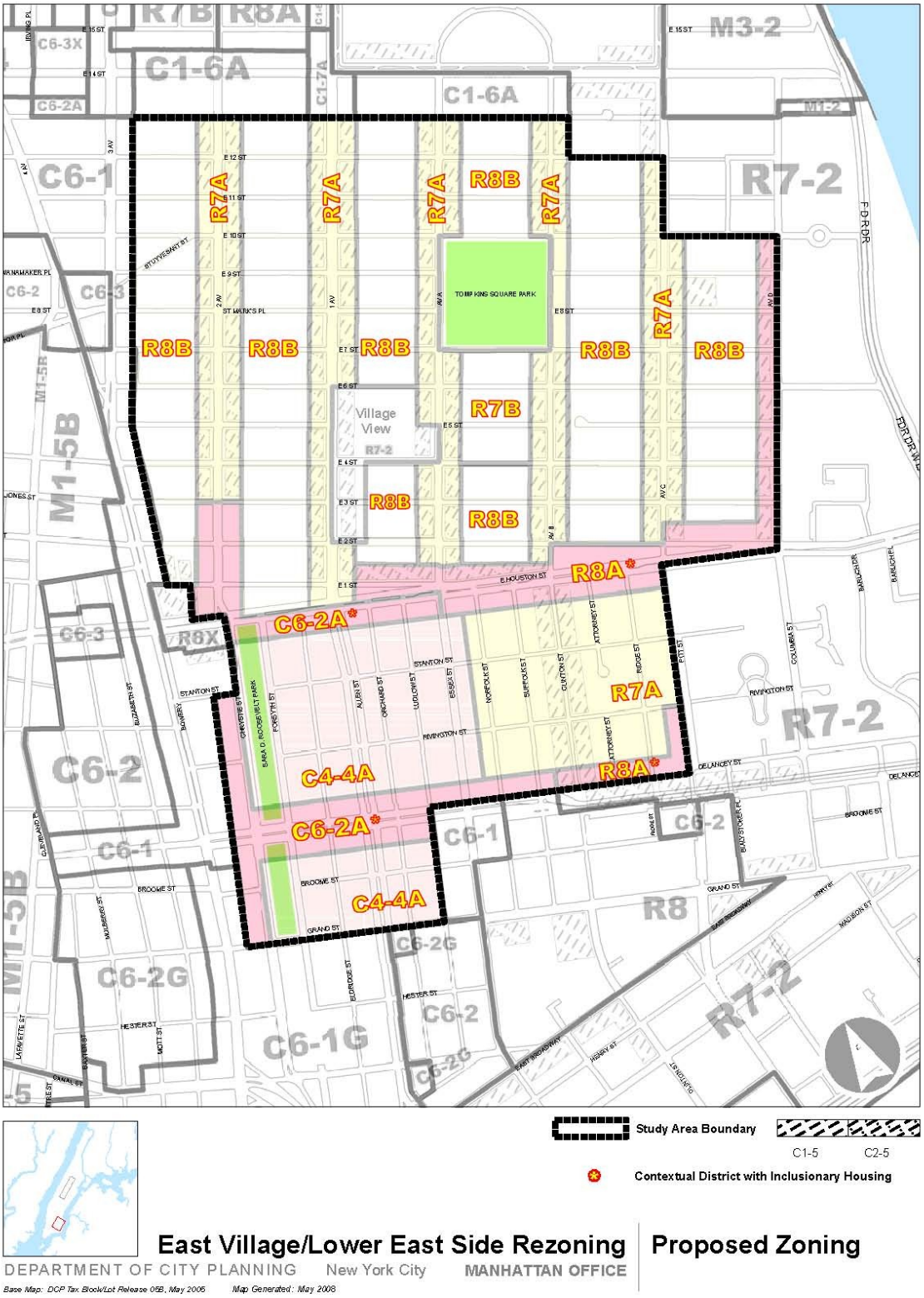
The most recent and major rezoning proposal for the Lower East Side was approved on November 19, 2008 (DCP, 2008a). The following two maps show the pre-2008 zoning (See Map 6-17) and approved proposed re-zoning by DCP in 2008. (See Map 6-18). Both maps are created by DCP and are rotated so that Manhattan's street grid appears to be aligned with true north. The rotation can be observed from the smaller maps located in the lower left corner which show the rezoning area (in red outline) and its location in Manhattan. In Map 6-18 a true north arrow is included at the lower right corner of the map. The major difference is the rezoning of the R7-2 district into R7A and R8B districts. While this dissertation does not intend to be a detailed land use study, the major difference between these different sub-categories of residential districts are as follows:

1. District R7-2 has a more flexible Floor Area Ratio (FAR) from 3.44 to 6.5. This range allows some flexibility in building design. Districts R7A and R8B have a rigid FAR of 4 and a specified maximum building height at 80 feet and 75 feet respectively.

2. Districts R7A and R8B also have a specified Street Wall Height so that new buildings in these districts need to be set-back for the higher floors. The reason for this requirement is to maintain a more uniformed streetscape for the building facades.



Map 6-17. East Village/Lower East Side Rezoning – Existing Zoning (DCP, 2008b).



Map 6-18. East Village/Lower East Side Rezoning – Proposed Zoning (DCP, 2003c).

6-3.2 Building Age

Similar to Park Slope, the existing structures in the Lower East Side were built predominantly before 1940. However, in reality the development of these two neighborhoods are quite different. While it is beyond the scope of this dissertation to detail the architectural styles associated with gentrification or the particular types of buildings in the study neighborhoods, these details will be addressed in the summary section of this chapter.

Figure 6-5 below illustrates the extent of how skewed the distributions are. For instance, in the Core, approximately 90% of the existing structures were built before 1940; it is lower in the Environs approximately 80%. Although in the Environs there is an increase in construction over subsequent decades, it does not reach 10% milestone.

When examining the maps included in the following pages (See Map 6-19 through Map 6-24), different patterns between the Lower East Side and Park Slope are evident. For instance, while the existing structures in the area were built before 1940 (See Map 6-19), in the years between 1940 and 1980 there was major construction on the larger tax lots in the Lower East Side study area. Between 1940 and 1959 (See Map 6-20) Stuyvesant Town, a working and middle class residential development was constructed, and occupies the majority of Census Tract 44 located above the Northern boundary of the Lower East Side Core. Along the East River, public housing projects were constructed by the New York City Housing Authority for low income residents. These larger tax lots are occupied of multiple buildings that have provided thousands of housing units. (See maps in the following population and housing unit sections). However, Stuyvesant Town itself is unique and its housing complex is very different when compared to the public

housing projects. The following maps illustrate the distinctive socio-economic status of this residential complex.

Both the 1980s and 1990s experienced sporadic construction in the Lower East Side area. During the study period from 1980 to present, the post-2000 years have slightly higher percentages of construction.

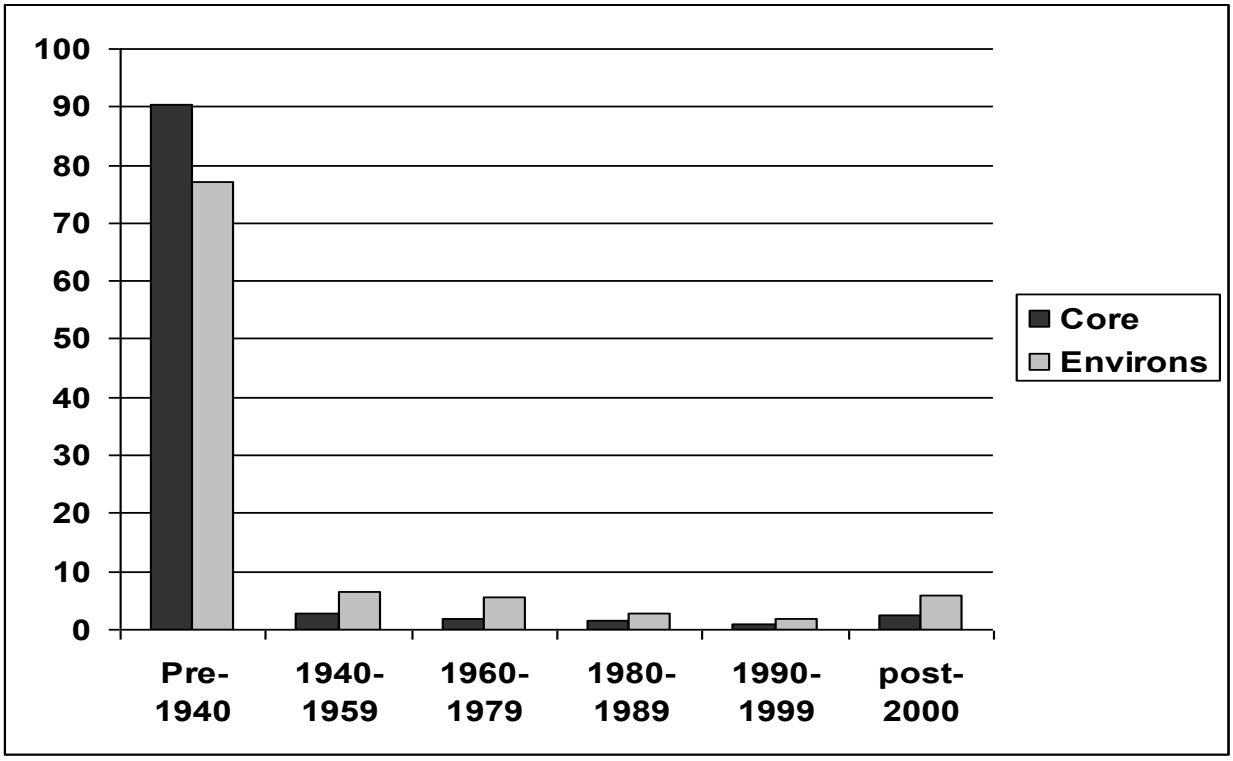
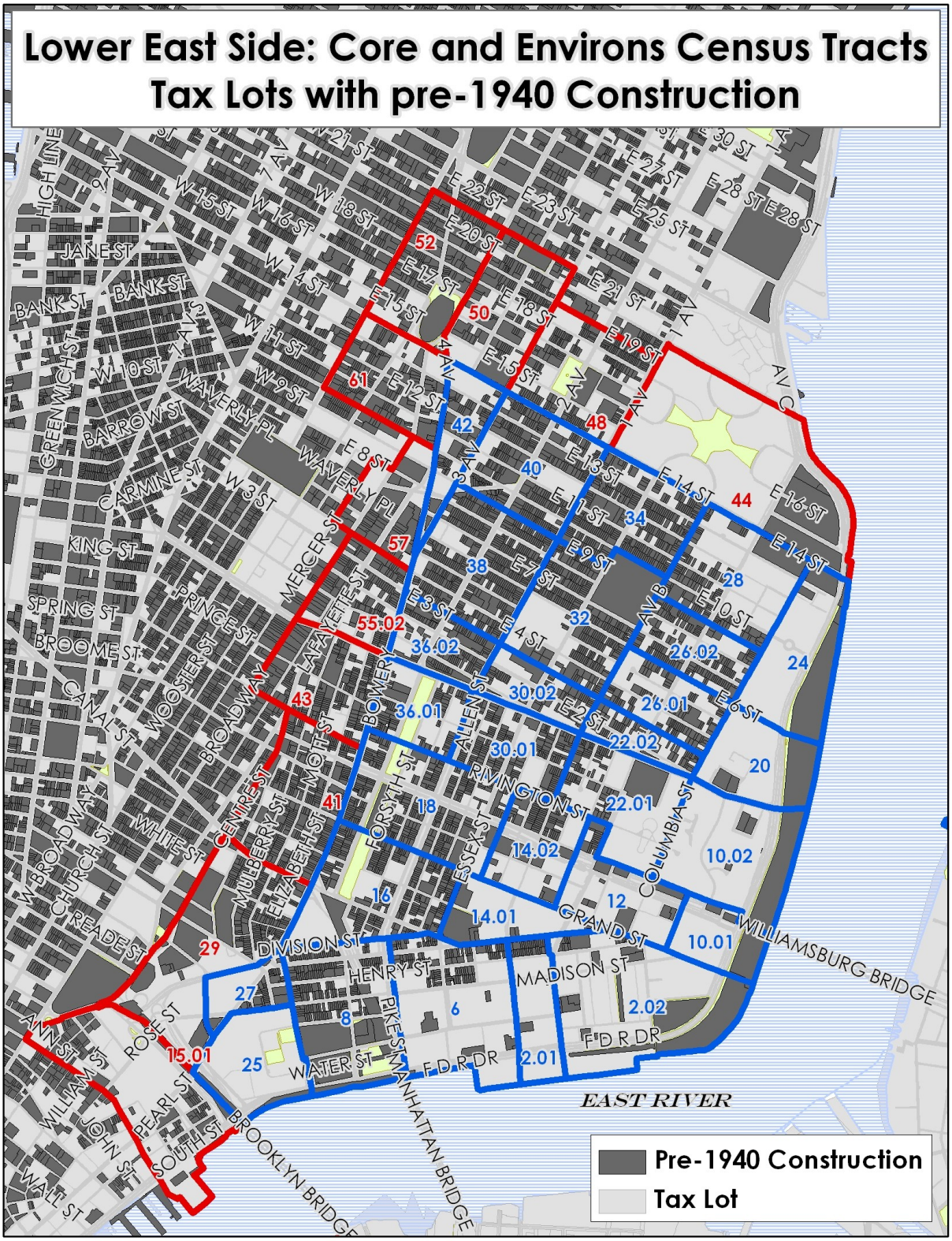
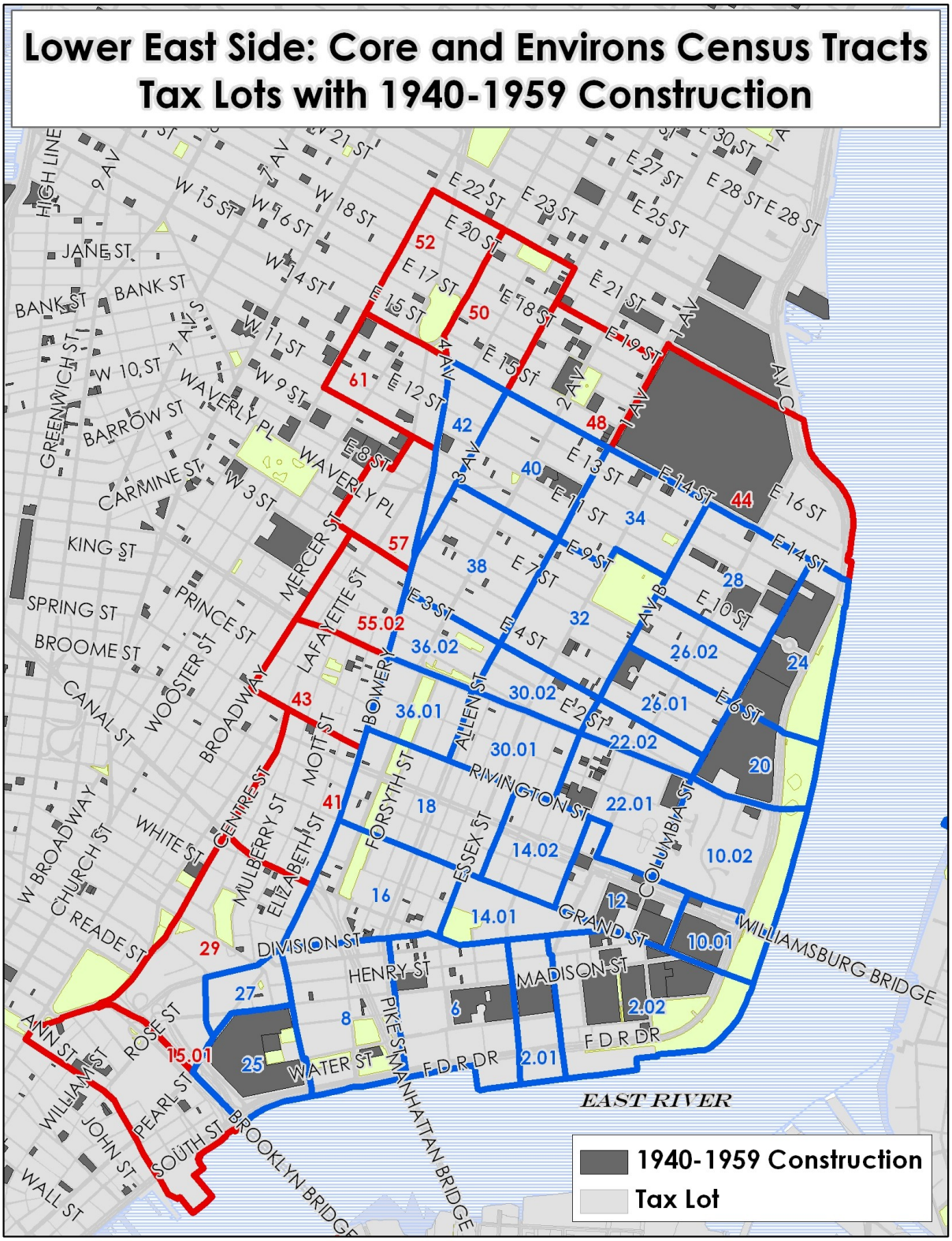


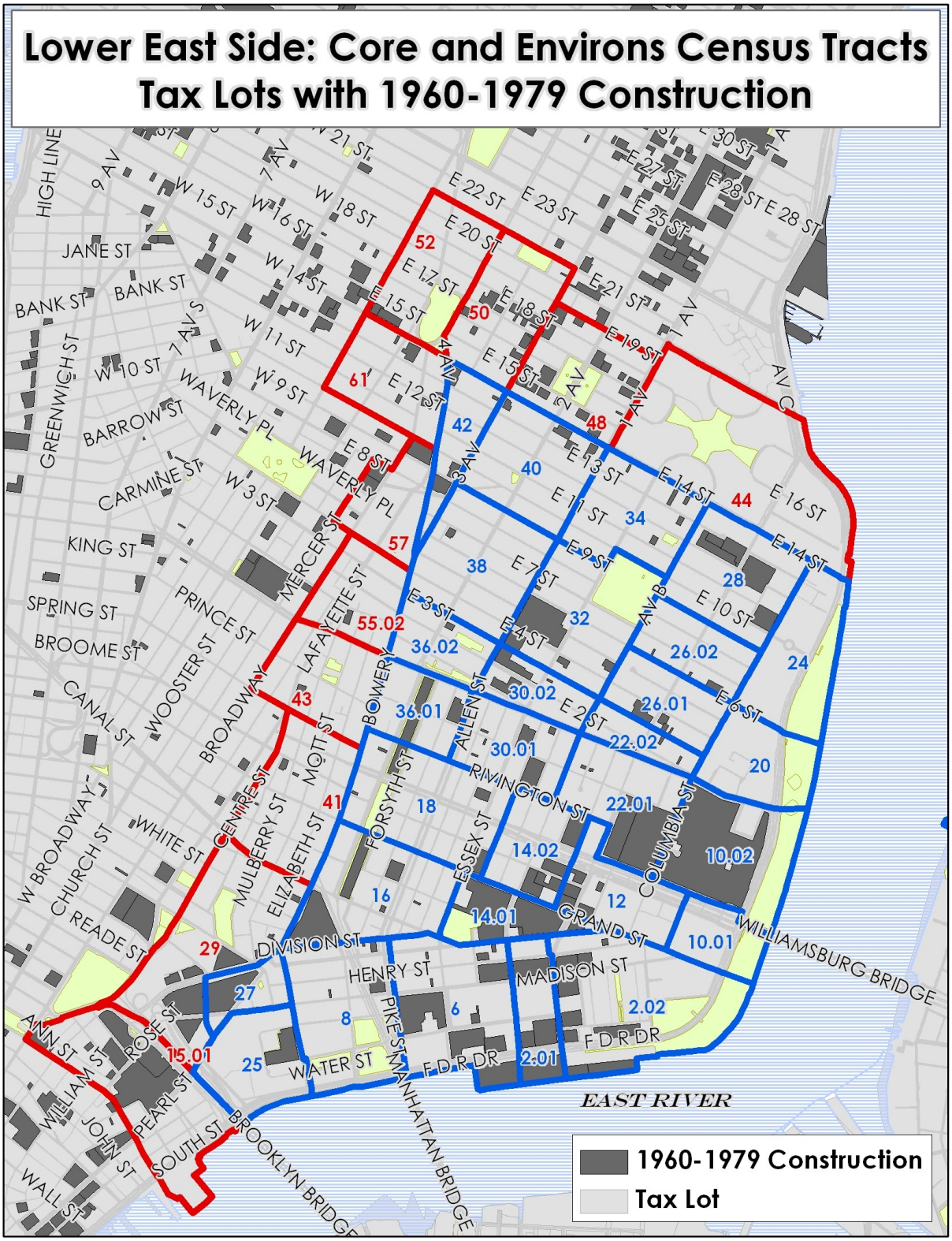
Figure 6-5. Percentage of Building Age, by Tax Lot Area, the Lower East Side - Core vs. Environs, 2010.



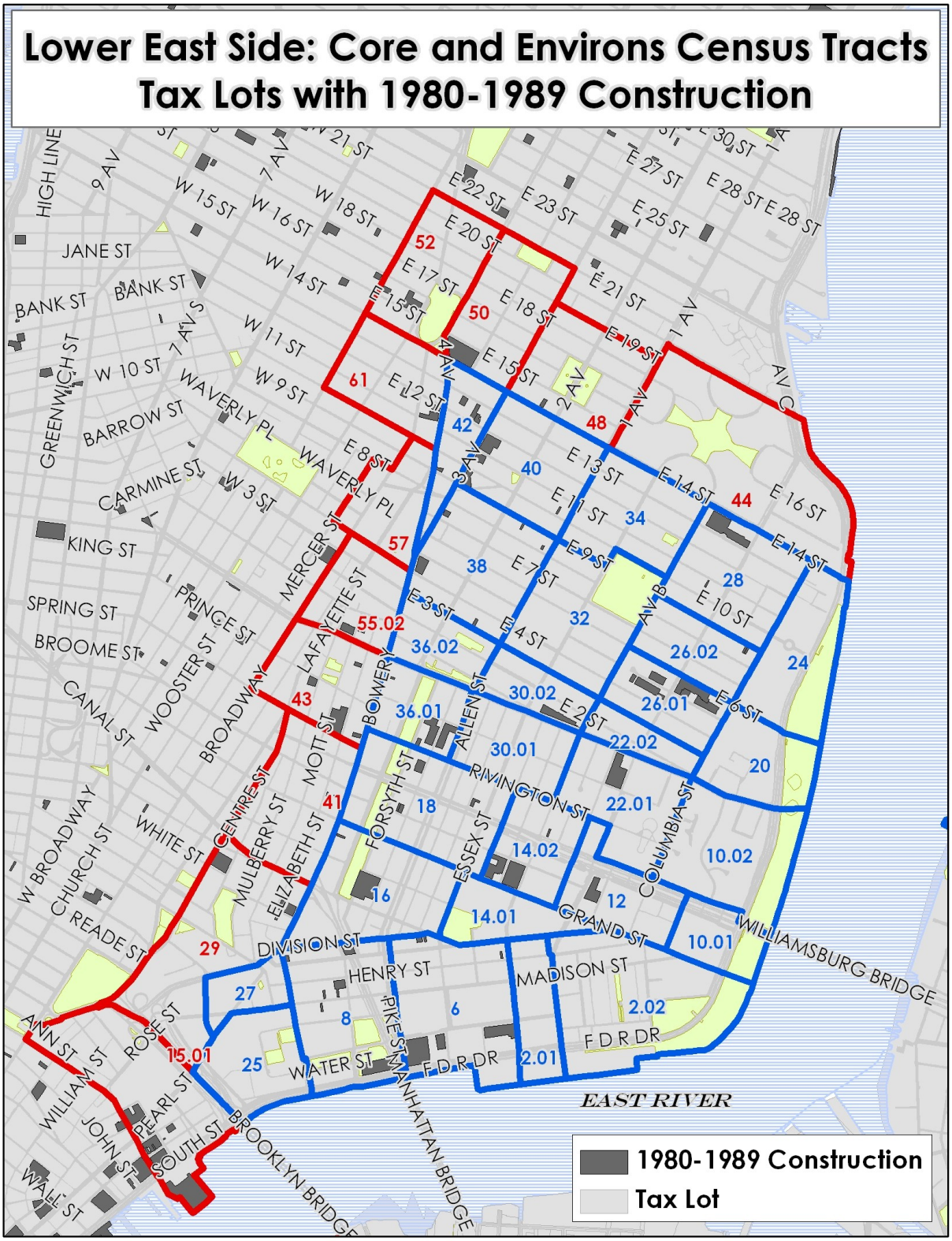
Map 6-19. Tax Lots with pre-1940 Construction.



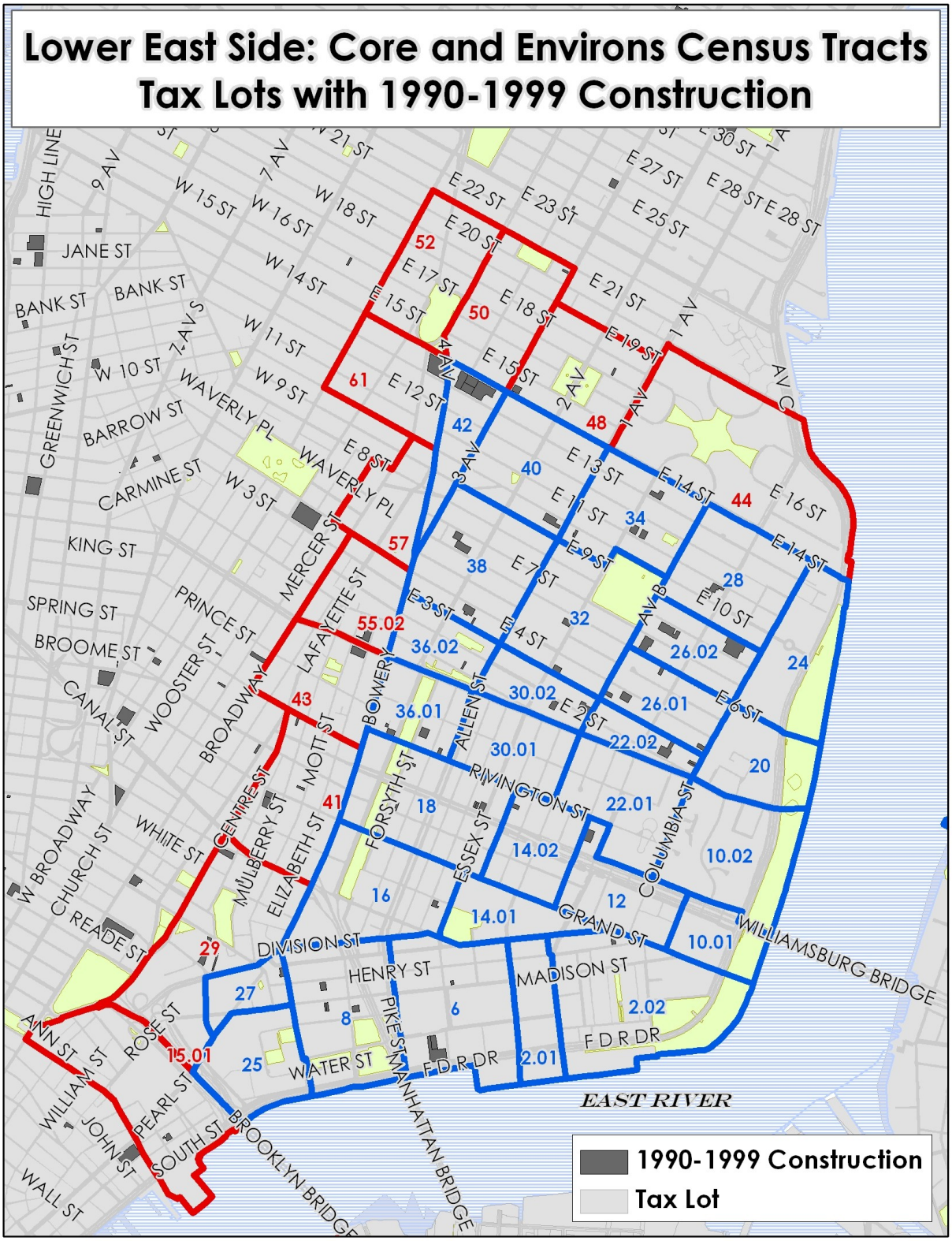
Map 6-20. Tax Lots with 1940 - 1959 Construction.



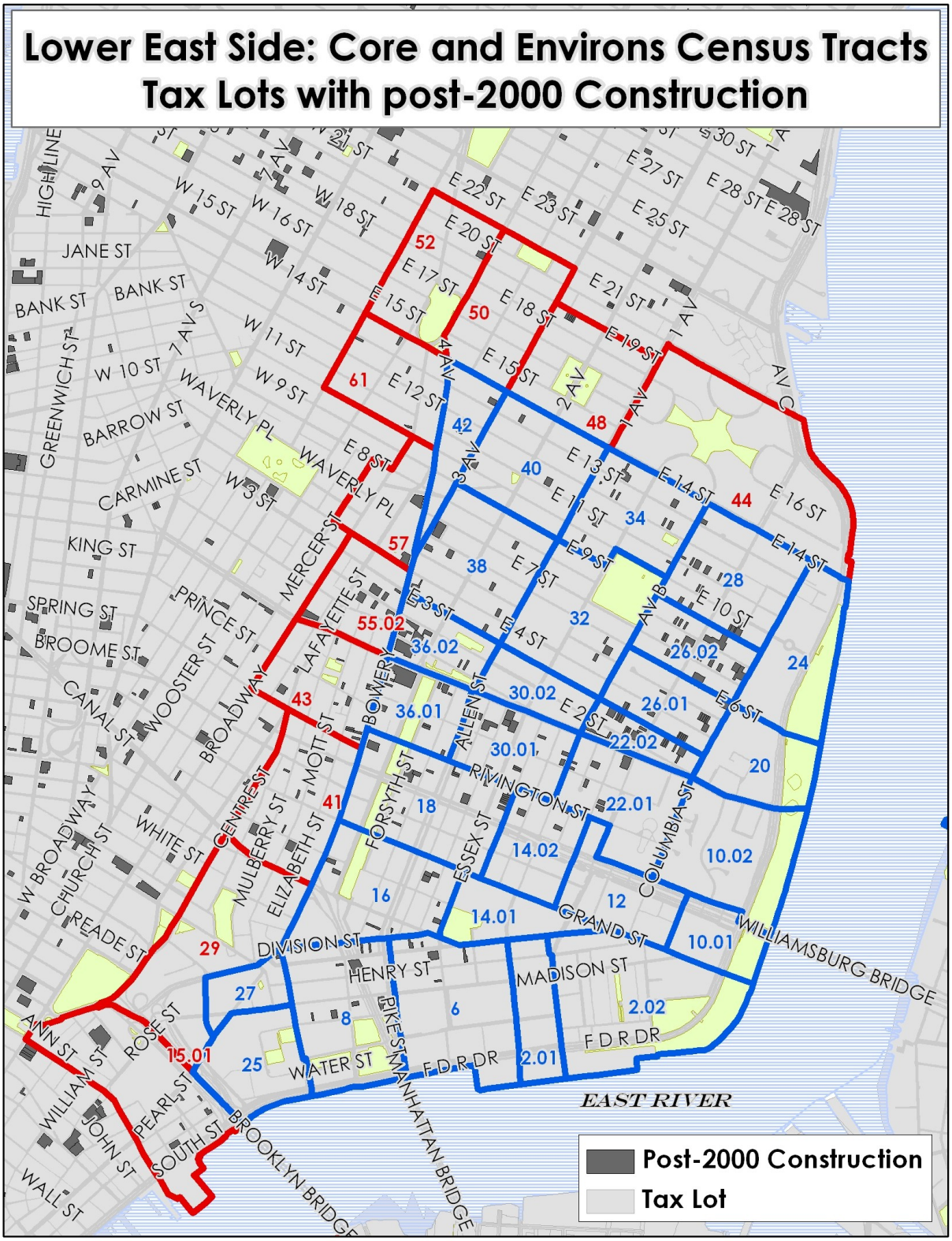
Map 6-21. Tax Lots with 1960 - 1979 Construction.



Map 6-22. Tax Lots with 1980 - 1989 Construction.



Map 6-23. Tax Lots with 1990 - 1999 Construction.



Map 6-24. Tax Lots with post-2000 Construction.

Several gentrification studies cite building-age as one factor that leads to gentrification. While historical preservation and old-world aesthetics are linked to gentrification (as was observed in Park Slope,) simply connecting gentrification with older buildings is an incomplete formula. For example, in Park Slope the older buildings constructed before 1940 are mostly brownstones; in the Lower East Side they are more likely to be tenement buildings. In the summary section of this chapter a further explanation of the different streetscapes for these two types of older buildings is provided.

6-3.3 Building Height

The following maps (See Map 6-25 through Map 6-30) depict another dimension of the physical environment, namely, the building heights. These are based on the "number of floors" attribute derived from MapPLUTO and used to approximate building heights. The building types associated with these categories are:

0 floor: no structure (See Map 6-25)

1 to 2-floor: short houses, factories, shops (See Map 6-26)

3 to 4-floor: taller houses, brownstones (See Map 6-27)

5 to 6-floor: walk-up apartment buildings (See Map 6-28)

7 to 12-floor: taller apartment building (See Map 6-29)

over 12-floor: high-rise buildings (See Map 6-30)

There are two distinctive building-height features that could be observed from these maps: the majority of the buildings in the Lower East Side is in the categories of 5 to 6-floor, followed by

the 1 to 2-floor and over 12-floor categories. For the Lower East Side Environs, the category with the highest percentage is in the over 12-flool category, followed by the 7 to 12-floor and 5 to 6-floor categories. There is a noticeable presence of buildings over 12-floor in the neighborhood that is not observed in Park Slope.

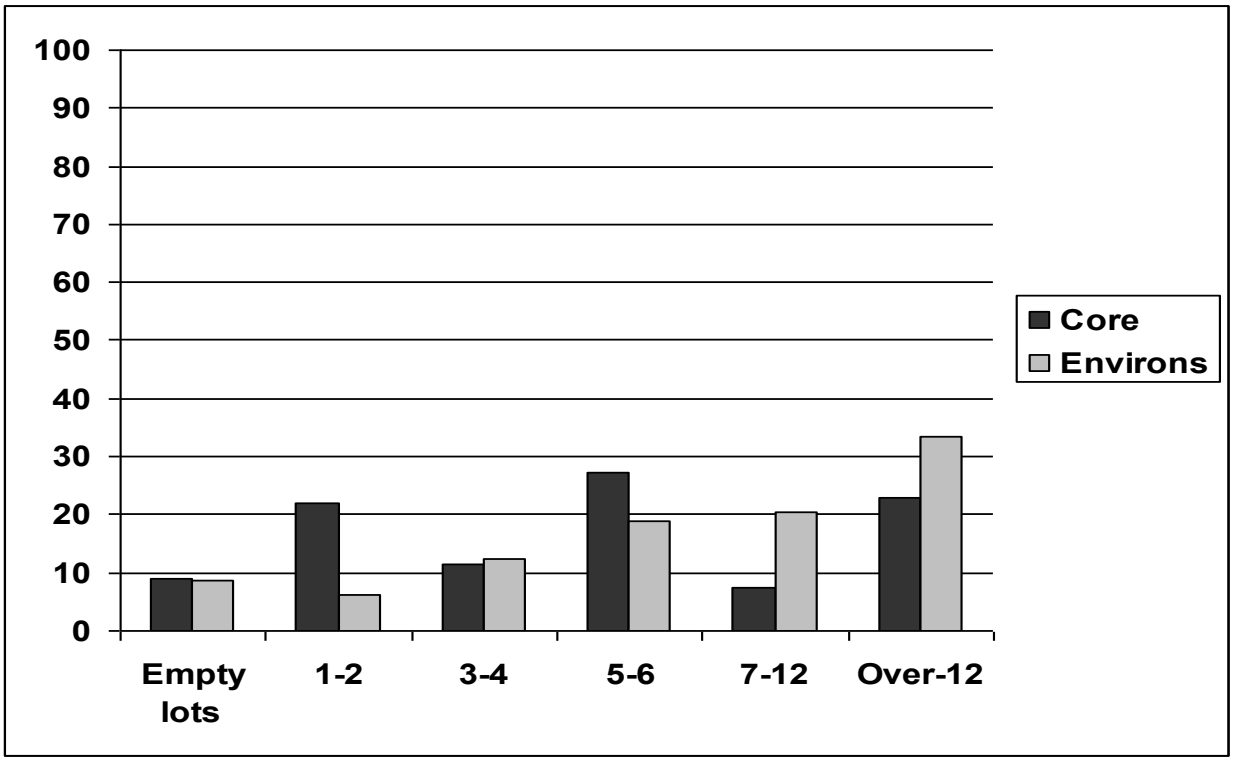
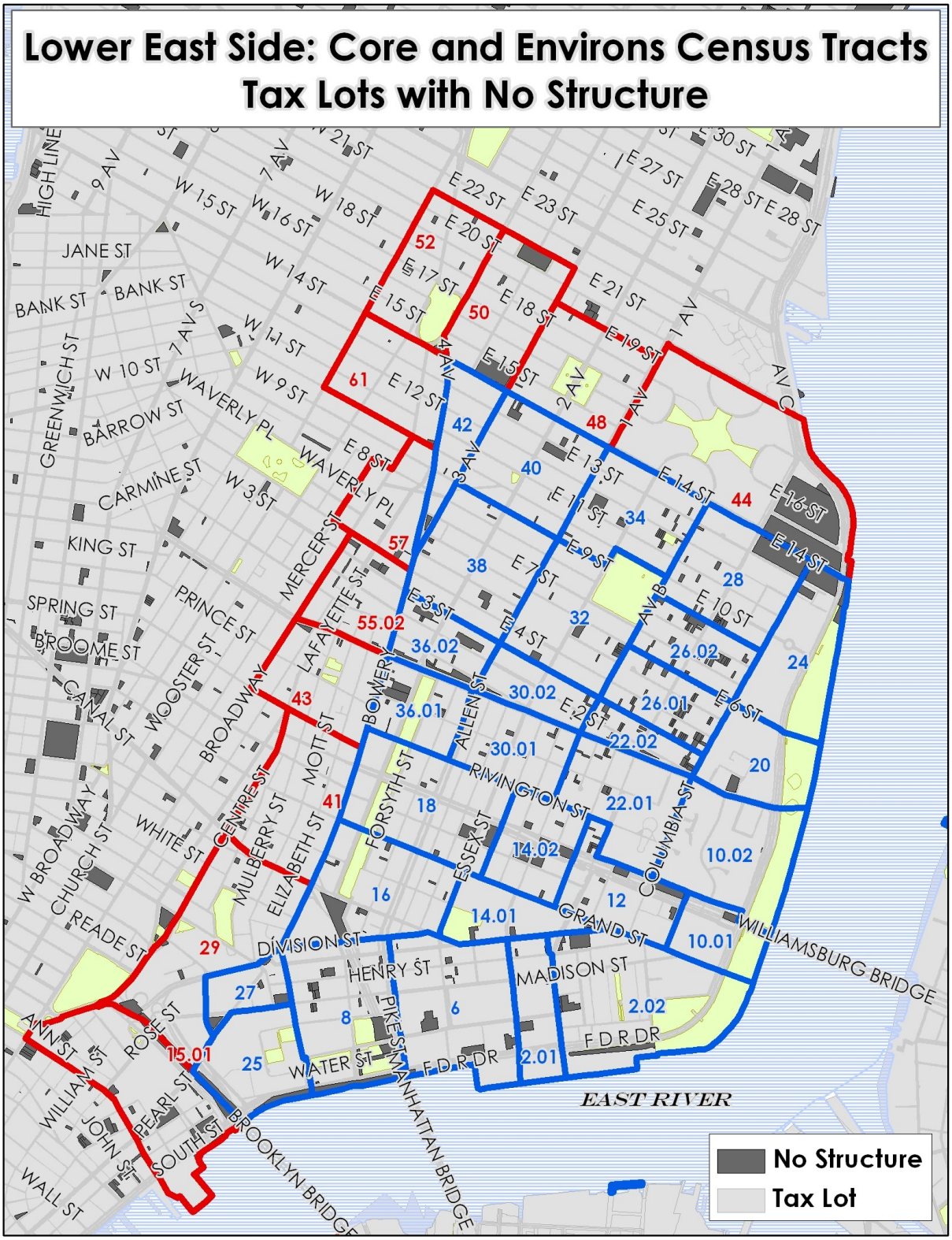
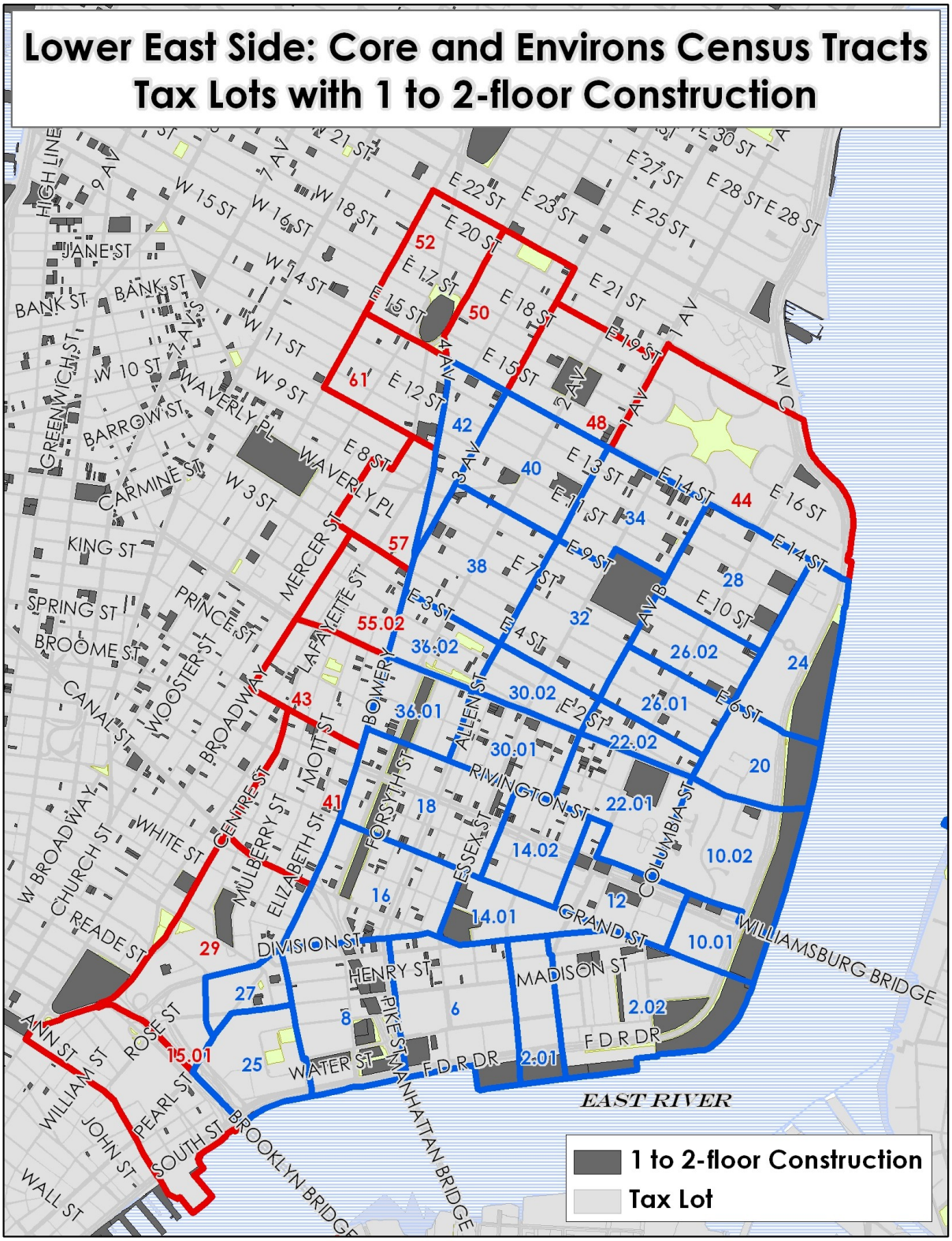


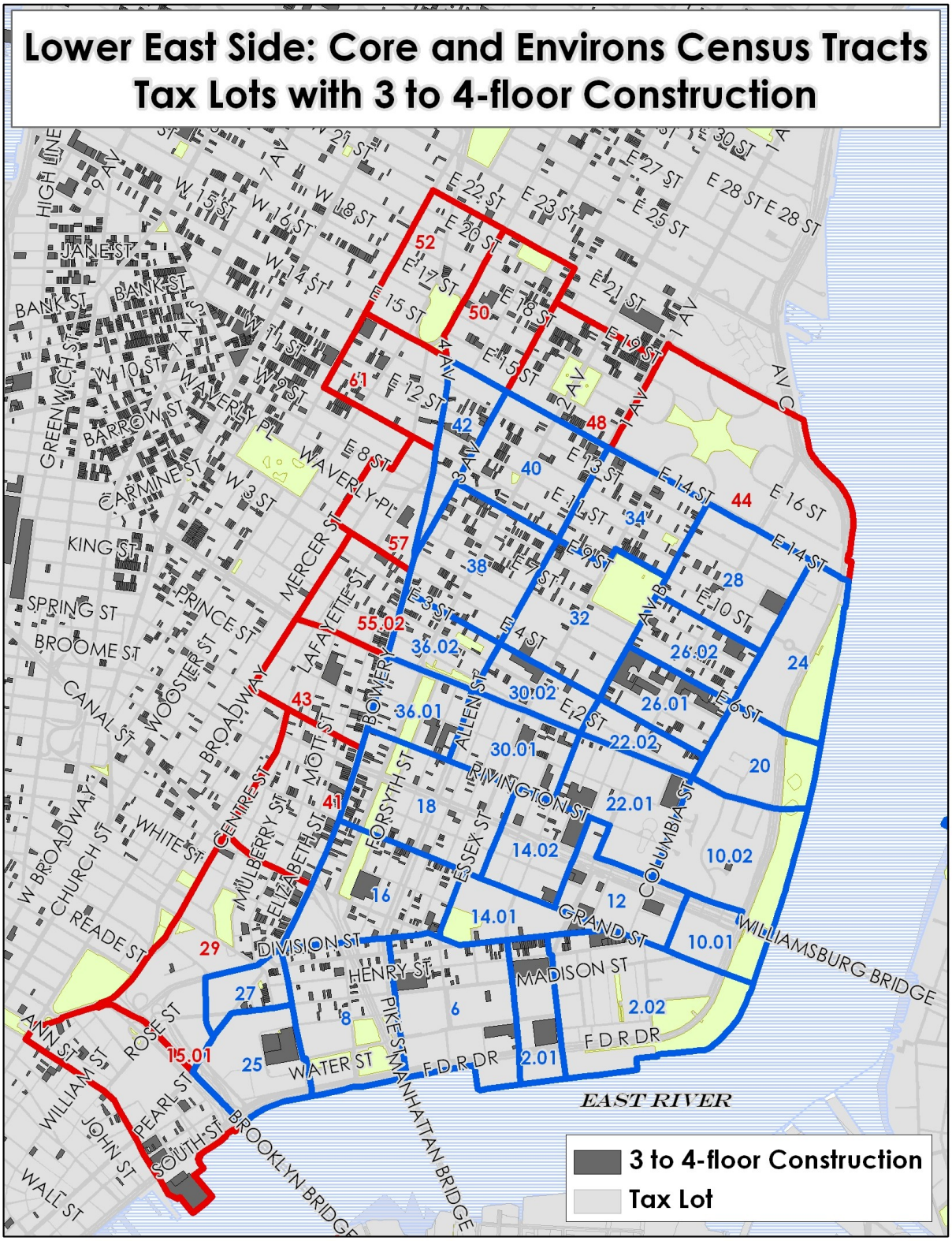
Figure 6-6. Percentage of Building Floors by Tax Lot Area, the Lower East Side - Core vs. Environs, 2010.



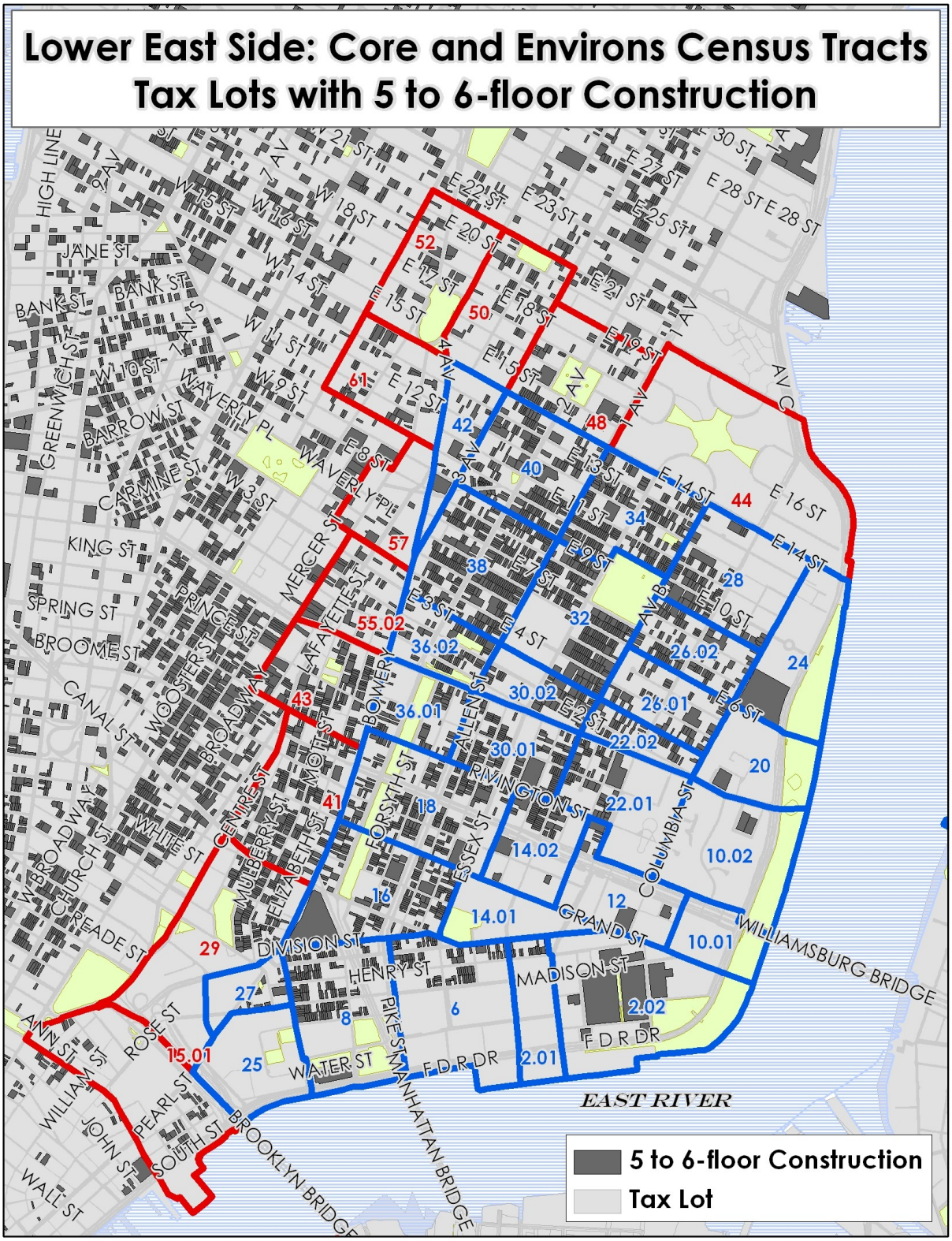
Map 6-25. The Lower East Side Tax Lots with No Structure.



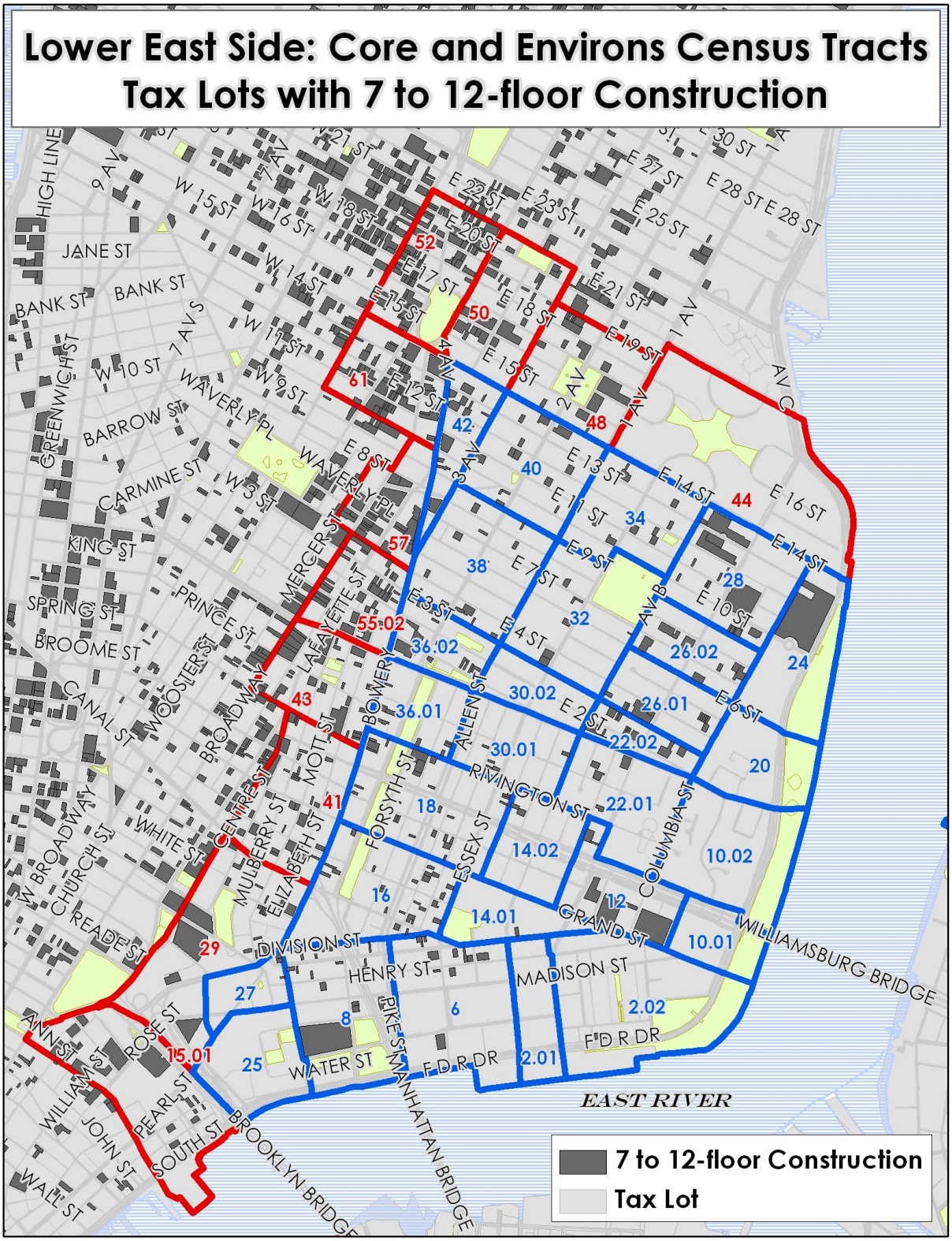
Map 6-26. The Lower East Side Tax Lots with 1 to 2-floor Construction.



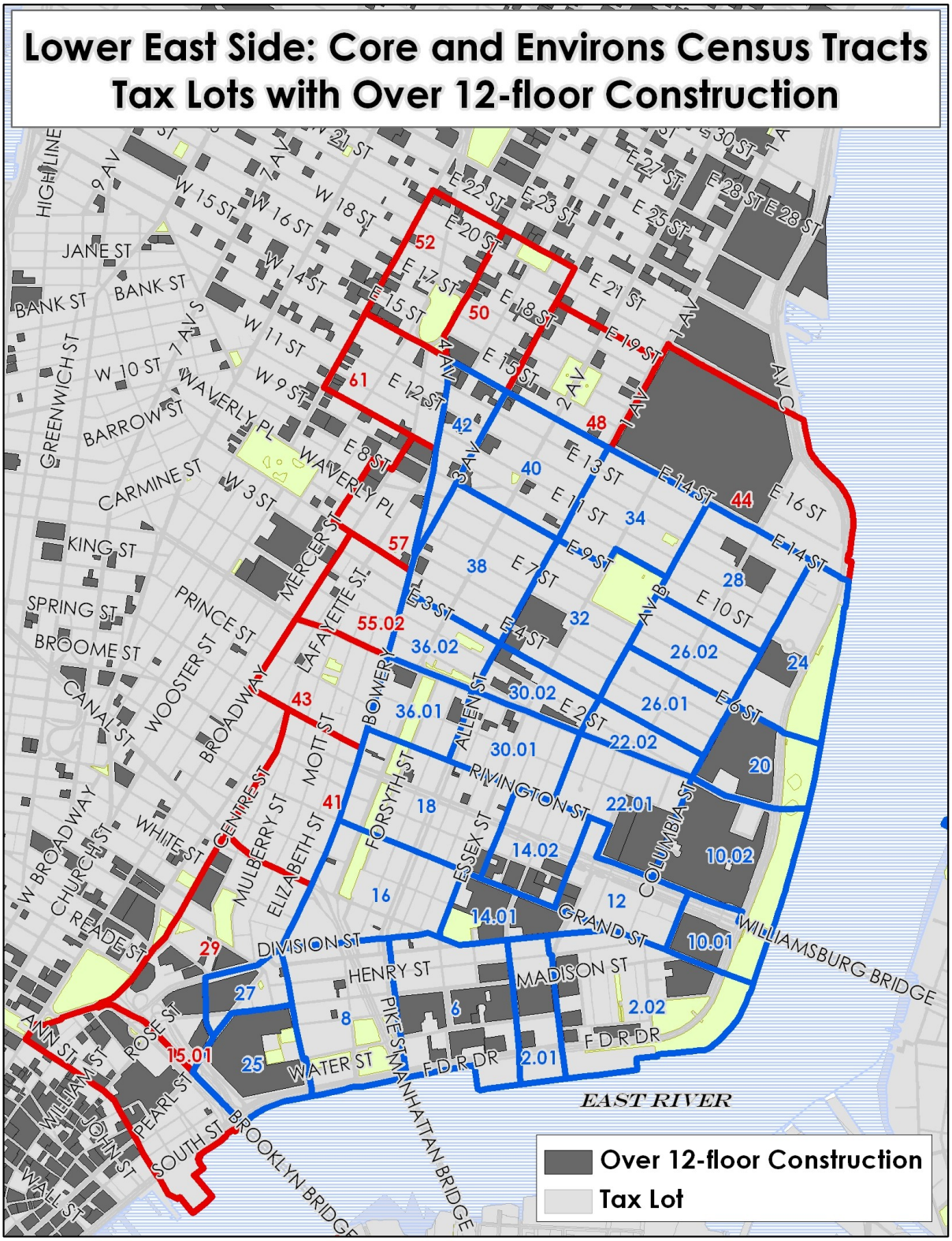
Map 6-27. The Lower East Side Tax Lots with 3 to 4-floor Construction.



Map 6-28. The Lower East Side Tax Lots with 5 to 6-floor Construction.



Map 6-29. The Lower East Side Tax Lots with 7 to 12-floor Construction.



Map 6-30. The Lower East Side Tax Lots with Over 12-floor Construction.

6-4 The Lower East Side: Social Environment

6-4.1 Total Population

Between 1980 and 2010 New York City and the Five Boroughs have slowly increased in population. Among the Five Boroughs, Brooklyn is consistently the most populous Borough. (See Figure 6-7 below).

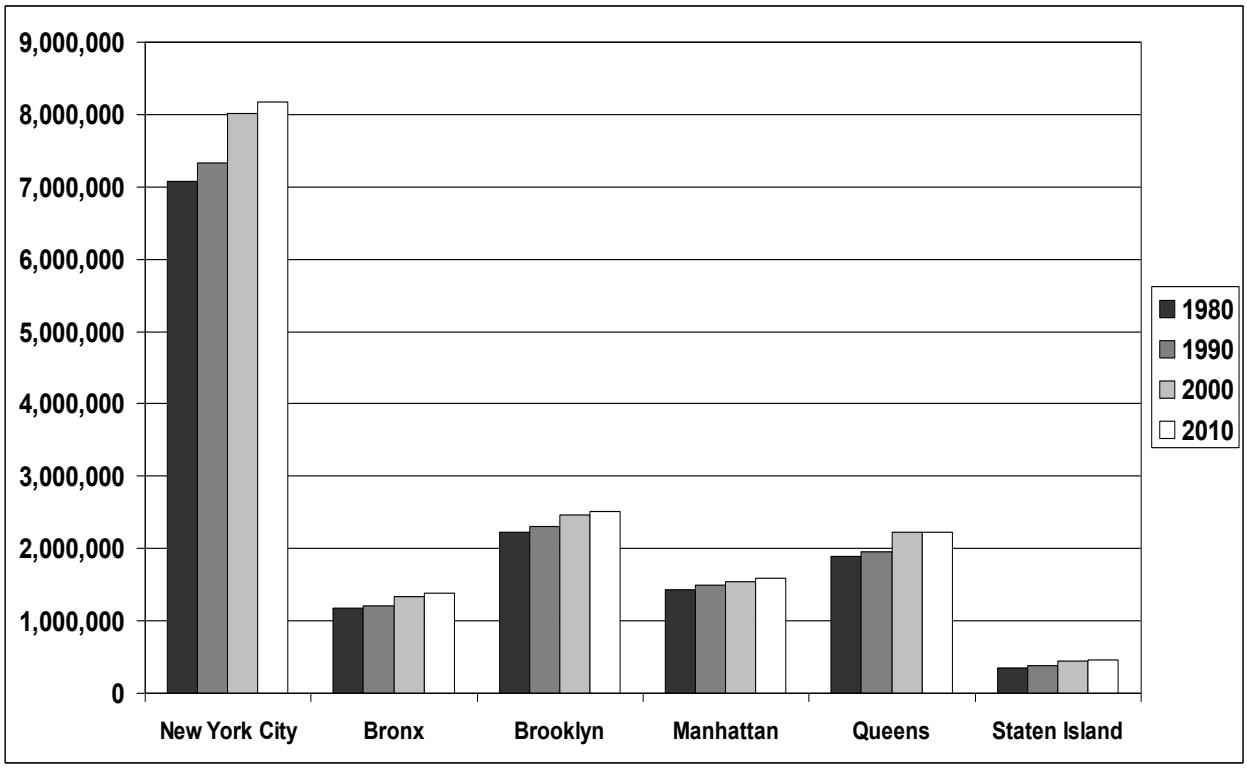


Figure 6-7. Total Population of New York City and the Five Boroughs, 1980-2010.

Of the three neighborhoods in this study, the Lower East Side in Manhattan is the most populous. Figure 6-8 below illustrates that between 1980 and 2010 the Lower East Side (with Core and Environs combined) experiences a slowly increasing total population; the same as New York

City as a whole itself and Manhattan. Figure 6-8 represents the Core and Environs separately, and although the slow increasing pattern is observed, the difference over time is small and without labeling the charts with the actual data, it is difficult to determine the population growth across the Census Survey years.

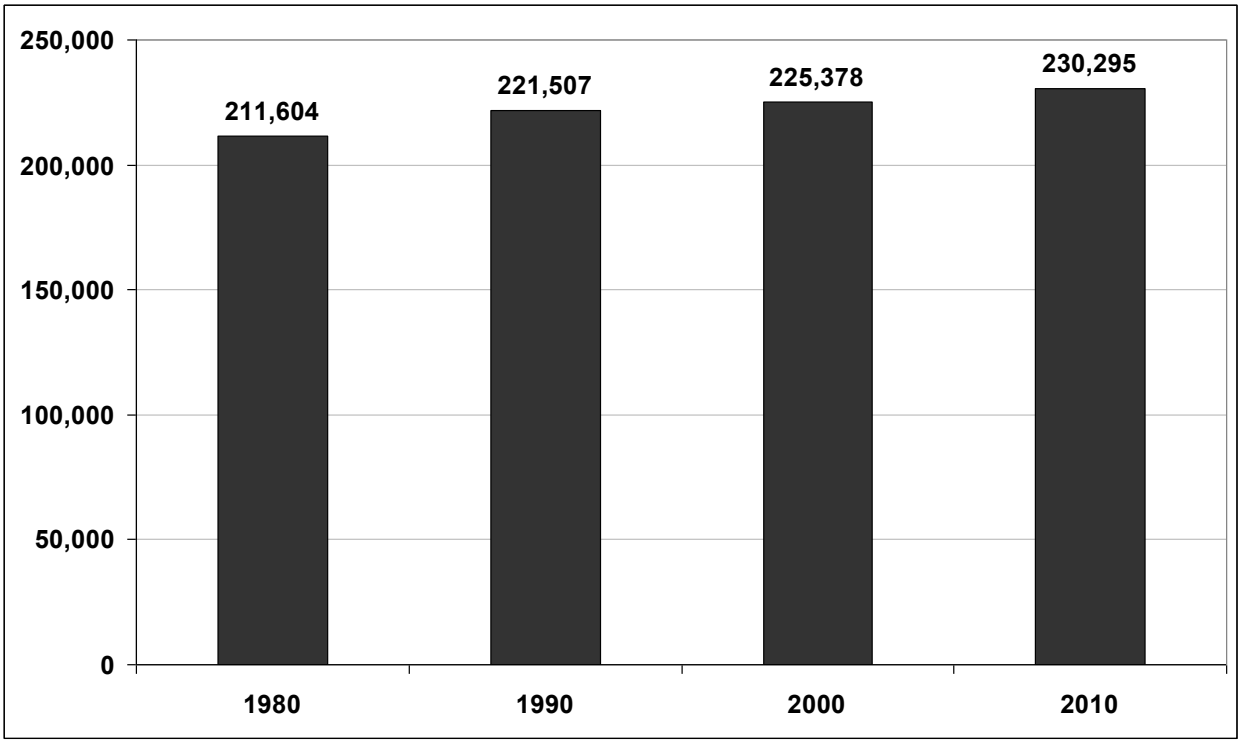


Figure 6-8. Total Population of the Lower East Side, 1980-2010.

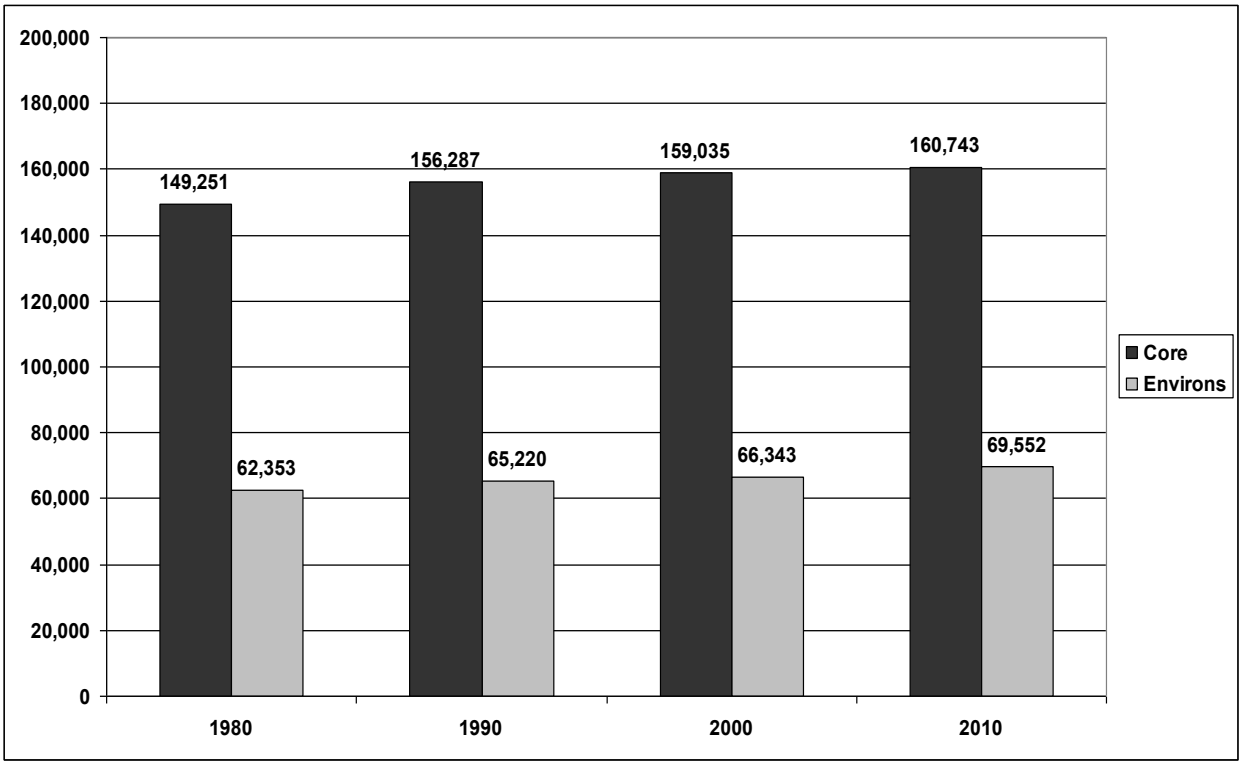
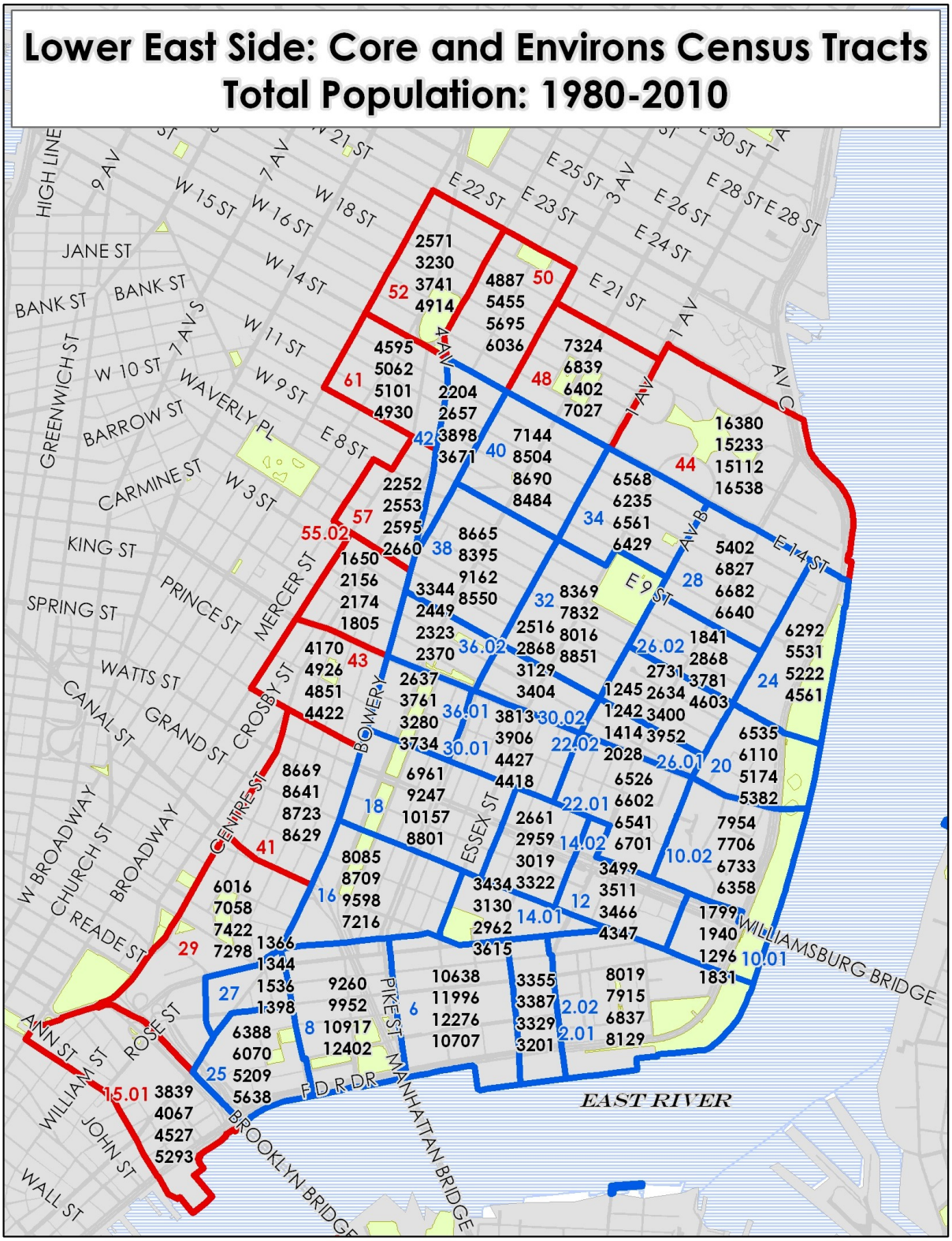


Figure 6-9. Total Population of the Lower East Side - Core vs. Environs Census Tracts, 1980 - 2010.

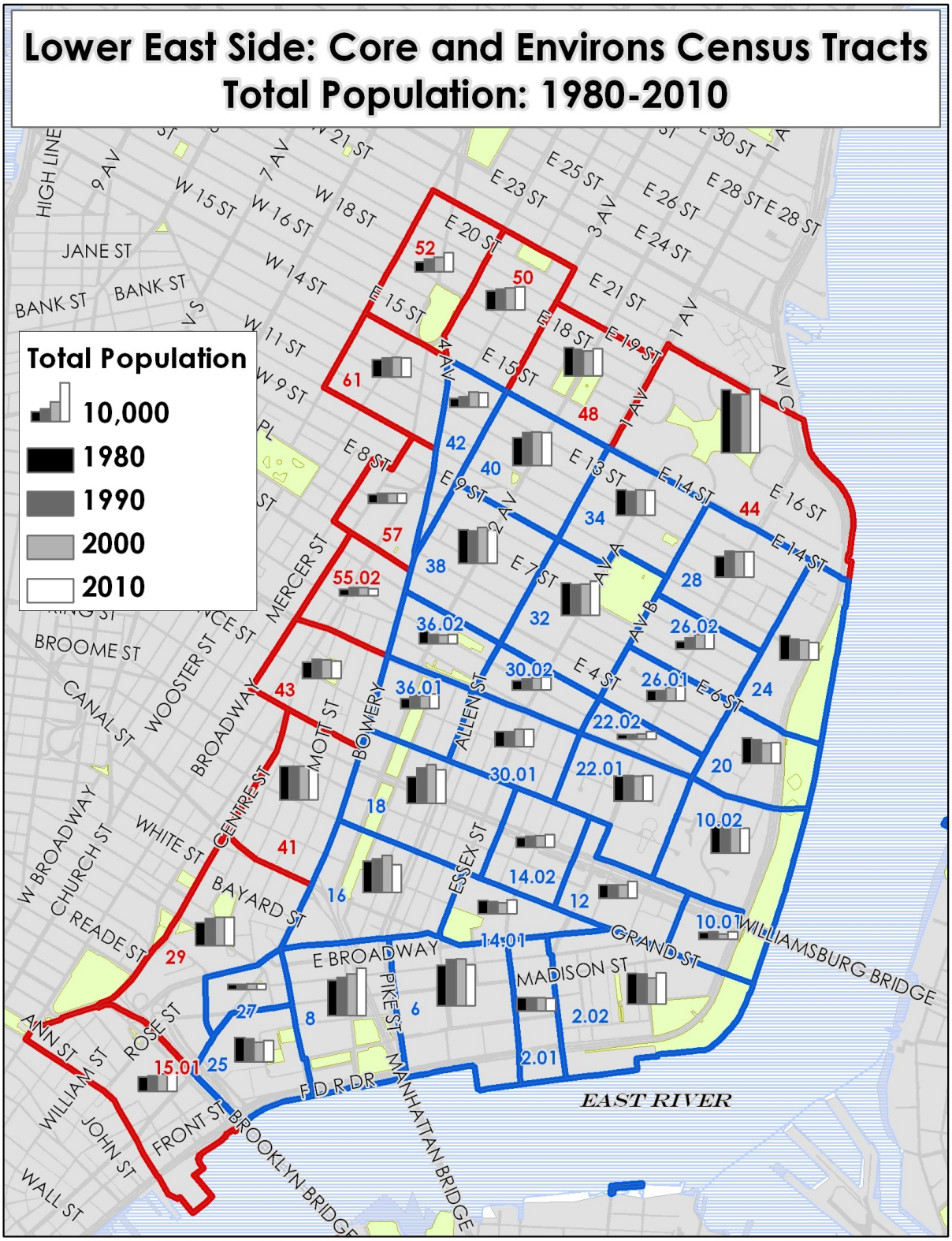
The population in the Lower East Side at the Census Tract level is not evenly distributed. The growth and decline trends are also different at the Census Tract level. Map 6-31 below illustrates the numerical values inserted into the Census Tracts on the map. As stated in the Park Slope chapter, when all the information is presented in this manner, it is not easy to make comparisons among the Census Tracts and is also difficult to determine the trend. Map 6-32 illustrates these numerical values converted into bar charts and embedded into the map, which facilitates understanding the differences among the Census Tracts. Figure 6-10 and Figure 6-11 represent the uncompressed bar charts so they do not need to be shrunk to fit in the map. Here one can observe a different characteristic of the Lower East Side: The Core contains almost three times as many Census Tracts as does the Environs (i.e. 29 and 11 respectively). In Park Slope, there

are exactly 12 Census Tracts each for the Core and Environs. In order to keep both figures on the same page for direct comparison process, the bar charts of the Core must be compressed horizontally; vertically these are not compressed and the scale is the same and the total population can be compared directly to the bar charts of the Environs.

The total population of the Lower East Side by Census Tract, as depicted in Map 6-32 below, demonstrates the complexities of zoning in New York City. Despite the fact that some Census Tracts are primarily zoned for commercial use (See Map 6-15 above), residents continue to occupy these Census Tracts.



Map 6-31. Lower East Side, Total Population in Numbers by Census Tract, 1980-2010.



Map 6-32. Lower East Side, Total Population in Bar Chart by Census Tract, 1980 - 2010.

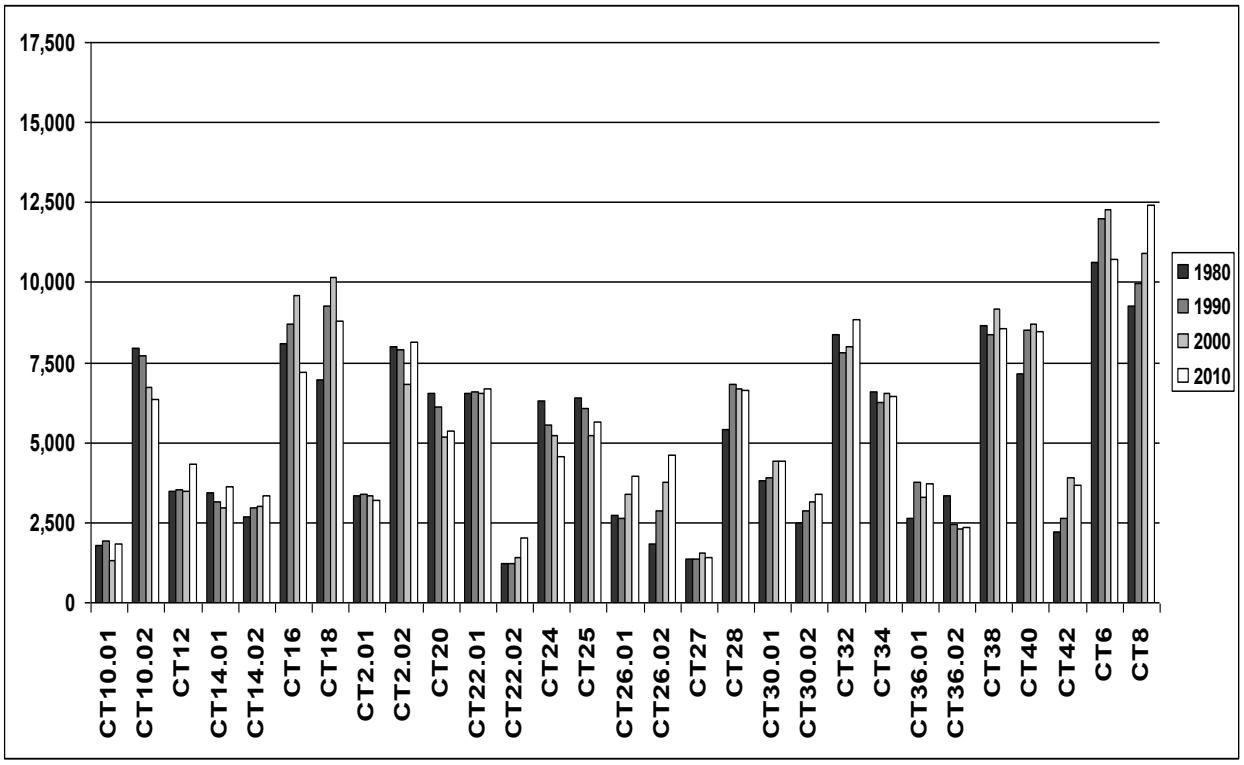


Figure 6-10. Total Population of Census Tracts, the Lower East Side - Core, 1980 - 2010.

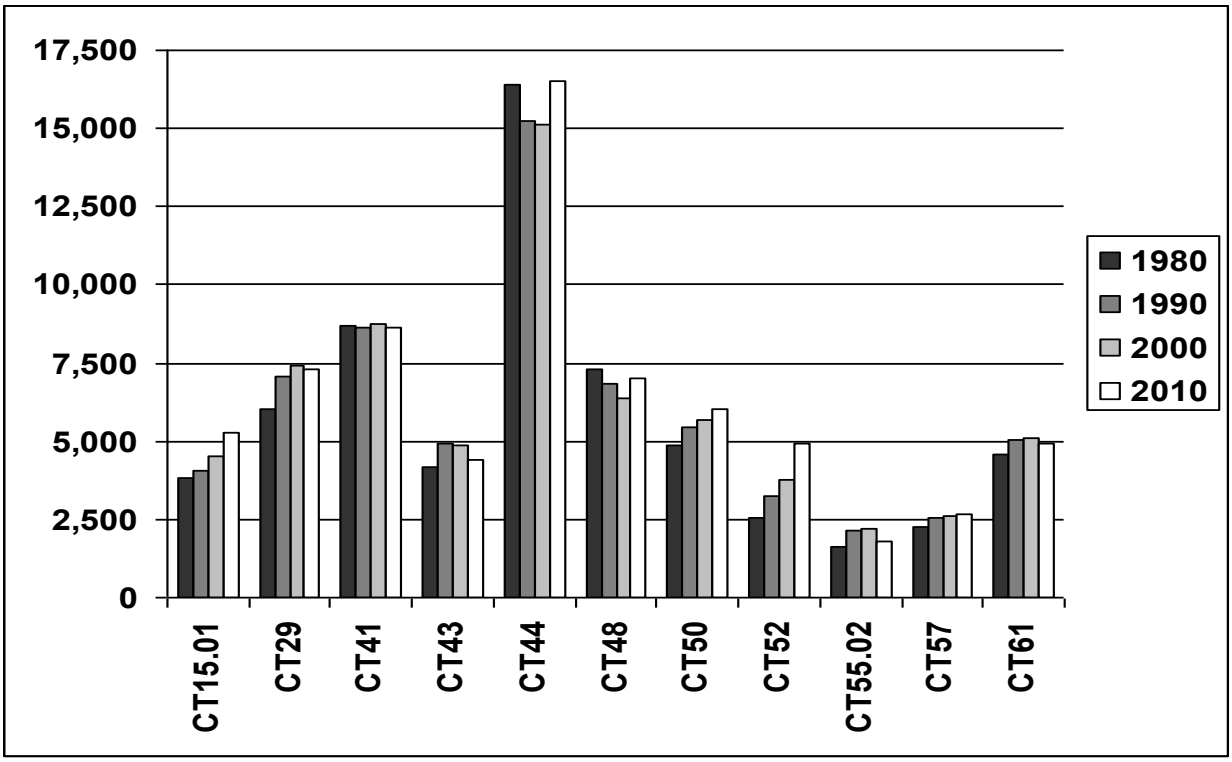


Figure 6-11. Total Population of Census Tracts, the Lower East Side - Environs, 1980 - 2010.

6-4.2 Selected Ethnic Groups Maps

In the next series of maps, selected ethnic groups (i.e. White, Black, Chinese and Hispanic-origin) are mapped each with its percentage at the Census Tract level. The size of the bar charts embedded in each Census Tract is standardized so that these maps can be compared directly to each other, and also to the ethnic group maps in the Park Slope chapter.

6-4.2a Percentage of the White Population

Figure 6-12 below compares the percentage of the White population of the Lower East Side Core and Environs to New York City and the Five Boroughs from 1980 through 2010. One overall trend is a decrease in percentages over time, with the exceptions of Brooklyn and Manhattan that have gained higher percentages between 2000 and 2010. The Lower East Side Core shares this pattern, while the Environs follow New York City's trend and shows steady decreasing percentages through the years.

Together, Map 6-13, Figure 6-13 and Figure 6-14 that demonstrate the percentages at the Census Tract level provide a more complicated and diverse picture. The usual design to form a neighborhood by aggregating several Census Tracts fails to illustrate the differences among the Census Tracts. The neighborhood-by-aggregated-Census-Tract design can easily misinterpret the conclusion that the Lower East Side is predominantly White. While this conclusion is not completely incorrect, the map below clearly shows the spatially uneven distribution of the White population. The Census Tracts in the Northern part of the Lower East Side (including the surrounding Environs Census Tracts) the White population is indeed the majority. However,

There are two areas that are exceptions: the first area is the riverfront Core where public housing located (three Census Tracts 24, 20, and 10.2) where the percentage of the White population has been consistently low; the second area is located at the Southern corner of the Core and extends into the Environs that is the Chinatown neighborhood that also has consistently low percentages of White residents through the study period.

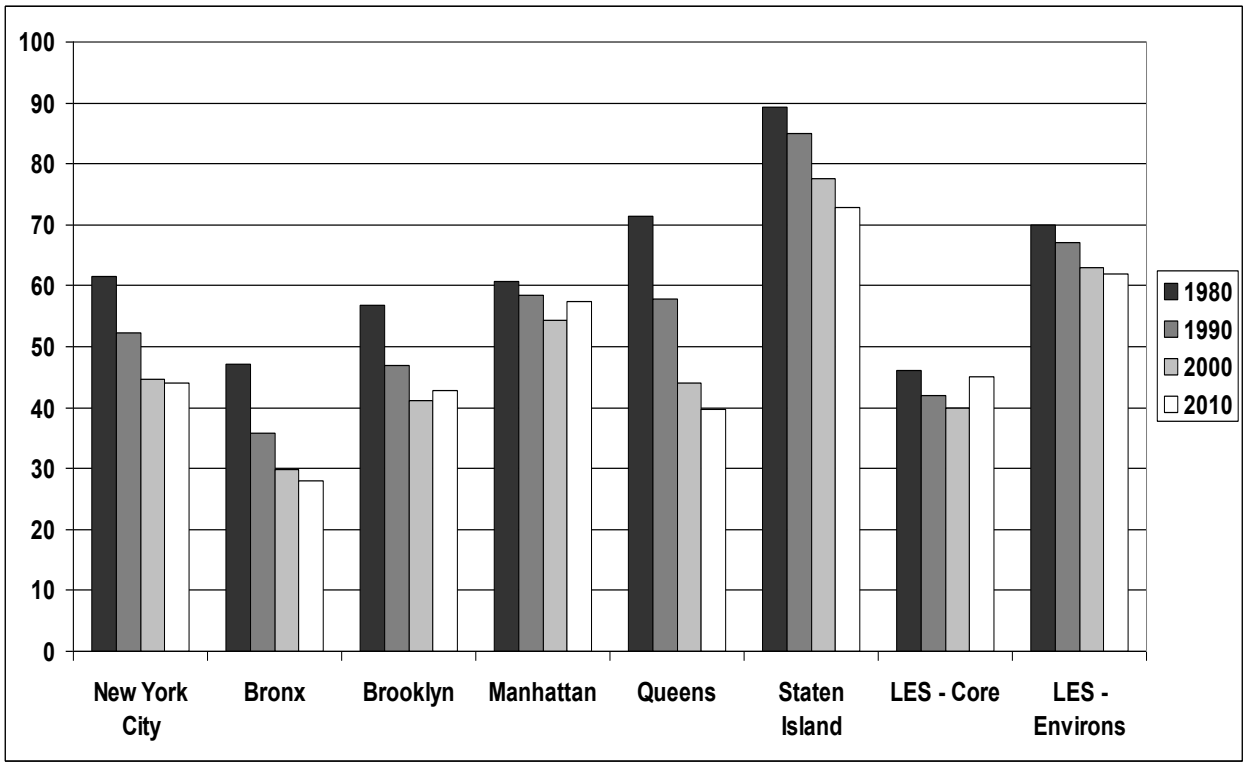
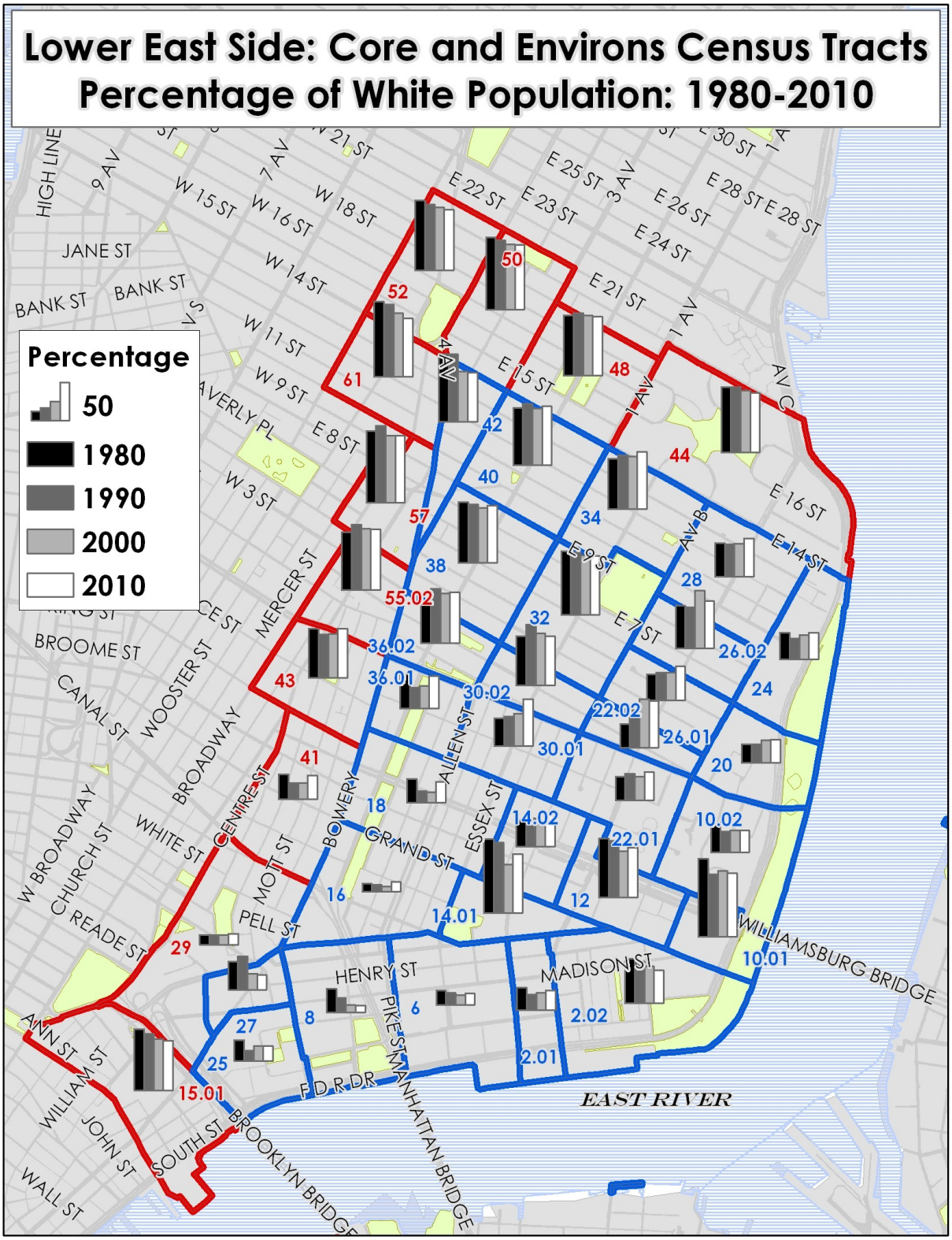


Figure 6-12. Percentage of the White Population in New York City, the Five Boroughs and the Lower East Side - Core and Environs, 1980 - 2010.



Map 6-33. The Lower East Side, Percentage of White Population by Census Tract, 1980 - 2010.

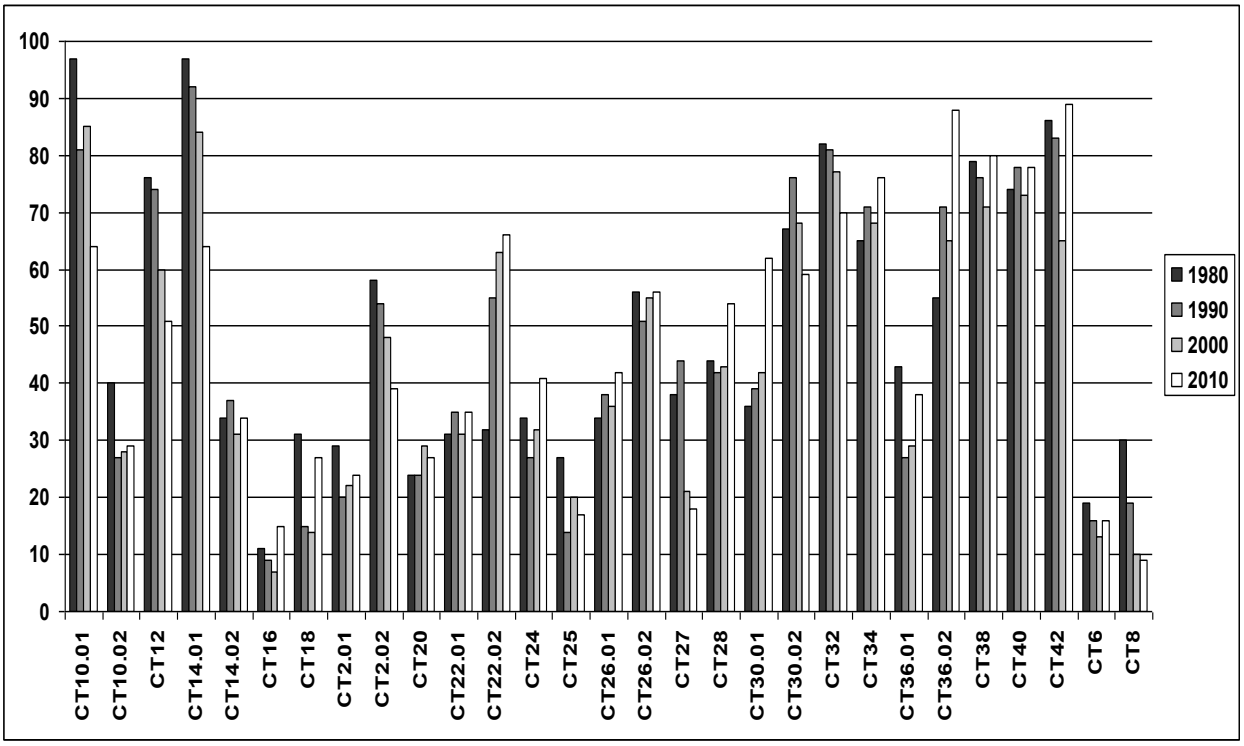


Figure 6-13. Percentage of the White Population in the Lower East Side - Core by Census Tract, 1980 - 2010.

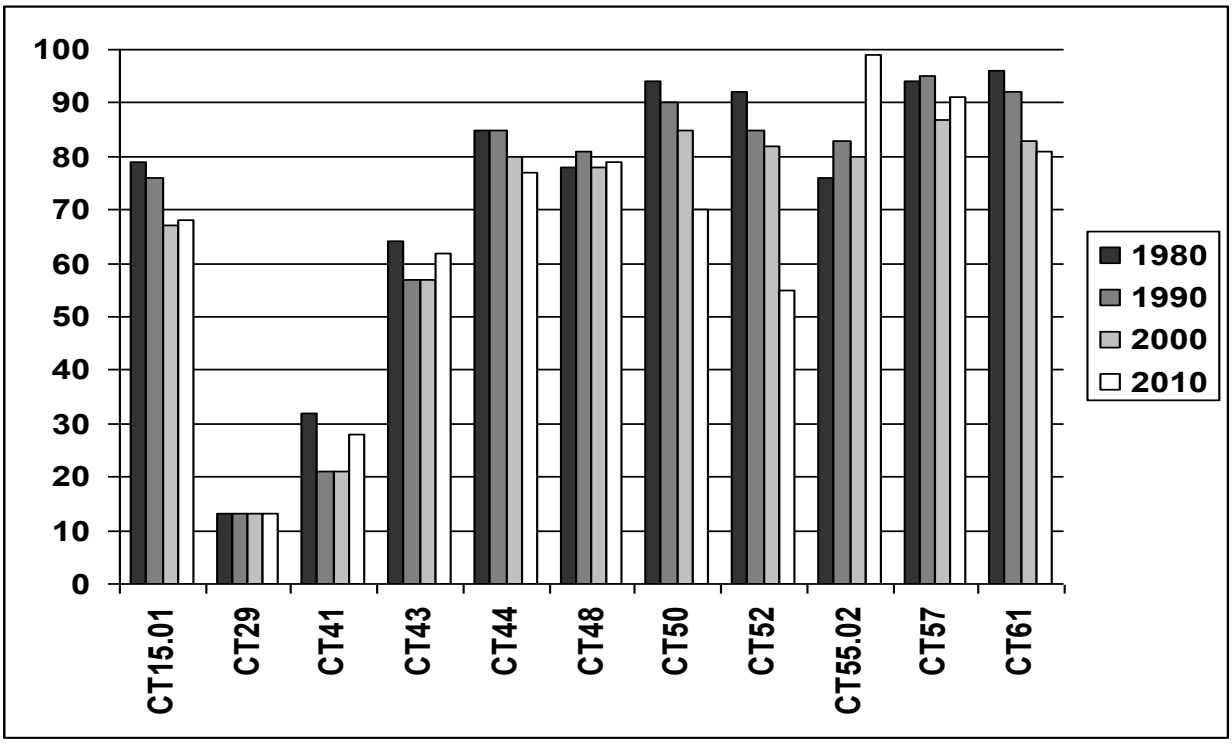


Figure 6-14. Percentage of the White Population in the Lower East Side - Environs by Census Tract, 1980 - 2010.

6-4.2b Percentage of the Black Population

Although the percentage of the Black population hovers around 25% for New York City as a whole between 1980 and 2010, both the Lower East Side Core and Environs have consistently low percentages of Black population throughout the study years (Figure 6-15, below). Between 1980 and 1990 the Core surpassed the 10% mark, but the percentage drops below this value in 2000 and 2010 whereas the Environs percentage is even lower and remains consistent throughout the study years.

Map 6-34, Figure 6-16 and Figure 6-17 illustrate the percentage at the Census Tract level. While the Census Tracts in the Environs have consistently low percentages throughout the study years, there are some variations among the Census Tracts in the Core. The Black population clusters toward the Eastern portion of the neighborhood and along East Houston Street (Census Tracts 30.01, 30.02, 36.01 and 36.02). At the North and North-west corners, the percentages do not reach 10% throughout the study period. When Considering the high percentages for the White population discussed in the previous section, these low percentages foe the Black population are to be expected. Lower percentages for the Black population are also observed in the Southern Core, which is predominantly Chinese which is discussed in the next section.

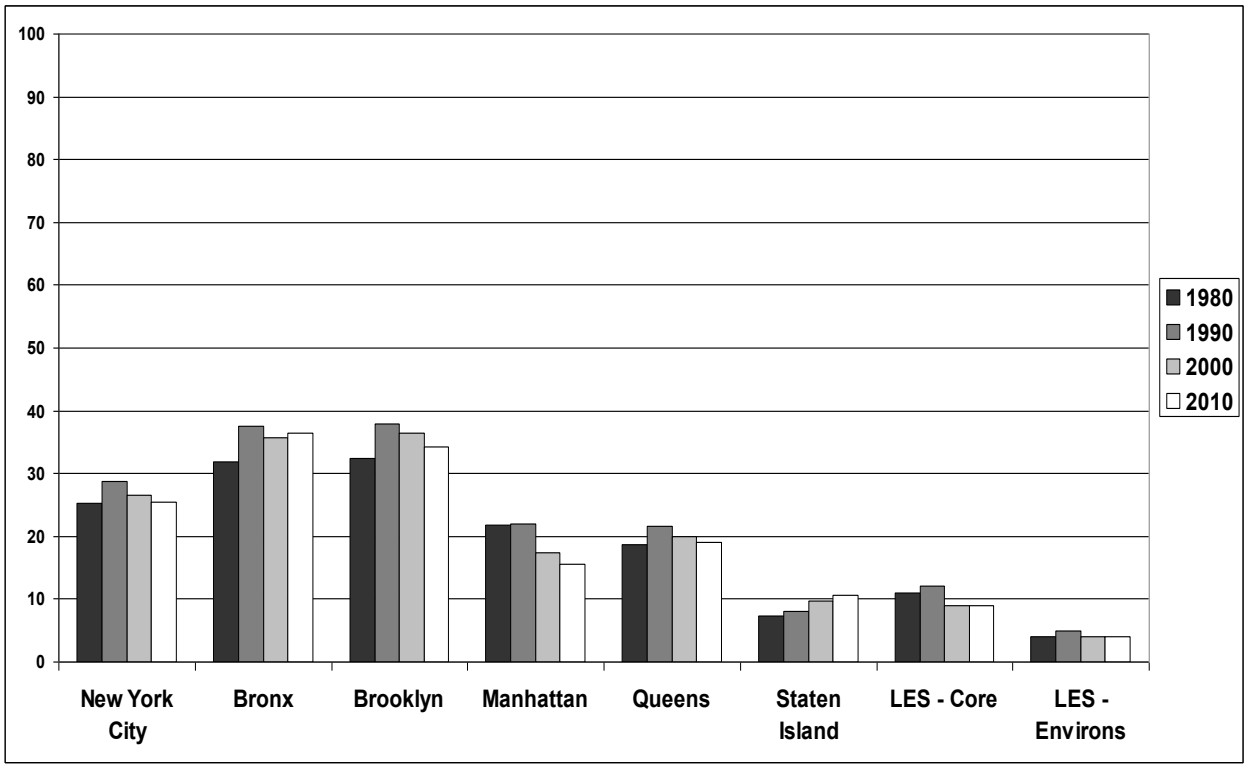
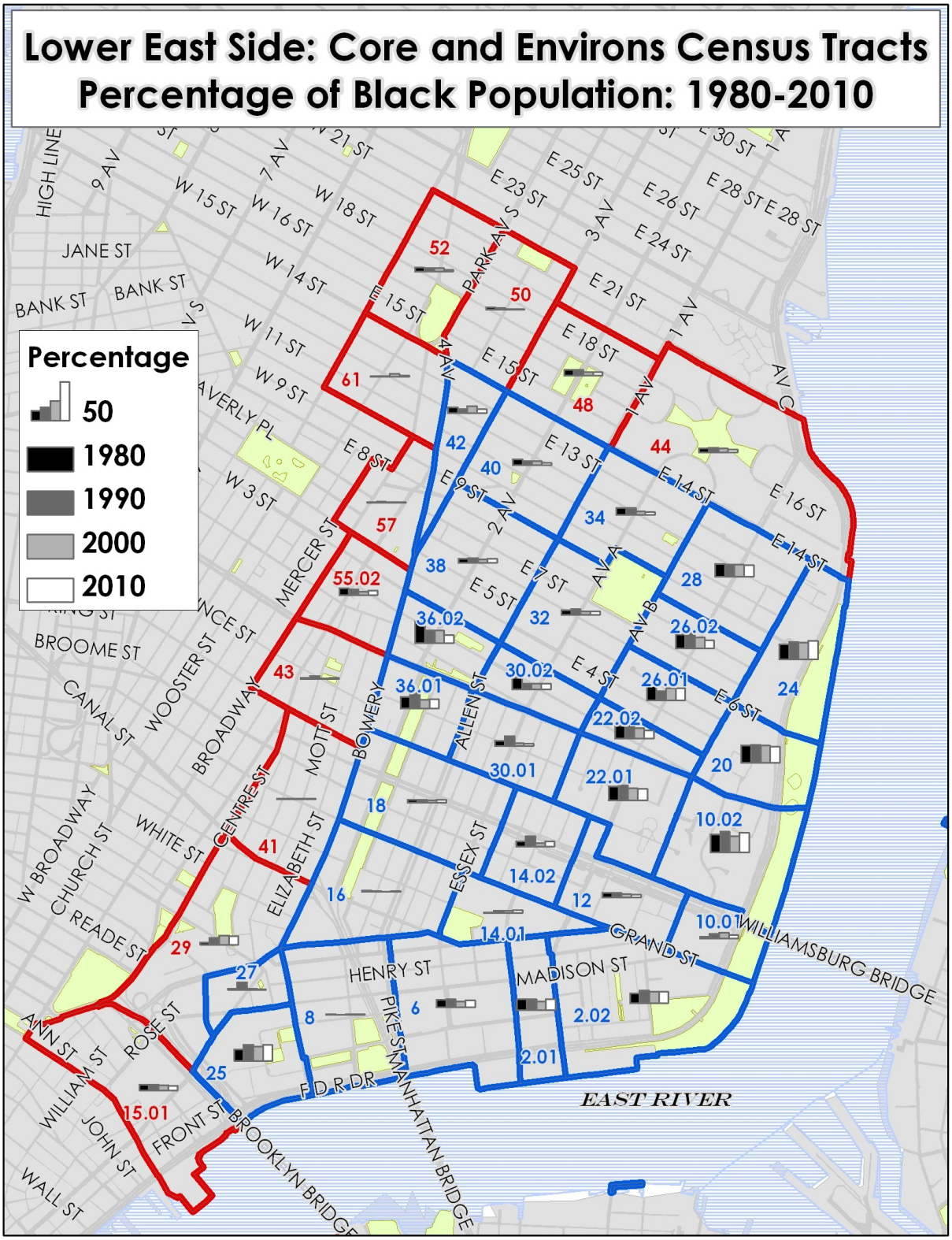


Figure 6-15. Percentage of the Black Population in New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.



Map 6-34. The Lower East Side, Percentage of Black Population by Census Tract, 1980 - 2010.

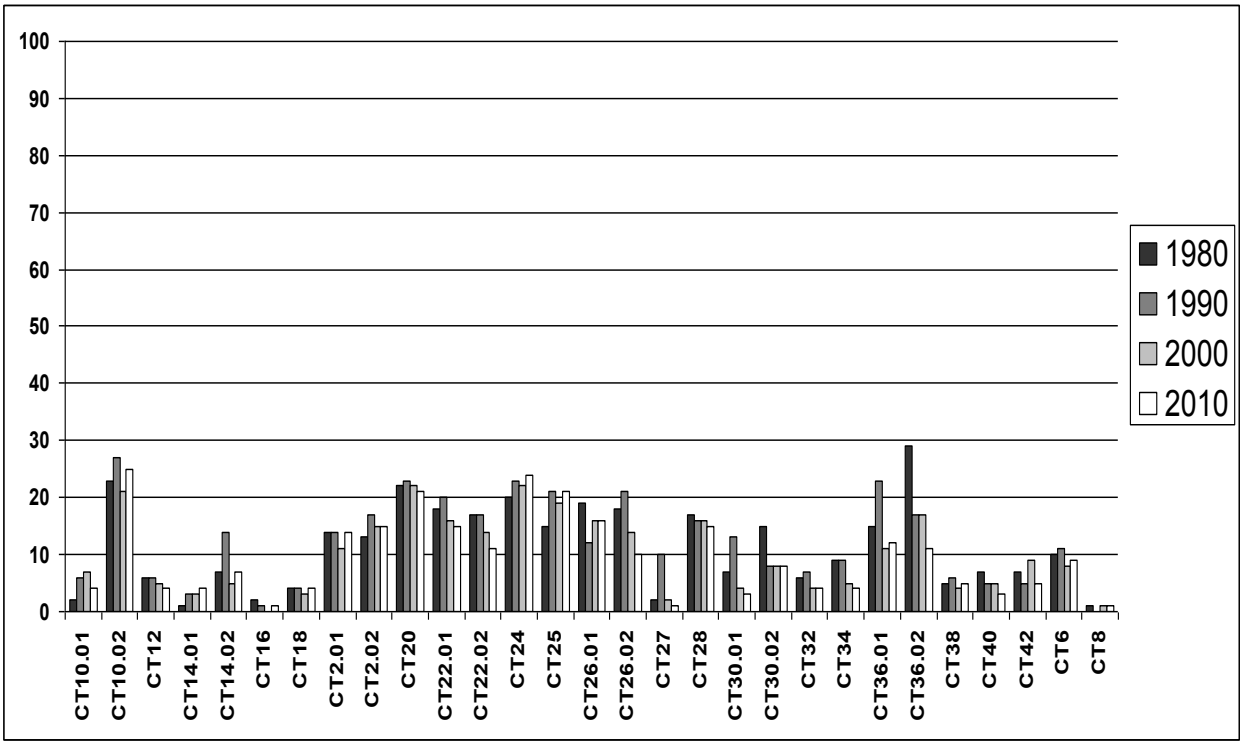


Figure 6-16. Percentage of the Black Population in the Lower East Side - Core by Census Tract, 1980 - 2010.

