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Christiana A. Boehme April 12, 2022

Race, Rezoning, and Risk:
Uncovering the Demographic and Air Pollution Patterns of Zoning Changes in Atlanta, GA

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Abstract

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By Christiana A. Boehme

This thesis examines links between zoning changes, or the different types of zoning changes, the demographic characteristics of where they occur, and residential cancer risk estimates within the City of Atlanta, Georgia from 1996 to 2021. Through using the digital geographic system (GIS) layer from the Atlanta Department of City Planning, which documents information about historic and current rezoning cases, as well through creating a novel ordinal scale to identify zoning designations by order of increasing allowable density and the intensity of permitted land use activities, I was able to analyze where, and which kinds of, rezonings occur. This information was combined with demographic, social, housing, and economic indicators from the 2000 Decennial census, and multiple ACS 5-Year-Estimates reports, to understand the distribution of rezonings and the demographic characteristics of residents experiencing them overtime. Further, a fixed-effects regression analysis using panel data was utilized with census tracts as the units of analysis, and five periods aligned with the availability of total cancer risk estimates from the EPA National Air Toxics Assessment reports. The results yielded that there is a positive, statistically significant relationship between the percentage of White residents in a tract and cancer risk estimates, likely signaling the change in demographic characteristics of neighborhoods experiencing gentrification-led redevelopment. Additionally, it was discovered that there is a positive relationship between zoning changes that allow for increased density and more intense land-use activities, referred to as upzoning, and total cancer risk estimates, providing evidence that upzonings are associated with an increase in the cancer risk of residents. It appears that race is not a significant factor in rezoning occurrences, with the racial composition of residents being similar for areas experiencing different types of zoning changes from 1996 to 2021. This may be due to the blending of residents as a result of recent gentrification in Atlanta. There is an inherent need for further research as rezoning occurrences continue to increase in cities across the U.S., and so examining their impact on residential outcomes is critical. Municipal planners must recognize the importance of equity in their decisions, which often become political as cities continue to gentrify to meet demands for urban housing from developers, investors, politicians, and urban professionals.

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Also, to my family and friends, who provided vital moral support and encouragement in my pursuit for environmental justice and the protection of human rights.

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"Environmental justice embraces the principle that all people and communities have a right to equal protection and equal enforcement of environmental laws and regulations."

— Dr. Robert D. Bullard
Dumping in Dixie: Race, Class, and Environmental Quality (2020)

"We abuse the land because we regard it as a commodity, belonging to us. When we see land as a community to which we belong, then we may begin to use it with love and respect."

— Aldo Leopold
A Sand County Almanac: And Sketches Here and There (1949)

Introduction

Kilynn Johnson is a long-time resident of the Grays Ferry neighborhood of South Philadelphia, living in the same home where her parents raised her. At the age of 8, she was diagnosed with asthma and, later in life, suffered from gallbladder cancer that almost took her life. Johnson is just one of the many in her neighborhood afflicted by severe cancers and respiratory illnesses, likely due to the historically Black community being zoned so closely to the highway and a 150-year-old energy plant (Villarosa 2020). Kilynn's case is a singular example of the inequitable pollution burden that minority and low-income communities face across the U.S., from "Asthma Alley" in the South Bronx neighborhood of New York to "Cancer Alley" in the river parish communities of Southern Louisiana. In 2018, the EPA's National Center for Environmental Assessment published findings illustrating this disparity, emphasizing that Blacks face 1.5 times more exposure to pollution from fossil-fuel burning facilities than other racial groups (Ihab Mikati 2018).

In the United States, zoning laws and land-use decisions are some of the most potent tools held by municipalities. Zoning changes are approved or denied via a public process involving planning and zoning commissions. Although they follow prescribed rules and procedures, they can often become *political* when dealing with controversial issues surrounding changes to proposed zoning standards. The planning and zoning commissions members are typically White, older, professional residents, and, in some instances, city council members tend not to be very representative of the local populace (Anderson et al. 2008). The ability to determine and approve the type of land use, intensity, and density of a land parcel directly impacts the environmental quality of its surrounding area. Since the zoning and land use decision process can become political through pressure from private and public actors, there is inherently room for abuse and mistreatment. Many critics of municipal zoning regulations and their related amendment processes argue that these become tools to separate households along socioeconomic lines. For example, restrictive density zoning designations for single-family homes versus multi-family homes contribute to neighborhoods' clustering by race and class (Sharkey 2013).

Additionally, many critics hold that mixed land use designations, permitting residences near commercial and industrial activities, are disproportionately assigned to low-income and minority communities. Such designations leave residents vulnerable to the placement of noxious facilities, exposing them to more pollution and "depressing [their] land values" (Shertzer et al. 2014). Zoning decisions function as a "gatekeeper" because they can regulate the placement of noxious, unwanted land uses that can emit high levels of toxins (Maantay 2002). There is a plethora of literature outlining the inequitable pattern of minority and low-income neighborhoods' proximity to industrial facilities, highways, and other sources of air pollution. However, the role of rezoning, and where different types of rezonings occur geospatially and demographically, has been hardly examined as a causal mechanism in the differential health outcomes of neighborhoods.

Within cities across the U.S., the legacy of discriminatory zoning policies continues to be felt by many minority residents. One of the most damaging historical influences on municipal zoning was the phenomena of redlining during the 1930s, in which neighborhoods with predominantly minority residents received a "high risk" grade denying their access to Federal Housing Administration (FHA) mortgages and loans (Nardone et al. 2020). Historically redlined areas have mostly remained predominately low-income, minority neighborhoods. As a result, residents remain continually marginalized by inequitable zoning decisions that impact the quality and value of their built environment. To better understand the patterns and impacts of rezoning decisions, this thesis will explore the different types of rezoning that a land parcel, or a lot, can experience, altering its permitted land use activities and density in connection to the demographic composition, air quality, and related health outcomes of its surrounding neighborhood.

This thesis will assess two types of rezonings related to the neighborhoods' demographic and health characteristics where they predominantly occur. The first type is *upzoning*, or the rezoning of a land parcel from a less dense designation that allows for fewer, less intensive land use activities to a denser designation that allows for more intensive land use activities. The second type is *downzoning*, or the rezoning of a land parcel from a denser designation allows for more intensive land use activities to a less dense designation that allows for fewer, less intensive land use activities. Since rezoning applies only to individual parcels, for purposes of analysis in this thesis, I tagged each parcel with