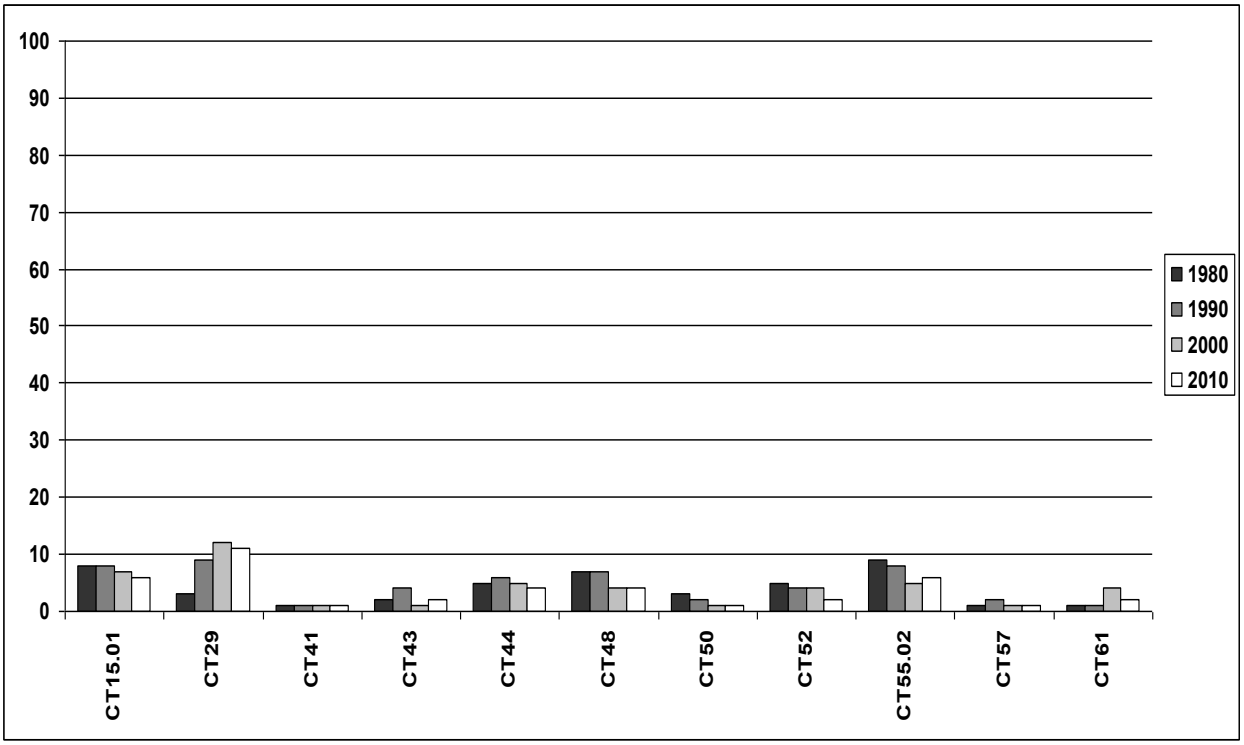


Figure 6-17. Percentage of the Black Population in the Lower East Side - Environs by Census Tract, 1980 - 2010.

6-4.2c Percentage of the Chinese Population

The inclusion of a map that reflects Chinese population in Park Slope may see irrelevant, however, because the Lower East Side includes the Eastern portion of Manhattan's Chinatown mapping the Chinese population in each of the three study neighborhoods illustrates the differences and how spatially uneven the Chinese population is represented in New York City. Even at the aggregated level of the Lower East Core and Environs, both would show considerably higher percentages of the Chinese population than New York City and the Five Boroughs. (See Figure 6-18 below). Despite the higher percentages of the Lower East Side Core and Environs, it is noteworthy that after the steady increase in the Chinese population between 1980 and 2000, the percentages of both areas in fact decreased in 2010.

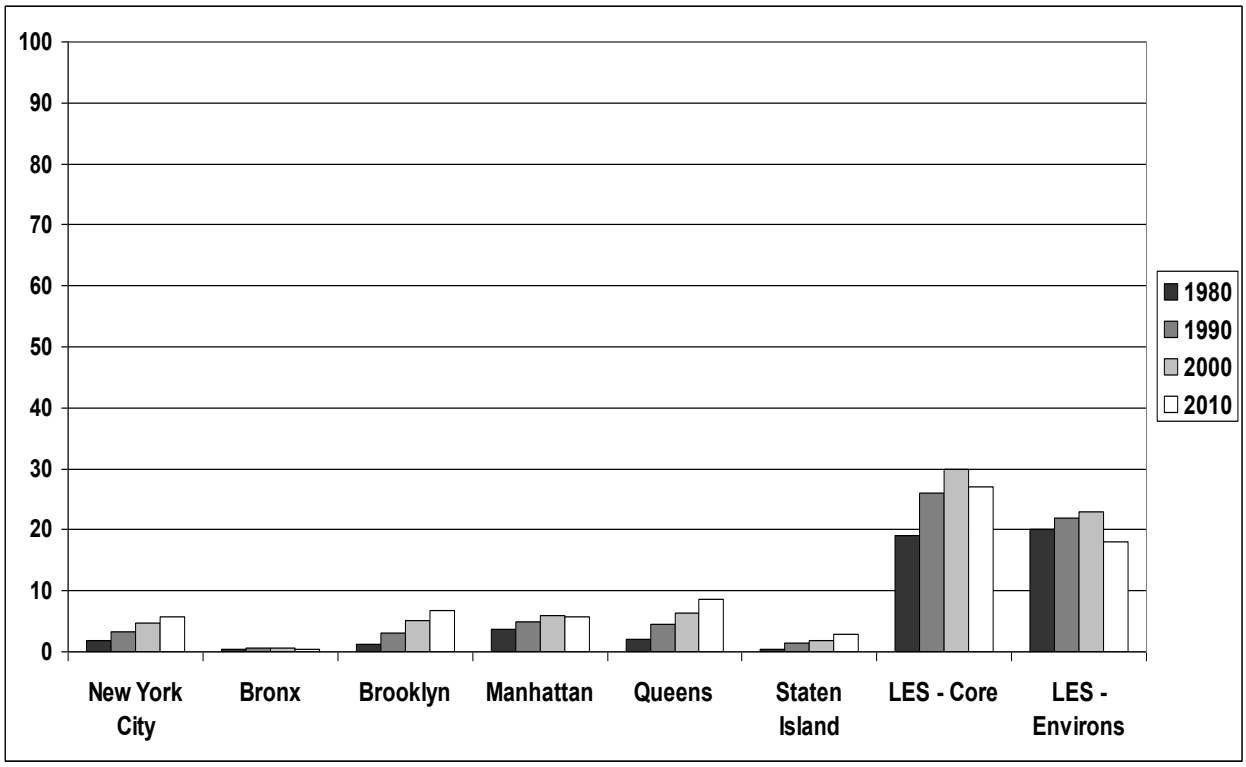


Figure 6-18. Percentage of the Chinese Population in New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.

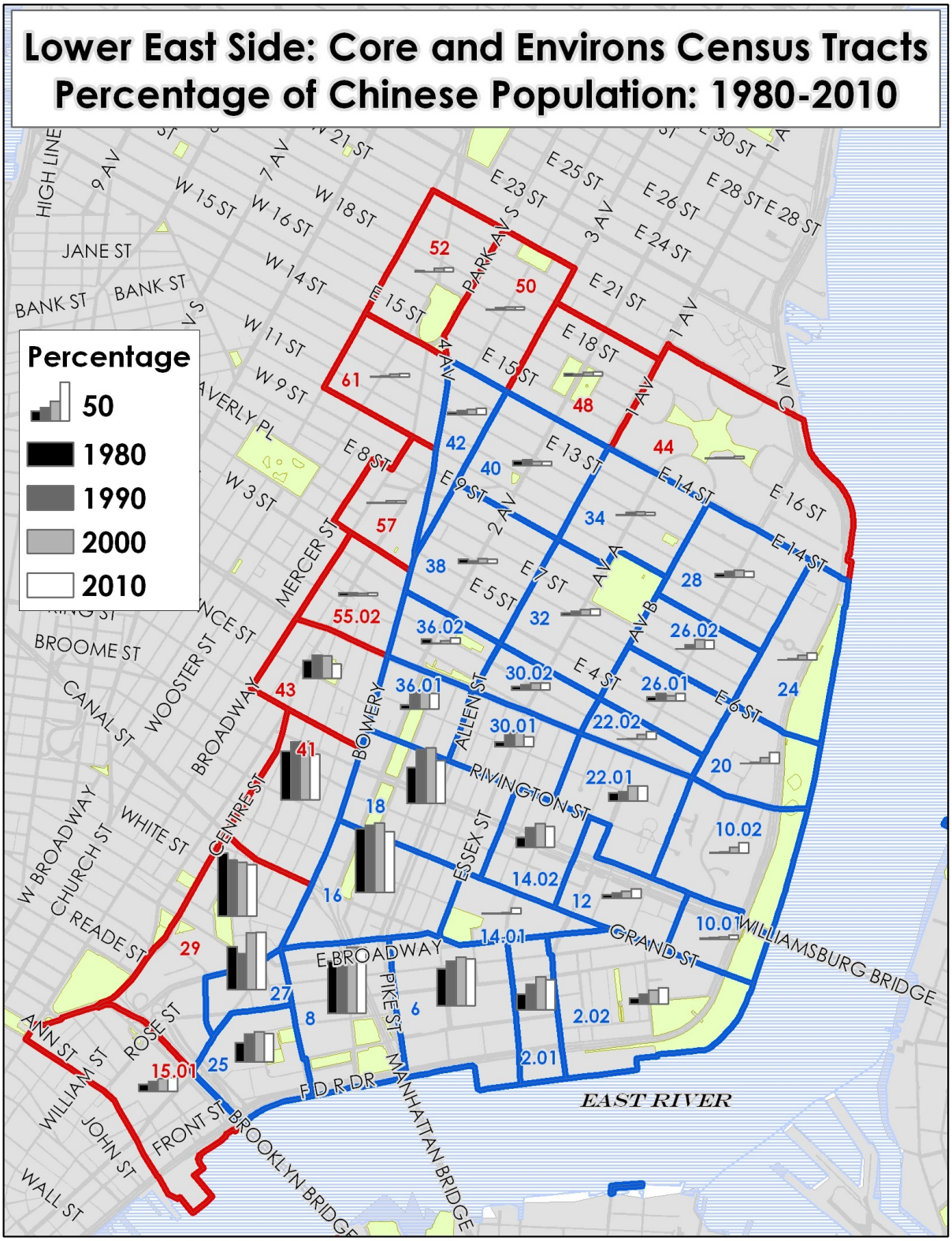
Map 6-35, Figure 6-19 and Figure 6-20 illustrate that within the Lower East Side, the Chinese population is unevenly distributed. Map 6-35 below is another example that demonstrates the inadequacy of aggregating several Census Tracts to form a neighborhood. That approach would even out the variations among the Census Tracts and does not reveal the location and extent of Chinatown in downtown Manhattan. Gentrification reveals and produces the uneven development across space and only research based on the smallest spatial unit where data is available can expose the spatial unevenness.

Although the percentage of the Chinese population in New York City grew steadily from less than 2% in 1980 to almost 6% in 2010, this increase does not translate to a general growth across New York City. In the Park Slope Core and Environs, the percentages remain the same between the Census Surveys 2000 and 2010 at 2% and 3% respectively. (See Figure 5-18). In Map 6-35 below we can observe low and single-digit percentages in the Northern portion of the Lower East Side as well. As we travel south and especially toward the South-west corner of the Lower East Side as defined by this study, the percentages rise rapidly and in fact the Chinese population becomes the majority in certain Census Tracts. This increasing pattern peaks around the South-west portion of the Lower East Side and then the percentages decrease as we travel past Chinatown.

Despite the strong presence of the Chinese population, changes do occur throughout the study period. In the Southern portion, while certain Census Tracts appear to have reached a plateau and experience only minor changes in recent years (Census Tracts 29, 27, 25, 8 and 6),Other Census

Tracts (i.e. 18 and 16) experienced a decrease between the two more recent Census Surveys 2000 and 2010.

Along the East River there are modest increases in the riverfront Census Tracts (24, 20, 10.02, 10.01 and 2.02); although the figures are still low compared to the Chinese-dominant Census Tracts, they register higher than the citywide figure in the 2010 Census Survey.



Map 6-35. The Lower East Side, Percentage of Chinese Population by Census Tract, 1980 - 2010.

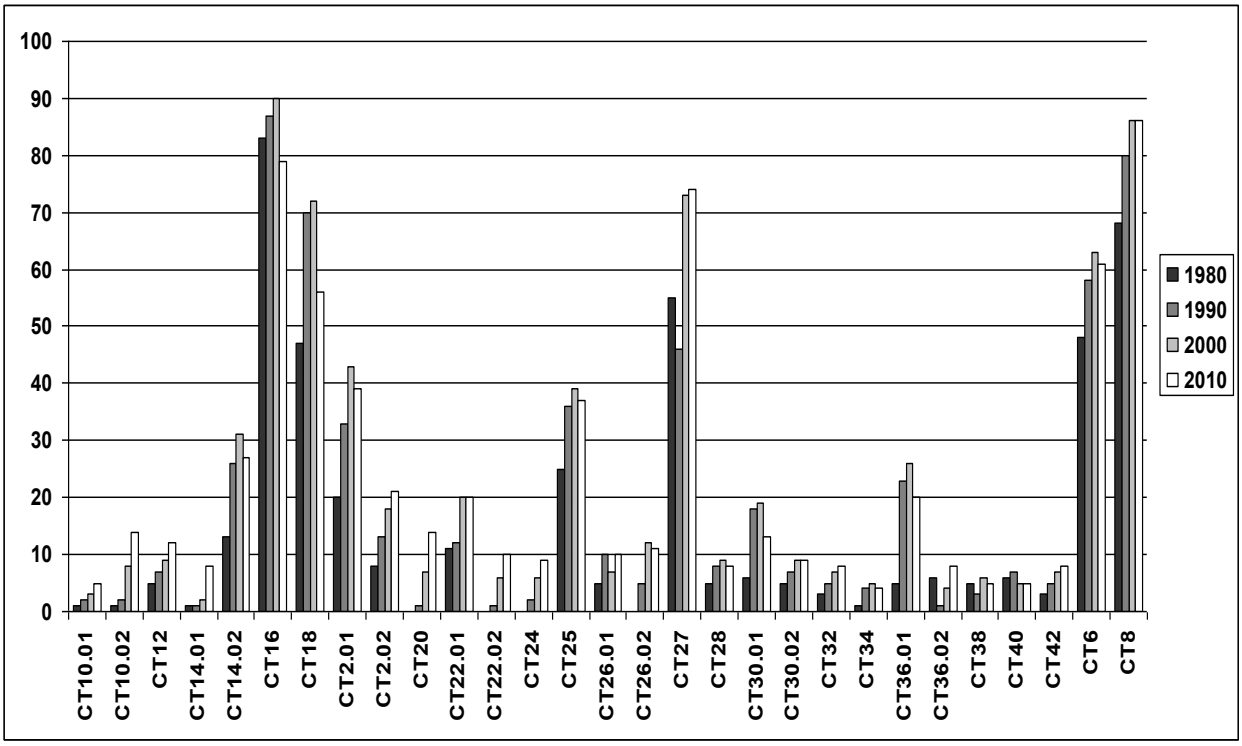


Figure 6-19. Percentage of the Chinese Population in the Lower East Side - Core by Census Tract, 1980 - 2010.

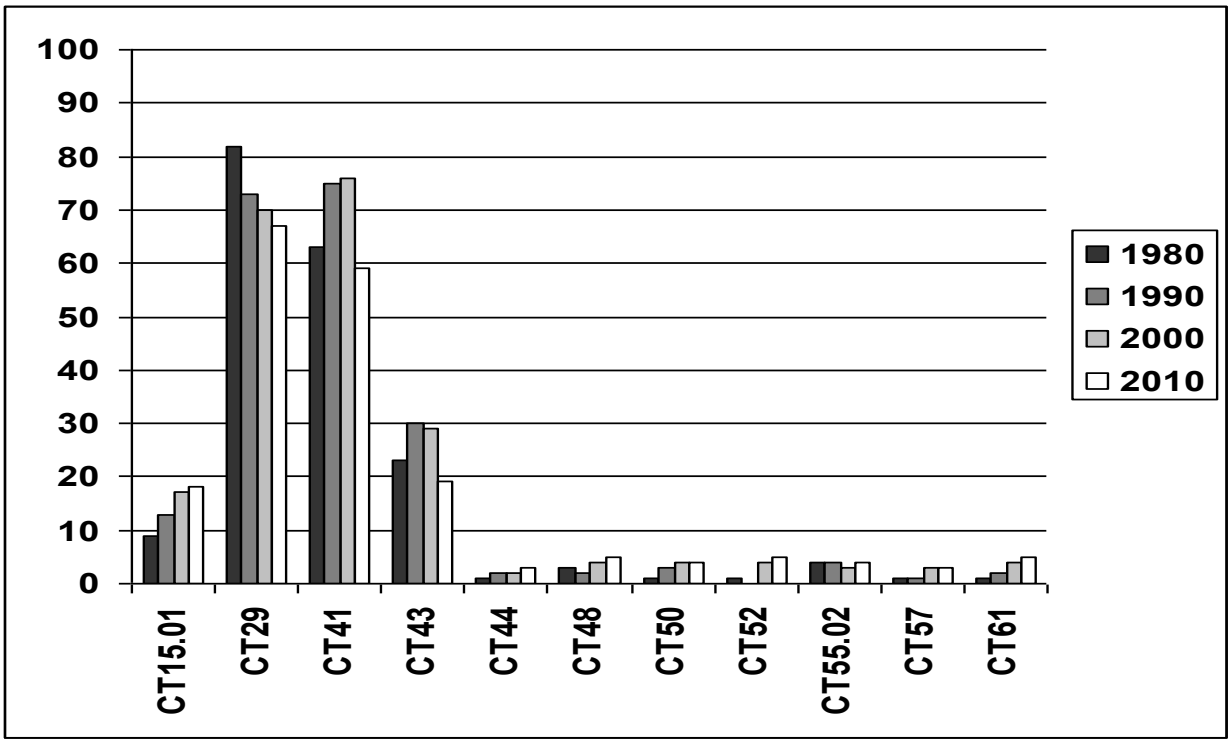


Figure 6-20. Percentage of the Chinese Population in the Lower East Side - Core by Census Tract, 1980 - 2010.

6-4.2d Percentage of the Hispanic-origin Population

Regarding the Hispanic population in the Lower East Side, it should be noted again by the design of the Census Survey being "Hispanic" is a separate question from other ethnic groups. Unlike the three previous maps which are based on mutually exclusive ethnic groups (i.e. White, Black and Chinese), the total population is divided into Hispanic(-origin) and non-Hispanic(-origin). As a result, the Hispanic population maps and figures, while listed under the ethnic group section in this study, cannot be compared directly to the previous three sections.

Figure 6-21 compares the Hispanic population in the Lower East Side Core and Environs to New York City as a whole and the Five Boroughs. Overall, New York City is experiencing an increasing Hispanic population. The same increasing pattern is also observed in the Bronx, Queens and Staten Island. The Bronx surpassed the 50% milestone in 2010. The trends for the Lower East Side Core and Environs are different: the Environs experience consistently low percentages throughout the study period, while the Core experiences decreasing percentages. In 1980 almost 40% of the population of the Lower East Side Core was Hispanic. The percentages continue decreasing throughout the study period by approximately 5% for each ten year period. Considering the rising percentages of the Hispanic population for New York City and some of the Boroughs, this decreasing pattern (also observed in Manhattan) appears to indicate that the Hispanic population is moving from the Lower East Side Core and also moving from the Borough of Manhattan.

Map 6-36, Figure 6-22 and Figure 6-23 illustrate the percentage of the Hispanic population by Census Tract and provide the following observations and patterns:

1. Similar to the Chinese population percentage map (See Map 6-35) there are sharp contrasts among the Census Tracts for the Hispanic population. While in general the percentages for the Hispanic population are higher in the Eastern part of the Core area, they are also higher along East Houston Street (i.e. Census Tracts 30.01, 10.02, 36.91 and 36.92); high percentages of the Hispanic population can also be observed in the Southern tip with the Core (i.e. Census Tract 25).

2. Over time, however, while certain Census Tracts on the Eastern portion retain high percentages of the Hispanic population, a decrease is observed in the center of the Core area. In fact, the percentages drop considerably west of the riverfront Census Tracts where the Hispanic population has changed from the majority to the minority.

3. Consistently low percentages of the Hispanic population throughout the study period are observed in the North and South ends of the Lower East Side. Combined with the previous ethnic group maps one can conclude that the North is predominantly White, non-Hispanic and the South Chinese, non-Hispanic.

It is important to stress that the ethnic composition of the Lower East Side is much more complex than the four groups described in this section. The results from this section serve only as a starting point for future gentrification and community studies that require a full-scale demographic analysis for a complex neighborhood like the Lower East Side.

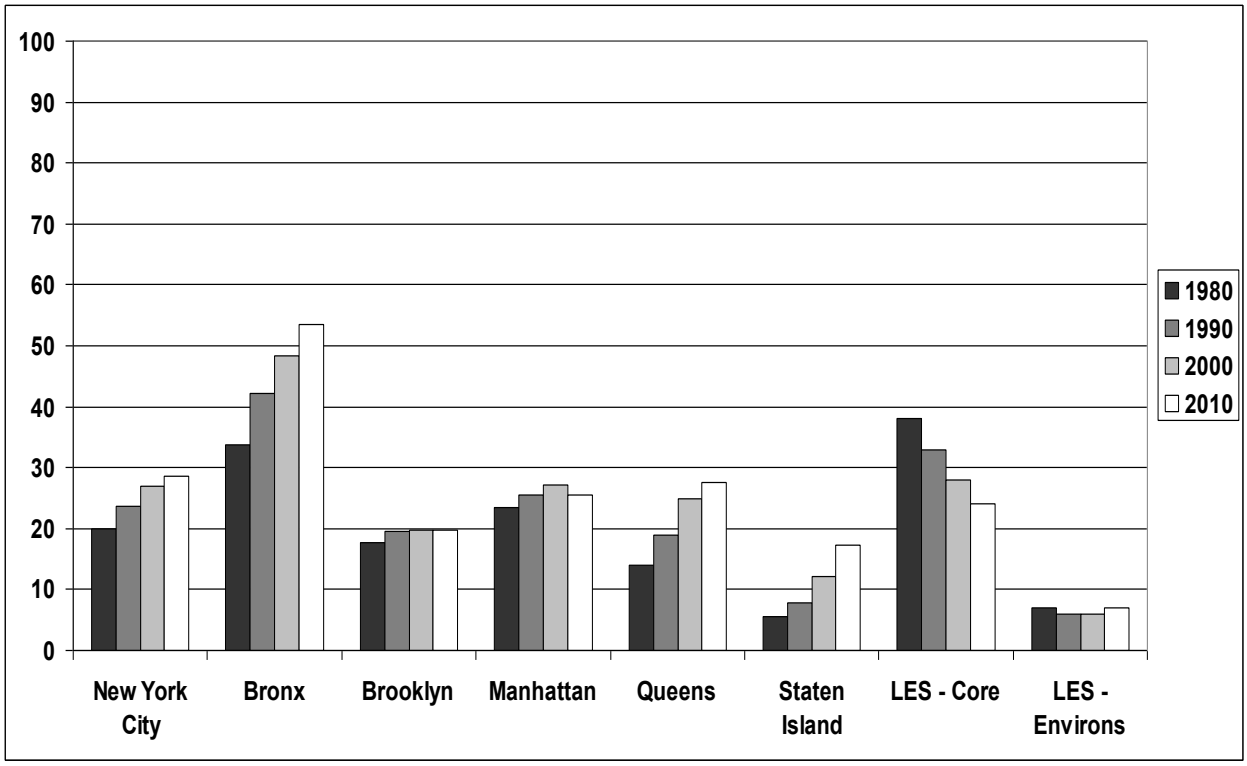
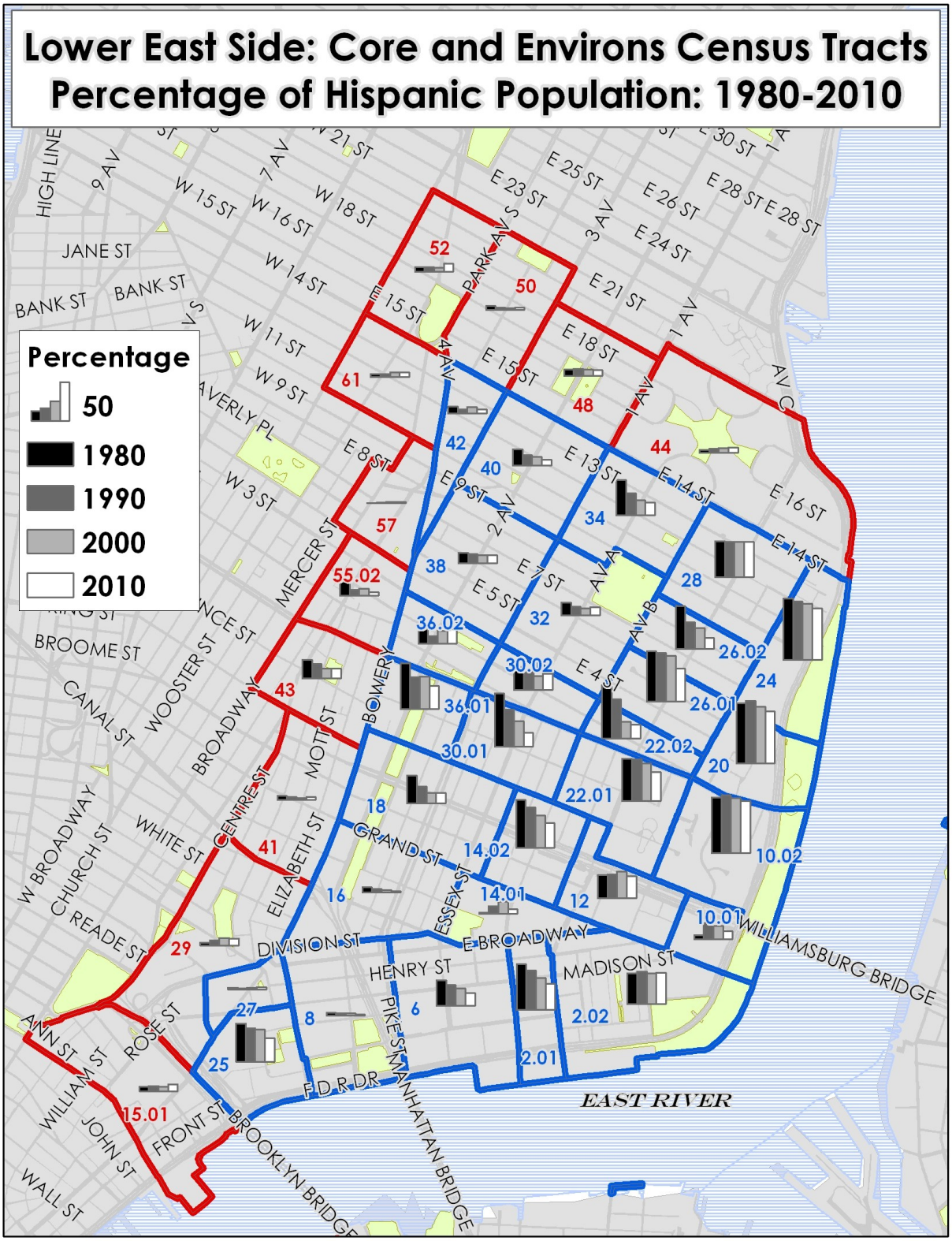


Figure 6-21. Percentage of the Hispanic Population in New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.



Map 6-36. The Lower East Side, Percentage of Hispanic Population by Census Tract, 1980 – 2010.

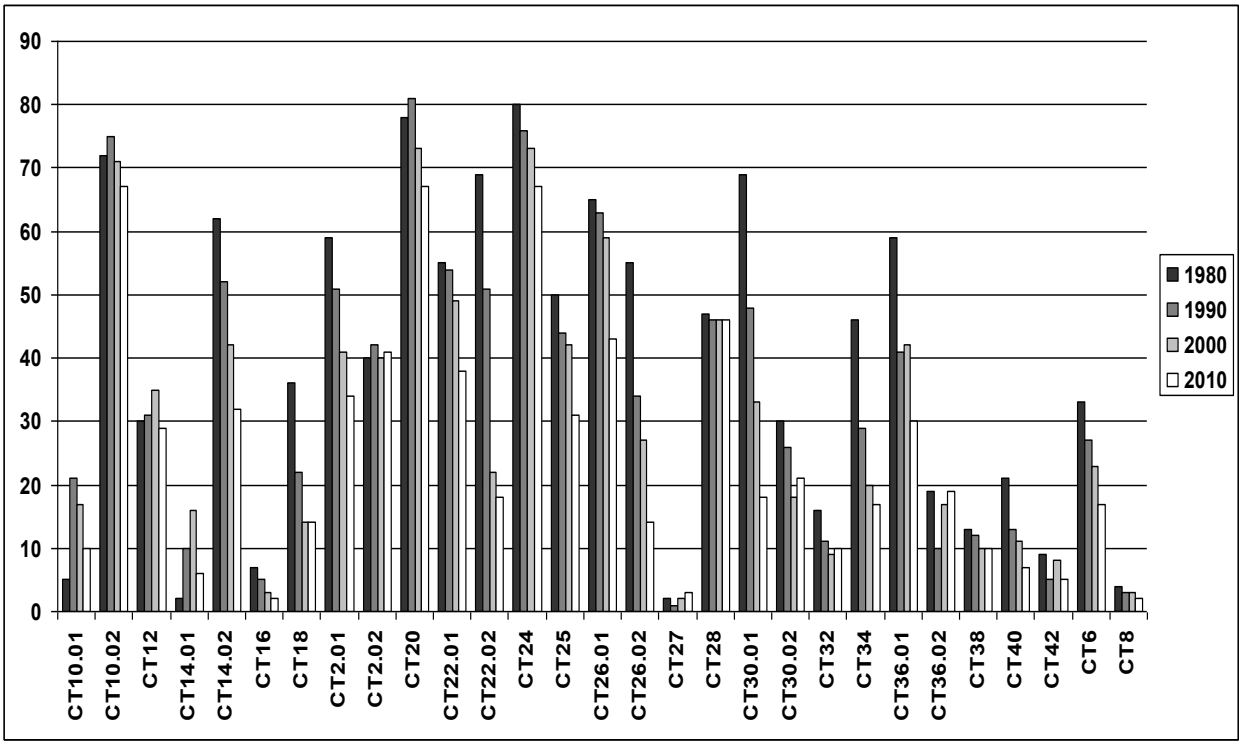


Figure 6-22. Percentages of the Hispanic Population in the Lower East Side - Core by Census Tract, 1980 - 2010.

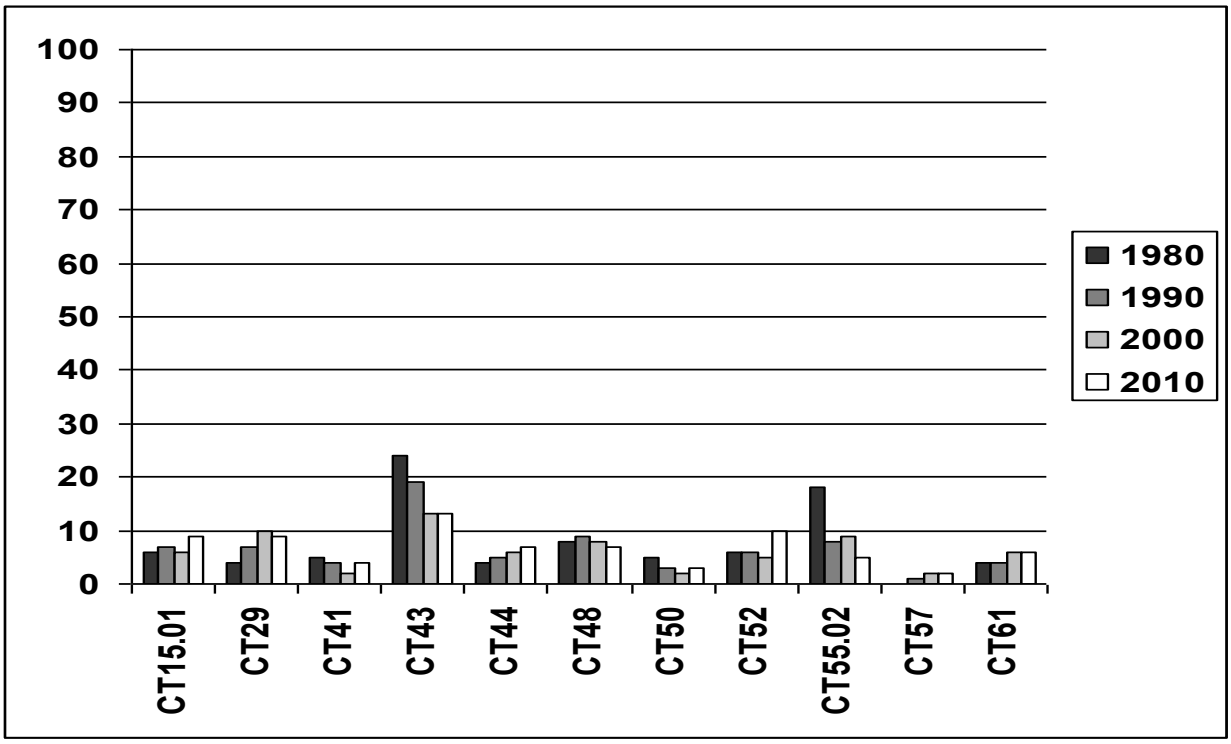


Figure 6-23. Percentages of the Hispanic Population in the Lower East Side - Environs by Census Tract, 1980 - 2010.

6-4.3 Selected Age Groups Maps

In the following pages, the percentages of three age groups are mapped, namely: Age under 5; 22-29; and Age 65 and Over. The scale in the bar charts embedded on the maps is standardized so that the maps can be directly compared to each other. The scales of the bar charts in the figures are sometimes enlarged (with the range from 1 to 10 instead of 1 to 100) to facilitate the comparisons of the lower values.

6-4.3a Age Under 5

Figure 6-24 below compares the percentages of the age group Under 5 against the total population in the Core and the Environs for the Lower East Side with New York City and the Five Boroughs. While New York City maintained a steady percentage of Age Under 5 between 6% and 7% between 1980 and 2010, the Lower East Side experienced a decreasing trend for this age group. The Core especially shows a decreasing pattern, in 1980 it reported an above-the-city 7%, but in subsequent years it dropped below New York City itself and Manhattan as well. The Environs began with a below-the-city 4% and in the following years remain low at a steady 4%. This is contrary to the Park Slope study which experiences increasing percentages between 2000 through 2010.

Map 6-37, Figure 6-25 and Figure 6-26 below illustrate the percentages for individual Census Tracts. With the low percentage values it is not easy to determine the differences among them. Nevertheless, one can observe slightly higher percentages clustered in those Census Tracts located in the center of the Core and also those Census Tracts closer to the East River. These

generally report a decreasing or steady trend (See Figure 6-25). Three of the Census Tracts east of Avenue B (26.02, 26.01, and 22.02) actually surpass the 10% mark in 1980 but then subsequently have lower percentages. This particular decreasing pattern is also observed in Census Tract 30.01, located south-west of this group. This decreasing trend for very young children is especially noteworthy because the median household income in some of the Census Tracts increased (See the map and figures in Section 6-5.5). Although this study does not employ regression analysis to examine the interaction between these two variables, these observations suggest that gentrification in these particular Census Tracts are likely a result of households that are less likely to include young children. Future and more detailed demographic studies are required to fully examine these changing household compositions.

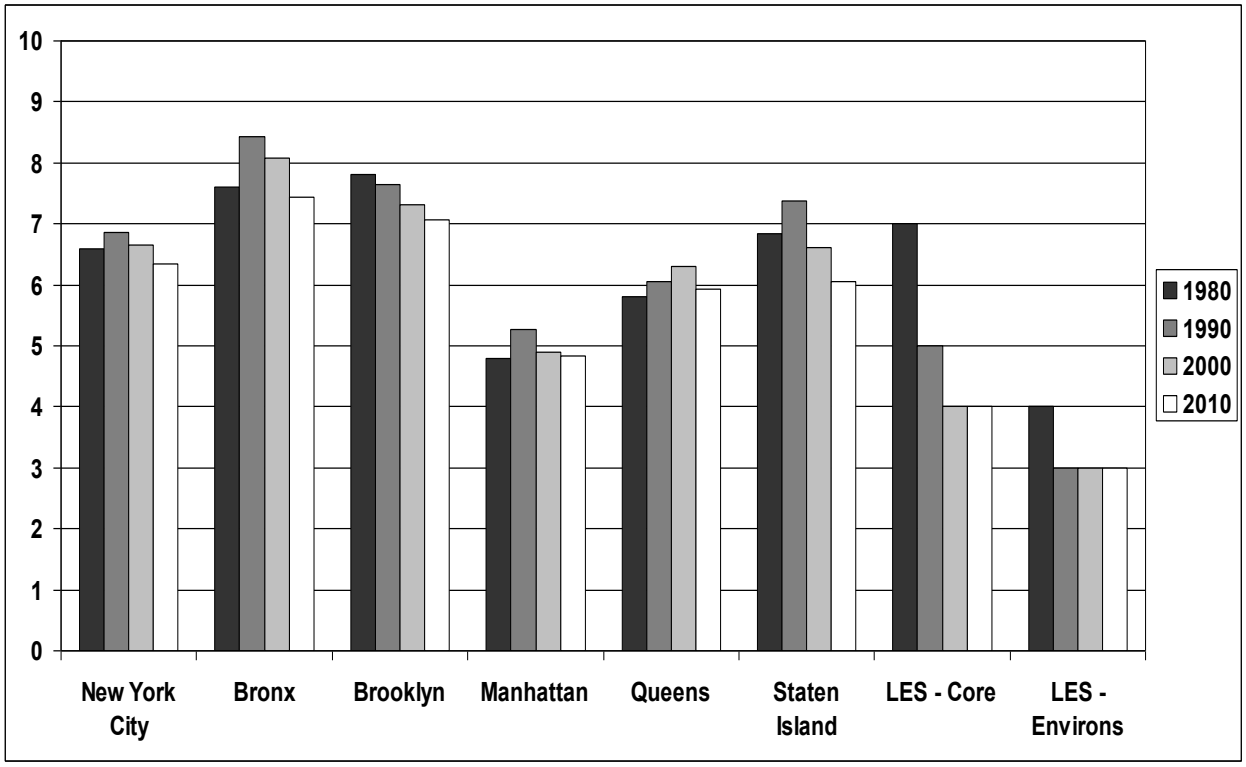
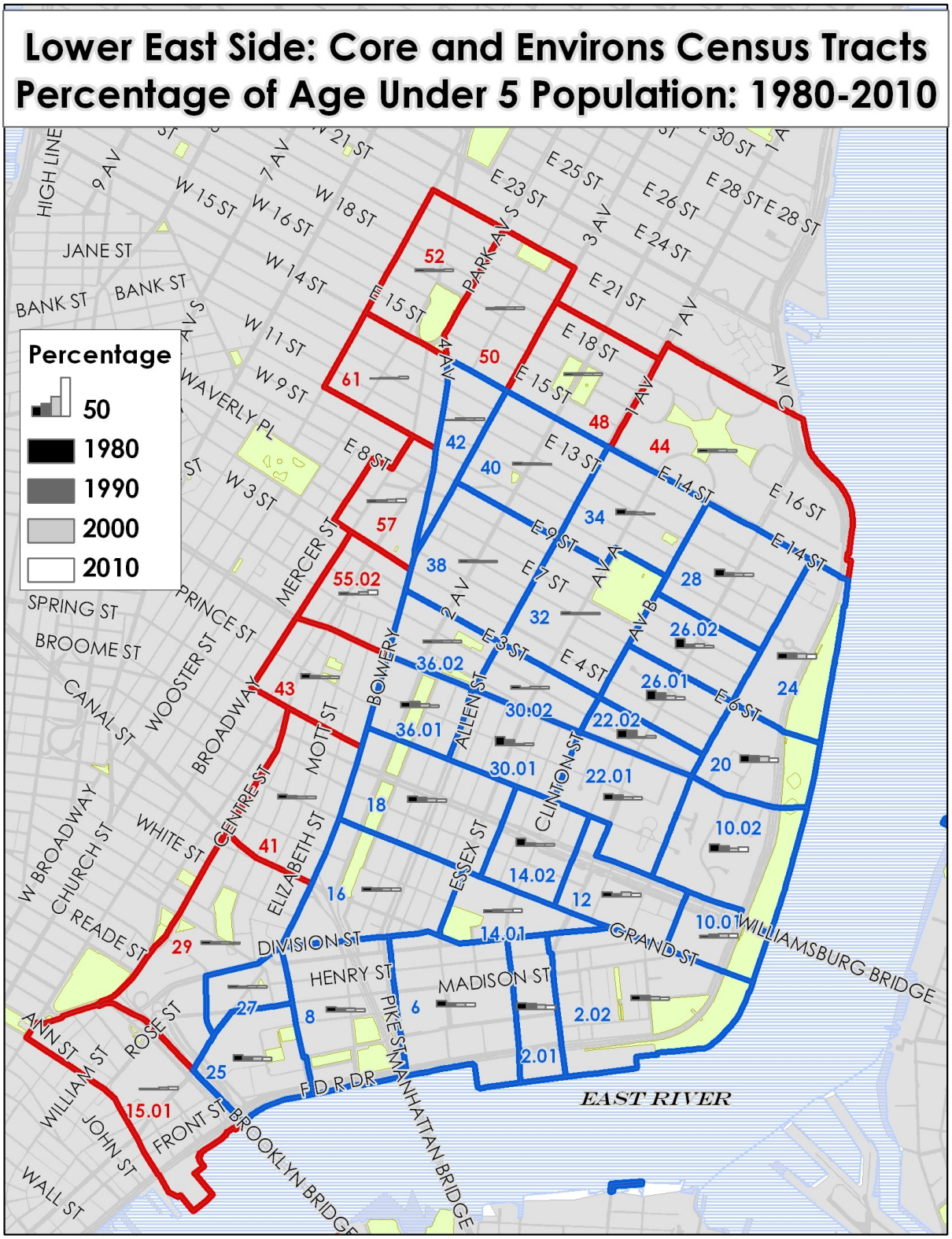


Figure 6-24. Percentage of the Age Under 5 Populations in New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.



Map 6-37. The Lower East Side, Percentage of Age Under 5 Population by Census Tract, 1980 - 2010

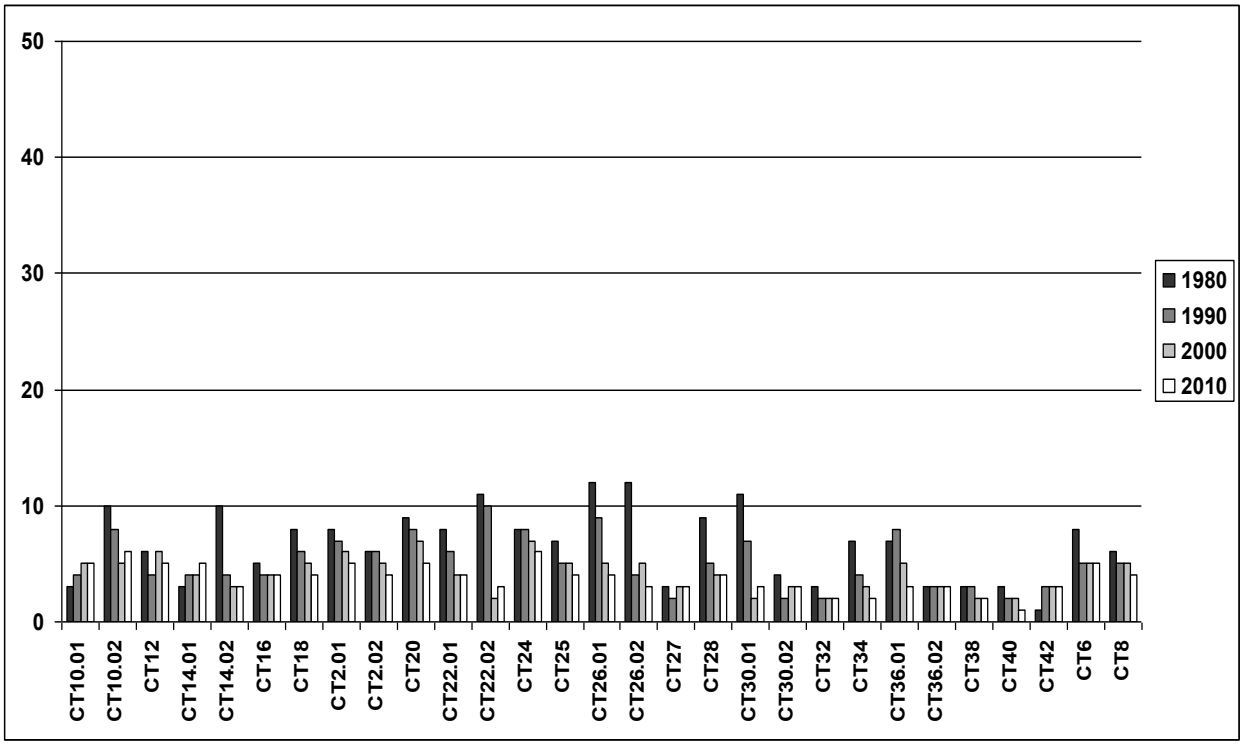


Figure 6-25. Percentage of Age Under 5 Population in the Lower East Side - Core vs. Census Tract, 1980 - 2010.

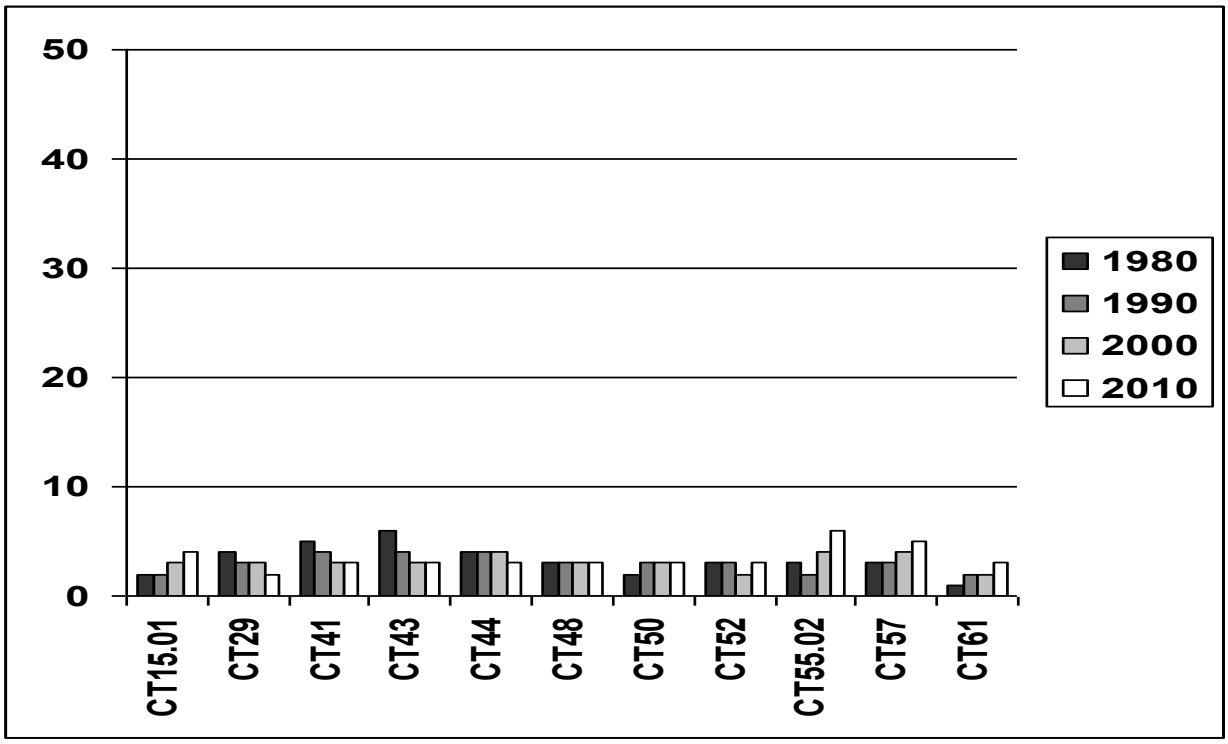


Figure 6-26. Percentage of Age Under 5 Population in the Lower East Side - Environs by Census Tract, 1980 - 2010.

6-4.3b Age 22-29

Figure 6-27 below compares the percentage of the Age 22-29 group to the total population. The Lower East Side has consistently higher percentages for this age group than does New York City, but not always higher than the Borough of Manhattan. The Lower East Side does, however, have higher percentages for this age group than do the other four Boroughs. Between 1980 and 1990, the Core experienced a slight decrease but has since shown an increasing trend. The Environs experience lower percentages in 1990 and 2000 and a considerable increase in 2010, reaching a peak at 20%.

Map 6-38, Figure 6-28 and Figure 6-29 below illustrate the percentage of the Age 22-29 group for individual Census Tracts. Differences can be observed within the Core or the Environs. For the Core, one can determine that the spatial distributions for this age group are quite uneven. There are Census Tracts that consistently have low percentages throughout the study years, that cluster on the East River riverfront. Census Tract 42, located at the North-west corner of the Core, shows a reverse pattern. In 1980 this age group composed nearly 40% of the total population. Although by 2010 it still reports more than 20% of this age group, this drop clearly shows the change in this particular section of the Core. Meanwhile, the Census Tracts clustered in the North and middle sections of the Core (except those in the riverfront) show increasing percentages.

Among the Census Tracts in the Environs one can also observe different patterns. Specific Census Tracts have noticeable increases between 2000 and 2010 such as Census Tract 44 (i.e. Stuyvesant Town) and Census Tracts 55.02 and 43 (i.e. near New York University). Adjacent to

the only Census Tract in the Core that shows decreasing percentage is Census Tract 42; Census Tracts 52 and 61 both have noticeable decreasing percentages as well. Although this study cannot verify whether the decreasing trend in this area is a result of the increasing pattern described above, these opposite pattern that are in such proximity must to be noted.

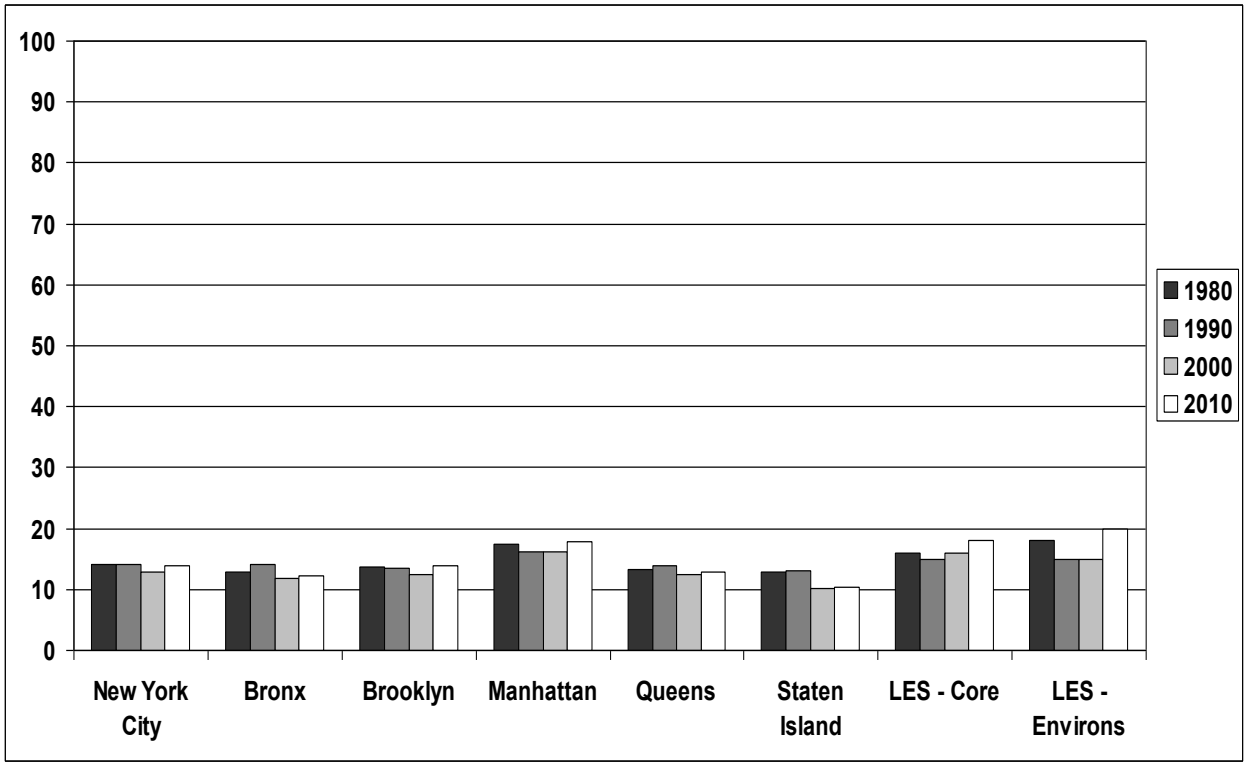
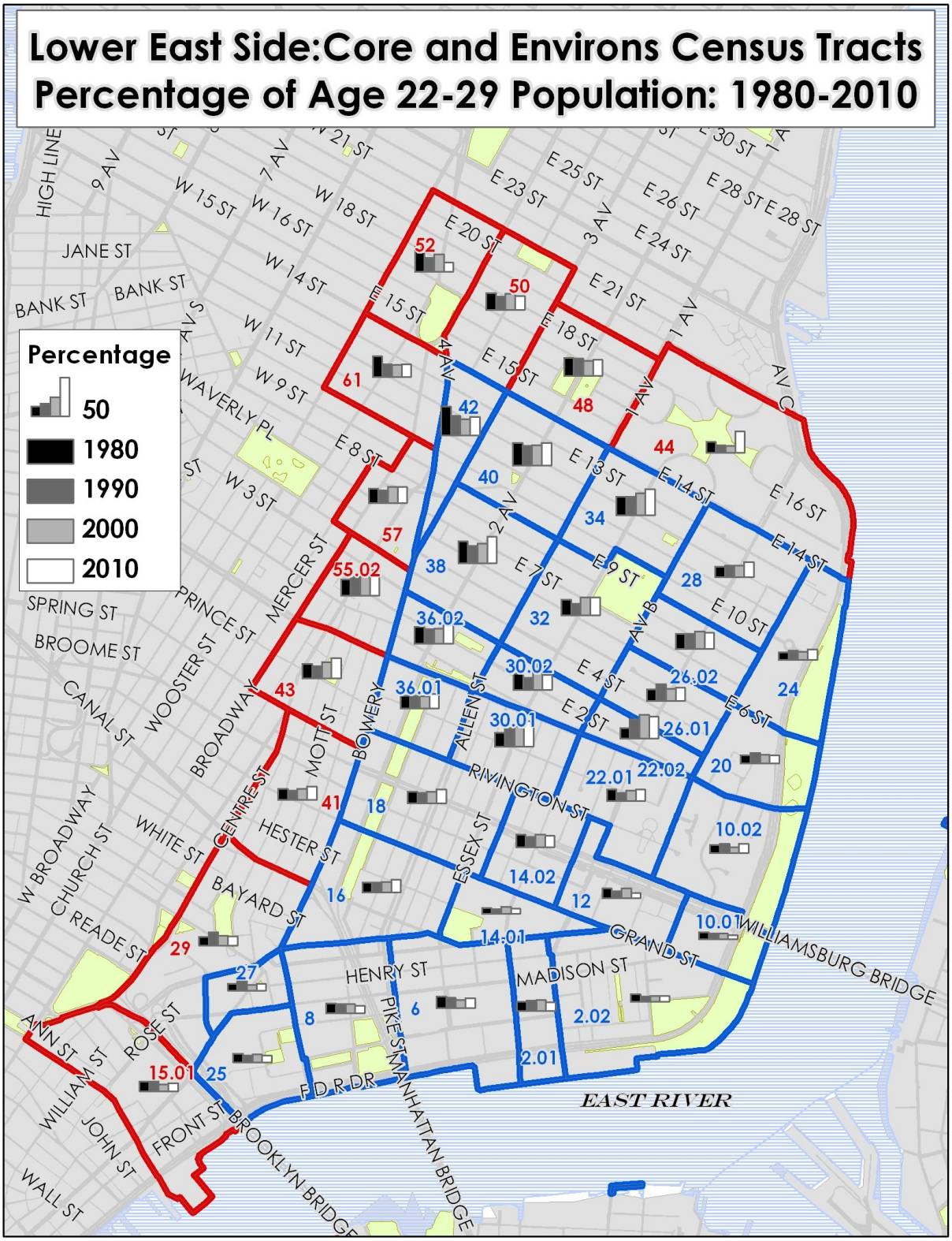


Figure 6-27. Percentage of the Age 22-29 Population in New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.



Map 6-38. The Lower East Side, Percentage of Age 22-29 Population by Census Tract, 1980 - 2010.

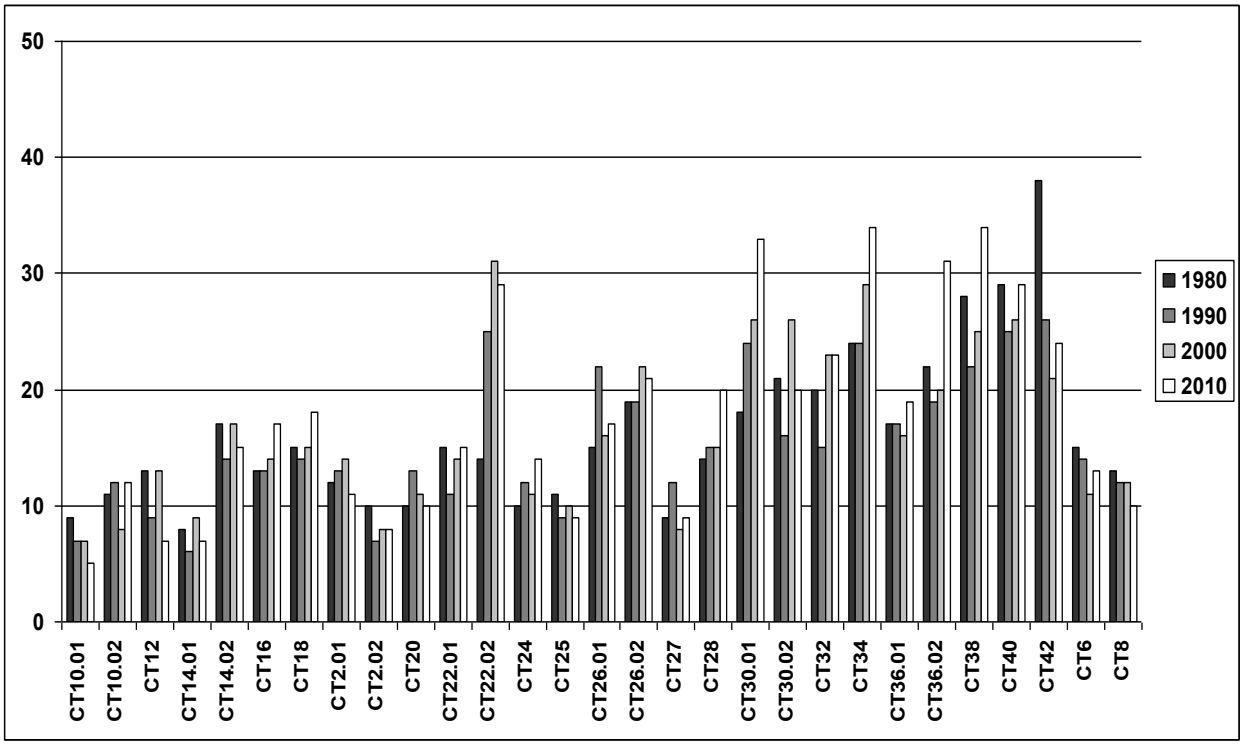


Figure 6-28. Percentage of the Age 22-29 Population in the Lower East Side - Core by Census Tract, 1980- 2010.

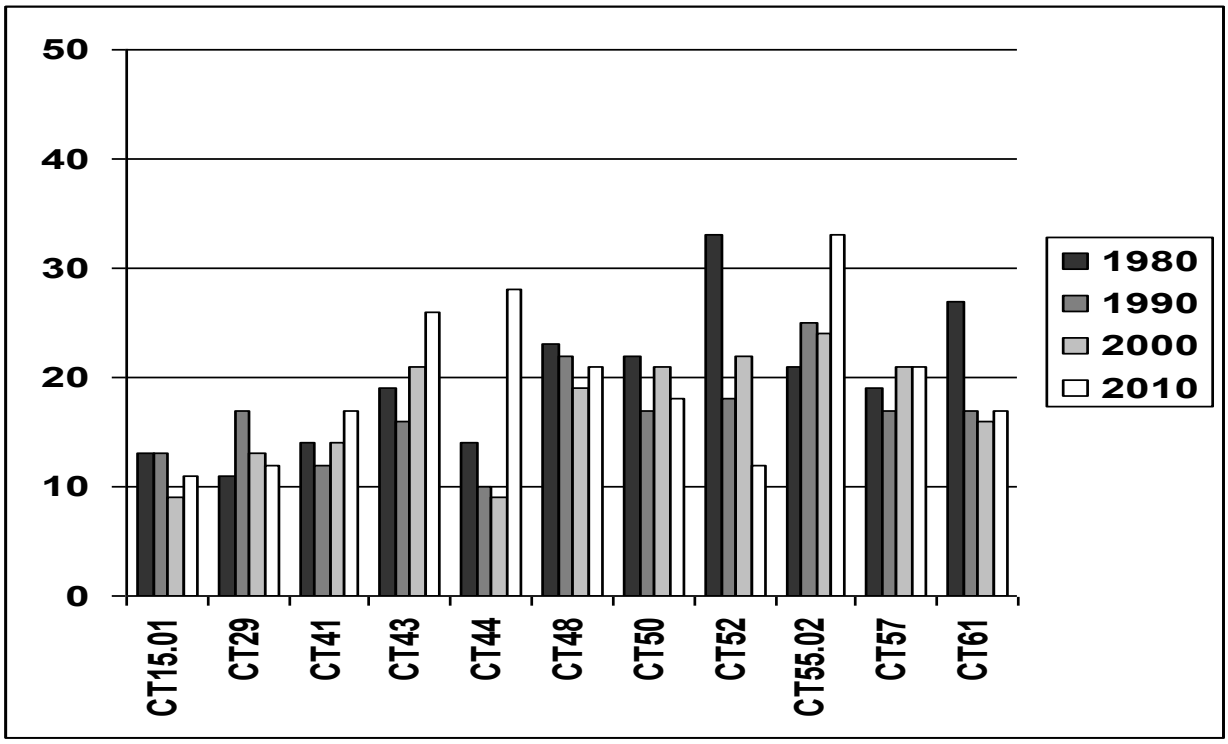


Figure 6-29. Percentage of Age 22-29 Population in the Lower East Side - Environs by Census Tract, 1980-2010.

6-4.3c Age 65 and Over

Figure 6-30 below compares the percentage of the Age 65 and Over group against the total population. There are no major increases or decreases among the Census Survey years for this age group although there are some modest changes. The overall citywide percentages show a decreasing trend despite a rebound in 2010. This pattern can be observed in all four Boroughs except Staten Island, which has a slowly increasing trend. The Core of the Lower East Side also shares this slowing increasing trend, while the Environs peak in 1990 and then shows a decreasing trend. It should be noted that despite this decreasing trend in the Environs the percentages are still higher than those in the other measured areas (i.e. the Five Boroughs and New York City itself).

Map 6-39, Figure 6-31 and Figure 6-32 record the percentage of Age 65 and Over by Census Tract. Once again one can easily observe the differences among the Census Tracts and the neighborhood figures do not always represent them accurately. Within the Core, there are several Census Tracts (32 and 30.02) that have consistently higher percentages. Census Tracts 32 and 30.02 cluster in the middle of the neighborhood. These Census Tracts with comparatively higher percentages also show a decreasing trend, while Census Tracts sour rounding them reported relative lower percentages but with an increasing trend. The design of this study including the maps and figures that are based on Census Surveys and ACS and cannot analyze the population migration pattern. What the map and figures present are snap shots at a ten-year interval.

Within the Environs the lower percentages are in the North-west corner; that clusters with the Core. Higher percentages are observed in Census Tract 44 (i.e. Stuyvesant Town) and toward the Southern tip of the Environs.

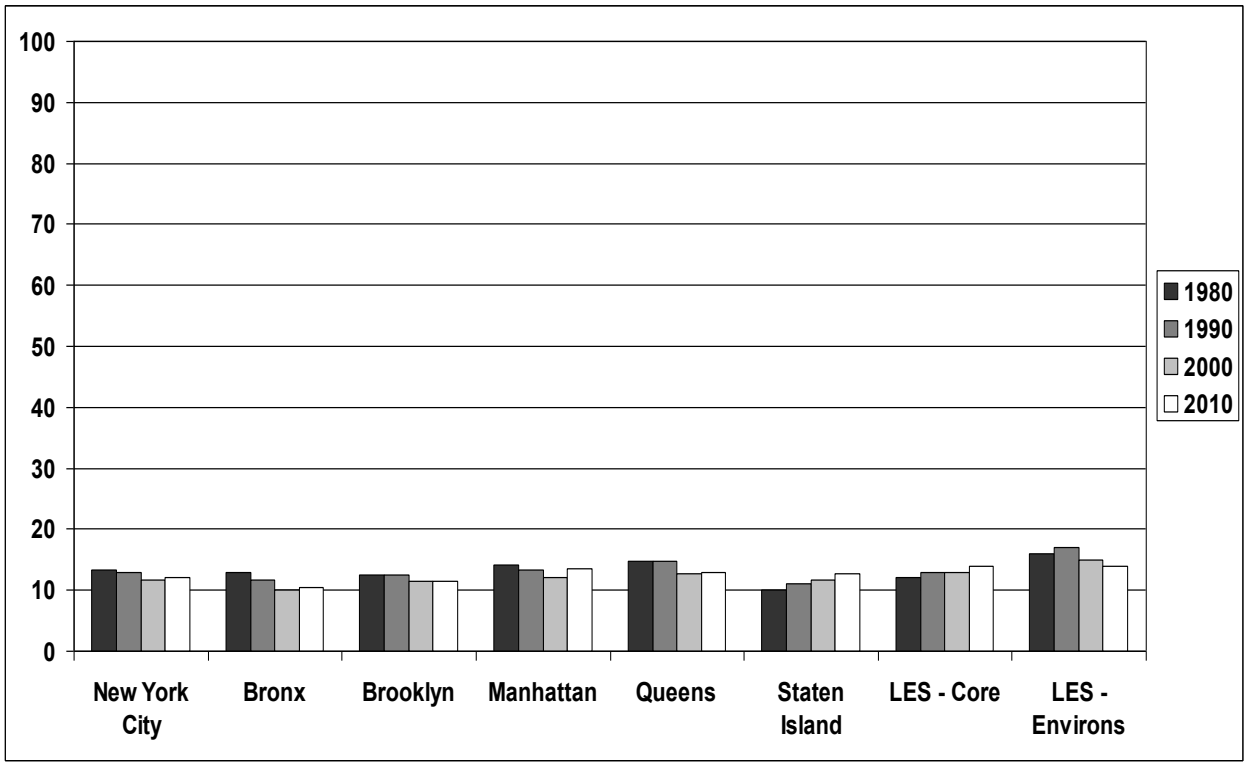
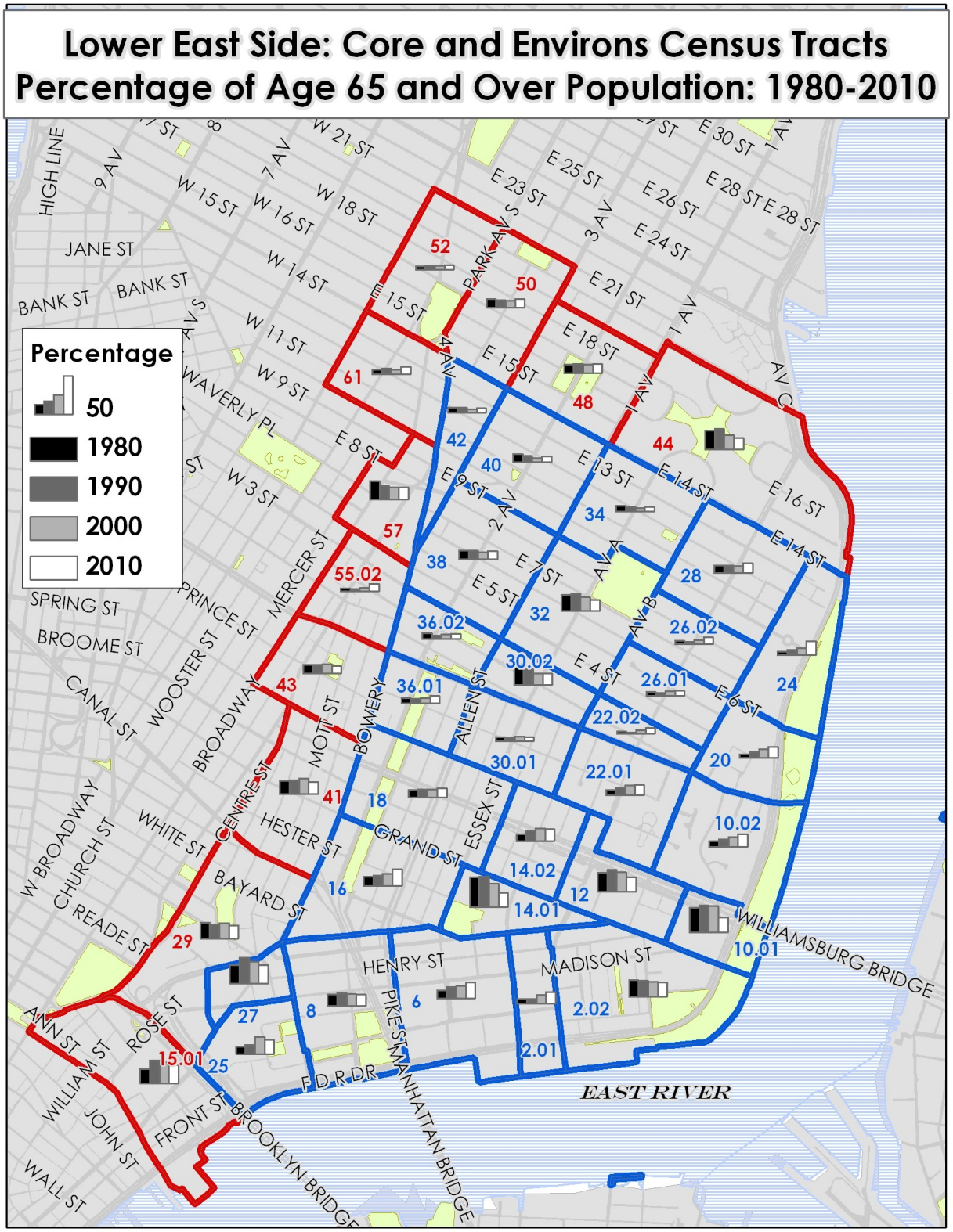


Figure 6-30. Percentage of the Age 65 and Over Populations in New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.



Map 6-39. The Lower East Side, Percentage of Age 65 and Over Population by Census Tract, 1980 - 2010.

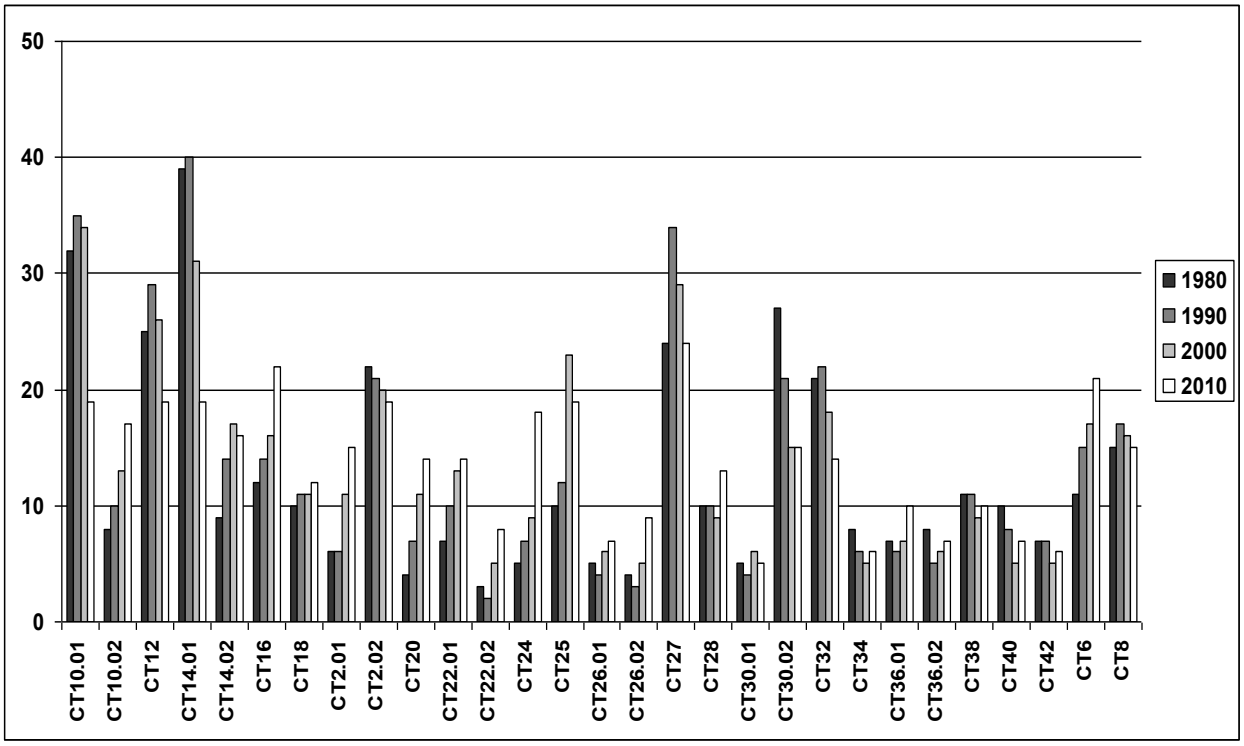


Figure 6-31. Percentage of Age 65 and Over Population in the Lower East Side - Core by Census Tract, 1980 - 2010.

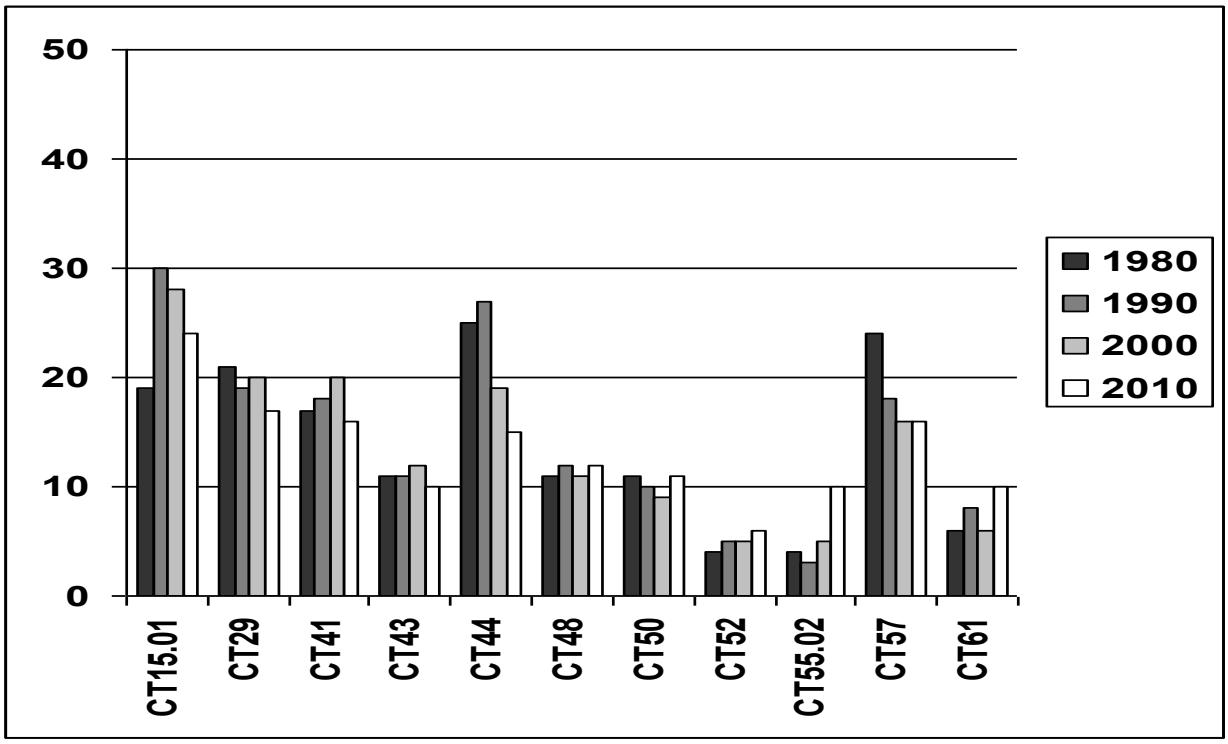


Figure 6-32. Percentage of Age 65 and Over Population in the Lower East Side - Environs by Census Tract, 1980 - 2010.

6-4.4 Housing Conditions

6-4.4a Total Housing Units

The total housing units in the Lower East Side Core and Environs have not changed much between 1980 and 2010 (See Figure 6-34 below). Map 6-40, Figure 6-35 and Figure 6-36 below show that certain Census Tracts have more housing units when compared to other Census Tracts. Overall, the middle section has fewer housing units. As previously discussed for zoning (See Map 6-14, Map 6-15 and Map 6-16) even though certain Census Tracts are not primarily zoned for residential use, housing units do exist in these Census Tracts. This observation does not translate as illegal land-use but rather illustrations of the fact that zoning in New York City is not always mutually exclusive. At times a tax lot that is zoned for commercial use can also have an overlay that is zoned for residential use. Tax lots with this overlay scheme may have commercial shops on the ground floors and apartments on the upper floor(s).

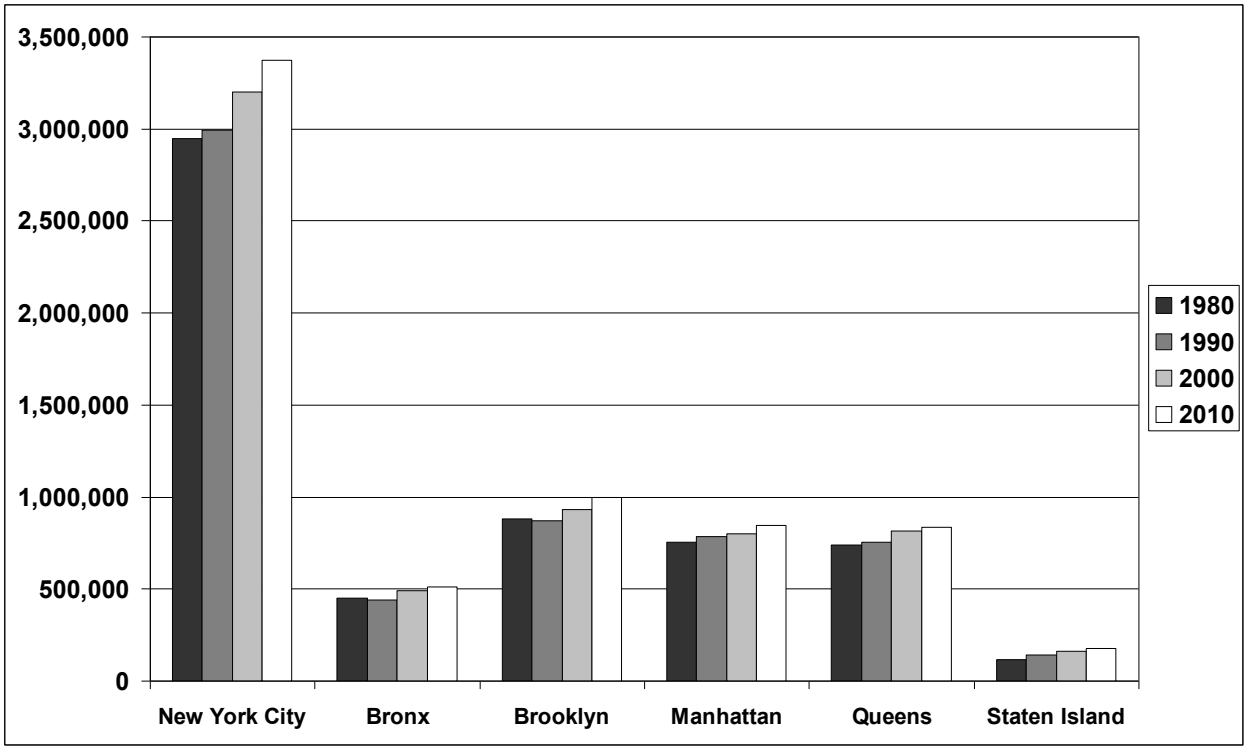


Figure 6-33. Numbers of Total Housing Units in New York City and the Five Boroughs, 1980 - 2010.

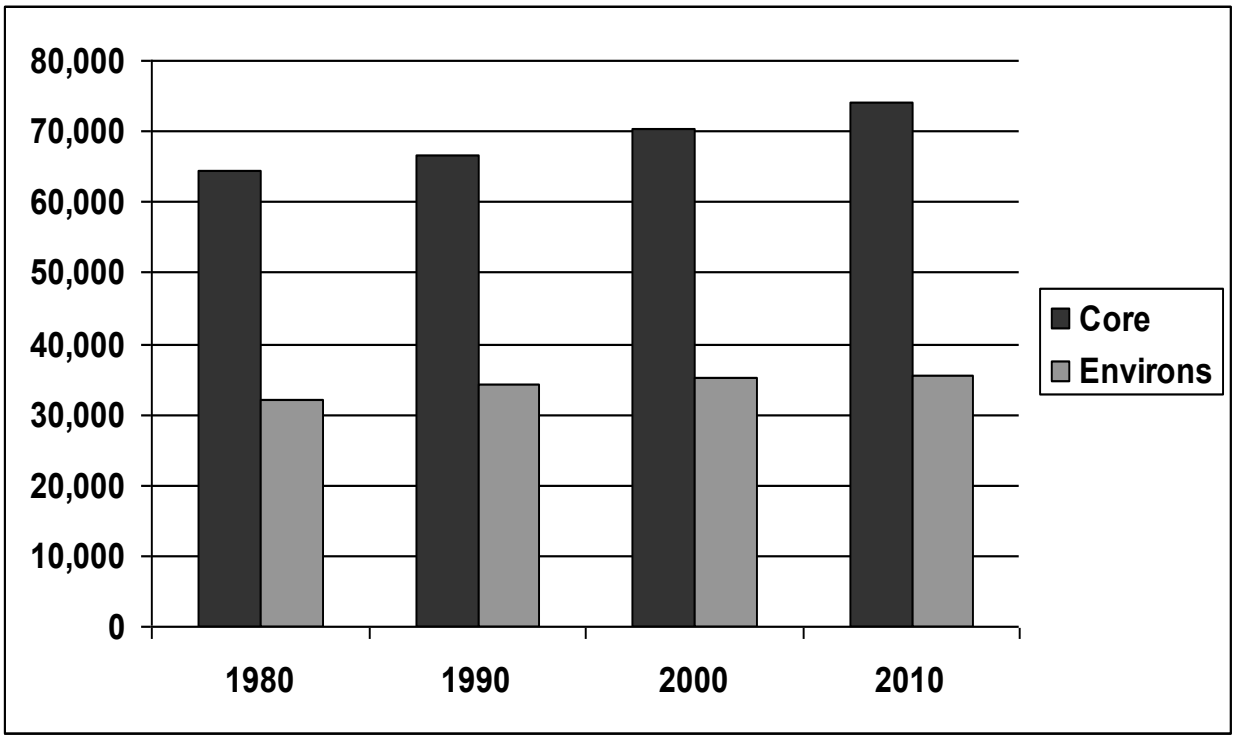
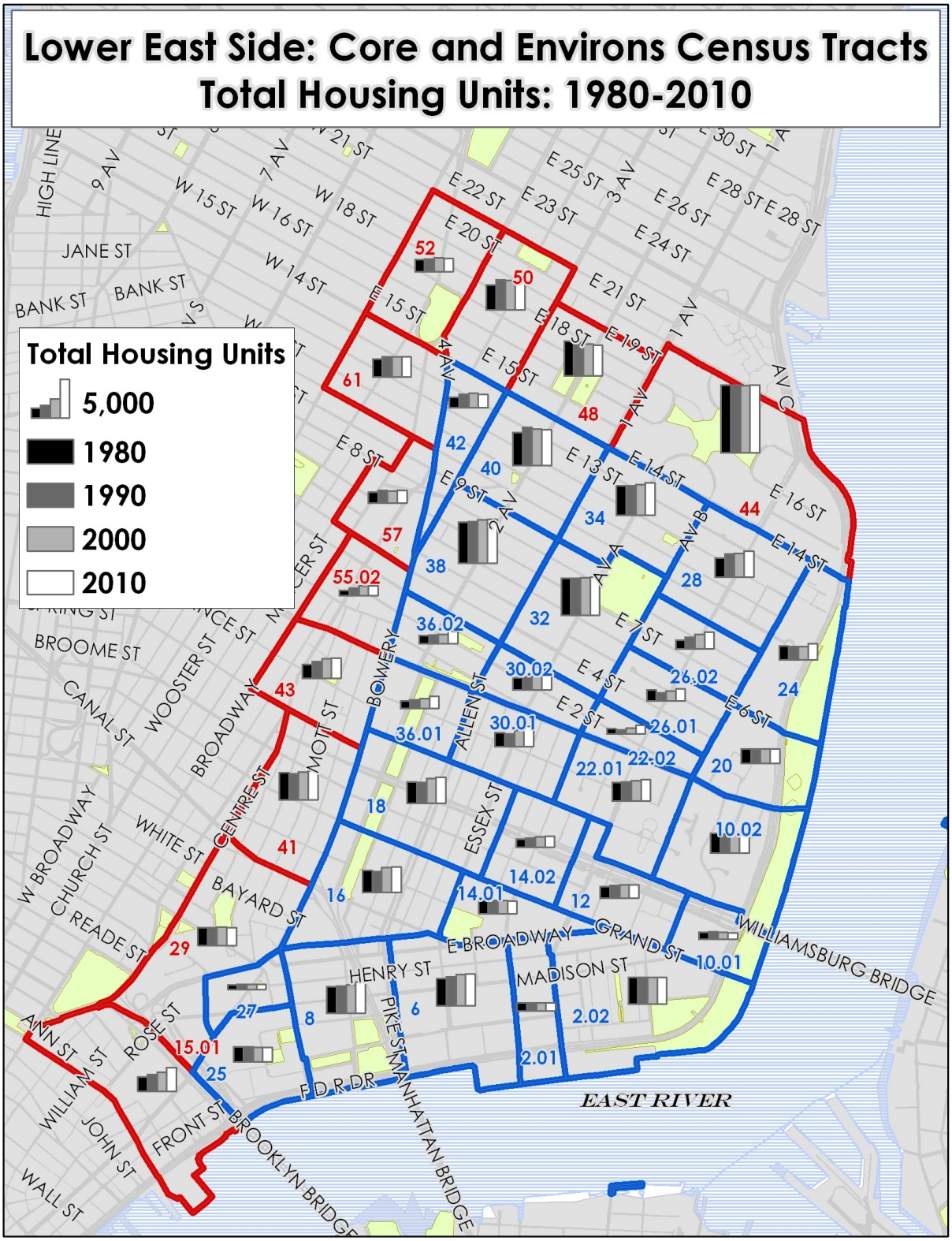


Figure 6-34. Numbers of Total Housing Units in the Lower East Side -Core vs. Environs, 1980 - 2010.



Map 6-40. Total Housing Units in the Lower East Side by Census Tract, 1980 - 2010.

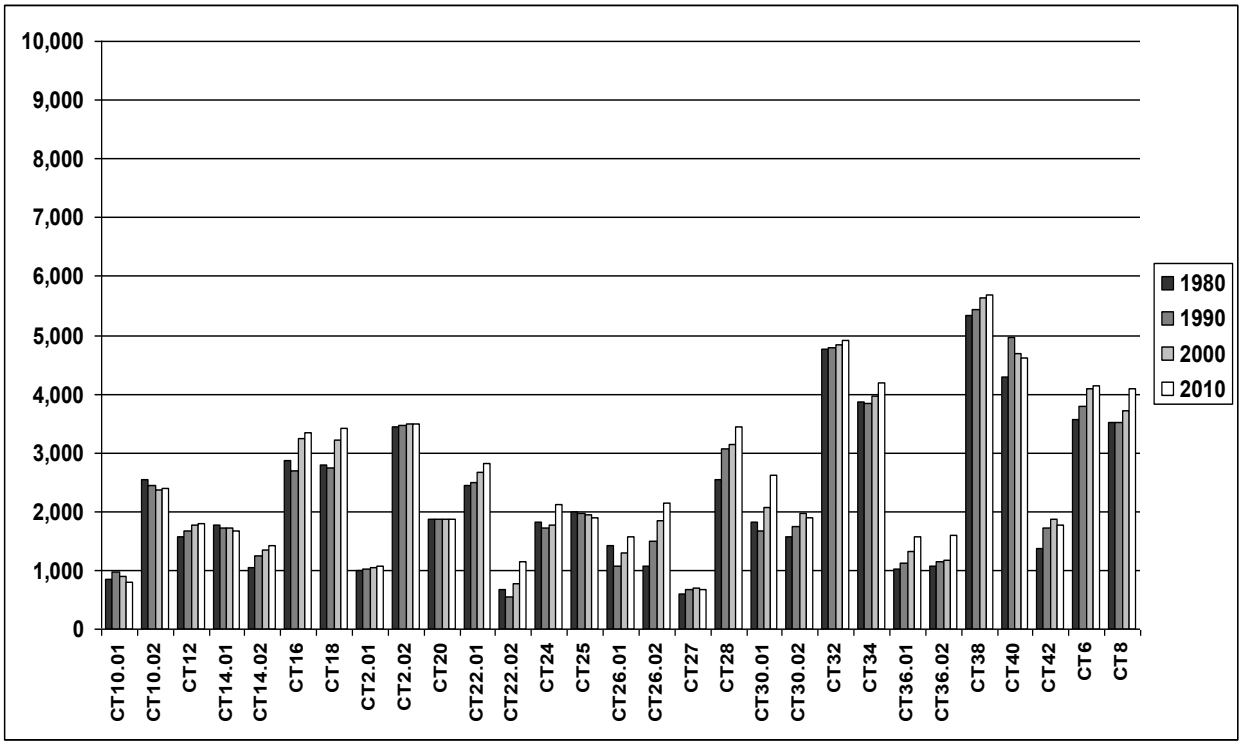


Figure 6-35. Total Housing Units in the Lower East Side - Core by Census Tract, 1980 - 2010.

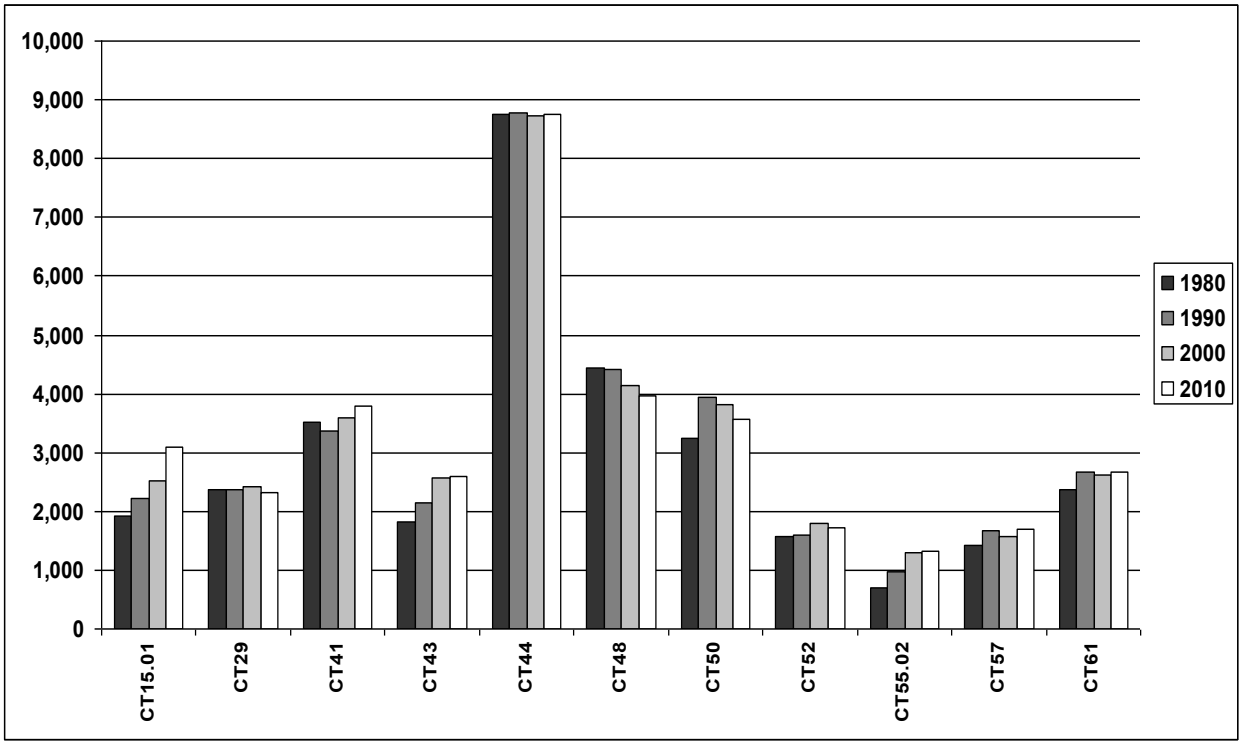


Figure 6-36. Total Housing Units in the Lower East Side - Environs by Census Tract, 1980 - 2010.

6-4.4b Percentage of Vacant Housing Units

Figure 6-37 compares the vacant housing unit percentage for New York City, the Five Boroughs and the Lower East Side. Although both the Core and Environs follow the citywide trend of increasing vacancy rates between 2000 and 2010, these patterns are differently; between 1980 and 2000 the Core consistently has decreasing percentages, while the Environs peaks in 1990 and has an overall zig-zag pattern. Map 6-41, Figure 6-38 and Figure 6-39 below record individual Census Tracts. The map reveals the degree of change during past three decades and echoes Smith's map that illustrates the dis-investment in the Lower East Side area. During the 1980s, certain Census Tracts report noticeable high percentages of vacant housing, while other Census Tracts reflect New York City's overall experience of single-digit percentages of vacant housing units.

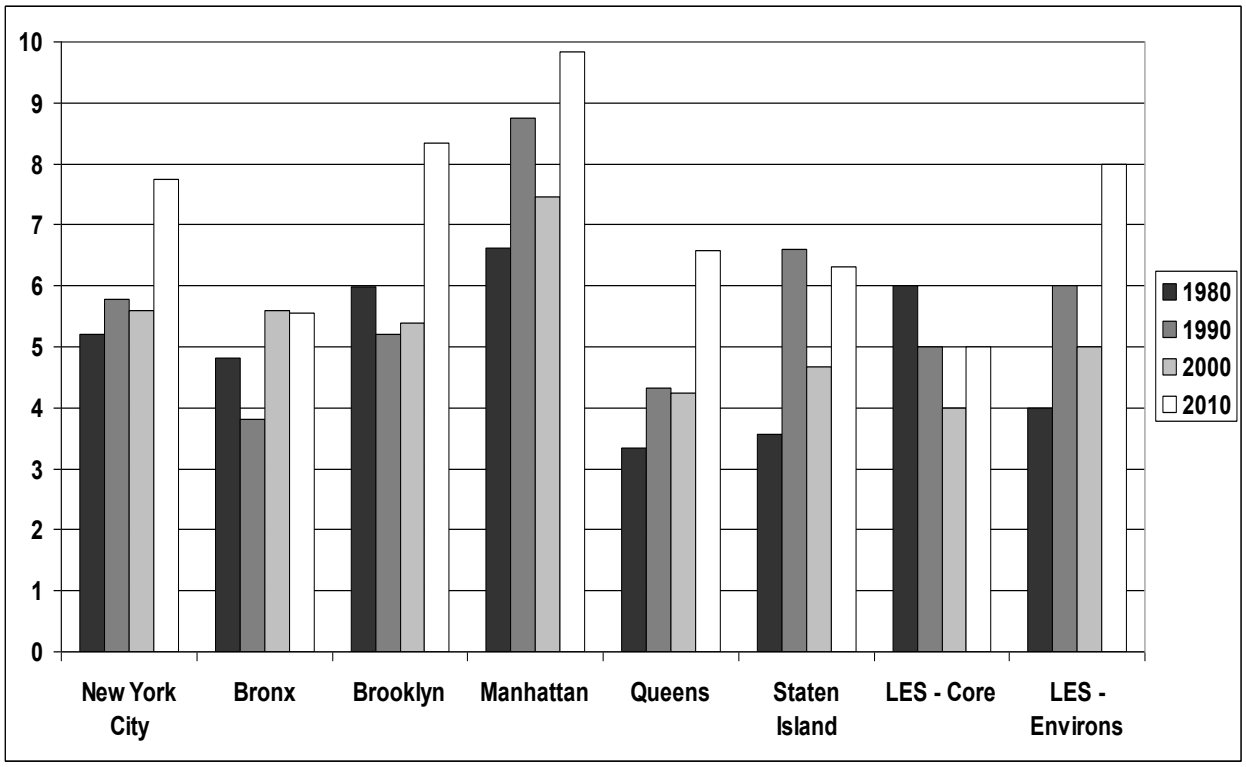
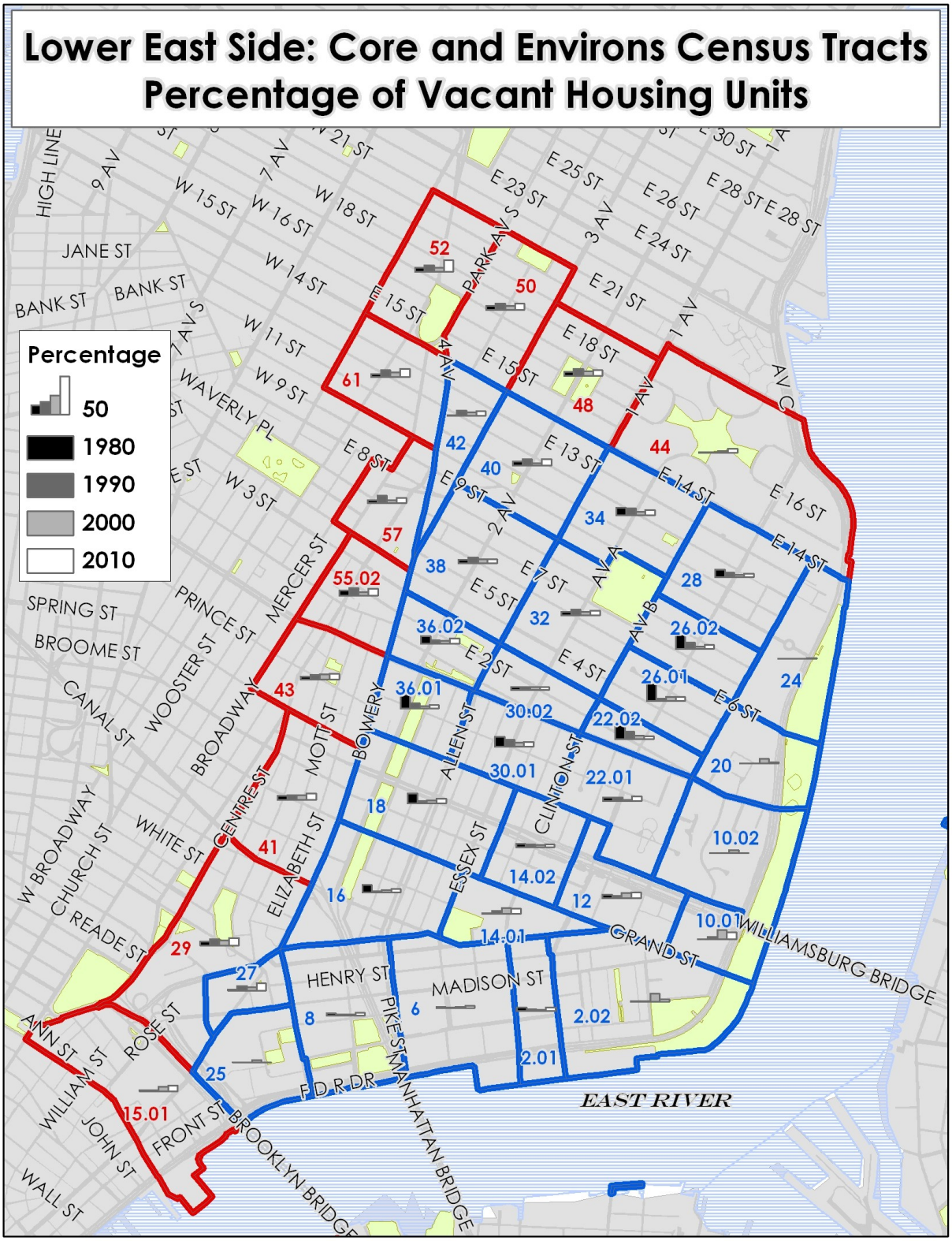


Figure 6-37. Percentage of Vacant Housing Units in New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.



Map 6-41. The Lower East Side, Percentage of Vacant Housing Units by Census Tract, 1980 - 2010.

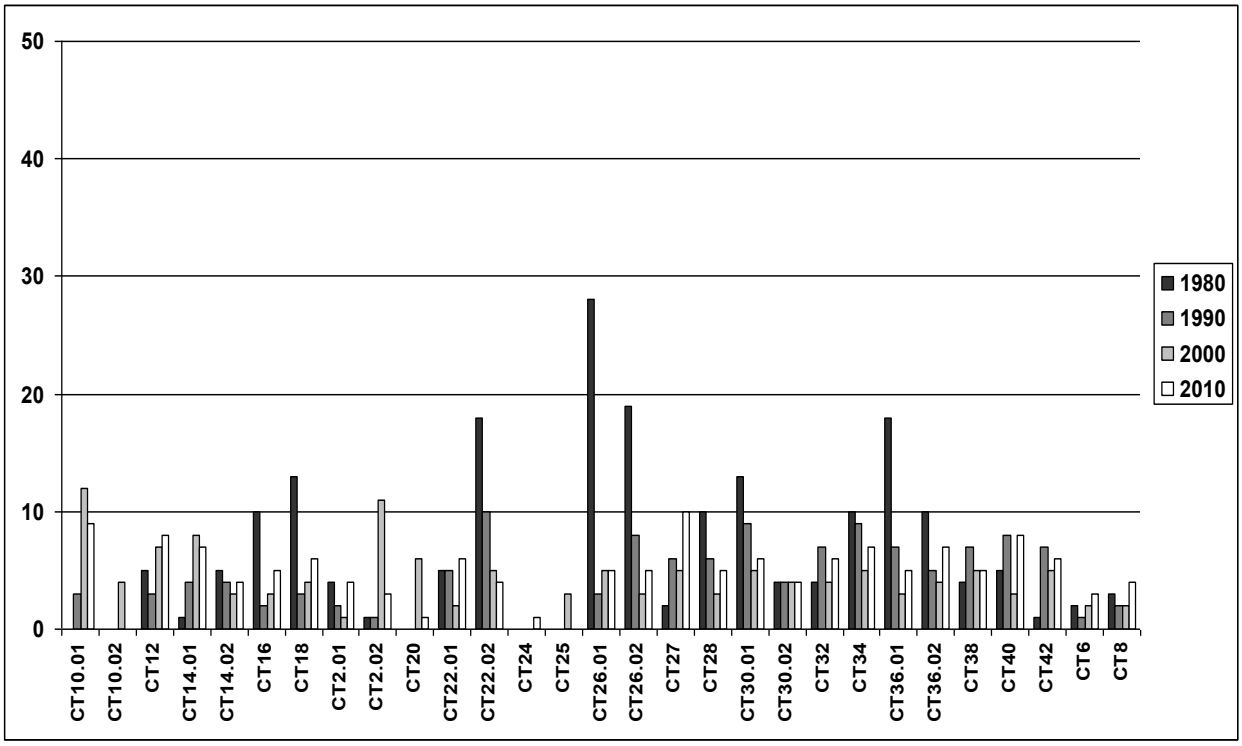


Figure 6-38. Percentage of Vacant Housing Units in the Lower East Side - Core by Census Tract, 1980 - 2010.

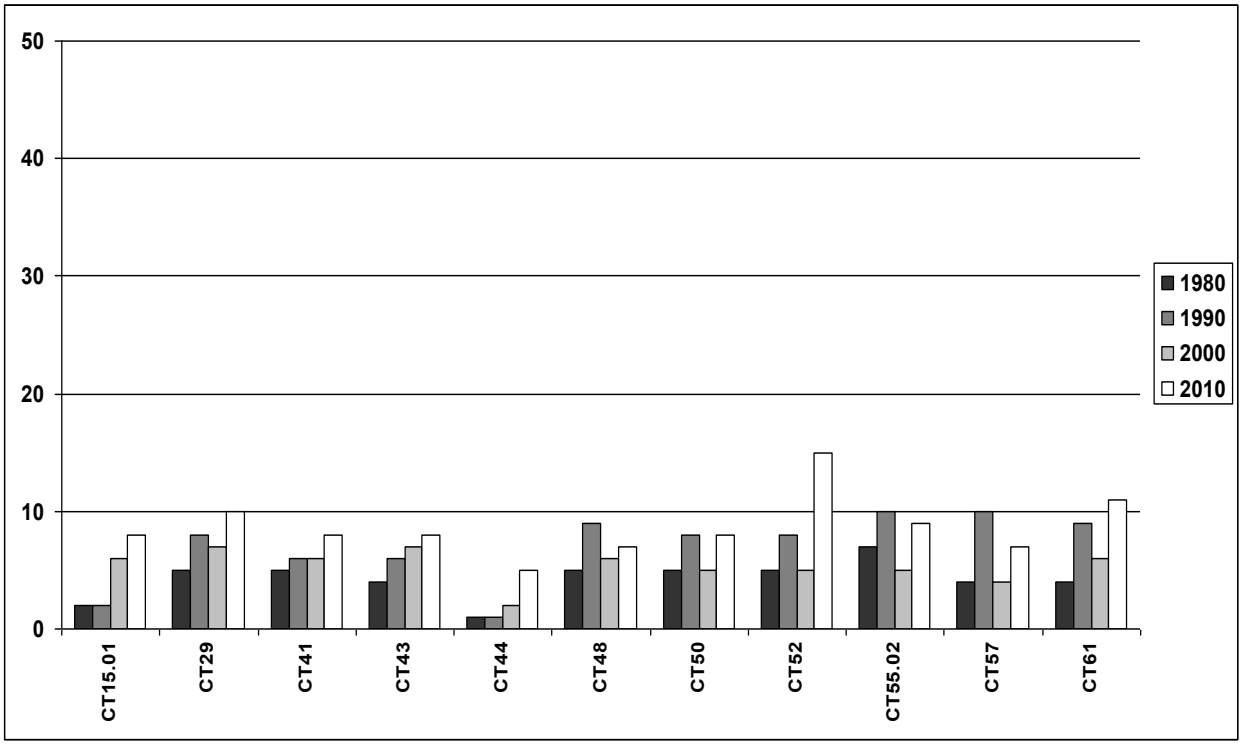


Figure 6-39. Percentage of Vacant Housing Units in the Lower East Side - Environs by Census Tract, 1980 - 2010.

6-4.4c Percentage of Renter-occupied Housing Units

Figure 6-40 compares the percentages of renter-occupied units among total housing units. While renters remain the majority in the Lower East Side Core and Environs, as observed in New York City and in Manhattan, both the Core and Environs areas are experiencing decreasing percentages of renter-occupied housing units between 1980 and 2010. This decrease is less pronounced for the Core. In 1980 both the Core and the Environs report 90% of the housing units occupied by renters; by 2010 it is 82% for the Core, the Environs has a 20% drop with only 70% renters.

Map 6-42, Figure 6-41 and Figure 6-42 below record the percentages at the Census Tract level. One can observe that certain Census Tracts experience greater decreases than do others Census Tracts; within the Core these cluster near the foot of the Williamsburg Bridge; within the Environs these cluster in the North and North-west end. The exception is Census Tract 44 (Stuyvesant Town) which has consistently over 90% of its housing units occupied by renters.

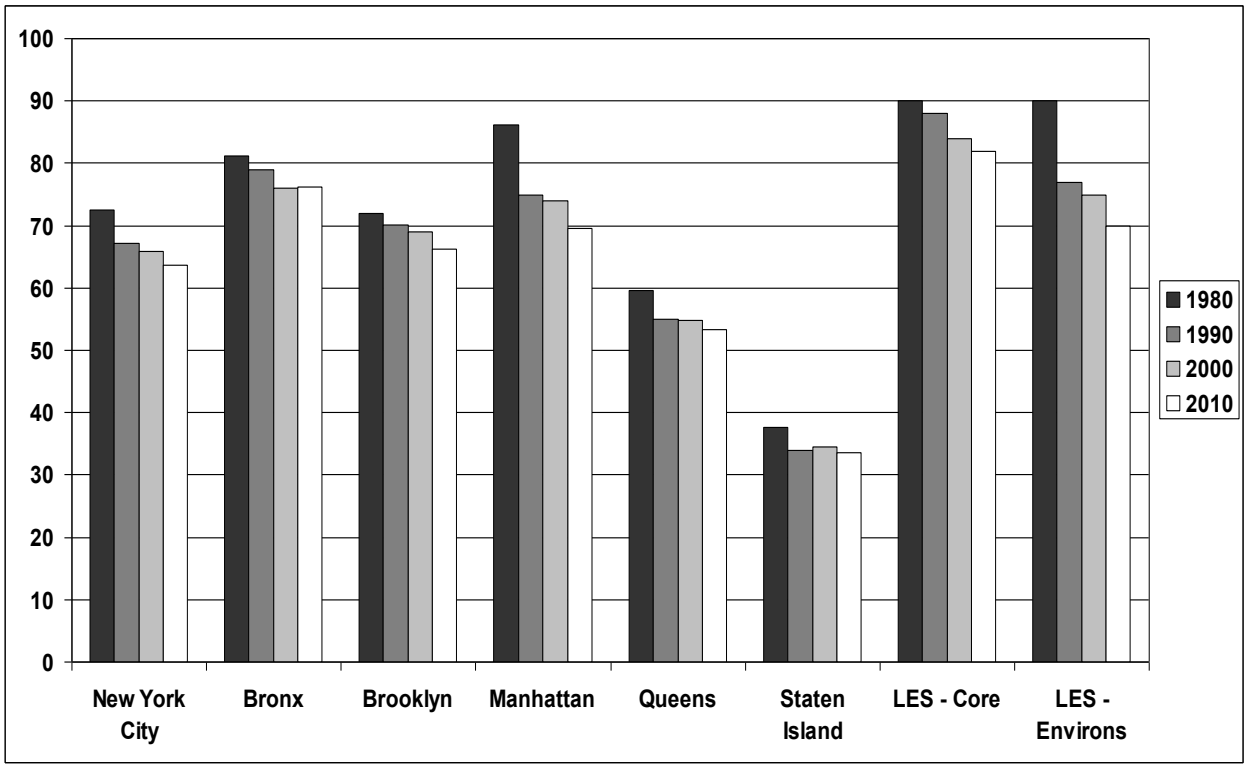
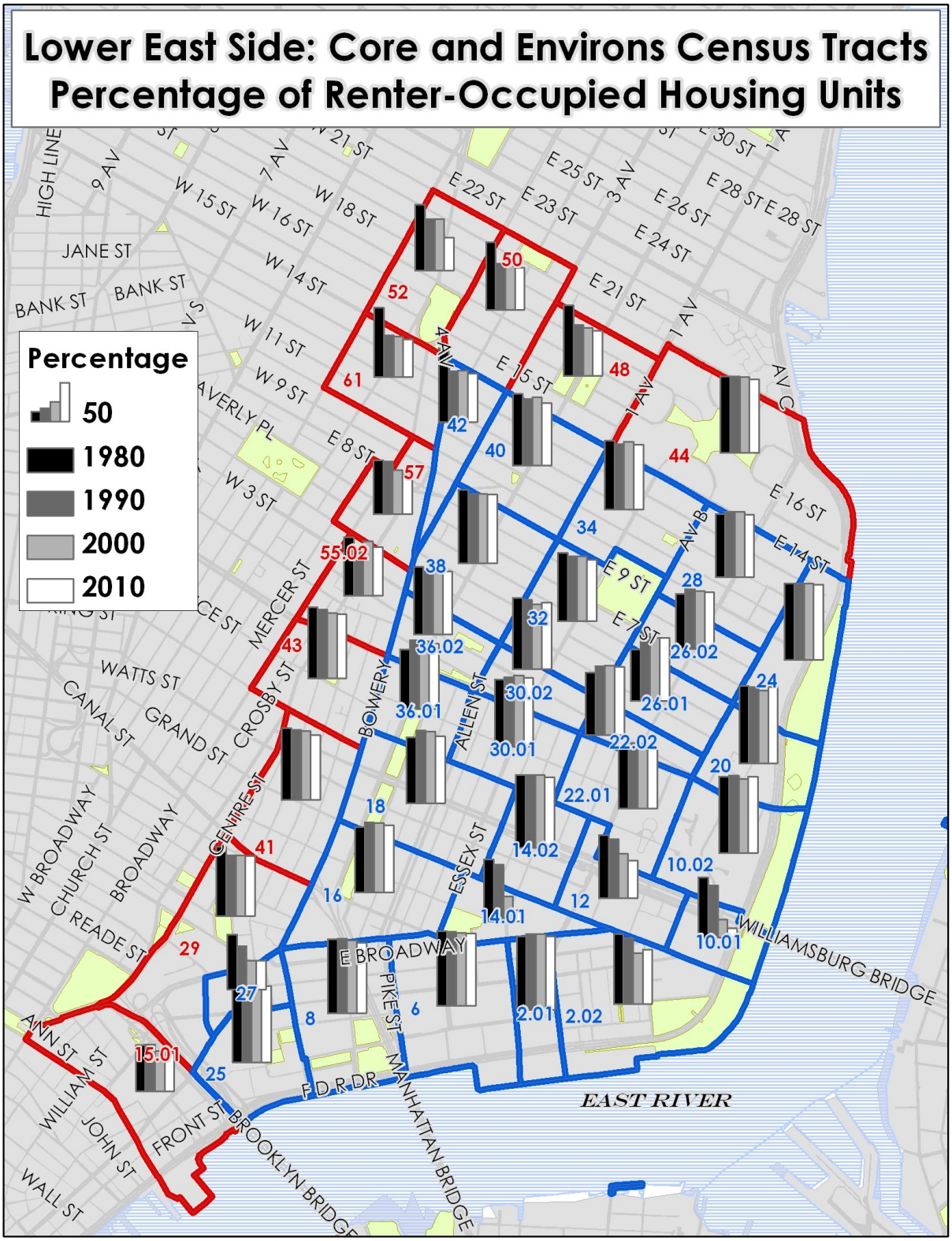


Figure 6-40. Percentage of Renter-occupied Housing Units in New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.



Map 6-42. The Lower East Side, Percentage of Renter-Occupied Housing Units by Census Tract, 1980 - 2010.

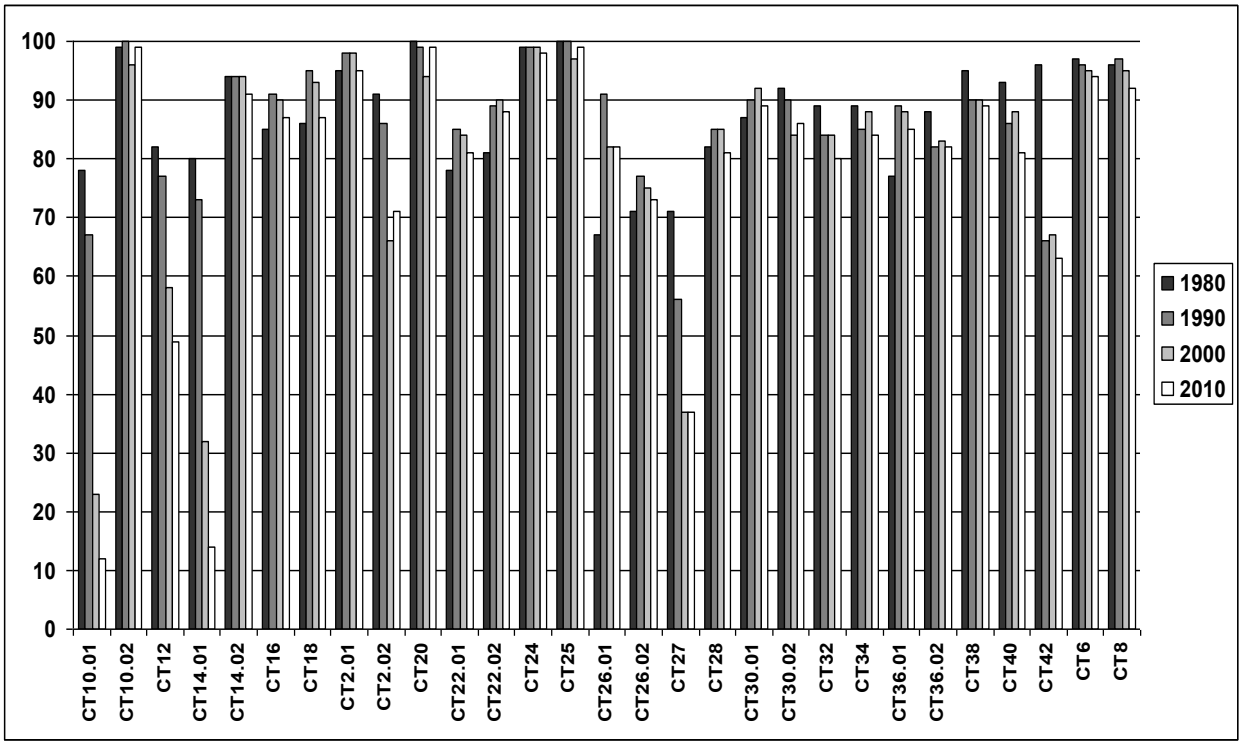


Figure 6-41. Percentage of Renter-Occupied Housing Units in the Lower East Side - Core by Census Tract, 1980 - 2010.

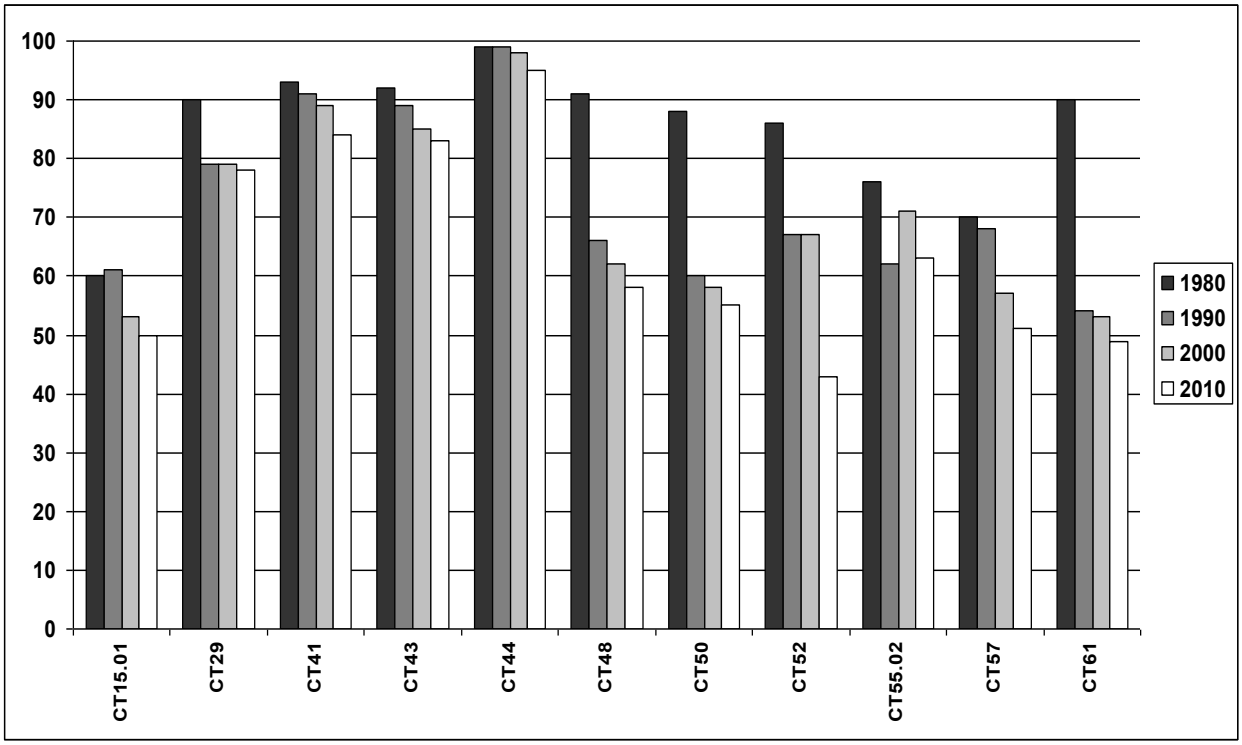


Figure 6-42. Percentage of Renter-Occupied Housing Units in the Lower East Side - Environs by Census Tract, 1980 - 2010.

6-4.5 Median Household Income

Figure 6-43 compares the median household income of New York City, the Five Boroughs and the Lower East Side Core and Environs. Unlike New York City and the Five Boroughs, which experienced increase and decrease between 1980 and 2010, both the Lower East Side Core and Environs consistently experienced increasing median household incomes; the Environs report considerable higher values than does the Core. Despite various studies that indicate gentrification of the Lower East Side, it appears that the presence of low-income households remains strong and keeps the median value low. Map 6-43, Figure 6-44 and Figure 6-45 below represent the median household income for individual Census Tracts and the wide range of variations among these Census Tracts.

It should be noted that the top value in the figures for the median household income for the Lower East Side was raised to $150,000 to accommodate some Environs Census Tracts. However, both the Core and the Environs averages do not surpass the $100,000 income level. Figure 6-44 and Figure 6-45 record individual Census Tracts and reflect this adjustment to accommodate some of the highest median household incomes recorded.

Specific observations regarding the median household income for individual Census Tracts in the Core and Environs are listed below:

1. In the Core area, there appears to be an overall increase in the median household income throughout the years. However, a closer examination of Map 6-43 reveals that the pattern of increasing income is more prominent in the Northern half of the Core. Certain Census Tracts that

are not located next to each other but are located in the middle section of the Core (i.e. Census Tracts 22.02, 14.01 and 10.01) display a more rapidly increasing pattern in the median household income than do the other Census Tracts.

2. There are Census Tracts within the Core that do not show much income growth throughout the years. With the exception of the Census Tract 10.01 cited above, certain Census Tracts along the East River riverfront show little increase in median household income, and others actually report decreasing income over the years.

3. In the Environs, the pattern is more clear and illustrates that throughout the years the Northern Census Tracts had higher median household incomes than reported by the Southern Census Tracts. One exception is the Southern tip (i.e. Census Tract 15.01) which reported a higher median household income than the adjacent Census Tracts (although it is not as high as those Census Tracts in the North).

Map 6-44, Figure 6-46 and Figure 6-47 further below compare the median household income throughout the years to those of Manhattan. It should be noted that those comparison maps (for both median household income and median gross rent) in the Park Slope chapter are compared to Brooklyn. The comparison maps in this Lower East Side chapter compare individual Census Tracts to Manhattan. The comparison maps from these two different neighborhoods located at different Boroughs are not comparable. (The comparison maps created for the Williamsburg chapter that follows, on the other hand, are comparable to those in the Park slope chapter). While comparing the Lower East Side to Manhattan may seem to be subject the Lower East Side to a

disadvantage, instead these comparison maps will demonstrate the differences in socio-economic trends among the Census Tracts and Manhattan. The top ranges for Figure 6-46 and Figure 6-47 were increased to 200 (as opposed to the 100 in the Park Slope Chapter) because certain Census Tracts report much higher median household incomes.

Map 6-44 compares the median household income of the Lower East Side to Manhattan and further illustrates the unevenness of this neighborhood. Within the Core area, the majority of the Census Tracts report lower values than the Borough. Unlike the similar map for Park Slope (Map 5-44) which indicate a clear "reverse" pattern (defined as when a particular Census Tract “reverses” from lower than the Borough to be higher than the Borough) is observed, in the Lower East Side this “reverse” pattern is not as evident as that of Park Slope. In fact, most of the Lower East Side Census Tracts in the Core area (despite some catching up to the Borough) still report median household income lower than the Borough. Some of East River riverfront Census Tracts actually continue to fall further behind the Borough throughout the years.

One exception to this lagging behind pattern is Census Tract 42 that is located at the North-west corner and adjacent to some of the wealthiest Environs Census Tracts. This Census Tract report above-the-Borough median household income throughout the study years. The adjacent Census Tract 40 reports in the first two Census Survey years (i.e. 1980 and 1990) below the Borough and then progresses ahead in 2000. Another cluster of above-the-Borough median household income is found in 2010 at the middle section of the Core (See Census Tracts 22.02, 14.01 and 10.01).

The Lower East Side Census Tracts in the Environs report different results when compared to the Borough itself. In general those in the North are higher than the Borough; the Southern Environs and the Southern Core continue to fall further behind the Borough.

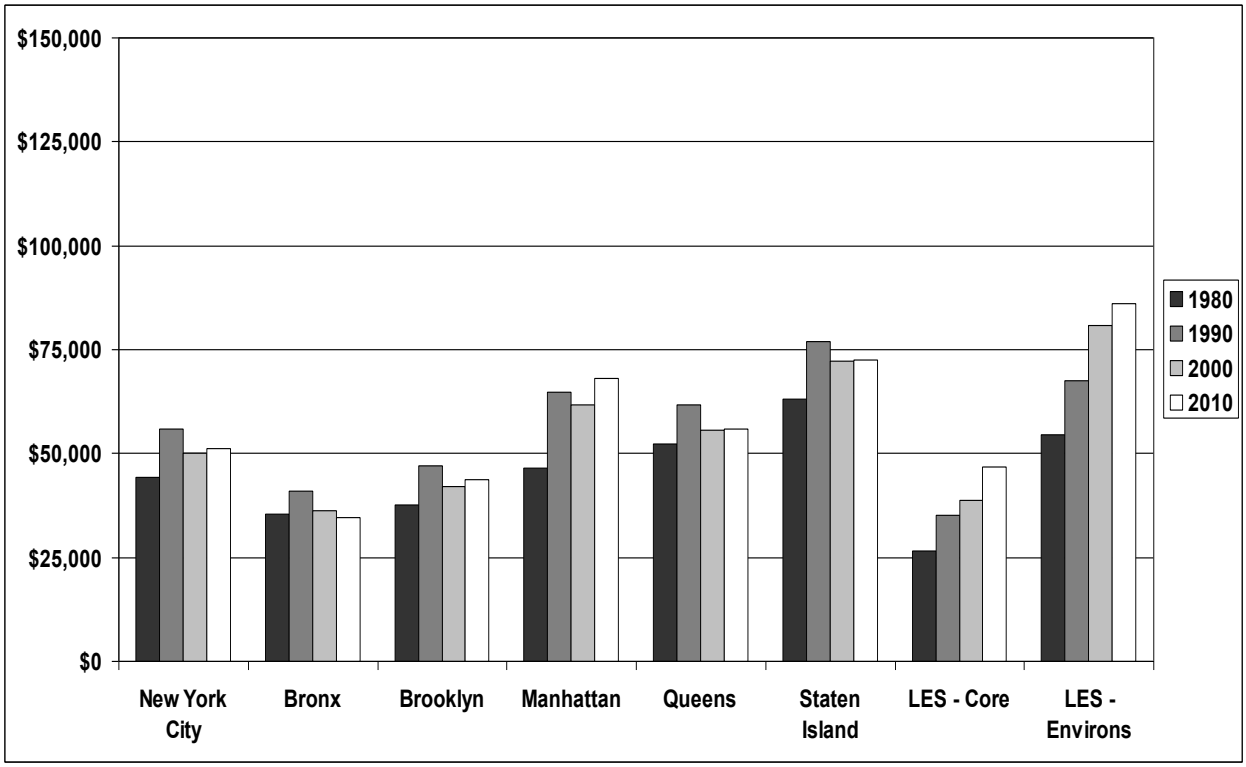
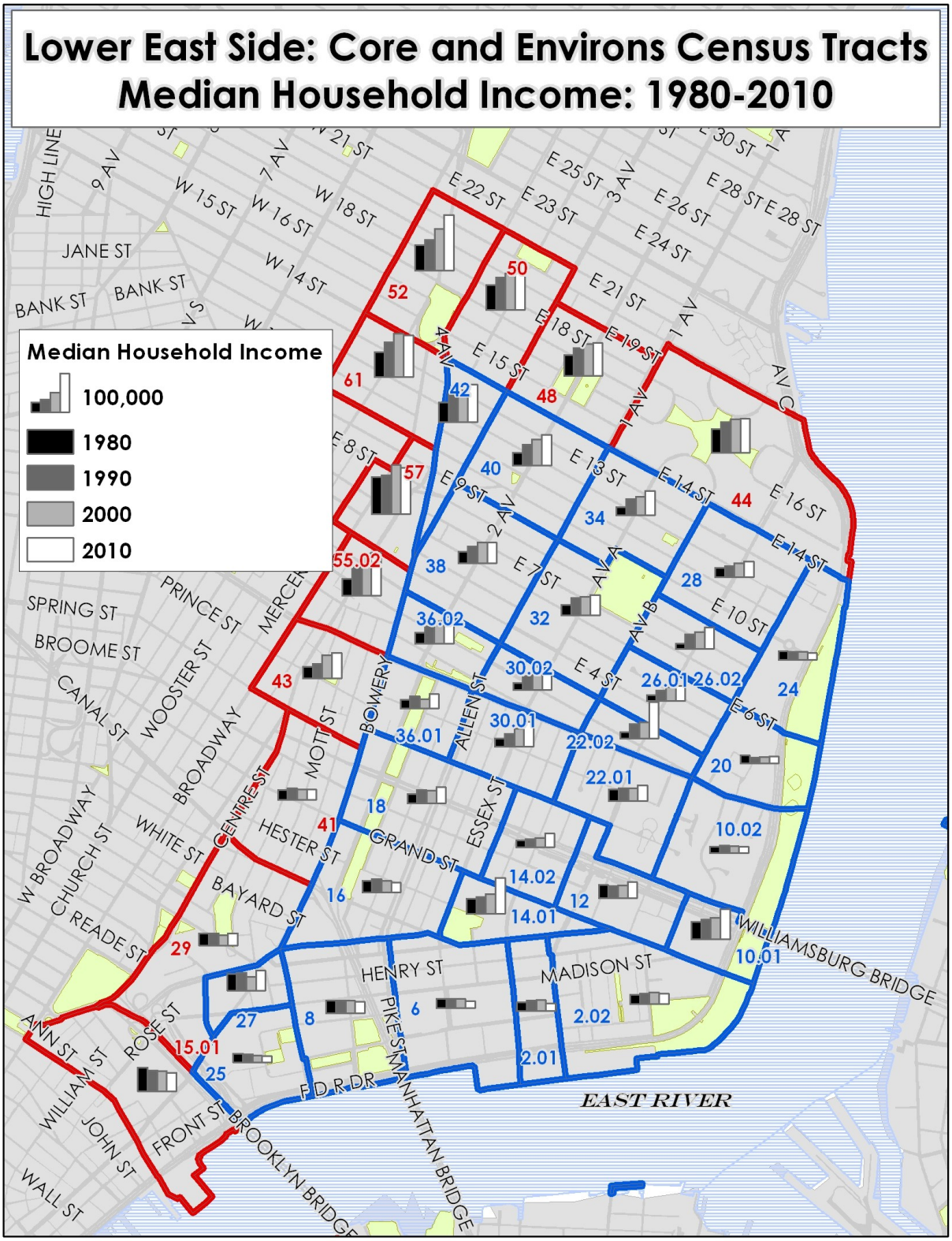


Figure 6-43. Median Household Income of New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.



Map 6-43. The Lower East Side, Median Household Income by Census Tract, 1980 - 2010.

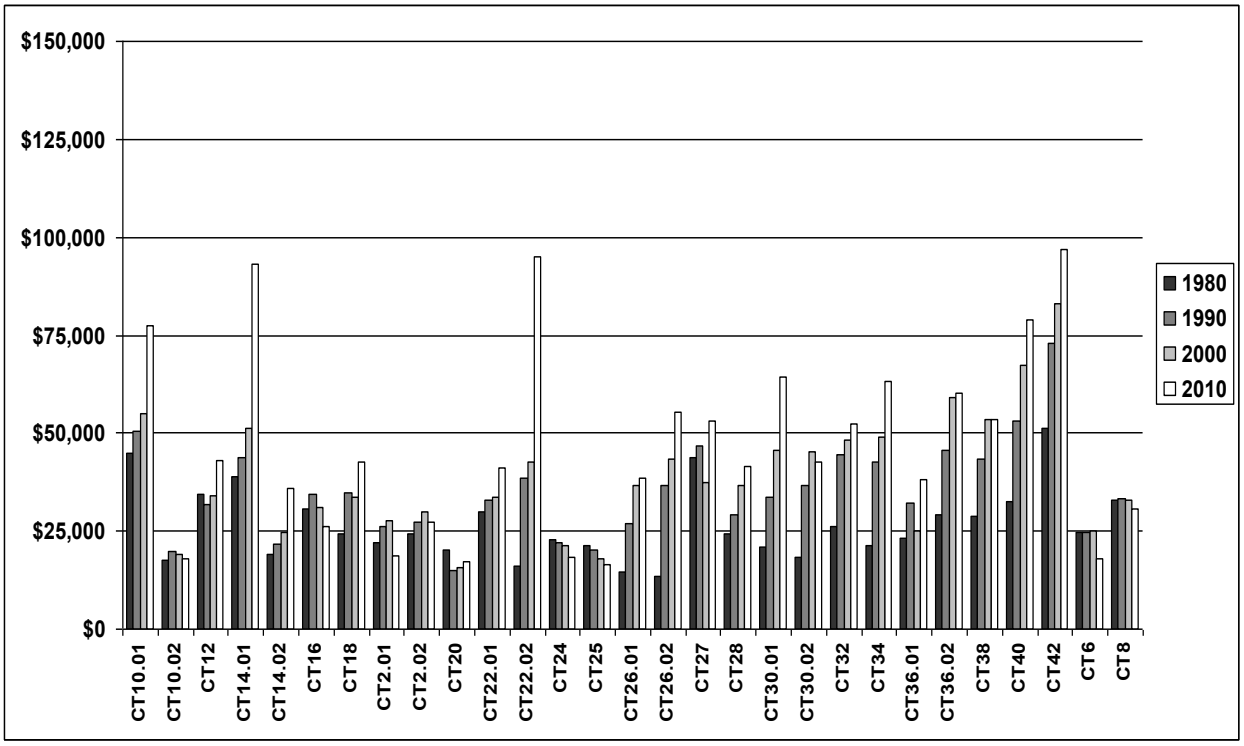


Figure 6-44. Median Household Income in the Lower East Side - Core by Census Tract, 1980 - 2010.

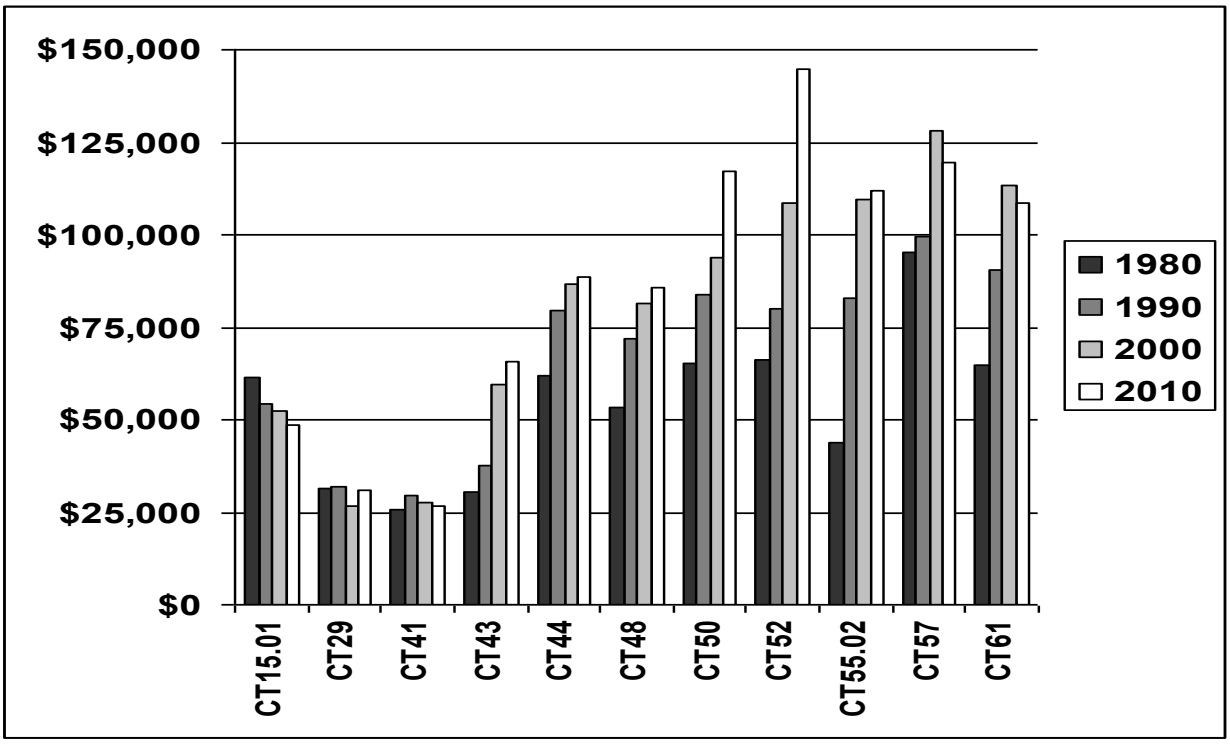
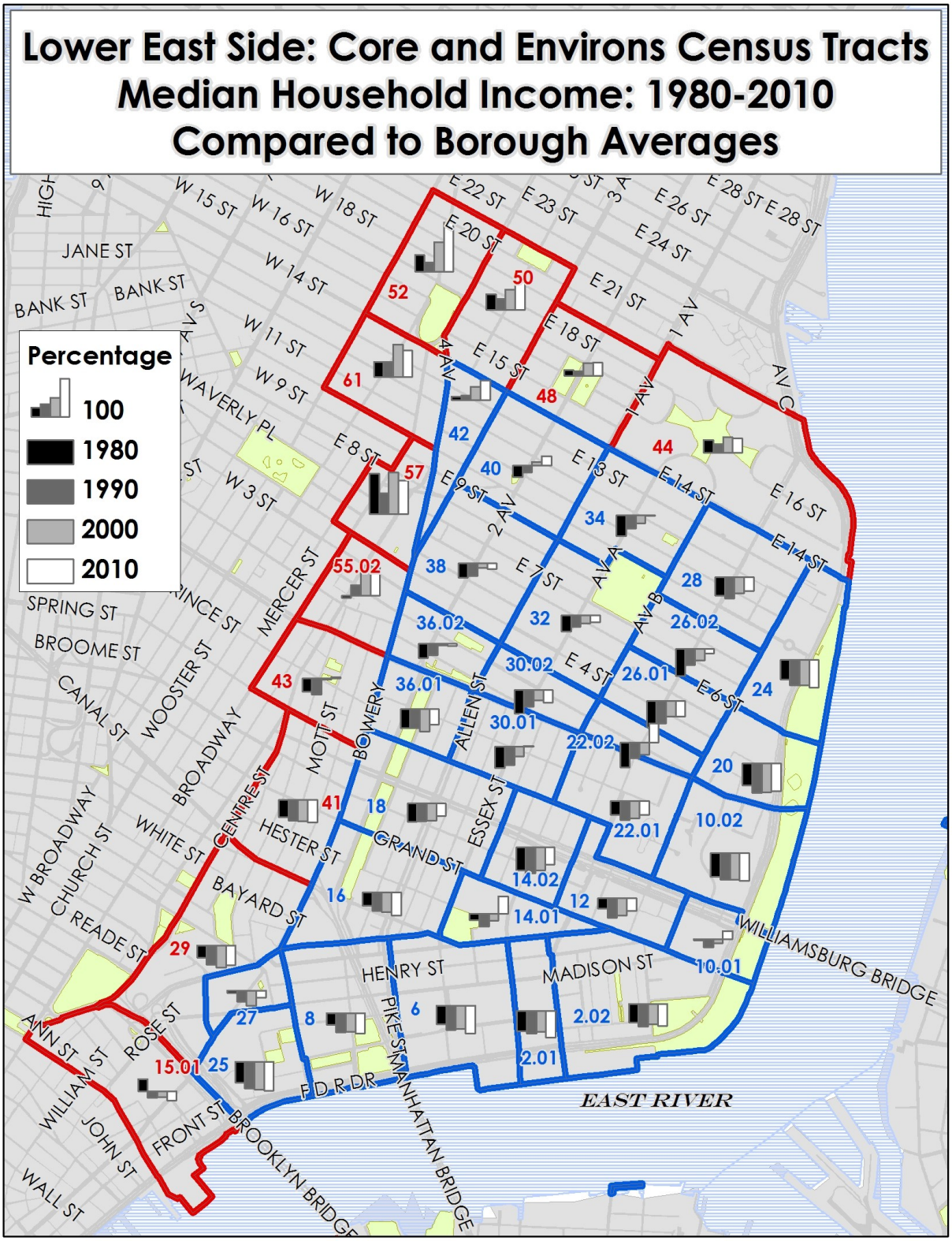


Figure 6-45. Median Household Income in the Lower East Side - Environs by Census Tract, 1980 - 2010.



Map 6-44. The Lower East Side, Median Household Income Compared to the Borough by Census Tract, 1980 - 2010.

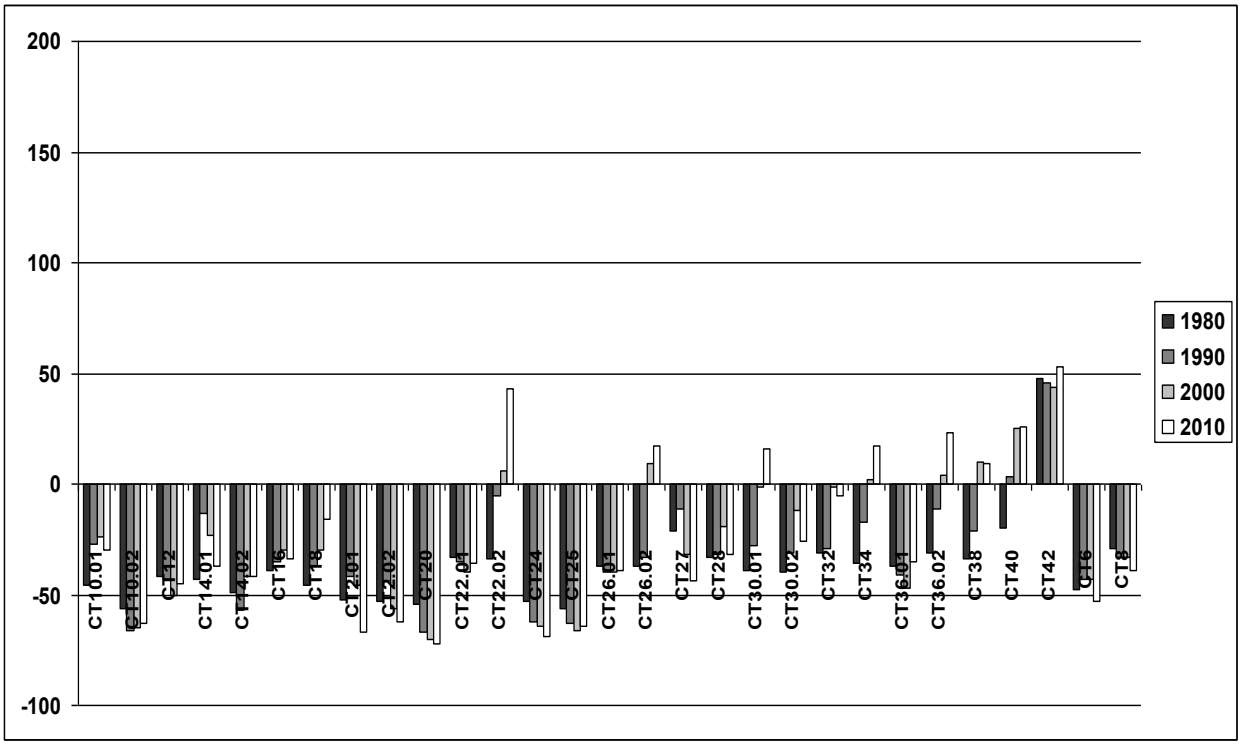


Figure 6-46. Percentage of Median Household Income Compared to the Borough by Census Tract, the Lower East Side - Core, 1980 - 2010.

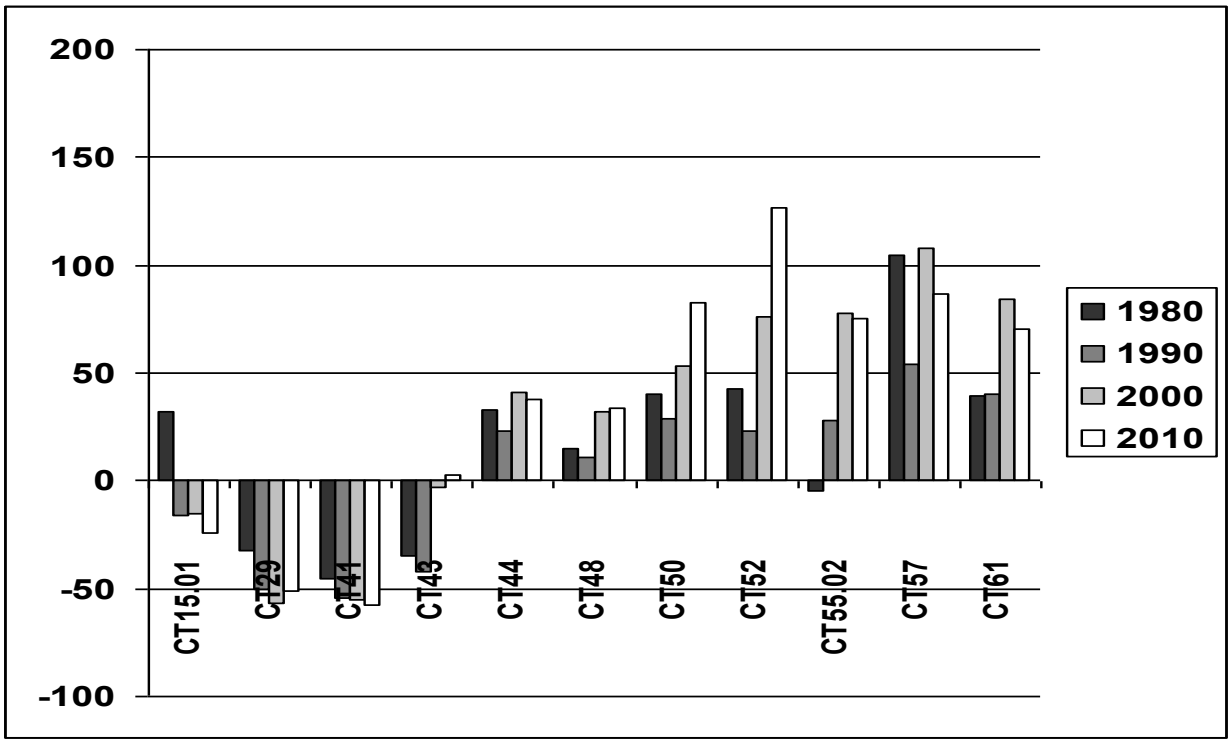


Figure 6-47. Percentage of Median Household Income compared to the Borough by Census Tract, the Lower East Side - Environs, 1980 - 2010.

6-4.6 Median Gross Rent

Figure 6-48 below compares the Lower East Side Core and Environs to New York City and the Five Boroughs. The overall trend is an increase in median gross rent. Both New York City and the Five Boroughs report an increase between 1990 and 2000 that is less than those for other years (i.e. 1980 vs. 1990; and 2000 vs. 2010). Although this pattern can also be applied to the Lower East Side Core, the increase between 1980 and 1990 is greater than those for New York City and the Five Boroughs. In fact, it changes from below the Borough in 1980 to be above the Borough in 1990 and it continues to have a higher median gross rent in the following two Census Survey years.

The Lower East Side Environs appears to have a different increasing pattern with the largest increase between 2000 and 2010, that is less than the Core. This discrepancy is due to the change in the data sources. As discussed in the research design chapter, between 1980 and 2000 there were two types of Census Survey forms used, namely: the short form that included essential questions for every household and the long form that included more detailed questions only administered to approximately one in every six households. The Census 2010 Survey changed format and only the short form was administered, and it did not include rent information. Therefore, the median gross rent data used in this study for 2010 is extracted from the American Community Survey (ACS). ACS used “above 2,000” (dollars) as the highest value and data recorded “2,000” for calculation purposes. Inflation adjustments were applied to calculate rents for the previous years, resulting in some Census Tracts appear to report lower median gross rents in 2010. These Census Tracts are indicated in Figure 6-49 and Figure 6-50 using hatch-line patterns.

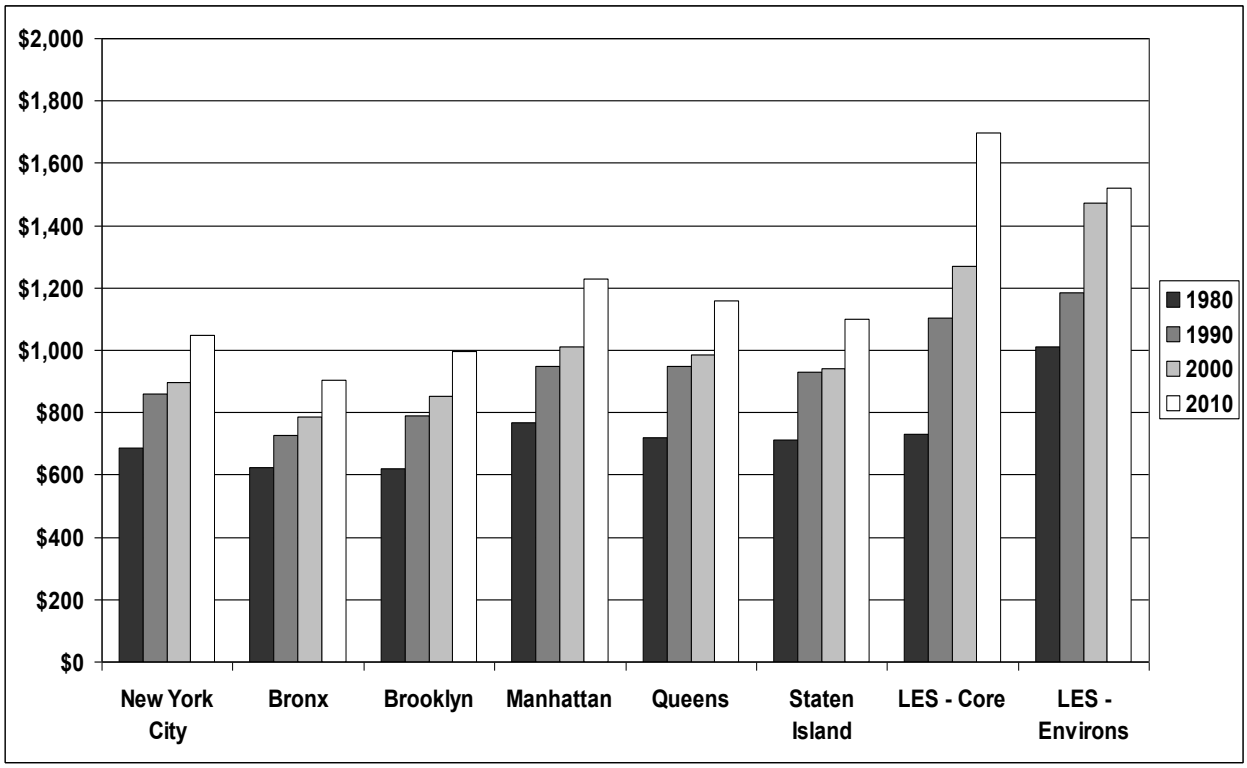


Figure 6-48. Median Gross Rent, New York City, the Five Boroughs and the Lower East Side, 1980 - 2010.

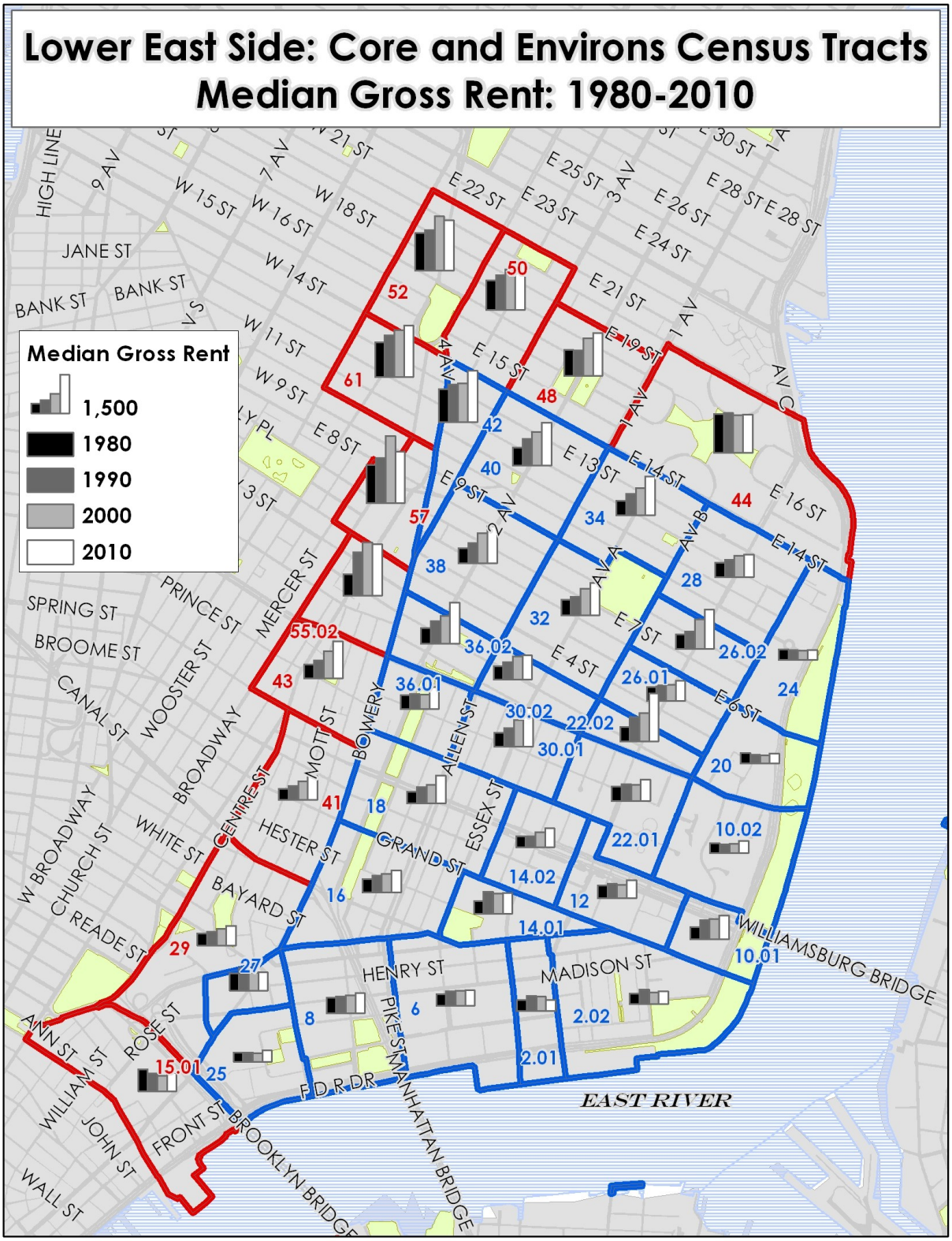
As renters dominate the Lower East side neighborhood, the monthly median gross rent (in Map 6-45) demonstrates the rental cost for the majority of the Lower East Side residents for their housing arrangements. Overall the Lower East Side Core and Environs both experience increasing rents throughout the years (see Figure 6-48 above). While it appears the Environs experienced a smaller increase than the Core, this comparison is inconclusive for the reasons described above, that is due to the design of the ACS. Compared to Manhattan, the Core reversed in 1990 and has continued to be higher than the Borough. The Environs have consistently experienced higher median gross rent than the Borough.

Two sets of maps and figures below record the median gross rent: Map 6-45 with Figure 6-49 and Figure 6-50 and reflect the amounts extracted directly from the Census Surveys and ACS, incorporating inflation adjustments so that they are comparable to each other. Map 6-46, Figure 6-51 and Figure 6-52 compare these values to the Borough and convert these values into percentages.

Within the Core, the overall trend is an increase in the median gross rent throughout the study period with the exception for those Census Tracts along the East River riverfront, which did not change much. This may be explained by the strong presence of subsidized public housing in these Census Tracts and proximity to high speed highway traffic. It can be observed that by 2010 certain adjacent Census Tracts report median gross rents that are several times higher. This stark difference can be expected to continue if the public housing projects remain in these locations. Compared to the Borough, the median rents of those Census Tracts with strong public housing project presence remain low, while the Borough experienced considerable rent increases through the years. More importantly, this signals two spatial characteristics for the rental market in the area. First, the private housing market can and may continue to rise as much as the free housing market will bear. Second, the continued demand for rental units in the Lower East Side can further push gentrification to closer proximity to the public housing projects.

Map 6-45 illustrates that the advance of the re-investment pattern that was mapped by Smith (1996) must take into account the existing physical infrastructure in the area. As in the case of Park Slope, gentrification spreads towards certain directions but is sometimes limited by existing land use patterns. In Park Slope the barrier can be the manufacturing tax lots near the industrial

Gowanus Canal area; in the Lower East Side it can be the East River riverfront public housing projects because these units are not properties that can be rented or sold on the private real estate market. One can speculate that the continuing gentrification of the Lower East Side is limited by this east-boundary and may "skip" the ungentrifiable public housing projects and spread instead into Williamsburg across the East River. The gentrification discussion and maps of Williamsburg in the next chapter should be reviewed with this proposition in mind. A discussion of the connections between gentrification of the Lower East Side and Williamsburg will be included in the final chapter of this study.



Map 6-45. The Lower East Side, Median Gross Rent by Census Tract, 1980 - 2010.

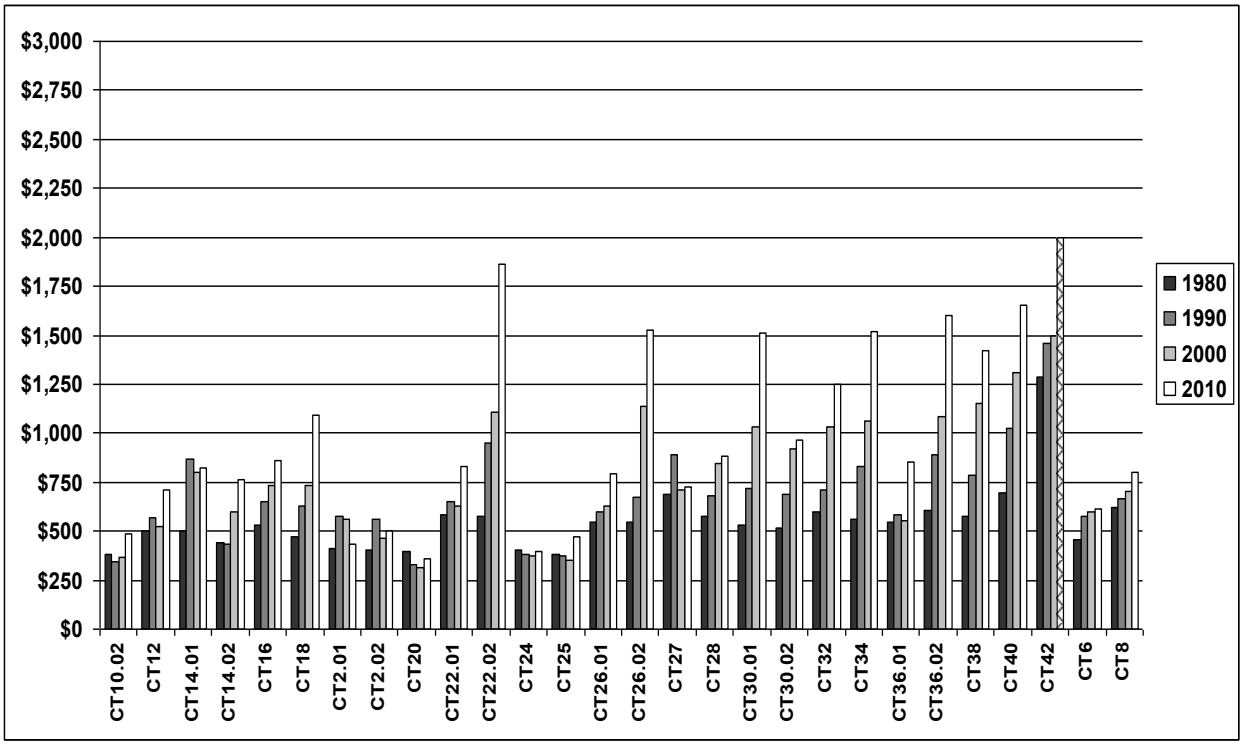


Figure 6-49. Figure 6-48. Median Gross Rent in the Lower East Side - Core by Census Tract, 1980 - 2010.

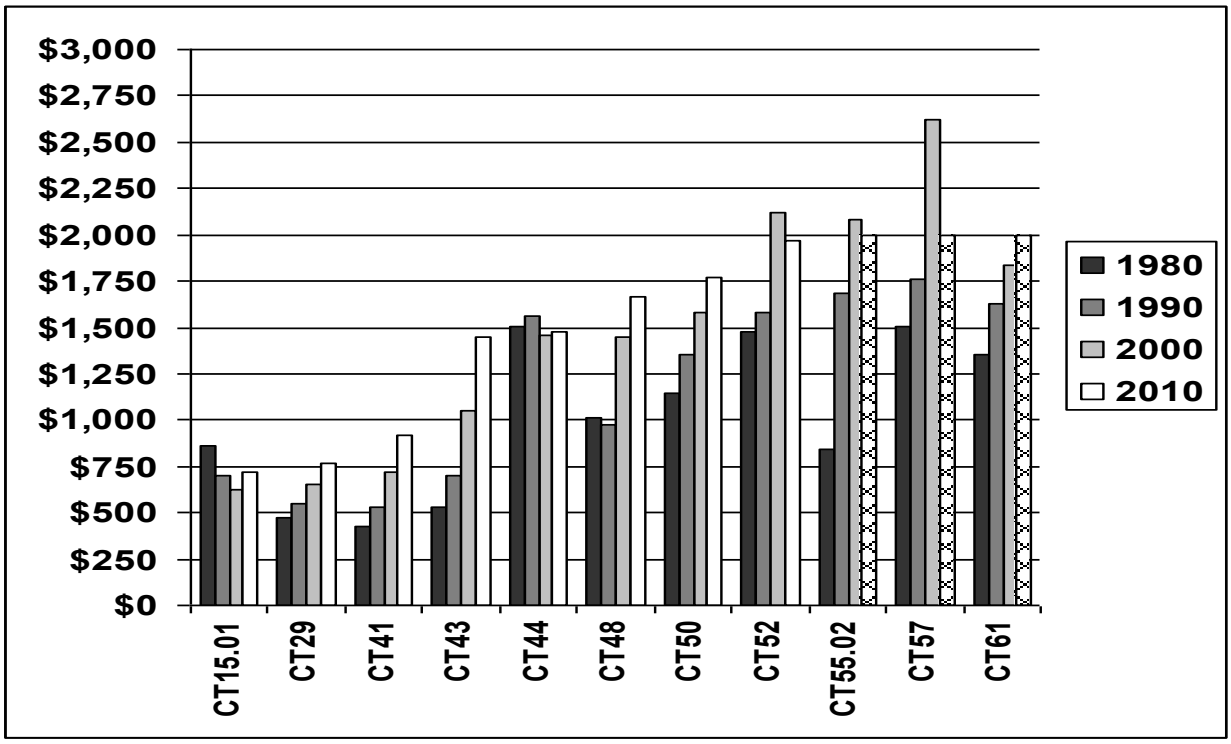
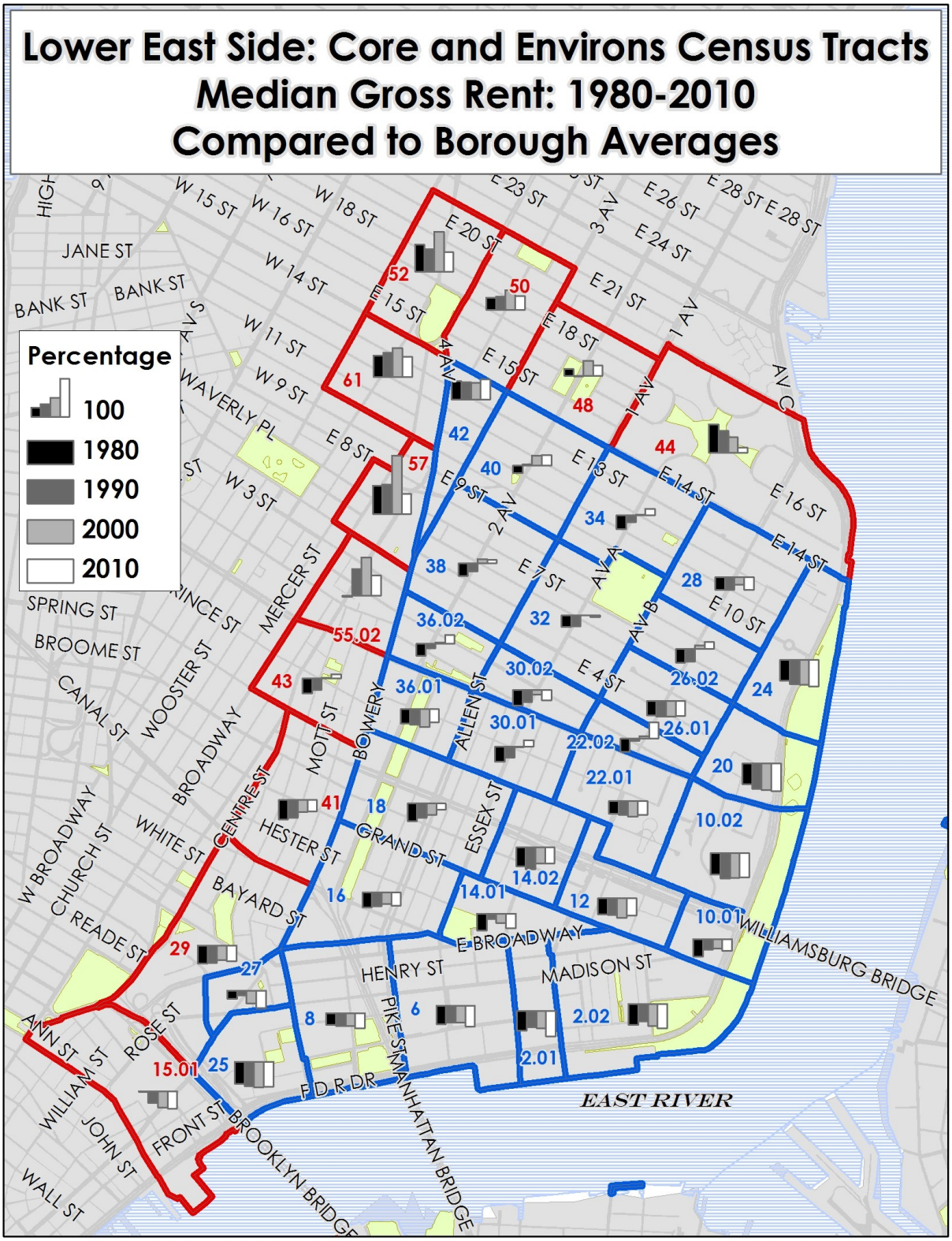


Figure 6-50. Median Gross Rent in the Lower East Side - Environs by Census Tract, 1980 - 2010. (Note: Bars filled with hatch-line pattern are from ACS and reach the 2,000 cap.)



Map 6-46. The Lower East Side, Median Gross Rent compared to Borough by Census Tract, 1980 - 2010.

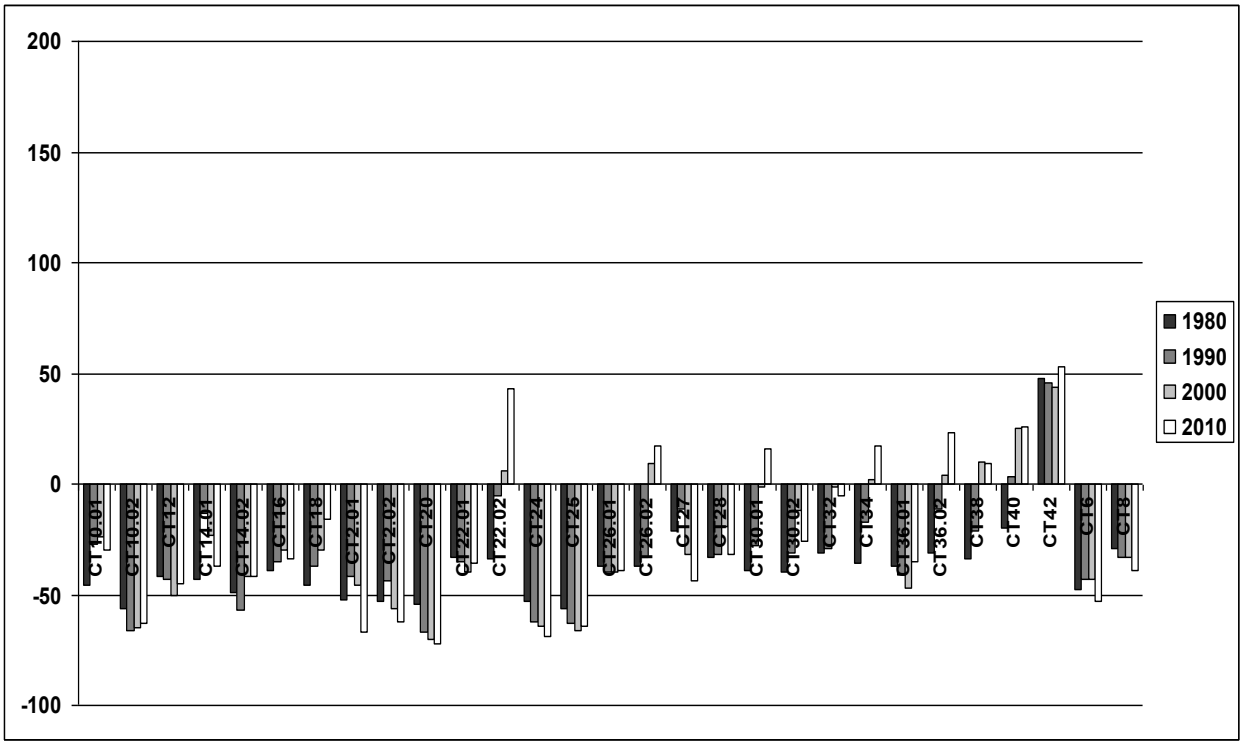


Figure 6-51. Percentage of Median Gross Rent Compared to the Borough by Census Tract, the Lower East Side - Core, 1980 - 2010.

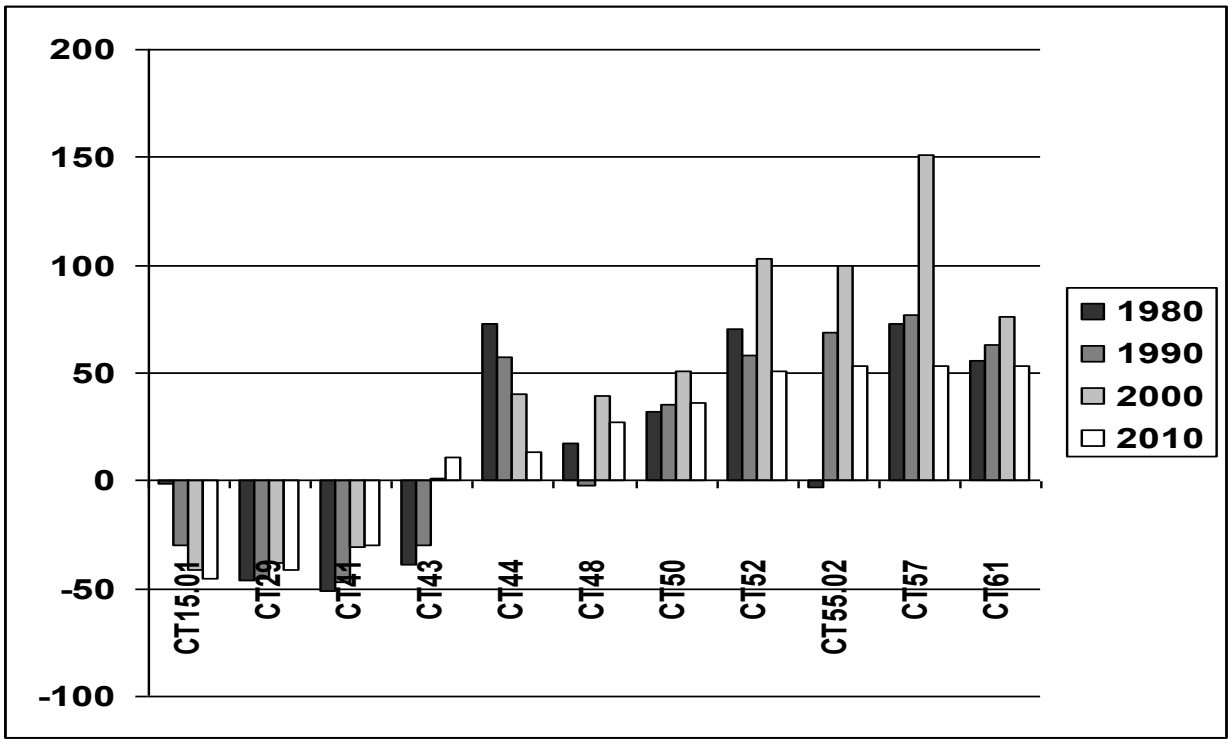


Figure 6-52. Percentage of Median Gross Rent Compared to the Borough by Census Tract, the Lower East Side - Environs, 1980 - 2010.

6-4.7 Educational Attainment

This section maps the two ends of educational attainment: those with College (or Above) Degree that has been a commonly used variable to indicate gentrification, and those without a High School Diploma to examine how gentrification affects their presence.

6-4.7a College (or Above) Degree

Figure 6-53 compares the percentage of people with College (or Above) Degrees in the total population of New York City, the Five Boroughs and the Lower East Side. Overall, both the Core and Environs show increasing percentages for those individuals with College (or Above) Degree. The Core has a sharper increase from 9% in 1980 to 28% in 2010. Regardless of the slower increasing trend, the Environs have consistently higher figures throughout the study period.

Two sets of maps and figures in the following pages record these percentages by Census Tract: Map 6-47, Figure 6-54 and Figure 6-55 for the percentages for the Lower East Side Core and Environs; Map 6-48, Figure 6-56 and Figure 6-57 compare these percentages to the Borough.

The spatial patterns observed in the median household income section is mirrored here. While the majority of the Census Tracts in both Core and Environs follow an increasing pattern throughout the years, the percentages are quite different. There are several spatial patterns that are observed in Map 6-47: Overall, the Northern half has higher percentages of people with College (or Above) Degree. The Environs Census Tracts in the North especially have

consistently higher percentages throughout the years. The Northern Core Census Tracts began with lower percentages but show a steady increase over the years. The exceptions are the East River riverfront Census Tracts that report low percentages, (only Census Tract 10.01 which breaks from this pattern). Naturally when the percentages are compared to the Borough those Census tracts with low percentages appear below the Borough (Map 6-48, further below).

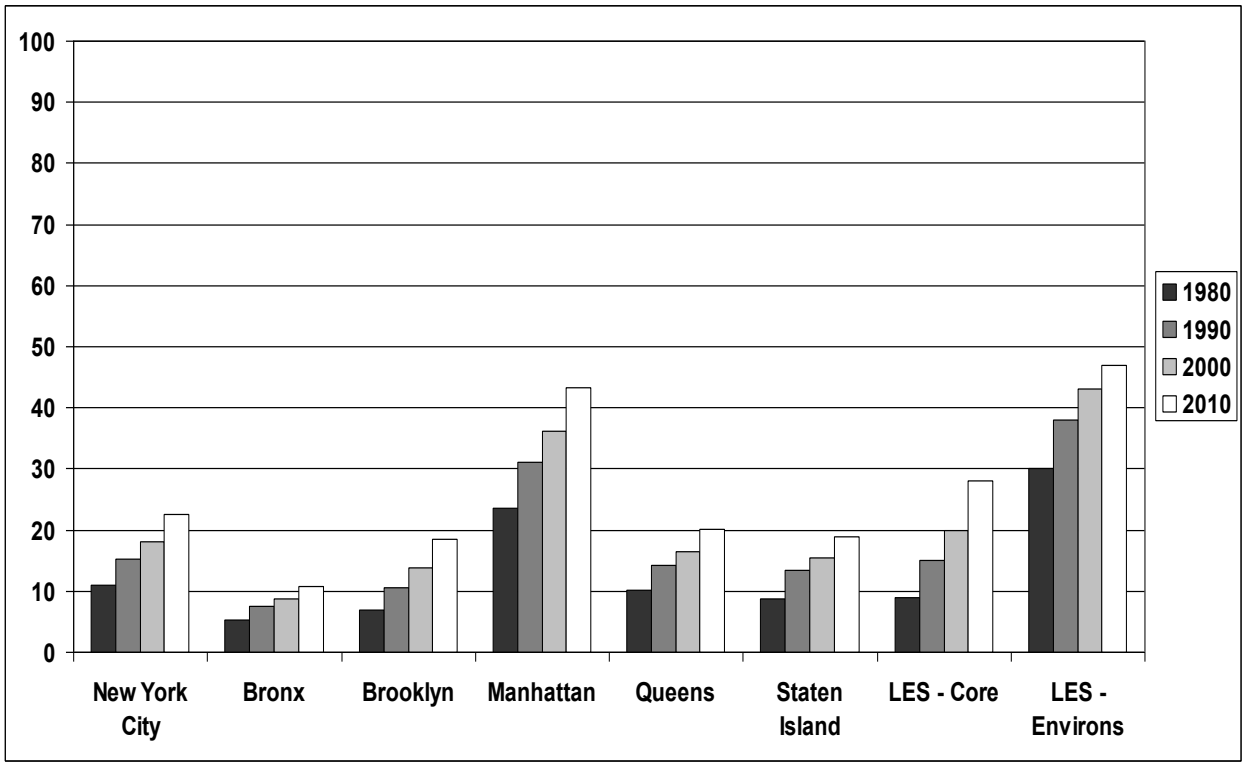
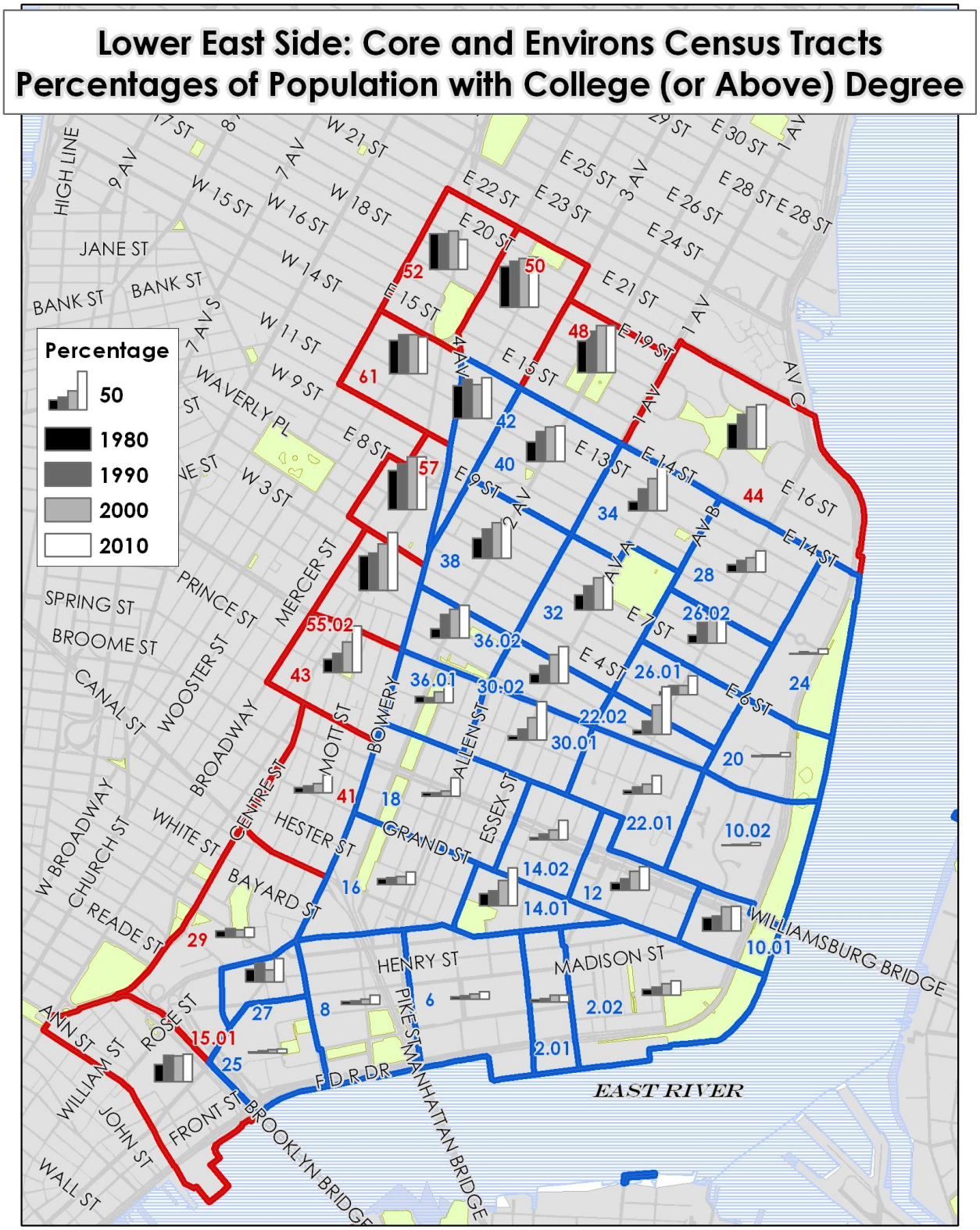


Figure 6-53. Percentage of Population with College (or Above) Degree in New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.



Map 6-47. The Lower East Side, Percentage of Population with College (or Above) Degree by Census Tract, 1980 - 2010.

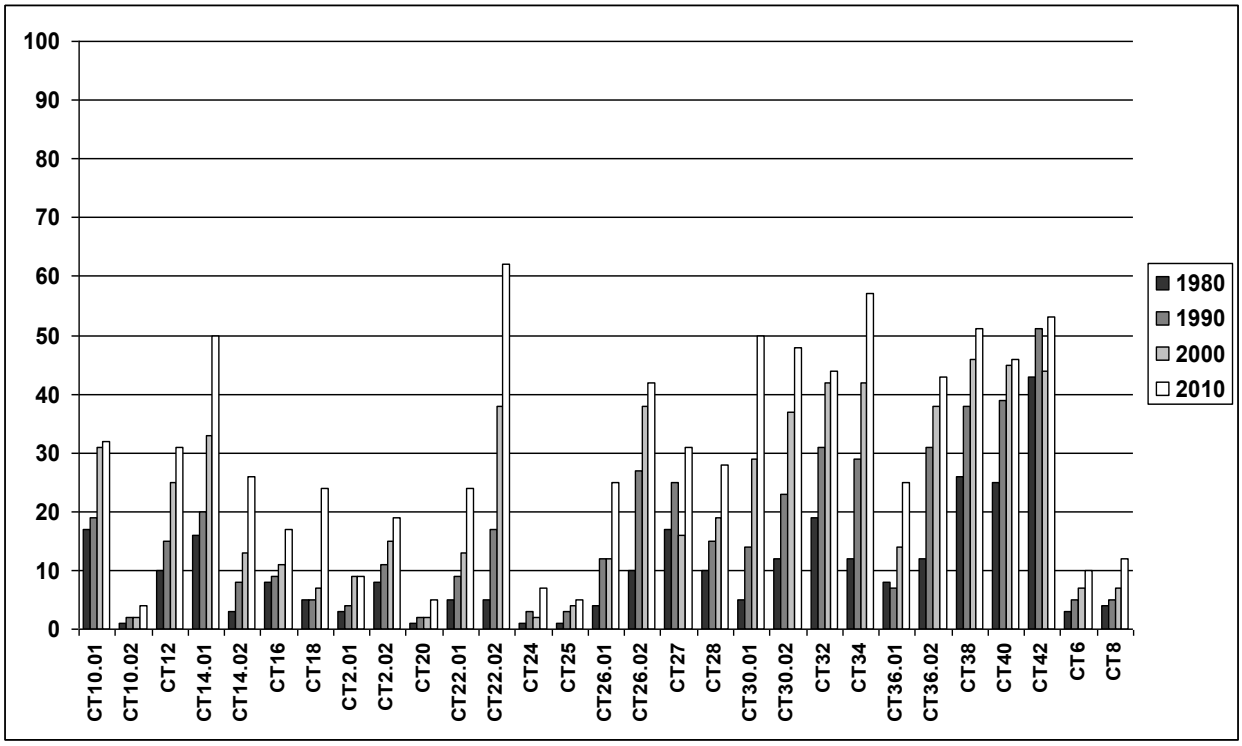


Figure 6-54. Percentage of Population with College (or Above) Degree in the Lower East Side - Core by Census Tract, 1980 - 2010.

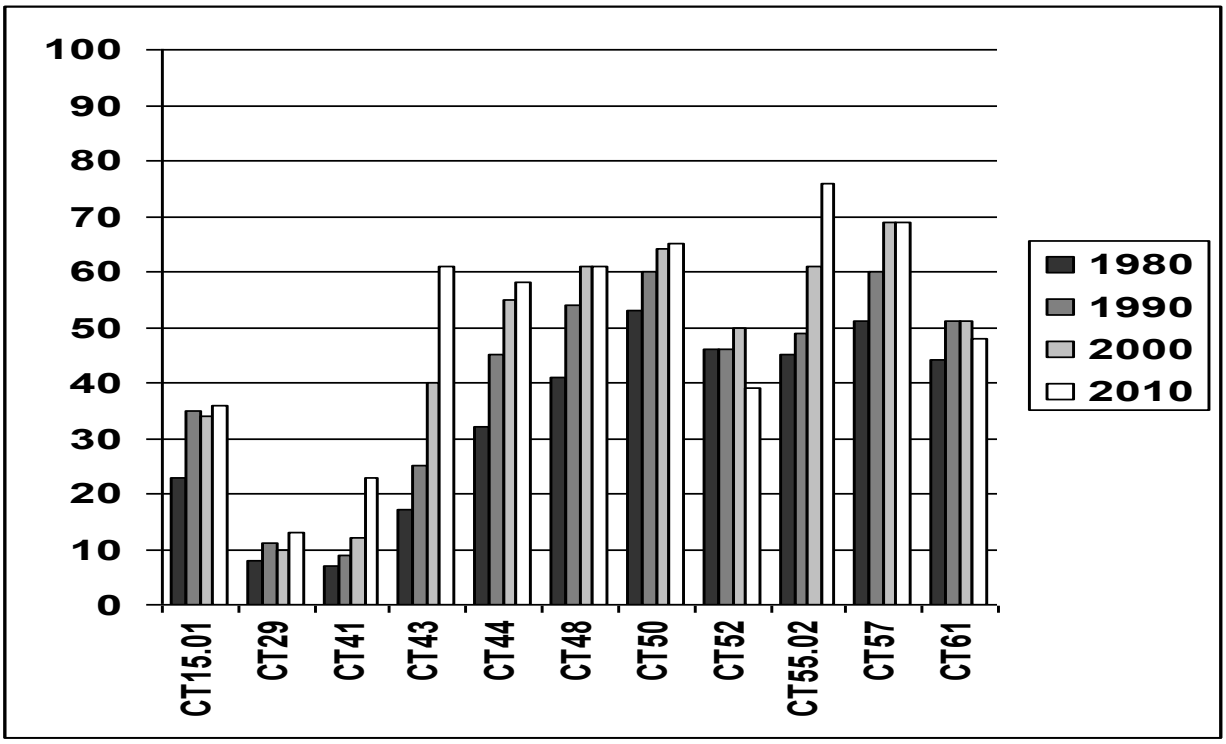
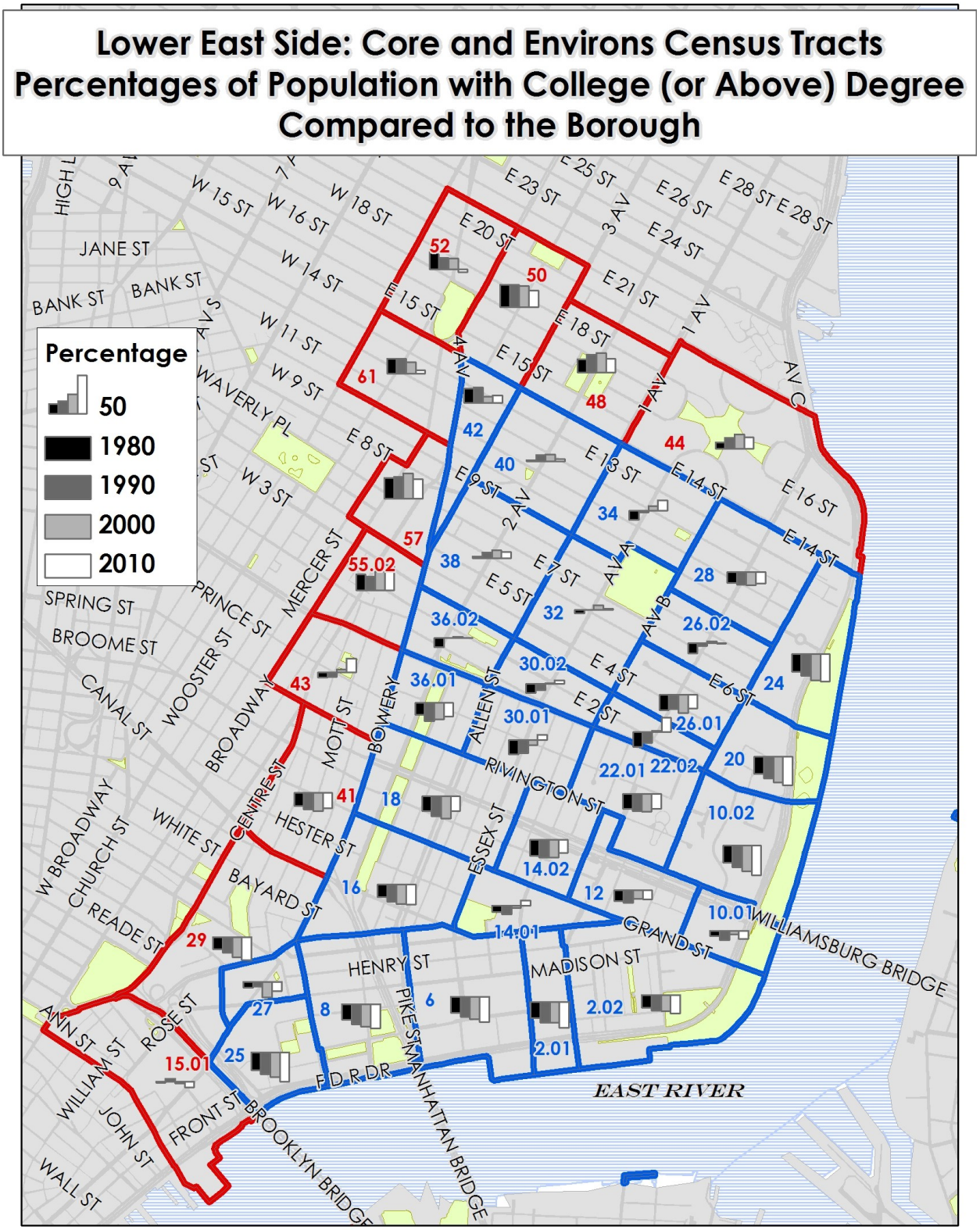


Figure 6-55. Percentage of Population with College (or Above) Degree in the Lower East Side - Environs by Census Tract, 1980 - 2010.

A closer examination of these two maps (Map 6-47 above for the percentages; and Map 6-48 for the comparison to the Borough) reveals distinctive differences from the findings in Park Slope, where gentrification is anchored by Prospect Park. The green and open space along the East River riverfront (See Census Tracts 24 then south to 20, 10.02, 10.01, 2.02, 2.01, 6, 8 and 25), with the exception of Census Tracts 10.01 and 2.02 all the other Core Census Tracts bordering the East River have noticeable low percentages for the individuals with College (or Above) Degree throughout the study years. These Census Tracts are dominated by public housing projects. The FDR Drive, though elevated and only partially obstructs access to the riverfront, this highway still acts as a barrier for residents accessing this long stretch of open space.



Map 6-48. The Lower East Side, Percentage of Population with College (or Above) Degree Compared to the Borough by Census Tract, 1980 - 2010.

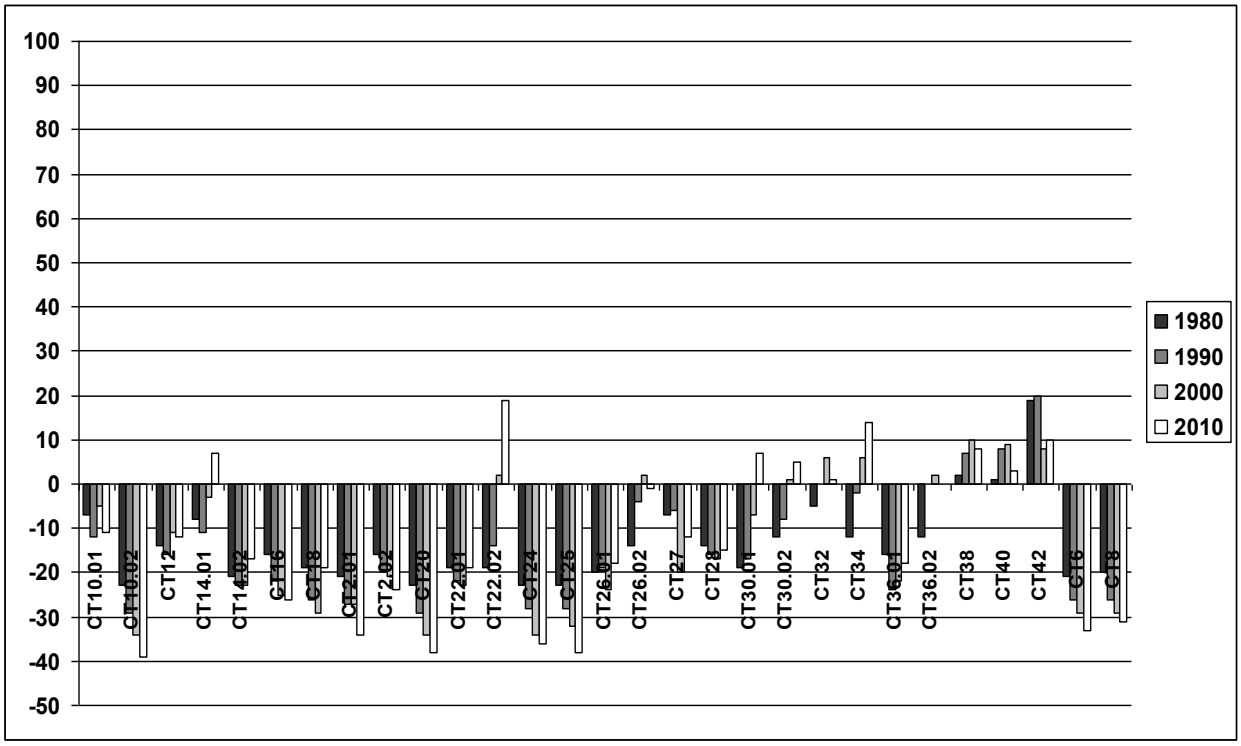


Figure 6-56. Percentage of Population with College (or Above) Degree Compared to the Borough in the Lower East Side - Core by Census Tract, 1980 - 2010.

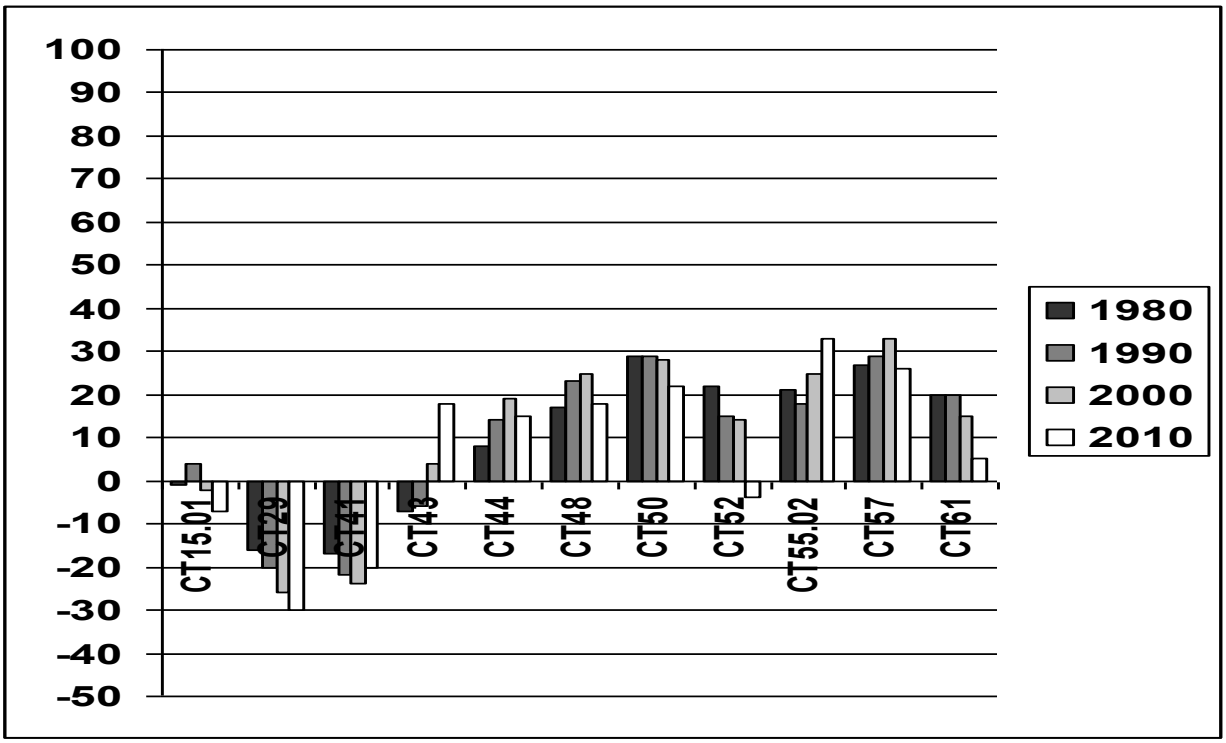


Figure 6-57. Percentage of Population with College (or Above) Degree Compared to the Borough in the Lower East Side - Environs by Census Tract, 1980 - 2010.

6-4.7b No High School Diploma

Figure 6-58 compares the percentage of people without a High School Diploma in the total population of New York City, the Five Boroughs and the Lower East Side. Overall, both the Core and Environs show decreasing patterns. The Core has consistently higher percentages than does New York City and the Borough. The Environs has slightly lower percentages than New York City and the Boroughs.

Two sets of maps with figures in the following pages to record the percentages by Census Tract: Map 6-49, Figure 6-59 and Figure 6-60 for the percentages; Map 6-50, Figure 6-61 and Figure 6-62 for the comparisons to the Borough.

Map 6-49 illustrates in the Core that the Census Tracts in the North report lower percentages and continue to decrease throughout the years. The East River riverfront Census Tracts (with the exception of Census Tract 10.01) and a few in the Southern area of the Core, show a decreasing pattern and still retain considerable individuals without high school diplomas.

The Census Tracts in the Environs also show several trends. Those Census Tracts in the North section report consistently low (and below the Borough) percentages. The pattern for the middle section is a decreasing trend and the percentages decrease throughout the study years. The Southern Environs including Chinatown (i.e. Census Tracts 41 and 29, with the adjacent Census Tracts 18 and 16 in the Core) have considerable individuals without high school diplomas and the percentages are decreasing.

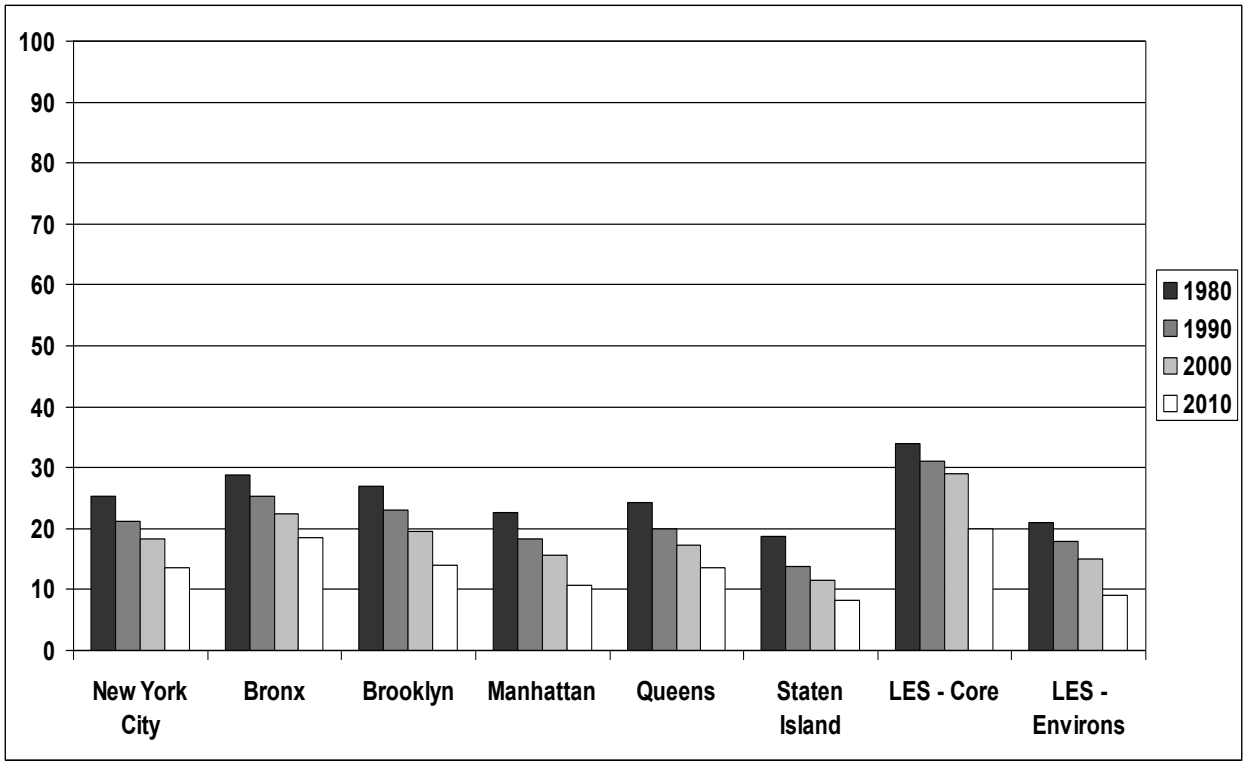
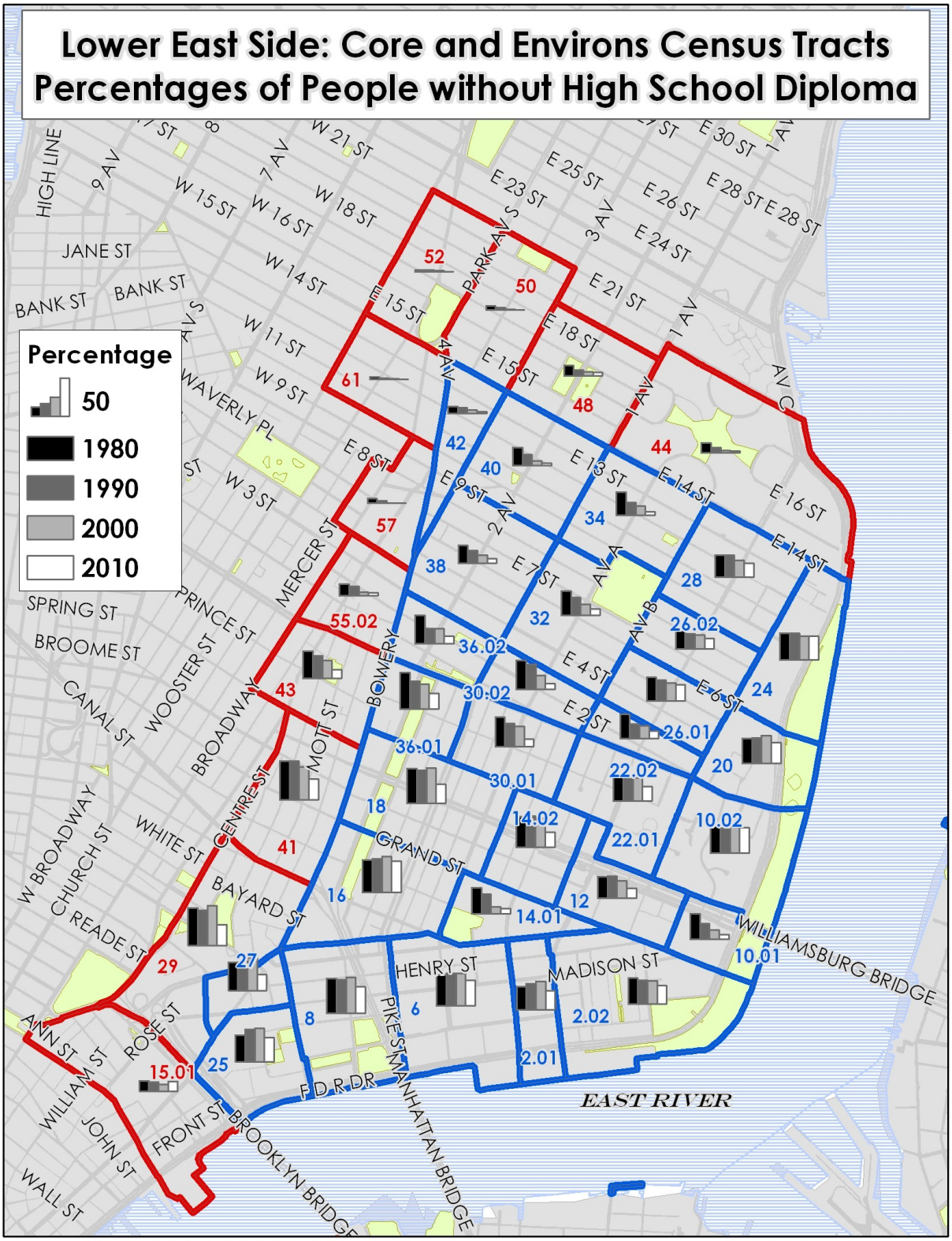


Figure 6-58. Percentage of Population without a High School Diploma in New York City, the Five Boroughs and the Lower East Side (LES) - Core vs. Environs, 1980 - 2010.



Map 6-49. The Lower East Side, Percentage of Population without High School Diploma by Census Tract, 1980 - 2010.

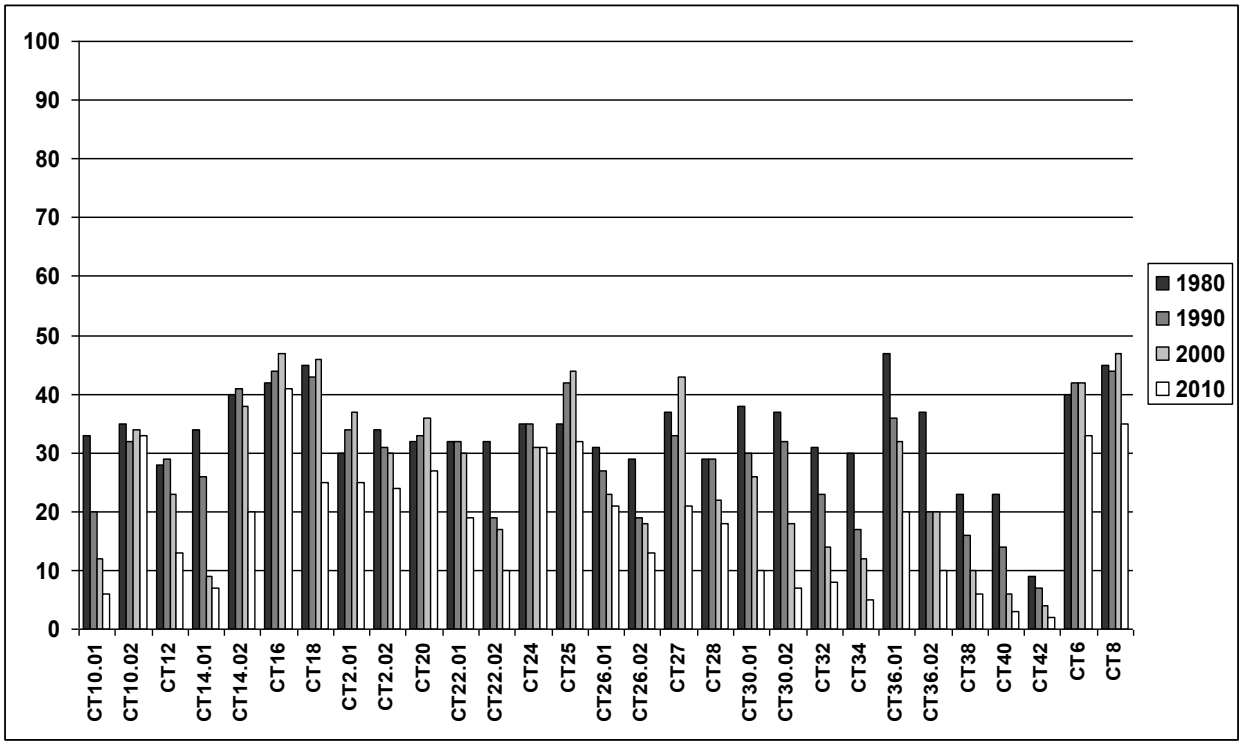


Figure 6-59. Percentage of the Population a without High School Diploma in the Lower East Side - Core by Census Tract, 1980 - 2010.

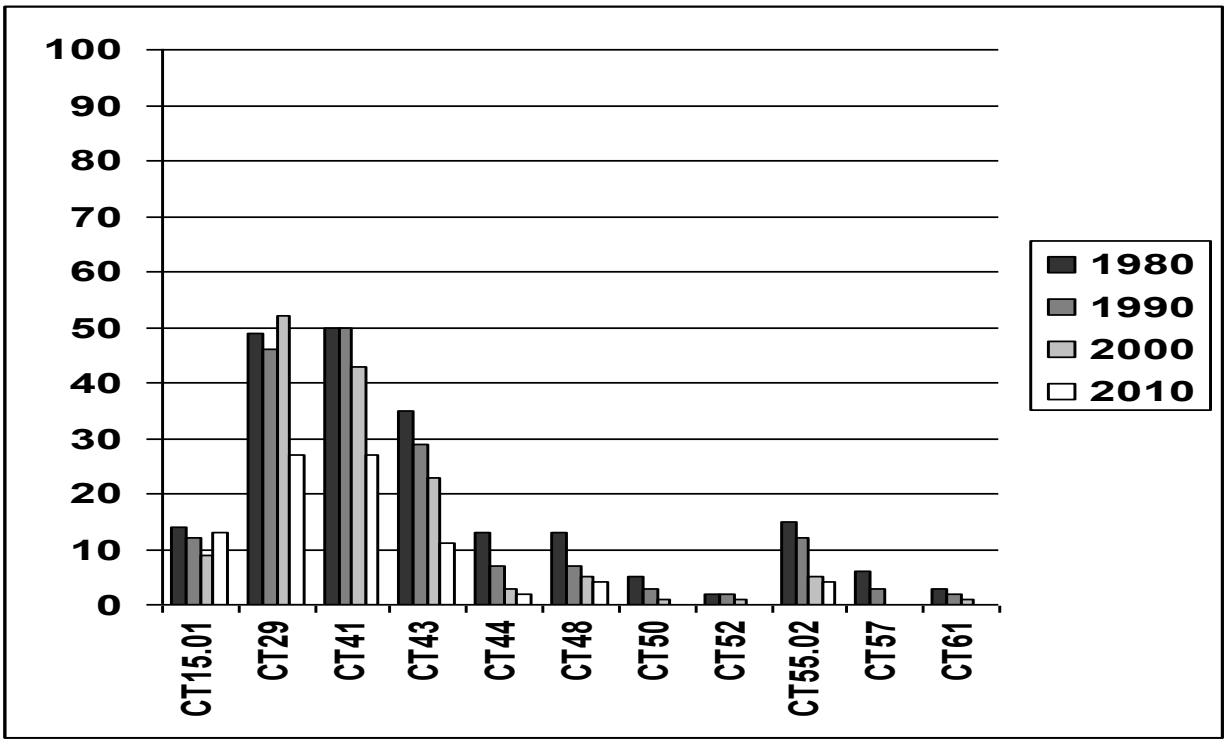
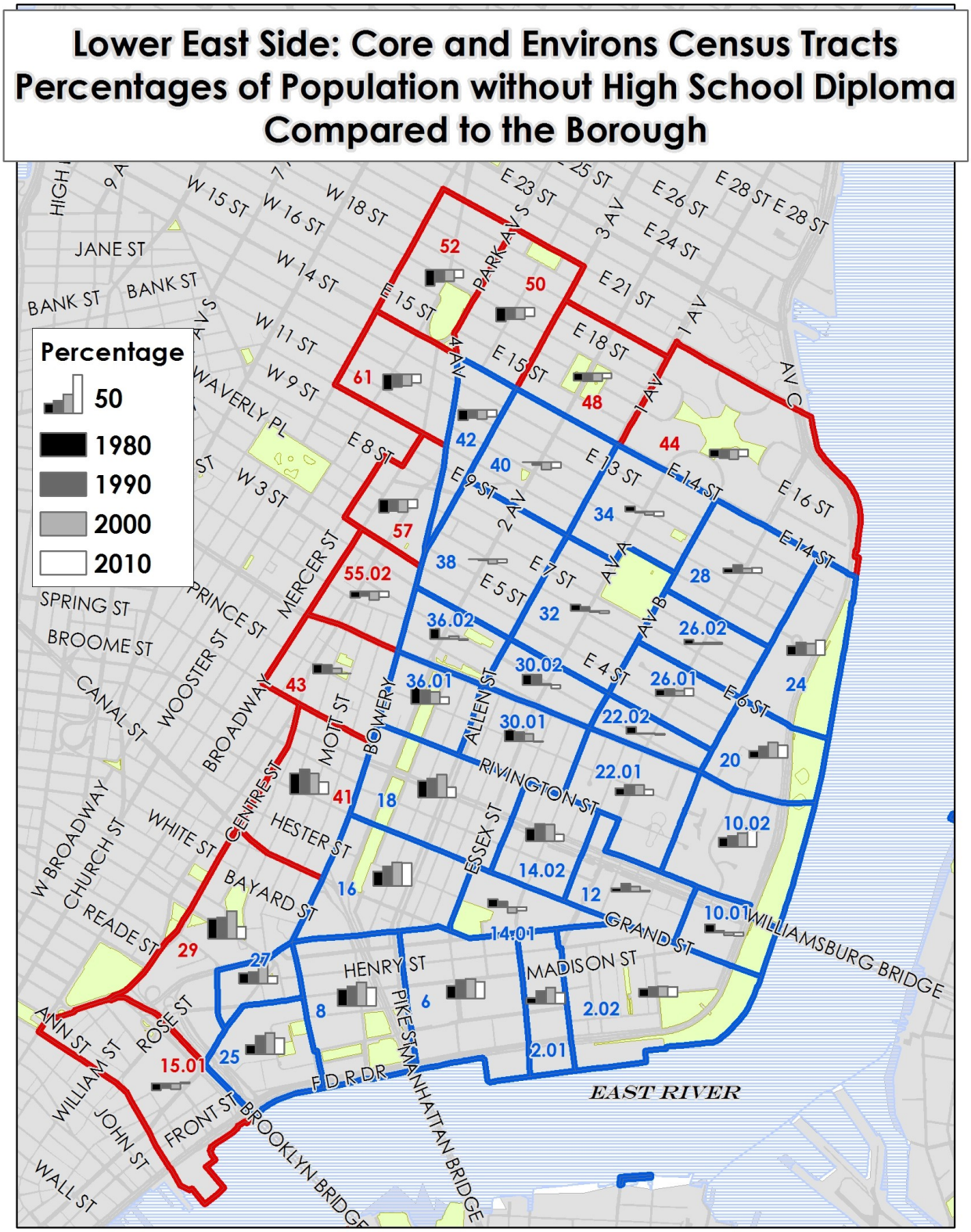


Figure 6-60. Percentage of the Population without a High School Diploma in the Lower East Side - Environs by Census Tract, 1980 - 2010.



Map 6-50. The Lower East Side, Percentage of Population without High School Diploma Compared to the Borough by Census Tract, 1980 - 2010.

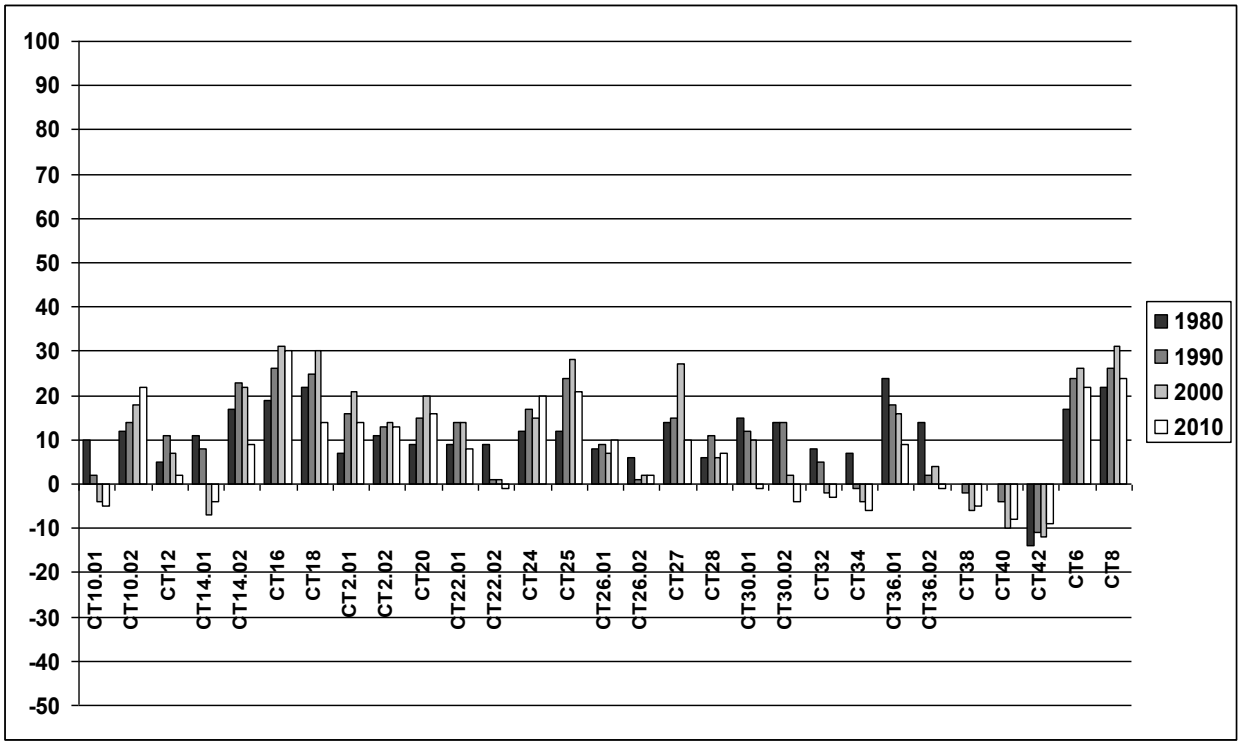


Figure 6-61. Percentage of Population without a High School Diploma Compared to the Borough in the Lower East Side - Core by Census Tract, 1980 - 2010.

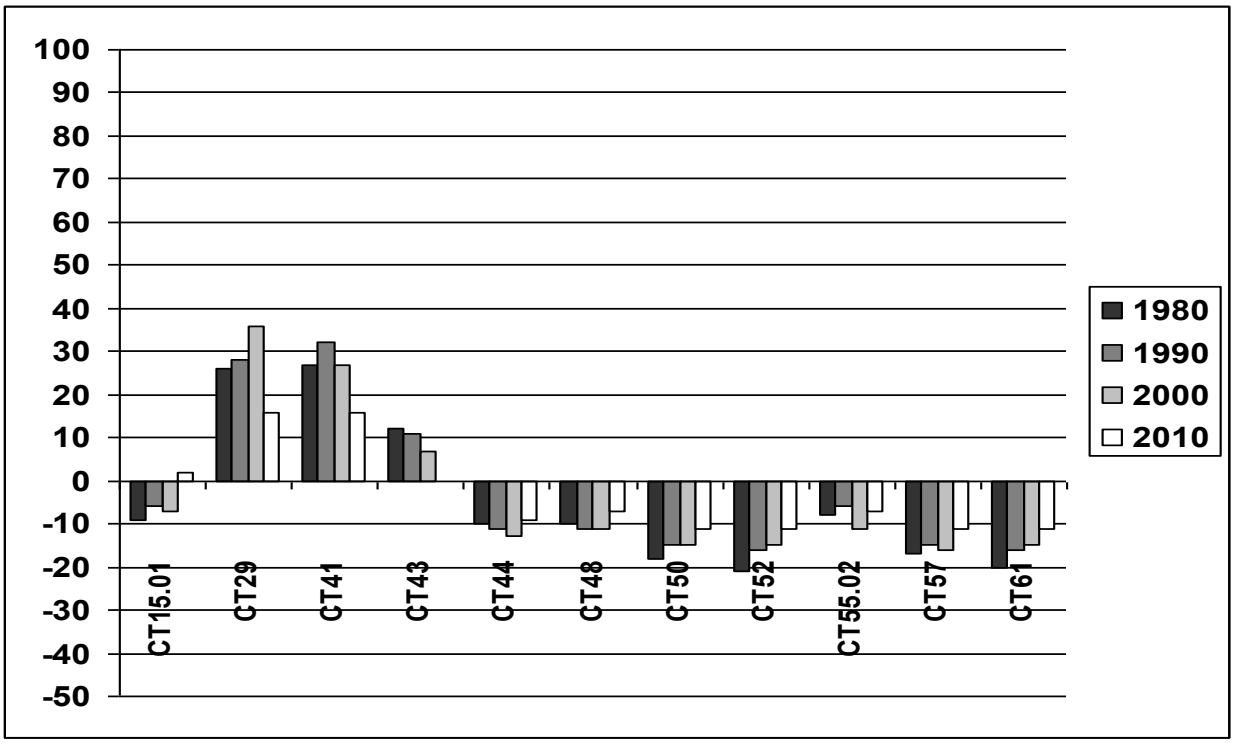


Figure 6-62. Percentage of Population without a High School Diploma Compared to the Borough in the Lower East Side - Environs by Census Tract, 1980 - 2010.

6-5 Lower East Side: Summary

The definition of the Lower East Side takes on a more inclusive approach. Some researchers have divided the "old Lower East Side" at Houston Street, a wide, multi-line thoroughfare and then referred the North area as the "East Village"; retaining the Lower East Side name only for the area South of Houston Street. This scheme leaves Thompson Square Park out of the Lower East Side neighborhood, which is famously associated with the gentrification of this area. This study uses a scheme that incorporates the East Village area that is north of Houston Street and extends up to East 14th Street. Located north of East 14th Street are the Stuyvesant Town and Peter Cooper Village residential complexes which, as the gentrification maps in this chapter illustrate, is considerably a different neighborhood from the Lower East Side. Figure 6-63 below is a photograph of the residential buildings in the Stuyvesant Town - Peter Cooper Village complex that are distinctively different from those residences in the Lower East Side.

Figure 6-63. Stuyvesant Town - Peter Cooper Village.

Referring only the Core areas, the Lower East Side is the largest neighborhood among the three selected for study for this dissertation. The Lower East Side is approximately twice the size of Park Slope and about fifty percent larger than Williamsburg (defined in the next chapter). It is also the most populous with about three times the number of residents than Park Slope or Williamsburg. These two factors alone would require a more in-depth study on the gentrification of the Lower East Side that can detail all of its complexities. However, to keep the structure of this dissertation's neighborhood discussions and chapters consistent and easier to compare against each other, identical types of maps are created with matching and uniformed numbering systems.

In contrast to the gentrification of Park Slope which has a more steady West-bound expansion, the gentrification of the Lower East Side is less uniform. Although earlier gentrification began in the Northwest corner, the subsequent gentrification only roughly follows what Smith (1996) describes as a steady eastbound expansion. This conclusion is a result of the different research design. The geographic unit used by Smith is a single tax lot and the study is based on tax arrears records. The unit used for the current study is a much larger Census Tract and relies more on the consumption side of gentrification theory. The coverage for this study, which includes Chinatown in Lower Manhattan, further complicates the review. Future studies may consider examining the entire lower Manhattan area to fully assess the neighborhood by neighborhood levels of gentrification and the interactions among these neighborhoods.

In summary of the gentrification maps created with GIS for this dissertation, the physical environment of the Lower East Side can be described as:

1. Complicated as far as zoning districts are concerned. The residential district is still the primary land use in the Lower East Side but the commercial district occupies almost the same area. The commercial district is a more dominant land use pattern in the Environs and this affects, or limits, the potential housing expansion from the Core. Manufacturing districts do not play significant roles in the Lower East Side Core and Environs areas. Park land occupies the same proportion for both the Core and Environs, although a considerable proportion of the Core park land is located along the East River which is not as accessible as for the residents in the Park Slope Core to Prospect Park.

2. Most existing buildings are built before 1940. New construction is sporadic. In contrast to Park Slope which is delineated by low buildings, the Lower East Side building types and number of floors are more evenly distributed. Taller buildings are mixed with shorter ones.

3. Historic preservation districts are not directly linked to gentrification directly within the Core area. Park land also does not play a significant role. The likely expansion for park land, or rather, to facilitate the accessibility to the East River riverfront open space depends on creative urban design that will “cross” the FDR barrier.

4. The rezoning in the area seems focused on keeping new construction in line with existing structures and not due to shifting land use patterns. Whether this may limit construction of additional housing units and affect future gentrification is unclear at this time. However, ongoing gentrification as a result of low vacancy rate and popularity of

the Lower East Side's central location will likely to keep the housing market in the area very competitive.

5. The presence of public housing projects along the East River riverfront Census Tracts requires particular attention when considering future gentrification in this neighborhood. As government owned properties that regulate low-income tenants these buildings need to be reviewed separately and not treated as equal to the average renter-occupied units. It is unlikely in the foreseeable future that these public housing projects will to be replaced by privately owned housing, and they will continue to act as un-gentrifiable properties in the neighborhood and enable low-income people to stay in the area.

In summary, the demographic characteristics of the Lower East Side can be described as:

1. The total population remains reasonably steady with the White population as the leading ethnic group, and the Chinese population experiencing a considerable proportion. This statement may be the result of this study's more expanded coverage that defines the Lower East Side. The Black population has been consistently low, with clusters in the East River riverfront Census Tracts.

2. Nine out of the eleven Environs Census Tracts have consistent low percentages (below 10%) of population that are Hispanic. Although the overall percentages of the Hispanic in the Core area decrease through the study period, Map 6-36 and Figure 6-22 illustrate the intra-neighborhood differences. The middle section of the Core experiences a decreasing

trend but the three riverfront Census Tracts where public housing projects are located (see Map 6-7) remain predominantly Hispanic. Contrast to the Hispanic population in Park Slope that increases in the Environs, in the Lower East Side the public housing projects might have provided the opportunities for them to remain in the neighborhood. Neither Park Slope nor Williamsburg has similar strong presence of public housing projects.

3. Overall, none of the age groups mapped has a particular dominant presence in 2010. The recent gentrification in the area is more likely to be associated with other age groups not selected by this study. Considering the relative high income and rent reported in recent Census Surveys and ACS, it is likely the gentrifiers are middle-aged white-collar professionals. .

In summary, the housing conditions of the Lower East Side can be described as:

The most noticeable changing housing condition of the Lower East Side is the consistent decrease in percentages of renter-occupied housing units. Although the percentages are still high, it should be noted that these figures include housing units in the public housing projects. Future researchers may conduct studies that exclude housing units in public housing projects that can better gauge how gentrification in this neighborhood affects the available units on the private housing market.

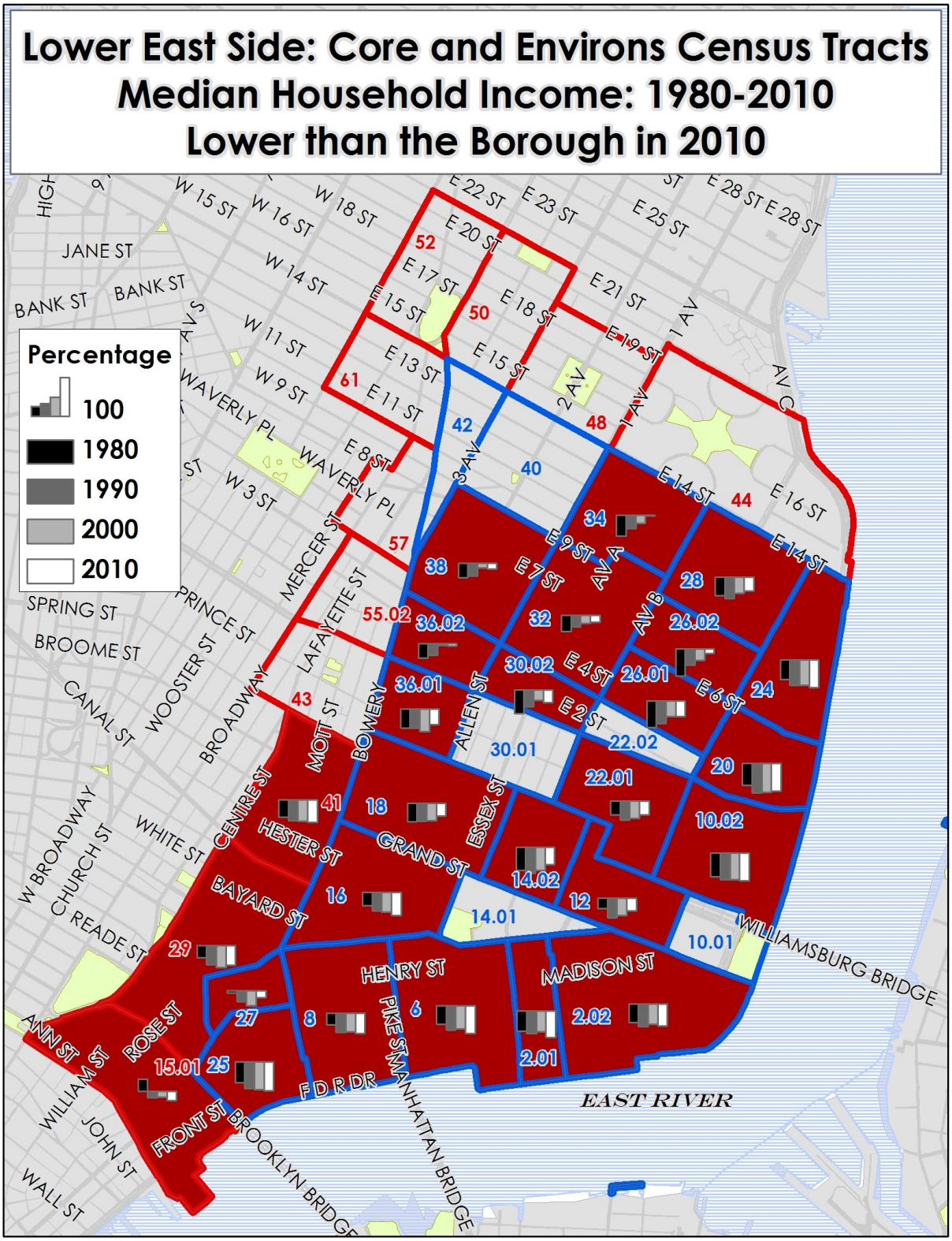
In summary, the socio-economic conditions of the Lower East Side can be described as:

Combing through the maps and findings from the median household income, median gross rent and higher educational attainment sections, a spatial and temporal gentrification pattern surfaces: starting in the North-west corner and spreading east bound as time progresses. The gentrification has not, nor does it seem likely to, continue into the East River riverfront Census Tracts which have a strong presence of public housing projects. In fact, these riverfront Census Tracts do not seem to experience much change in the last thirty years; when compared to the Borough itself they appear staying at the same condition.

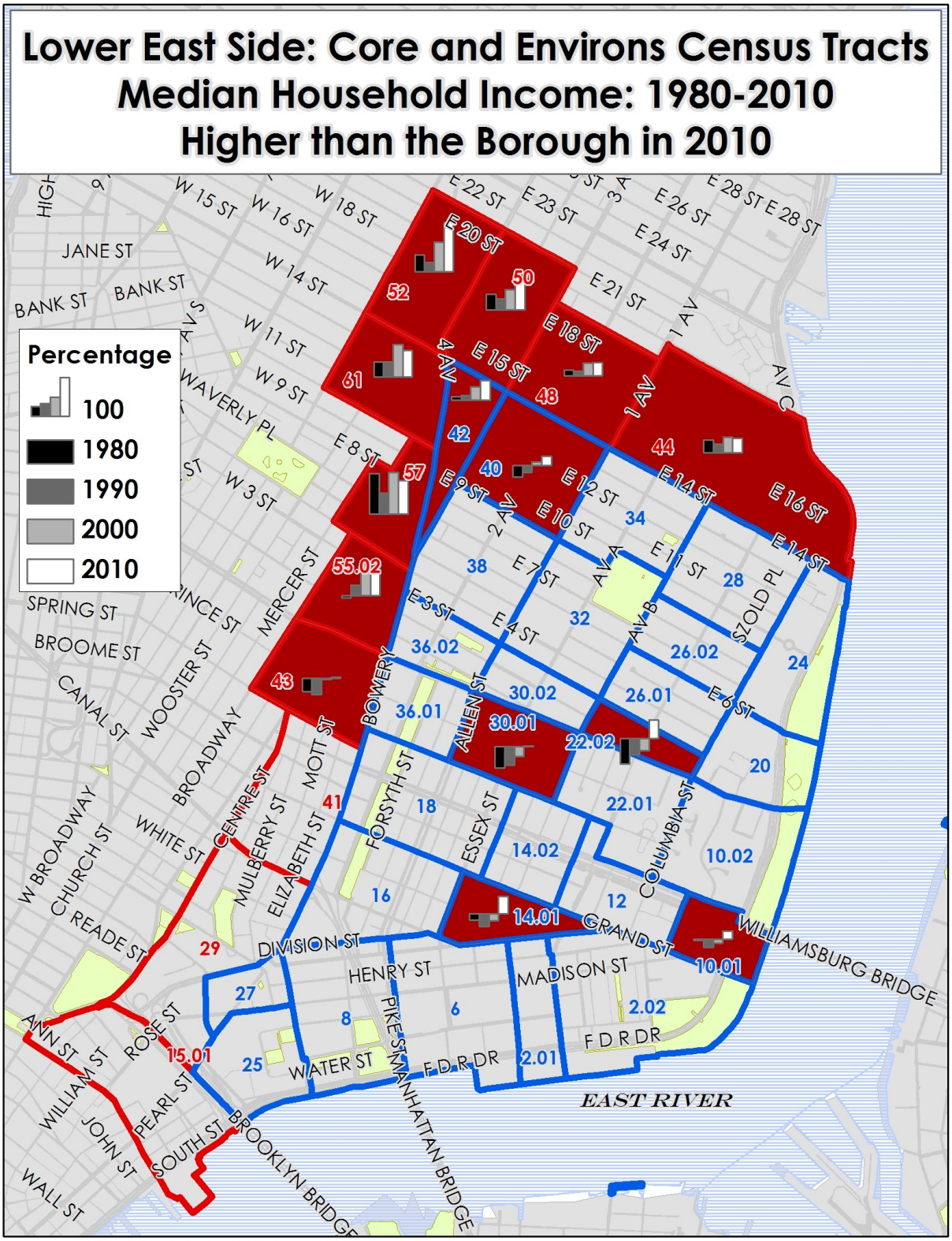
In contrast to the pattern experienced in Park Slope, where the gentrification spills over into certain Environs Census Tracts, in the Lower East Side some of its surrounding areas were already gentrified in 1980, the starting point for this study. As mentioned earlier, the whole picture of gentrification in the Lower East Side may require a larger geographical coverage to include all of the Lower Manhattan neighborhoods. Contrary to the gentrification of Park Slope that spills over into surrounding areas, it appears that the gentrification of the Lower East Side is at least partially the result of gentrification outside the neighborhood that expanded into the Lower East Side area. For instance, how the gentrification of Greenwich Village, SoHo and TriBeCa (which are only partially mapped and analyzed in the study) affects the changes in the Lower East Side remains to be fully examined and vice versa.

Map 6-51 through Map 6-55 in the following pages illustrate the “reverse” scheme used in the Park Slope chapter. These maps specifically compare only the median household income to the Borough, the “reverse” (changing from below-the-Borough to above-the-Borough) of Census Tracts are highlighted in dark red. By reviewing the maps in a reverse sequence (by flipping

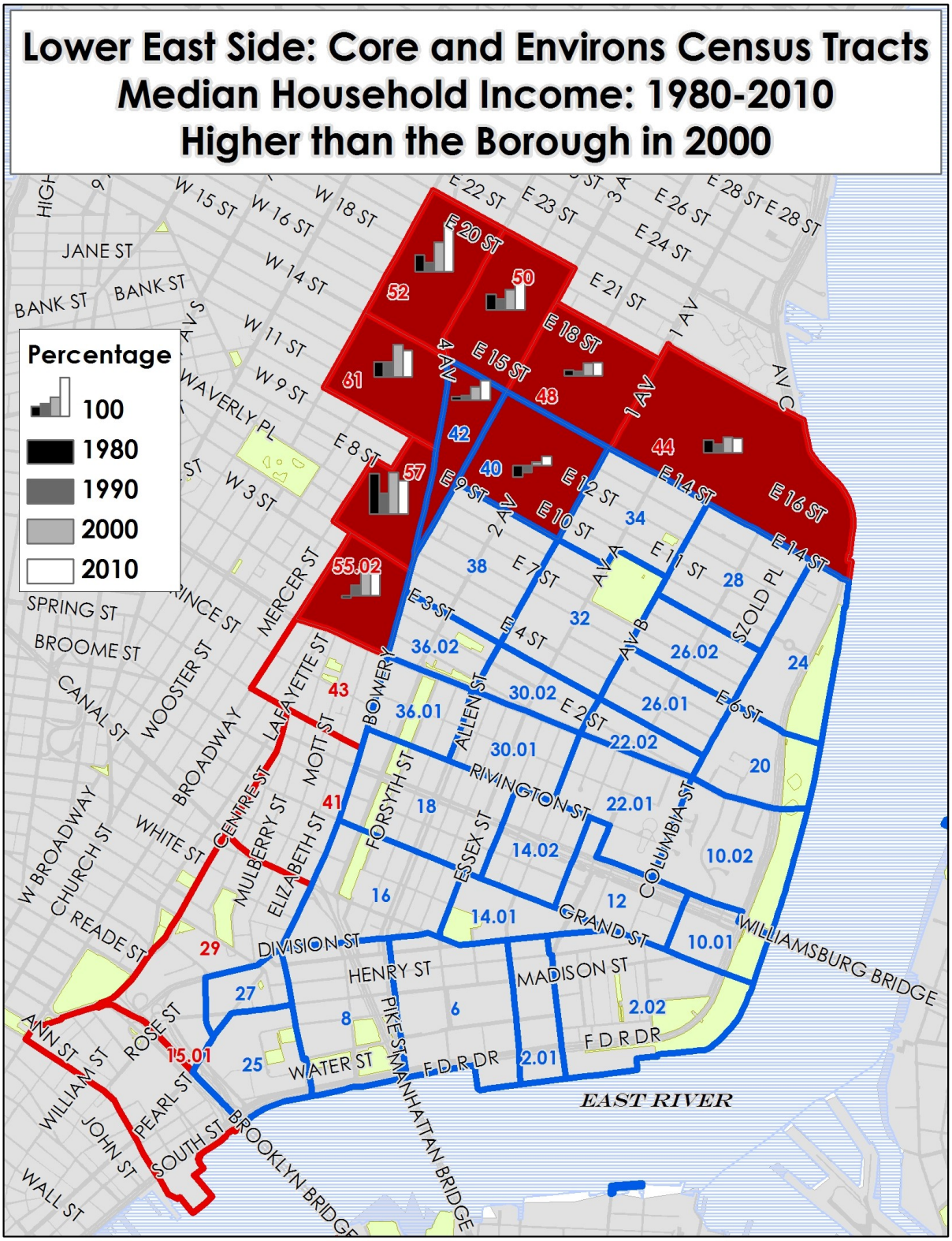
backwards through the pages) the gentrification pattern can more easily be observed than the narrative in the median household income section. While the median household income does not equate precisely to gentrification, this characteristic appear to capture the gentrification in movement and its expansion. In conclusion, all the other gentrification maps in this chapter help to evaluate the gentrification of the Lower East Side because these maps provide clues and illustrate the changing physical and social environments of the Lower East Side.



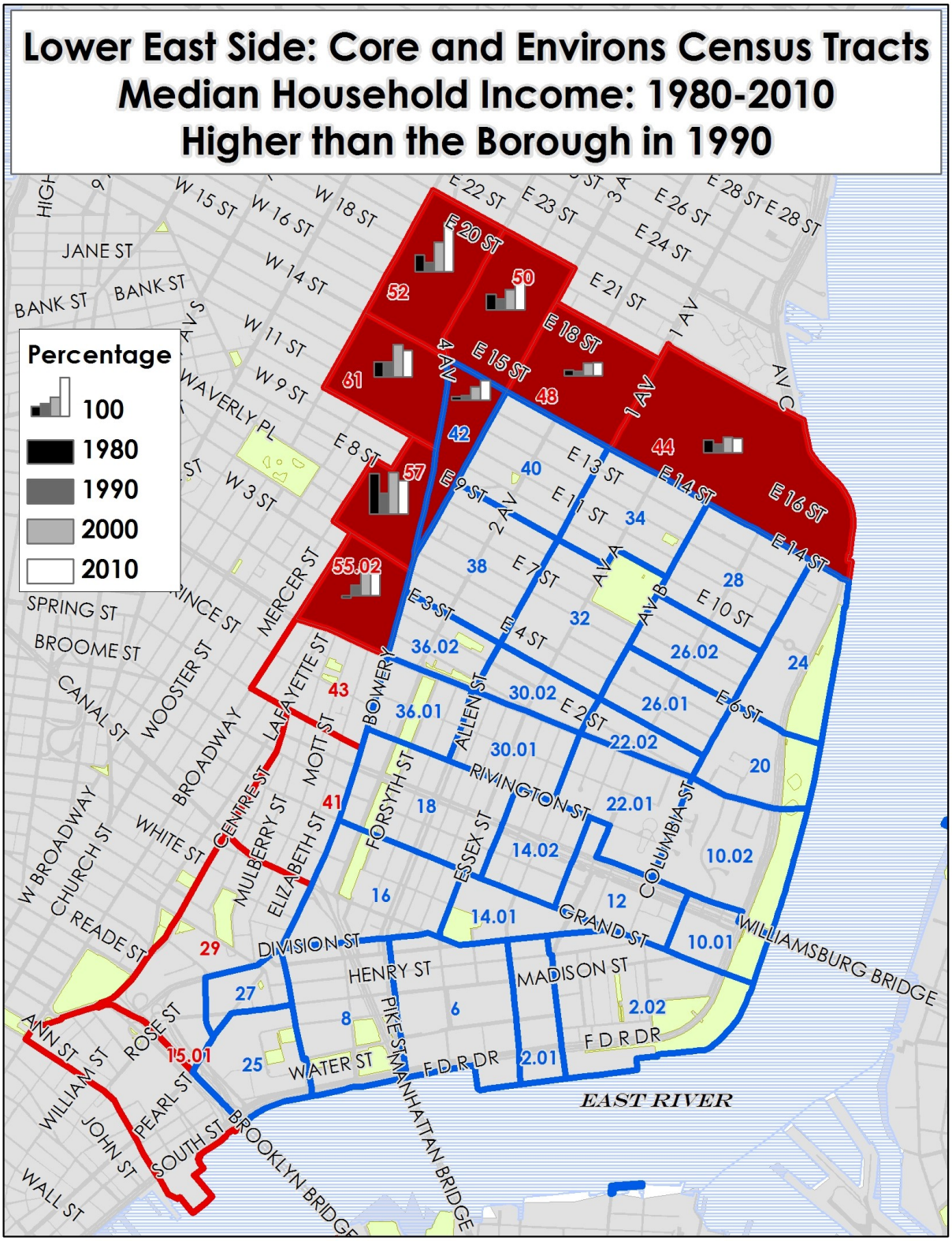
Map 6-51. Median Household Income Lower than the Borough in 2010.



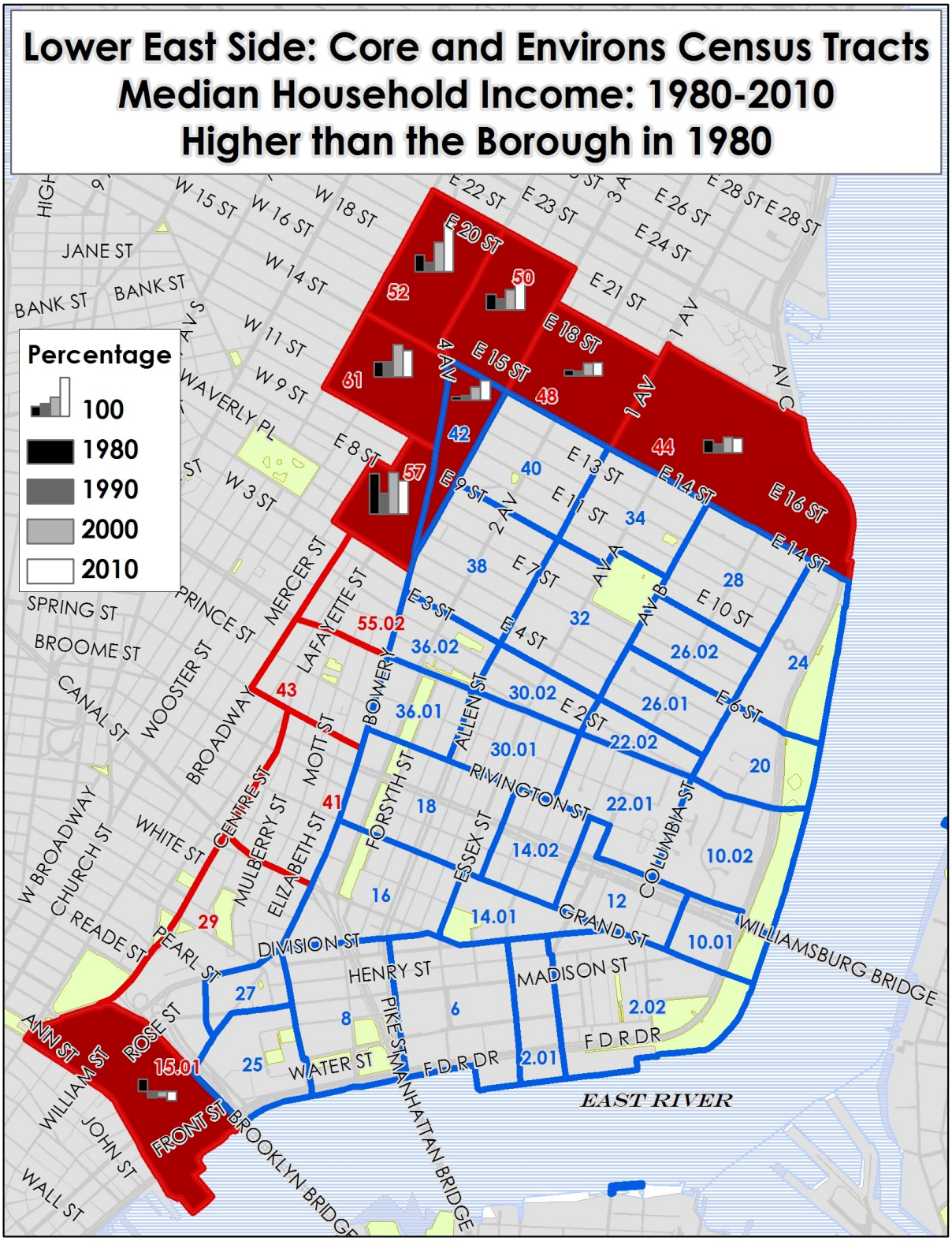
Map 6-52. Median household Income Higher than the Borough in 2010.



Map 6-53. Median household Income Higher than the Borough in 2000.



Map 6-54. Median household Income Higher than the Borough in 1990.



Map 6-55. Median household Income Higher than the Borough in 1980.

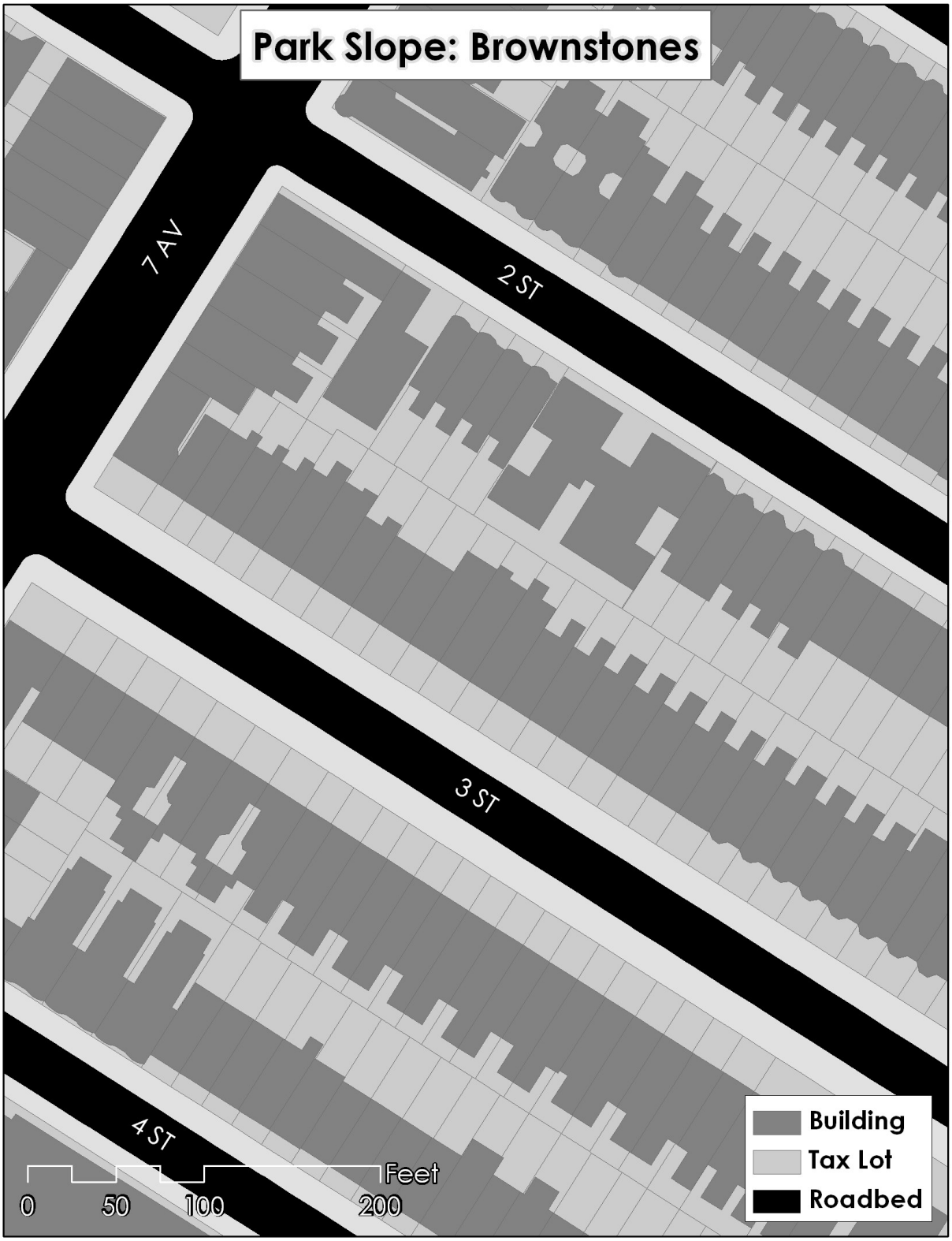
6-6 Additional Maps for the Lower East Side

As mentioned in the physical environment section, tenement houses have been linked to the Lower East Side and their design is another environmental component of the Lower East Side that is not captured by the gentrification maps. Two additional maps are created to compare the tenement houses in the Lower East Side to the brownstones in Park Slope (See Map 6-56 and Map 6-57 respectively). These two maps use the same scale so they can be compared directly to each other.

The dumbbell-shaped "New Law" tenement houses can still be easily found in the Lower East Side as Map 6-56 illustrates the tenement apartments in the city block surrounded by Suffolk, Delancey, Clinton and Rivington Streets. In a typical New York City tax lot with 25-ft frontage and 100-ft depth, the tenement houses are almost built to the maximum extent with the building façade lined up with the frontline of the tax lots. In front of these tenement houses are narrow pedestrian pavements adjacent to the roadbeds. There are no set-backs for these tenement buildings and no gardens in front of them. The rear of the tenement houses is also extended to the maximum limits of the tax lots, which leaves only approximately twenty feet to the rear of the opposite buildings. This construction design results in very small backyards for residents of these tenement buildings. The dumbbell-shape, caused by the narrow air-shafts between buildings, allows for nominal air flow and minimal sunlight into the apartments on the lower floors. These tenement houses are generally six stories tall with staircases placed in the middle of the building. The window-less staircases provide access to the four units on each floor.

Map 6-57 further below illustrates the brownstones in Park Slope, which provide a clear explanation why for after the competition of the Brooklyn Bridge, residents with means moved away from the crowded condition in Manhattan. Although the streets in the Lower East Side and Park Slope share the same width at 25-ft, the set-backs of the brownstones in Park Slope make the distance between buildings across the street approximately four times the width of the street itself. Meanwhile, in the Lower East Side with the buildings façades built to the front lines of the tax lots, the distance between tenement buildings is only two times the width of the street, giving the streetscape a tighter and more dense feeling. While the brownstones in Park Slope are generally no more than four stories, the taller tenement houses in the Lower East Side further create a sense of narrower and more crowded streets.

Map 6-56. Dumbbell-shaped Tenement Houses in the Lower East Side.

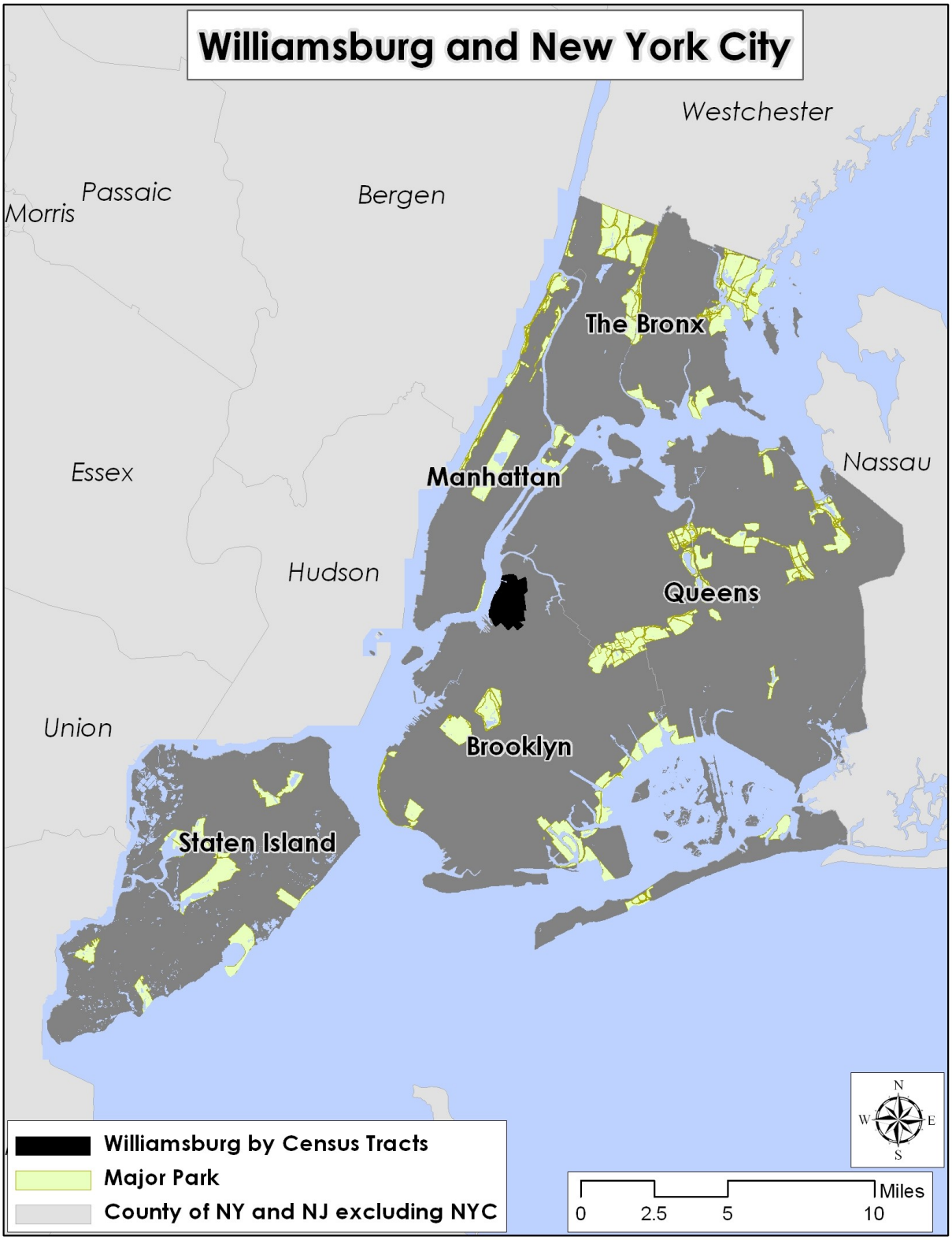


Map 6-57. Brownstones in Park Slope.

Chapter Seven : Williamsburg

This chapter returns to the Borough of Brooklyn and maps the gentrification of Williamsburg. Map 7-1 below shows the location of Williamsburg, a neighborhood in Northern Brooklyn that has gathered both academic and media attention in recent years for its rapid gentrification (Curran, 2004; Finn, 2012). Like Park Slope and the Lower East Side, the gentrification maps of Williamsburg examine both the changes in its physical and social environments. These changes are compounded not only by the local history, which is different from the two other study neighborhoods, but also by its proximity to the Lower East Side, located directly across the East River and connected by the Williamsburg Bridge.

As stated in the history section of the Lower East Side, the opening of the Williamsburg Bridge in 1903 facilitated commuting between Williamsburg and Manhattan. The connection was further strengthened by the subway L-line which runs along 14th Street in Manhattan, the Northern boundary of the Lower East Side. This study does not intend to claim whether the East-bound re-investment in the Lower East Side during the 1990s (Smith, 1994) expanded across the East River to influence the neighborhood changes experienced in Williamsburg beginning in the 2000s. The gentrification maps of these two neighborhoods might serve as explorations to consider whether these changes are spatially and temporally linked to each other. For this reason, the gentrification of the Lower East Side is described and mapped prior to the discussion and mapping of Williamsburg in this study.



Map 7-1. Williamsburg and New York City.

Figure 7-1. Buildings in Williamsburg.

Figure 7-1 above shows through photographs a sample of buildings in Williamsburg. Some are re-purposed buildings, such as the one in the photograph at the top right corner which was converted from a former factory to commercial and residential uses. Tall and new construction,

such as the photograph at the bottom right corner can seem out-of-scale and not in-line with existing structures. Hostile sentiments toward new construction and its prospective up-scale customers can be observed by the spray painted words on the wooden boards surrounding a construction site: “Yuppies out of Brooklyn!” featuring a skull and cross bone sign, “No more condos” and probably the most telling “fight gentrification!” (See Figure 7-2 below). These words echo ”Die Yuppie Scum” which were chanted by demonstrators in the Tomkins Square Park against the gentrification in the Lower East Side in 1988 (*New York Times*, 2008).

Figure 7-2. Spray Paint Anti-gentrification Words at a Construction Site in Williamsburg.

Unlike Park Slope, the historical development of Williamsburg had a considerable industrial component. Despite the overall de-industrialization in New York City, manufacturing activities still have a noticeable presence in the Williamsburg area as the Zoning Maps in the physical environment section of this chapter demonstrate. This industrial component needs to be considered together with the gentrification maps to examine the uneven development in Williamsburg.

7-1 Defining the Williamsburg Neighborhood

Defining modern Williamsburg is not as straightforward as the case of Park Slope or the Lower East Side. The Williamsburg neighborhood went through several stages of first being a village, a city of its own and then being consolidated into the Borough of Brooklyn. The definition for this study begins with the street boundaries established by the 1978 edition American Institute of Architects (AIA) guide with consideration taken from the current New York City Department of City Planning Neighborhood Tabulation Area (DCP NTA) boundaries.

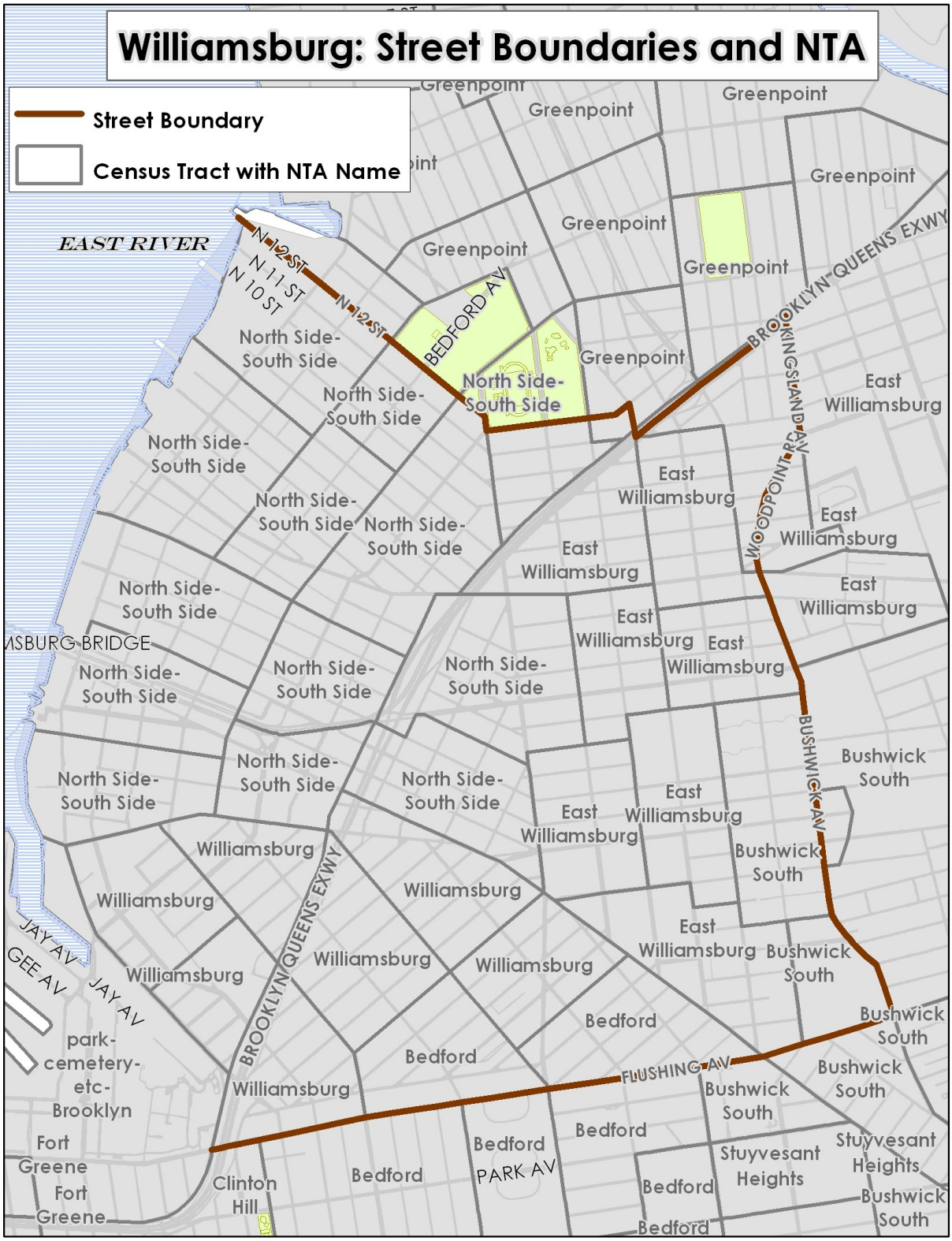
The street boundaries (AIA, 1978) for Williamsburg are: on the North, North 12th Street and the South border of McCarren Park, then follows the BQE and turns South on Kingsland Avenue, continues South bound to Woodpoint Road and Bushwick Avenue, which serve as the Eastern boundary separating Williamsburg from Bushwick. The Southern street boundary is Flushing Avenue until it reaches the Navy Yard. The East River serves as the Western boundary. These street boundaries are highlighted as dark brown lines in Map 7-2. Also on Map 7-2 is the current DCP NTA, which assigns neighborhood code names to each Census Tract. As the map shows, these street boundaries define a larger Williamsburg that includes other neighborhoods,

especially toward the East and South fronts. This study adopts a more conservative scheme and focuses on the Census Tracts with the NTA code “North Side – South Side” as the Core. (See Map 7-3 below). These Census Tracts are selected as the Core for this study. This particular NTA code name is derived from the street names that bear the prefix of either “North” or “South” in the area, with Grand Street as the demarcation.

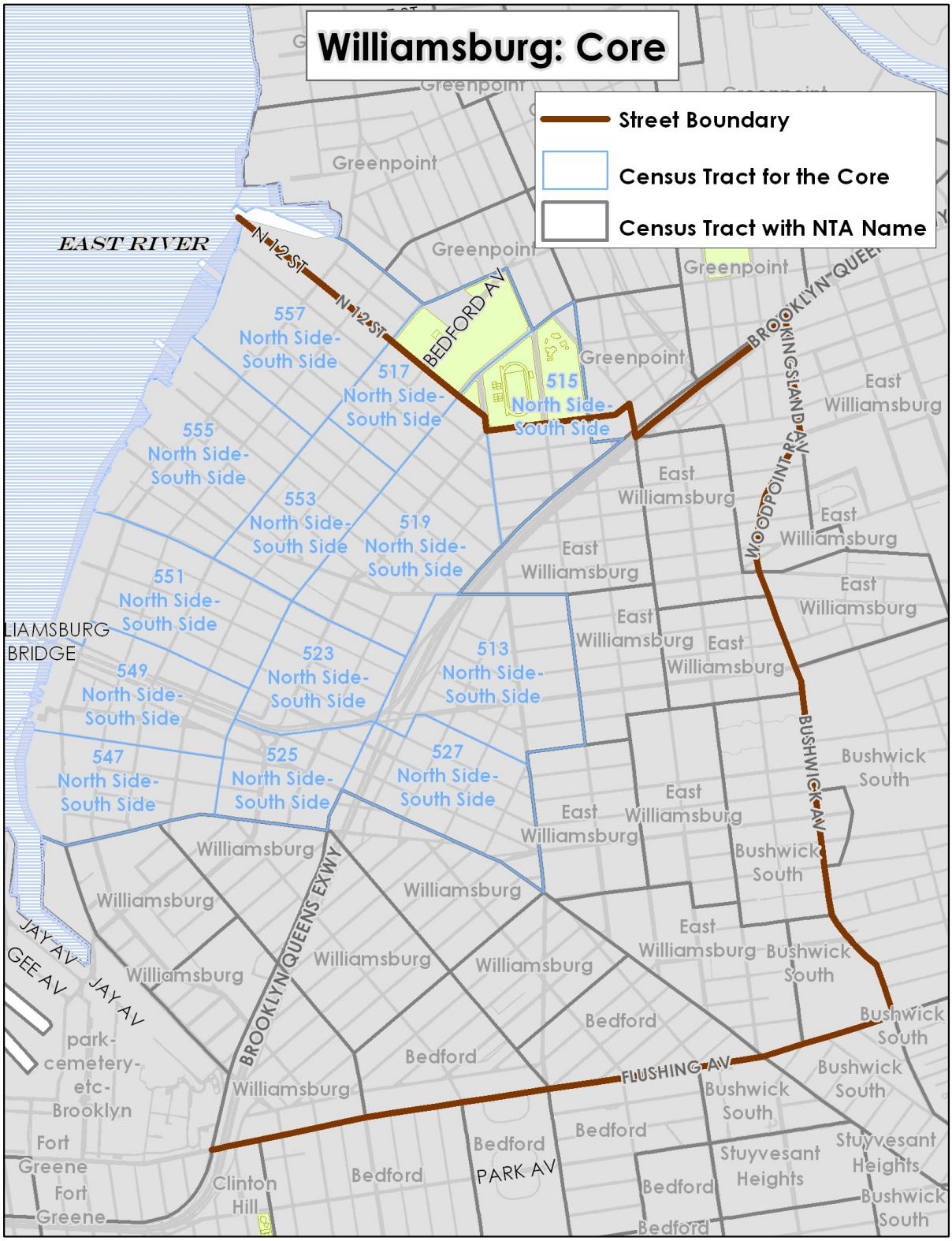
The Census Tracts that immediately surround these Core Census Tracts are selected as the Environs (See Map 7-4 below). They include portions of Greenpoint (in the North), East Williamsburg (in the East) and somewhat confusingly Williamsburg (in the South). The rationale for this more conservative selection is to focus on a smaller area for the Core designation. For instance, if the Census Tracts with the East Williamsburg NTA code are selected, then the Environs would encompass a much larger and more complex area, such as: Bushwick (in the East), Clinton Hill, Bedford, and Stuyvesant-Heights (in the South). This second scheme, though may comply more closely with the street boundaries established by the AIA guide, but would have resulted in a much more complex neighborhood destination for this study of Williamsburg.

Map 7-4 shows the selected Census Tracts for the Williamsburg Core and Environs (in blue and red, respectively). Map 7-5 removes the colorization to maximize clarity for the embedded bar charts and serves as the base map for the Williamsburg gentrification maps. Similar to the significance of Prospect Park is to Park Slope, and the East River is to the Lower East Side, it should be noted that the East River, although excluded from this definition of Williamsburg, has been an integral part of this neighborhood since its earliest days. In fact, the East River, serves to both separate Williamsburg from Manhattan and also links this neighborhood to Manhattan; first

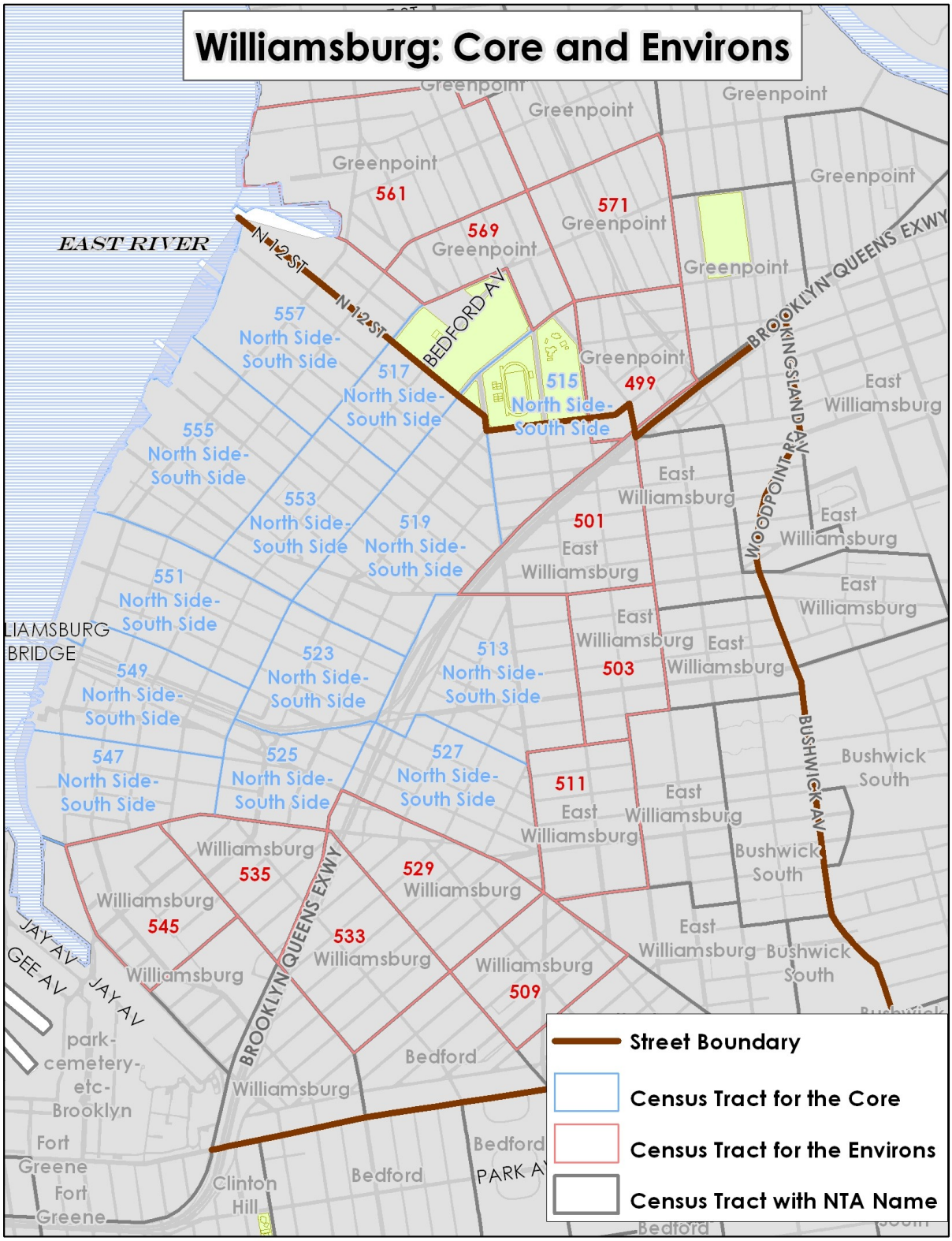
by ferries and then by bridges and subway lines. This connection of Williamsburg to Manhattan is described in more detail in the following history section.



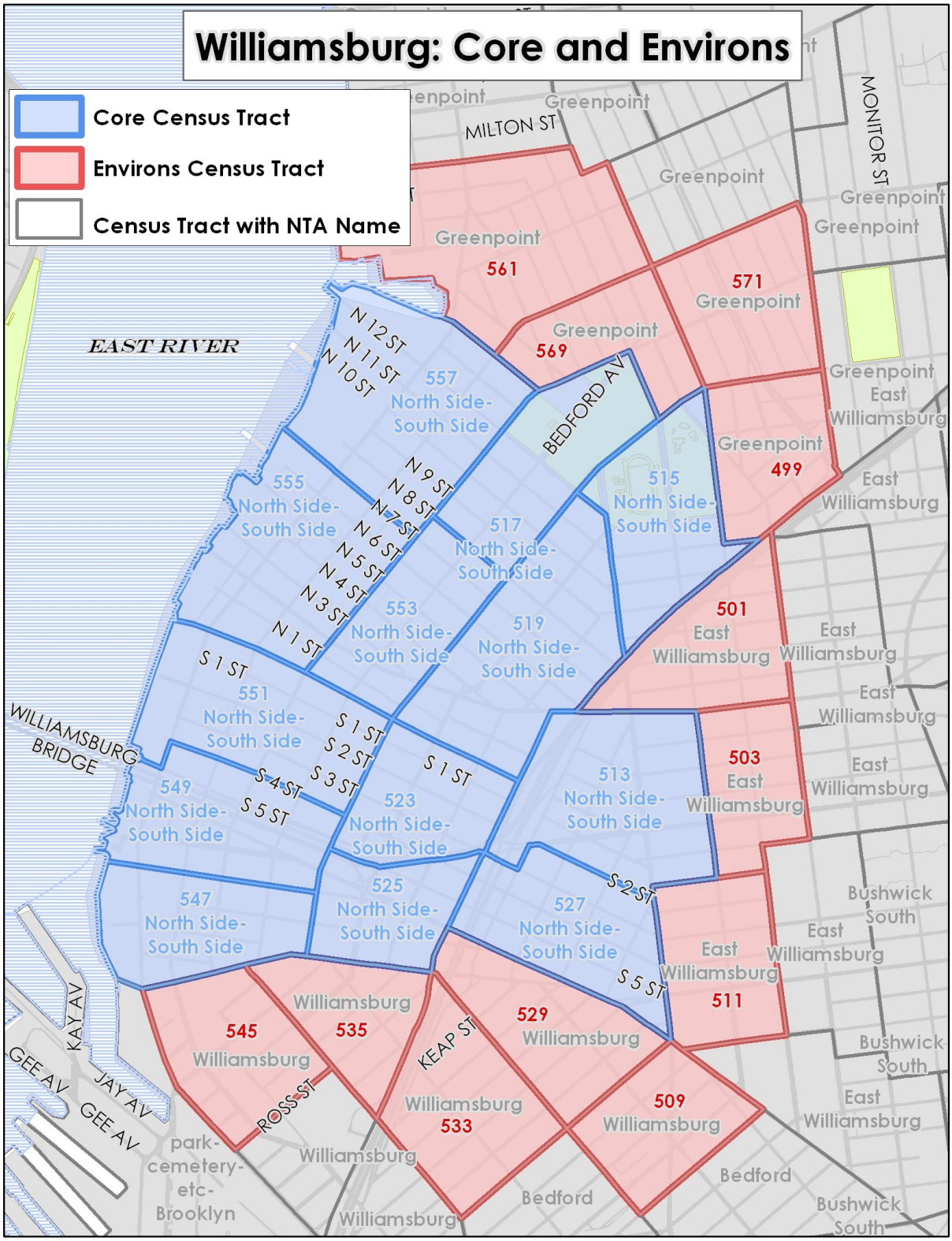
Map 7-2. Williamsburg Street Boundaries.



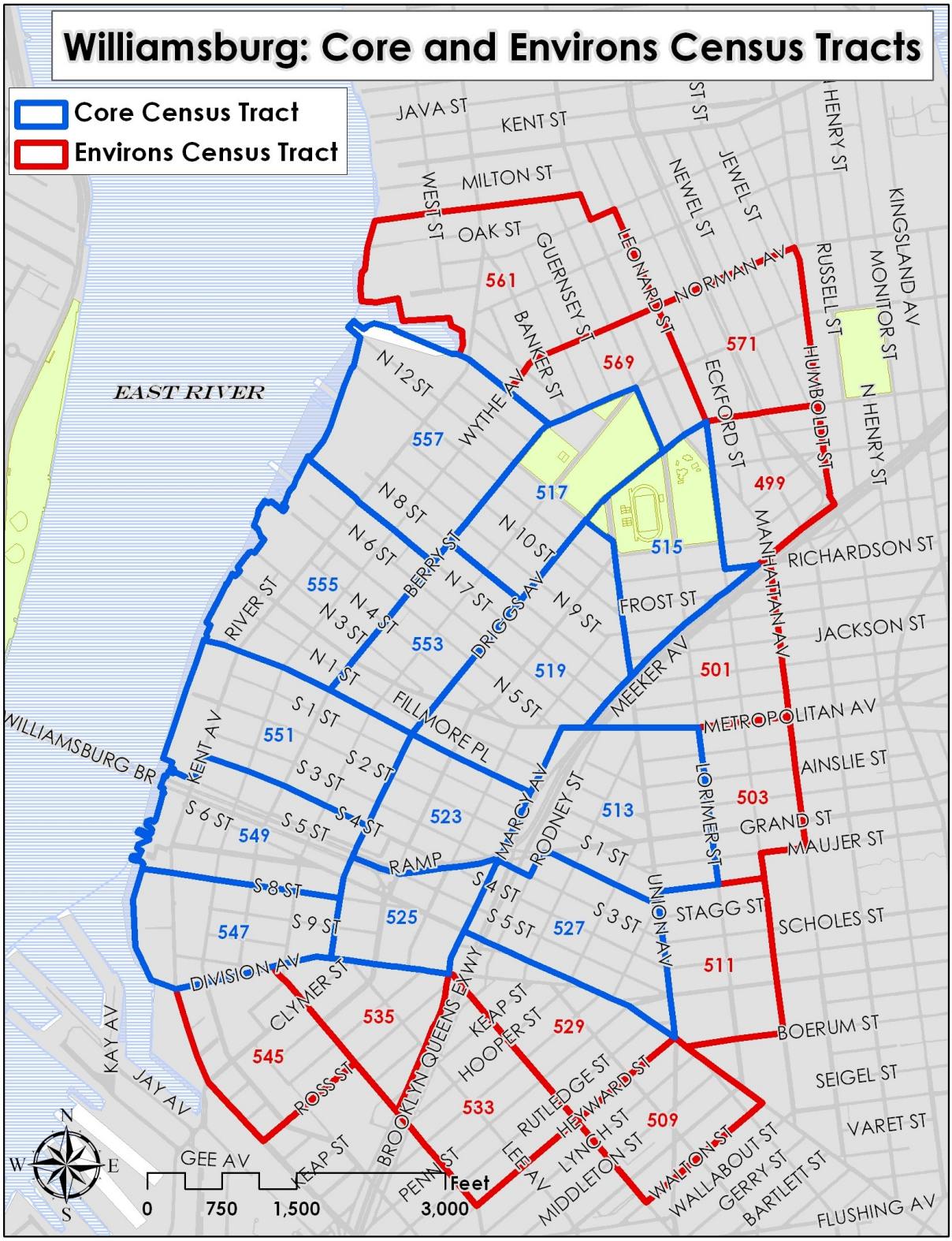
Map 7-3. Williamsburg: Core, with Census Tracts.



Map 7-4. Williamsburg: Core and Environs, with Census Tracts.



Map 7-5. Williamsburg: Core and Environs, with Census Tracts.



Map 7-6. Williamsburg: Core and Environs, with Census Tracts.

7-2 A Brief History of Williamsburg

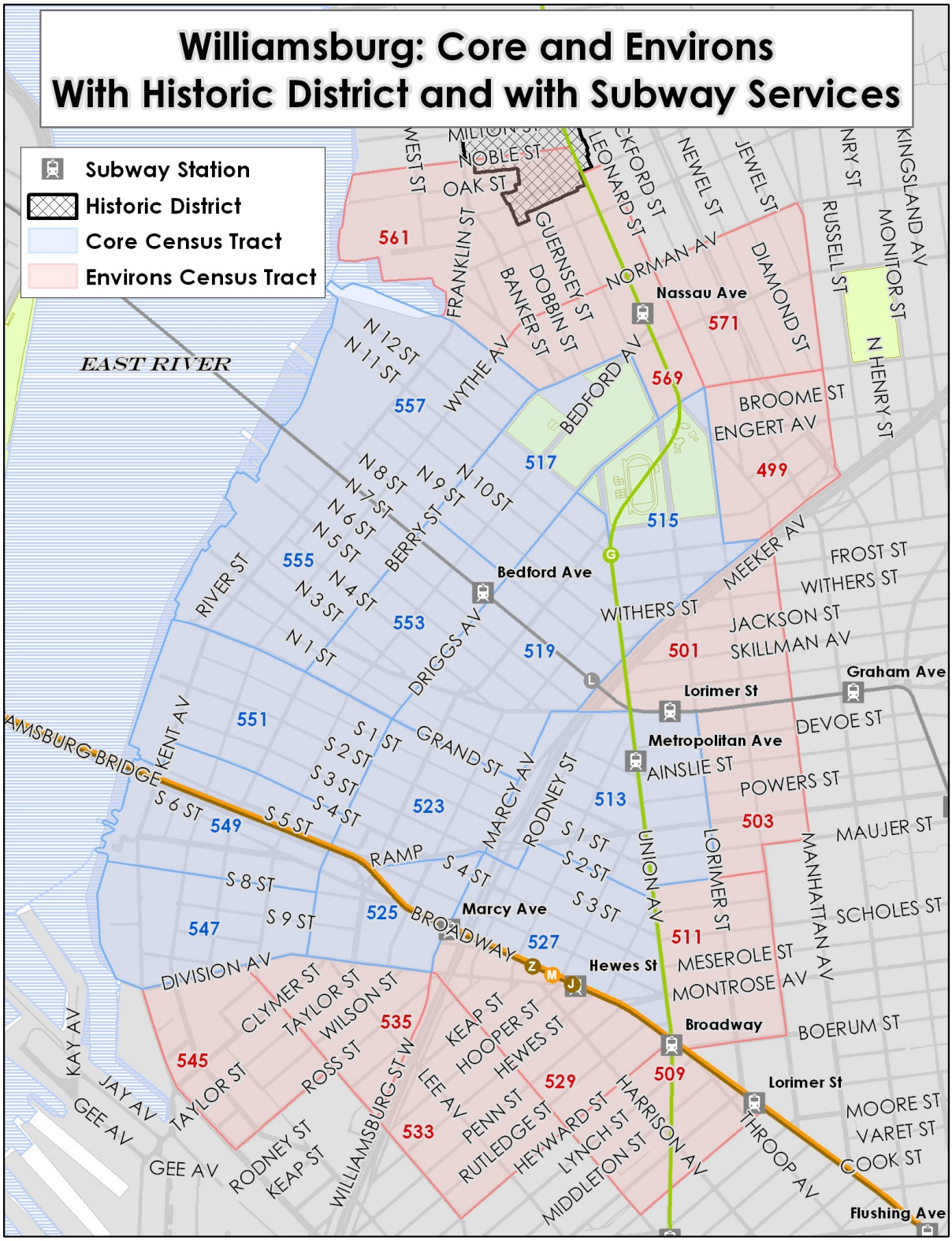
In the late 1670s, the area was part of the Dutch Village of Boswijck and remained farmland until the nineteenth century. In 1802, Richard M. Woodhull offered to provide ferry service to link the area to Manhattan and bought properties around the proposed ferry landing (at the foot of what is now South 2nd Street), and named this area after his surveyor Jonathan Williams. Although Woodhull declared bankruptcy in 1811, other developers soon followed and ferry service was later established which helped farmers in the area to sell their products in Manhattan.

In the early nineteenth century, distilleries and other industries were established in the area and led to the area's prosperity. In 1818 David Dunham opened a steam ferry that resulted in further development and land speculation. The Village of Williamsburg was incorporated in 1827 and in 1852 the Village grew into its own City and in 1855 it was consolidated into the City of Brooklyn (with the ending 'h' dropped from its name). The area continued to grow and attracted major industrial firms such as: Pfizer Pharmaceutical Company (1849-2007) and Brooklyn Flint Glass (later known as Corning Glassware).

In 1903 the completion of the Williamsburg Bridge brought working-class Jews from the Lower East Side to the area. Other immigrants also came to Williamsburg to work in the factory jobs. Six-story tenements replaced brownstones to accommodate the growing population. During the Great Depression iI the 1930s, many businesses declared bankruptcy and the more prosperous residents left the area. The Jewish community, however, continued to grow as European refugees escaping Nazism moved in and formed Jewish Orthodox Hasidic synagogues and schools.

The remaining manufacturing jobs attracted later immigrants, especially Puerto Ricans, to settle in this area around the mid-twentieth century. At the same time, aging buildings were torn down to construct public housing projects. However, the construction of the Brooklyn Queens Expressway in 1957 destroyed thousands of low-income housing and only some remain today. Although Pfizer and some other business remained in the area, by 1990 the manufacturing employment in the area had decreased considerably, leaving the area predominantly occupied by a low-income population (illustrated in the gentrification maps to follow). In more recent years, with the rising rents in other parts of New York City and the proximity of Williamsburg to lower Manhattan and its comparatively lower housing cost prompted the "discovery" of Williamsburg to people seeking alternative and affordable housing. The gentrification maps in this chapter examine and illustrate some of these changes and factors.

Similar to the Lower East Side, in Williamsburg no Historic Perseveration District is located inside the Core Census Tract area. The Greenpoint Historic Preservation District, established in 1982, occupies only a small section of Census Tract 561 of the Environs. In contrast to the Lower East Side, there is no Historic Preservation District surrounding Williamsburg. Map 7-7 below shows the Historic Preservation District and the subway services in the area. The cross-town G Subway (light green line) runs through the East part of the neighborhood and links Williamsburg to the Borough of Queens (on the North) and South-bound to Church Avenue in Brooklyn (South of Park Slope). The L Subway (gray line) and the J-M-Z Subway (orange and brown lines) all link the Williamsburg neighborhood to Manhattan (to the West) and other parts of Western Brooklyn. To highlight the color-coded subway lines, the boundaries for the Core and Environs Census Tracts are displayed with thinner lines and muted colors.



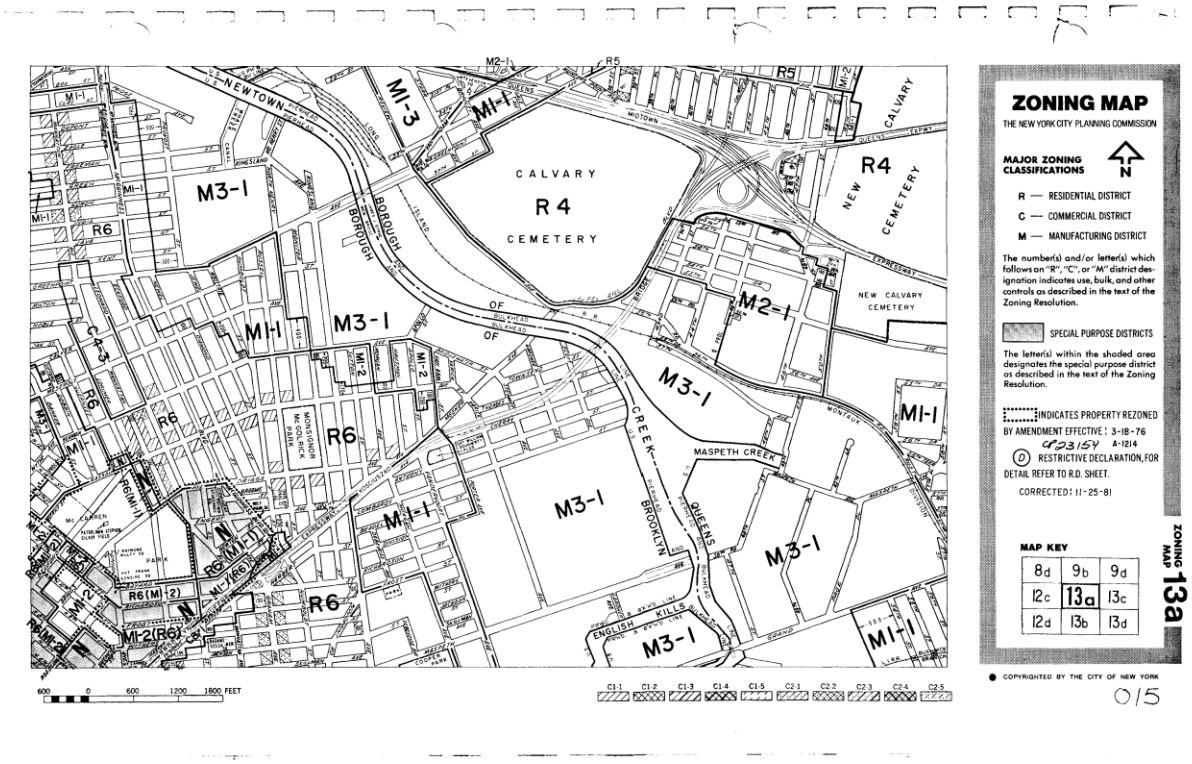
Map 7-7. Williamsburg: Core and Environs Census Tracts with Historic District and Subway Services.

7-3 Williamsburg: The Physical Environment

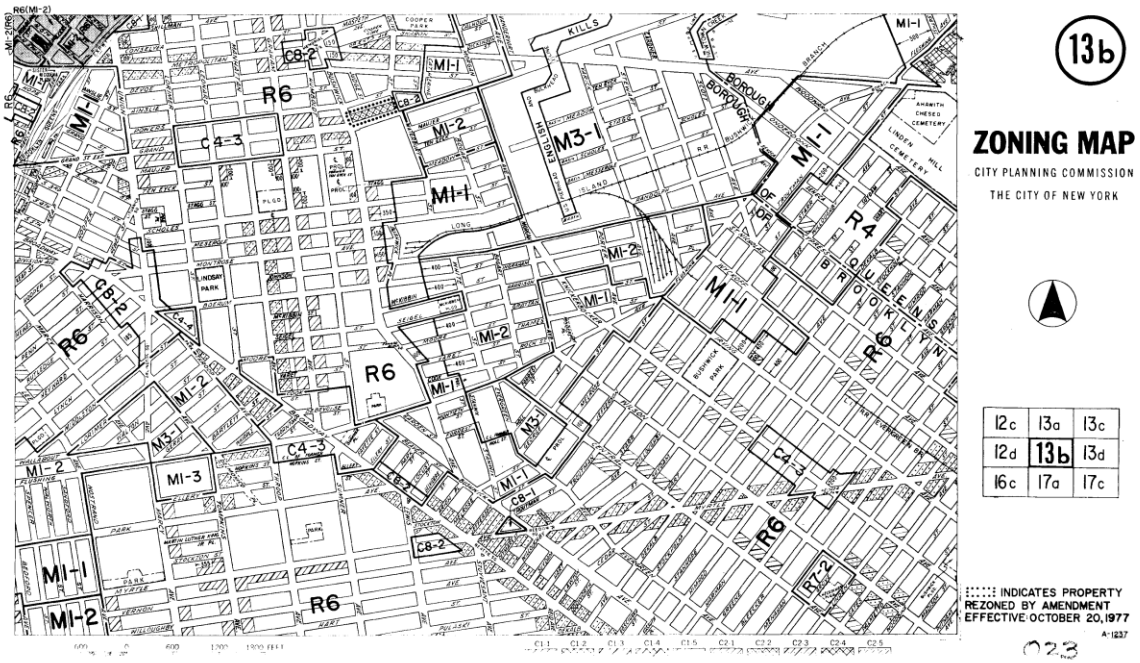
This section is divided into three segments: zoning, building age and building heights. These maps are to demonstrate the current state of the physical characteristics of the Williamsburg neighborhood.

7-3.1 Zoning Maps

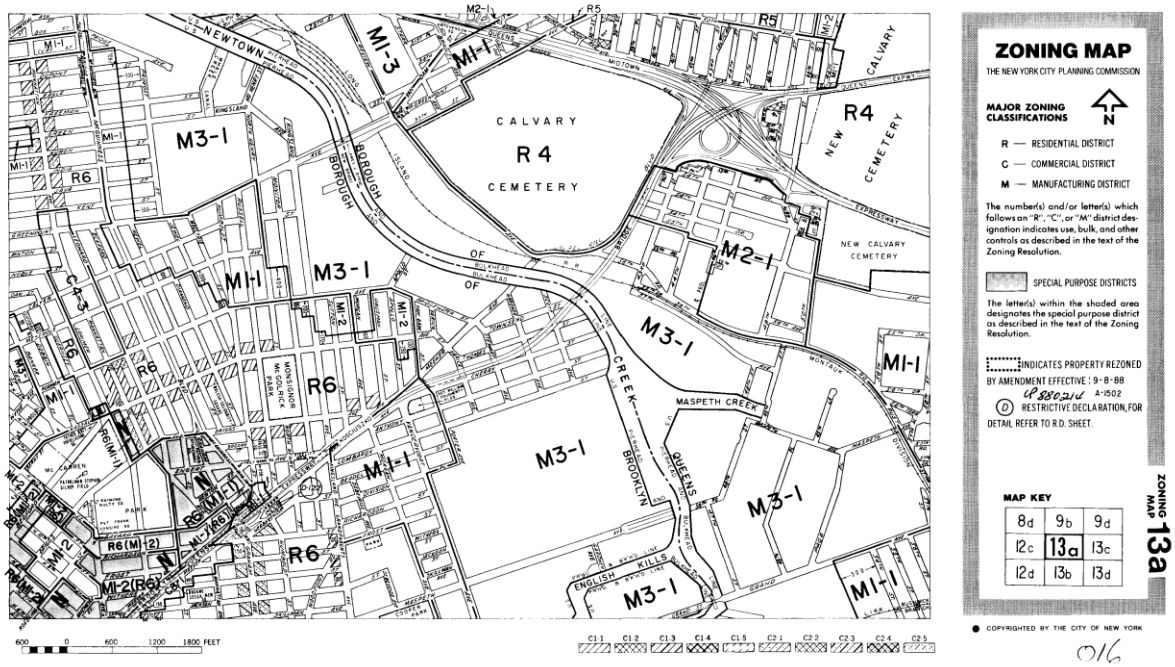
This section is divided into two parts: the Historical Zoning Maps that approximately correspond to the years of the first three Census Survey years (i.e. 1980, 1990, and 2000) and are used to map the social environment. These maps are downloaded from the DCP website. The 2011 release of the MapPLUTO data set, which records the land-use for the year 2010, is used to produce the zoning maps that correspond to match the latest Census Survey (i.e. 2010) and is used for the social environment. A portion of the Historical Zoning Maps can be observed from those maps included in the Lower East Side chapter. The following pages only include maps for the areas not covered in the previous discussions which are from DCP grids 13a and 13b (DCP, 2013).



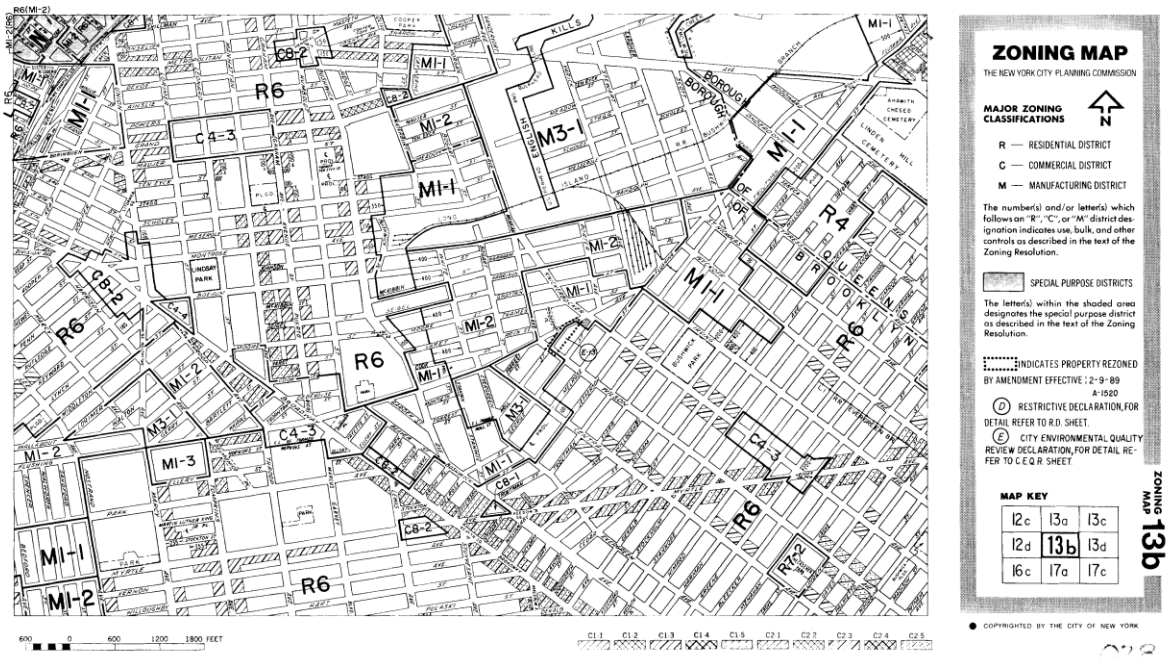
Map 7-8. Historical Zoning Map 13a - 1976.



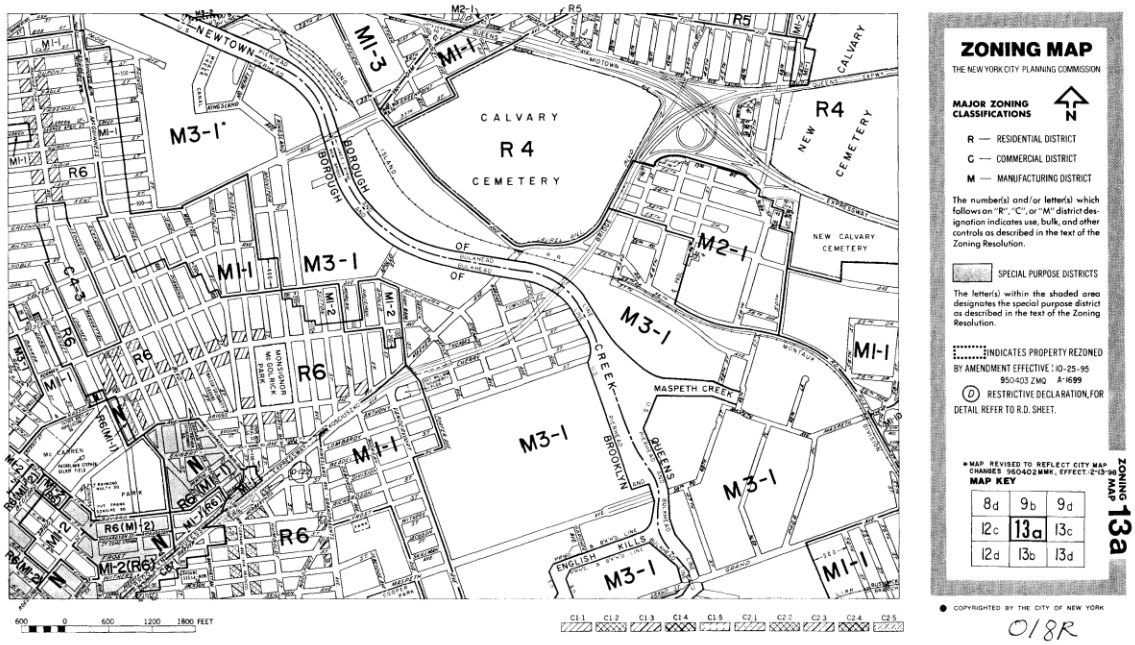
Map 7-9. Historical Zoning Map 13b - 1977.



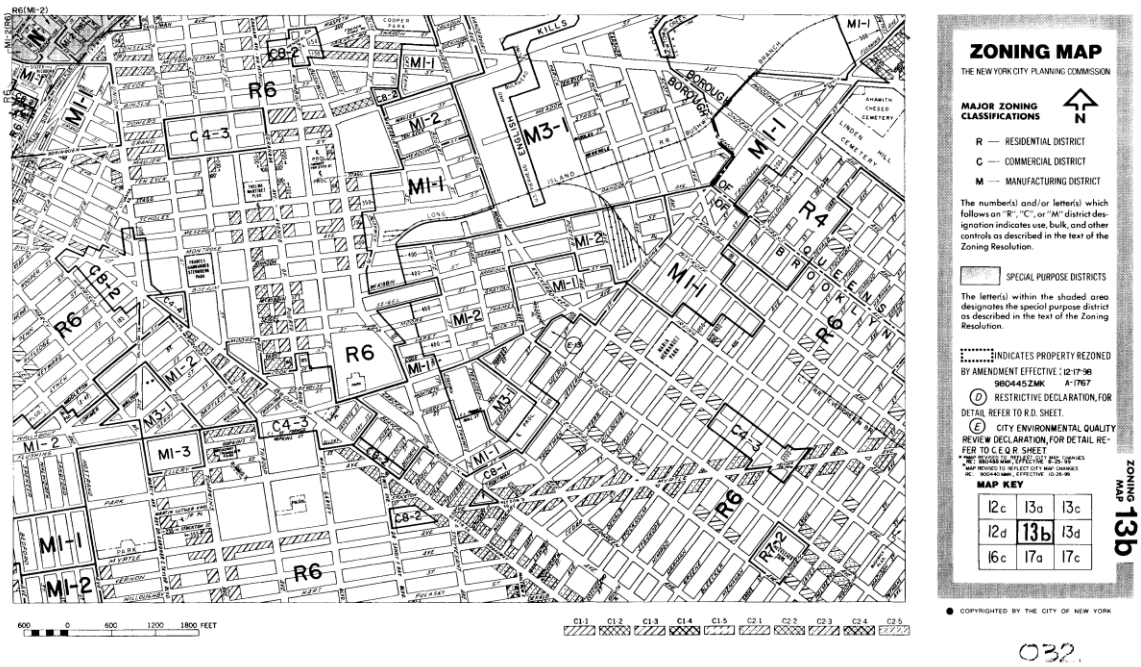
Map 7-10. Historical Zoning Map 13a - 1988.



Map 7-11. Historical Zoning Map 13b - 1989.



Map 7-12. Historical Zoning Map 13a - 1995.



Map 7-13. Historical Zoning Map 13b - 1998.

Figure 7-3 and Figure 7-4 below are two pie charts that illustrate the distribution of primary zoning districts in the Williamsburg Core and Environs and illustrate how these two areas differ from each other. In the Williamsburg Core the dominant zoning district is manufacturing, with residential or commercial districts representing low the percentages. On the other hand, in the Environs the residential district is the majority and occupies 62% of the tax lot area. While this is more than double that for the Core, it does not meet the highest percentage observed in Park Slope Core at 79% (See Figure 5-3).

The commercial district in both Williamsburg Core and Environs occupies less than 30% of the neighborhood; Map 7-15 below shows the spatial pattern that is similar to that of Park Slope (i.e. they are lined up along major artery streets).

Once again, while the pie charts give a quick and easy understanding of the neighborhood's land use characteristics, they do not convey the spatial patterns which can only be observed from the Zoning Maps. In fact, the three Zoning Maps (Map 7-14, Map 7-15 and Map 7-16) below illustrate additional characteristics that are not revealed by the pie charts:

1. In the Core the residential tax lots cluster in the Middle and South sections; in the Environs these residential tax lots are more evenly distributed.

2. The commercial tax lots mirror the pattern observed in Park Slope; they line-up along certain artery street segments. One can almost imagine, just by looking at this map, that a walk down these streets one would encounter neighborhood shops, and on the residential

side streets, walking on these sidewalks it would be quieter without any commercial activities.

3. The manufacturing tax lots are also not evenly distributed, and are clustered toward the Middle and North sections of Williamsburg. It should also be noted that within the South and South-east corners the Census Tracts, tax lots generally are not zoned for manufacturing. The exceptions are Census Tract 509 and Census Tract 571 in the North-east Environs.

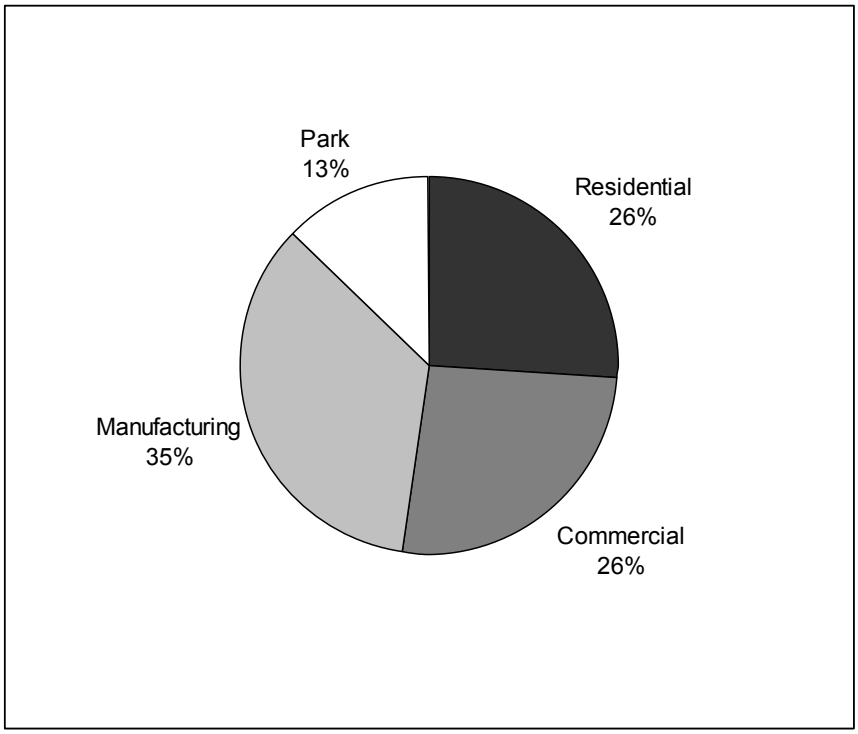


Figure 7-3. Percentages of Different Zoning Districts in Williamsburg - Core, by Tax Lot Area.

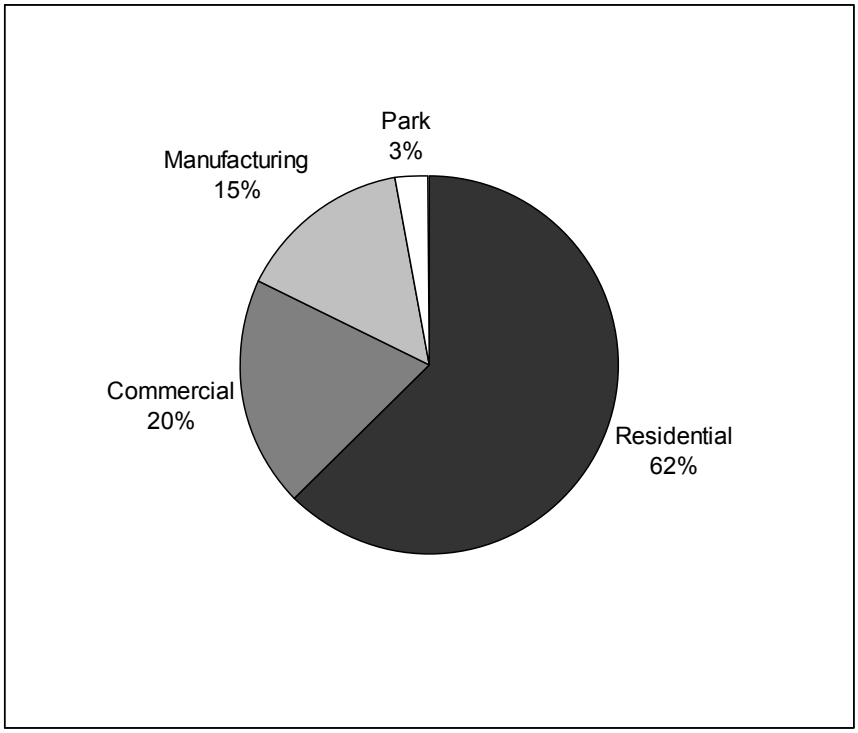
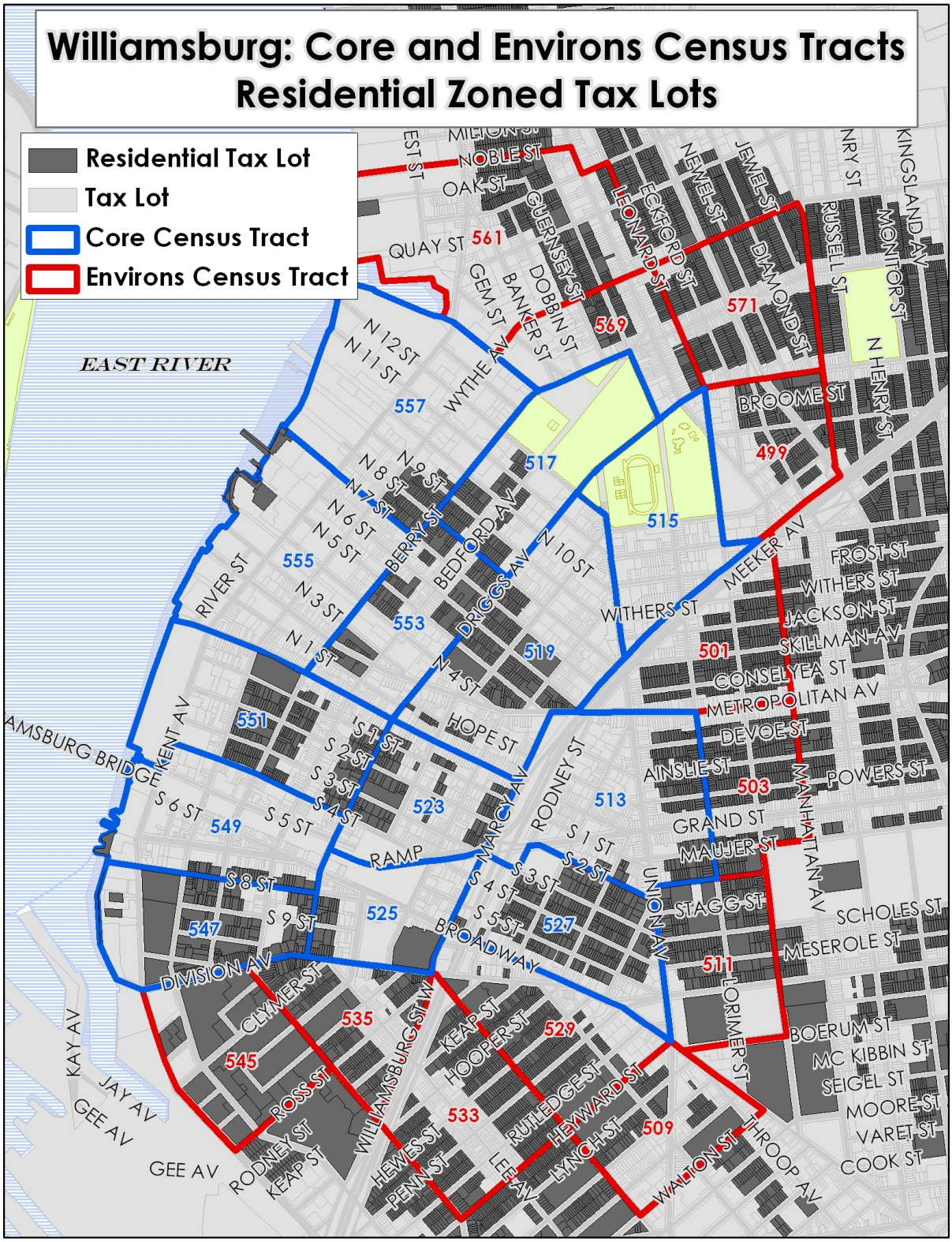
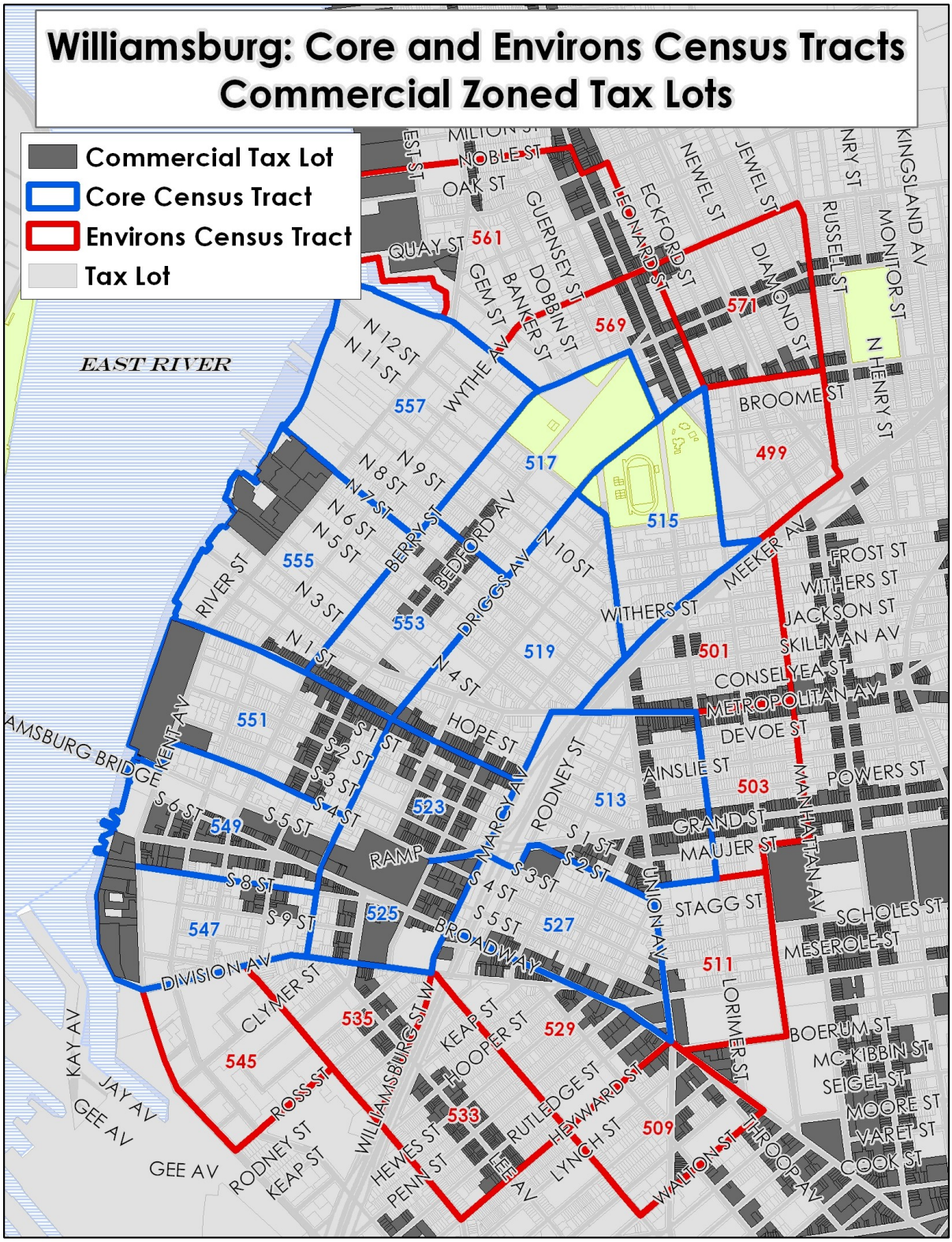


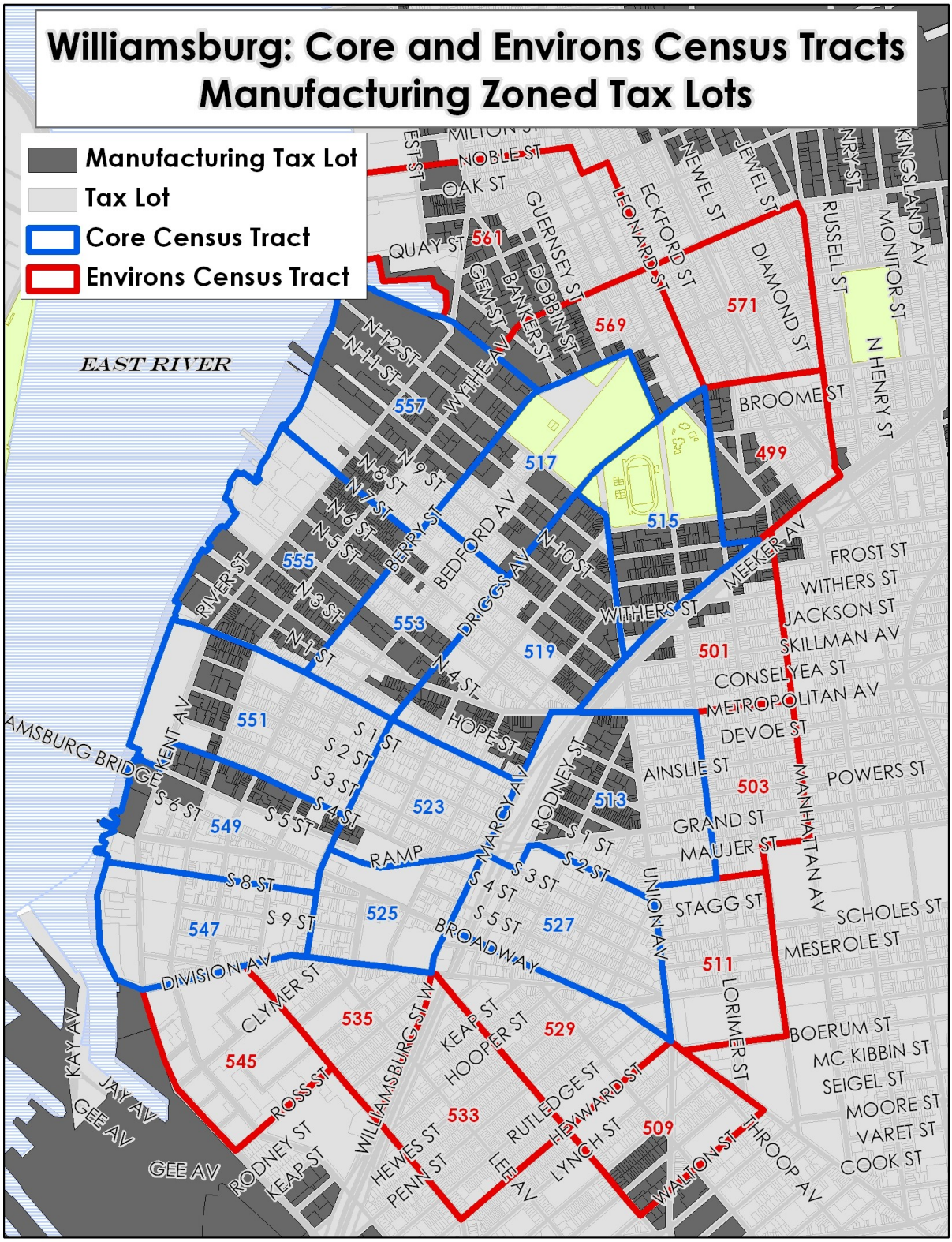
Figure 7-4. Percentages of Different Zoning Districts in Williamsburg – Environs, by Tax Lot Area.



Map 7-14. Residential Zoned Tax Lots in Williamsburg, 2010.

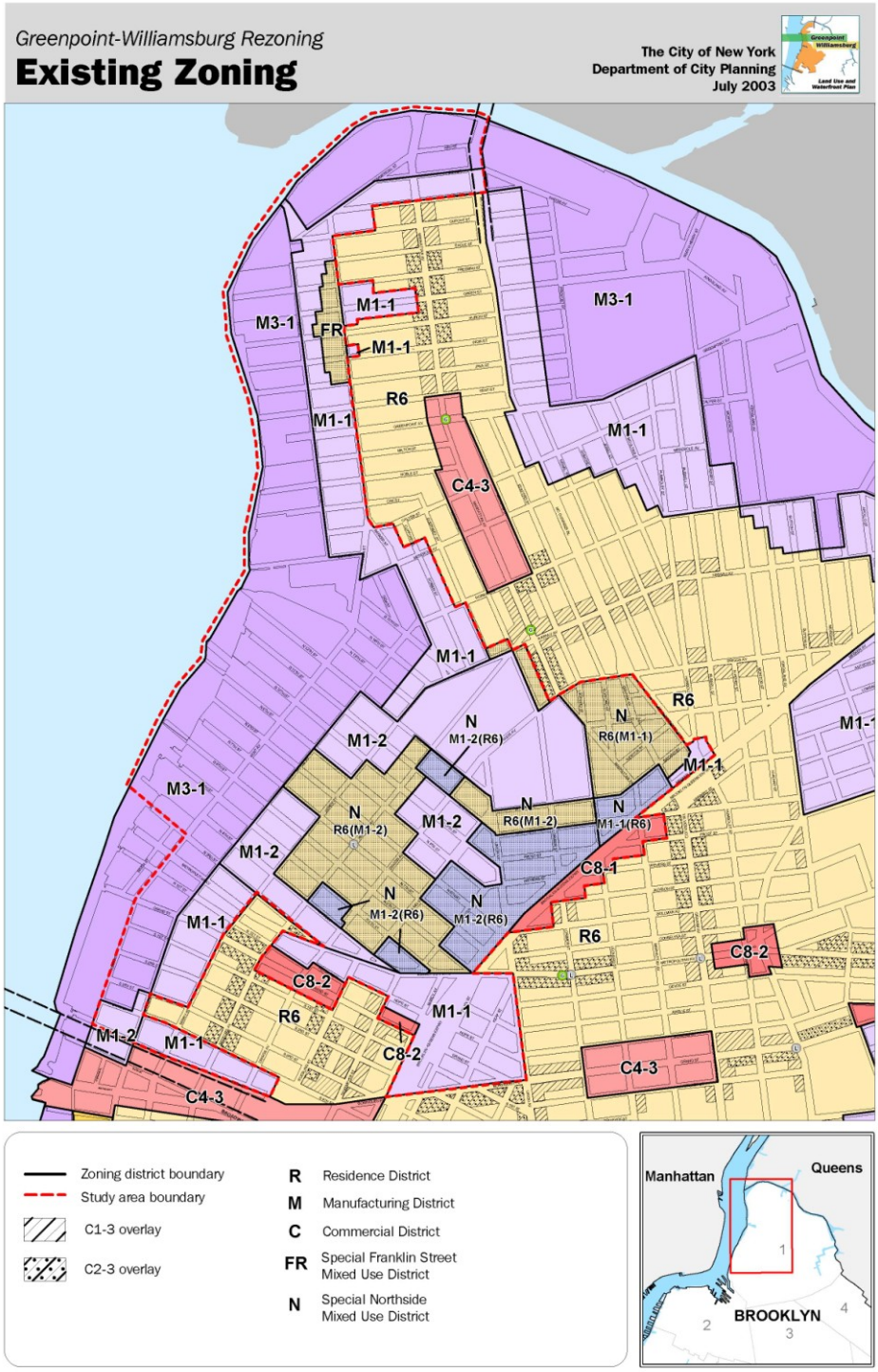


Map 7-15. Commercial Zoned Tax Lots in Williamsburg, 2010.

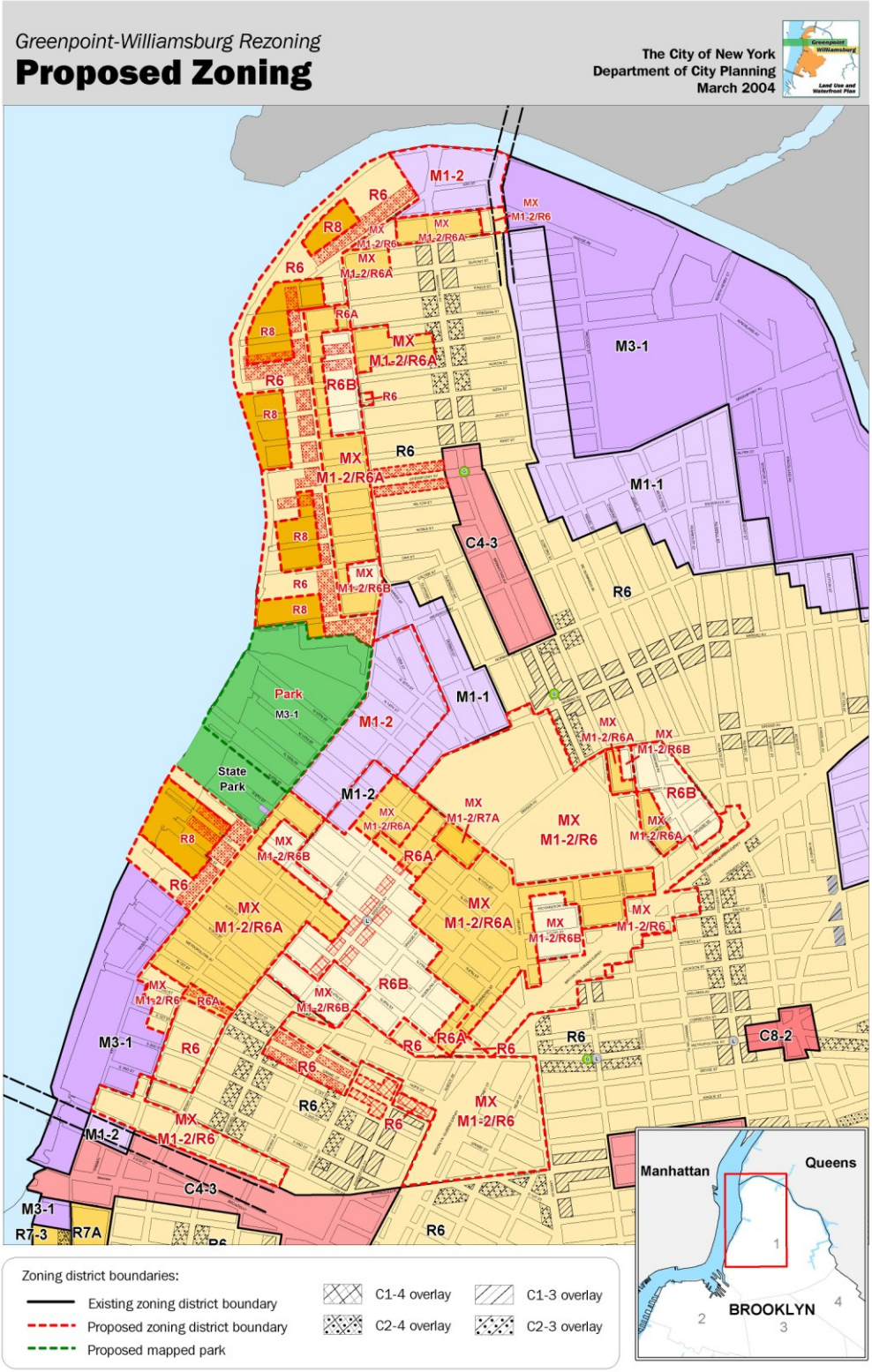


Map 7-16. Manufacturing Zoned Tax Lots in Williamsburg, 2010.

Since 2000, DCP has put forth two major rezoning proposals for Williamsburg. The first one was approved in March 1, 2006, focusing on the rezoning of manufacturing tax lots for mixed or residential use (See Map 7-17 A and B, below) (DCP. 2006a). These two maps, downloaded from the DCP website, show the proposed and approved rezoning (DCP, 2006b, 2006c). The majority of the waterfront tax lots, except the Southern portion, have been rezoned for residential use and park land. Combined Map 7-20 that shows post-2000 construction, one can visualize the transformation for these tax lots, namely, factories have been replaced by new residential buildings. An exploration of how these land use changes here translated into gentrification will be illustrated using gentrification maps for the social environments in the follow sections.

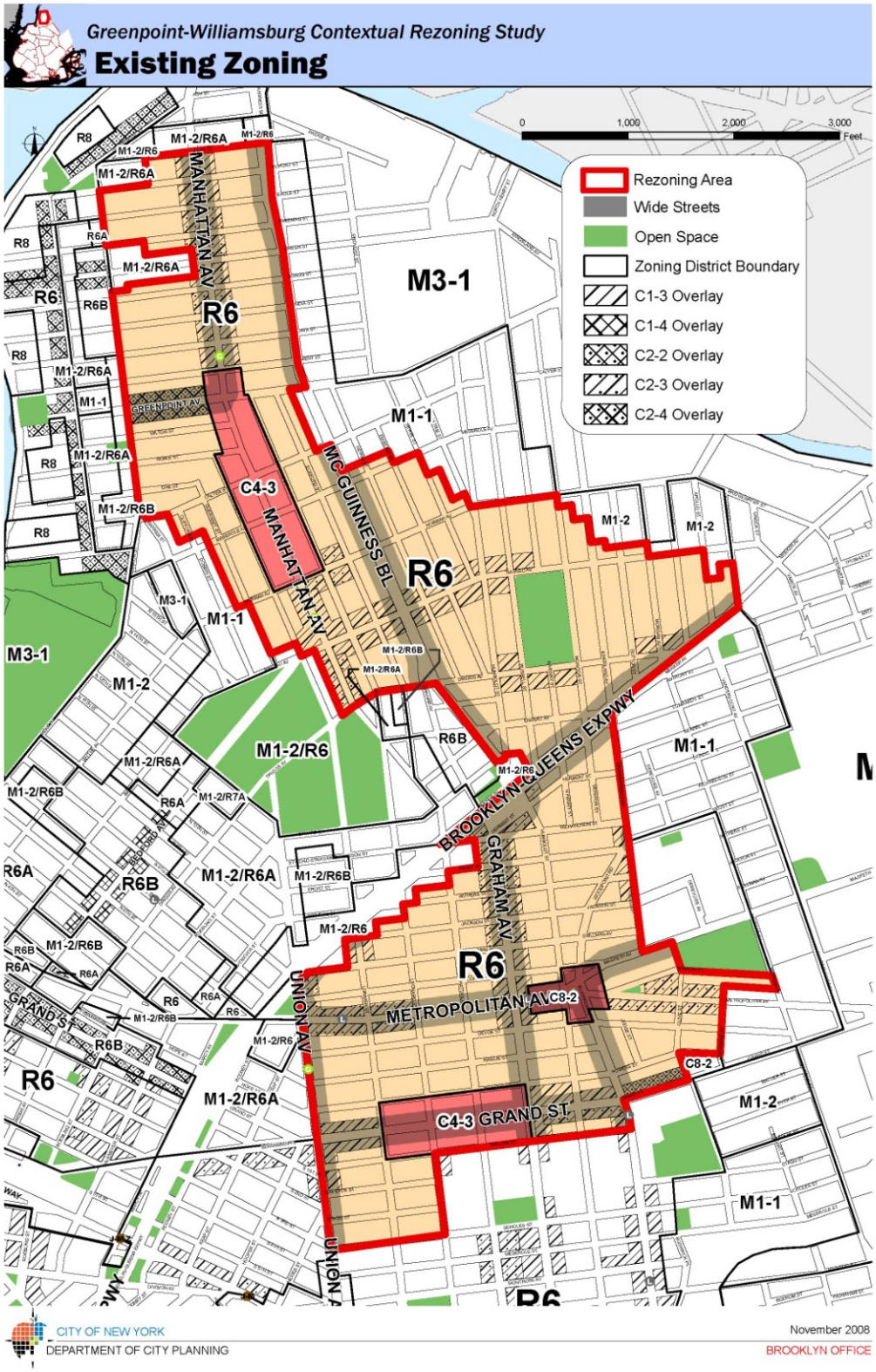


Map 7-17-A. Existing Zoning of Manufacturing Tax Lots along the East River (DCP, 2006b).

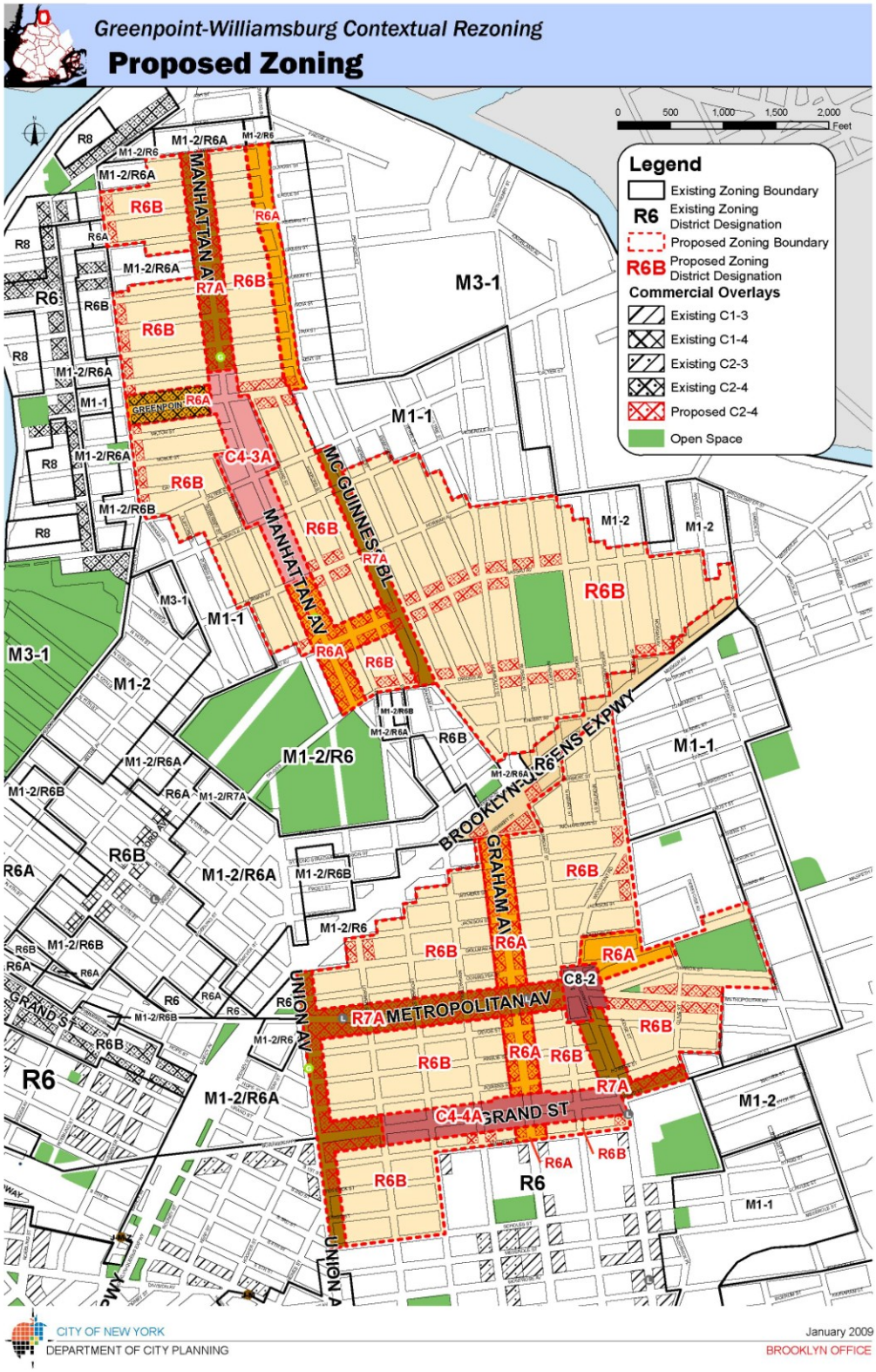


Map 7-17-B. Proposed Rezoning for Residential and Park Land (DCP, 2006c).

The second and more recent rezoning proposal, approved in 2009, titled *Greenpoint-Williamsburg Contextual Rezoning* which "seeks to protect the existing character of residential areas East of the 2005 rezoning area" (Map 18 A and B below) (DCP, 2009a) is North and West of the Core area. Without discussing the technical details, the difference between the existing R6 and the proposed/approved R6B zoning is similar to the rezoning in the Lower East Side. For instance, new developments in the R6B district are required to line-up with the existing and neighboring structures to maintain the street wall. This will prevent the design and construction of new taller buildings adjacent to older, much shorter existing structures. Map 7-18 A and B show where this rezoning impacts Williamsburg and Greenpoint to its North (DCP, 2009b, 2009c).



Map 7-18-A. Existing Zoning of R6 District (DCP, 2009b).



Map 7-18-B. Proposed Rezoning to R6B (DCP, 2009c).

7-3.2 Building Age

Similar to Park Slope and the Lower East Side, the existing structures in Williamsburg were constructed predominantly before 1940 (See Figure 7-5 below). Although the percentage is not as high as those in Park Slope and the Lower East Side, Williamsburg is still largely represented by older buildings. On the other hand, neither Park Slope nor the Lower East Side has over 10% of new construction built in the last decade among their existing structures as does Williamsburg. Although pricing for these new buildings is not analyzed in this study, this comparatively high percentage of additional new housing needs to be taken into account in the gentrification in the Williamsburg area.

Figure 7-5 illustrates that few existing buildings were erected in the decades after 1940. In fact, with the exception of post-2000 Core, none reaches 10%. The decade of the 1980s has the lowest percentage. One cannot conclude the low construction in the 1980s because MapPLUTO overwrites old structures with new ones. Map 7-19 through Map 7-24 illustrate these figures. Map 7-24 illustrates that certain larger tax lots located on the East River front experienced post-2000 construction wave, although regular size tax lots throughout the neighborhood have also experienced new construction and do not seem to cluster in a particular area within the Williamsburg neighborhood.

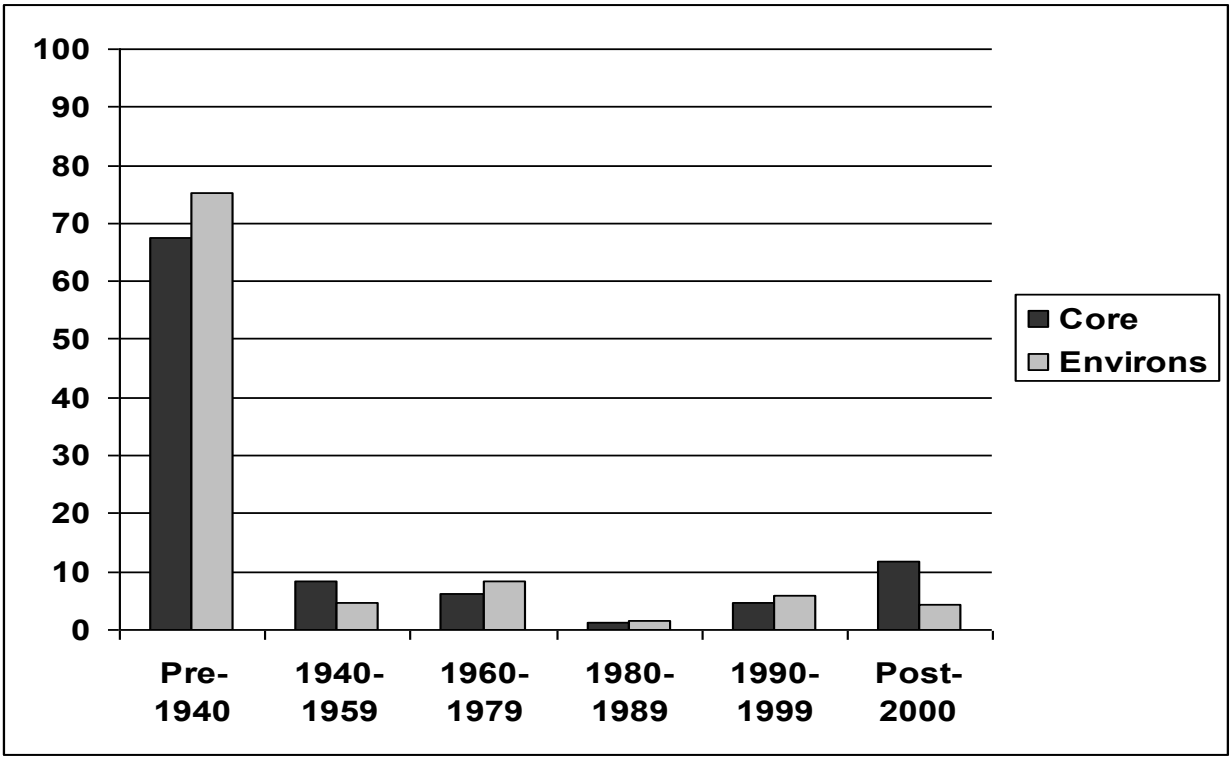
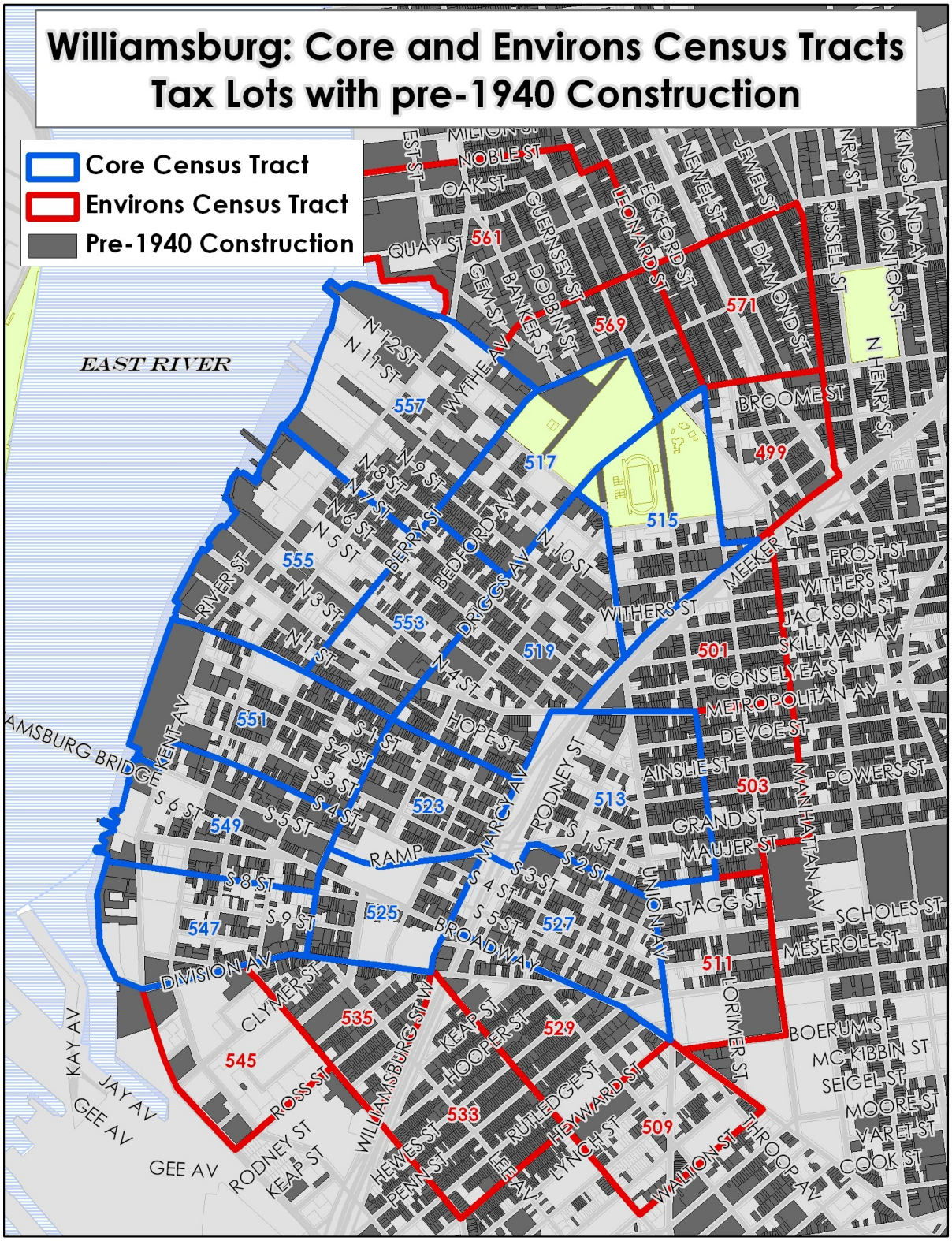
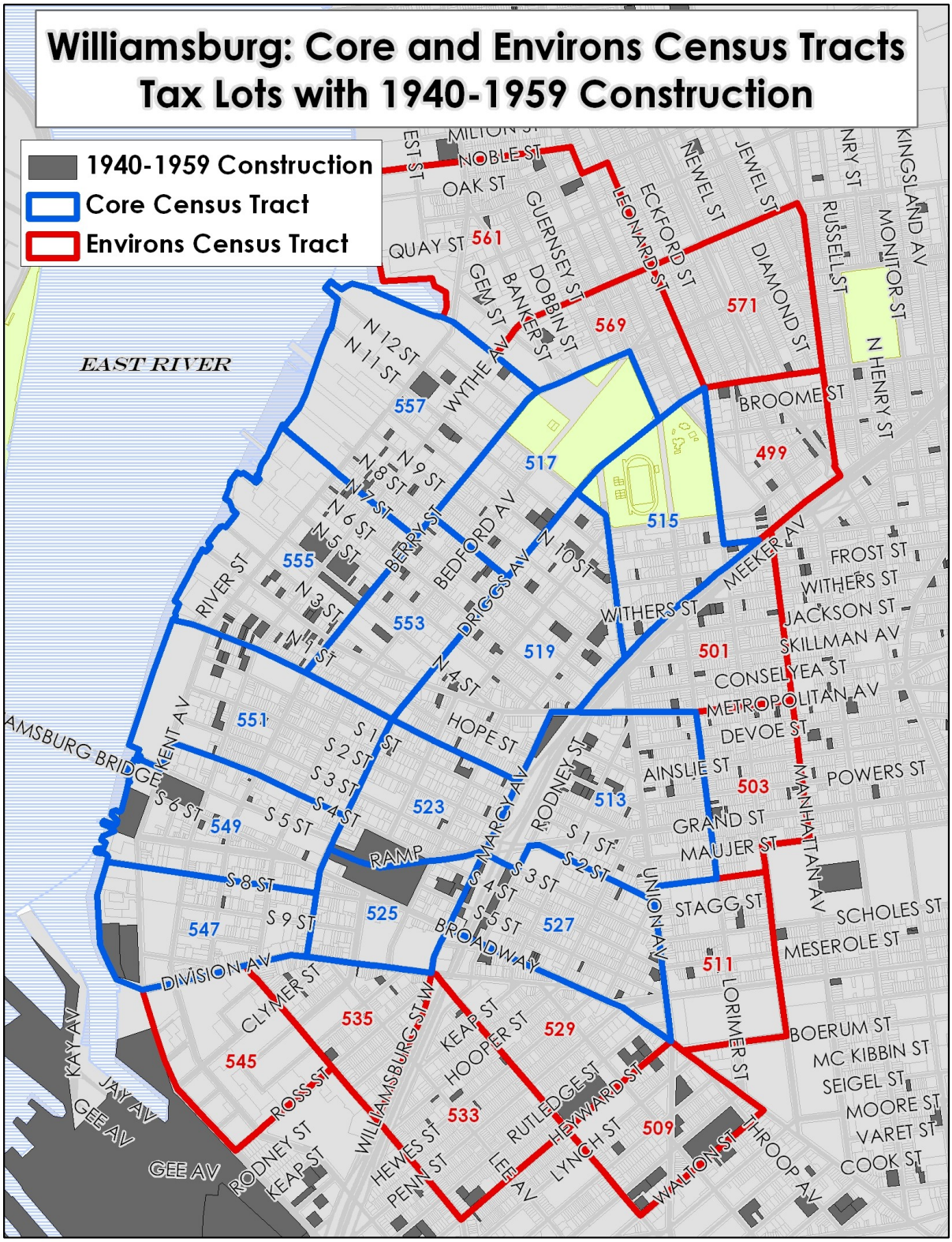


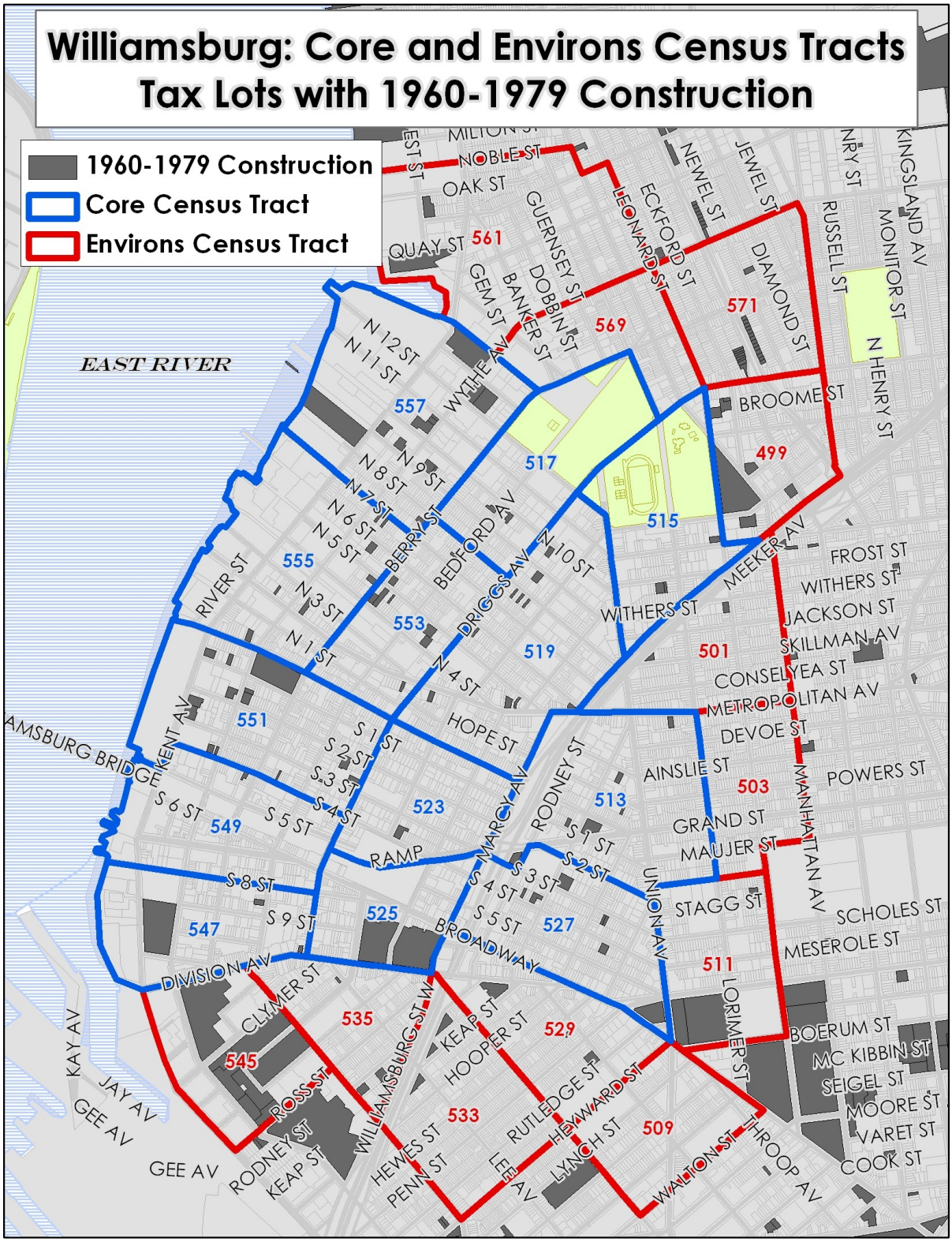
Figure 7-5. Percentage of Building Age, by Tax Lot Area, Williamsburg - Core vs. Environs, 2010.



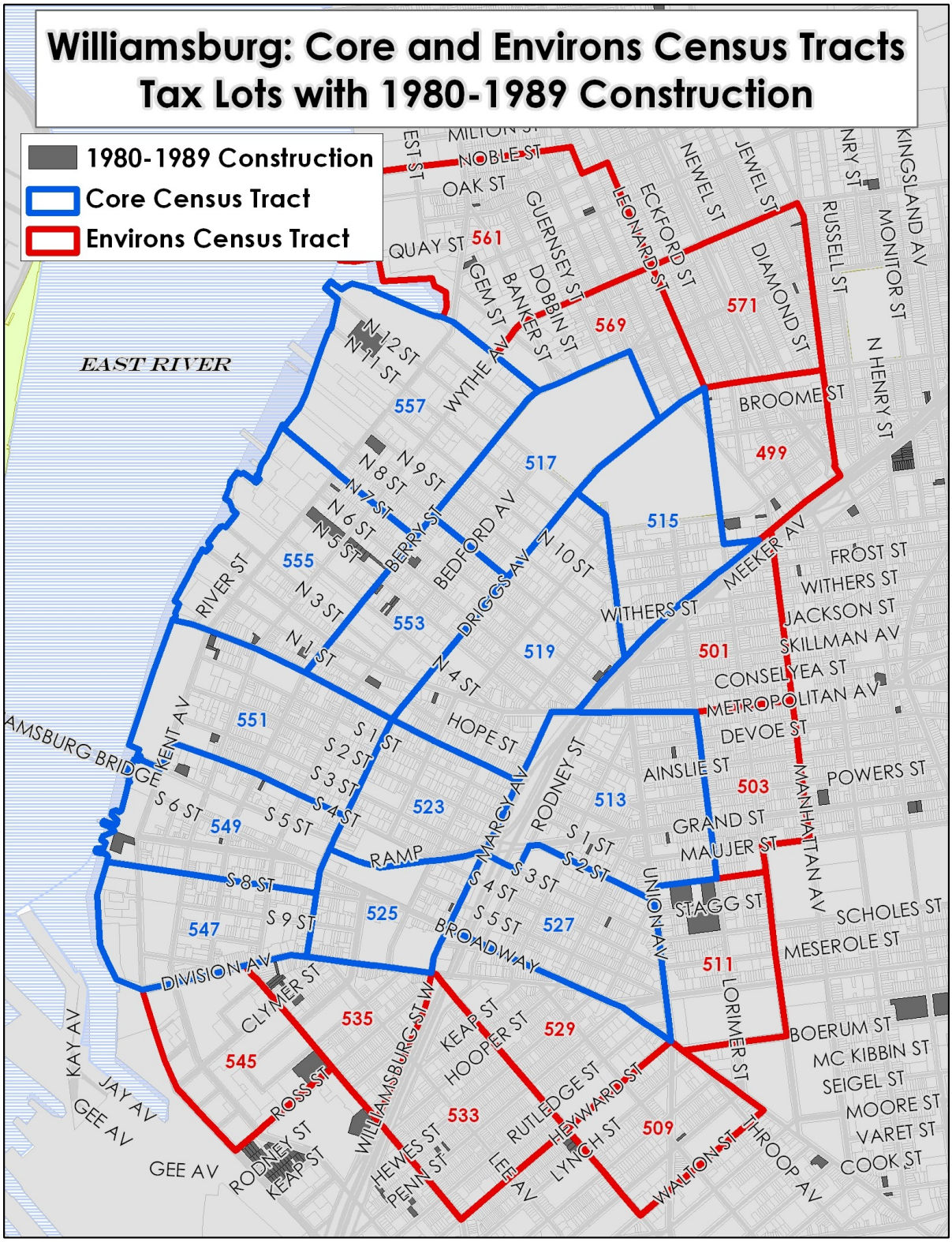
Map 7-19. Williamsburg Tax Lots with pre-1940 Construction.



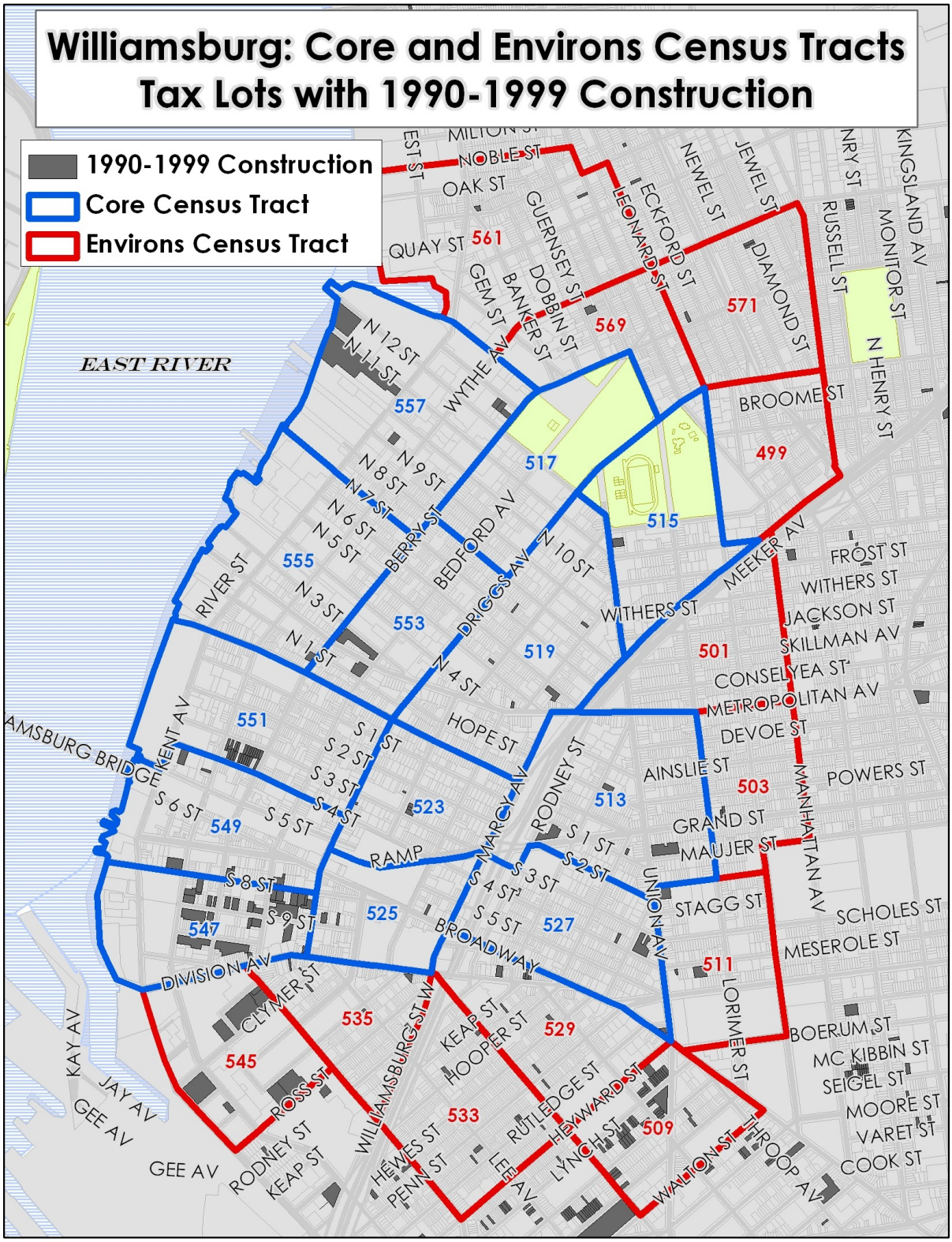
Map 7-20. Williamsburg Tax Lots with 1940 - 1959 Construction.



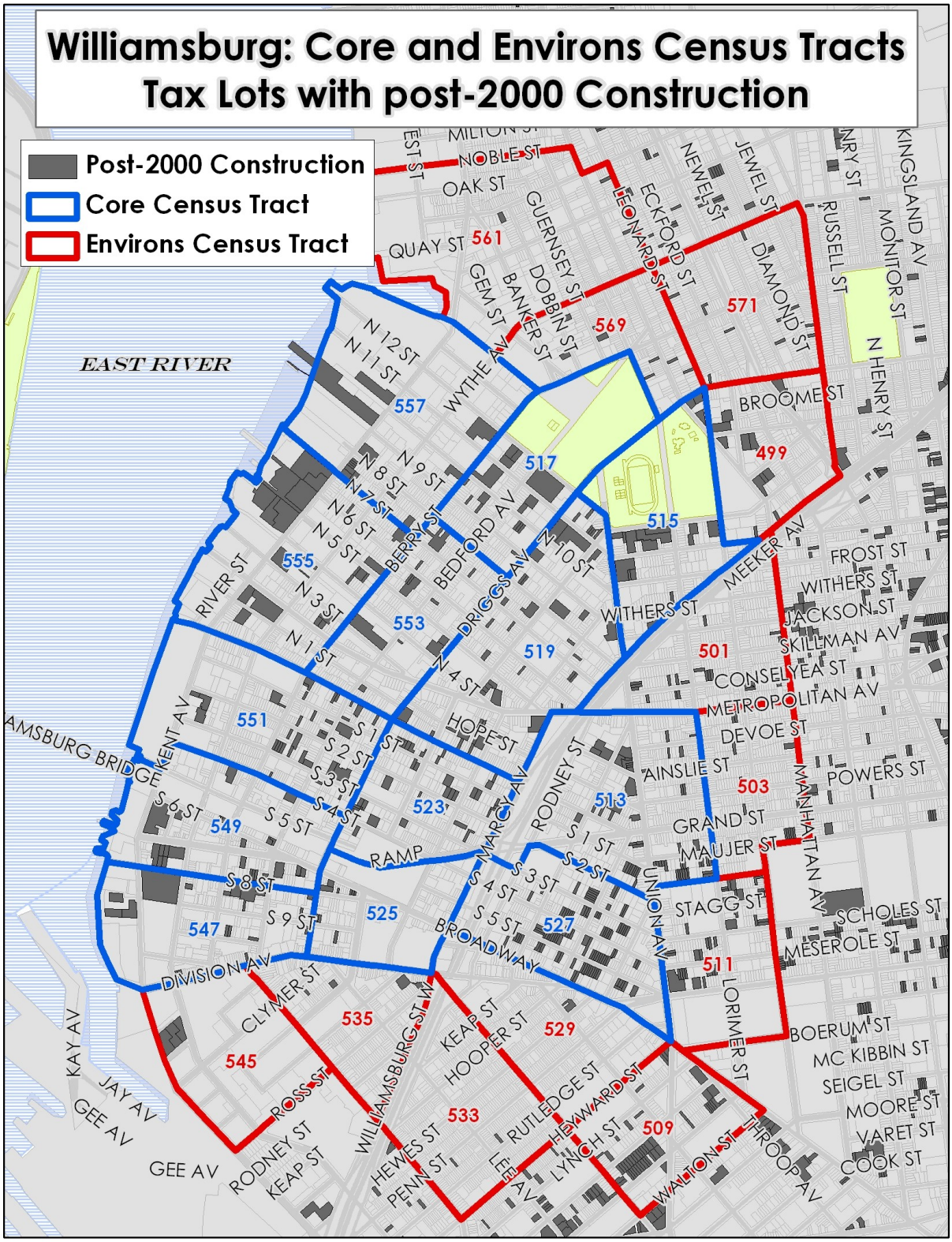
Map 7-21. Williamsburg Tax Lots with 1960 - 1979 Construction.



Map 7-22. Williamsburg Tax Lots with 1980 - 1989 Construction.



Map 7-23. Williamsburg Tax Lots with 1990 - 1999 Construction.



Map 7-24. Williamsburg Tax Lots with post-2000 Construction.

7-3.3 Building Height

Similar to Park Slope, Williamsburg has predominantly short buildings in the 1 to 2-floor and 3 to 4-floor categories. There are differences observed between the Core and Environs, namely, in the Core and Environs the two percentages for the 1 to 2-floor buildings are similar but the 3 to 4-floor category represents more than 50% of the tax lot area in the Environs and only 35% in the Core. These two categories (1 to 2-floor and 3 to 4-floor buildings) are the predominant building heights in Williamsburg. Overall the building landscape of Williamsburg is more similar to that of Park Slope than it is to the Lower East Side which has a considerable higher percentage of taller buildings.

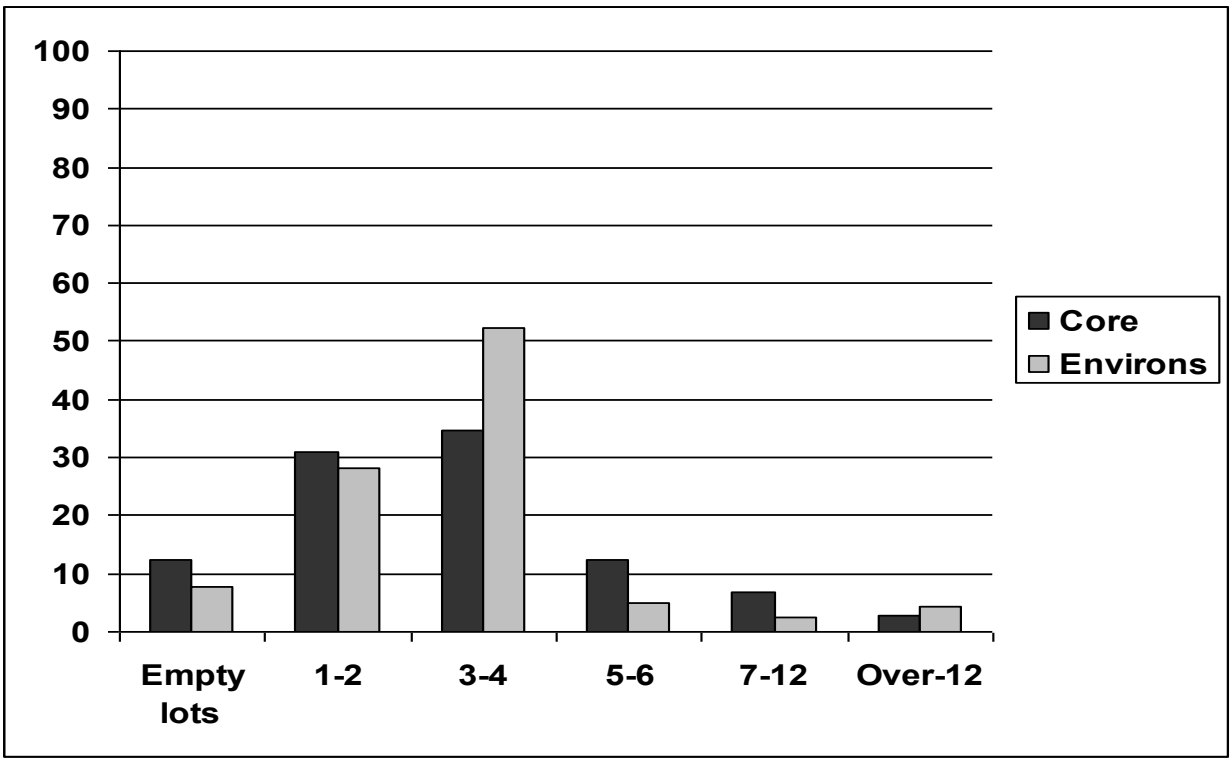
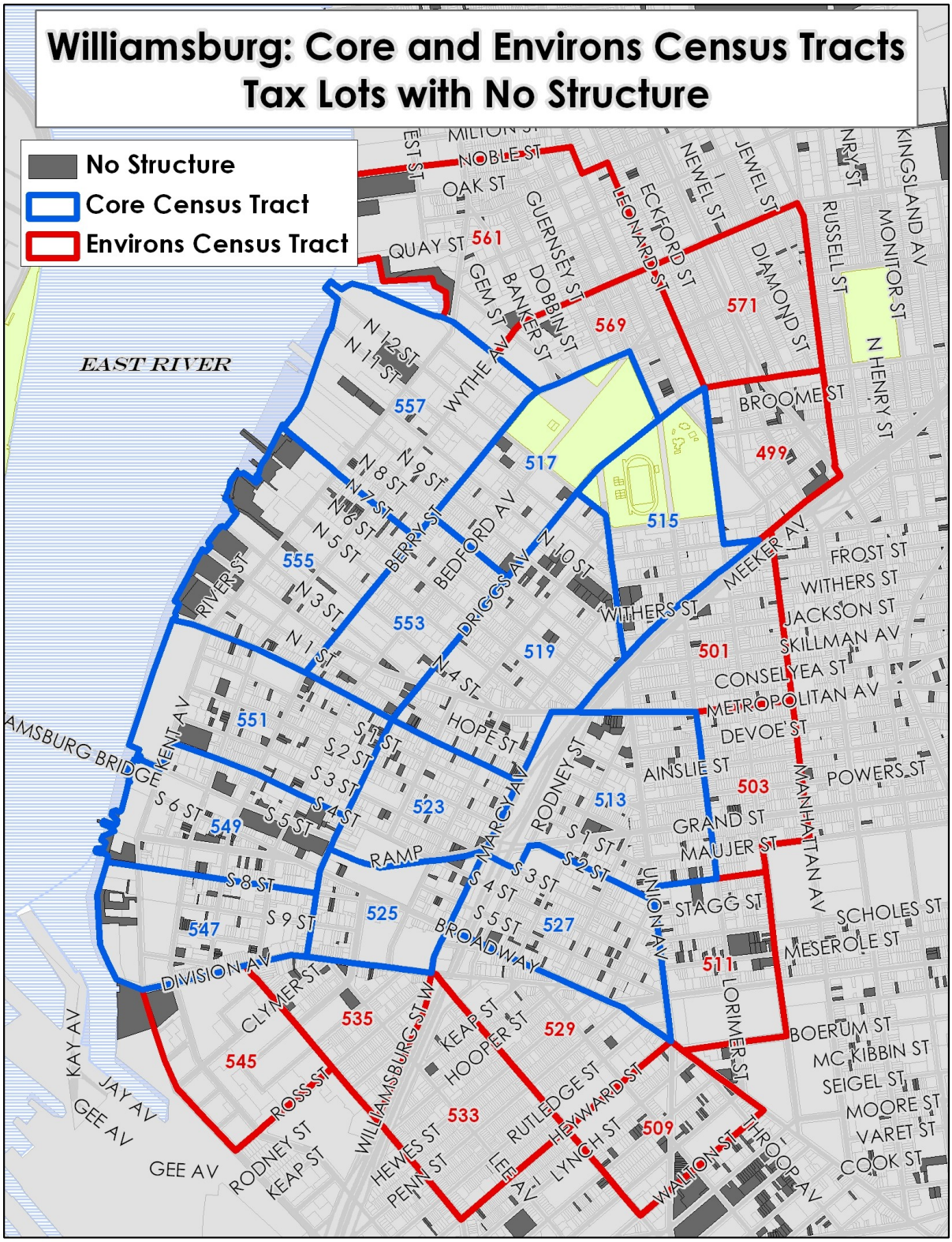
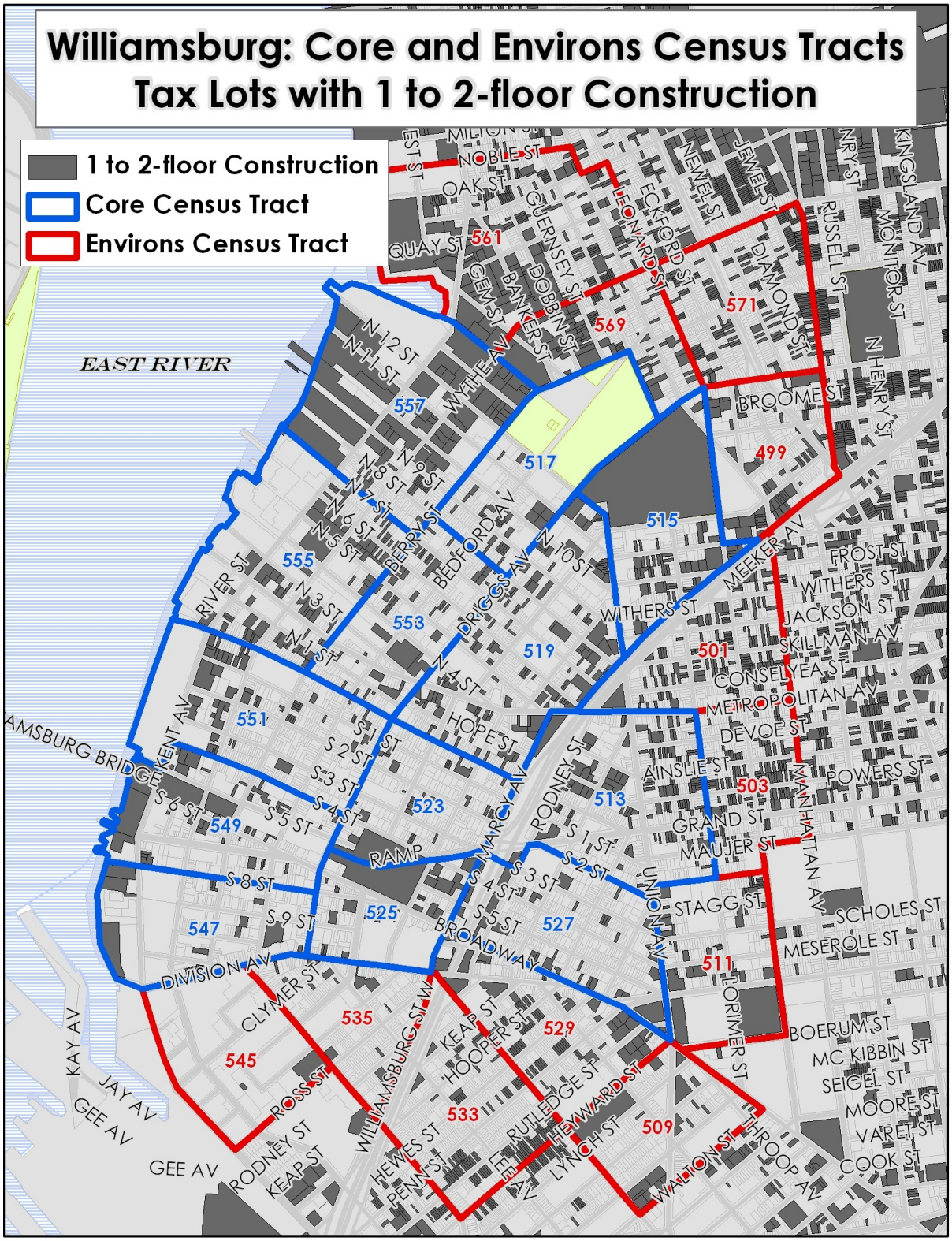


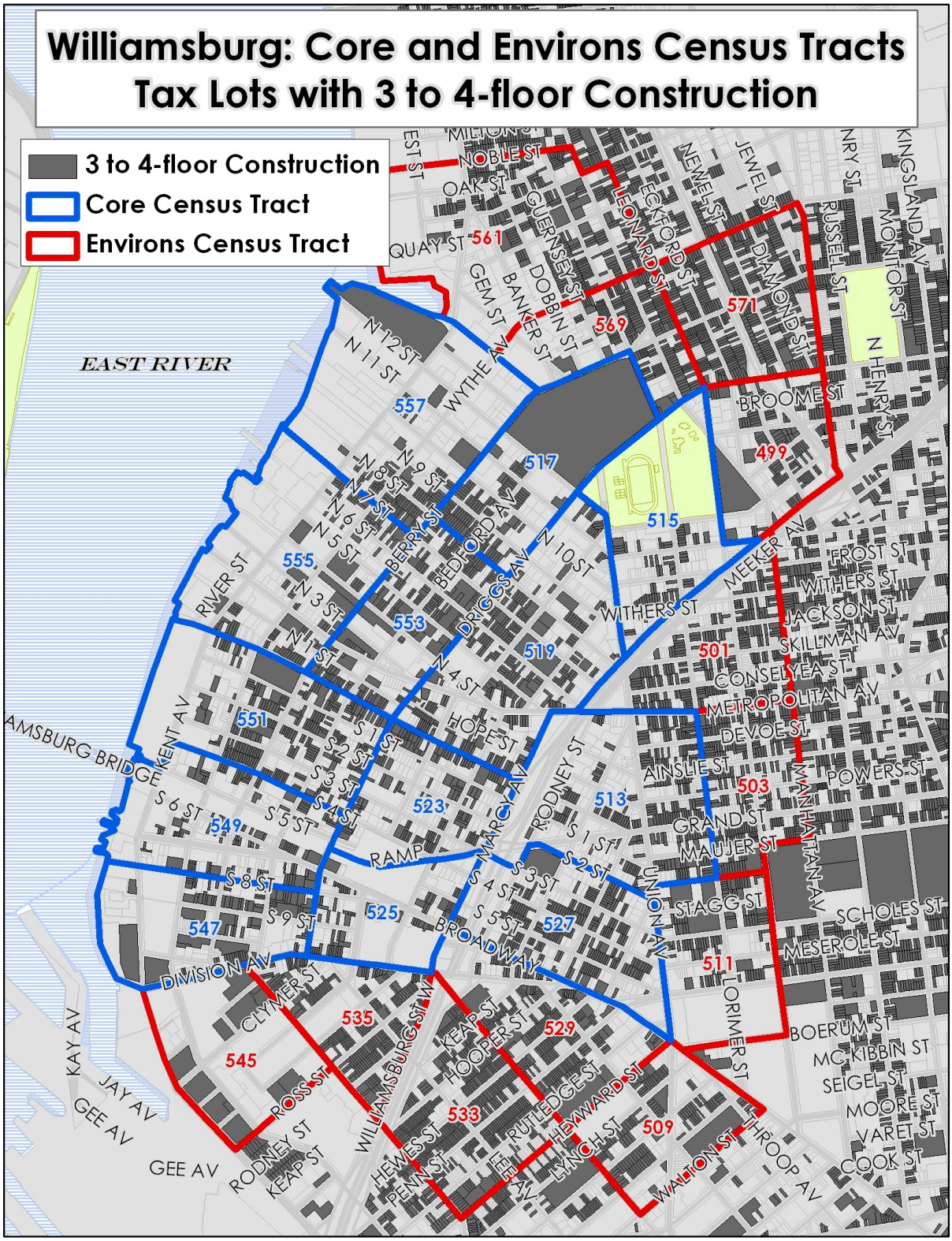
Figure 7-6. Percentage of Building Floor category by Tax Lot Area, Williamsburg - Core vs. Environs, 2010.



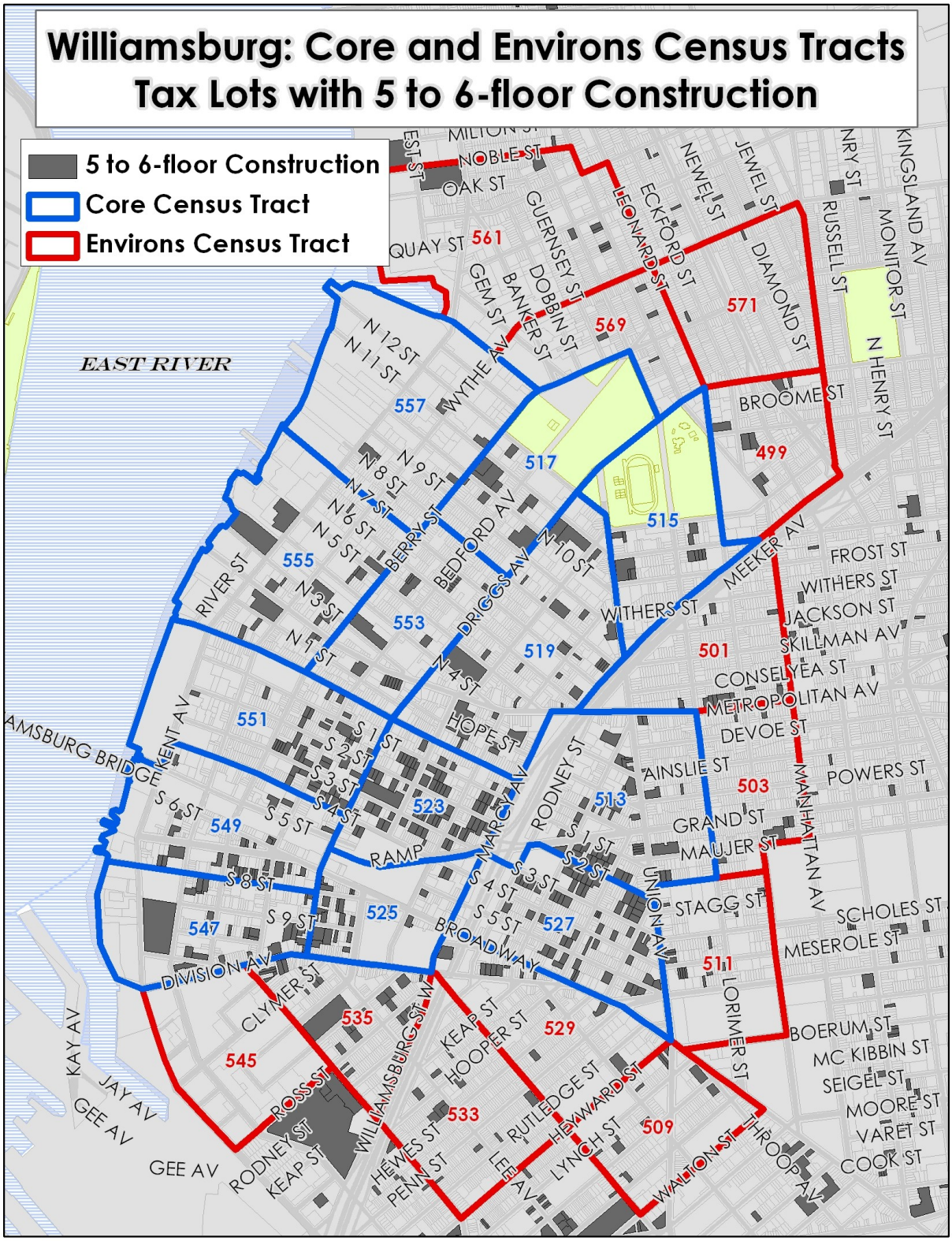
Map 7-25. Williamsburg Tax Lots with No Structure.



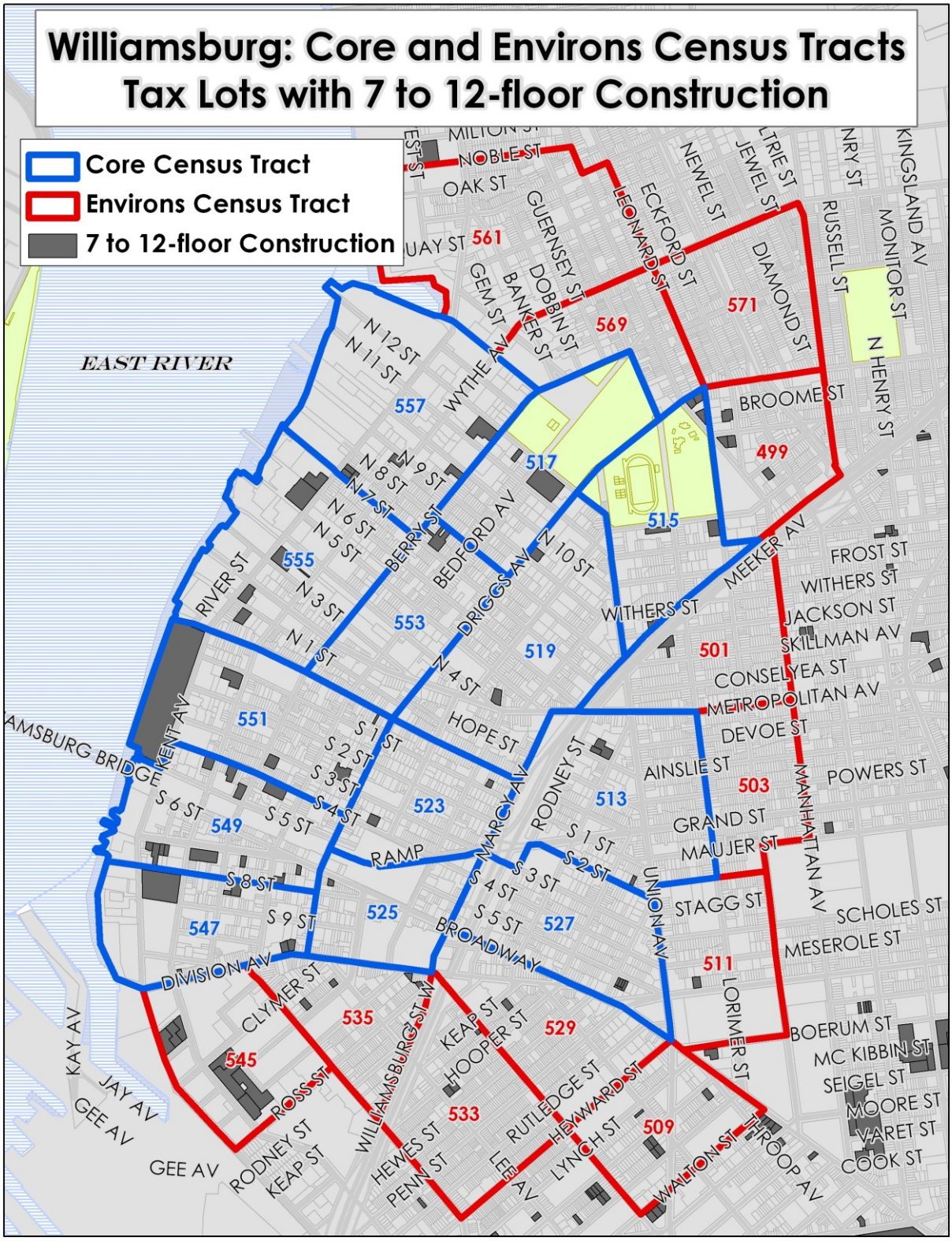
Map 7-26. Williamsburg Tax Lots with 1 to 2-floor Construction.



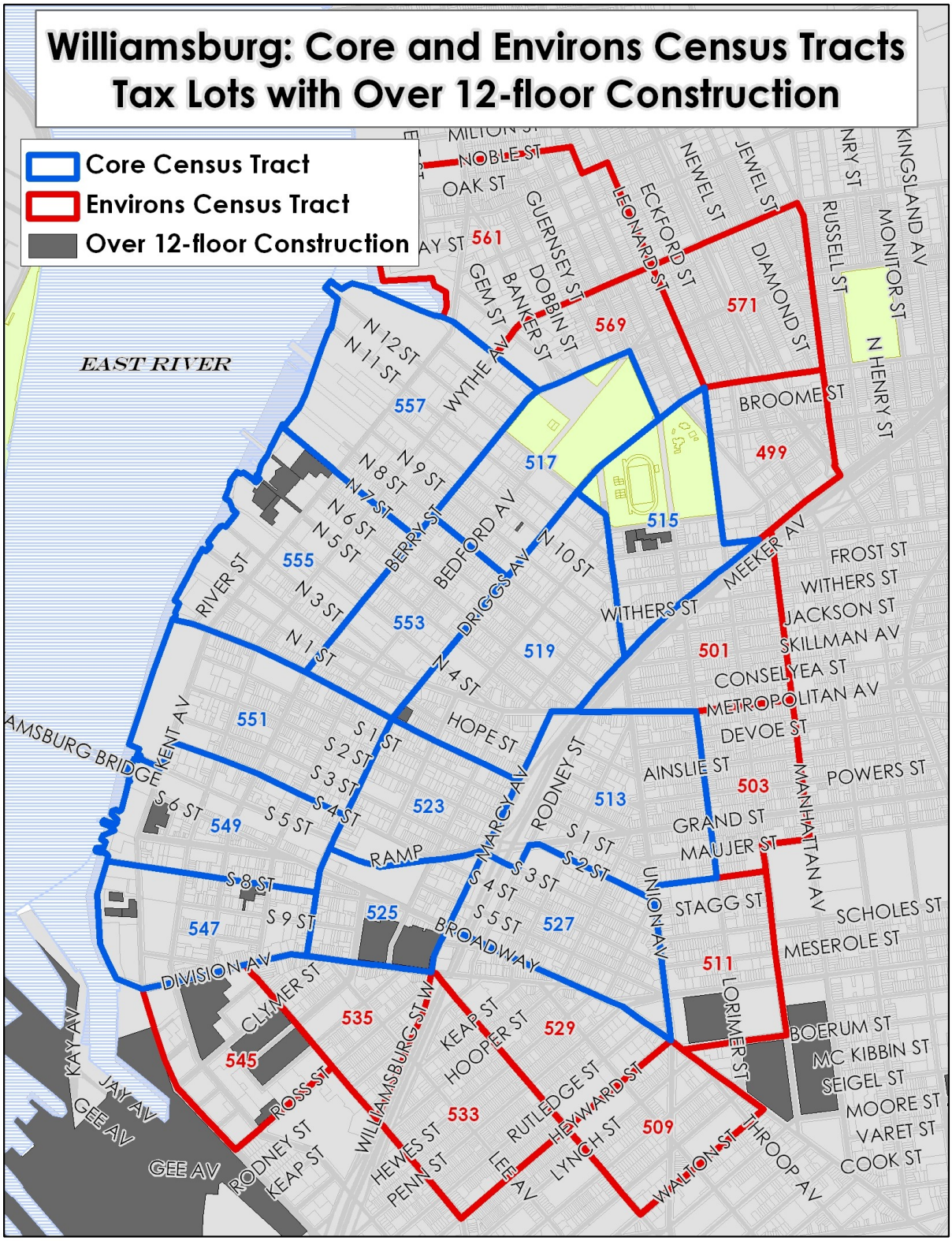
Map 7-27. Williamsburg Tax Lots with 3 to 4-floor Construction.



Map 7-28. Williamsburg Tax Lots with 5 to 6-floor Construction.



Map 7-29. Williamsburg Tax Lots with 7 to 12-floor Construction.



Map 7-30. Williamsburg Tax Lots with Over-12 floor Construction.

7-4 Williamsburg: The Social Environment

7-4.1 Total Population

Between 1980 and 2010 New York City and the Five Boroughs experienced slowly increasing populations. Among the Five Boroughs, Brooklyn is consistently the most populous Borough (See Figure 7-7 below).

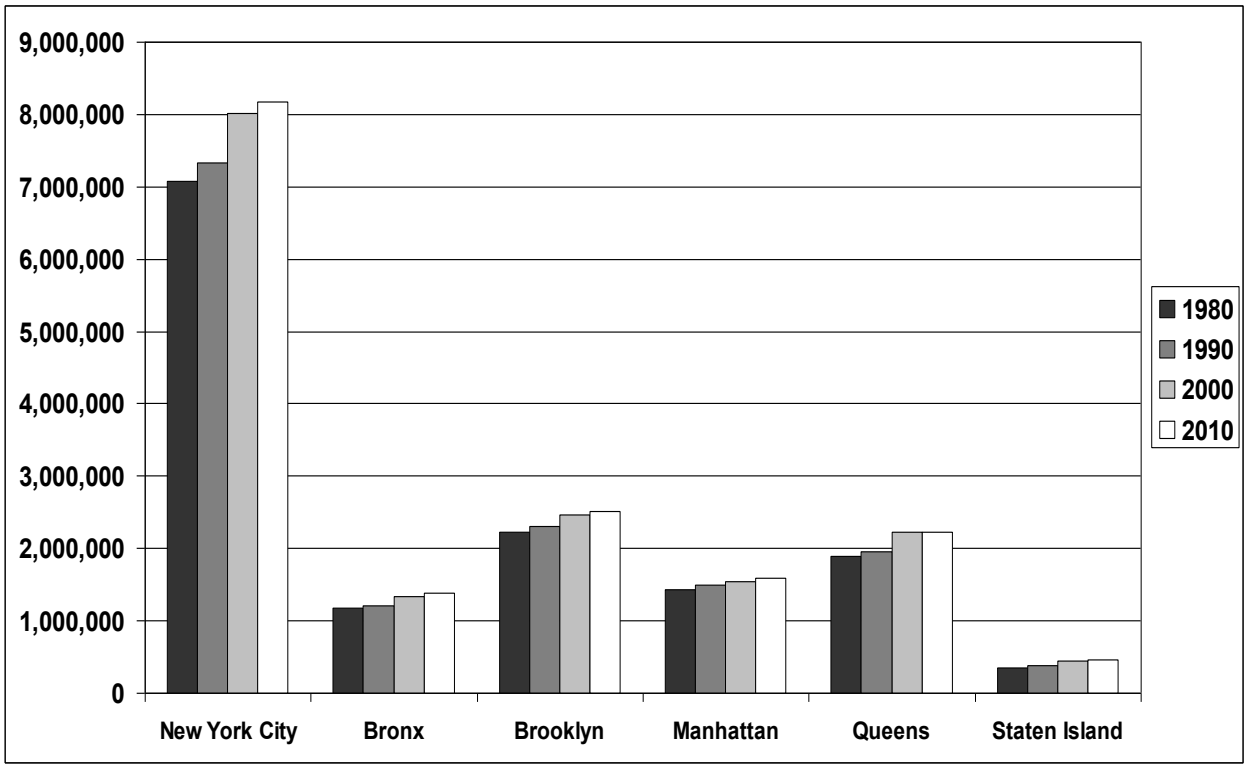


Figure 7-7. Total Population of New York City and the Five Boroughs, 1980 - 2010.

There is a rising trend for the overall population in Williamsburg from 1980 through 2010 (See Figures 7-8 below). Figure 7-9 compares the total population for the Core and Environs. The Environs have consistently experienced a larger population than the Core between 1980 and 2010, and the gaps are almost the same up to 2000. Thereafter, there is a noticeable population

increase in the Core between 2000 and 2010 and by 2010 the population gap almost disappears because the Core has increased faster than the Environs. This increasing trend in Williamsburg mirrors those of New York City itself and the Five Boroughs (See Figure 7-9).

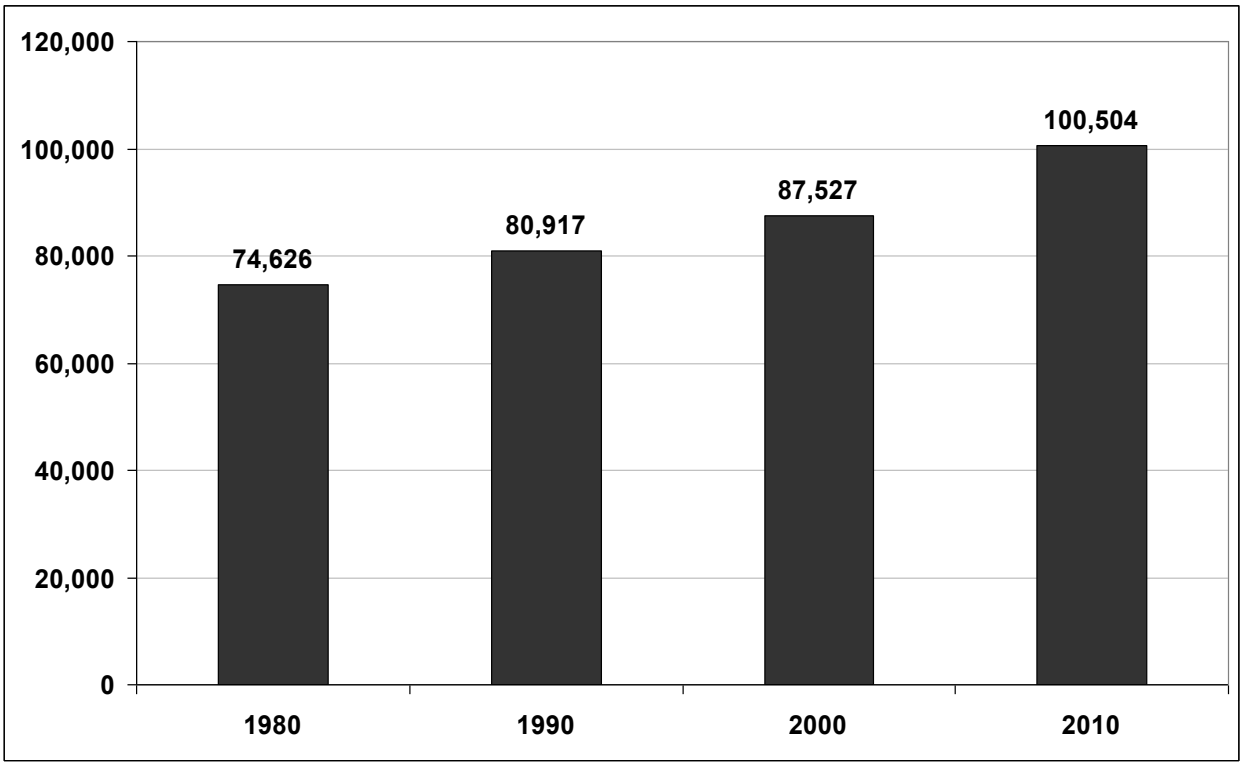


Figure 7-8. Total Population of Williamsburg, 1980 - 2010.

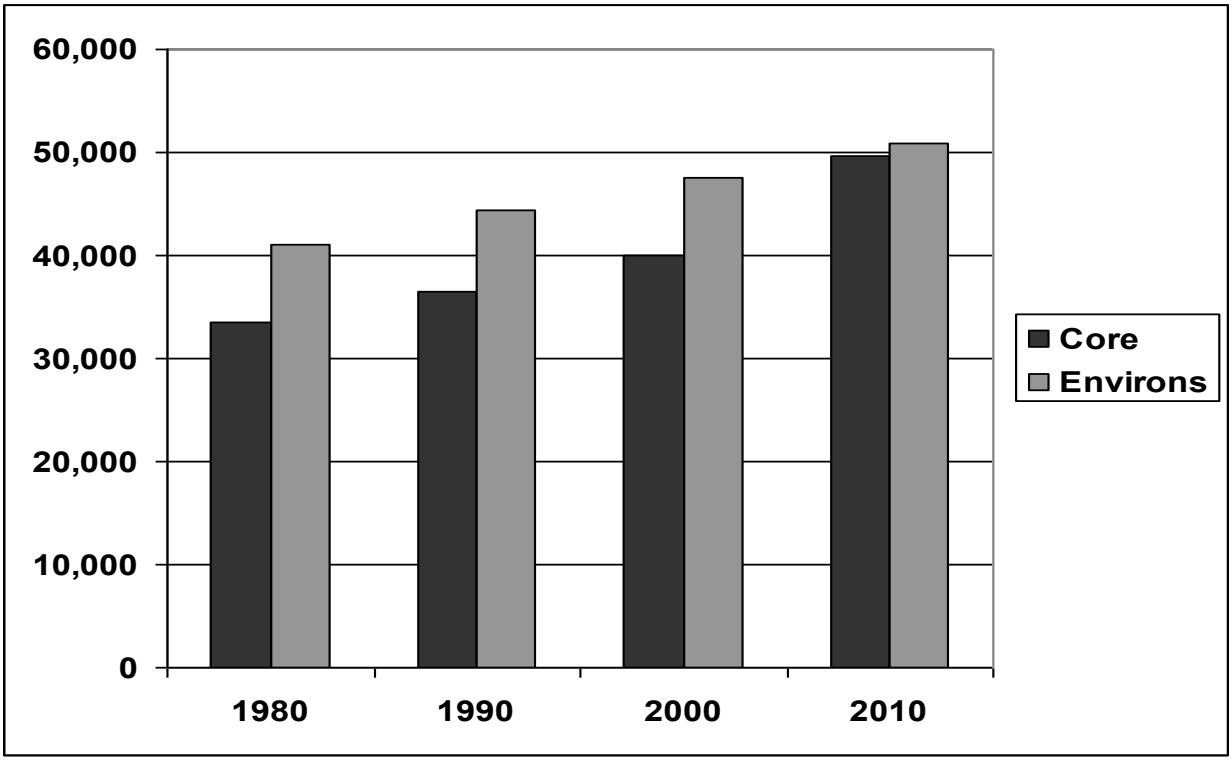


Figure 7-9. Total Population of Williamsburg - Core vs. Environs, 1980 - 2010.

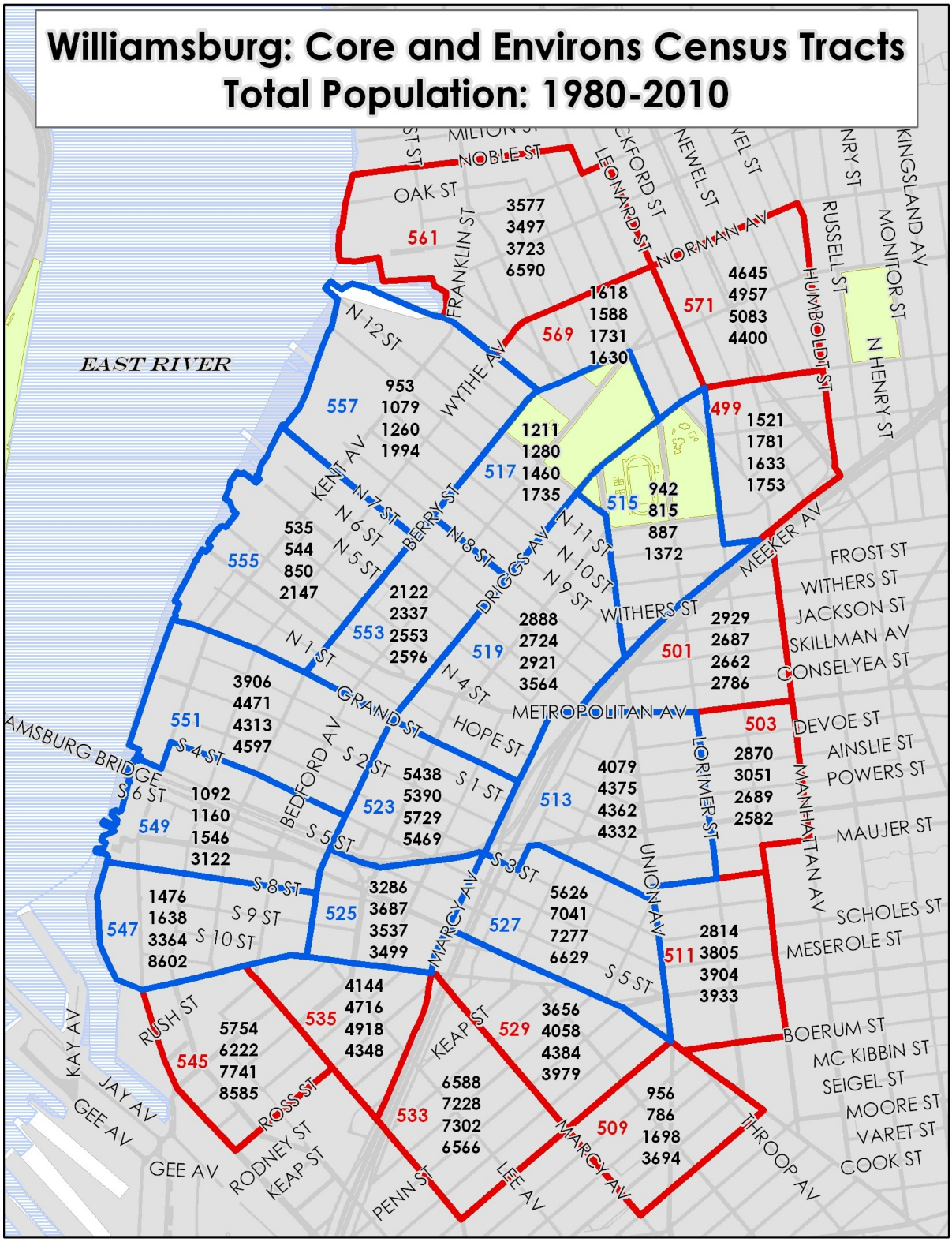
As discussed in the previous Park Slope and the Lower East Side chapters, if one wants to examine the population changes throughout the years at the Census Tract level, one can attach the head-count values to the map (See Map 7-31). The drawback of this design is that it requires considerable effort to ascertain the trends. Convert these values into bar charts and embed them into the map results in the creation of a map that is easier to understand (See Map 7-32, below). Figure 7-10 and Figure 7-11 below include the individual Census Tract bar chart for the total population or the Core and Environs. Using this map together with these two bar charts, one can observe their population growth is uneven among the Census Tracts: within the Core, Census Tract 549 more than doubles its population between 2000 and 2010; within the Environs, Census Tract 509 and Census Tract 561 experience noticeable growth during the same period.

Map 7-32 and the accompanying Figure 7-10 and Figure 7-11 are based on the Census Tract level values and illustrate additional intra-neighborhood differences than the aggregate numbers:

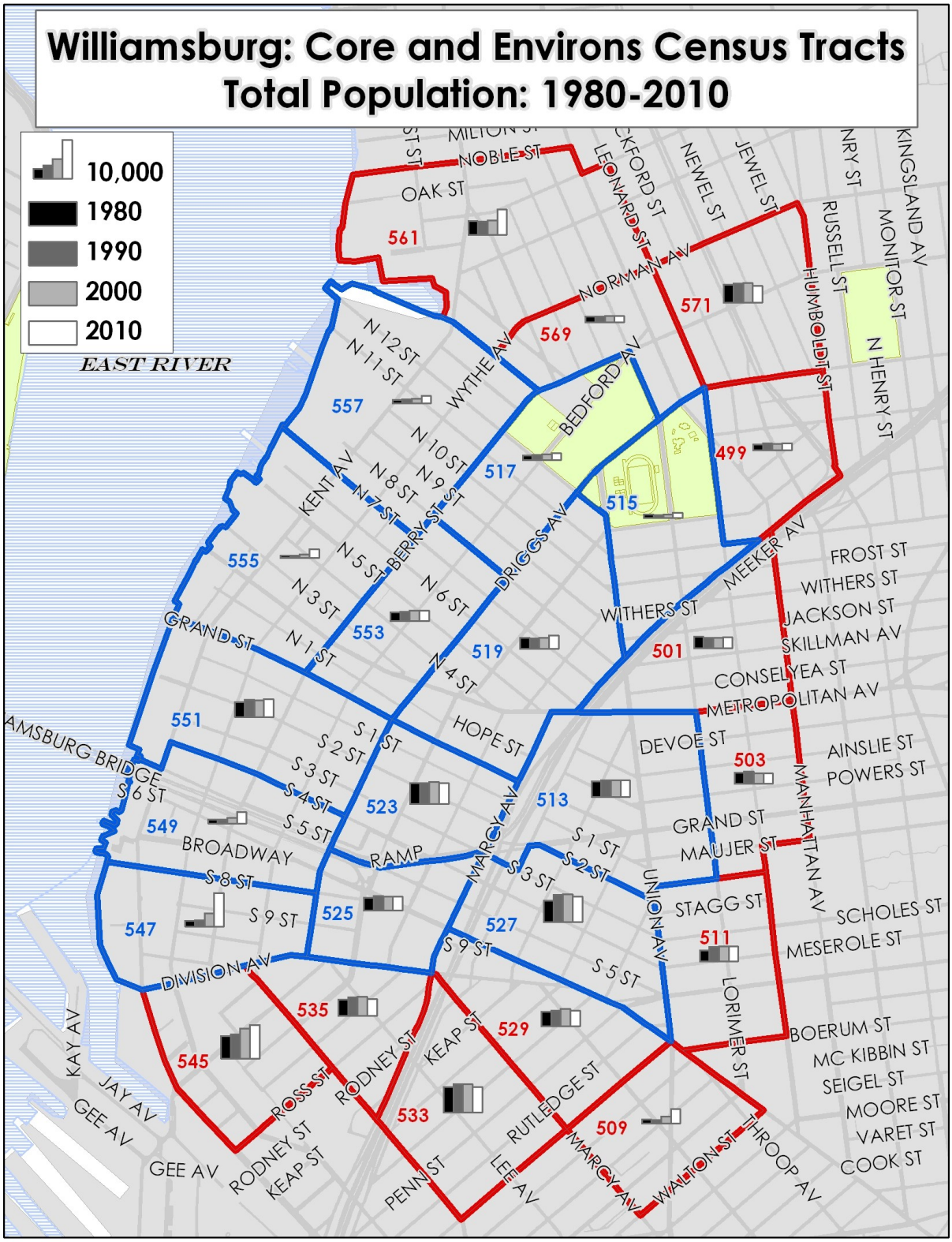
1. Overall, the Census Tracts in the Southern Core are more populated. This is to be expected when considering the large amount of tax lots along the East River riverfront (i.e. Census Tract 555 and Census Tract 557) are zoned for manufacturing. Census Tract 515 and Census Tract 517 both have approximately 50% of their areas zoned as park land and are not inhabited.

2. The Environs area's populations are also a reflection of zoning for the land use. Those with more tax lots zoned for residential district have a larger population.

3. The population growth is uneven among the Census Tracts. Within the Core, Census Tract 547 at the Southern tip has a noticeable increase between 2000 and 2010. Three other Census Tracts (549, 555 and 557) also have more noticeable increases during the same period. These four Census Tracts together with Census Tract 551 actually line-up along the East River riverfront in the Core area. Map 7-33 reveals this spatial pattern and Map 7-24 reveals that the post-2000 construction is not limited only to these Census Tracts. It is likely that these new construction sites may house a portion of the new population. It should also be noted that unlike the Lower East Side neighborhood, there is no highway that is situated along the Williamsburg East River riverfront. This feature should allow the rezoned East River riverfront residential and park land tax lots to be more accessible to people residing in the inland areas.



Map 7-31. Williamsburg, Total Population in Numbers by Census Tract, 1980 - 2010.



Map 7-32. Williamsburg, Total Population Bar Chart by Census Tract, 1980 - 2010.

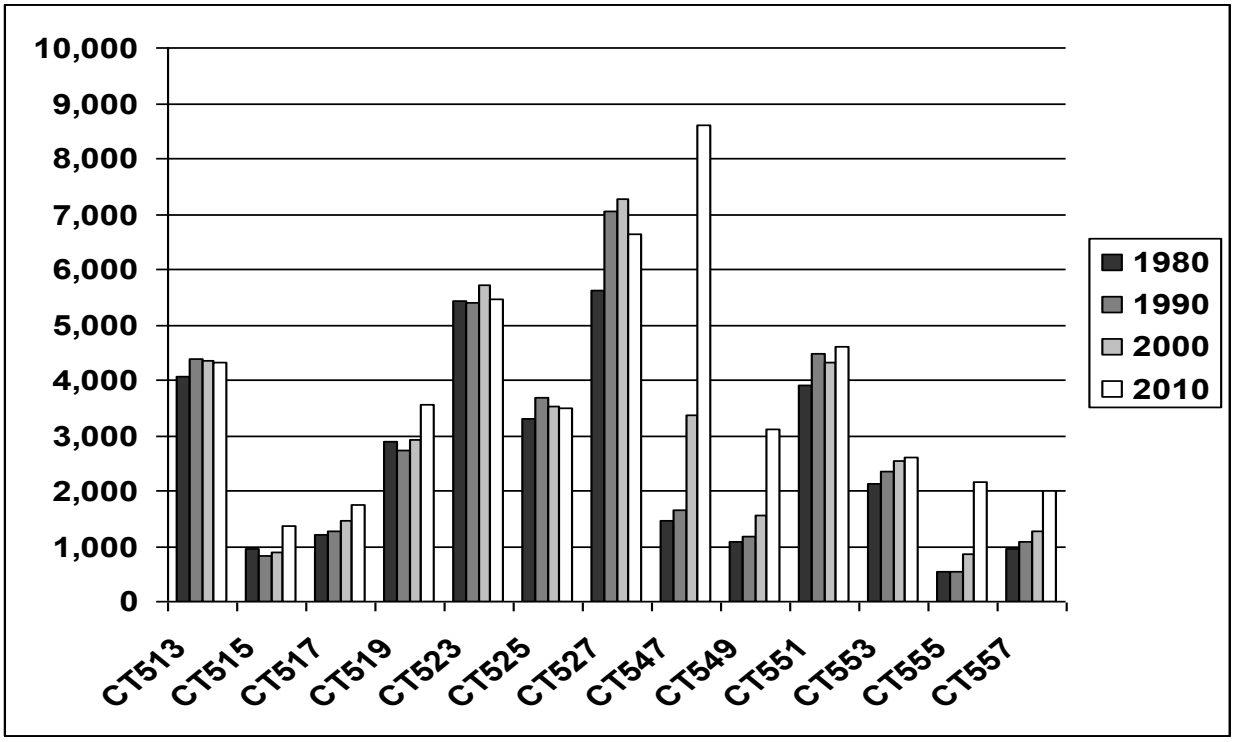


Figure 7-10. Total Population of Census Tracts, Williamsburg - Core, 1980 - 2010.

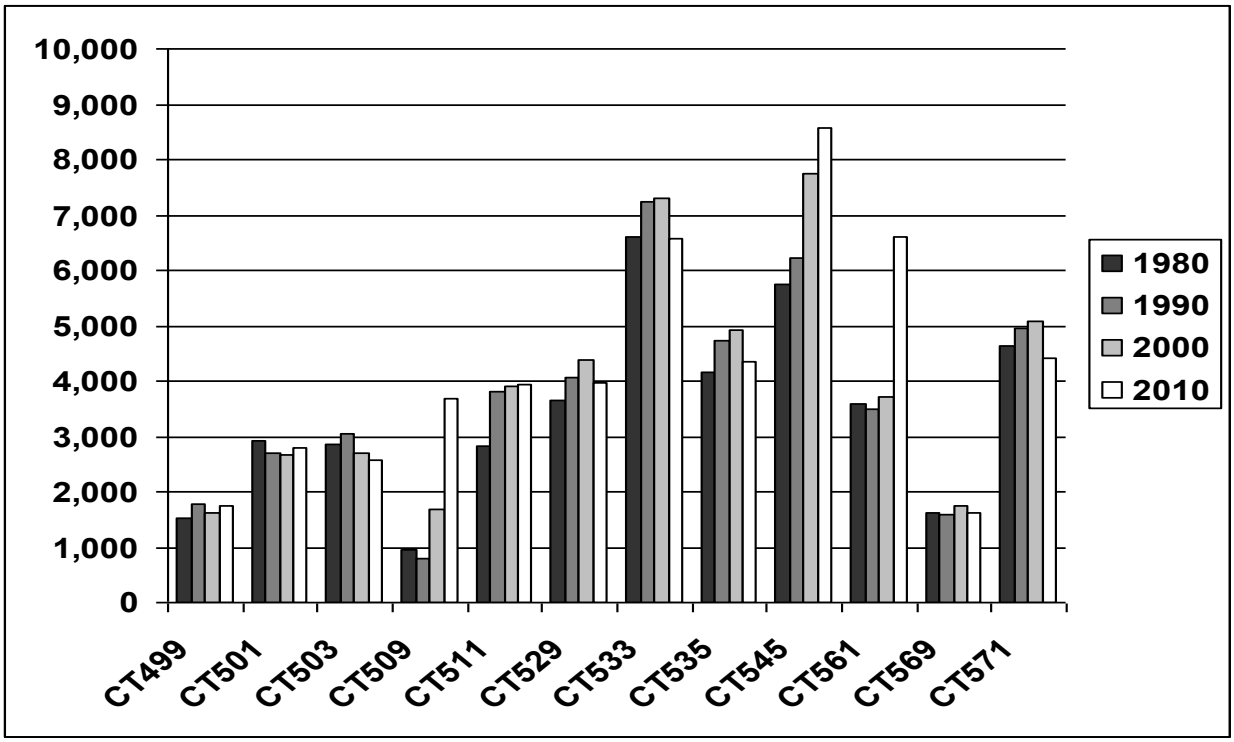


Figure 7-11. Total Population of Census Tracts, Williamsburg - Environs, 1980 - 2010.

7-4.2 Selected Ethnic Groups Maps

In this series of maps, selected ethnic groups (i.e. White, Black, Chinese and Hispanic-origin) are mapped by their percentage of the total population for each Census Tract. The percentage figures are calculated from the four Census Survey years (i.e. 1980, 1990, 2000 and 2010) and represented as a bar chart embedded into each Census Tract in the maps. The bar chart sizes for the percentages on the maps are standardized so they can be compared to each other directly.

7-4.2a Percentage of the White Population

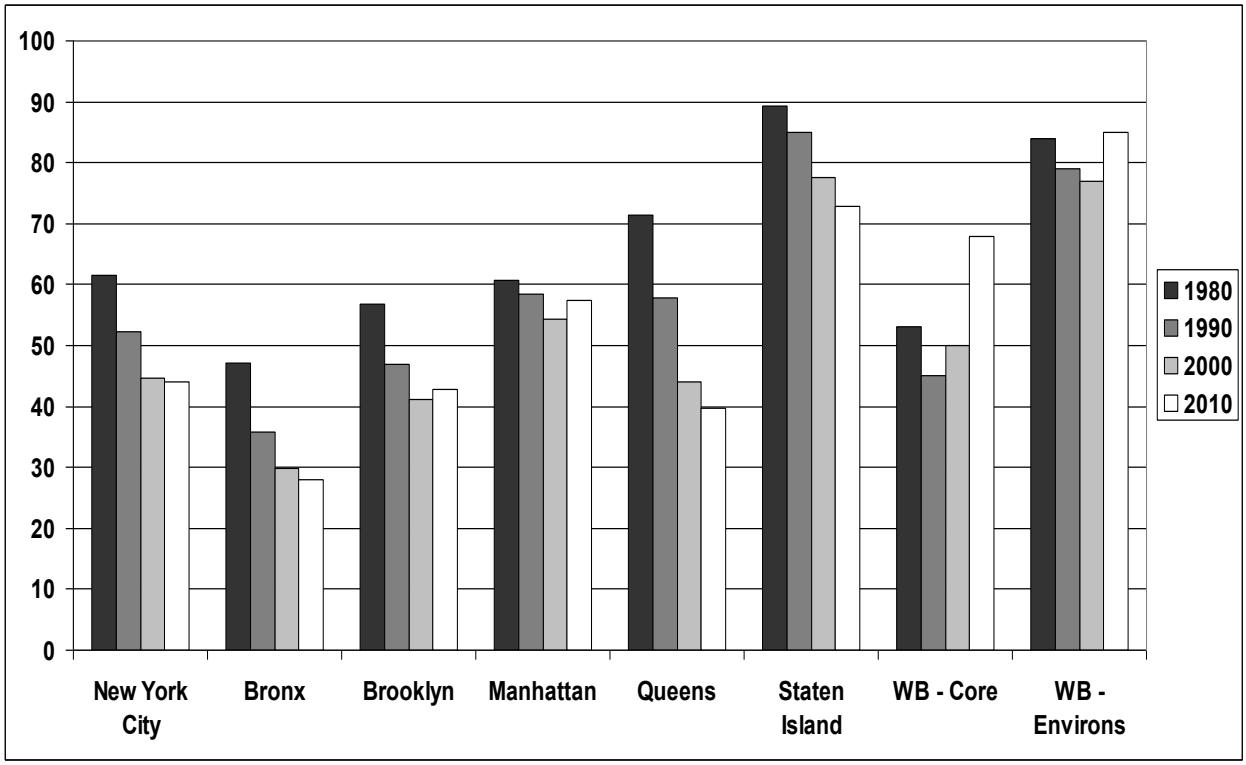


Figure 7-12. Percentage of the White Population in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.

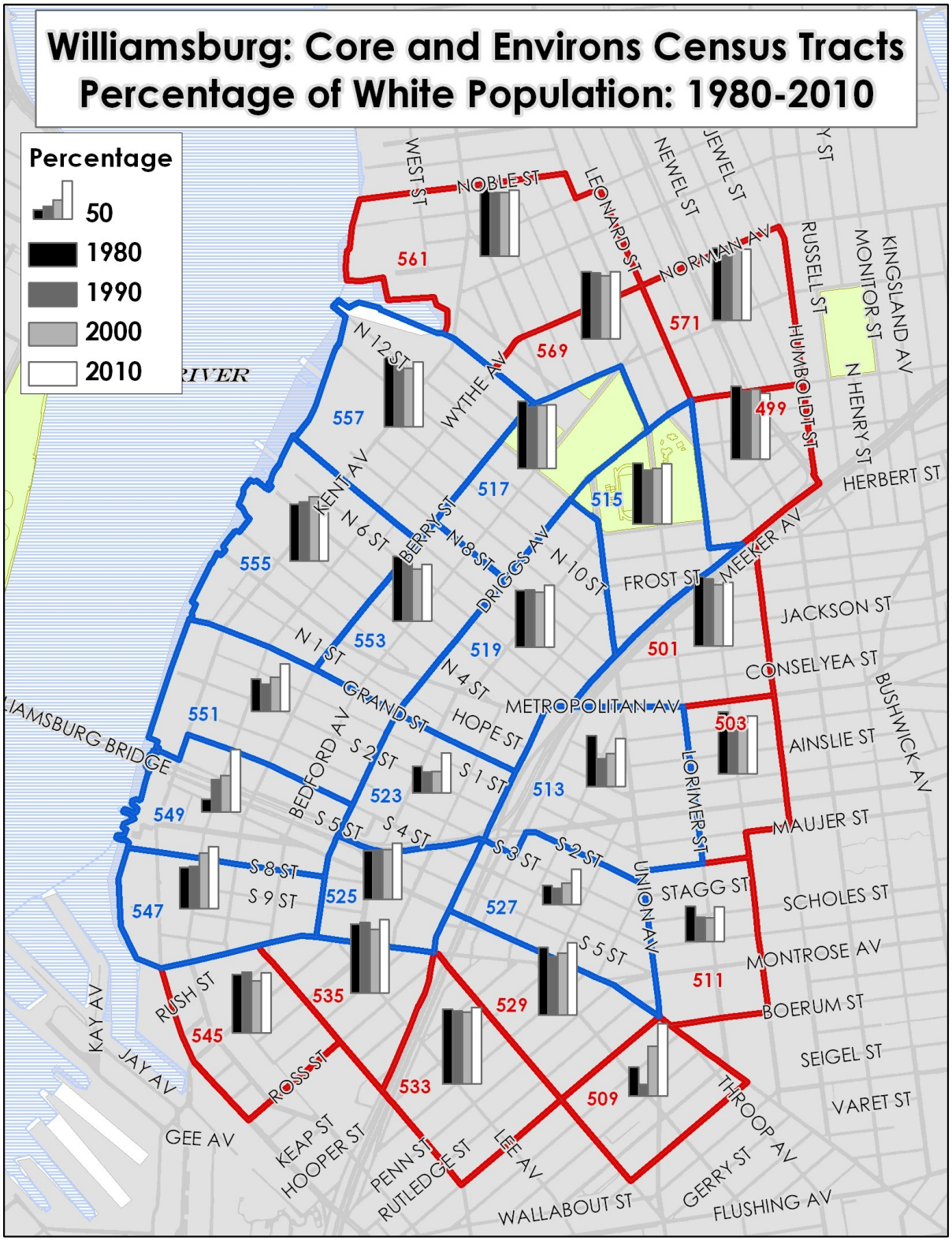
Regarding the percentages for the White population, both the Core and the Environs in Williamsburg share a similar pattern: decreasing numbers between 1980 and 1990; and then

increasing numbers in more recent decades (See Figure 7-12 above). The Environs experience consistently higher numbers than does the Core and the Borough itself. The growing trend for Williamsburg in more recent decades are the opposite to that of the City, which experiences a decreasing trend.

Map 7-33 and the accompanying Figure 7-13 and Figure 7-14 are based on the Census Tract level values, illustrate additional intra-neighborhood differences than the do aggregated numbers. While the overall trends show increasing percentages for the White population in both the Williamsburg Core and Environs between 2000 and 2010, these increases are not evenly distributed: within the Core, the Census Tracts South of Grand Street experience more noticeable increases (i.e. Census Tracts 551, 549, 523 and 527), while Census Tracts 547 and 525 have consistently high percentages throughout the study years. The change in Census Tract 549 is especially evident. Located at the foot of the Williamsburg Bridge which connects the Williamsburg neighborhood to the Lower East Side, Census Tract 549's percentage for the White population increases from 16% in 1980 to 42% in 1990, remains at 42% in 2000 and increases to 81% in 2010. In fact, within three decades, the White population changes from a slim minority to the majority.

In the Environs the changes are uneven as well: while the majority of the Census Tracts report considerably high percentages for the While population, Map 7-33 and Figure 7-14 illustrate Census Tracts 509 and 511 that are adjacent to the Census Tracts discussed above that show an increasing pattern in the Core, likewise a show considerable percent increase for the White population between 2000 and 2010. The change reports in Census Tract 509 is especially unique:

located next to Census Tracts 529 and 533 that have consistently high percentage numbers, in Census Tract 509 there is a percentage drop between 1980 and 1990, and in the subsequent twenty years, the percentage increases sharply from less than 20% to over 90%.



Map 7-33. Williamsburg, Percentage of White Population by Census Tract, 1980 - 2010.

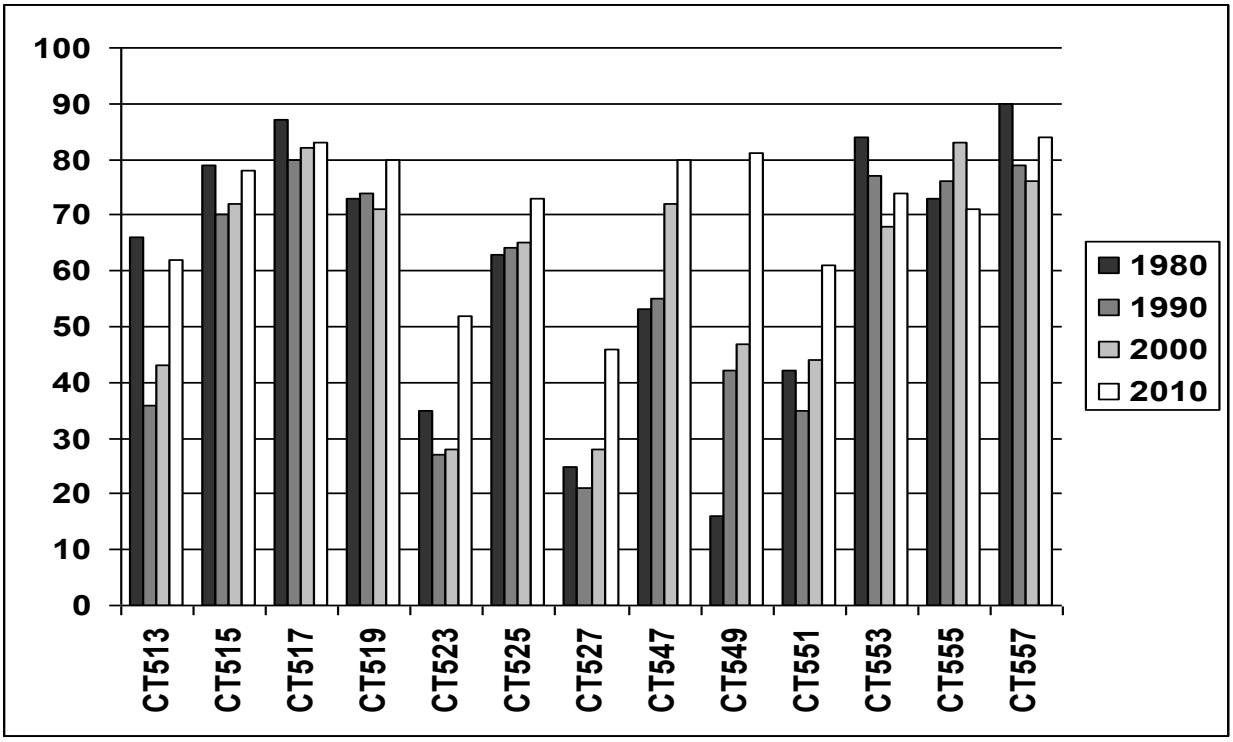


Figure 7-13. Percentage of the White Population in Williamsburg - Core by Census Tract, 1980 - 2010.

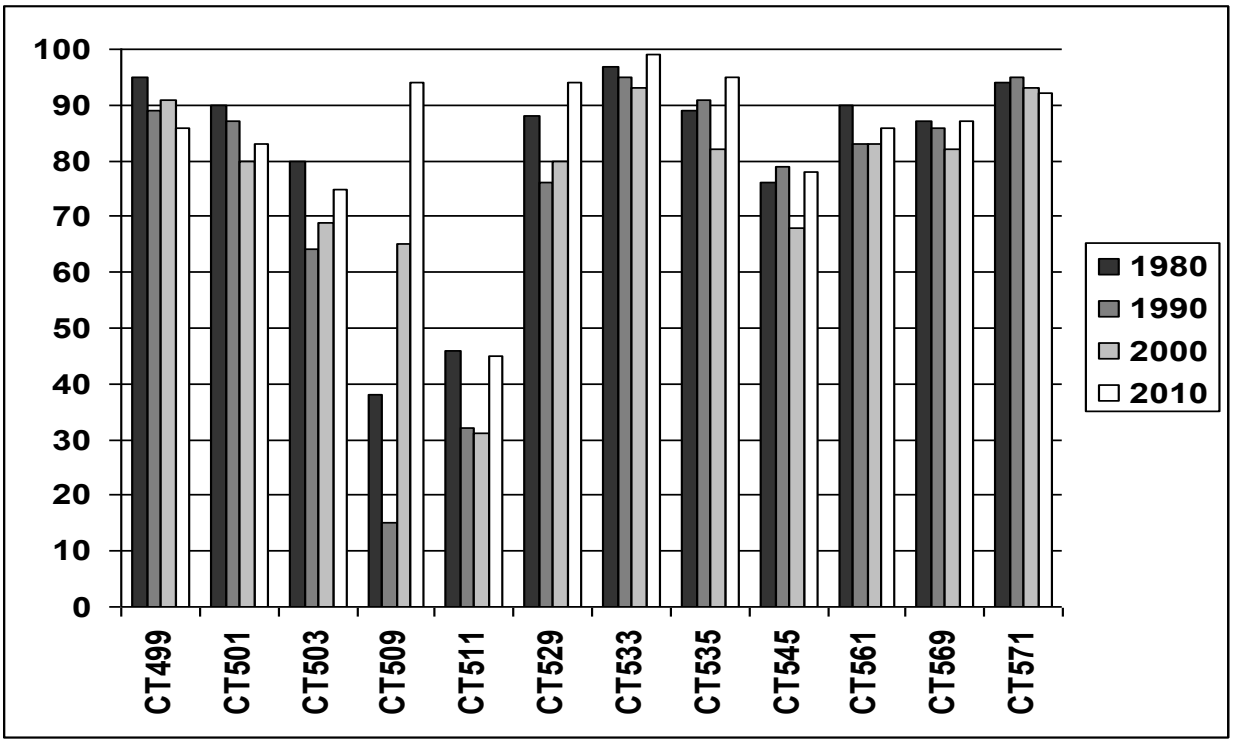


Figure 7-14. Percentage of the White Population in Williamsburg - Environs by Census Tract, 1980 - 2010.

6-4.2b Percentage of the Black Population

Throughout the study period, Williamsburg has consistently reported low percentages for the Black population. The only exception is the percentage reported in 1990 in the Core, when the percentage for the Black population peaked at 14%. Other than this peak, the overall percentages of Core and Environs are less than 10%. In Map 7-34 with Figure 7-16 and Figure 7-17 this peak is observed in several Census Tracts in the Core area. Map 7-34 also illustrates the Census Tracts North of Grand Street have lower percentages and the bar charts look flat. Census Tract 571 of the Environs located north of the Core area has only a few Black residents that the percentages throughout the study period are less than 1% and the values are too small for the mapping software to generate a bar chart.

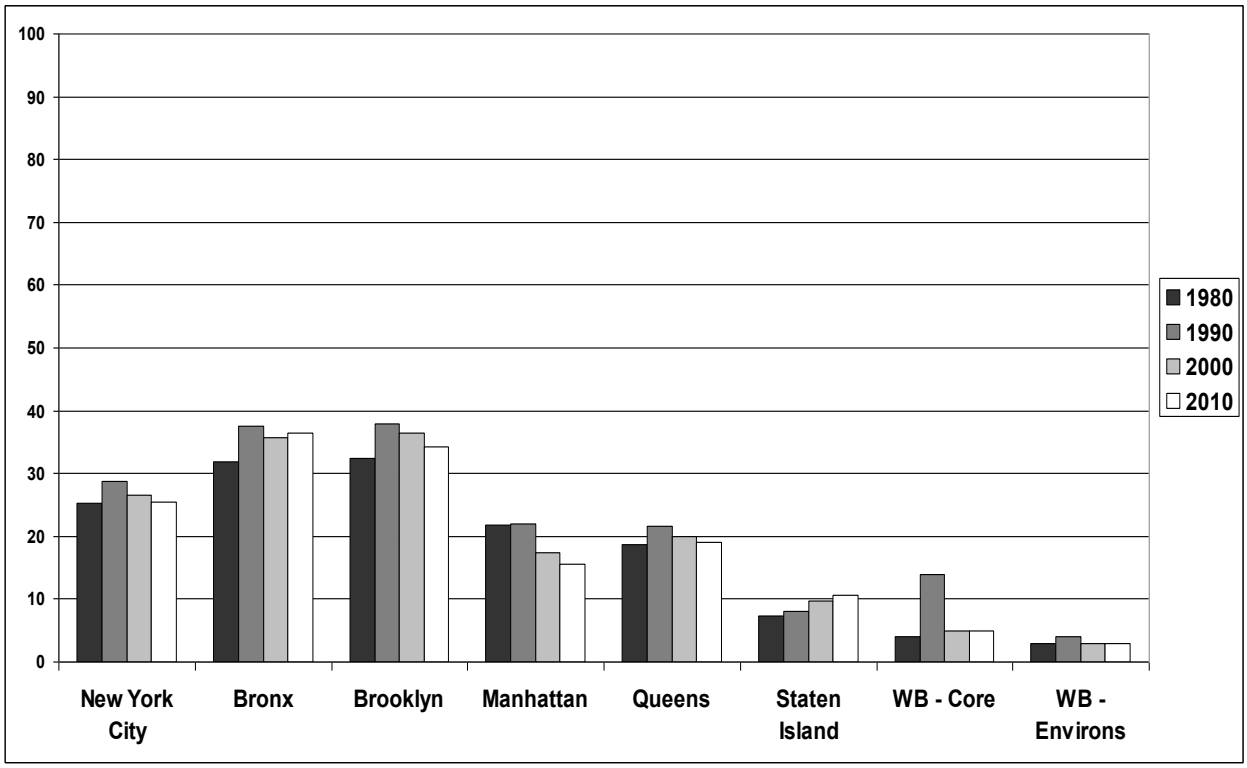
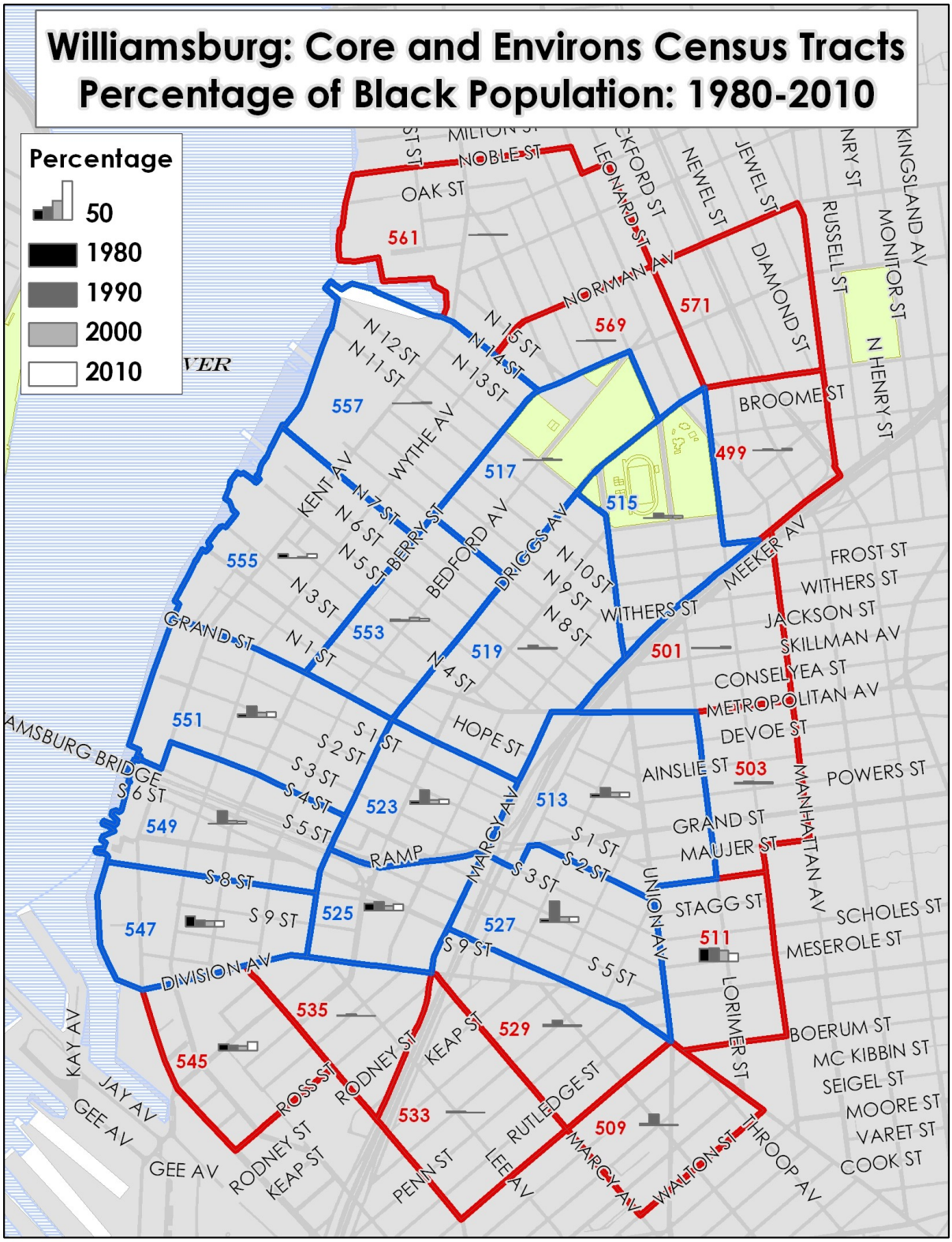


Figure 7-15. Percentage of the Black Population in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.



Map 7-34. Williamsburg, Percentage of Black Population by Census Tract, 1980-2010.

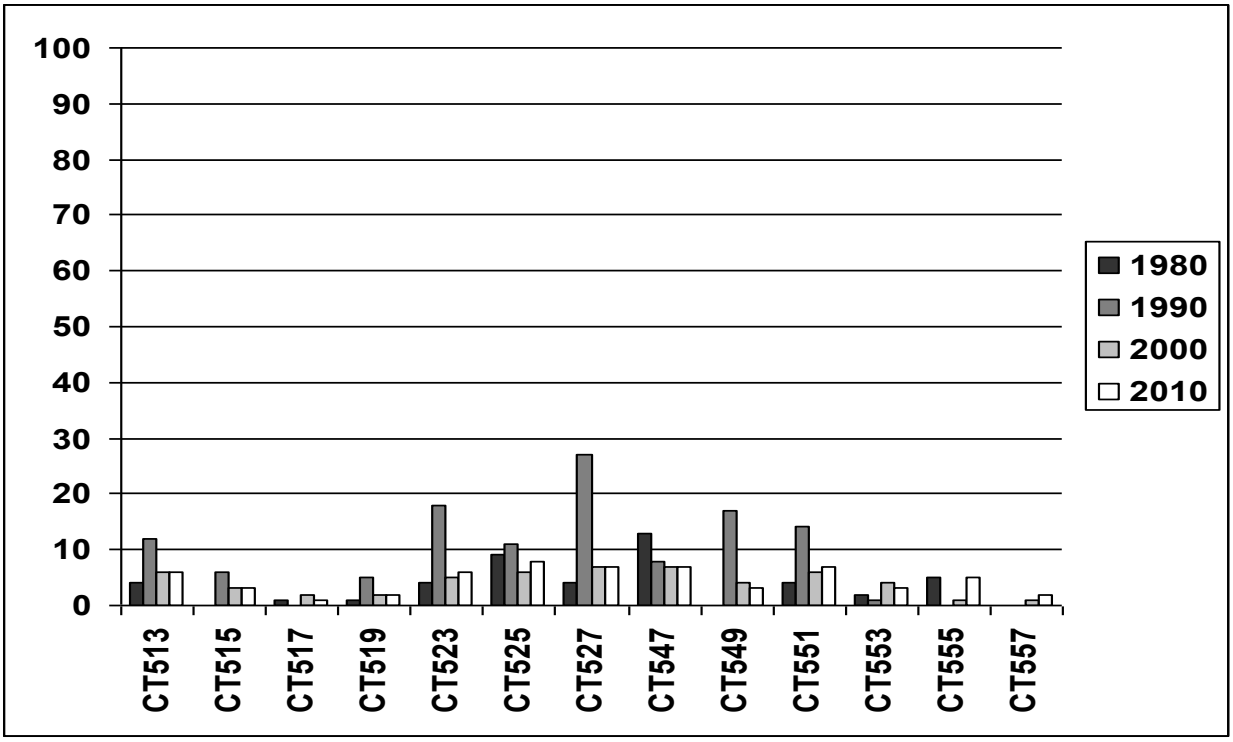


Figure 7-16. Percentage of the Black Population in Williamsburg - Core by Census Tract, 1980 - 2010.

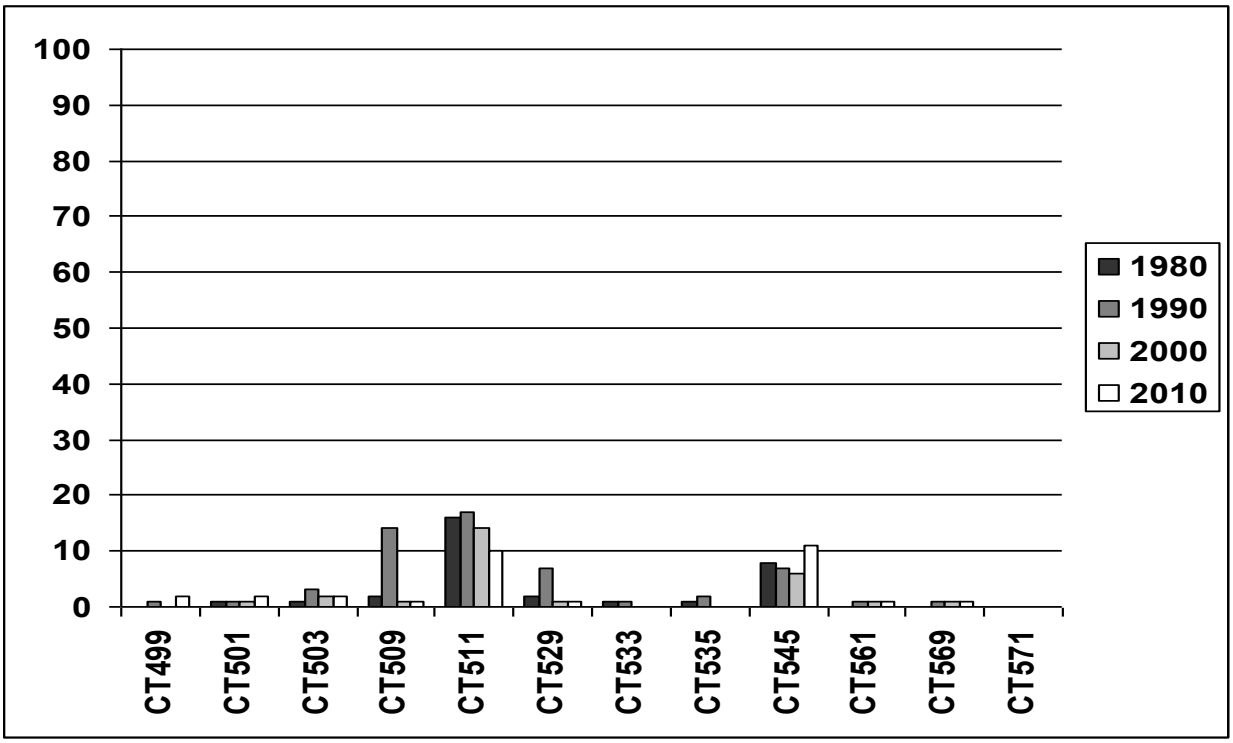


Figure 7-17. Percentage of the Black Population in Williamsburg - Environs by Census Tract, 1980 - 2010.

7-4.2c Percentage of the Chinese Population

Although there are some variations among the Census Tracts in Williamsburg Core and Environs, overall the percentages of the Chinese population is consistently low and generally less than 10%. Other than the nominal growth between 1980 and 1990 for the Core, the percentages remain at a constant 2%. This stagnant growth pattern is also found in the Bronx and Staten Island, while the Chinese population grows steadily in some of New York City's other Boroughs such as Brooklyn, Manhattan and Queens.

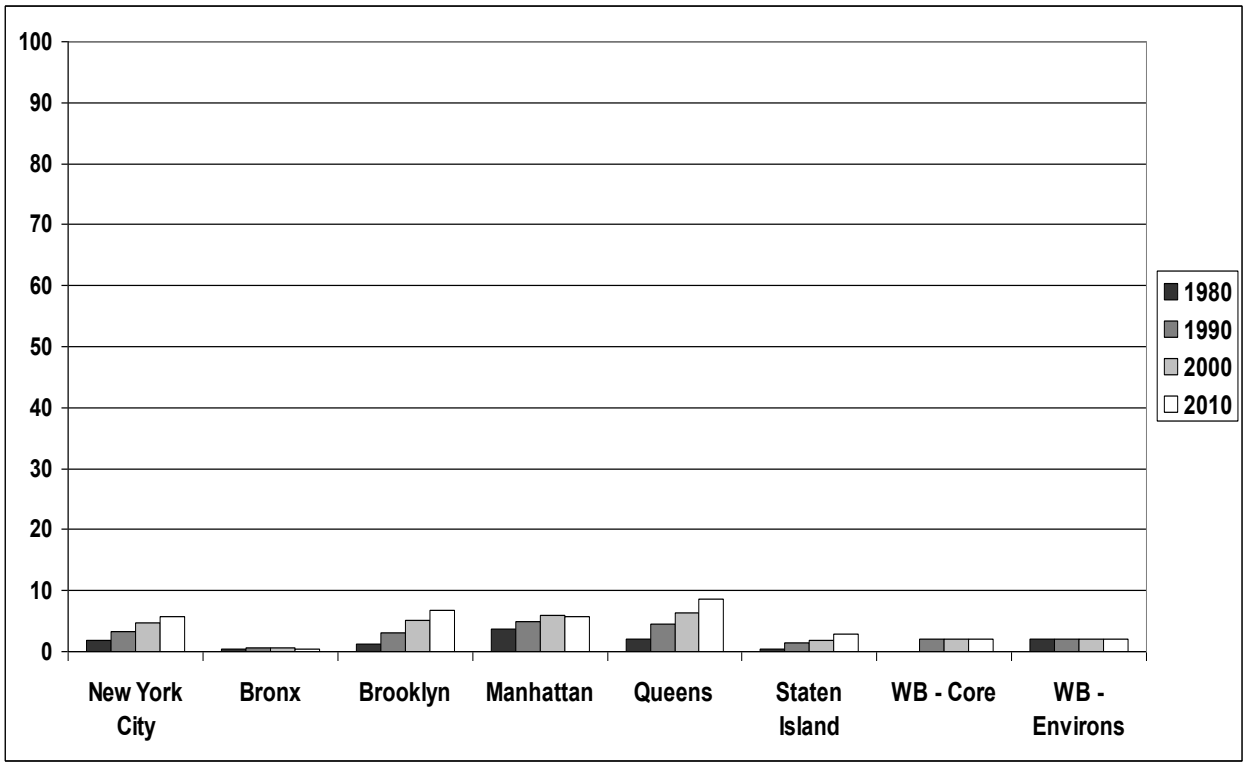
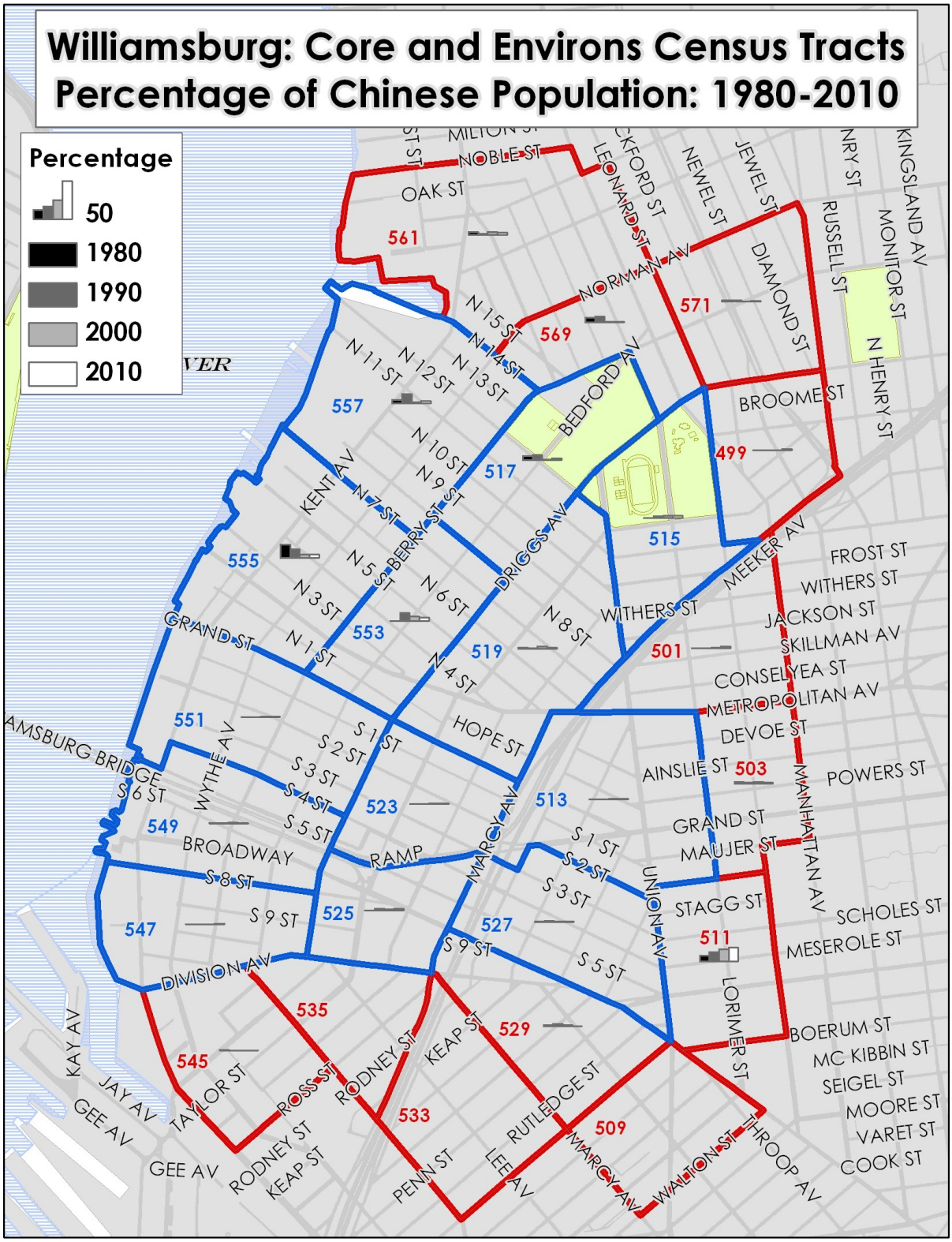


Figure 7-18. Percentage of the Chinese Population in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.

Map 7-35, Figure 7-19 and Figure 7-20 reveal some differences among the Census Tracts: within the Core, Census Tracts 553, 555 and 557 that are located in the Northern portion of

Williamsburg have comparatively higher percentages in the earlier years, while at the same time the remaining Census Tracts have consistently very low percentages. Within the Environs, Census Tract 511 reports an increasing trend throughout the study period and by 2010 almost reaches 20%. Although this percentage is still far below the highest percentages observed in lower Manhattan's Chinatown, it is especially unique given the fact that Map 7-35 shows the adjacent Census Tracts have practically no change at all for the Chinese population throughout the years.



Map 7-35. Williamsburg, Percentage of Chinese Population by Census Tract, 1980 - 2010.

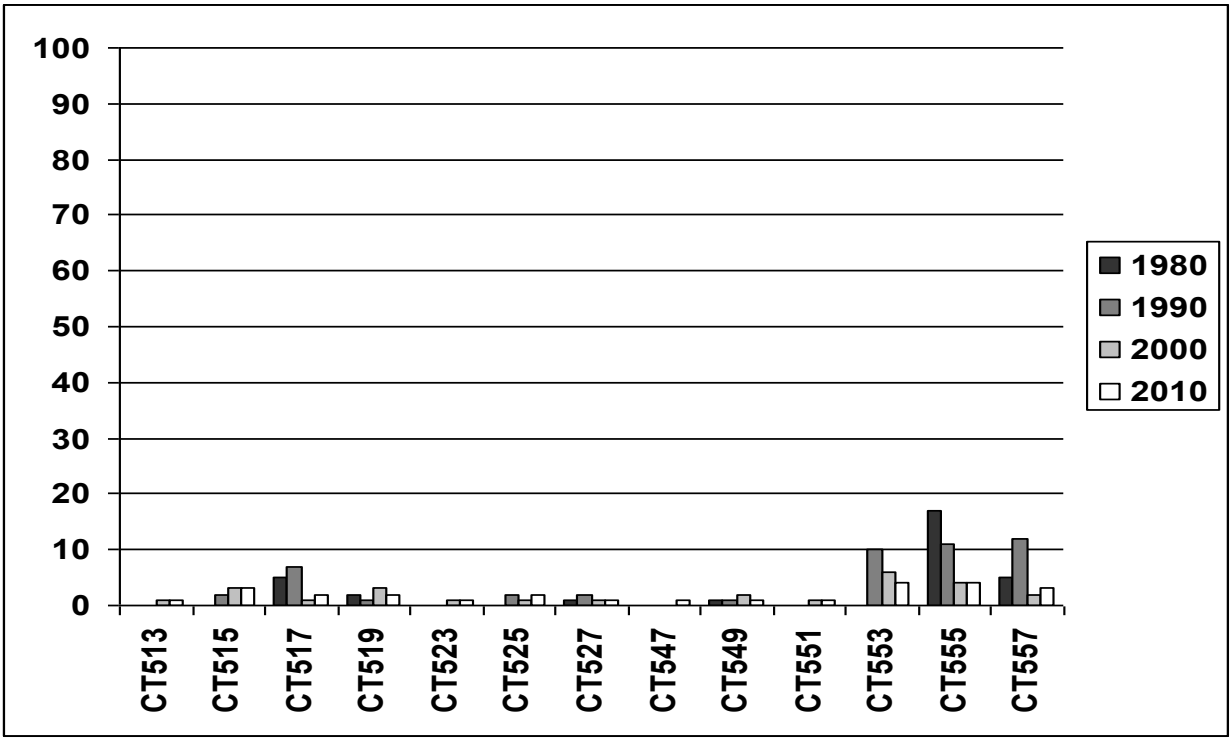


Figure 7-19. Percentage of the Chinese Population in Williamsburg - Core by Census Tract, 1980 - 2010.

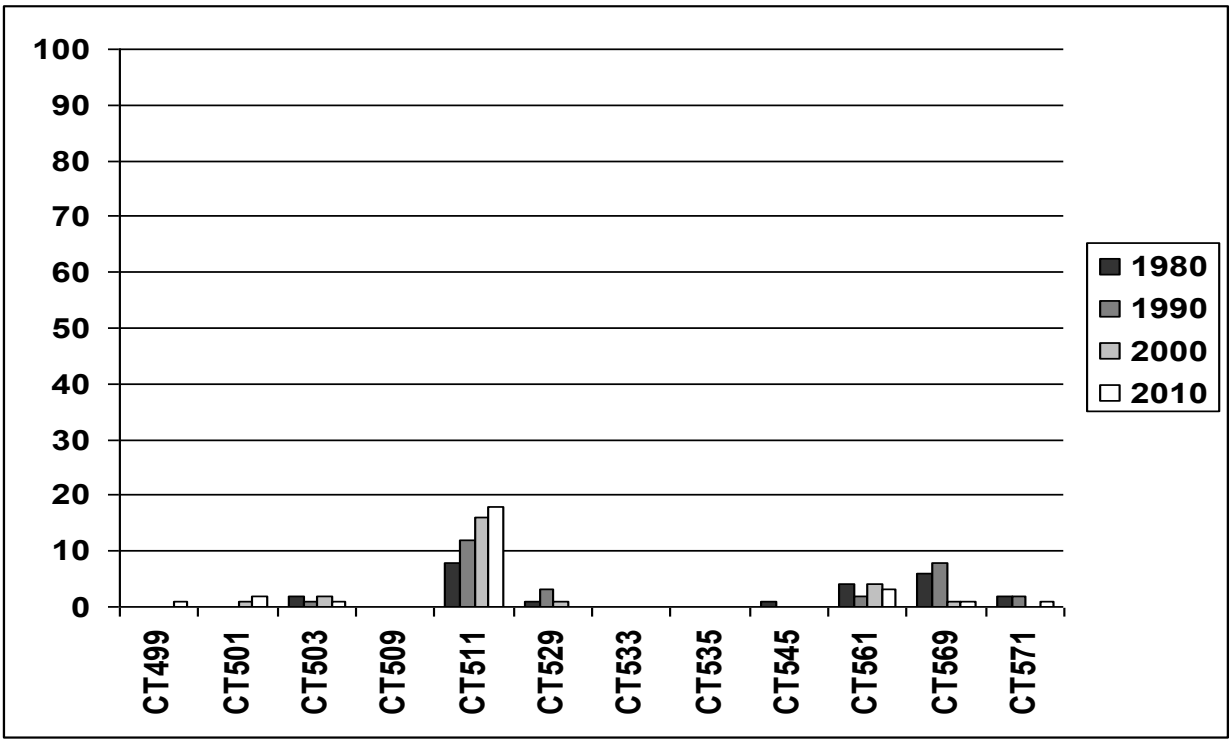


Figure 7-20. Percentage of the Chinese Population in Williamsburg - Core by Census Tract, 1980 - 2010.

7-4.2d Percentage of the Hispanic-origin Population

As a reminder, the Census Bureau's definition of "Hispanic" is binary. Survey respondents selected yes or no to identify as Hispanic, therefore this category is not exclusive of the previous ethnic groups. The Hispanic percentage of Williamsburg Core and Environs shares a decreasing trend that is contrary to New York City's trend for the Hispanic population (See Figure 7-21 below). In the Core, the percentages remain the same between 1980 and 1990 at 67%. After 2000 the percentage began to decrease and by 2010 only 35% of the population identified themselves as Hispanic.

The Environs have consistently lower percentages when compared to the Core. The Census Tracts show a general decreasing trend in recent decades, with the exception of a slightly higher value in 1990. It should be noted that despite the different trends between the Core and the Environs, between 1980 and 2010 the presence of the Hispanic population decreased by half: 67% to 35% for the Core; 22% to 11% for the Environs. This is a stark contrast to New York City itself which experiences an increasing trend, and contrasts with Brooklyn that levels-off and maintains a 20% Hispanic population since 1990.

Map 7-36, Figure 7-22 and Figure 7-23 provide more information about the decreasing trend of the Hispanic population in Williamsburg. With the Core, regardless of the initial percentages in 1980, all Census Tracts except one (i.e. Census Tract 513) show a decreasing trend for the Hispanic population. In other words, whether or not the Hispanic population had a strong representation in 1980, in the subsequent years all Census Tracts decrease.

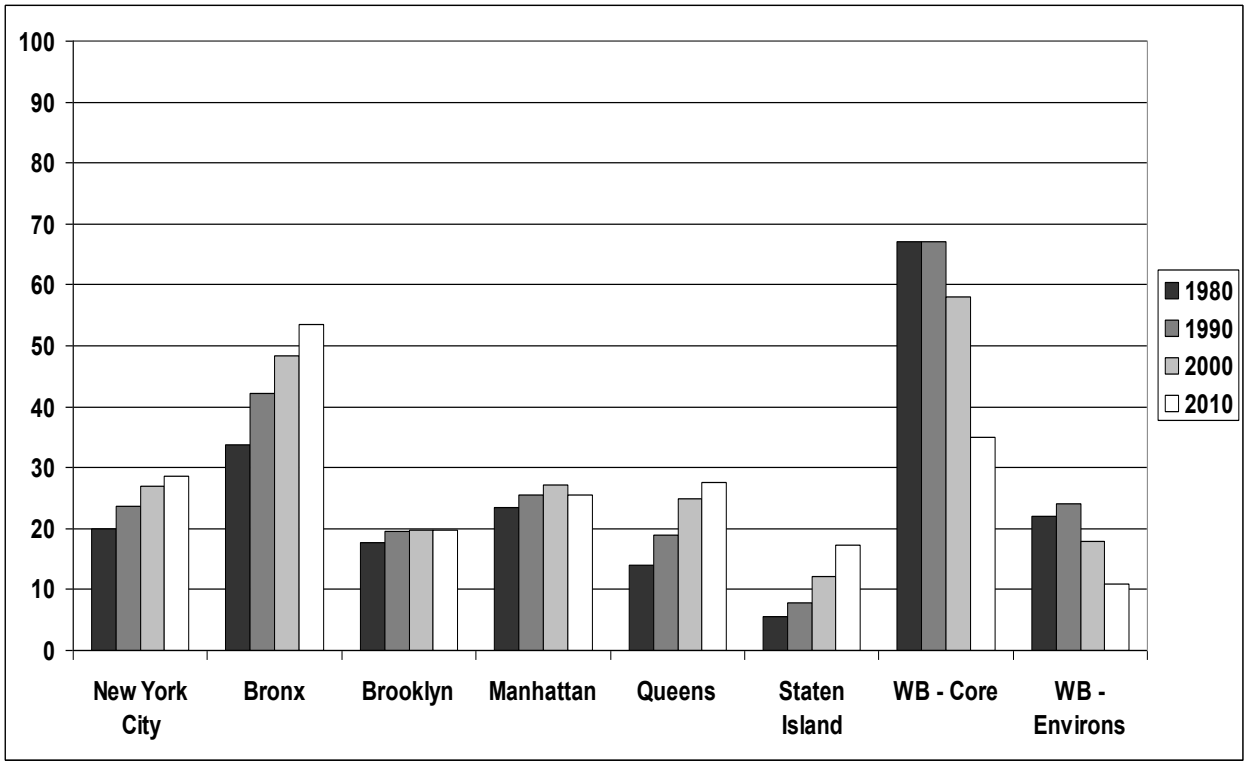
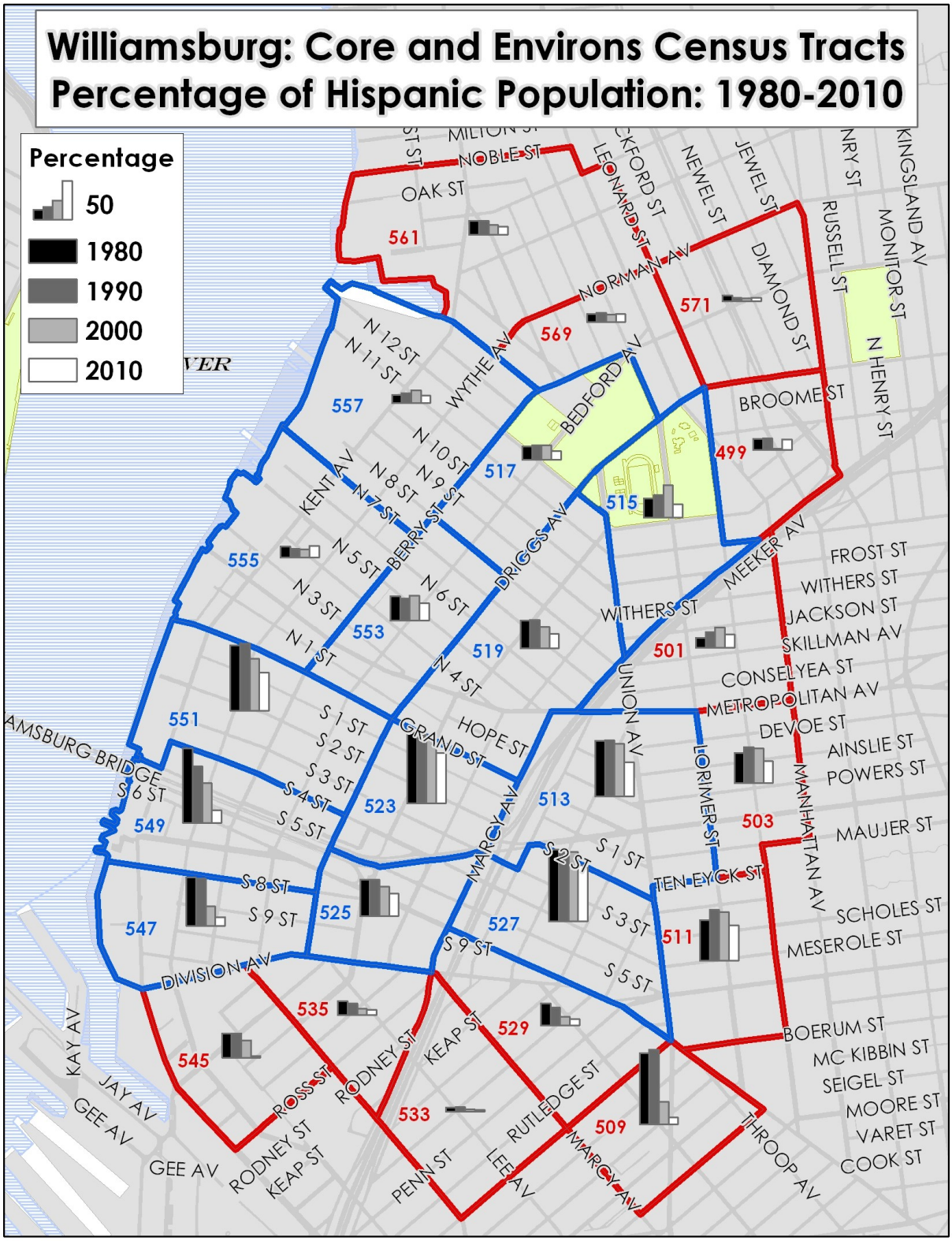


Figure 7-21. Percentage of the Hispanic Population in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.



Map 7-36. Williamsburg, Percentage of Hispanic Population by Census Tract, 1980 -2010.

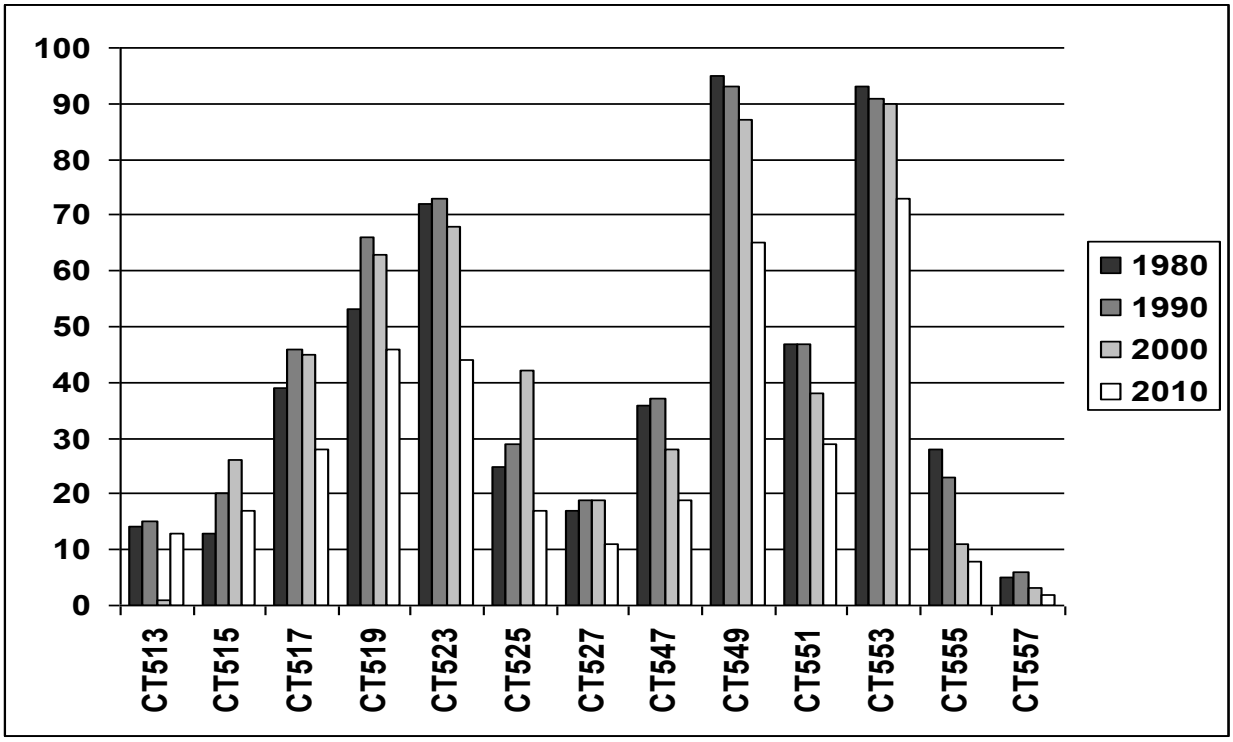


Figure 7-22. Percentage of the Hispanic Population in Williamsburg - Core by Census Tract, 1980 - 2010.

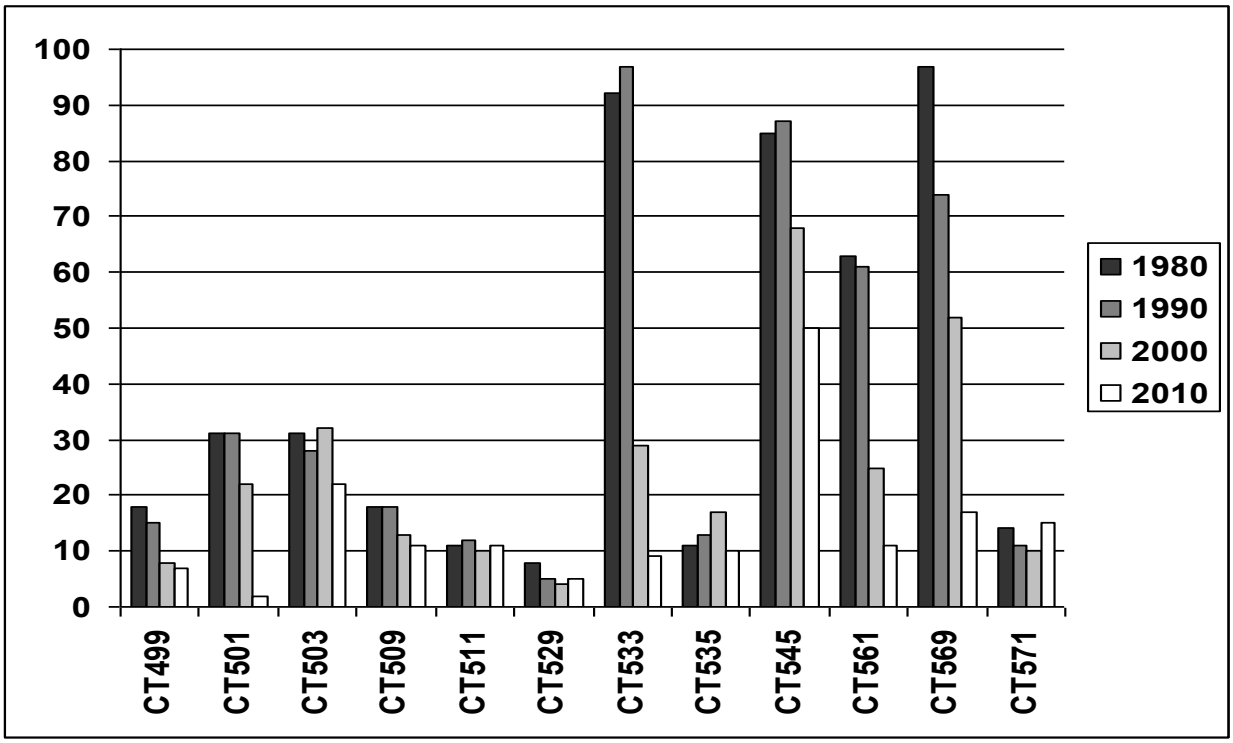


Figure 7-23. Percentage of the Hispanic Population in Williamsburg - Environs by Census Tract, 1980 - 2010.

7-4.3 Selected Age Groups Maps

In the following pages, the percentages of three age groups are mapped: under 5, 22-29 and over 65. The scale of the bar charts embedded in the maps is standardized so that the maps can be directly compared to each other. At times scales of the bar charts in the figures are enlarged, with the range from 1 to 10 instead of 1 to 100, to facilitate comparisons of the lower-values.

7-4.3a Age Under 5

Figure 7-24 below compares the percentage for this age group: compared to New York City and the Borough averages, both the Core and the Environs have slightly higher values. However, throughout the study years, the Core shows consistently decreasing percentages. In fact, when compared to Brooklyn which experiences a slow decrease, the decrease in the Core is steeper; between 1980 and 2010, the Core changed from higher than that of Brooklyn, to below it. On the other hand, the Environs have consistently higher percentages than does New York City and Brooklyn; although the percentages drop between 1980 and 1990, they have since maintained steady.

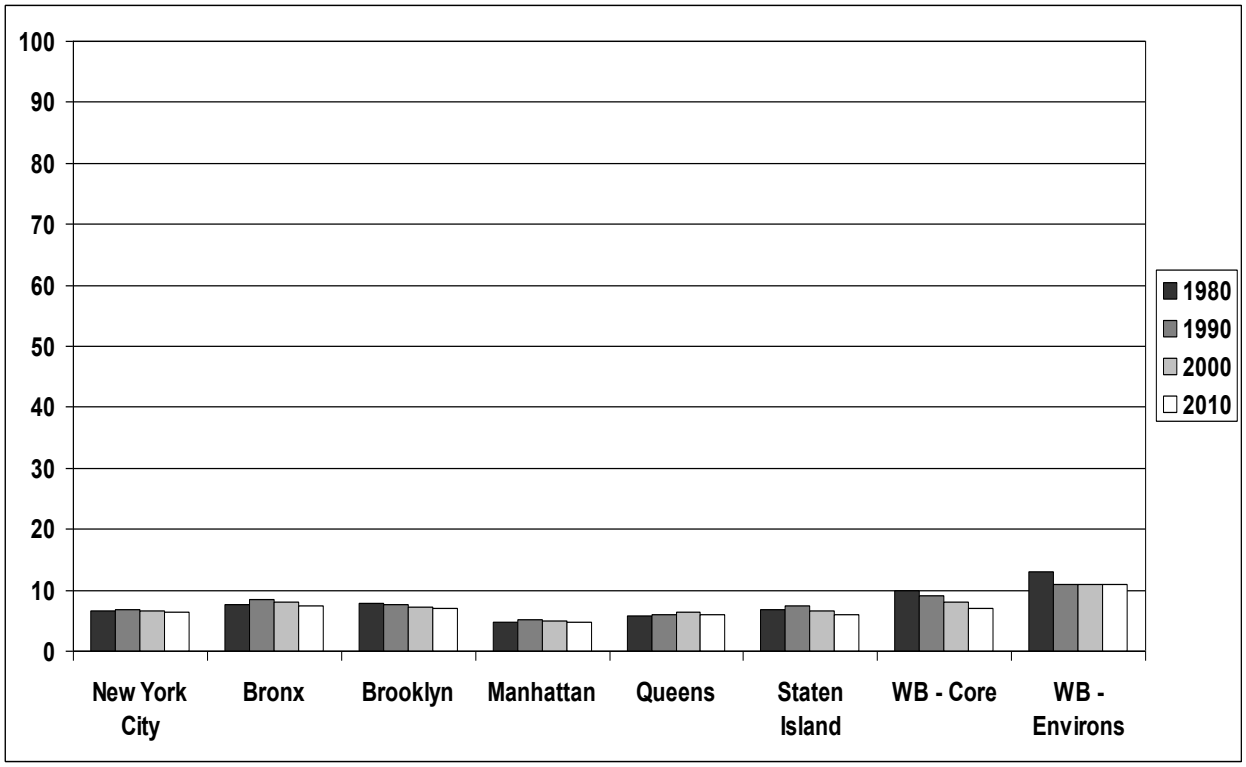
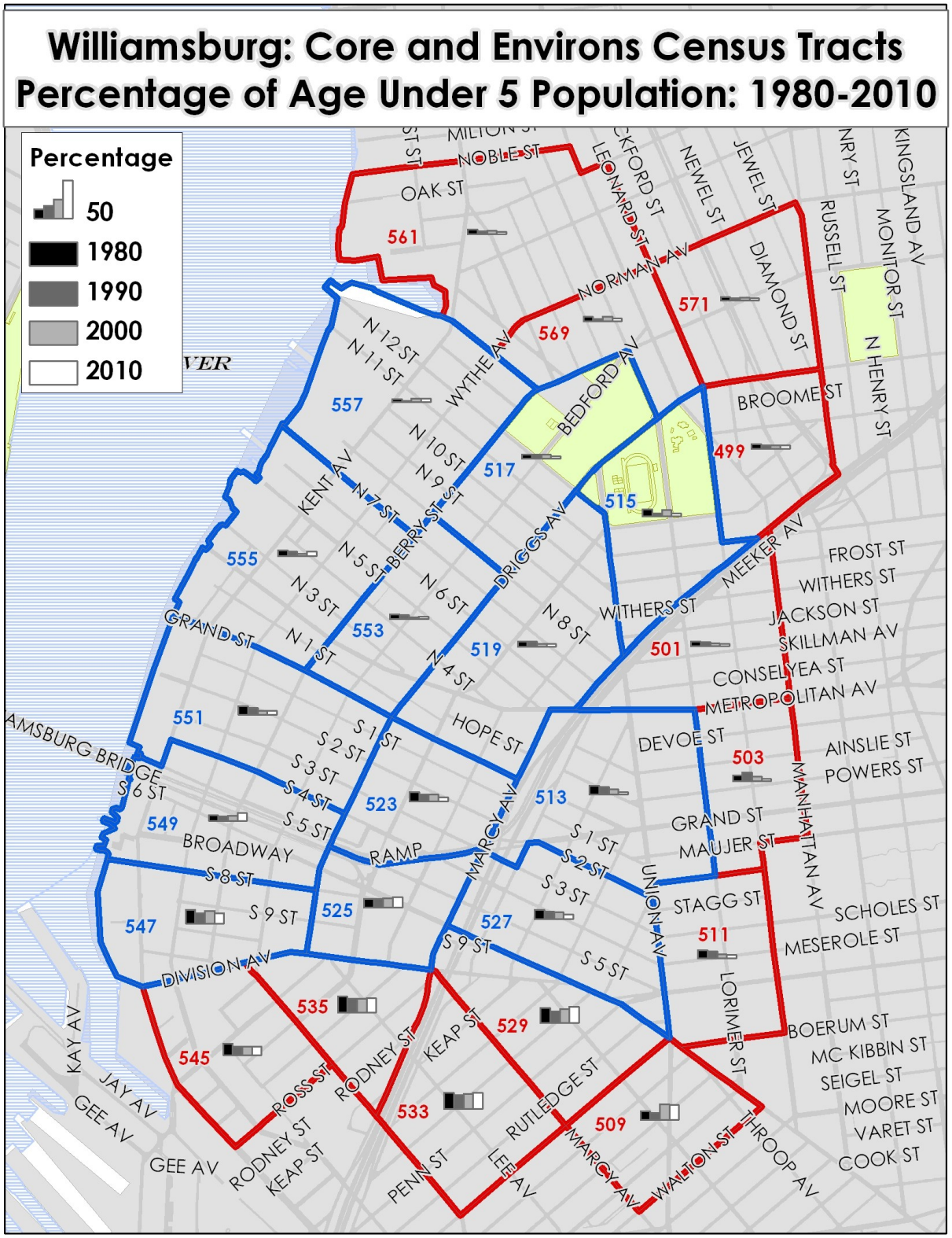


Figure 7-24. Percentage of the Age Under 5 Populations in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.

While Park Slope might have gathered media attention for its masses of baby strollers, it is the Southern part of Williamsburg, Core and Environs, that report high percentages of the Age Under 5 population. (See Map 7-37, Figure 7-25 and Figure 7-26 below). These percentages remain consistently higher than those percentages in the Middle and North sections of the Williamsburg neighborhood. This might be attributed to the Hasidic Jewish community residing in the area who tend to have larger than average households and calls for further investigation that is beyond the scope of this study.



Map 7-37. Williamsburg, Percentage of Age Under 5 Population by Census Tract, 1980 - 2010.

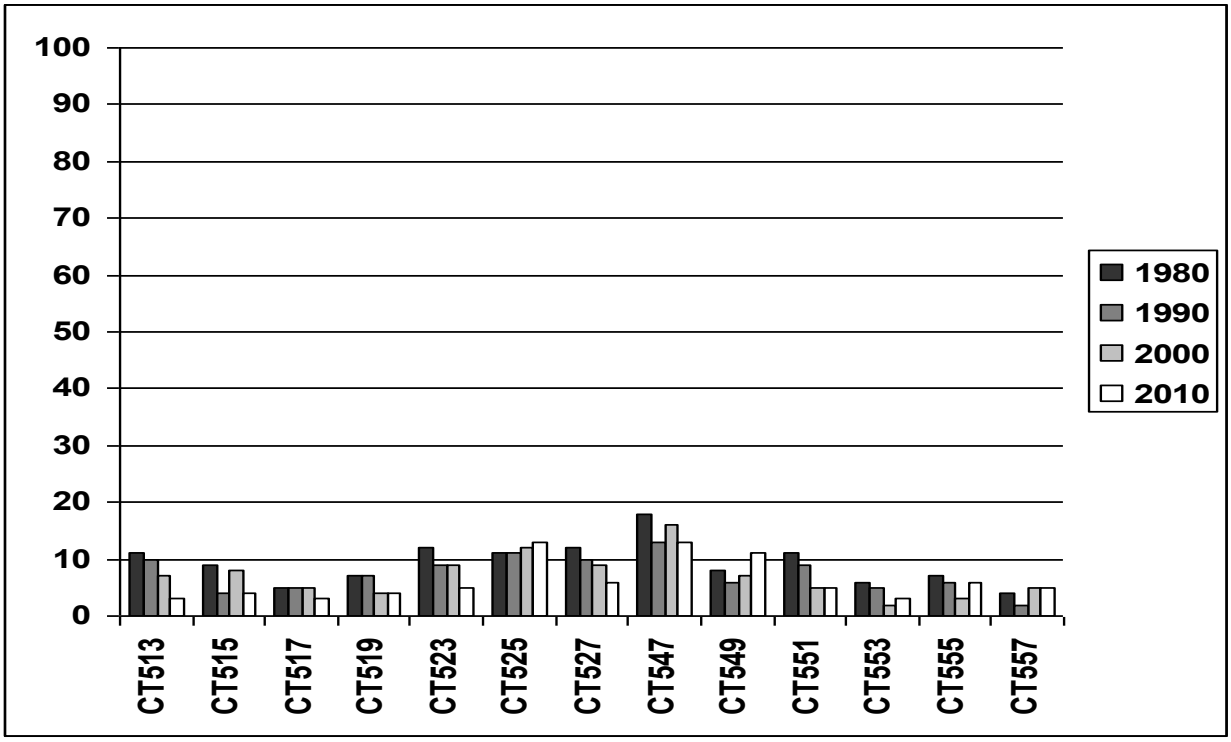


Figure 7-25. Percentage of Age Under 5 Population in Williamsburg - Core by Census Tract, 1980 - 2010.

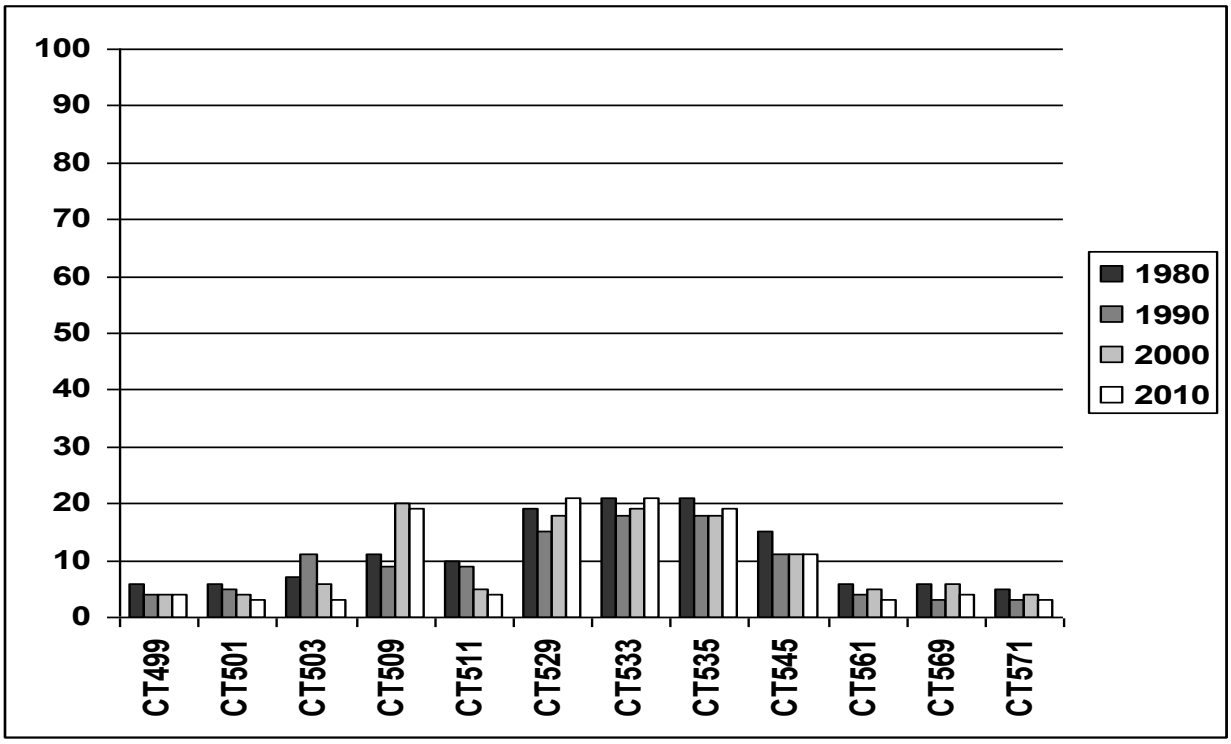


Figure 7-26. Percentage of Age Under 5 Population in Williamsburg - Environs by Census Tract, 1980 - 2010.

Figure 7-26. Percentage of Age Under 5 Population in Williamsburg - Environs by Census Tract, 1980 – 2010

7-4.3b Age 22-29

Compared to the citywide percentages, the changes in both the Williamsburg Core and Environs are especially remarkable (See Figure 7-27 below). Between 1980 and 2010 in New York City, this particular age group has a steady proportion to the total population, at either 13% or 14%. In the Williamsburg Core, initially it is 14% for both the 1980 and 1990 Census Surveys, which is the same percent as New York City itself; this age group increases to 18% in 2000 and to 23% in 2010. In the Environs the increases are slower but still noticeable: initially at the same level at 14% in 1980, dipped to 12% in 1990, and rose to 14% in 2000 and 18% in 2010. While the measurements of this age group do not equate to the so-called “hipsters” in mass media, the increasing presence of the Age 22-29 year olds signifies a considerable demographic change in Williamsburg.

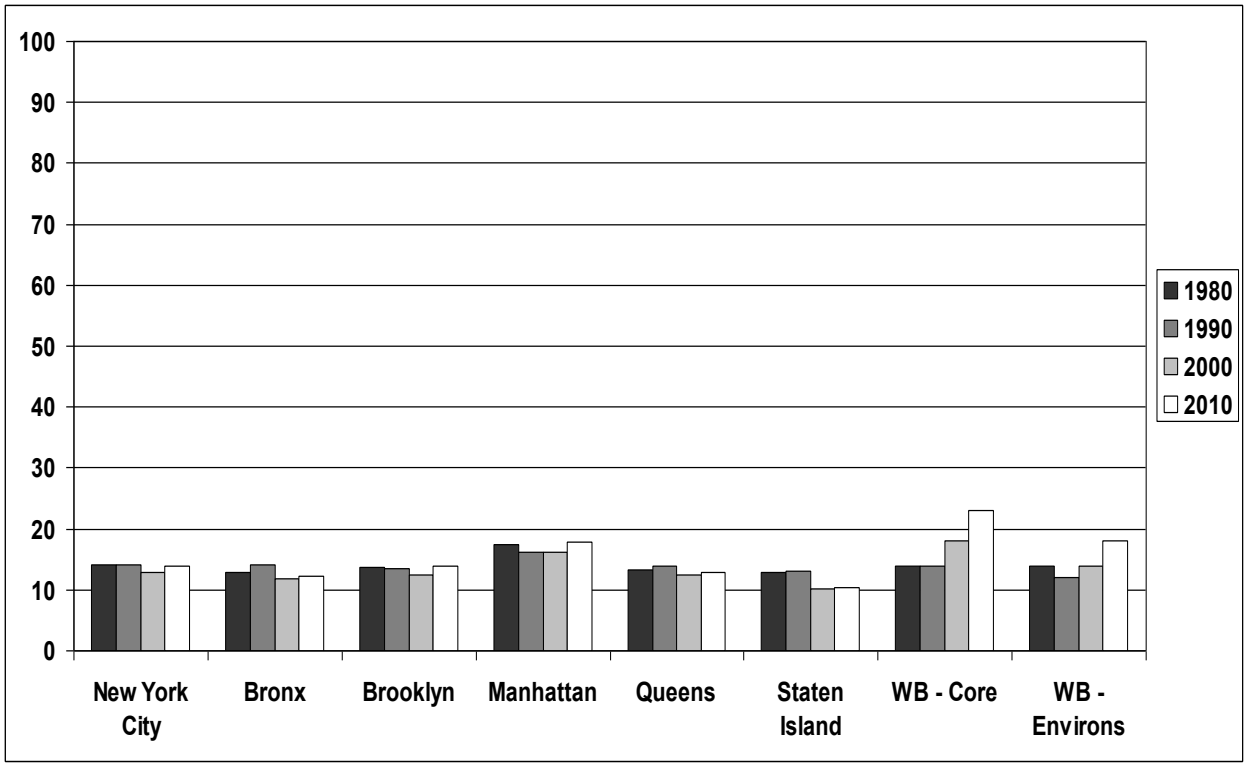
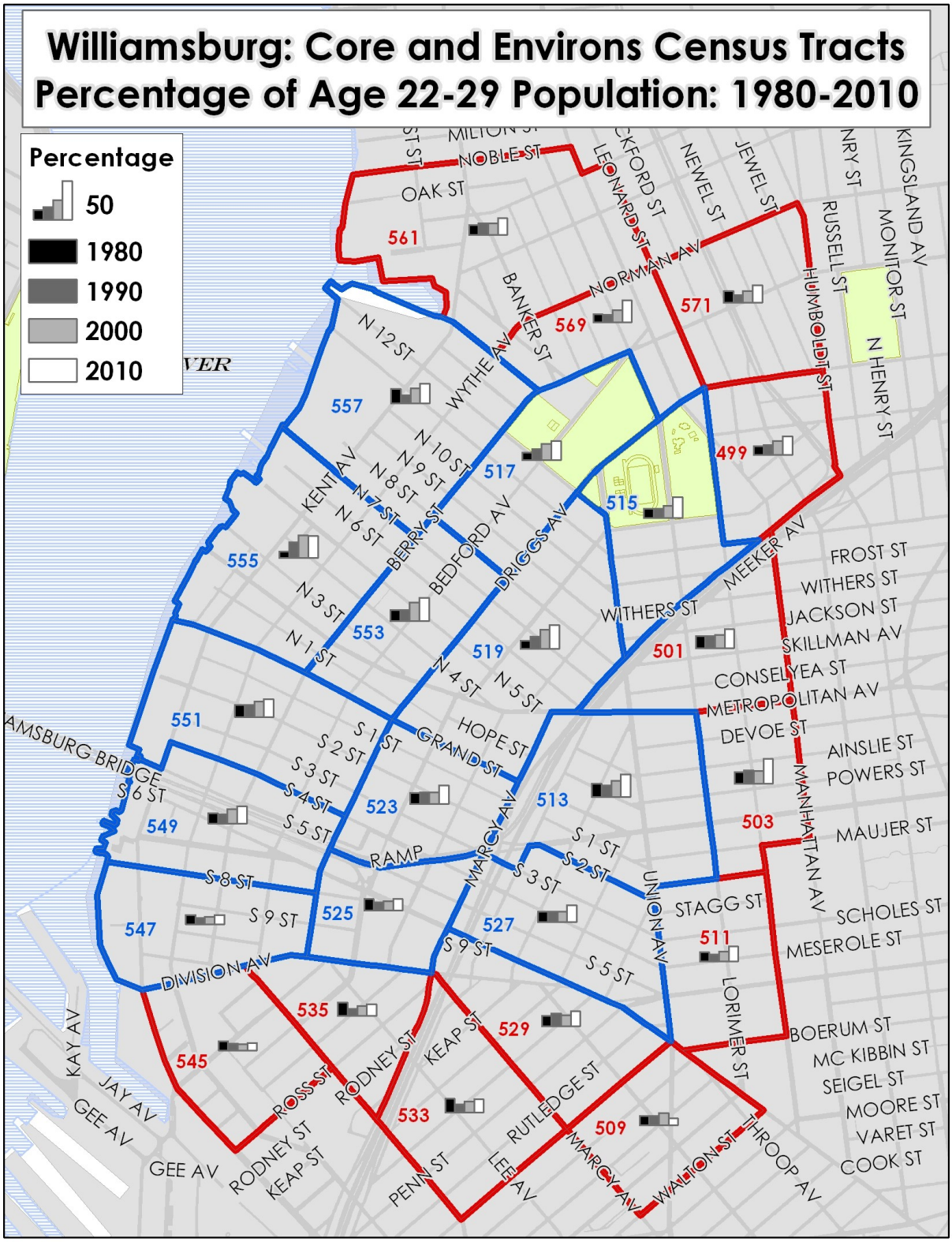


Figure 7-27. Percentage of the Age 22-29 Population in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.



Map 7-38. Williamsburg, Percentage of Age 22 - 29 Population by Census Tract, 1980 - 2010.

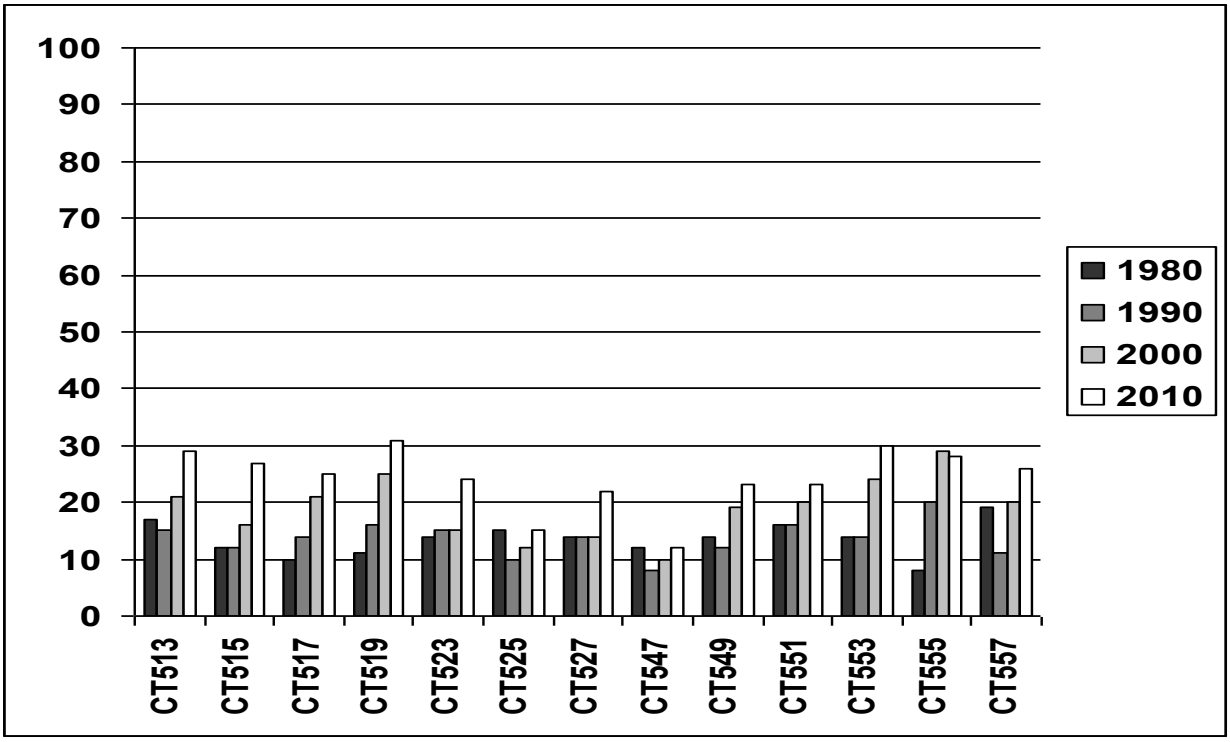


Figure 7-28. Percentage of Age 22-29 Population in Williamsburg - Core by Census Tract, 1980 - 2010.

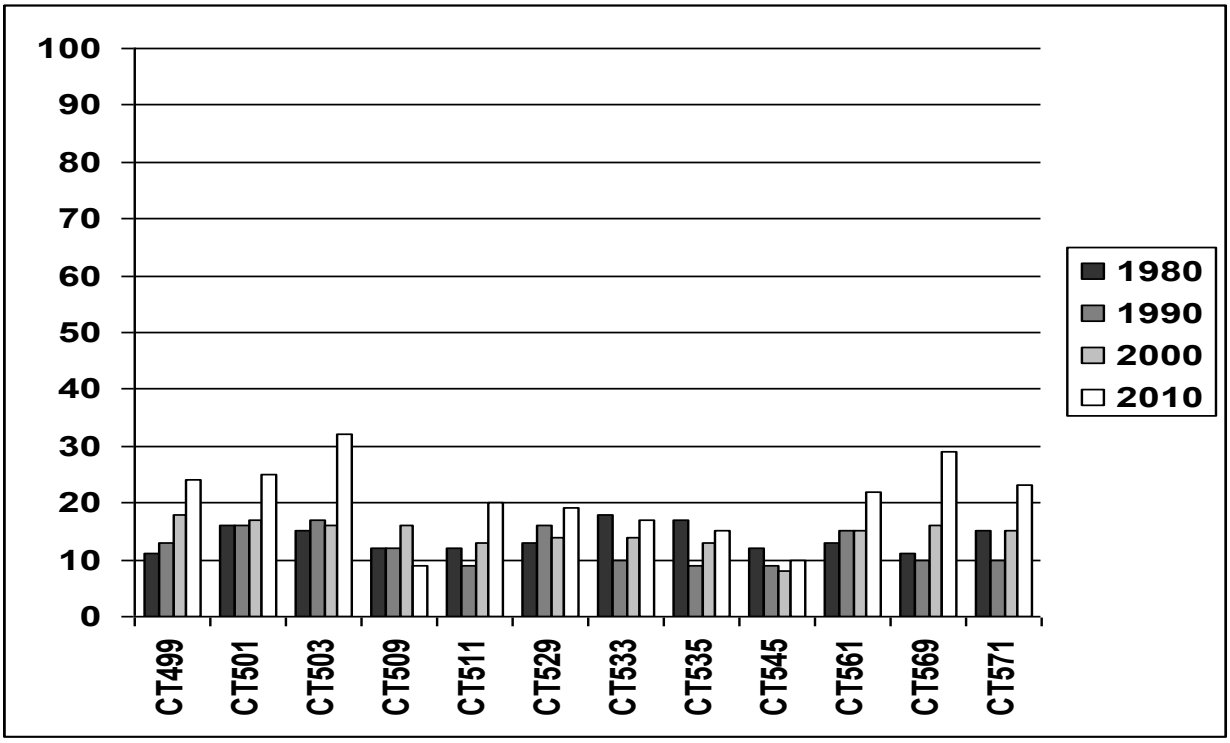


Figure 7-29. Percentage of Age 22-29 Population in Williamsburg - Environs by Census Tract, 1980 - 2010.

Map 7-38 illustrates the percentages of the Age 22-29 group compared to the total population by Census Tract. Figure 7-28 and Figure 7-29 represent this age group with bar charts. From these two figures one can easily observe the larger increase in the Core. Among the 13 Census Tracts in the Core (See Figure 7-28), 11 show increasing percentages with the exception of Census Tracts 525 and 547 that are located next to each other and at the Southern area of the Core.

Among the 12 Census Tracts in the Environs, four of them show either steady or decreasing percentages: (See Census Tracts 509, 535, 533 and 545). These four Census Tracts line-up with the Southern Environs with Census Tracts 545 and 535 adjacent to Census Tracts 525 and 547 (from the Southern Core) mentioned above. An examination of these steady or decreasing Census Tracts together, one can observe that the Age 22-29 group increases are clustered in the Middle and North sections of Williamsburg.

7-4.3c Age 65 and Over

The age group of the Over 65 population has a steady presence in New York City throughout the study years, representing either a 12% or 13% of the total population (See Figure 7-30 below). The Core shares the same steady percentage for this age group although the values are consistently lower at either 8% or 7%. The Environs has a more dynamic range at 12% and 13% in 1980 and 1990 respectively and then in 2000 the percentage drops to 10% and to 9% in 2010.

However, Map 7-39 and accompanying Figure 7-30 and Figure 7-31 below illustrate how uneven the Age 65 and Over group is distributed. In the Core area, the steadiness of the overall percentages throughout the years is not applicable to most of the Census Tracts. Instead one can

observe that the four Census Tracts at the Northern part report noticeable decreases (See Census Tracts 555, 557, 517 and 515); meanwhile, three Census Tracts at the Middle section (See Census Tracts 551, 523, and 527) report an increasing trend.

In the Environs, two Census Tracts at the North (See Census Tracts 561 and 569) show a more noticeable decrease. An examination of all of these intra-neighborhood differences at the Census Tract level, the overall picture is that the presence of this particular age group (65 and Over) becomes weaker in the North, stronger in the Middle, and remains approximately the same for the remaining of the Williamsburg neighborhood.

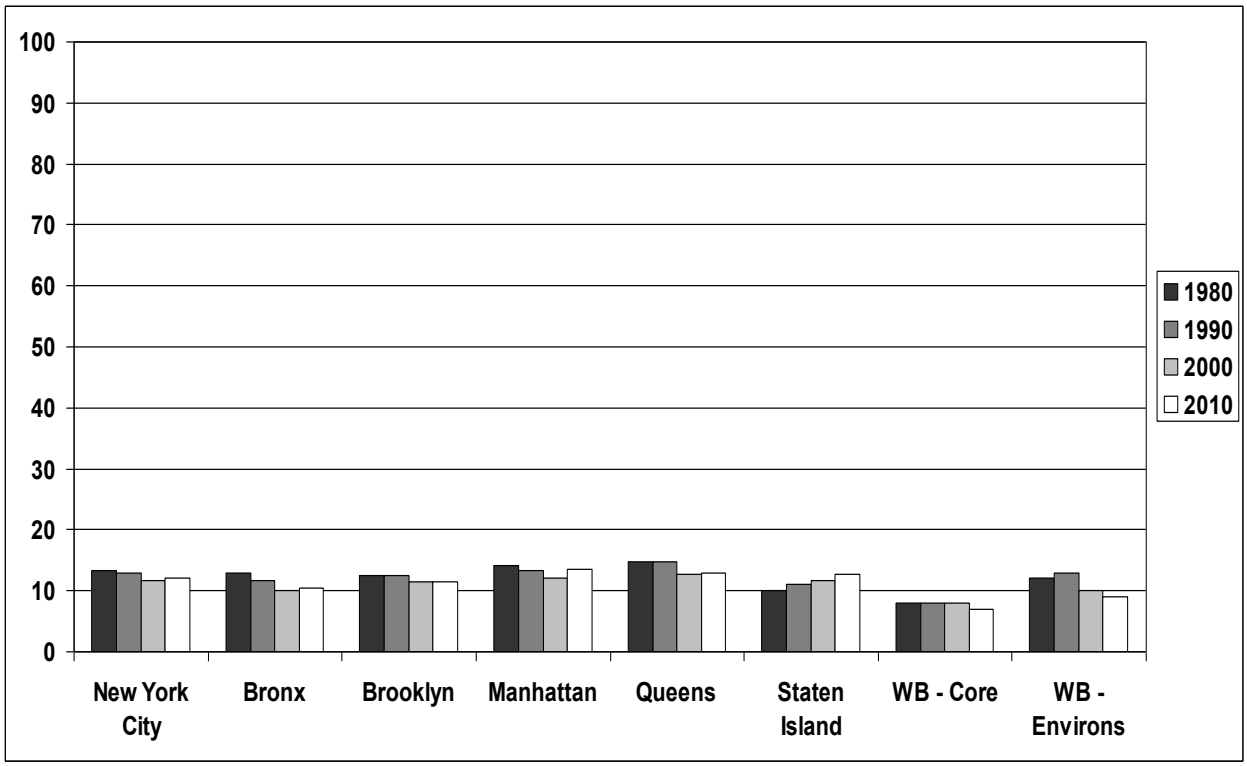
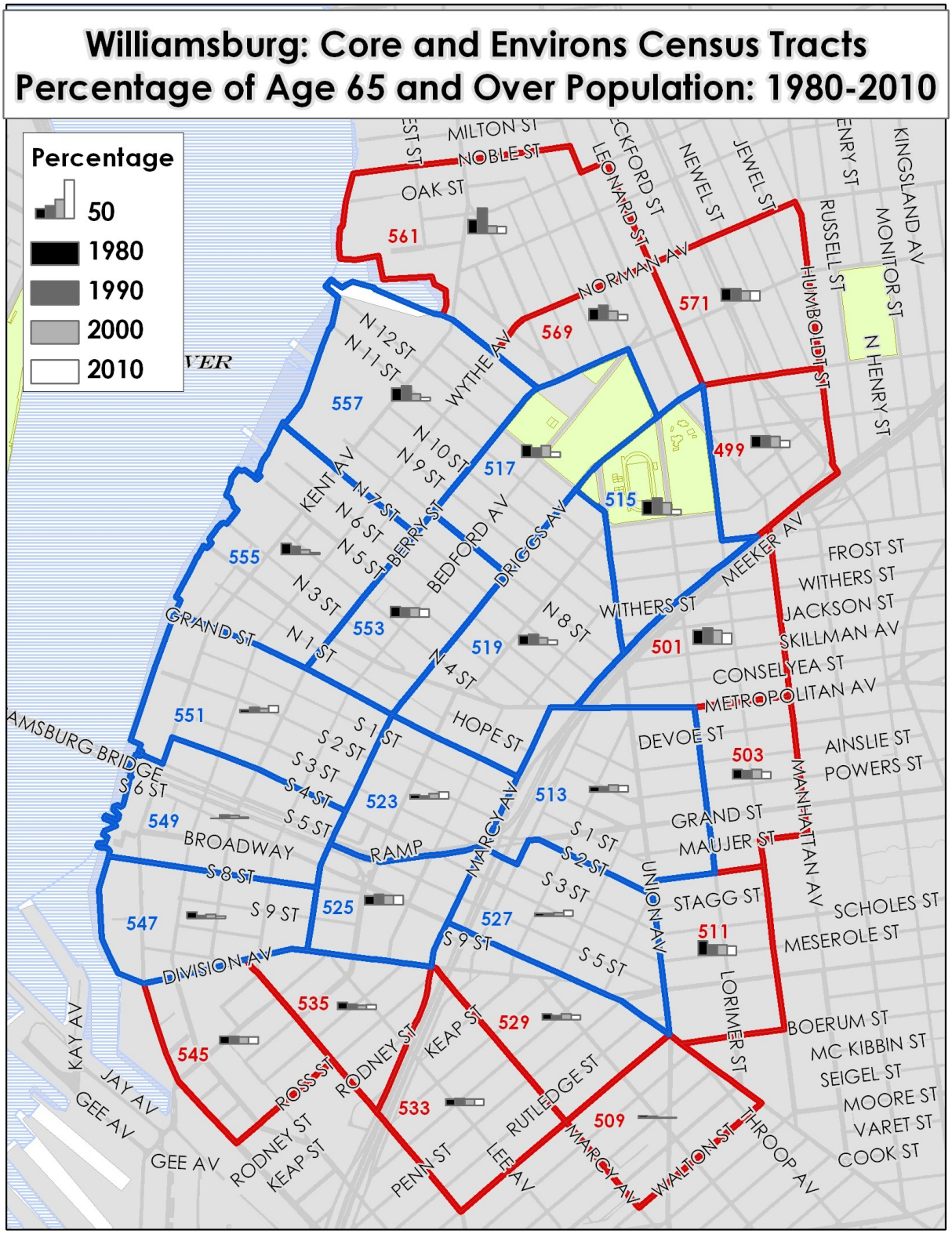


Figure 7-30. Percentage of the Age 65 and Over Population in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.



Map 7-39. Williamsburg, Percentage of Age 65 and Over Population by Census Tract, 1980 - 2010.

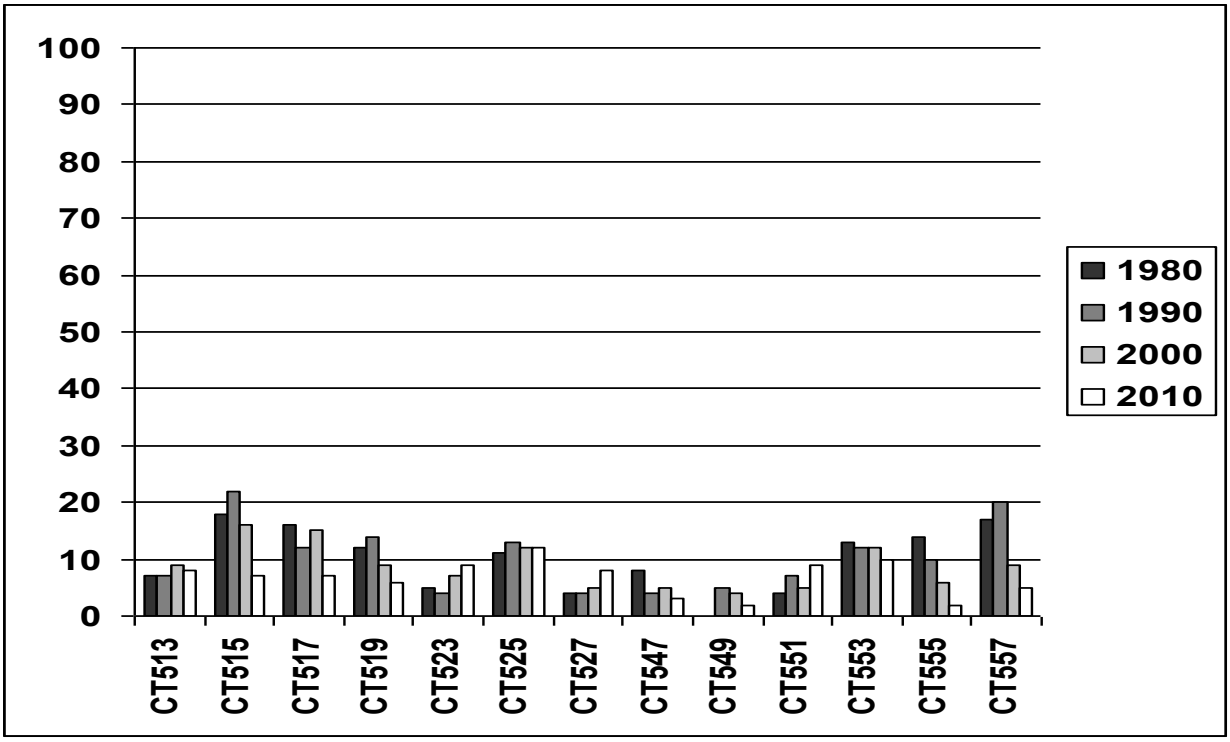


Figure 7-31. Percentage of the Age 65 and Over Population in Williamsburg - Core by Census Tract, 1980 - 2010.

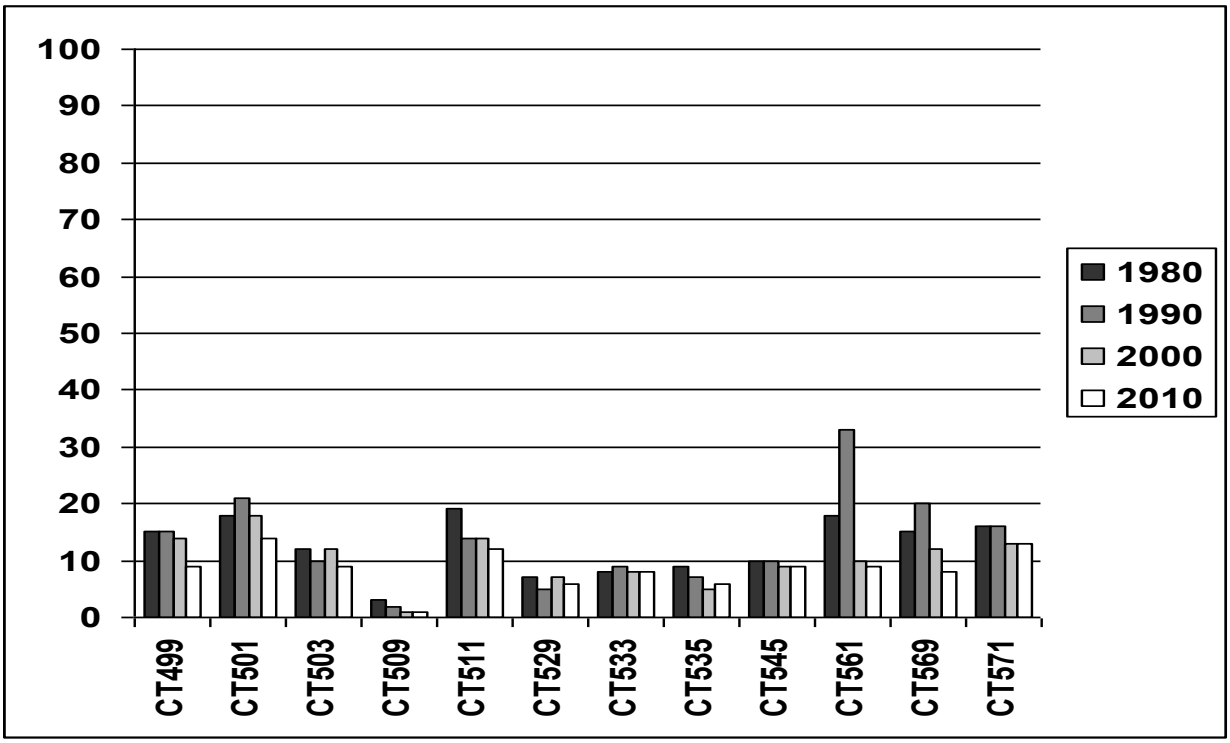


Figure 7-32. Percentage of the Age 65 and Over Population in Williamsburg - Environs by Census Tract, 1980 - 2010.

7-4.4 Housing Conditions

7-4.4a Total housing units

The overall housing units for New York City and the Five Boroughs increase between 1980 and 2010 (See Figure 7-33 below). This trend is shared by Williamsburg with the exception that between 1980 and 1990 the Core actually temporarily lost housing units (See Figure 7-34 below), and the number rebounded in 2000. What is most unusual is the differences between 2000 and 2010. In the Core there is a considerable increase in the number of housing units. Although this growth is revealed previously in Map 7-20 which illustrates post-2010 construction, now one additionally can observe the distinctive numbers in 2000 and 2010. The increase between the last two Census Surveys represents approximately half of the existing housing stock. In other words, for every two existing housing units in the Core, in 2000, there is a new one built during the next ten years; there are also new housing units added in the Environs but the increase is not as dramatic. This rapid increase also results in the Core containing more housing units than the Environs, which is the reverse during the previous three Census Surveys.

Although the other two study neighborhoods also show growth in total housing units (See Figure 5-34 for Park Slope and Figure 6-34 for the Lower East Side), they do not experience this large scale of new construction. The traditional definition of gentrification is geared toward refurbishing existing and older structures, but the more recent and expanded definition that includes the addition of new construction must also be considered when analyzing a neighborhood such as Williamsburg.

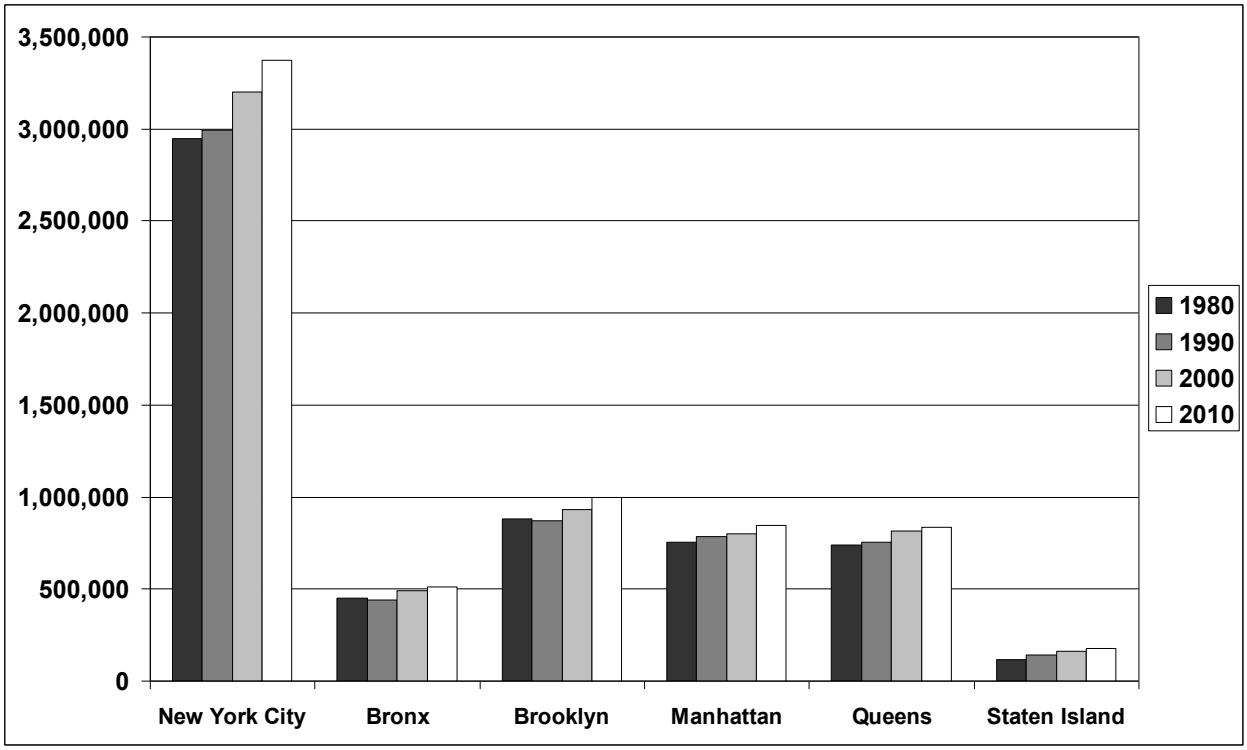


Figure 7-33. Number of Total Housing Units in New York City and the Five Boroughs, 1980 - 2010.

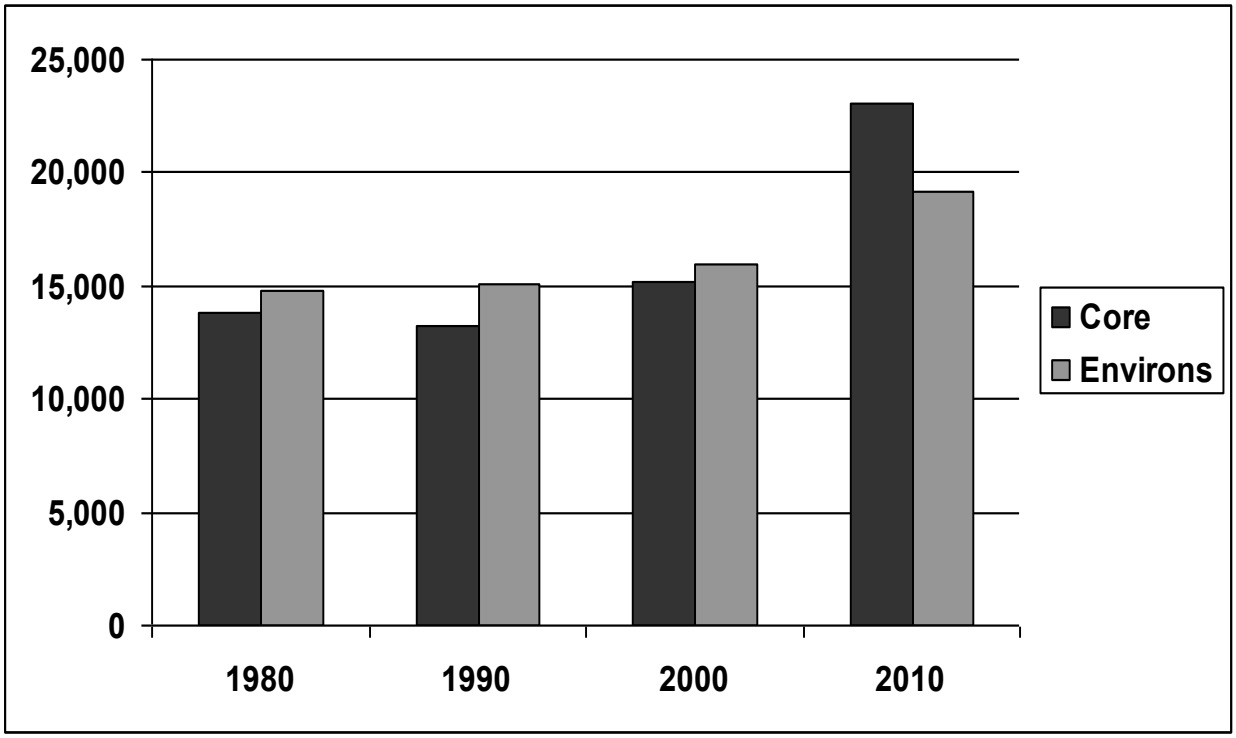
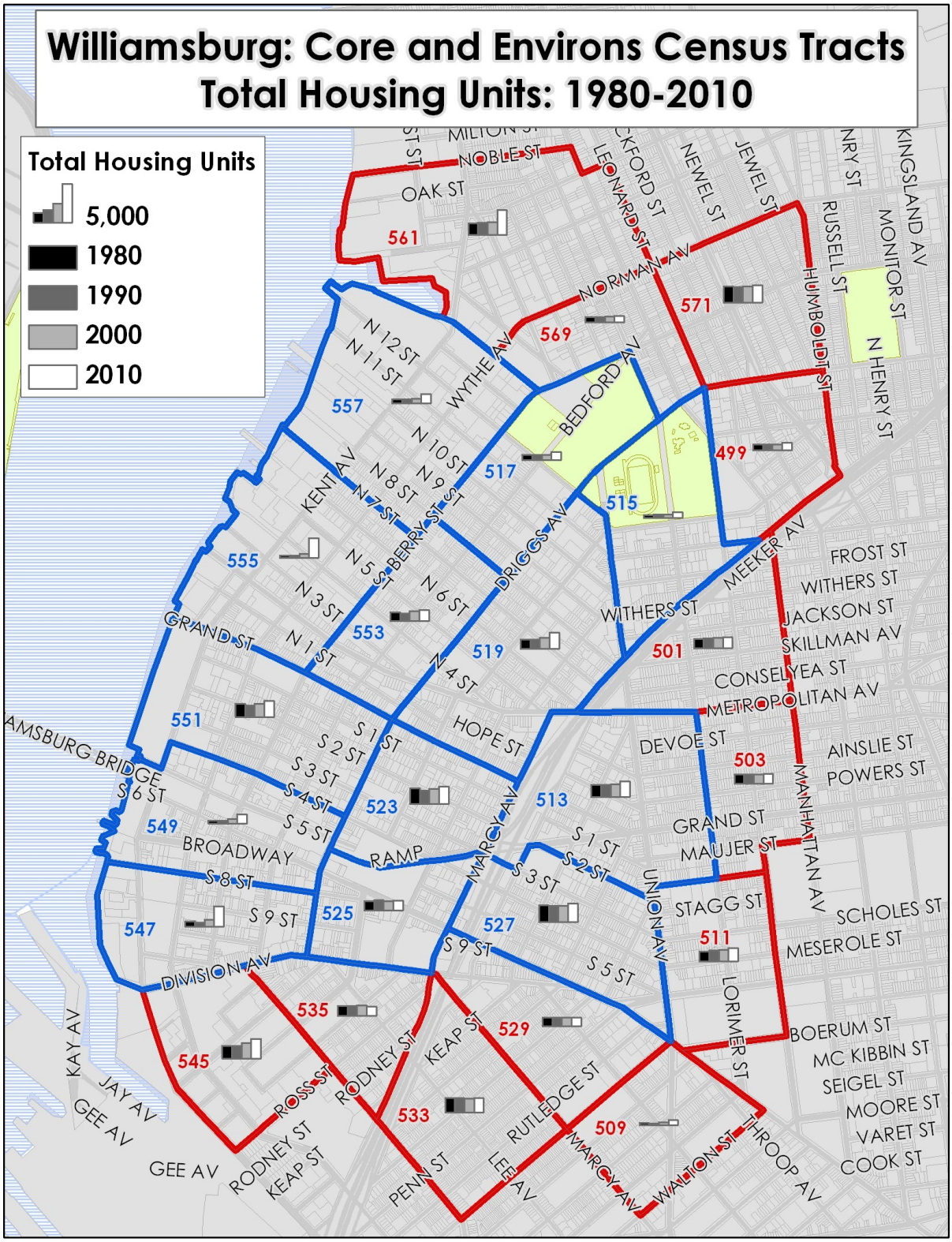


Figure 7-34. Number of Total Housing Units in Williamsburg - Core vs. Environs, 1980 - 2010.



Map 7-40. Total Housing Units in Williamsburg by Census Tract, 1980 - 2010.

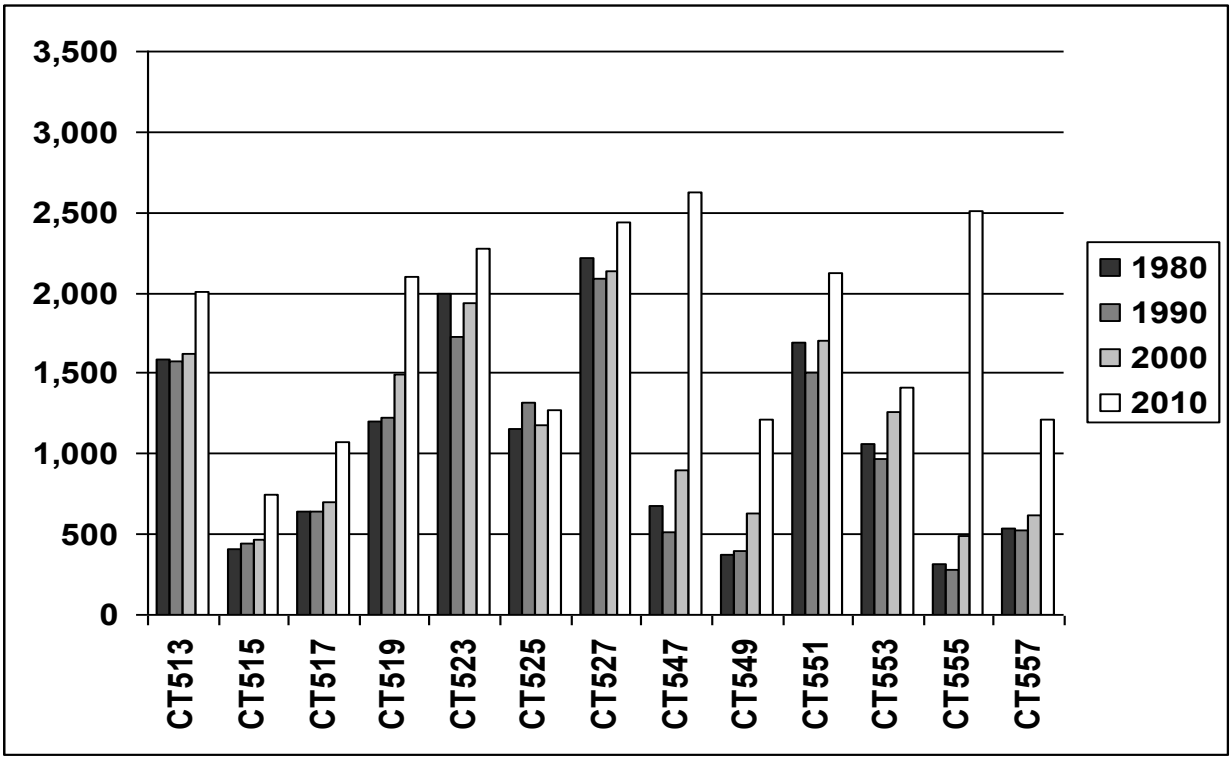


Figure 7-35. Total Housing Units in Williamsburg - Core by Census Tract, 1980 - 2010.

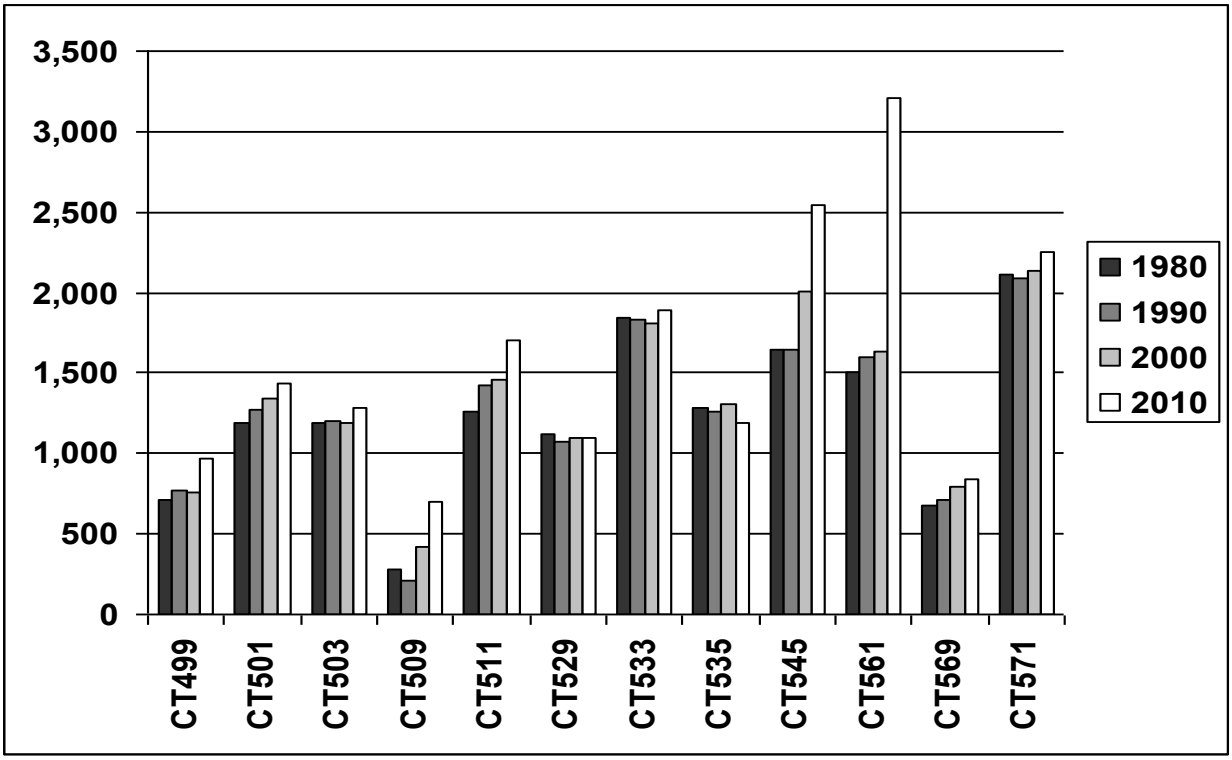


Figure 7-36. Total Housing Units in Williamsburg - Environs by Census Tract, 1980 - 2010.

Map 7-40, Figure 7-35 and Figure 7-36 above show total housing units recorded between 1980 through 2010 at the Census Tract level. In the earlier years, the housing units are distributed toward the Middle and inland areas of the Williamsburg neighborhood. With the exception of Census Tract 551 (in the Core) and Census Tract 545 (in the Environs) which have historically high numbers, the rapid growth in total housing units between the 2000 and 2010 Census Surveys are located in the remaining of the East River riverfront Census Tracts.

7-4.4b Percentage of Vacant Housing Units

Figure 7-37 below compares the percentage of the vacant housing units in Williamsburg Core and Environs to New York City itself and the Five Boroughs. The Core has a rather unique pattern not found elsewhere: the Core has a rather high vacancy rate of 13% in both 1980 and 2010, while in 1990 and 2000 it has comparable 7% and 5% to the Borough of Brooklyn and also the Environs.

This considerable high but same percentage in 1980 and 2010 does not come from the same housing-unit universe though. While there are increasing housing units in Williamsburg Core and Environs between 1980 and 2000, the increases are small when compared to that of the 2010 numbers. This can be observed from the maps that show post-2000 construction (See Map 7-20) and total housing units (See Map 7-41). In other words, between 1980 and 2000 vacant housing units in the Williamsburg Core decreases, and between 2000 and 2010 the higher number might be the result of the new but unoccupied units because of the economic downturn once the construction was completed. This is as much as the aggregated neighborhood level numbers can

tell. Map 7-41, Figure 7-37 and Figure 7-38 illustrate the percentage of vacant housing units by Census Tract.

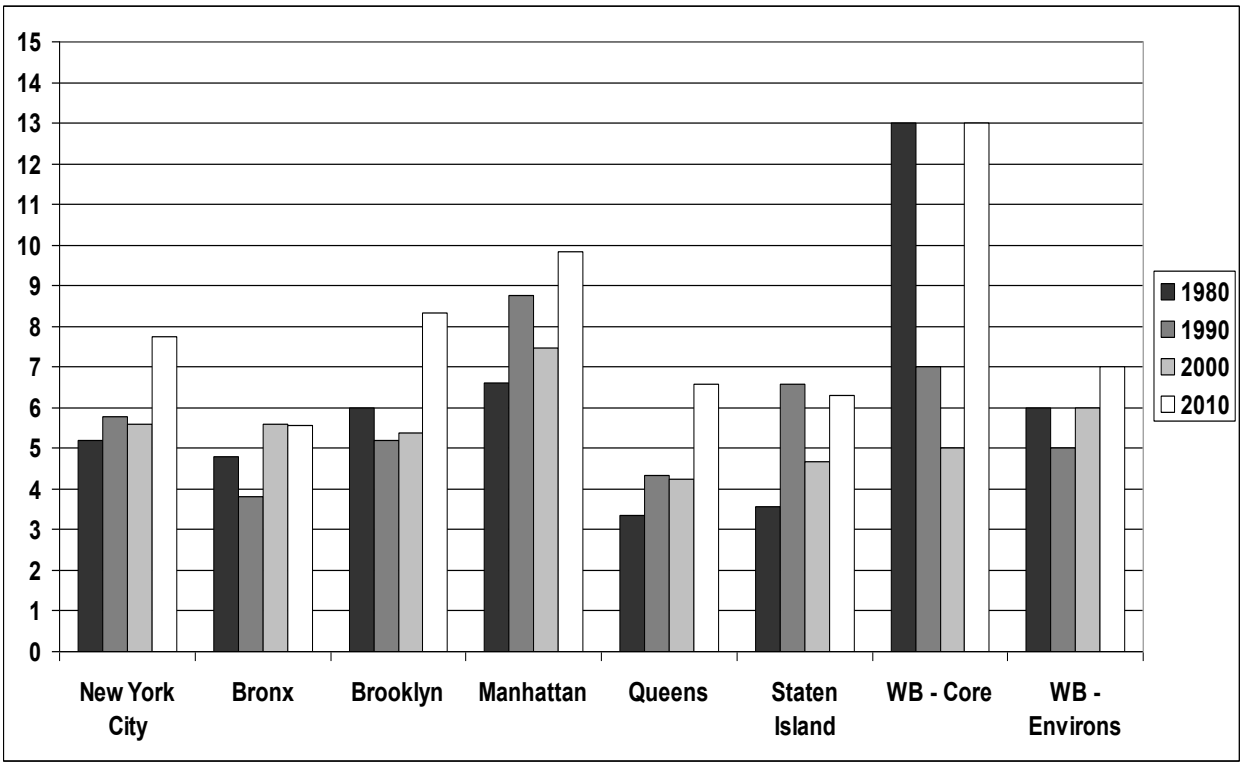
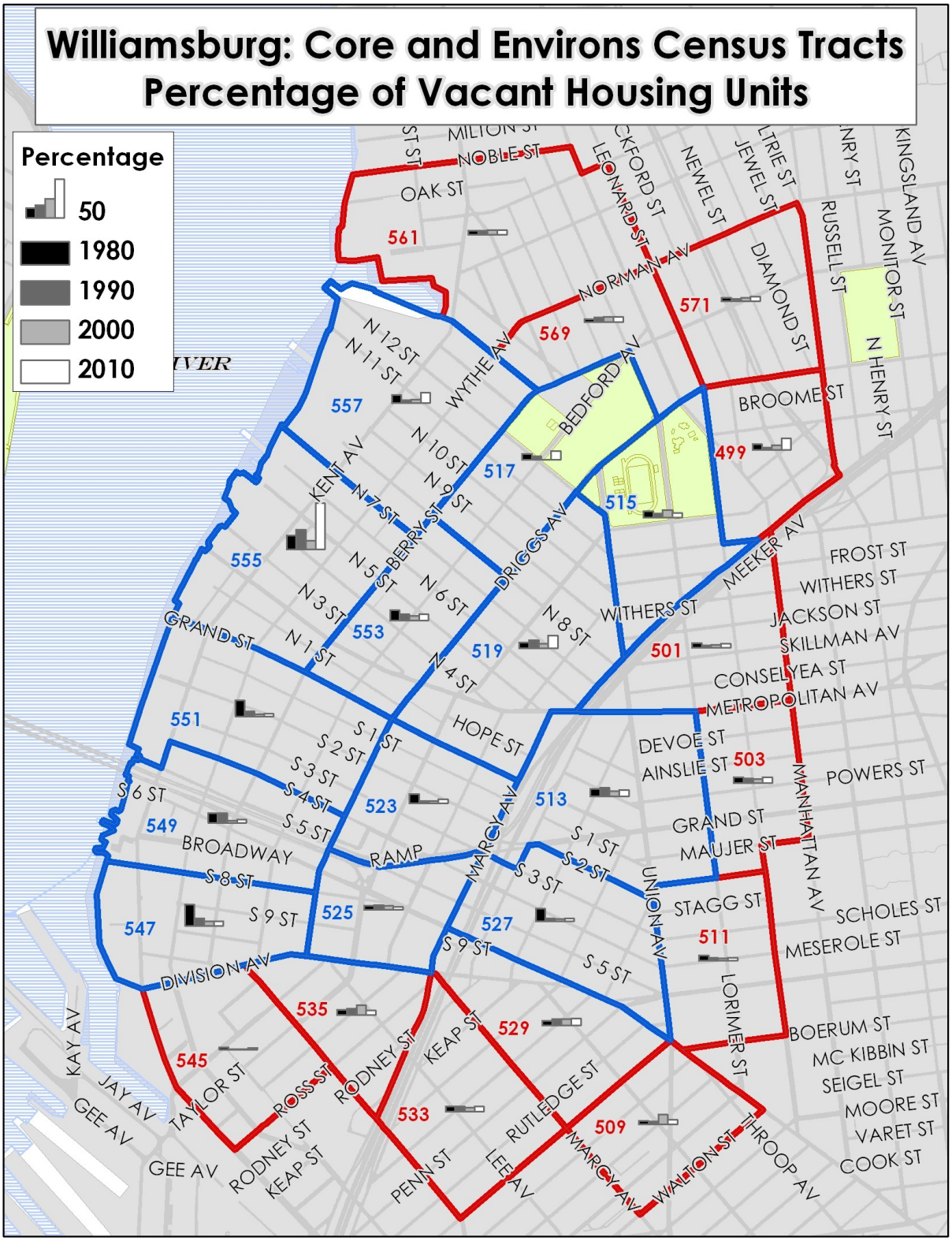


Figure 7-37. Percentage of Vacant Housing Units in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.

Using Map 7-41 and Figure 7-37 one can determine the location that impacts the high vacancy percentage in Williamsburg Core: namely, the East River riverfront Census Tract 555. While Census Tract 555 has a slightly higher percentage in 1980 and 1990, it is the outstanding vacancy rate of 60% in 2010 that skews the percentage for the entire Williamsburg Core area. This clearly creates a housing situation not experienced in Park Slope and the Lower East Side. Neither of them experiences this kind of increase in simultaneously new and vacant housing units. Whether these newly built units will be occupied in the subsequent years and advances the gentrification in the East River riverfront area, or if these new units will remain vacant as a result

of the overall economic downturn remains to be determined with the next ACS or the Census Survey in 2020.



Map 7-41. Williamsburg, Percentage of Vacant Housing Units by Census Tract, 1980 - 2010.

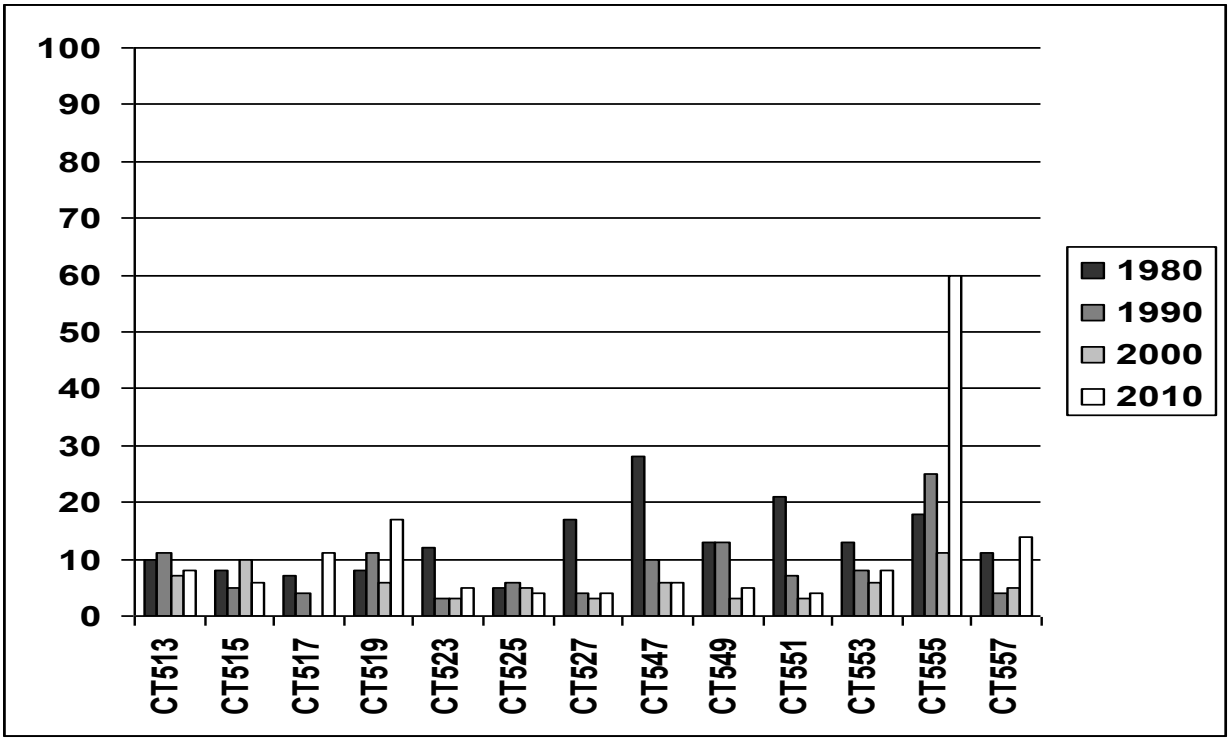


Figure 7-38. Percentage of Vacant Housing Units in Williamsburg - Core by Census Tract, 1980 - 2010.

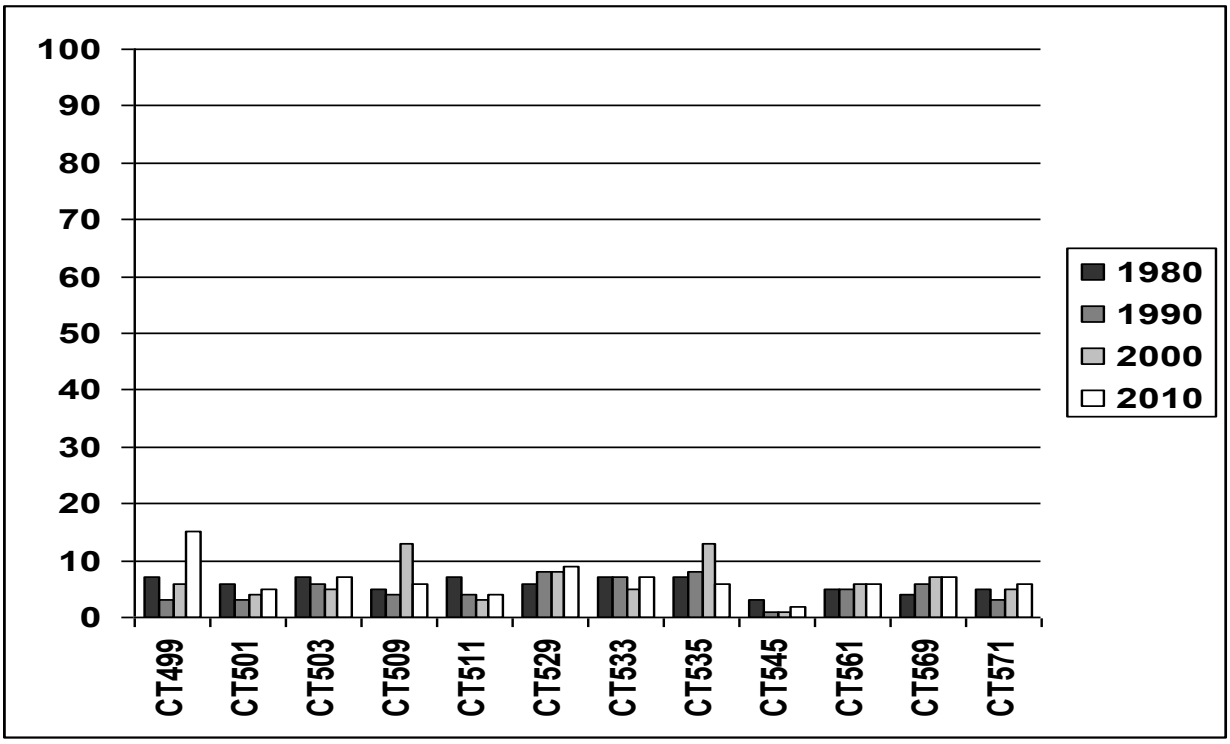


Figure 7-39. Percentage of Vacant Housing Units in Williamsburg - Core by Census Tract, 1980 - 2010.

7-4.4c Percentage of Renter-Occupied Housing Units

Renters remain the majority in Williamsburg Core and Environs throughout the study years. (See Figure 7-40 below). Both areas have slightly higher percentages than the Borough of Brooklyn itself. While there is a slightly decreasing trend for New York City and the Borough, the Core experiences an increasing trend from 1980 through 2000. In 2000 the percentage drops, but from the previous discussion on vacant housing units we can assume this decrease is caused by the acceleration of new and unoccupied units in a single Census Tract, namely 555. The Environs hold a steady percentage of renters throughout the study period.

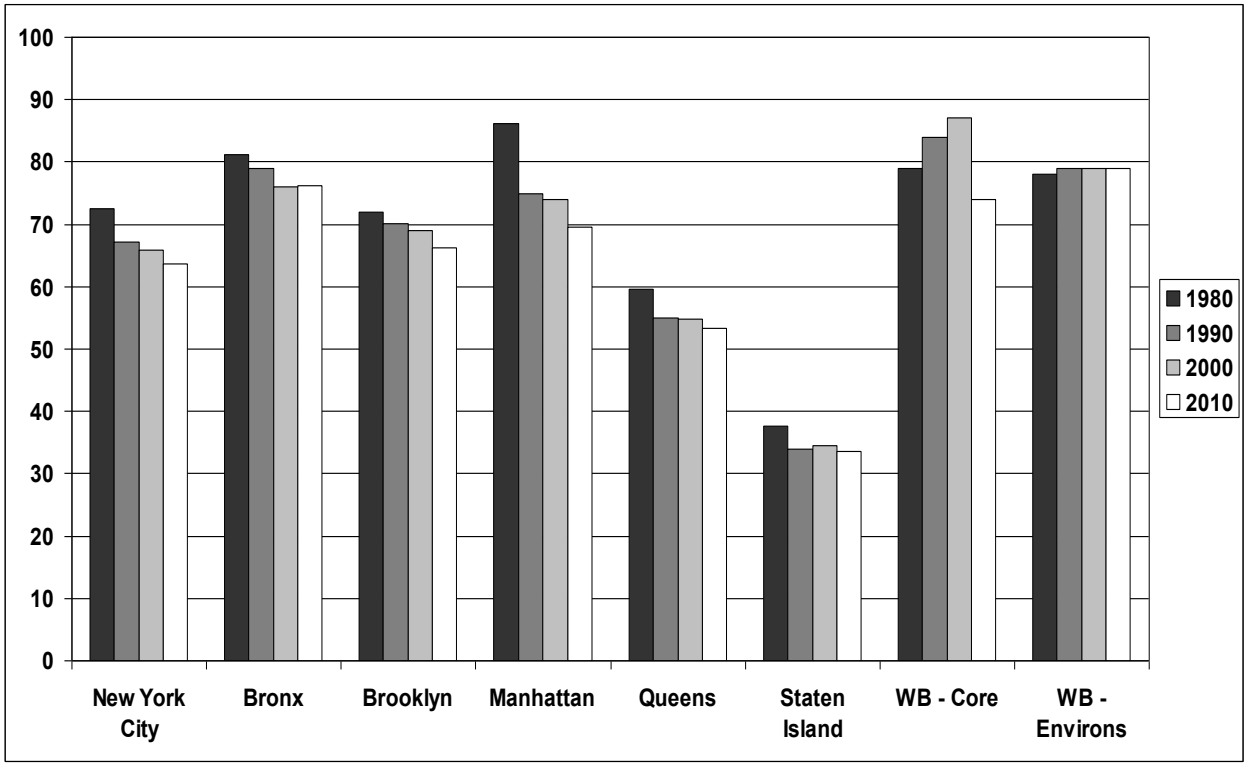
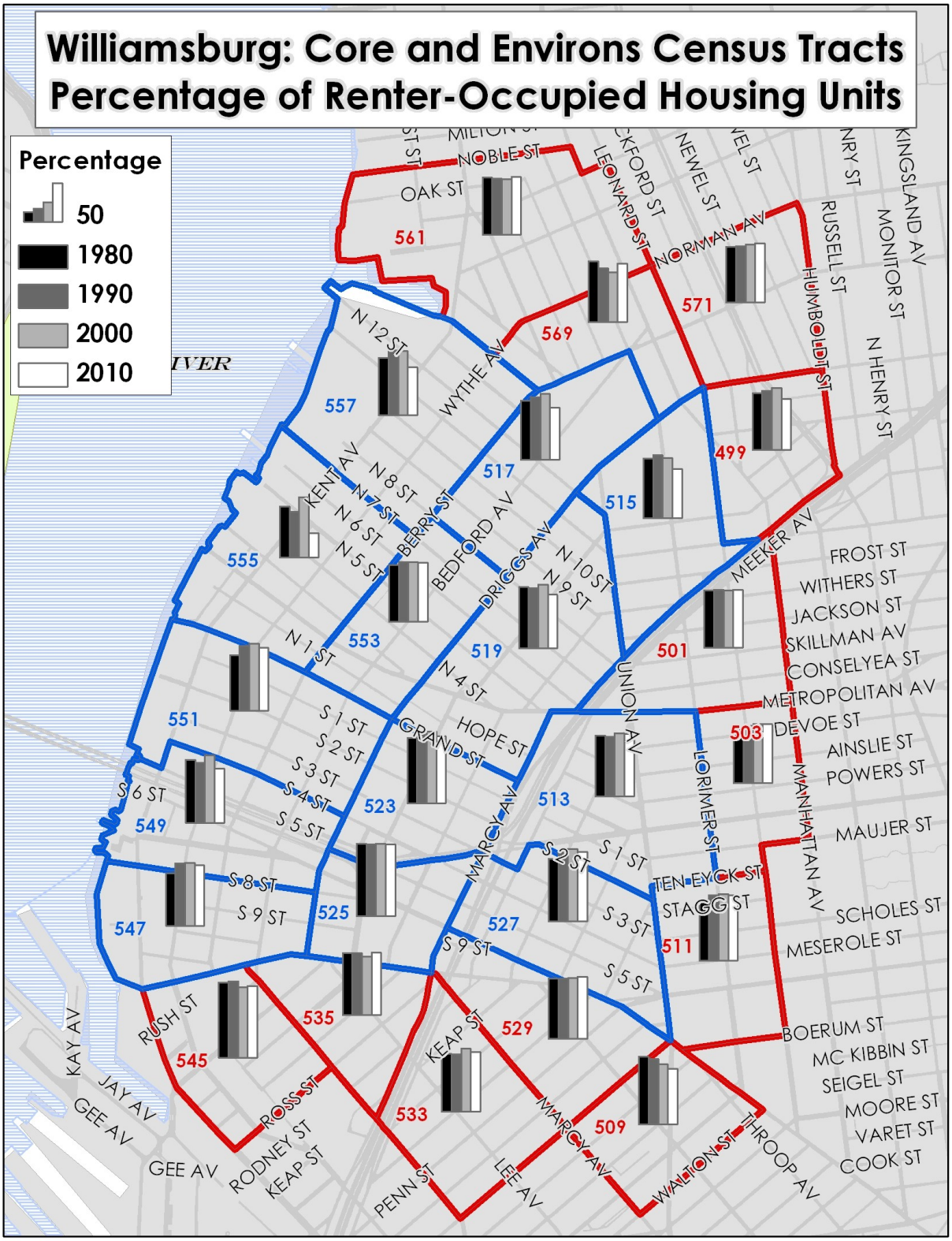


Figure 7-40. Percentage of Renter-Occupied Housing Units in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.

Map 7-42, Figure 7-41 and Figure 7-42 below illustrate the renter-occupied percentages by Census Tract in Williamsburg Core and Environs. Map 7-42 shows a noticeable drop in renter-occupied units in Census Tract 555. However, Figure 7-41 also indicates there are other Census Tracts within the Core that have experienced decreasing percentages between 2000 and 2010 (See Census Tracts 515, 517, 519, 549 and 557). Four of these five Census Tracts are located in the North part of the Core; only 549 is located at the foot of the Williamsburg Bridge area. The remainder of the area has fairly stable percentages of renter-occupied units.

In the Environs, the changes throughout the study years are nominal, although two Census Tracts in the North (See Census Tracts 569 and 571), adjacent to the Core Census Tracts, show decreasing percentages during the same period. While this map and these figures cannot explain the reason for this change in opposite directions at this location, this observation is a unique development that is not found in other parts of Williamsburg.



Map 7-42. Williamsburg, Percentage of Renter-Occupied Housing Units by Census Tract, 1980 - 2010.

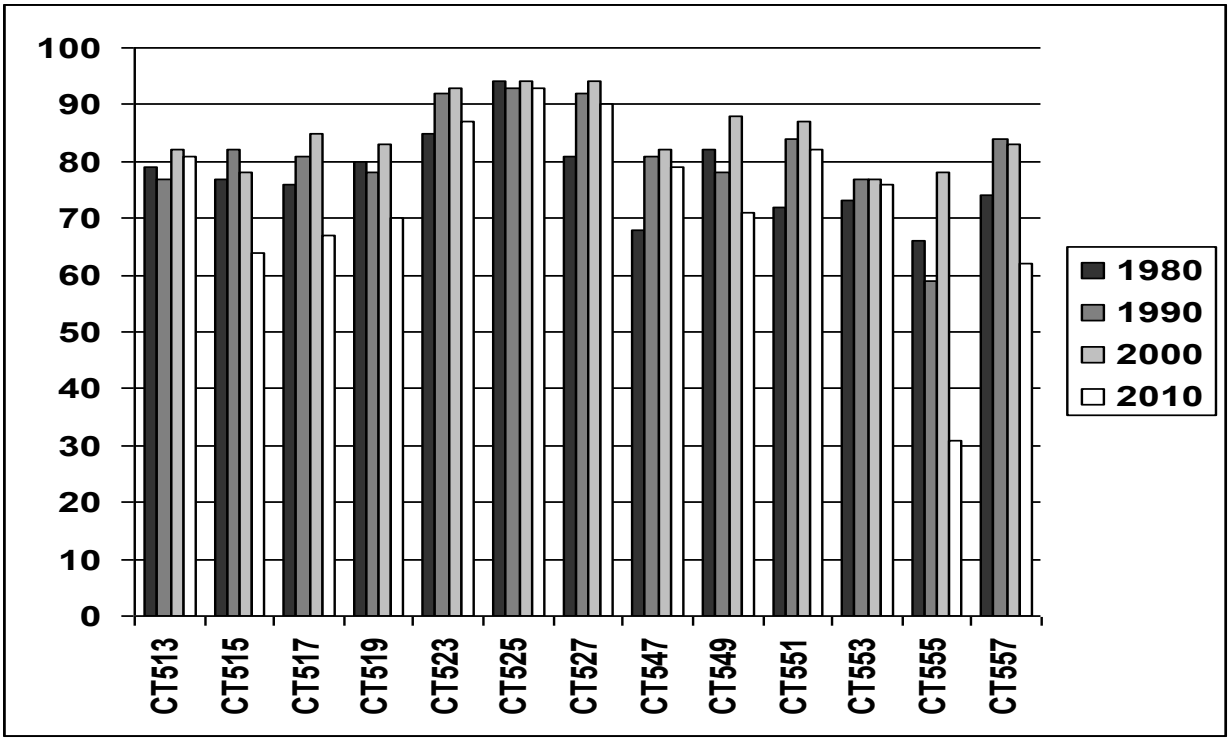


Figure 7-41. Percentage of Renter-Occupied Housing Units in Williamsburg - Core by Census Tract, 1980 - 2010.

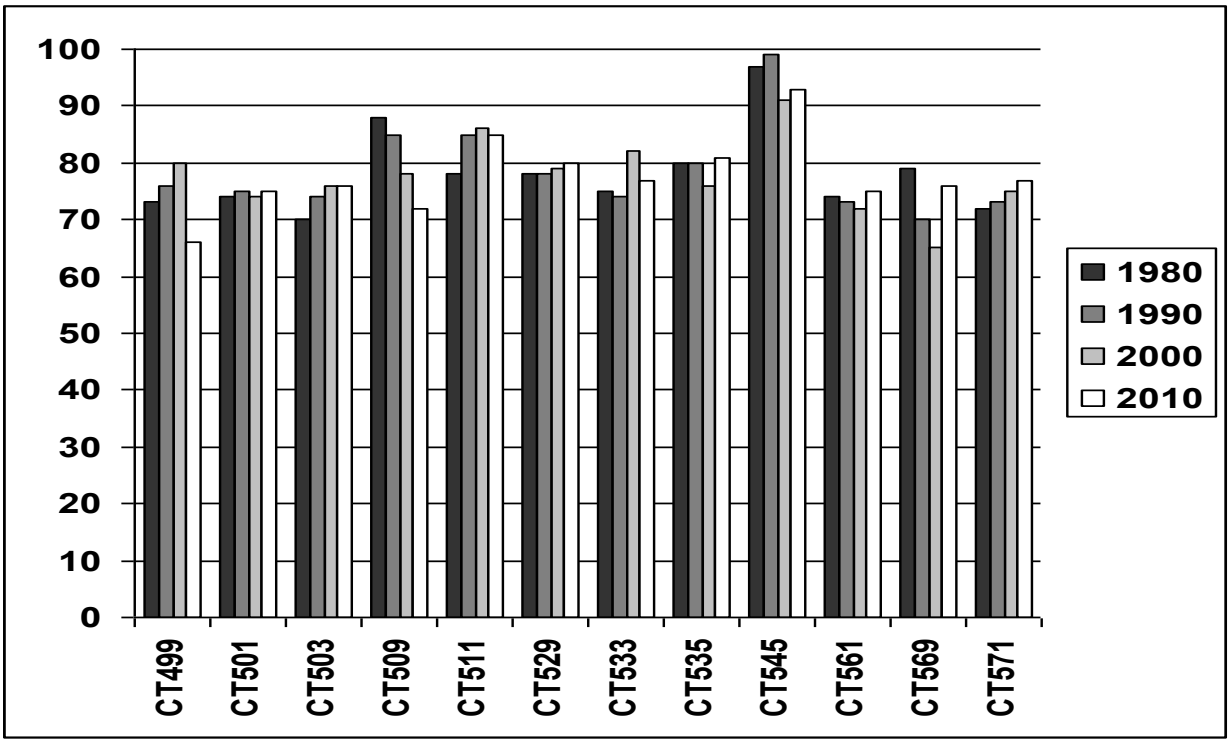


Figure 7-42. Percentage of Renter-Occupied Housing Units in Williamsburg - Environs by Census Tract, 1980 - 2010.

7-4.5 Median Household Income

Figure 7-432 below compares the median household income of the Williamsburg Core and Environs to New York City and the Five Boroughs. It clearly shows two unique features of Williamsburg: first, the Core has a consistently increasing trend while the Environs mirror that of New York City; second, the household income of the Core exceeds the Environs in 2000; and exceeds both the Environs and the Borough of Brooklyn in 2010.

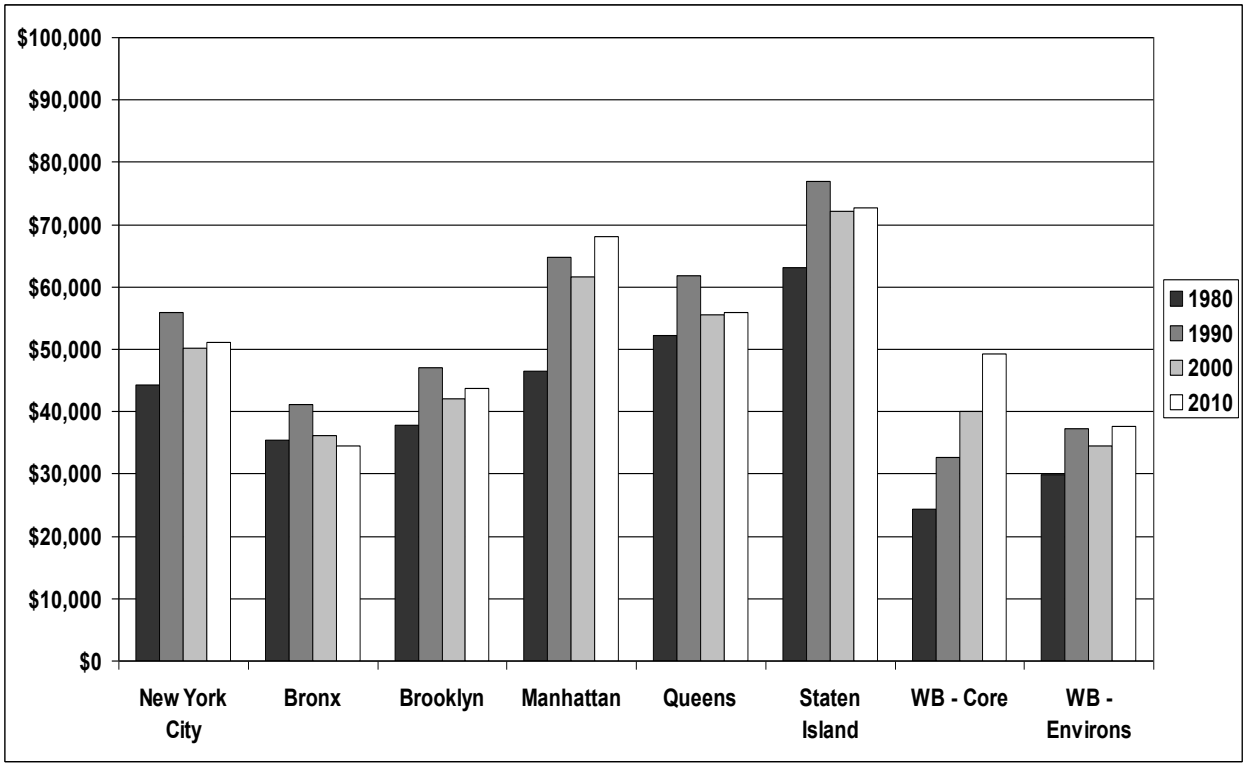
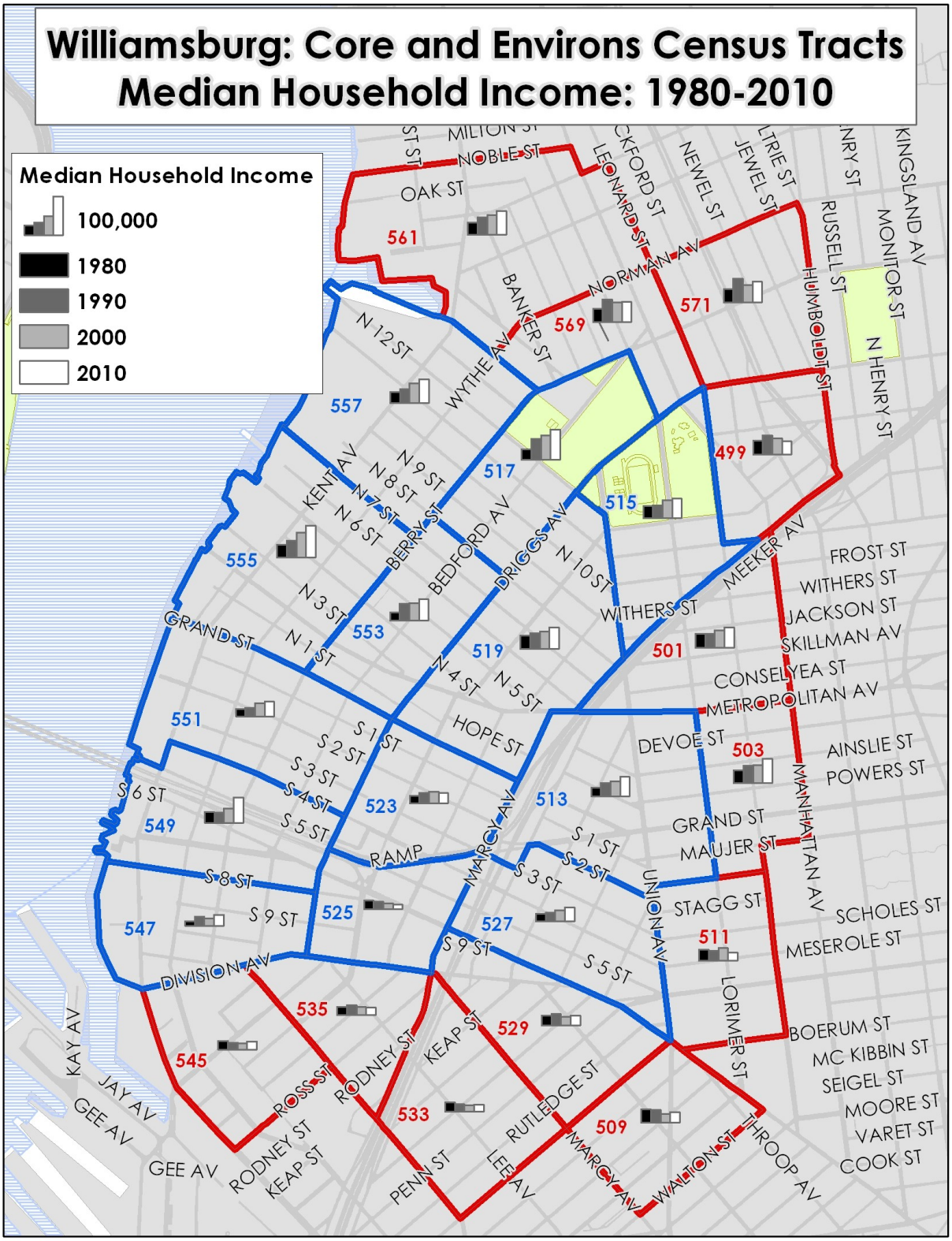


Figure 7-43. Median Household Income in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.

In the following pages are two sets of maps with figures to illustrate median household income at Census Tract level. The first set (See Map 7-43, Figure 7-44 and Figure 7-45) illustrates median household income from 1980 through 2010 by Census Tract. The second set (See Map 7-44,

Figure 7-46 and Figure 7-47) compares these household income values to the Borough itself and converts them into percentages.

For median household income, the increases are more noticeable in the Core Census Tracts located North of Grand Street. This pattern can also be observed among the Environs Census Tracts located north of the Core. Census Tract 499 is the only exception that it reports decreasing household income since 1990. Census Tracts south of Grand Street (both Core and Environs) generally reported lower household incomes and a slower increasing trend. The only exception to this pattern is Census Tract 549 which had a noticeable increase in 2010. Certain Census Tracts actually had reported decreasing household incomes during the study period (See Core Census Tract 525 and several Census Tracts in the Environs in Figure 7-45).



Map 7-43. Williamsburg, Median Household Income by Census Tract, 1980 - 2010.

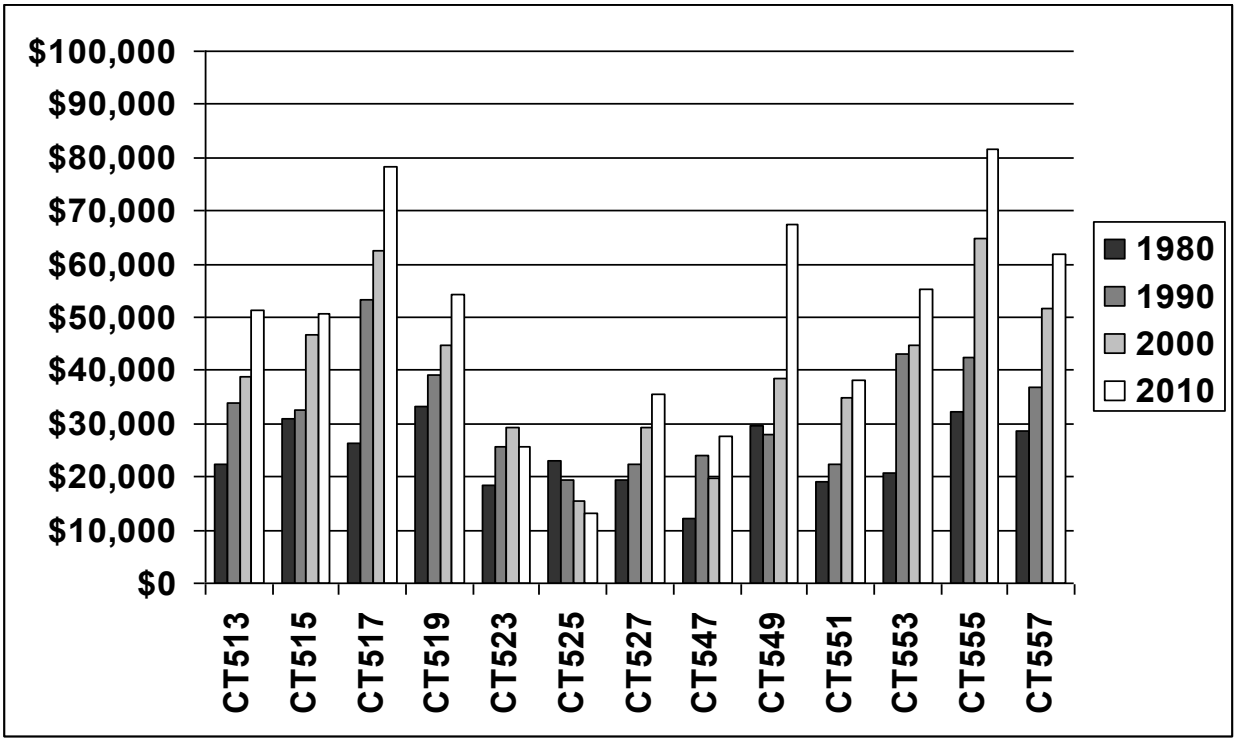


Figure 7-44. Median Household Income in Williamsburg - Core by Census Tract, 1980 - 2010.

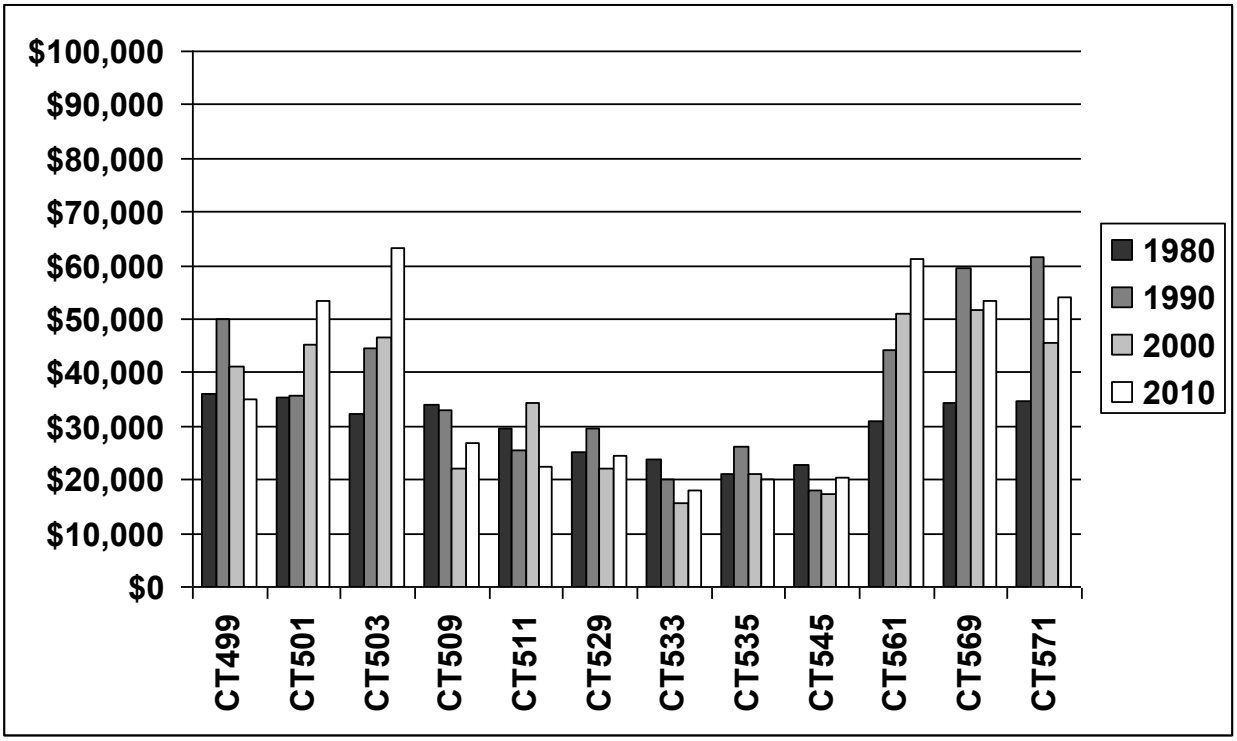
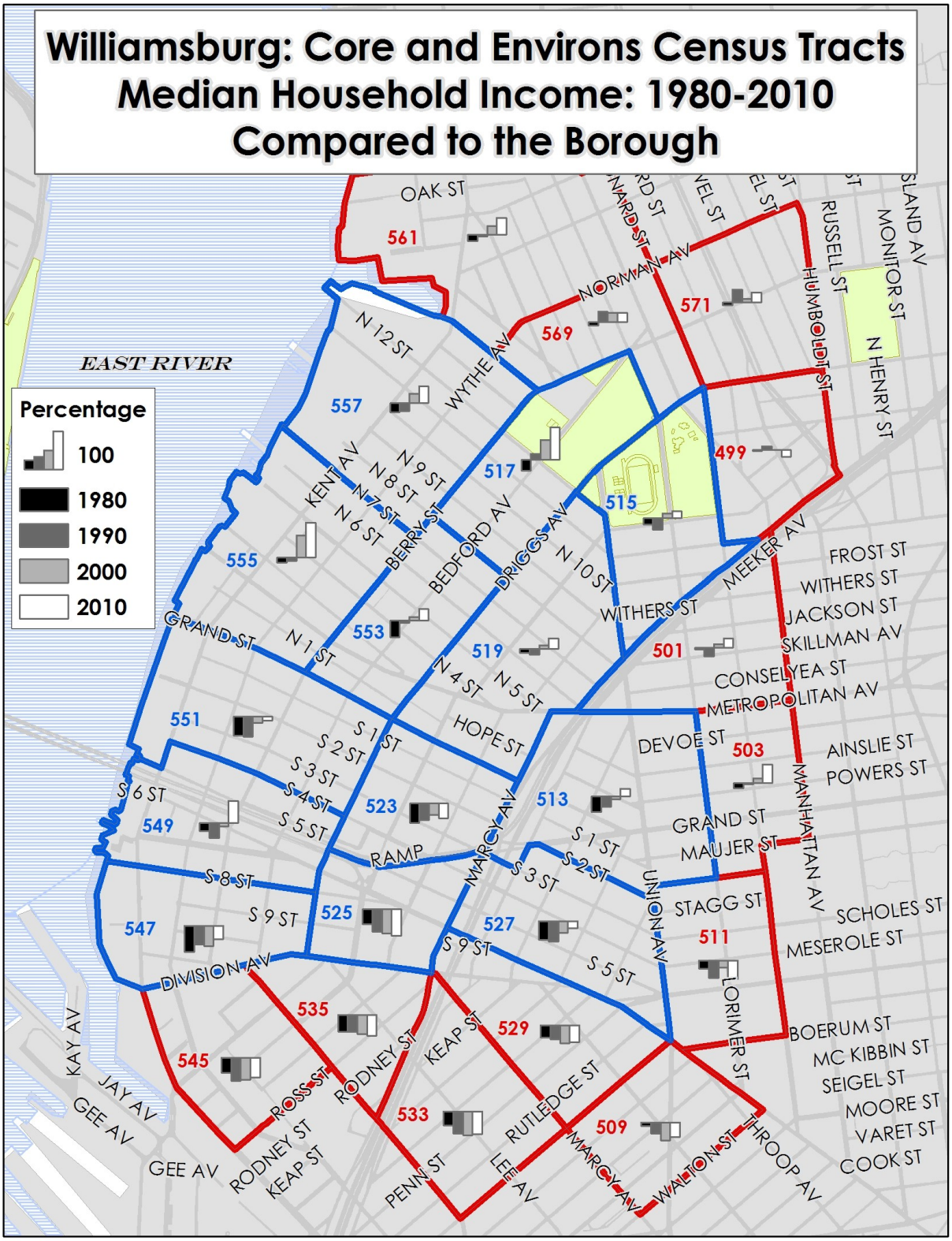


Figure 7-45. Median Household Income in Williamsburg - Environs by Census Tract, 1980 - 2010.

Map 7-44, Figure 7-46 and Figure 7-47 below compare median household income to the Borough of Brooklyn revealing patterns that are quite different from those in Park Slope. In 1980, none of the Census Tracts in the Williamsburg Core and Environs areas reported household incomes higher than the Borough. In 1990, only one Census Tract in the Core, namely, Census Tract 517 and three in the Environs, namely Census Tracts 499, 569 and 571 Northwest of the Core, had household incomes slightly higher than the Borough.

In 2000, Census Tract 517 continued to outpace the Borough. Other Census Tracts in the Core also report household incomes higher than the Borough, namely, Census Tracts 557 and 555 at the East River riverfront located North of Grand Street had more noticeable higher percentages, while other Core Census Tracts North of Grand Street had less noticeable increased changes in percentages of median household income. These Census Tracts continue an increasing pattern in median household income in 2010.

Generally the Core Census Tracts South of Grand Street had incomes lower than the Borough. The exceptions are Census Tracts 549 and 513 which had reported incomes higher than the Borough only in 2010. The Environs Census Tracts located south of these Census Tracts also reported incomes lower than the Borough throughout the study period.



Map 7-44. Williamsburg, Median Household Income Compared to the Borough by Census Tract, 1980 - 2010.

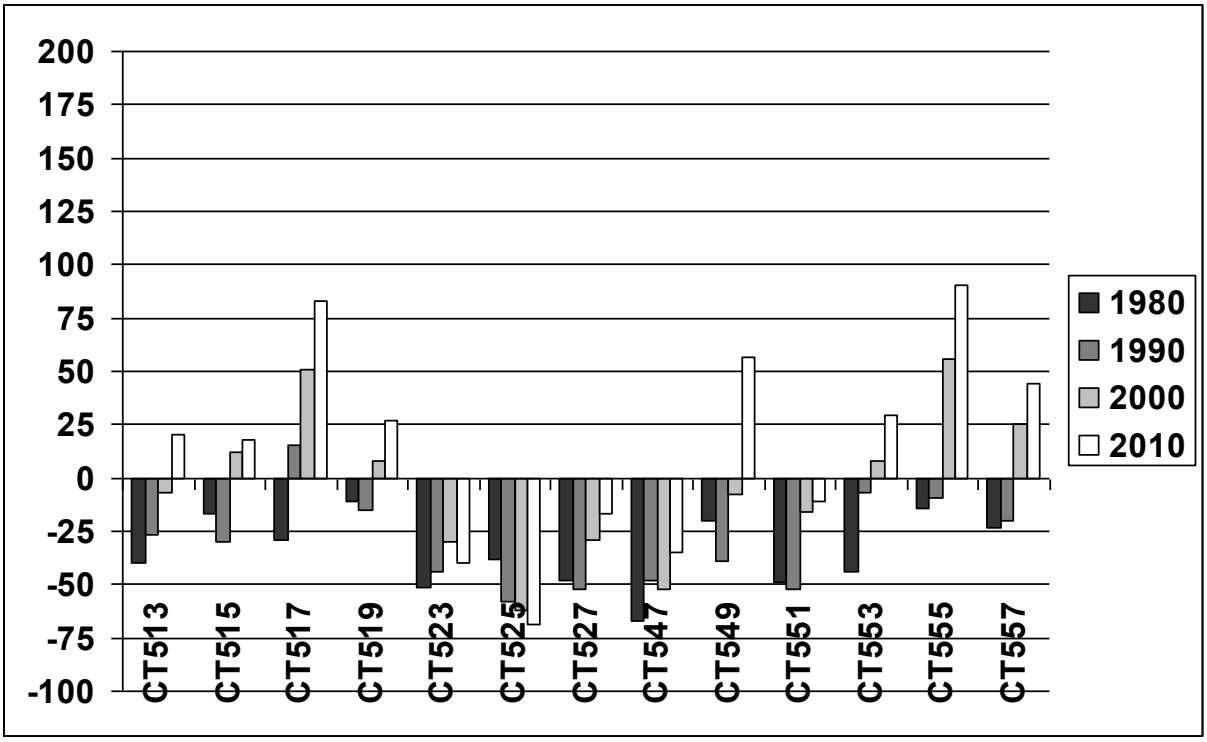


Figure 7-46. Percentage of Median Household Income Compared to the Borough by Census Tract, Williamsburg - Core, 1980 - 2010.

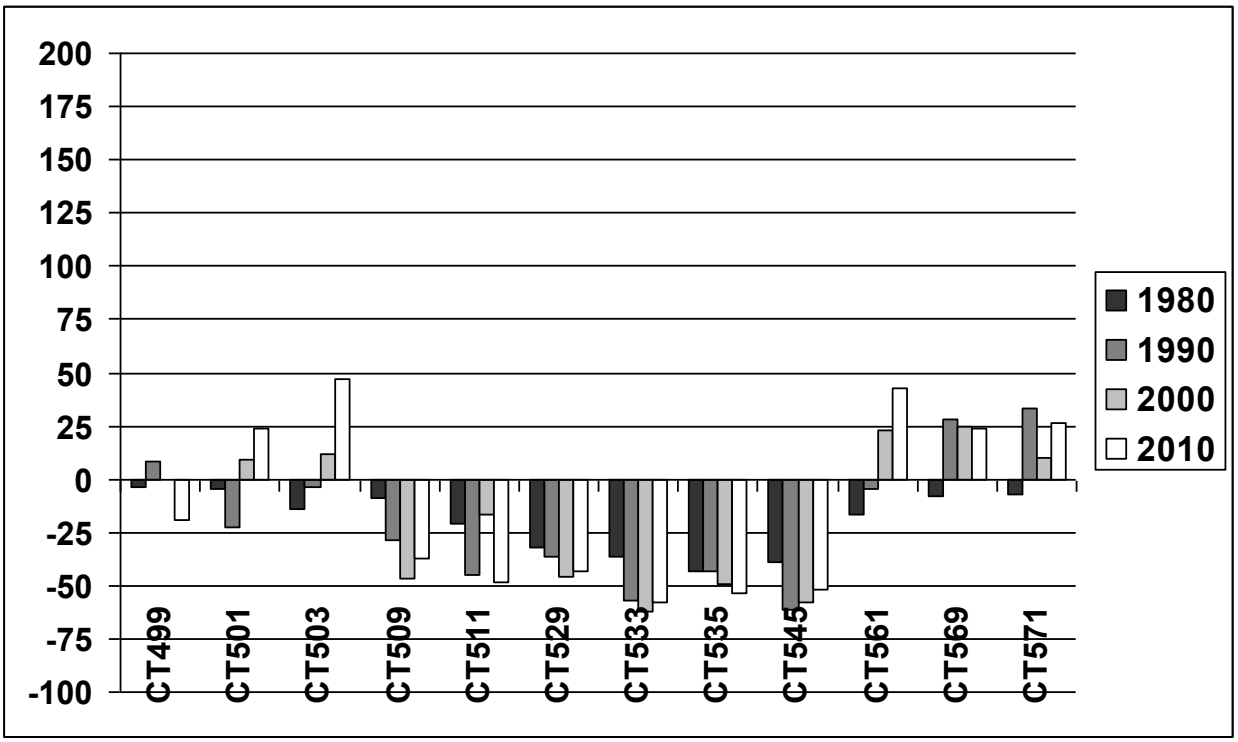


Figure 7-47. Percentage of Median Household Income Compared to the Borough by Census Tract, Williamsburg - Environs, 1980 - 2010.

7-4.6 Median Gross Rent

Figure 7-48 below compares the median gross rent of the Williamsburg Core and Environs to New York City and the Five Boroughs. The trend for all the plotted areas is rising, although a closer review reveals some differences among them. In New York City and the Five Boroughs, the median gross rent did not change much between 1990 and 2000. In contrast, the Williamsburg Core has a more noticeable increase in the median gross rent. This increase is repeated between 2000 and 2010 for both the Williamsburg Core and Environs. It should also be noted that in both 1980 and 1990, the Core had reported lower rents than that of the Environs, and this pattern is reversed in 2000 and 2010. Despite these increases, it was only in 2010 that both the Core and the Environs reported rents higher than the Borough itself.

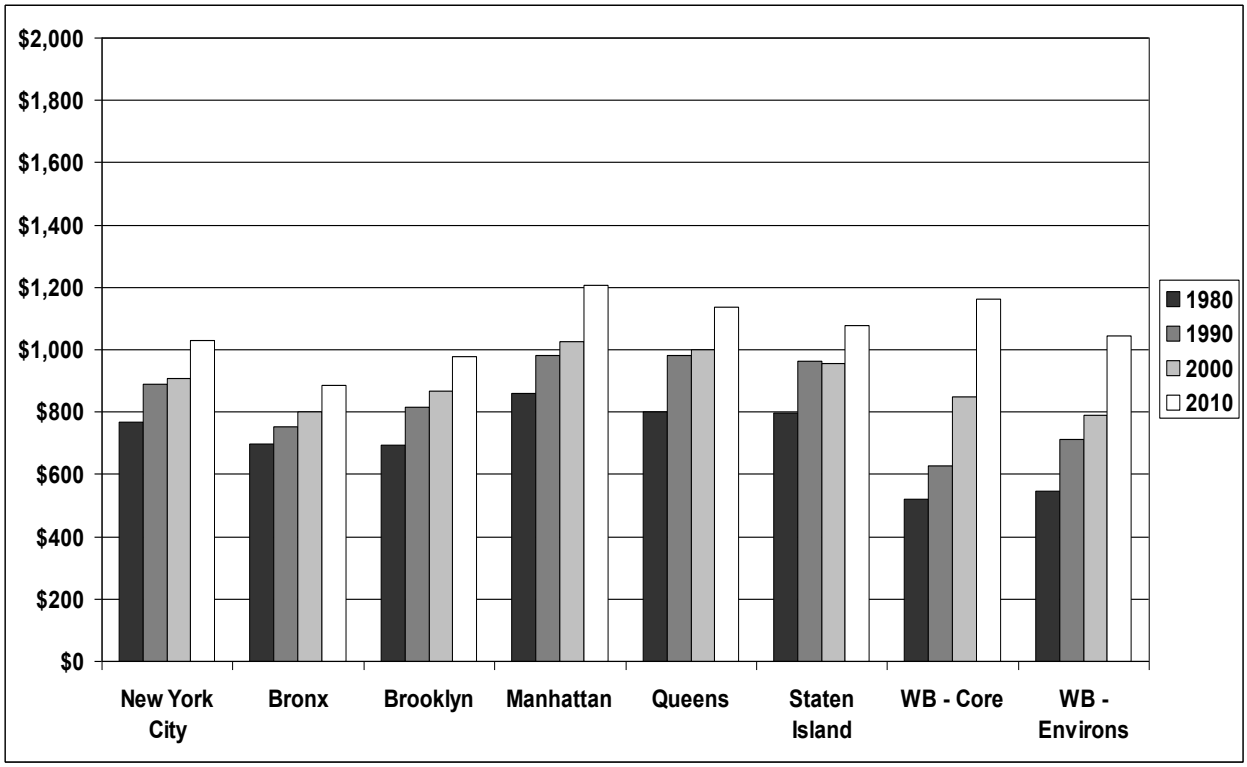
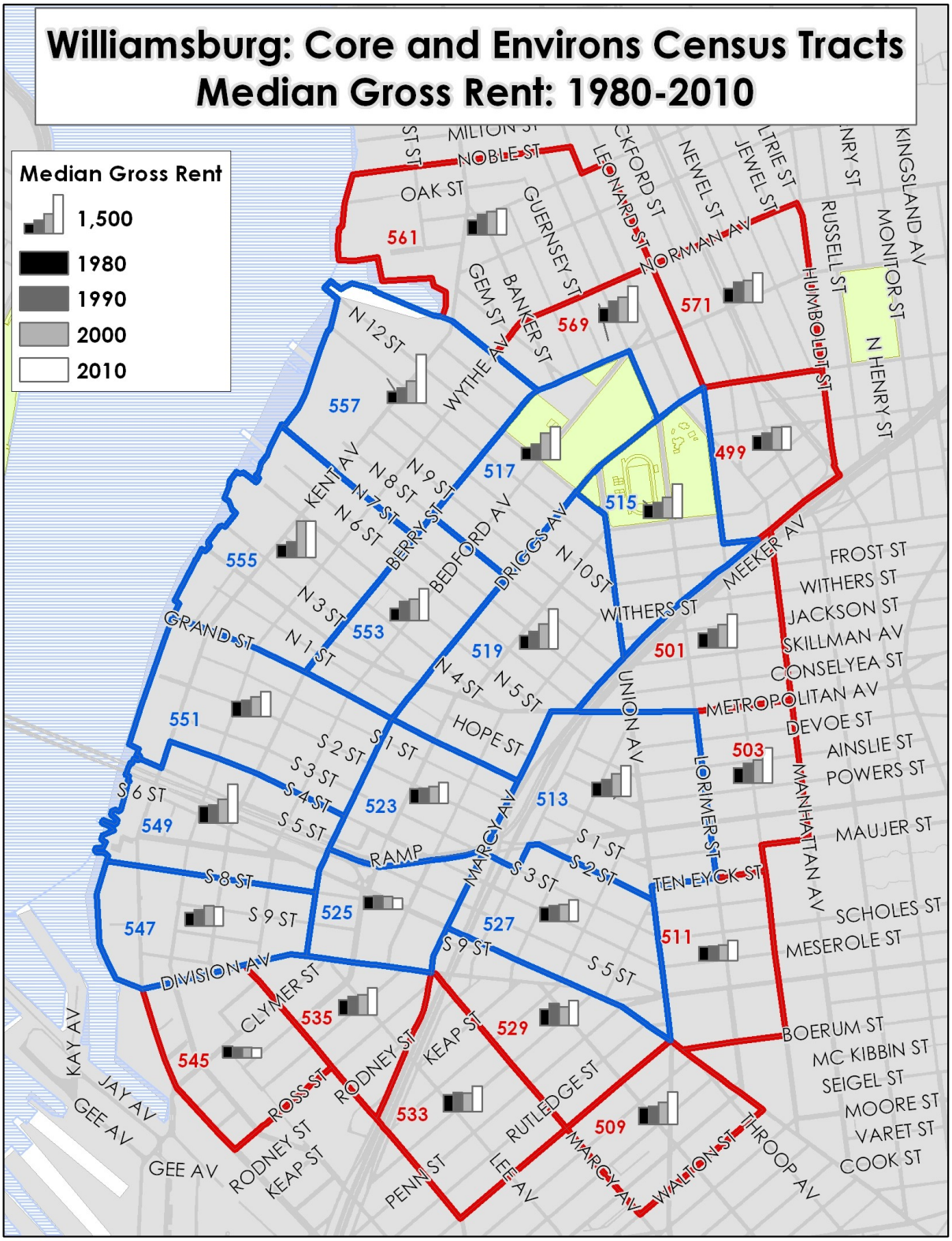


Figure 7-48. Median Gross Rent in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.

Map 7-45, Figure 7-49 and Figure 7-50 below illustrate the median gross rent of Williamsburg Core and Environs by Census Tract. Among the Census Tracts in the Core, those located North of Grand Street had more noticeable increases in the median gross rent. South of Grand Street, only Census Tract 549 shares this pattern. The Environs Census Tracts generally had reported increasing rents, with the exception of Census Tracts 511 and 545, which had fairly stable rents throughout the study period.



Map 7-45. Williamsburg, Median Gross Rent by Census Tract, 1980 - 2010.

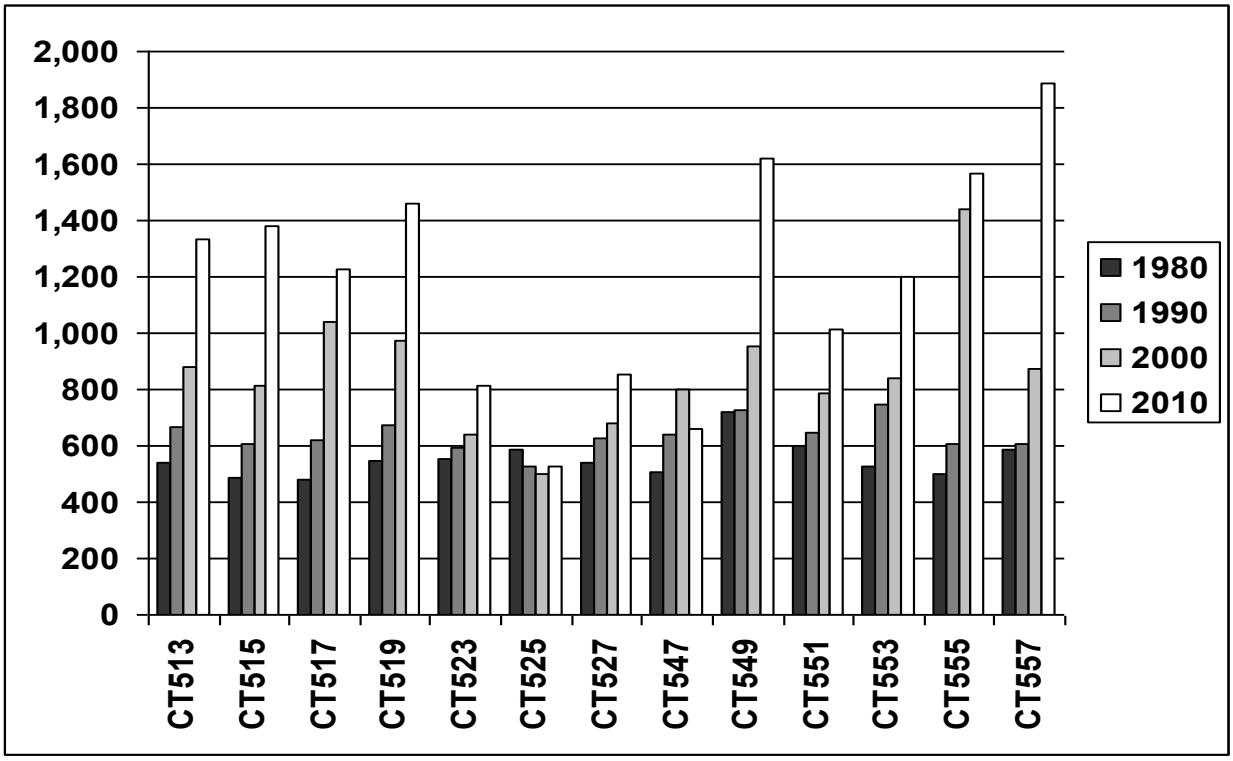


Figure 7-49. Median Gross Rent in Williamsburg - Core by Census Tract, 1980 - 2010.

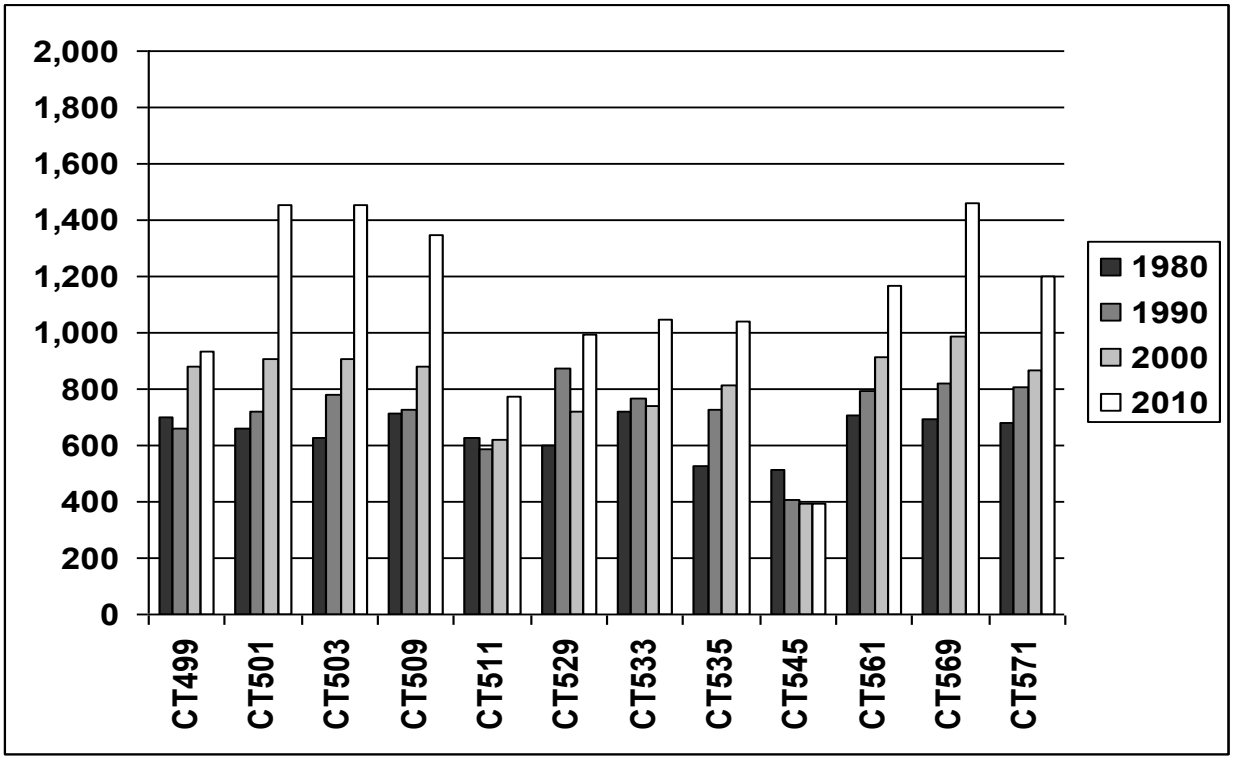
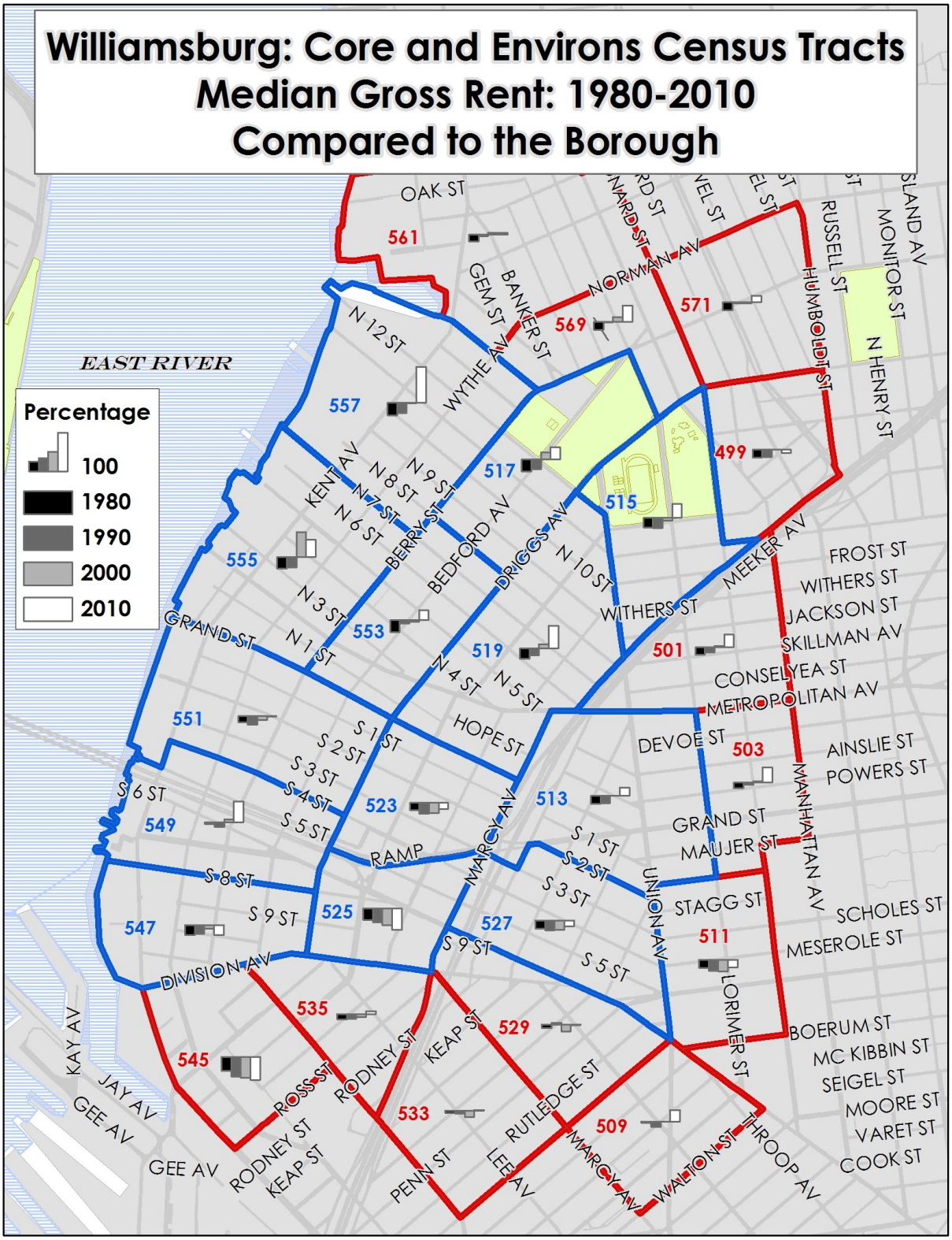


Figure 7-50. Median Gross Rent in Williamsburg - Environs by Census Tract, 1980 - 2010.

Map 7-46, Figure 7-51 and Figure 7-52 below compare the median gross rent to the Borough itself. Unlike Park Slope, most of the Census Tracts in Williamsburg Core or Environs had reported rents lower than the Borough. It was not until 2000 when certain Census Tracts reported rents higher than the Borough. Grand Street appears to be the line of demarcation. The Census Tracts North of Grand Street had reported rents higher than the Borough in the most recent Census Survey year. South of Grand Street with Census Tract 549 is the only exception, as all the other Census Tracts had reported rents lower than the Borough itself.



Map 7-46. Williamsburg, Median Gross Rent Compared to the Borough by Census Tract, 1980 - 2010.

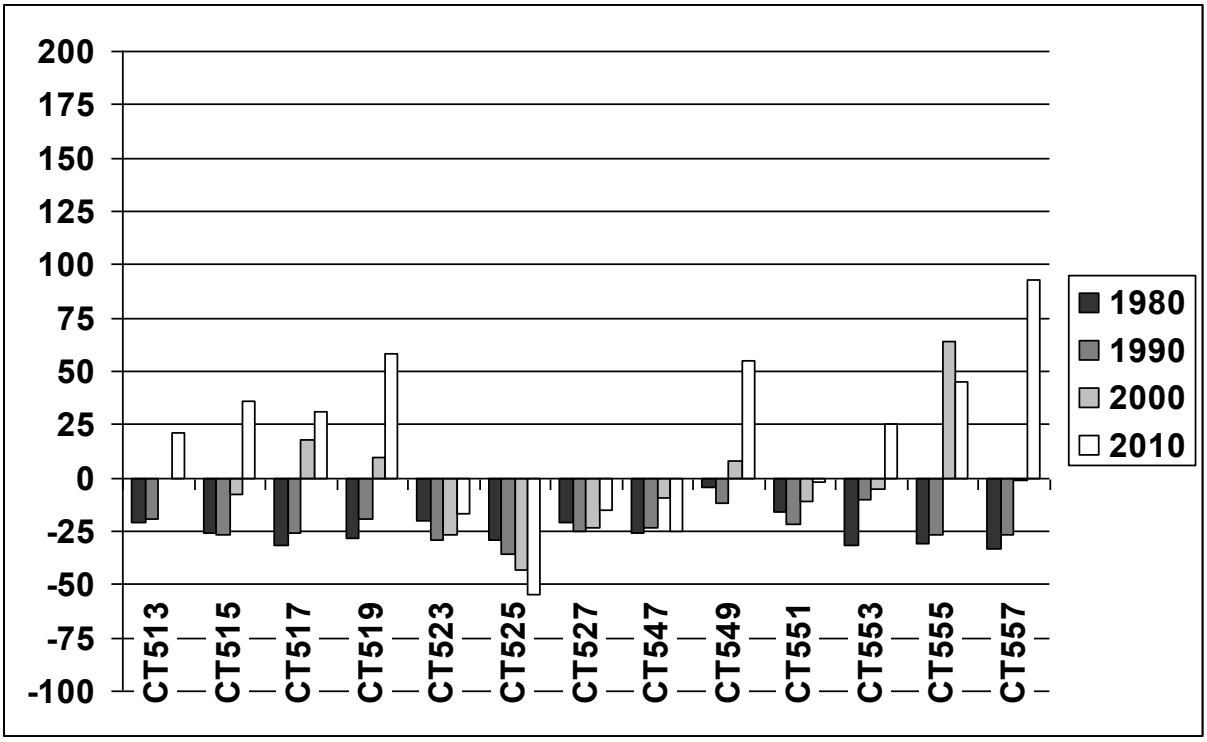


Figure 7-51. Percentage of Median Gross Rent Compared to the Borough by Census Tract, Williamsburg - Core, 1980 - 2010.

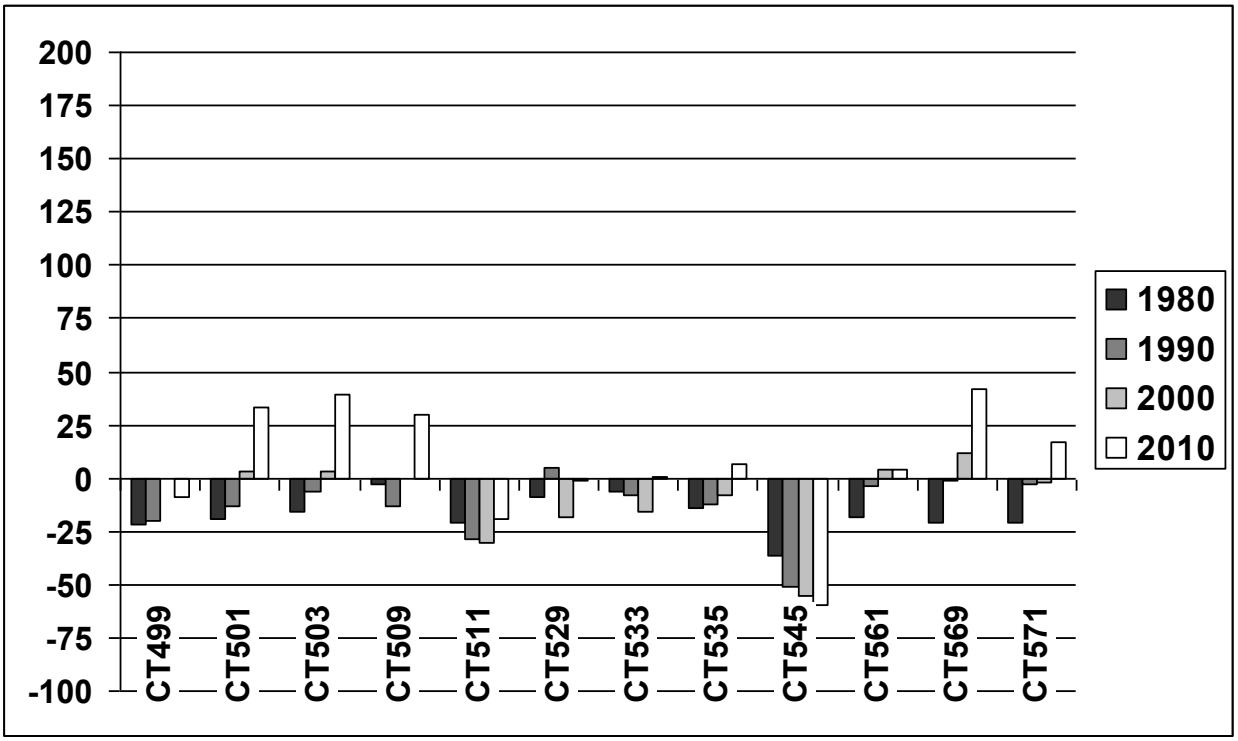


Figure 7-52. Percentage of Median Gross Rent Compared to the Borough by Census Tract, Williamsburg - Environs, 1980 - 2010.

7-4.7 Educational Attainment

This section maps the two ends of the spectrum of educational attainment: those with College (or Above) Degree that is a commonly used variable to indicate gentrification, and those without a High School Diploma, to examine how gentrification affects their presence.

7-4.7a College (or Above) Degree

Figure 7-53 below compares the percentage of those individuals with College (or Above) Degree among the total population. All the study areas show an increasing trend in educational attainment but again there are differences among them. While the increases in Brooklyn throughout the study years remain steady at 7%, 10%, 14%, and 19% (in 1980, 1990, 2000 and 2010 respectively) the changes in the Williamsburg Core and Environs are not this stable. The Core has a head start in 2000, while the Environs experience a more noticeable increase later in 2010.

Map 7-47, Figure 7-54 and Figure 7-55 below further refine these percentage increases at the Census Tract level. One can observe that the Census Tracts located in the North have higher percentages and also more noticeable increases than those Census Tracts located in the South. The North-South divide at Grand Street is also observed in the previous discussions regarding median household income and median gross rent. This demarcation at Grand Street is still applicable to educational attainment, although in Map 7-47 one can observe that the Census Tracts immediately South of Grand Street also have a strong presence of College graduates in recent study years. Further south the percentages are so low that it is difficult to determine from Map 7-47 whether there are any changes during the study period.

Figure 7-54 and Figure 7-55 illustrate through the use of bar charts and one can observe how these Southern Census Tracts (two from the Core: Census Tracts 525 and 547; five Environs Census Tracts South of the Core area, namely Census Tracts 545, 535, 533 529 and 509) report a consistently low percentages and reach below 10% throughout the study years. Whether an increase of this group will occur further south will be determined in the next Census Survey in 2020. Considering the overall Borough increases in College (and Above) Degree educational attainment and especially how rapidly those nearby Census Tracts have changed in the last thirty years, the reasons for the percentages in these particular Southern Census Tracts that remain consistently low is probably not a gentrification issue, but related to education.

When compared to the Borough numbers through the study years (See Map 7-48, Figure 7-56 and Figure 7-57), the Grand Street demarcation again is evident. The Census Tracts located North of Grand Street surpass the Borough and those located South of Grand Street lag behind. (The only exception is Census Tract 499 in the Northeast Environs, which is approximately on par with the Borough.)

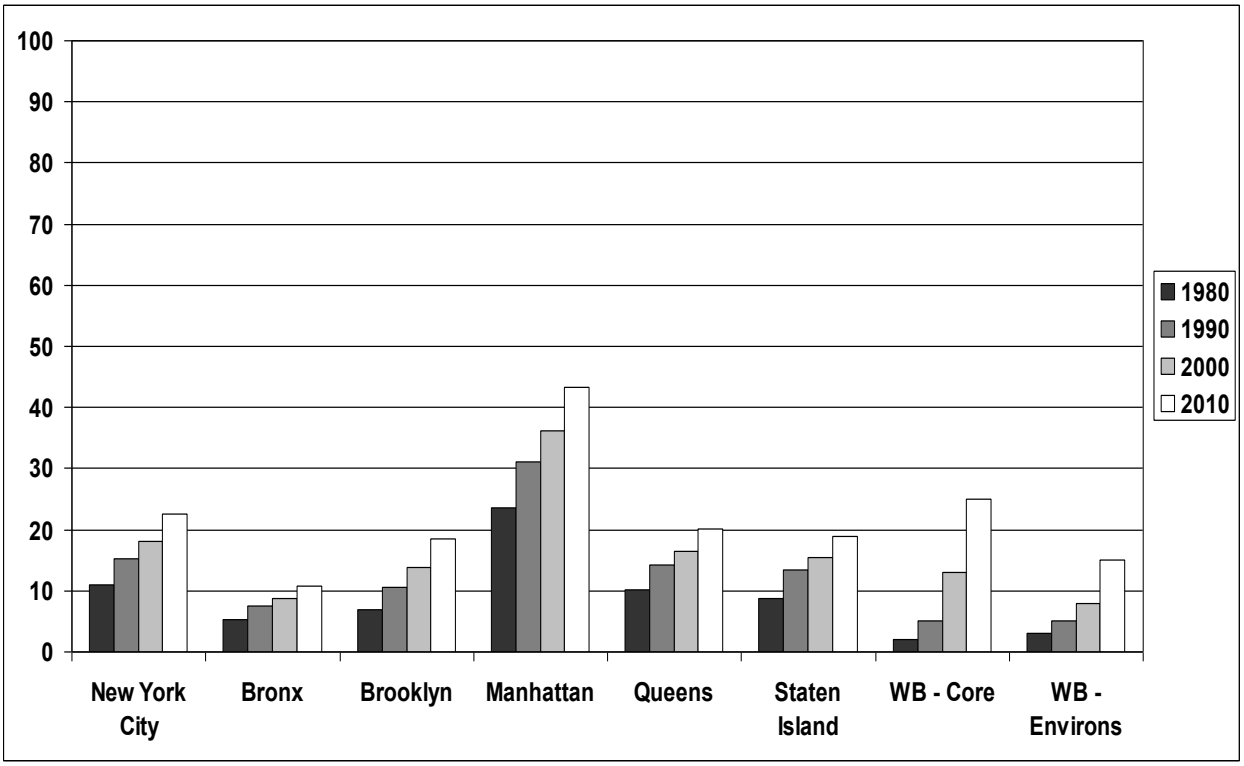
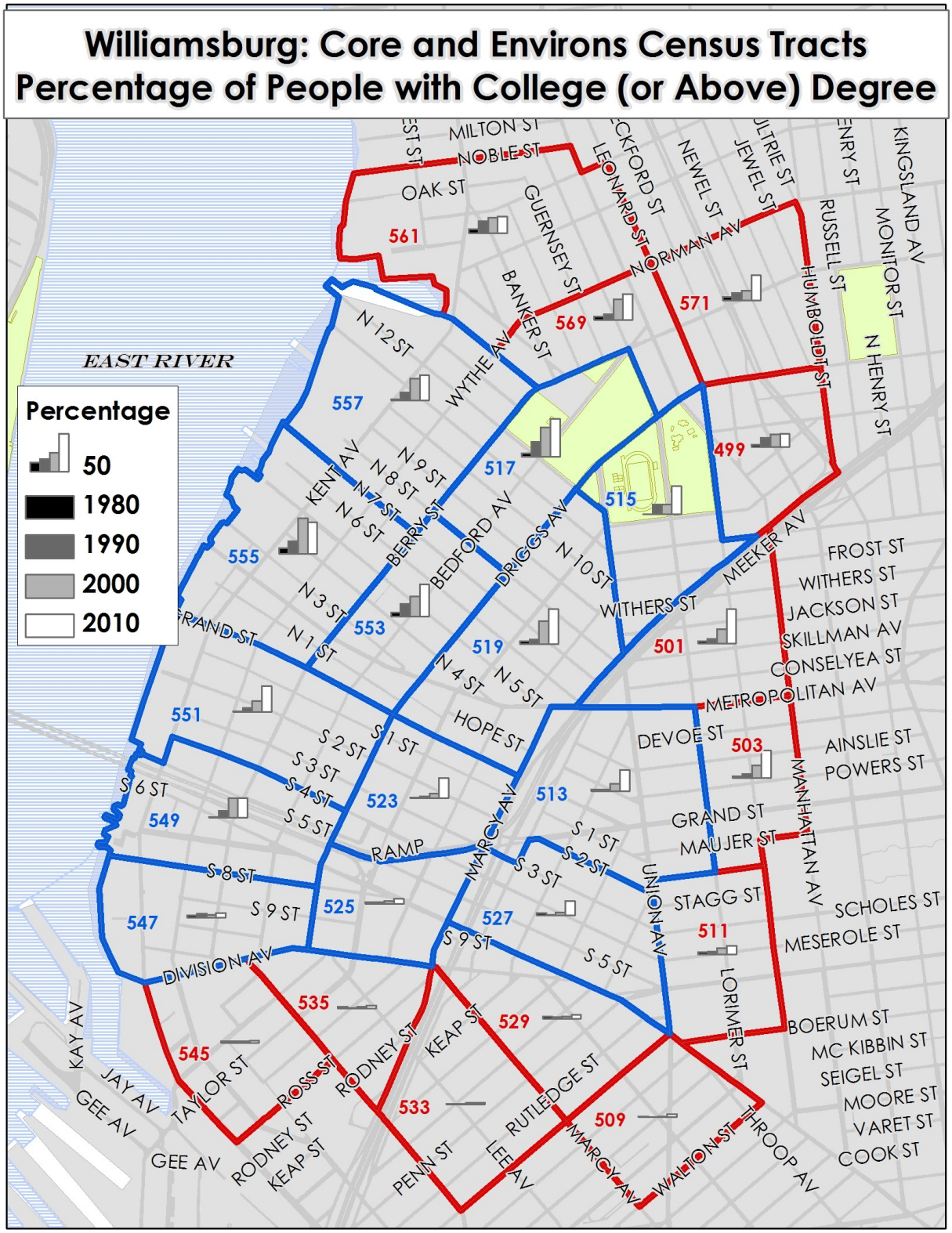


Figure 7-53. Percentage of the Population with College (or Above) Degree in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.



Map 7-47. Williamsburg, Percentage of Population with College (or Above) Degree by Census Tract, 1980 - 2010.

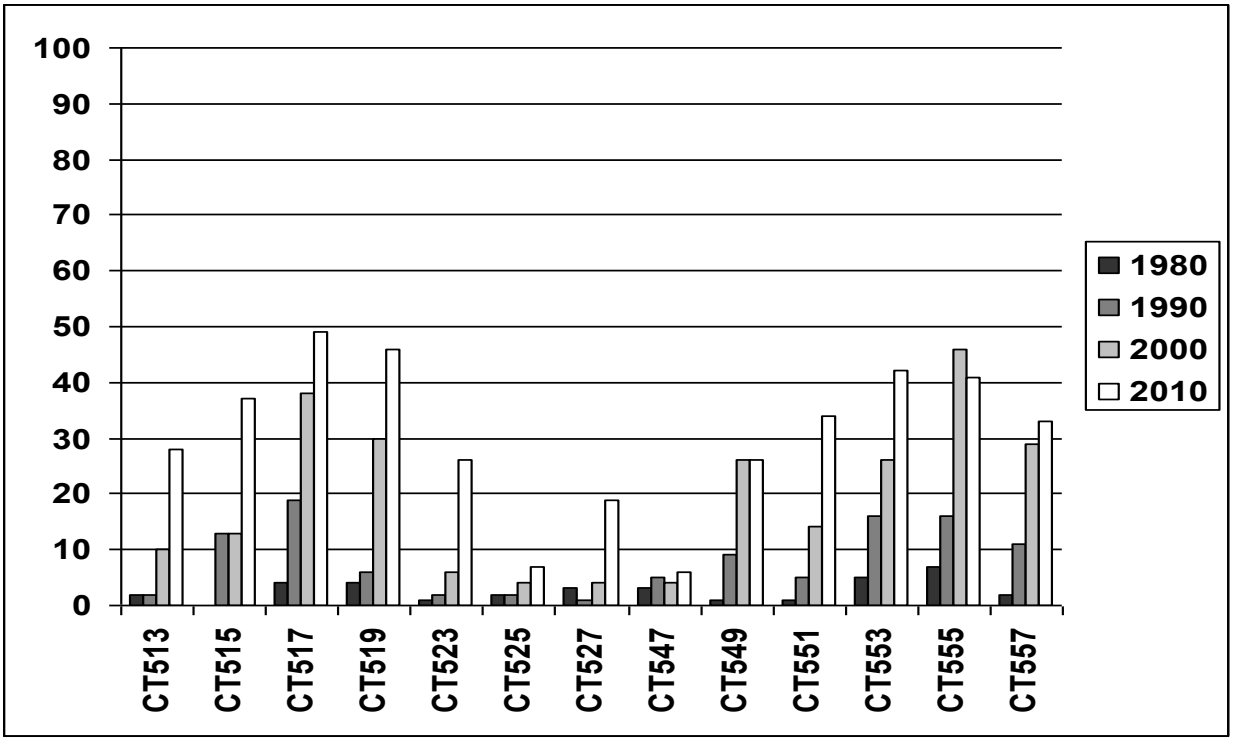


Figure 7-54. Percentage of the Population with College (or Above) Degree in Williamsburg - Core by Census Tract, 1980 - 2010.

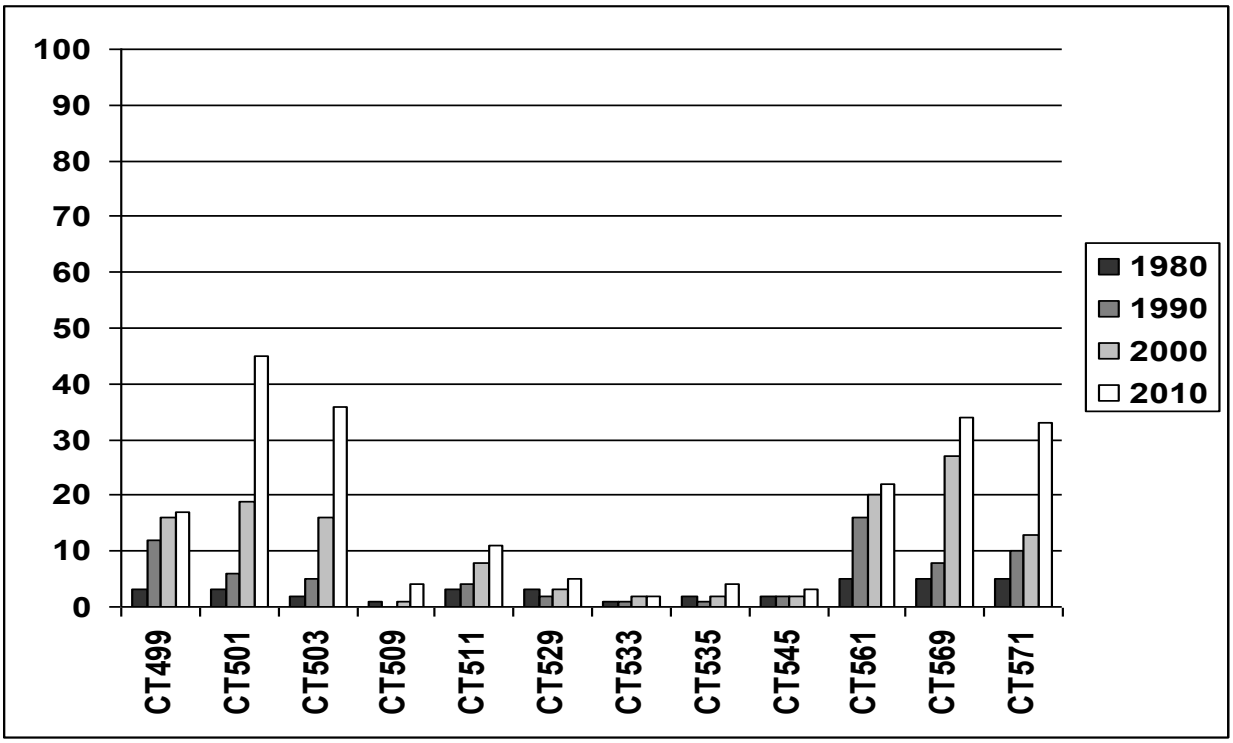
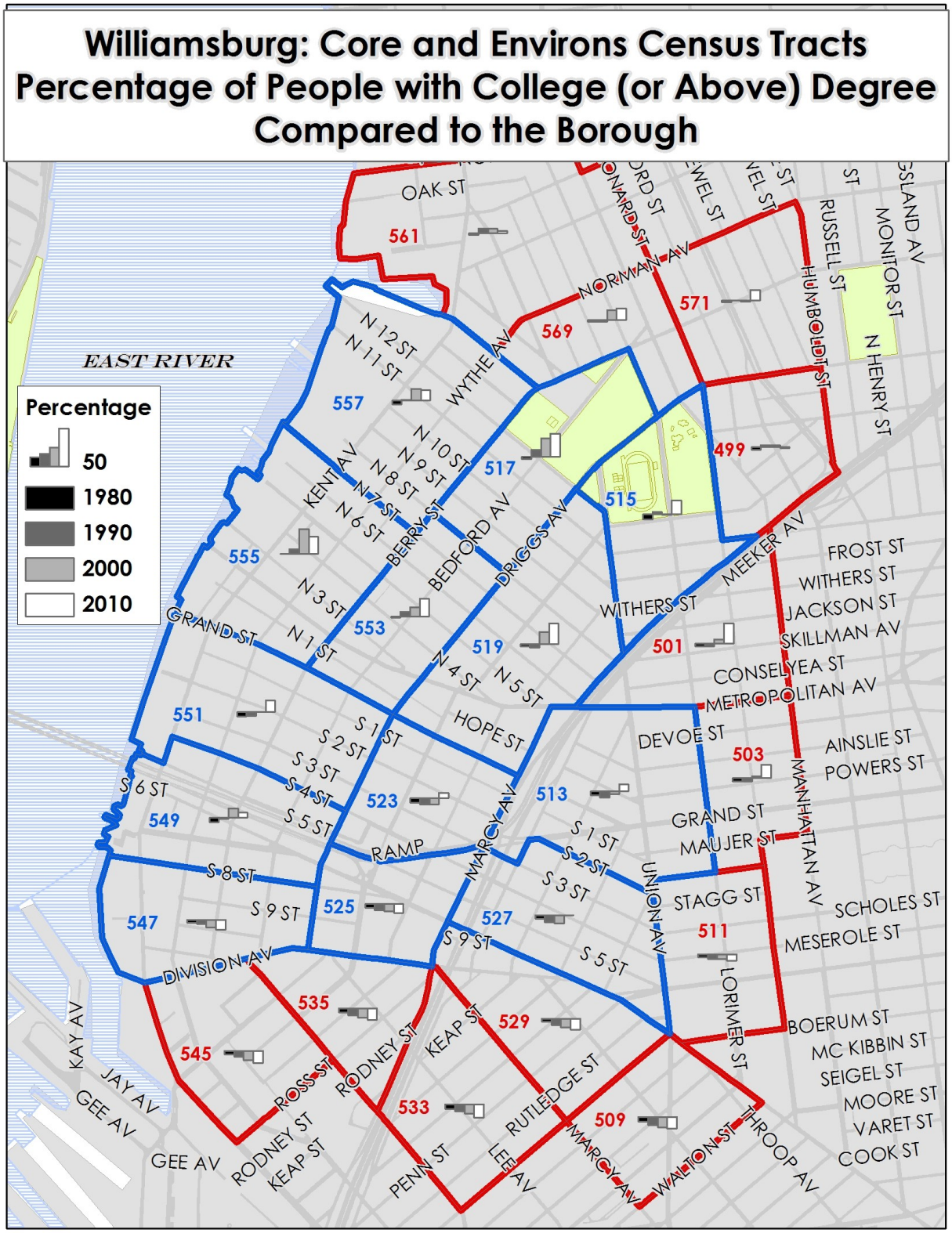


Figure 7-55. Percentage of the Population with College (or Above) Degree in Williamsburg - Environs by Census Tract, 1980 - 2010.



Map 7-48. Williamsburg, Percentage of Population with College (or Above) Degree by Census Tract, Compared to the Borough by Census Tract, 1980 - 2010.

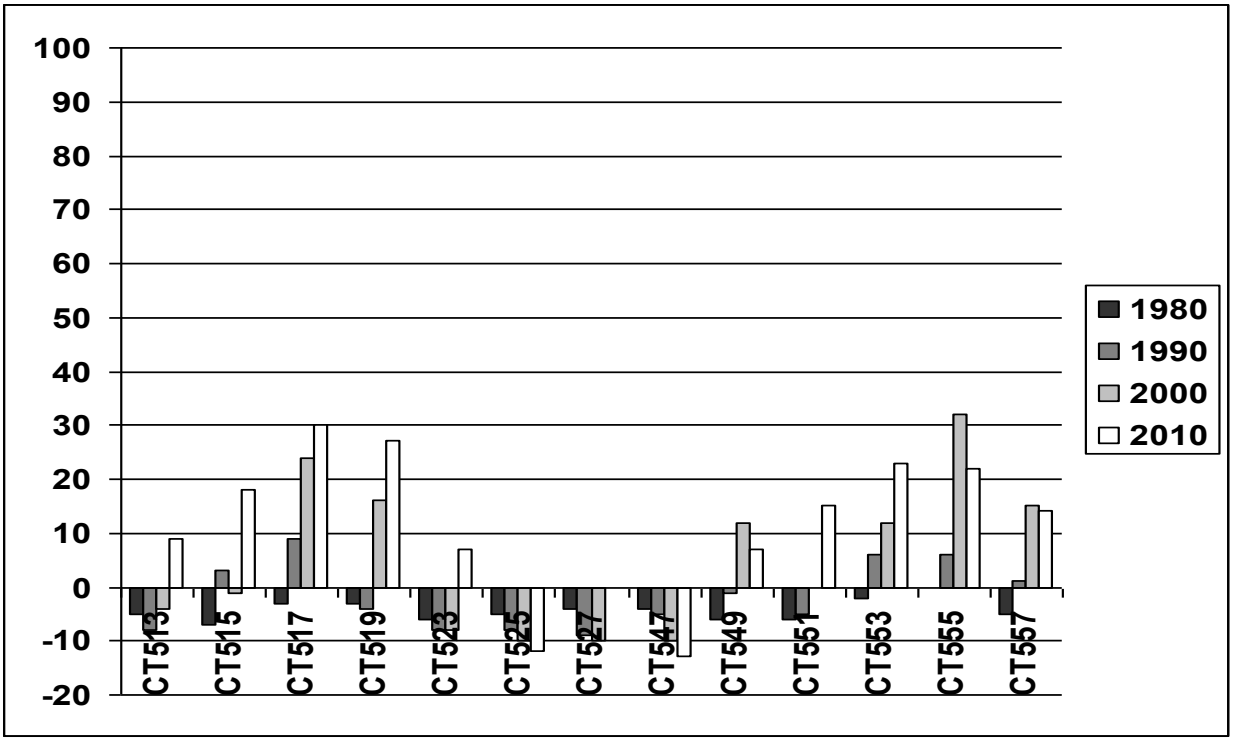


Figure 7-56. Percentage of the Population with College (or Above) Degree Compared to the Borough in Williamsburg - Core by Census Tract, 1980 - 2010.

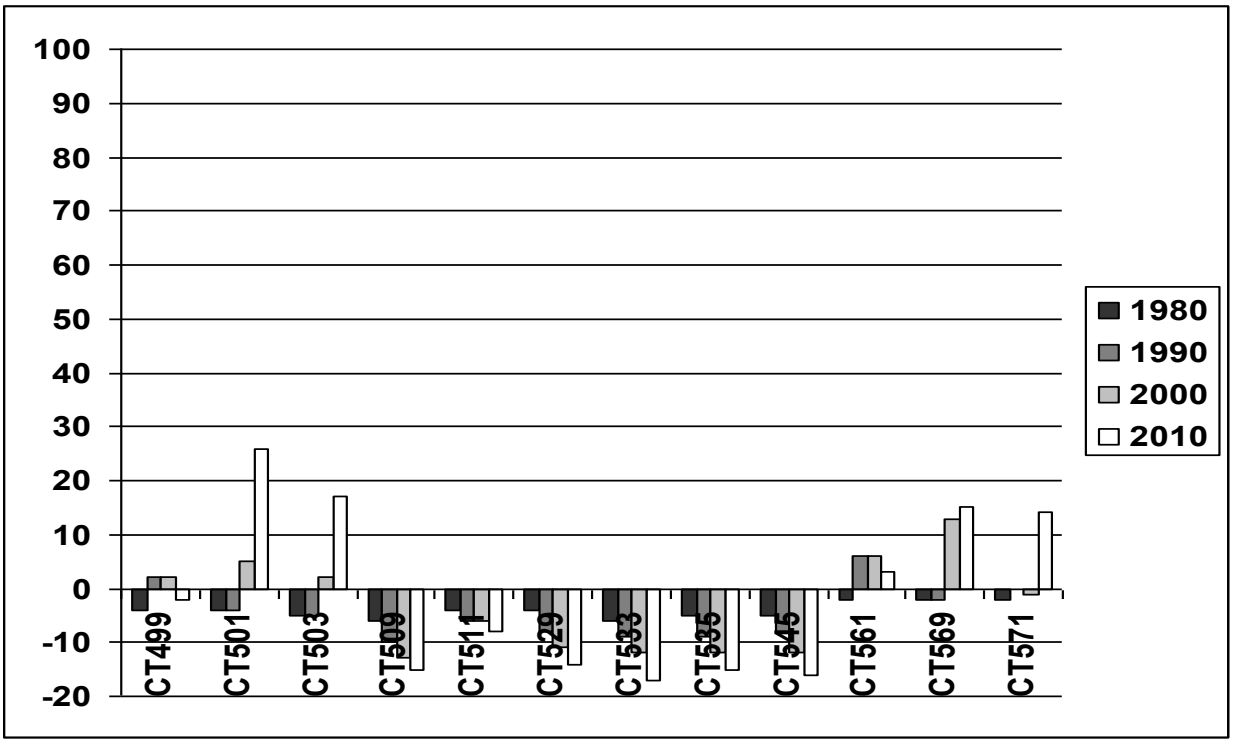


Figure 7-57. Percentage of the Population with College (or Above) Degree Compared to the Borough in Williamsburg - Environs by Census Tract, 1980 - 2010.

7-4.7b No High School Diploma

Figure 7-58 below shows the percentage of those individuals without a High School Diploma in New York City, the Five Boroughs, and Williamsburg. All the areas show decreasing trends. The Core continues to have higher percentages than does the Borough from 1980 through 2010, although the Borough has been increasing. In 1980, the Core is 38% vs. 27% for the Borough, and by 2010 it is 14% vs. 15% for the Borough. Also in 1980, the Environs began with lower than the Core at 32%, and in 2010 the Environs reaches the same percentage as the Borough at 14%. If the decreasing presence of people without a High School Diploma can be considered an indicator of gentrification, then both the Williamsburg Core and Environs are being gentrified, although Williamsburg has yet to out-perform the Borough as Park Slope has experienced.

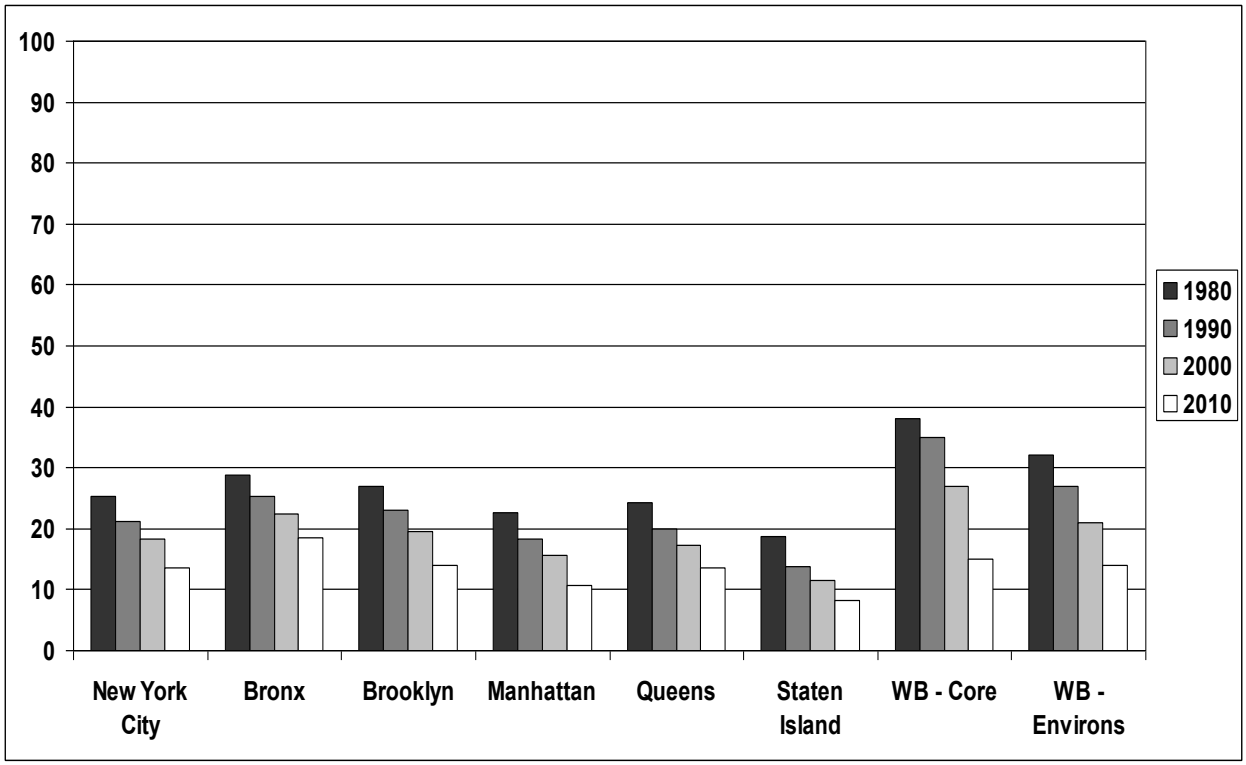
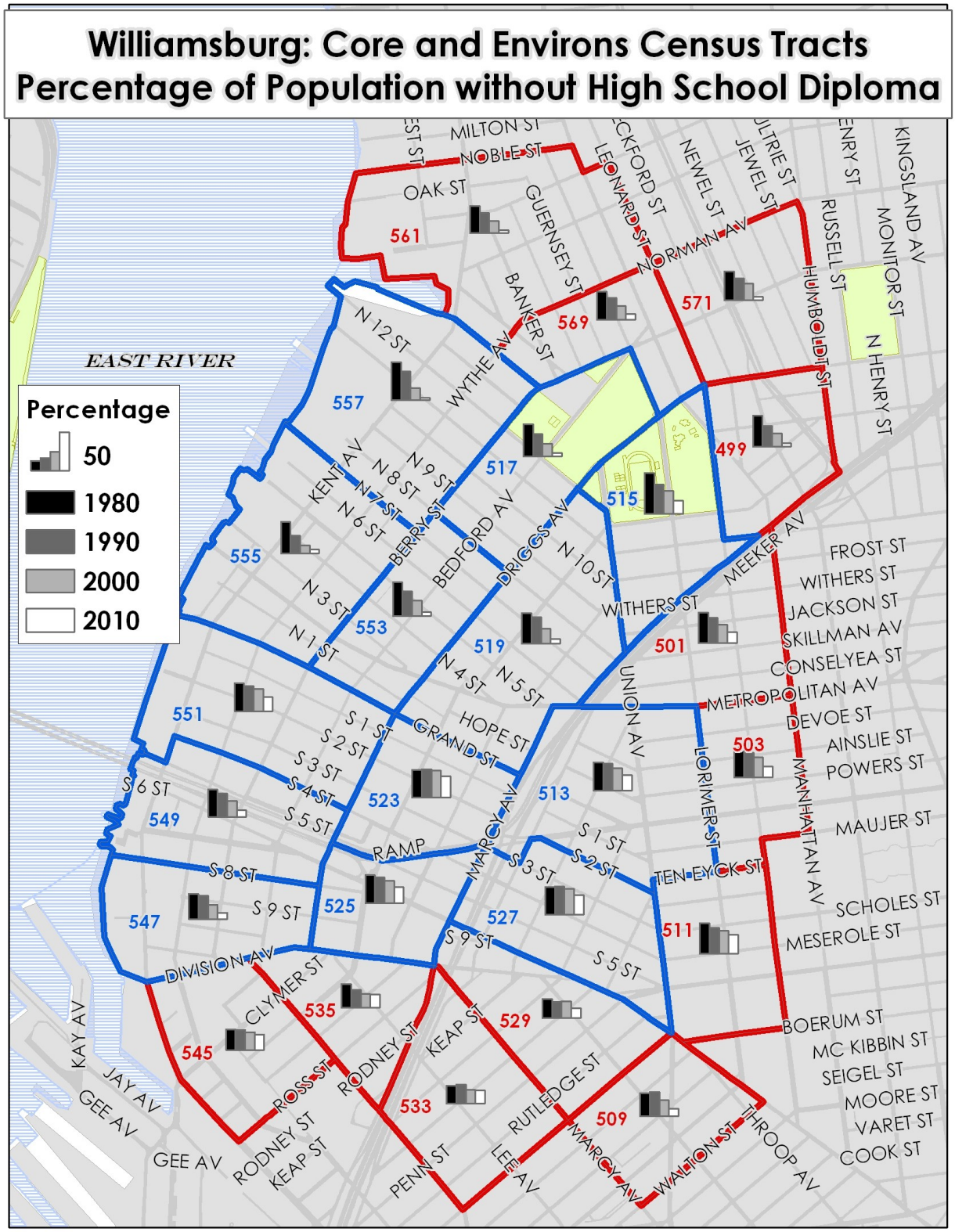


Figure 7-58. Percentage of the Population without a High School Diploma in New York City, the Five Boroughs and Williamsburg (WB) - Core and Environs, 1980 - 2010.

Map 7-49, Figure 7-59 and Figure 7-60 illustrate this group at the Census Tract level. While there are some exceptions, generally the Census Tracts in the Core and the Environs have decreasing percentages of people without a high school diploma. The Grand Street demarcation is not the only spatial pattern. While the Census Tracts on the North side have lower percentages, this pattern does not seem to cross the Brooklyn-Queens-Expressway (BQE). The Census Tracts East of the BQE continue to have higher percentages. There is also an exception regarding the two East River riverfront Census Tracts at the Southern section of the Core that also have lower percentages, while their adjacent Census Tracts show slower gains.

When compared to the Borough (See Map 7-50, Figure 7-61 and Figure 7-62 farther below) the patterns described above seem to repeat, namely, the Census Tracts within the Core and West of the BQE report more gains in educational attainment. Other Census Tracts in the Core continue to lag behind the Borough. Among the Environs, those Census Tracts in the North surpass the Borough and have lower percentages; those Census Tracts to the West are gaining; those Census Tracts in the South show a seemingly flat-line pattern and are slightly above or below the Borough.



Map 7-49. Williamsburg, Percentage of Population without High School Diploma by Census Tract, 1980 - 2010.

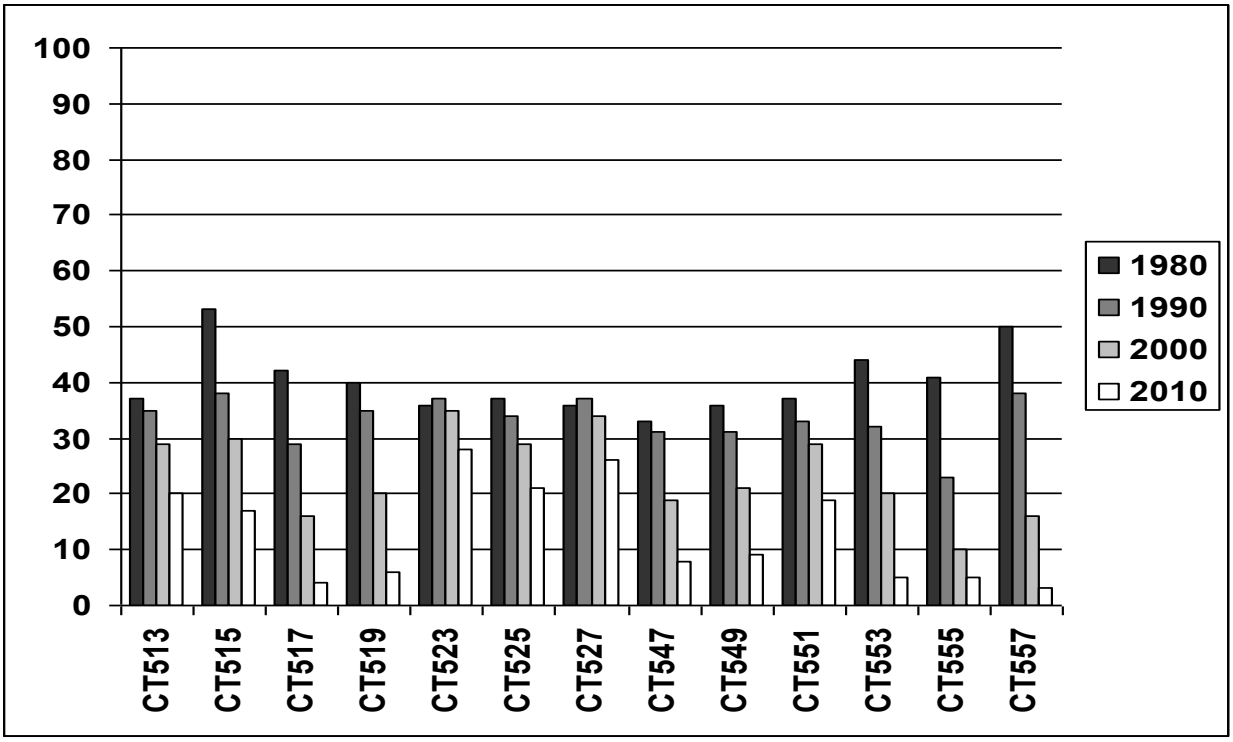


Figure 7-59. Percentage of the Population without a High School Diploma in Williamsburg - Core by Census Tract, 1980 - 2010.

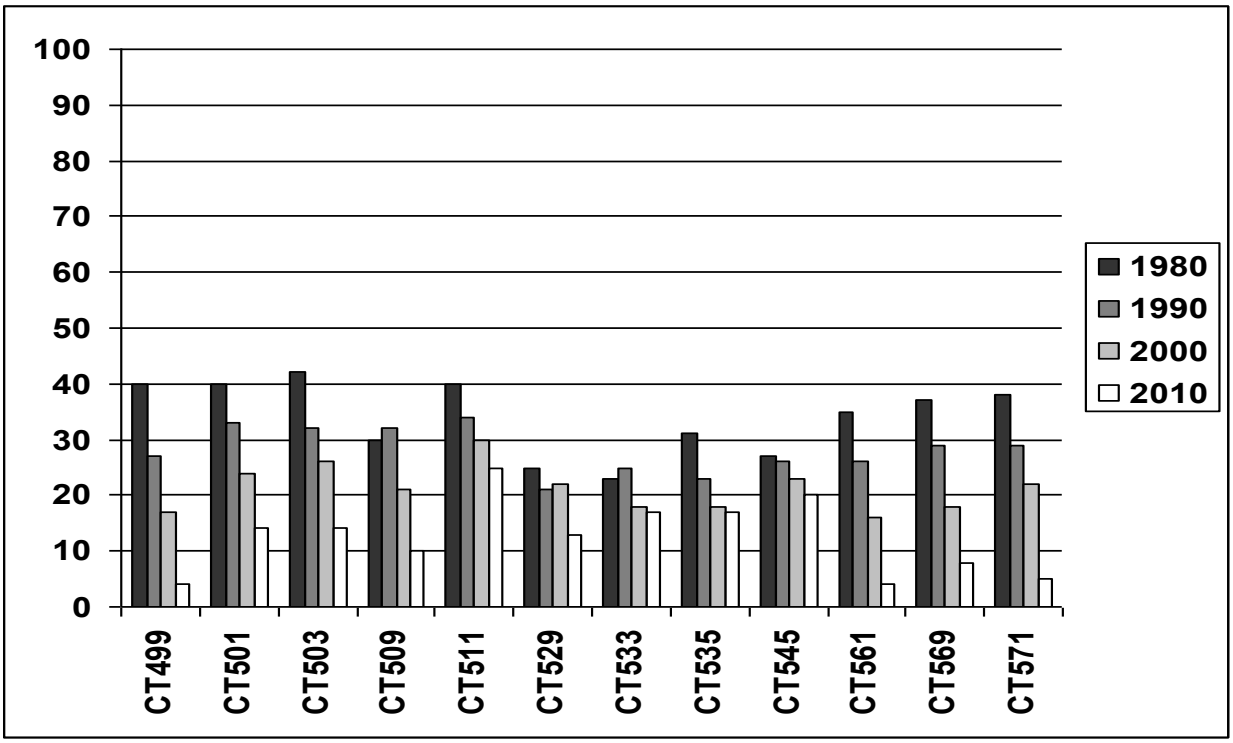
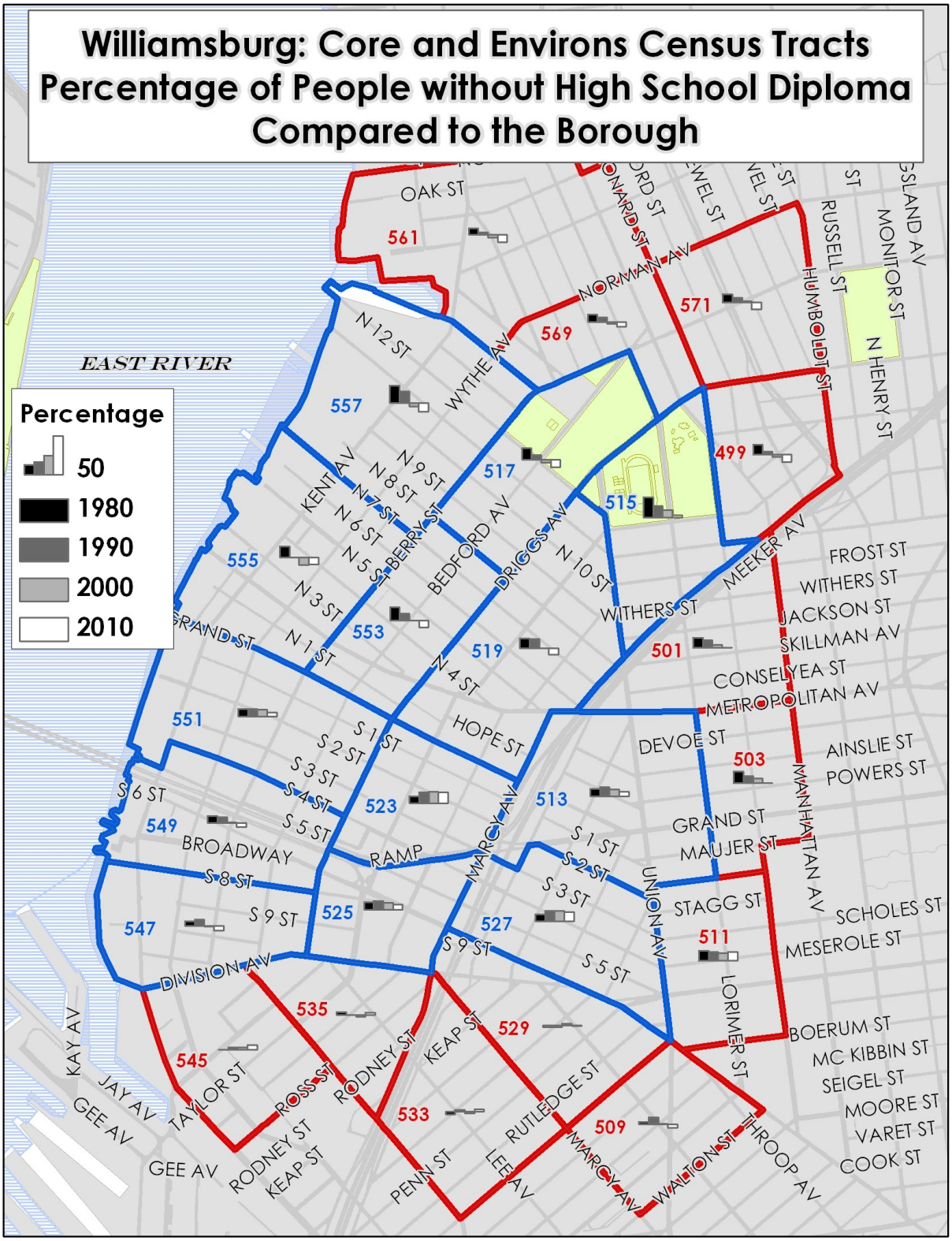


Figure 7-60. Percentage of the Population without a High School Diploma in Williamsburg - Environs by Census Tract, 1980 - 2010.



Map 7-50. Williamsburg, Percentage of Population without High School Diploma, Compared to the Borough by Census Tract, 1980 - 2010.

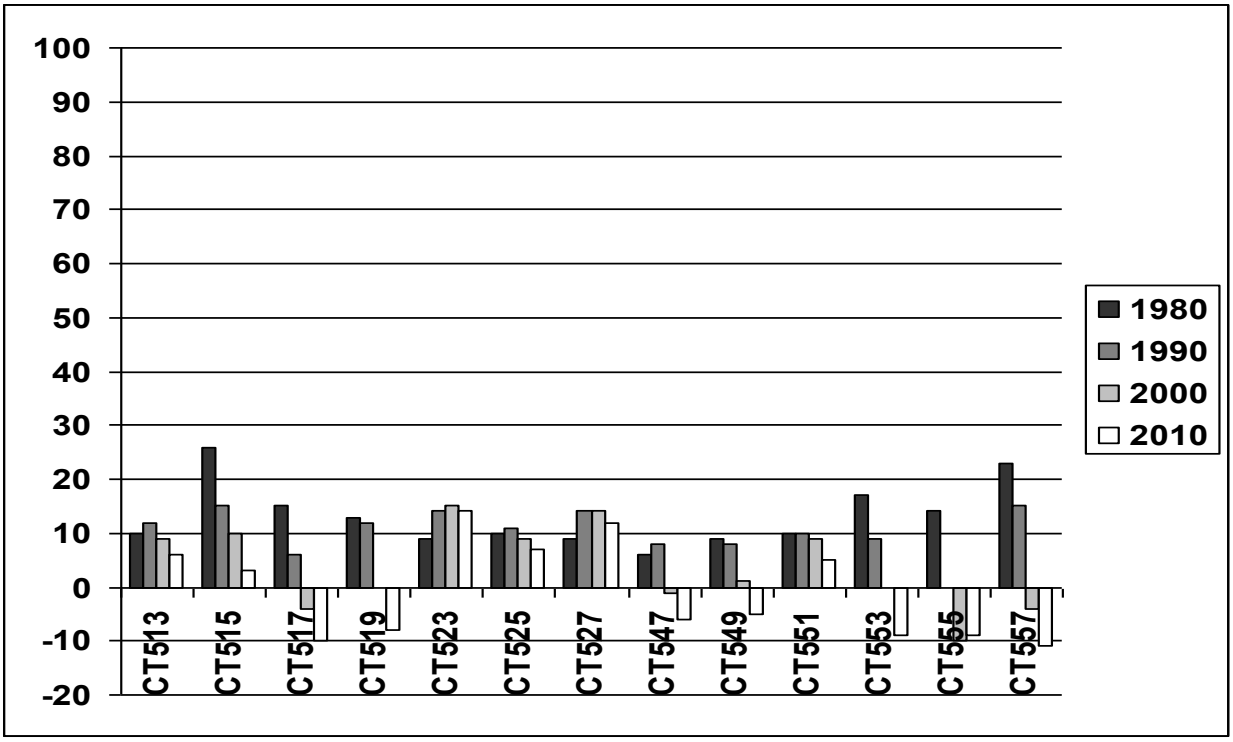


Figure 7-61. Percentage of the Population without a High School Diploma Compared to the Borough in Williamsburg - Core by Census Tract, 1980 - 2010.

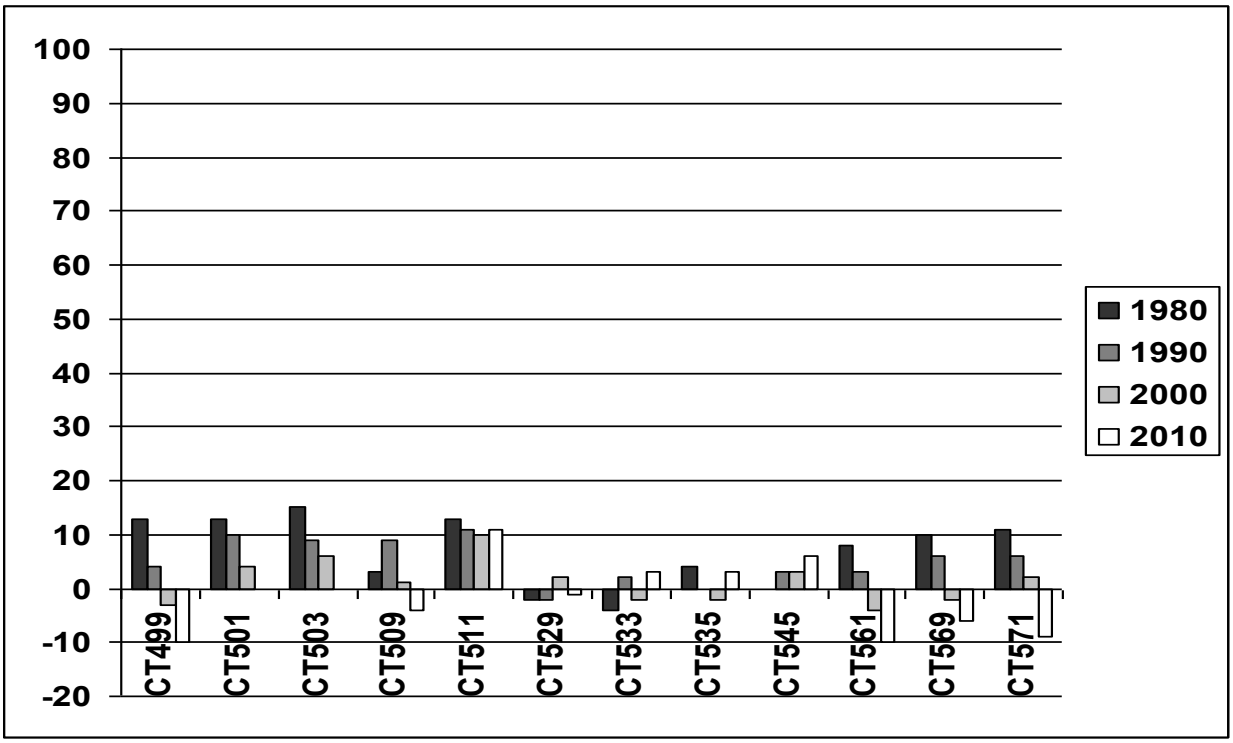


Figure 7-62. Percentage of the Population without a High School Diploma Compared to the Borough in Williamsburg - Environs by Census Tract, 1980 - 2010.

7-5 Williamsburg: Summary

As mentioned in the previous neighborhood summary discussions, the first goal of the series of gentrification maps is to establish a well-defined neighborhood. The study neighborhood case of Williamsburg has proved to be especially challenging because it has a history of changing municipalities. More importantly, the gentrification is most recent as the maps and charts in this chapter demonstrate. Together these facts prohibit the formulation of a proper definition for Williamsburg, that remains a topic for debate among historians, long-time residents, new-arrivals, and probably the most flexible - the real estate agents. The more established Greenpoint neighborhood located North of Williamsburg, has allowed the boundaries between these two neighborhoods easier to distinguish as defined by the DCP assigned NTA codes (See Map 7-2).

While the East River provides a definitive natural boundary on the West side, the East and South parameters of Williamsburg are often unsettled and undefined. This study selects a less comprehensive definition and focuses on the North and South Sides of Williamsburg (using the streets names with “North” or “South” as prefixes) and designates the surrounding Census Tracts as the Environs. This specific definition used in this study may be challenged by other researchers or residents, but at least it is clearly defined and mapped. This study’s definition of Williamsburg is also Census Tract based and it is adjustable by adding or subtracting other Census Tract(s) whenever the coverage area of Williamsburg shifts.

The intra-neighborhood differences, and the uneven development and changes during the study period from 1980 through 2010 are the primary focus of the series of gentrification maps in this chapter. In summary, the physical environment of Williamsburg can be described as follows:

1. There are more manufacturing zoned tax lots in the Core than there are in the Environs. Nevertheless, with the recent rezoning and development at the East River waterfront, the distribution of manufacturing zoned tax lots is likely to change considerably in the future.

2. Although the existing structures were built predominantly before 1940 and are short structures, one also observes an acceleration of new construction during the last decade on the East River riverfront. While a large proportion of these new housing units were unoccupied in 2010, their future is likely to play an important role in Williamsburg's gentrification in the future.

3. Unlike Park Slope, where the gentrification appears to be anchored by Prospect Park and the more established Historic Preservation District, the gentrification in Williamsburg appears on a more arbitrary North vs. South partition. If the above mentioned East River riverfront Census Tracts located in the North Core continue to attract more affluent residents, it might further influence gentrification East-bound into East Williamsburg and Bushwick neighborhoods.

In summary, the demographics of Williamsburg can be described as follows:

1. The overall growing population is certainly increasing the density of Williamsburg. One has also observed the rising percentages of the White population in recent years, especially in the Middle section of the Core.

2. The Black and Chinese populations continue to represent very small percentages in Williamsburg. The only exception is the increasing presence of the Chinese population in one Census Tract at the Southeast Environs.

3. The presence of the Hispanic population continues to decrease, an observation that is inconsistent with the general for New York City and the Borough. It is particularly notable that in certain Census Tracts the percentage of the Hispanic population drops throughout the study years, and changes from being the majority to the minority.

4. Williamsburg is not widely reported as being a family-oriented neighborhood, and the percentage of the Age under 5 group in the Core continues to drop between 1980 and 2010. In the Environs the percentages of the Age under 5 group are consistently high and it is likely due to the Hasidic Jewish community that resides there, especially to the South.

5. The twenty-something presence in the neighborhood does increase considerably in recent decades and coincides with media and press reports. Increases in "Age 20-29", however, clustered toward the North side and are not evenly distributed across Williamsburg. The presence of the Age 65 and over group decreases in the North, but increases slightly south of the Grand Street.

The housing condition in Williamsburg presents a scenario that is different from that of Park Slope and the Lower East Side. Specifically, new buildings, especially those within the Core,

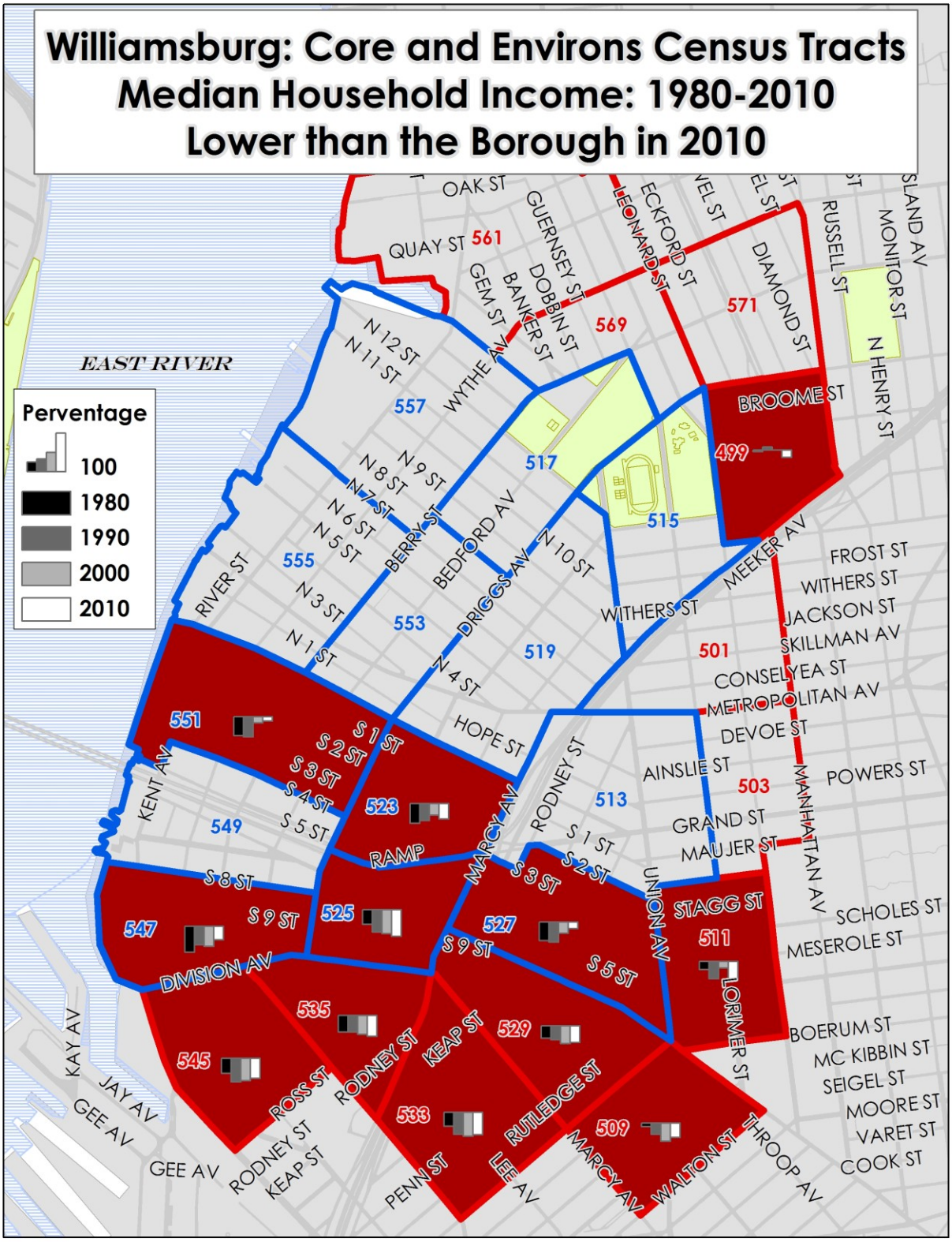
play a larger role among existing housing units and are likely to change the course of the future housing characteristics. Renters remain the majority that reside in Williamsburg and it is likely that they keep the vacancy rate low in the neighborhood. The exception is Census Tract 555 that had numerous new units that remained vacant in 2012.

In summary, the socio-economic conditions of Williamsburg can be described as follows:

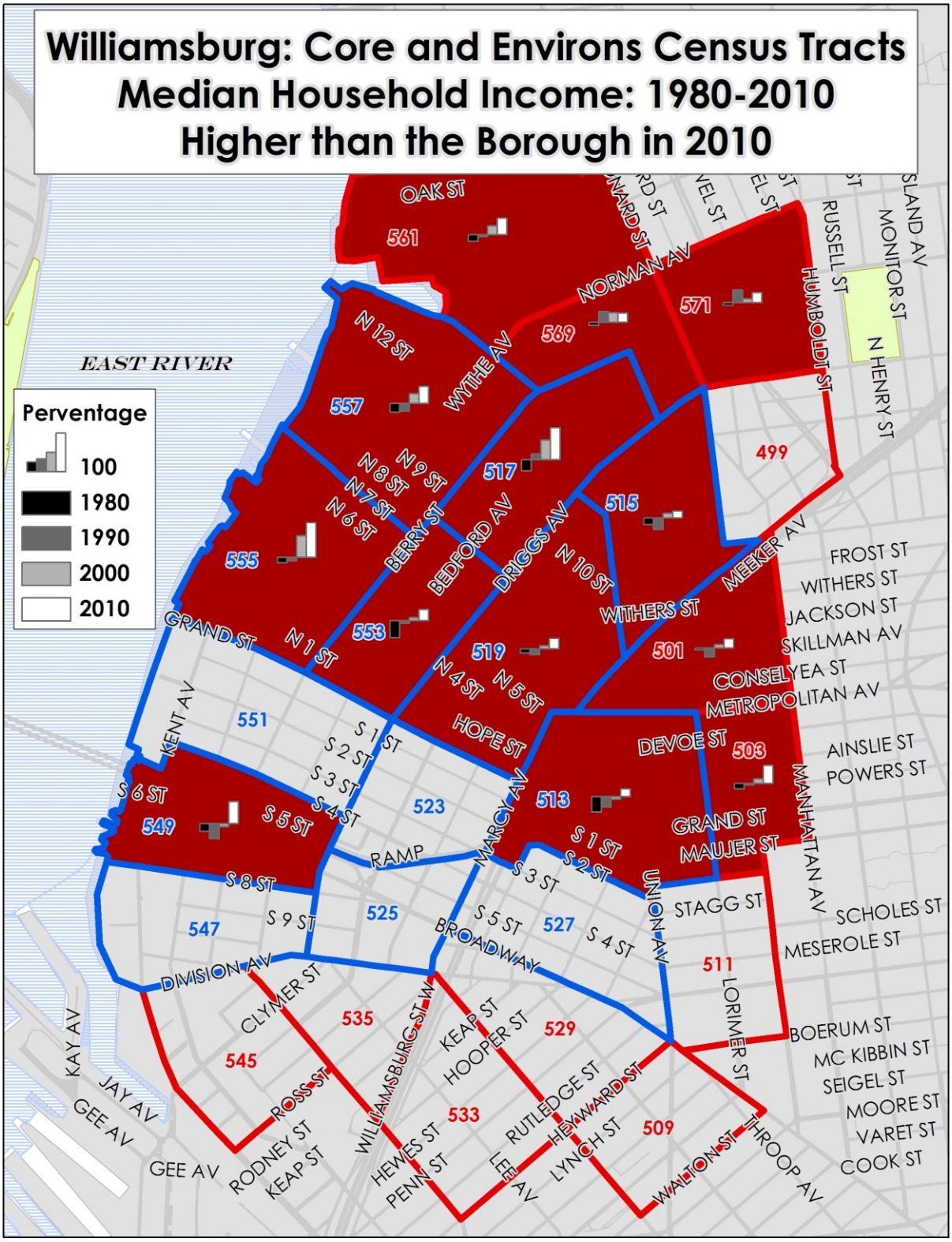
1. Whether it is the median household income, median gross rent, or the percentage of people with high educational attainment that has been used as indicators of gentrification, the intra-neighborhood differences within Williamsburg is very different from that of Park Slope and the Lower East Side. While gentrification in these neighborhoods has a spreading pattern, in Williamsburg it is Grand Street that divides the North side from the South side and serves as an approximate gentrification demarcation line. Moreover, between 2000 and 2010, SES indicators in the North side surpass the Borough, while the South have SES values lower than the Borough.

2. The North vs. South differences are not limited to the Core, but also extend to the Environs, indicating that the spreading gentrification pattern is not limited to the Williamsburg neighborhood and might have spread beyond the Environs Census Tracts defined in this study. Follow-up studies for gentrification in the Williamsburg area and surrounding area will need to consider this finding and cast a larger net to capture the full extent of the changes.

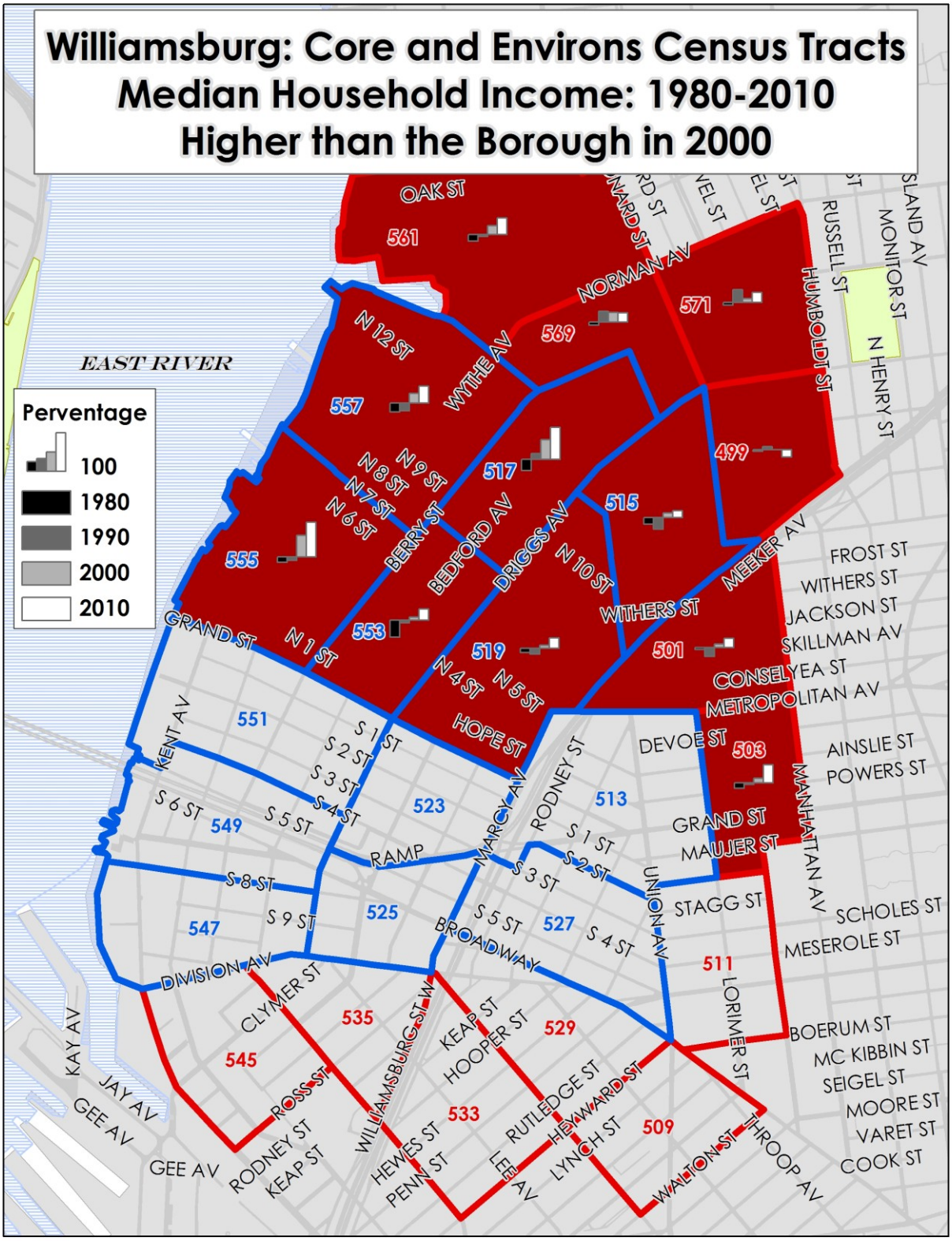
The next series of maps compare the median household income to the Borough throughout the study period. Unlike Park Slope, in 1980 none of the Census Tracts in Williamsburg had reported median household incomes higher than the Borough; in 1990, three Census Tracts in the North had reported incomes higher than the Borough; in 2000, Census Tracts North of Grand Street had reported incomes higher than the Borough; and finally, in 2010 the South-bound increase continued into Census Tract 513 and leapfrogged into Census Tract 549 (See Map 7-52). It should be noted, again, that this comparison is only based on median household income. Although, this series of maps also illustrates the different pace between Park Slope and Williamsburg: as of 2010, most Census Tracts in Williamsburg located South of Grand Street still had incomes lower than that of the Borough. Census Tract 499 in the North Environs is also in this category despite it had incomes higher than the Borough in earlier years but reported lower median household income than the Borough in 2010, a sign illuminating the gentrification in the Williamsburg area (at least as median household income is concerned) is not always a one-directional transition.



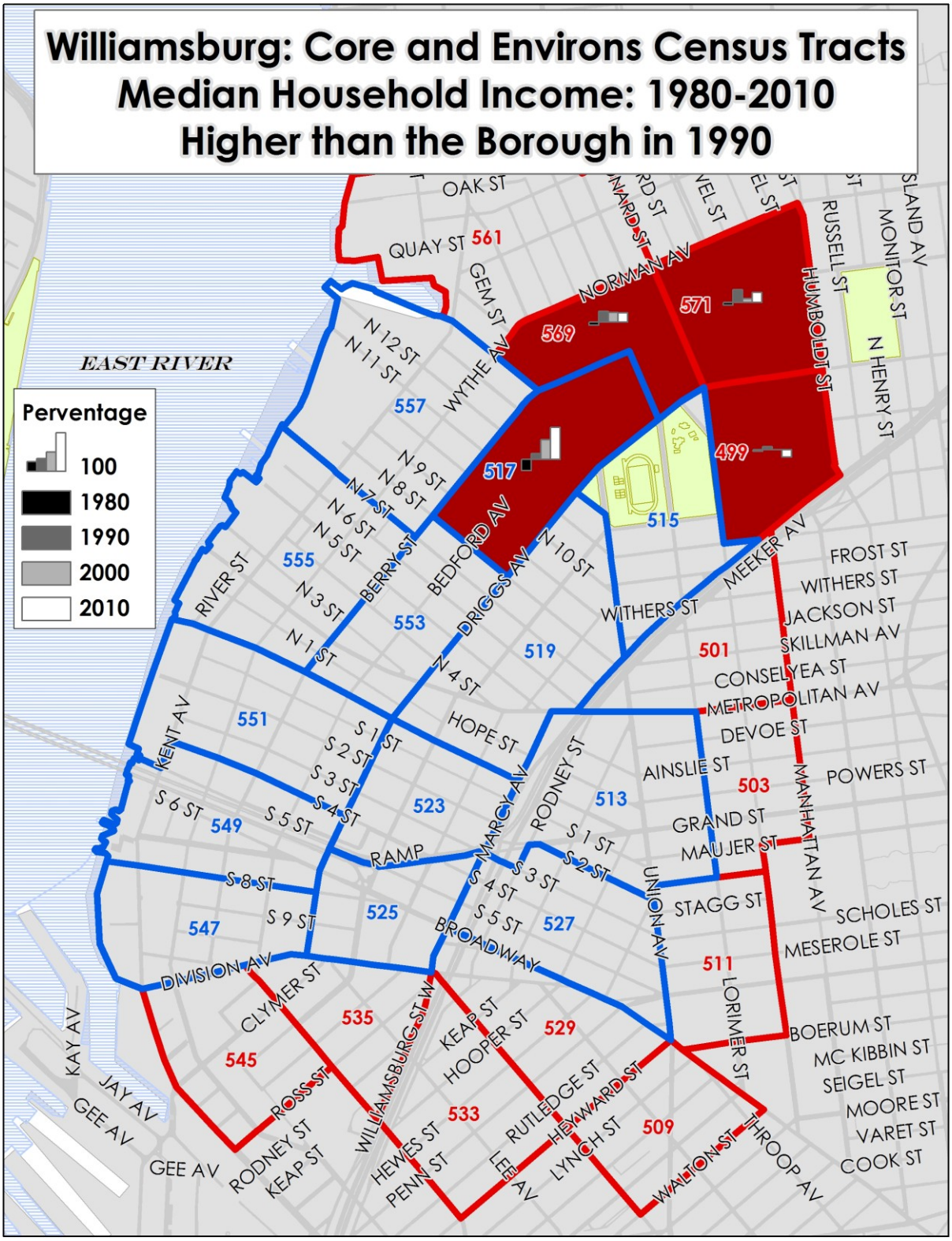
Map 7-51. Median Household Income Lower than the Borough in 2010.



Map 7-52. Median Household Income Higher than the Borough in 2010.



Map 7-53. Median Household Income Higher than the Borough in 2000.



Map 7-54. Median Household Income Higher than the Borough in 1990.

Chapter Eight : Conclusion and Discussion

This chapter is divided into two sections: the first section summarizes the findings of the gentrification maps regarding the three neighborhood chapters and compares the results; the second section focuses on the advantages of using GIS to map gentrification, specifically, this discussion introduces how the findings from these GIS-generated gentrification maps provide additional insights that are not available in the existing gentrification research. The limitations of these gentrification maps and the data-sets they are based on is also discussed together with recommendations for future in-depth follow-up studies.

8-1 Findings from the Gentrification Maps

The findings gleaned from the gentrification maps from each of the three study neighborhoods have already been discussed in each preceding chapter's summary section. This section will focus on the overall intra-neighborhood uneven developments in addition to the inter-neighborhood comparisons. Although the three New York City neighborhoods selected for this study are the subjects of other gentrification research, previous studies have generally centered attention on these neighborhoods as complete entities unto themselves and often overlooked the intricate details of the uneven developments experienced within each neighborhood. While certain studies did in fact present detailed spatial patterns, these research designs relied on unique data-sets which does not allow replication with other study periods and comparative locations are difficult, if not altogether impossible. This dissertation offers case study of each of three New York City neighborhoods. The utilization of publicly-available data-sets ensures that this research design can be followed-up with subsequent data and readily applied to other

locations for comparable gentrification mapping, analysis and discussion. In the early years of gentrification research there might be justification such as early stage gentrification scattered across inner cities and gentrified properties were not clustered to affect aggregated survey data area like Census Tracts. As gentrification progresses and matures in certain areas such as the three neighborhoods in this dissertation, the gentrification maps clearly display spatially uneven patterns through time. Although the design does not reconcile the debates from both sides of gentrification theories, the gentrification maps do capture both changing socio-economic and physical environments to provide a better understanding of the changes in these neighborhoods.

The gentrification experienced by each neighborhood is unique because of the distinctive individual history and existing conditions at the initial period demonstrated by the gentrification maps for each neighborhood. The summary sections at the end of each neighborhood chapter focus on the findings for the individual neighborhood. The following section focuses on the overall findings exhibited by all three study neighborhoods viewed together.

8-1.1 Gentrification Progresses Unevenly through Space

In this study, gentrification, or more precisely, the demographic and socio-economic indicators associated with gentrification, progressed unevenly through the three neighborhoods through the study period. To reiterate and expand the classical definition by Ruth Glass, gentrification is a process with temporal and spatial dimensions associated with existing social and physical environments. In Park Slope, the gentrification maps illustrate that the gentrification is anchored by the existing affluent area adjacent to Prospect Park and the Historic Preservation District. By 1980 this portion of Park Slope was already gentrified. Throughout the thirty-year study period

gentrification remains and in fact expands into Census Tracts farther from this initial gentrified area. By 2010, only a single Census Tract has a median household income lower than the Borough (see Map 5-53). Although the progress of gentrification needs to be considered with additional factors beyond median household income, this particular comparison at minimum least provides an indicator of its movement and progression.

In the Lower East Side, the temporal and spatial patterns are slightly different from those of Park Slope. Gentrification began initially outside the defined neighborhood boundaries. In 1980, the Census Tract-level median household income was reported that in the areas North of East 14th Street and West of the Bowery had higher percentages than that of the Borough of Manhattan. This could be attributed to the historically middle-class housing complex known as Stuyvesant Town - Peter Cooper Village and also SoHo. The Stuyvesant Town - Peter Cooper Village housing complex did not experience dis-investment as the Lower East Side, while the SoHo area experienced loft-conversions that changed its neighborhood characteristics from industrial to residential.

Although it might be unfair to compare the Census Tract readings from the Lower East Side to those of Manhattan, which has an overall higher median for socio-economic indicators than New York City, this more strict comparison does put the Lower East Side in the context of Manhattan. As of 2010, Map 6-51 shows that the majority of the Census Tracts located in the Lower East Side have median household incomes lower than Manhattan, although certain Census Tracts in the Middle section of the Lower East Side experienced an increase in the median household income between 2000 and 2010. This pattern indicates that when compared to the overall

Manhattan trends, gentrification in the Lower East Side is far from complete. It can be anticipated that the residents of the Lower East Side will continue to face the pressures of expanding gentrification or "super-gentrification" in future years. Although the public housing projects that are located at the East River riverfront Census Tracts are excluded to date from private real estate development, these residents will face and cope with the challenges and effects of gentrification such as rising prices for consumer products.

The gentrification maps of Williamsburg present another and different spatial-temporal pattern reflecting an uneven intra-neighborhood development. When compared to Park Slope, gentrification in Williamsburg occurred later, notably in the decade between 2000 and 2010. When one considers the median household income map to date, it is only the North-side of the Williamsburg neighborhood that shows signs and characteristics of gentrification. (See Map 7-44). When one considers the most recent rezoning of riverfront tax lots from industrial to residential use, the gentrification of Williamsburg is an excellent example of the Three Wave Gentrification Theory, namely that the State is an active participant. The comparatively higher percentages of new building construction in Williamsburg (when compared to Park Slope and the Lower East Side) are clearly the direct results of rezoning by the New York City government. Although the gentrification of Williamsburg began in more recent years, one can anticipate that these new developments will accelerate the gentrification across the neighborhood. Although the spatial-temporal patterns of gentrification in Williamsburg is only at an early stage, future gentrification could expand in several directions, namely, to occupy newly constructed buildings, to progress into the Southern part of Williamsburg, or move East-bound to follow the subway L-line.

Although the spatial-temporal patterns of gentrification are very different from each other among the three neighborhoods, the maps demonstrate that gentrification is a process. These gentrification maps should urge other researchers to scrutinize intra-neighborhood differences and to assess the process of how gentrification spreads throughout a neighborhood.

8-1.2 Gentrification is a Multi-Faceted Phenomenon

A comparison of the median household income seems to have efficiently captured the progression of gentrification and illustrated how it has spread within the three study neighborhoods. However, without the accompanying gentrification maps that are based on the physical environment, demographics as well as other socio-economic indicators it would be difficult to gauge how these patterns are realized. Although future gentrification researchers might use this particular design as a litmus test to detect gentrification, it should be clear that gentrification is a multi-faceted phenomenon and needs to be evaluated, measured and mapped utilizing numerous indicators.

It should also be noted that while these gentrification maps clearly demonstrate the uneven patterns of gentrification, within the three study neighborhoods, the maps are only explorations of the underlying complex relationships among the selected variables. The maps do not purport to provide a definitive causal explanation for how these indicators interact with each other. Nevertheless, these maps serve as visual aids or “windows” so that one can observe the various factors of gentrification. The maps are also helpful to predict the trajectories of future gentrification in the three study neighborhoods, especially when the maps are considered in conjunction with related policy changes, such as rezoning or government-corporation

partnerships that result in new construction developments in the area. For example, the former case could be the riverfront tax lots being rezoned from manufacturing to residential in Williamsburg, or the rezoning in Park Slope to construct a “big-box” supermarket rather than a local small business grocery store.

The new Atlantic Yards Development in Brooklyn that includes a sports arena, commercial and residential developments, represents as a new and significant feature that Hackworth and Smith (2002) consider the driving force of the latest wave of gentrification, namely, a government-corporate partnership. Although the Atlantic Yards Development’s location in downtown Brooklyn is beyond the defined Park Slope neighborhood, its effect on the gentrification of the surrounding downtown area and potential ripple effect on Northern Park Slope, should be subject of future gentrification studies. Land-use changes and commercial development should also be considered and integral into the mapping of gentrification trends.

In this regard, perhaps it is more appropriate to consider the gentrification maps created in this study collectively as a gentrification “atlas” because there are multiple factors from both social and physical environments; both sides need to be analyzed to complement each other. Each map individually illustrates a single theme, but collectively a map “atlas” depicts the multi-facets of neighborhood gentrification. Also, while this study focuses on three individual neighborhoods and examines the surrounding single-layer Census Tracts, an expanded research design that studies a neighborhood with all of its adjacent neighborhoods might a yield further understanding of the spatial and temporal patterns of gentrification.

8-1.3 Gentrification Advances through Time

On the temporal dimension of this dissertation and its gentrification maps, there are two findings: the first is that within the study period (between 1980 and 2010) the Census Tracts that show signs of gentrification, the pace is generally in one-direction. In other words, once the gentrification process begins it continues. While this observation corresponds with the classical definition of Ruth Glass, it should also be noted that during the same period there are un-gentrifying Census Tracts (such as those located in the riverfront in the Lower East Side) that remain un-gentrified within these three study neighborhoods. These observations have theoretical as well as policy implications.

How do these Census Tracts avoid or inhibit gentrification? While it is beyond the scope of this study to address this question, it could be assumed that either there are effective measures to halt or deflect gentrification, or perhaps there are factors that make certain selected areas un-gentrifiable. For example, in the case of the Lower East Side, the public housing projects on the riverfront Census Tracts have served as such barricades because they are not part of the private real estate market. New York City also has instituted several rent regulation laws such as rent-controlled and rent-stabilized apartments that are measures that can prevent or stall gentrification. While these laws have prohibited unlimited rising rents, de-regulation has eroded the availability of affordable housing stock in New York City and this effect on gentrification remains to be mapped and incorporated into future gentrification research.

Most of the gentrification maps in this study illustrate rising socio-economic status that corresponds with gentrification throughout the study period. This factor alone should not be

considered as proof that discredits the Rent/Value Gap concept that requires an economic phase of dis-investment by property owners, real-estate developments and financial institutions. These observations do not indicate that dis-investment did not occur. There are several possible explanations: first, is as straightforward as Wyly and Newman's (2006) critique of Freeman's (2003) study on displacement which stated that by 1980, the three neighborhoods selected in this study could have already passed their dis-investment phase and were well on the road to gentrification. In this respect, at least for those Census Tracts that exhibit signs of continuous gentrification, they are comparable and examples of Lees' "super-gentrification" concept. Future studies could either expand spatially to include additional surrounding areas or expand temporally to go further back in time to explore the prior decades histories for these neighborhoods. Another possible temporal direction would be to conduct follow-up studies to detect whether gentrification slows down, halts, or maybe even reverses itself by mapping socio-economic status indicators from Census Surveys.

The second possible explanation for the apparent lack of dis-investment in these three study neighborhoods, as noted in the literature review, is that the ten-year interval between Census Surveys cannot capture the sometimes rapid changing real estate market. The gentrification maps from this study should be considered as documenting a general trend. In other words, perhaps some Census Tracts experience decreasing socioeconomic status, but they cannot be captured by the Census Surveys. While the American Community Survey uses a shorter interval between surveys, its focus at the County (Borough) level is too large in scope and too generalized to capture complex and intricate neighborhood changes in New York City and other urban areas. Although the American Community Survey also generates estimated values for smaller

geographic unit such as Census Tracts, (which this study used the 2005-2009 estimates to fill in for those variables not available in Census Survey 2010), the long-term effects of this new ACS measuring tool remains to be fully analyzed when more data is available.

8-2 The Advantages of Mapping Gentrification with GIS

The first noticeable and clear advantage of mapping gentrification using GIS is that the maps clearly illustrate the locations and boundaries of the study areas. This clarity eliminates the geographic uncertainties that occur when a study site is only defined by its name. The second advantage is that the gentrification maps provide a direct and clear visualization of the differences within a single neighborhood. This is further achieved by the design of this study, namely, not to aggregate Census Tracts to define a neighborhood, and also to insert bar-charts reflecting gentrification indicators directly onto these maps in there corresponding locations.

8-2.1 Illustrating a Well-Defined Study Site

The gentrification maps created for this dissertation do not end the debates between the "production" and "consumption" sides of gentrification theorists. However, the maps do provide clear geographic definitions of the three study sites. While neighborhood boundaries are subjective and evolve over time, gentrification studies must be clear about defining the study sites so that contemporary and future researchers can make comparable studies. Without clearly defined study sites, incomparable case studies will remain case studies and no synergy can be achieved to further the understanding of gentrification in these sties. It is the intent of the

gentrification maps created for this dissertation to promote Lees' call for researchers to pay attention to the "geography of gentrification" (Lees, 2000) because gentrification is in essence, an inquiry into the uneven development of a given defined spatial area. If this "given" is not clearly defined and illustrated using GIS, then gentrification research might be viewed as a collection of incomparable case studies.

8-2.2 Uncovering the Intra-Neighborhood Uneven Development

Once the study sites are defined clearly, the gentrification maps illustrate the uneven development within these neighborhoods. The embedded bar-charts within their corresponding Census Tracts illustrate the changes throughout the study period. In the case when variables have consistently low values the accompanying bar-charts (using an enlarged scale) can be examined to clarify the compressed embedded bar-charts. The ability of these gentrification maps to illustrate how each selected variable progresses differently through time and space. This research design distinguishes this dissertation from other gentrification research that rely only on texts, descriptive narratives and statistics.

8-2.3 Exploring the Progress of Gentrification

As described in the literature review for GIS, one of the principles of GIS is to separate the environment into layers. Queries can be administered to either identify spatial patterns within a particular layer, or to explore spatial relationships between multiple layers. This dissertation's research uses these query functions at the end of each neighborhood chapter by comparing the

median household income to the respective Borough's values throughout the study period and gauged the progress of gentrification. One exploratory research question is whether to investigate how or if the presence or absence of park land facilitates or inhibits gentrification.

The gentrification maps in Chapter Five illustrate that gentrification began in the Census Tracts adjacent to Prospect Park and approximately correspond to the Historic (Preservation) District. This observation concurs with the notion that environmental amenities such as Prospect Park, and distinctive architectural features such as the Historic District, facilitate gentrification. To further investigate the role Prospect Park serves in gentrification, a series of exploratory maps based on this study's design has been created.

Map 8-1 below illustrates Prospect Park Census Tract 177 (highlighted in gray) and its surrounding areas. The color scheme that represents the Park Slope Core and Environs are included to identify their locations. Using Prospect Park Census Tract 177 as the base and conducting a spatial query to select Census Tracts within 2,000 ft. results in the Census Tracts represented in bright blue boundaries in Map 8-2. Map 8-3 illustrates the result of further expanding the selection parameter to 4,000 ft. This spatial query covers the Park Slope Core and Environs and is the base for this expanded analysis. Map 8-4 adjusts the color scheme with the selected Census Tracts represented in gray. The Park Slope Core and Environs outlined in blue and red are retained.

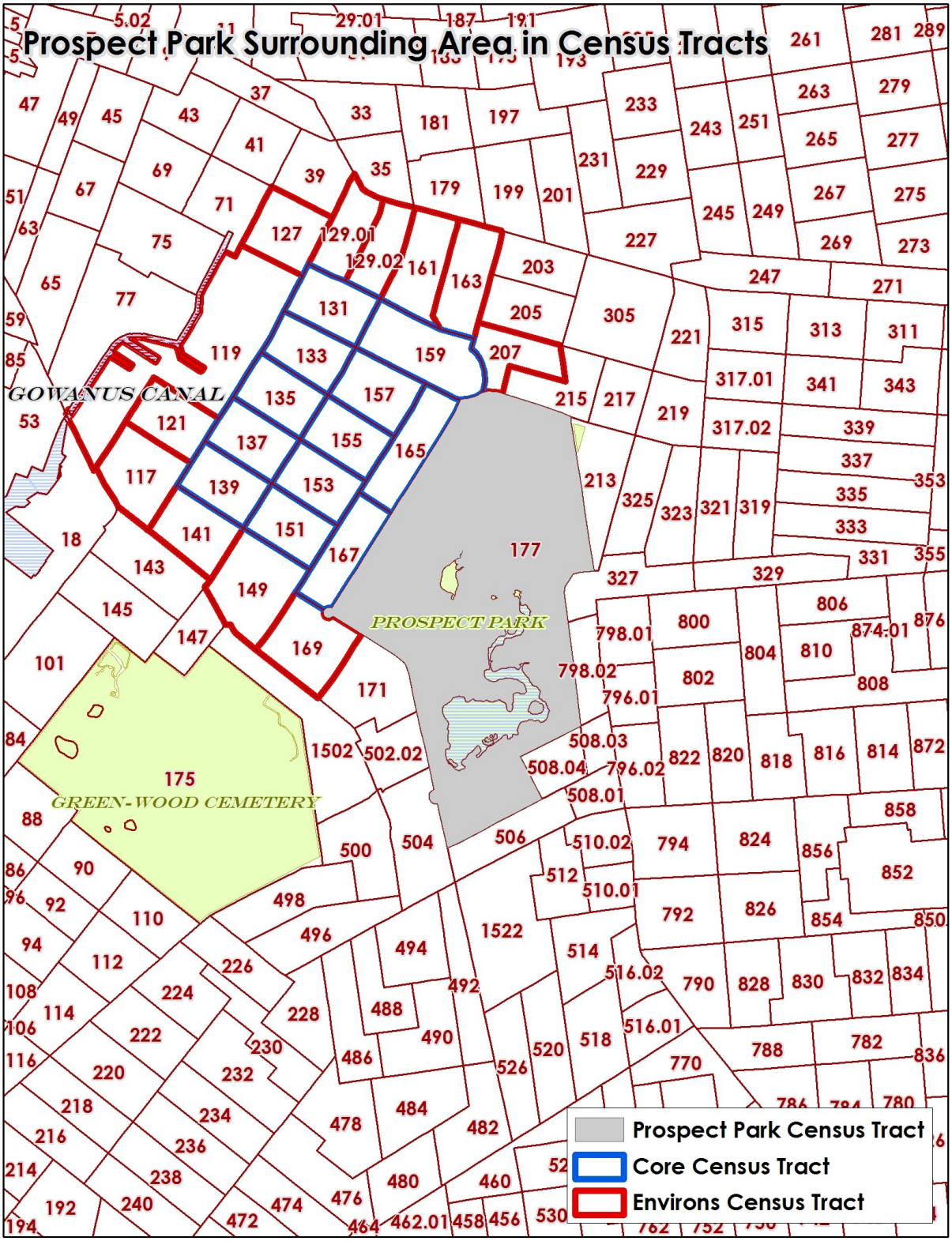
Map 8-5 and Map 8-6 illustrate the median household income of these Census Tracts and the results (in percentages) when compared to the Borough. These two maps illustrate the distinctive

characteristics of Park Slope. Throughout the study period, the increase in median household income reported in Park Slope is not applicable to other Census Tracts that surround Prospect Park. In fact, other than the few Census Tracts sandwiched between Prospect Park and Green-Wood Cemetery as well as Census Tract 1502 that have similar though smaller increases in median household income, the surrounding Census Tracts do not report noticeable increasing median household incomes.

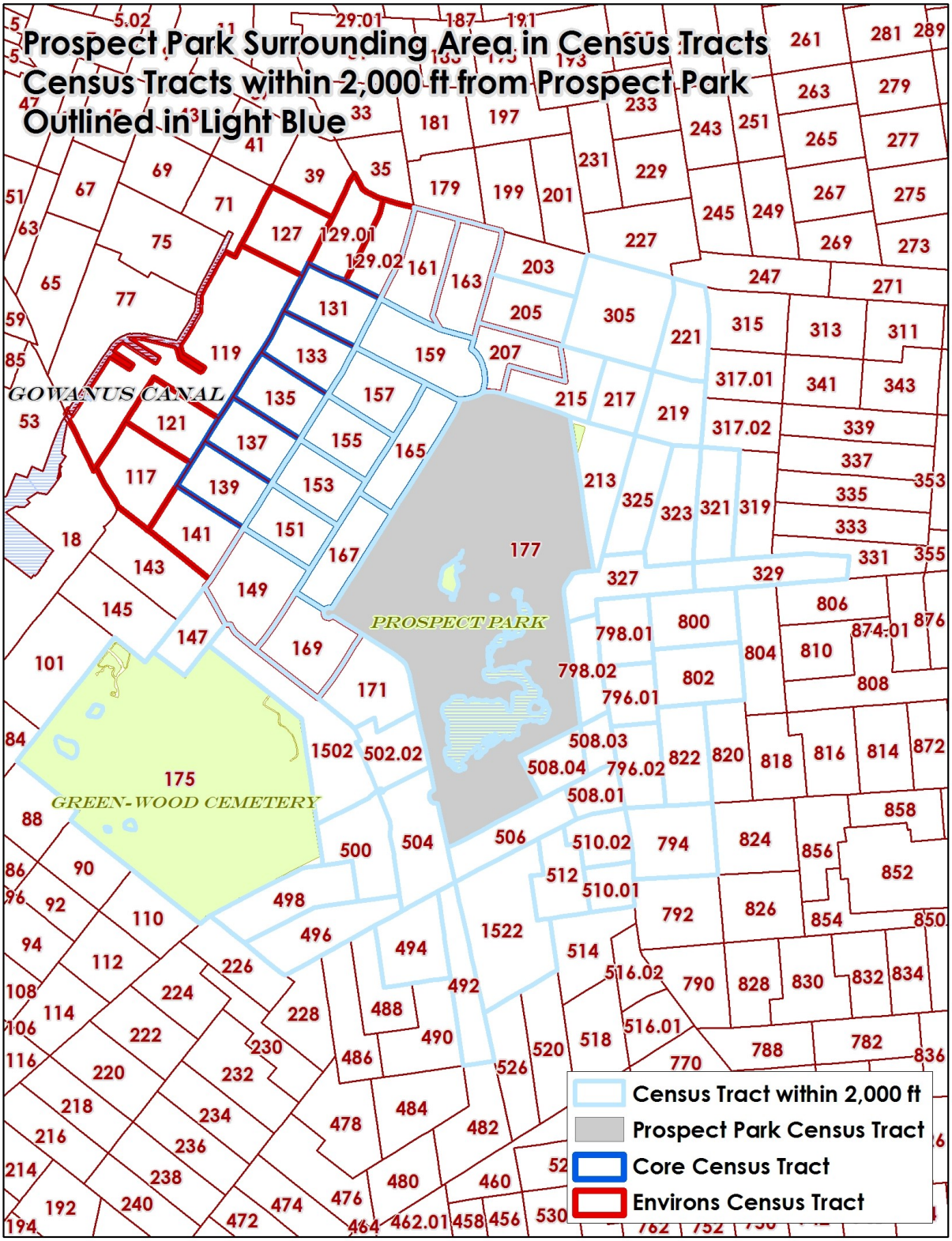
Map 8-7 through Map 8-10 further below illustrate the results of these conditional queries to select specific Census Tracts highlighted in dark red to indicate which have median household incomes higher than the Borough. While some Census Tracts on the opposite side of Prospect Park also meet these requirements, the embedded bar-charts demonstrate that the median household incomes are not as high as those in the Park Slope Core. In other words, although proximity to Prospect Park is a factor that facilitated the gentrification in Park Slope, close proximity does not necessarily result in gentrification by itself.

Map 8-11 through Map 8-14 illustrate the reverse pattern and highlight Census Tracts in dark blue when the median household income is lower than the Borough. A review of this series of maps one can also observe whether the Census Tracts in Park Slope Core and Environs are different from those in other areas. As gentrification progresses throughout Park Slope, by 2010 only one Census Tract in the North-west corner reports median household income lower than the Borough. This sign of gentrification is not reported in the Census Tracts on the opposite side of Prospect Park. In fact, many Census Tracts report median household incomes lower than the Borough throughout the study period.

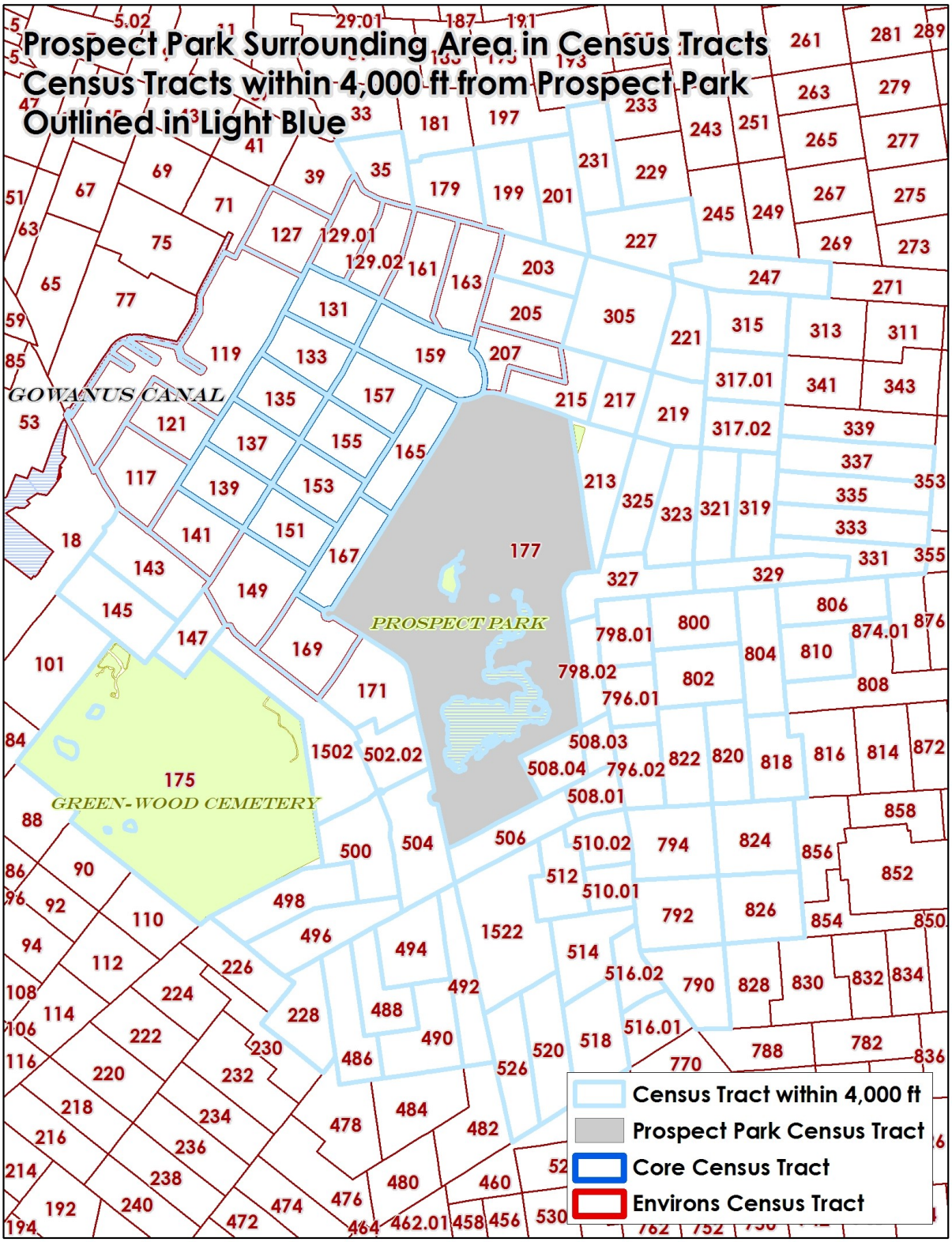
These two additional series of maps further emphasize that the GIS query functions can assist researchers to visualize and explore spatial and temporal patterns of gentrification. While it is important to gauge what factors might facilitate gentrification in the three study neighborhoods, it is also crucial to investigate whether these factors have a sole impact or whether they are part of a combination of several environmental factors. These two series of maps also expose the constraints of GIS as an exploratory research method. For example, the possibilities and variations of conditional and spatial queries are almost endless and it would be utterly inefficient for researchers to use them without first formulating a cogent and underlying hypotheses. The following section further describes limitations of this study.



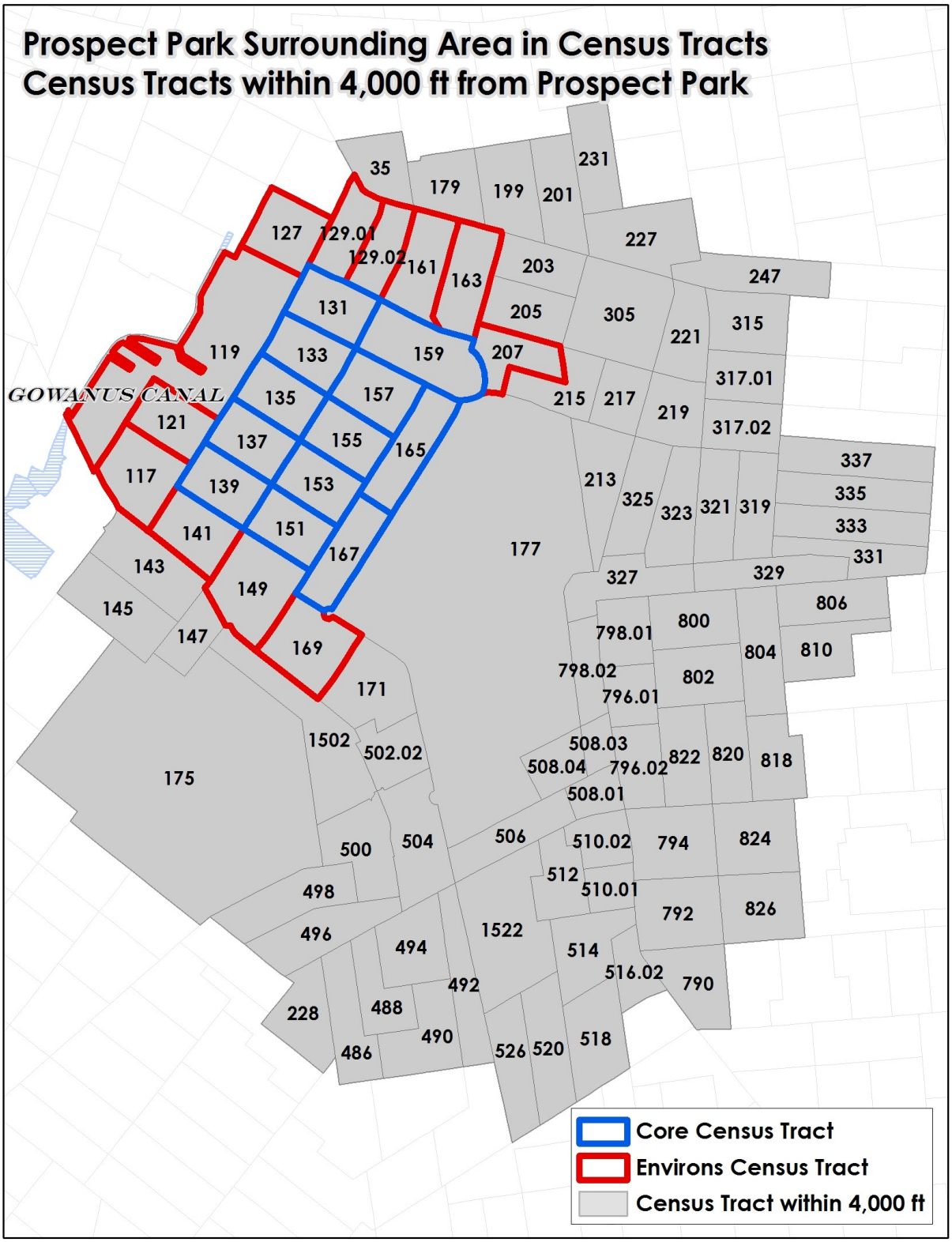
Map 8-1. Census Tracts around Prospect Park (the park is highlighted with gray).



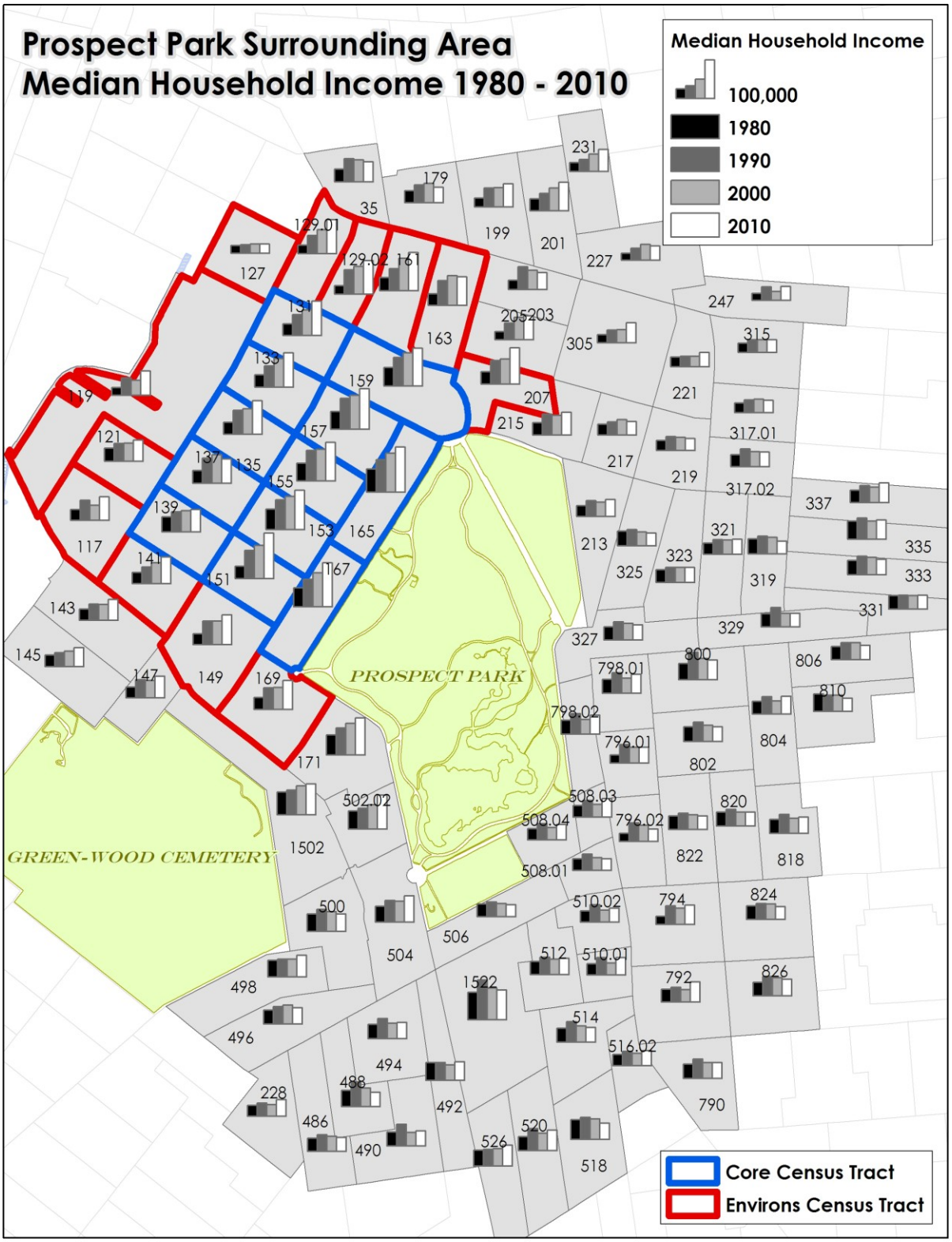
Map 8-2. Results of a spatial query to select Census Tracts within 2,000 ft from Prospect Park Census Tract (177).



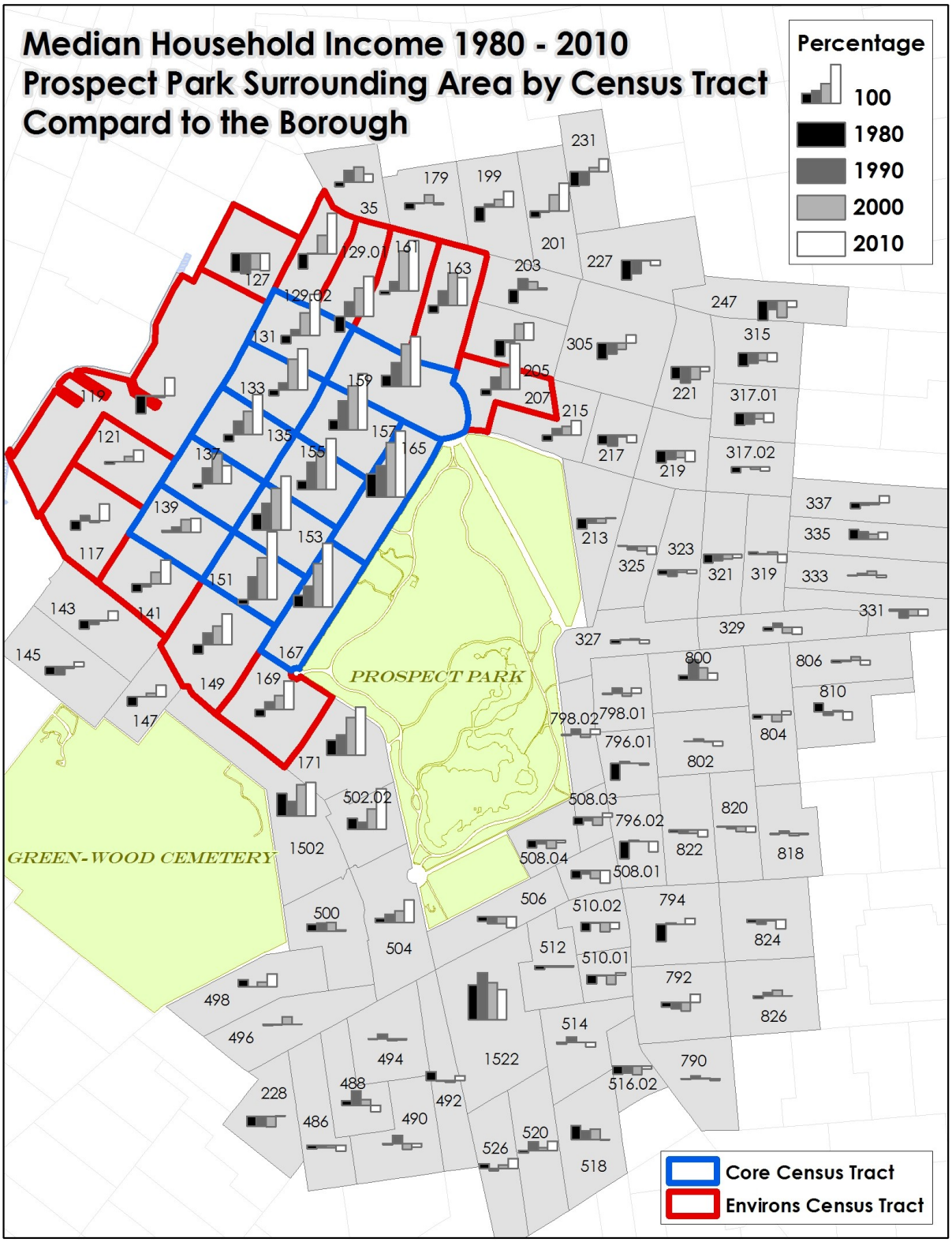
Map 8-3. Results of a spatial query to select Census Tracts within 4,000 ft from Prospect Park Census Tract (177).



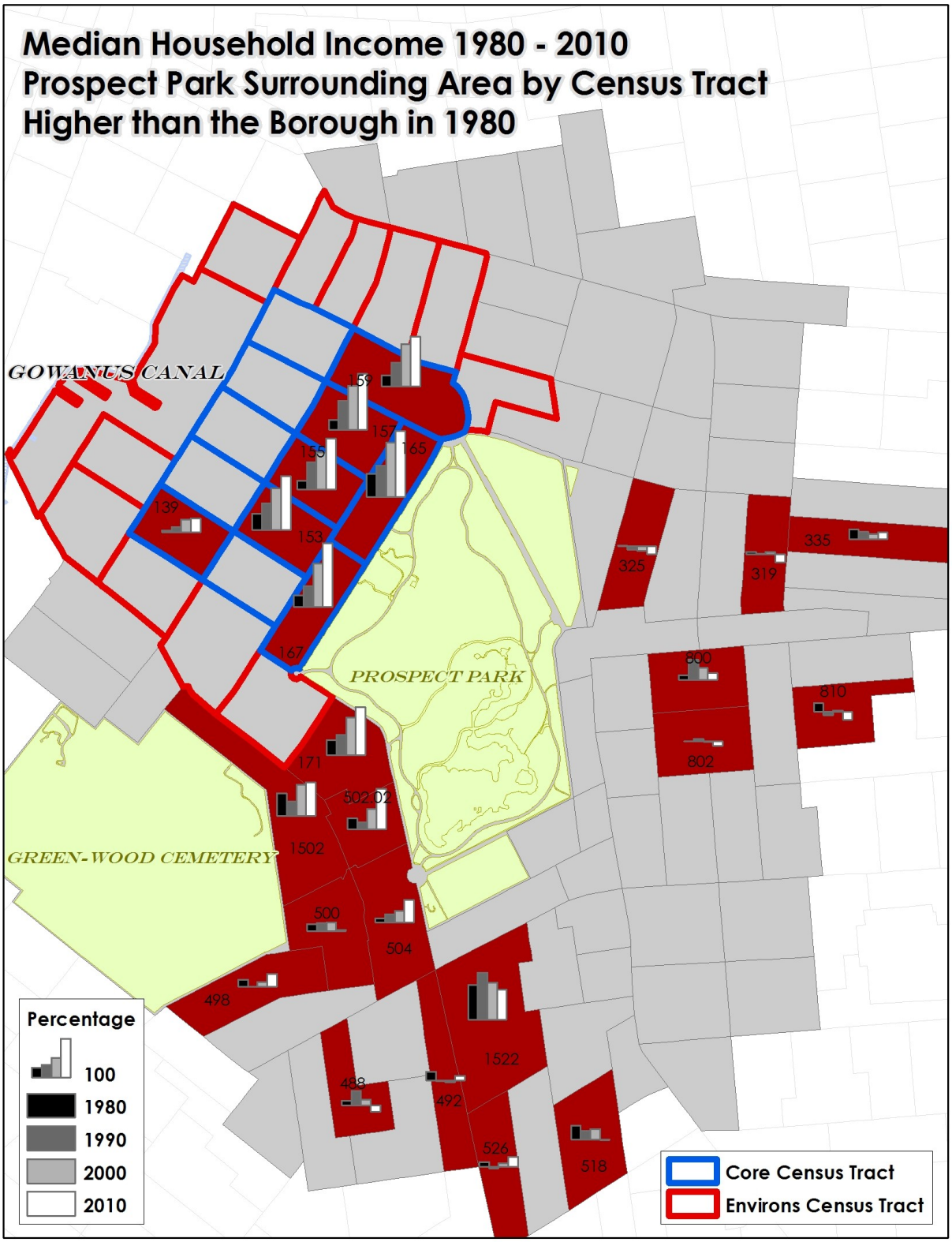
Map 8-4. A different display to highlight the Census Tracts within 4,000 ft from Prospect Park Census Tract (177).



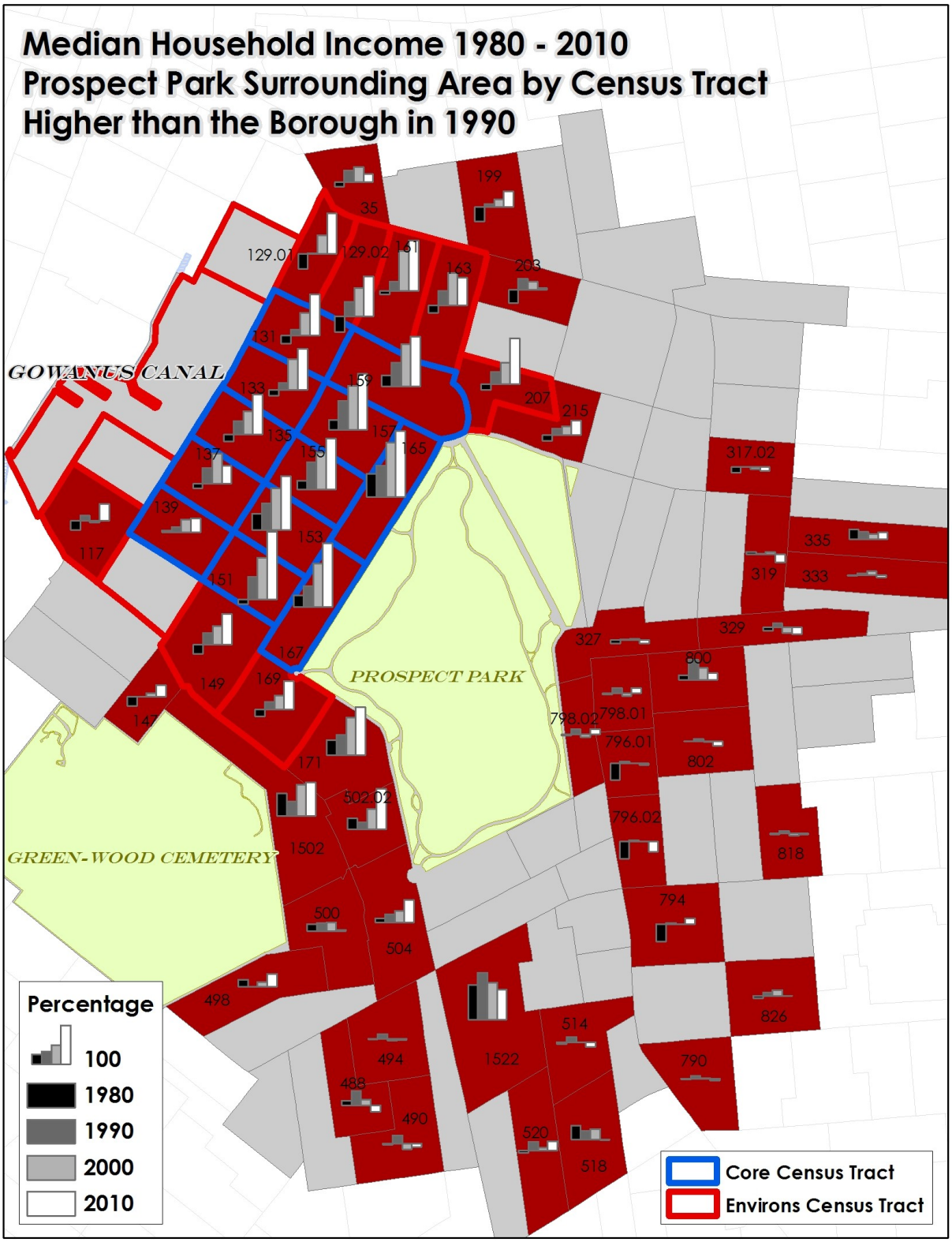
Map 8-5. Map 8-5. Median Household Income, 1980-2010.



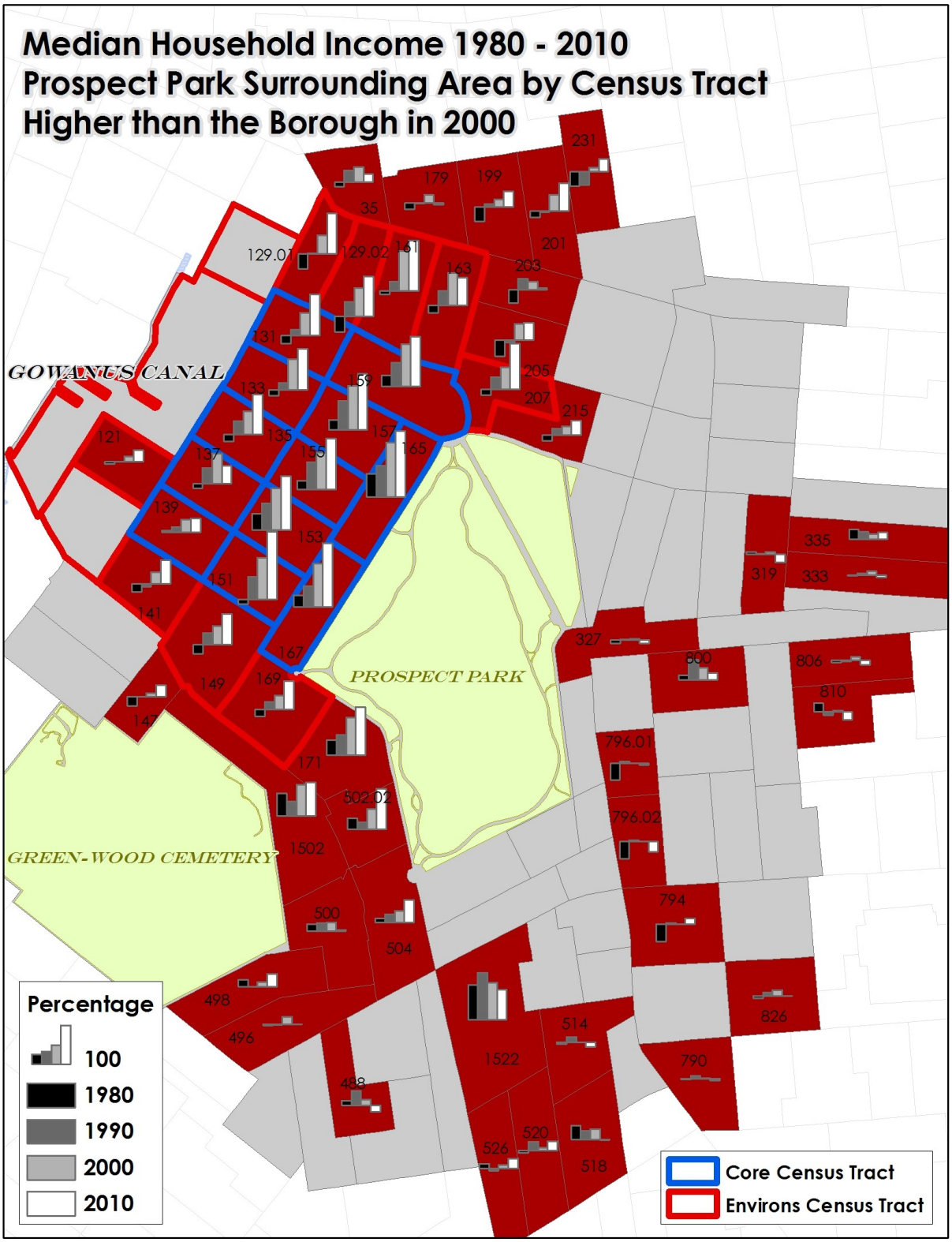
Map 8-6. Median Household Income compared to the Borough, 1980-2010.



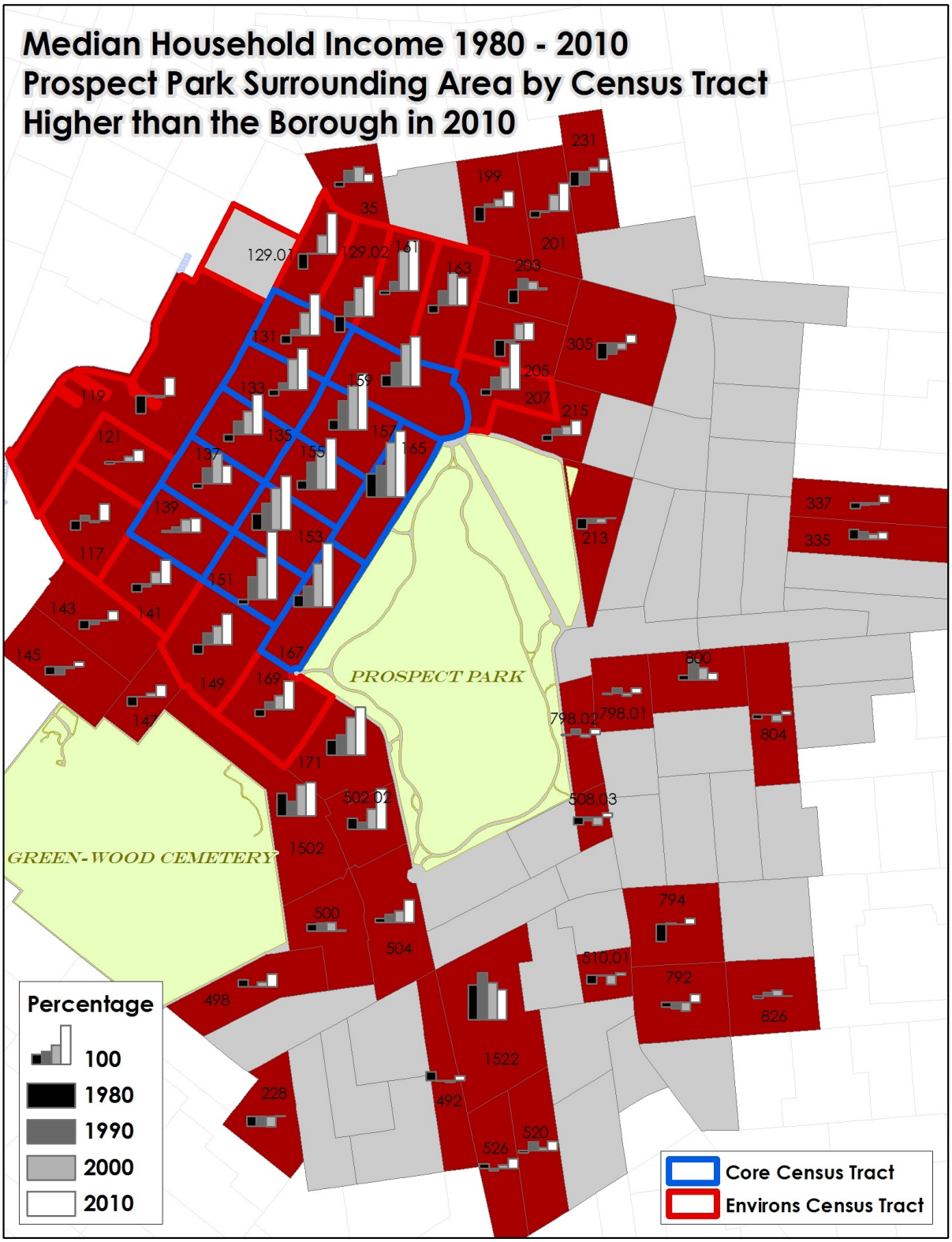
Map 8-7. Census Tracts with Median Household Income Higher than the Borough in 1980.



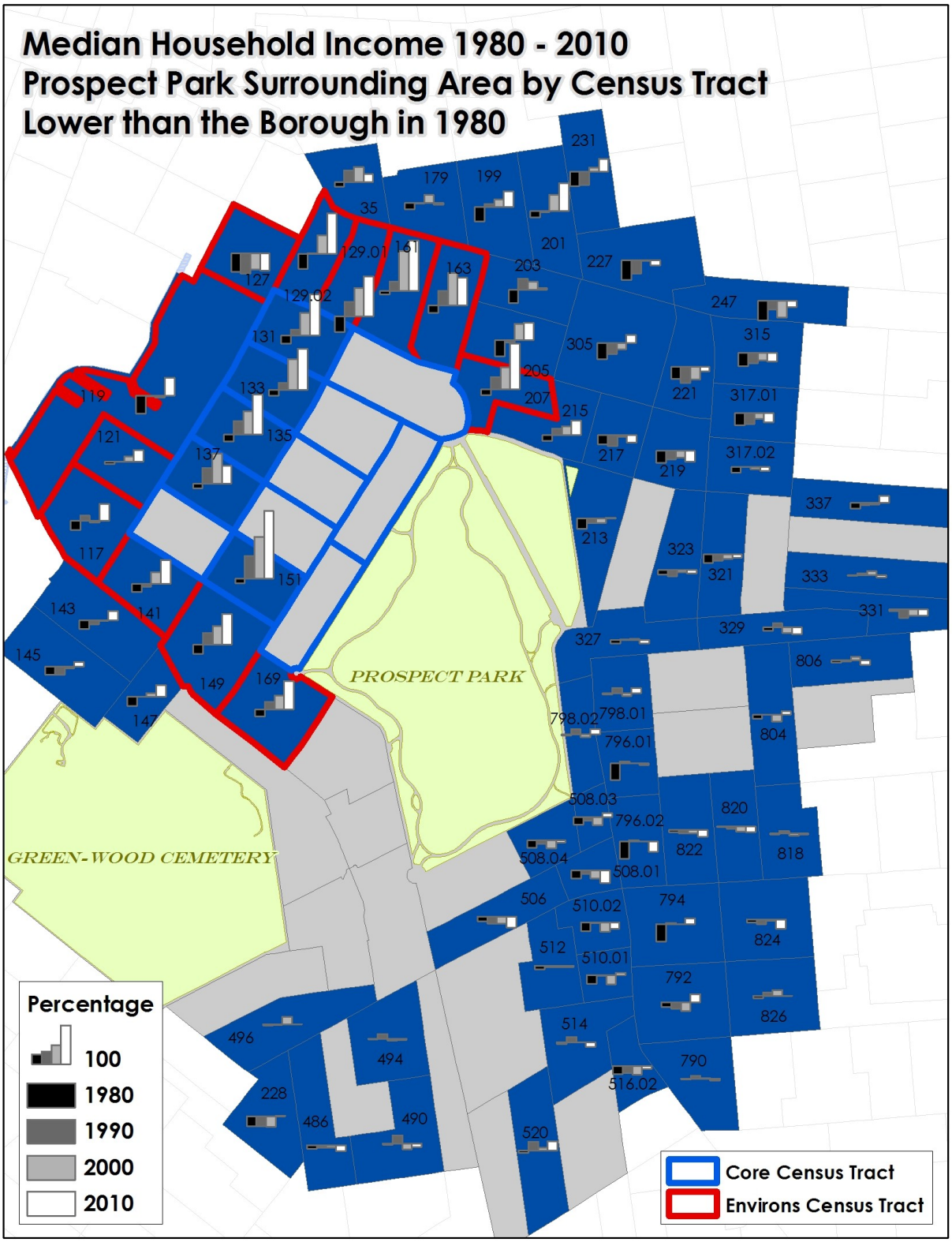
Map 8-8. Census Tracts with Median Household Income Higher than the Borough in 1990.



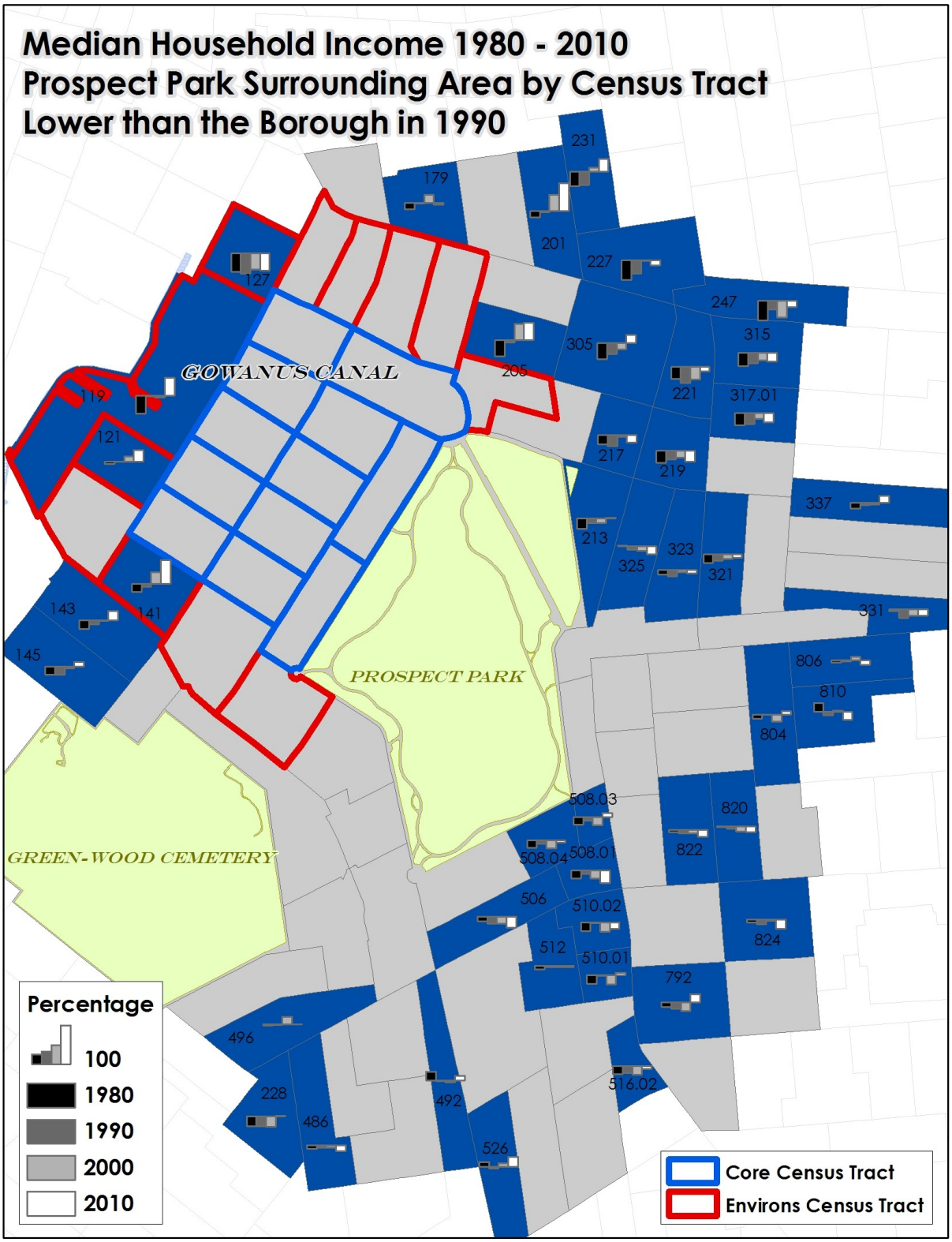
Map 8-9. Census Tracts with Median Household Income Higher than the Borough in 2000.



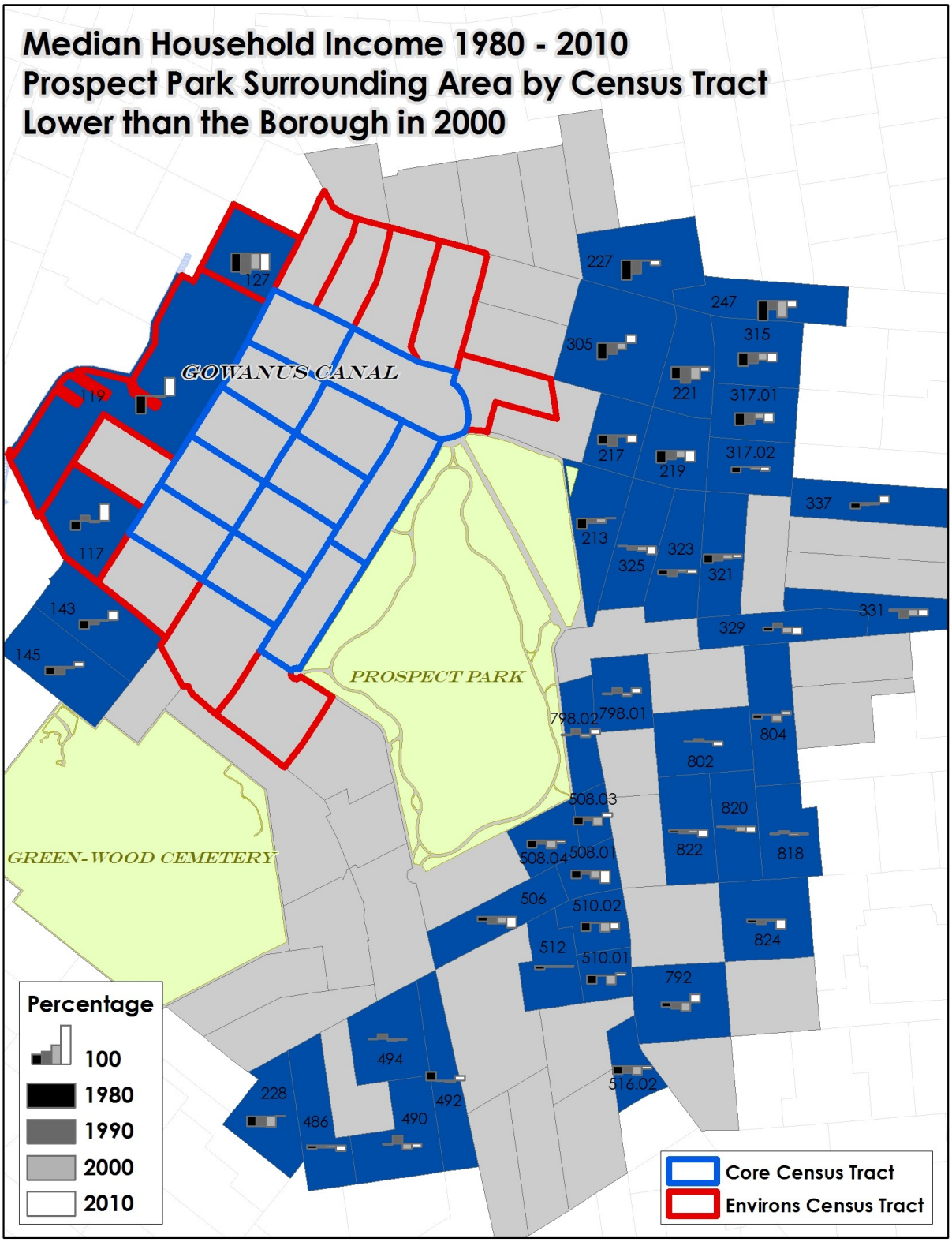
Map 8-10. Census Tracts with Median Household Income Higher than the Borough in 2010.



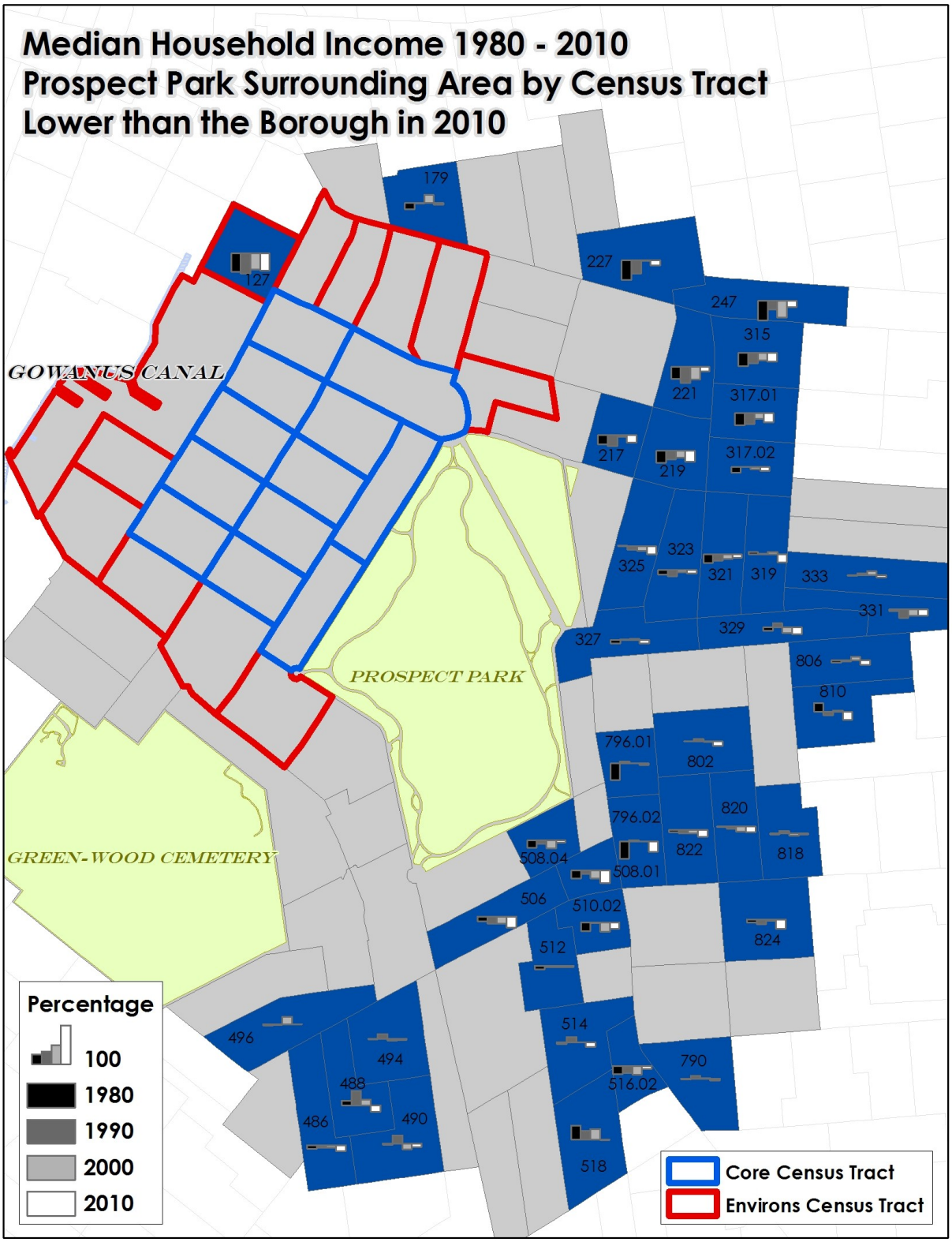
Map 8-11. Census Tracts with Median Household Income Lower than the Borough in 1980.



Map 8-12. Census Tracts with Median Household Income Lower than the Borough in 1990.



Map 8-13. Census Tracts with Median Household Income Lower than the Borough in 2000.



Map 8-14. Census Tracts with Median Household Income Lower than the Borough in 2010.

8-3 The Limitations of this Dissertation

The limitations of this dissertation and the gentrification maps are two-fold: the first issue is related to the data itself; the second, is related to the GIS software as a research tool.

8-3.1 Data Issues

Similar to all other research analysis, GIS is also based on data and the analyses can only accomplish as much as the underlying data-sets will afford. In the case of this dissertation, while data-sets from the U.S. Census Surveys have the advantage of being reasonably consistent and publicly accessible, the ten-year intervals between Census Surveys can easily overlook the rapidly changing demographic and socio-economic conditions that exist. The recently devised American Community Survey (ACS) has a shorter interval between surveys which provides more up-to-date results. However, this benefit is at the expense of geographic precision because ACS generally releases data for larger geographic areas.

The five Boroughs of New York City and the Public Use Microdata Areas (PUMAs) – are approximately the same but are not exactly equal to the Community District boundaries. These areas now have annual estimates derived from ACS, but data for smaller geographic areas such as Census Tracts, are estimated based on multiple-year averages. The variables that are not available in the 2010 Census Survey are replaced with the ACS 5-year (i.e. 2005-2009) estimates. The long-term effects of this cross-survey type comparison (between 2000 and 2010) are yet to be fully analyzed because this is the first time the Long Form from the Decennial Census Survey is replaced by ACS. Nevertheless, this study has exposed one of the deficiencies

of ACS data. Specifically, the ACS categorization on rent needs to be expanded to fully capture the complex rental market that exists in New York City (and possibly other urban areas) that experiences intense gentrification related to new construction for luxurious rental markets. The top ACS category established only "$2,000 or more" in rent which is inadequate when compared to inflation-adjusted values from previous Census Surveys. This top rent category also fails to distinguish the expense of higher-end rental housing in New York City that can exceeds tens of thousands of dollars for luxury renal apartments.

Second, although the design of this dissertation emphasizes the use of publicly-available data-sets, the research design still requires considerable computer literacy to take full advantage of the vast amount of data released by the Census Bureau that can be used to either map gentrification trends and changing environmental conditions. It should also be noted that publicly-available does not equate as free data. The MapPLUTO data-set used in this dissertation to map zoning and other tax lot physical features are publicly-available but at a cost.

In responding to the concerns that GIS as a return to the positivism, I believes that the gentrification maps discussed in the three study neighborhood chapters reveal that gentrification is a complicated phenomenon and that each gentrification map only represents a portion of the gentrification phenomenon. Even using the same underlying data, the gentrification maps are open for interpretation and cannot fully explain what might have caused or facilitated gentrification. At the time of completing this dissertation there is still no agreed-upon quantitative standard for gentrification studies. A growing percentage of residents with higher socio-economic status are signs of gentrification, but since there is no standardized threshold

these gentrification maps are open for interpretation and debate regarding when gentrification begins and when ends. The GIS-generated gentrification maps created in this dissertation cannot be considered a “silver bullet” that concludes the gentrification debate, but rather these maps are supplements to the existing research methods to fully document and explain gentrification.

For example, the studies on displacement continue to disagree with each other, even when using the same data-sets. The selection of variables to use for mapping gentrification and displacement remain open for discussion and or depends on how one defines gentrification. There is also the topic of map representation and map design which is discussed in the next section on GIS software.

8-3.2 GIS Software Issues

Although the data used in this study is publicly available and mostly cost-free from the Census Bureau, the GIS software used to produce the gentrification maps is costly. While more and more GIS analyses can be accomplished using free on-line applications, advanced spatial analysis remains costly to assemble the required software, hardware and GIS professional.

As mentioned in the previous research design chapter, while this dissertation aims to present and argue the advantages of using GIS to map gentrification, it does not intend to review the particular brand and version of GIS software used to create these gentrification maps. Computer software including GIS software programs receives periodic updates and revisions. Therefore, it is likely that by the time of completion of this dissertation, the GIS software used for this study may be out-dated. Critics of specific software features are futile as newer versions could have

changed these particular functions and features. While one the goals of software companies is to promote user-friendliness, mapping using GIS software requires a high level of skill. Similarly, map-reading also requires skill that cannot be taken for granted. During the course of this study, several members of the dissertation seminar group served as test map-readers to test and enhance the design of the maps. While this study does not explore all the different possibilities available to present the same the data using GIS, and does not claim that the finished maps included in this study are the optimum designs, it is clear that no two individuals read maps exactly the same way. If the advantages of mapping gentrification are to be fully appreciated, it might be most helpful to include an introductory chapter in map design principals prior to the full before the full narrative.

8-4 Conclusion

In this study and through the many other gentrification maps, it is my hope and intent that the first goal accomplished is to establish this study's sites clearly and then demonstrate that different gentrification indicators progress unevenly at the sub-neighborhood level. By that I mean a clearly-defined geographical unit that is smaller than the general and sometimes vaguely- or ill-defined "neighborhoods" at Census Tract level. Off-hand statements such as "Park Slope is being gentrified" leads to follow-up questions such as "What area does Park Slope cover?" and "Is the gentrification the same throughout the neighborhood?" The designations of the study neighborhoods reflected in these gentrification maps might not be universally agreed upon but at least they are clear and the maps illustrate some spill-over effects. This study is an attempt to address Lees' call for a "geography of gentrification" because if gentrification researchers do not

clearly address the fundamental question of “where does gentrification occur” then the question of “what” and “how” cannot be addressed or answered.

My second goal is to document the uneven gentrification within the study neighborhoods through the use of GIS. Other researchers have previously observed the intra-neighborhood differences and some researchers have attempted to capture these intra-neighborhood variations. It is my hope that my particular research design has achieved a scheme that can be easily replicated so other follow-up studies can be comparable and advance our collective understanding of gentrification trends. I also hope the gentrification maps in this dissertation have clearly illustrated the uneven developments of different spatial and temporal patterns reflected by the selected gentrification indicators. While this dissertation aims first to explore GIS as a new research tool and to argue its advantages through visualizing spatial data, it also aims to push the gentrification debate forward by providing a deeper understanding of how gentrification moves through space and time.

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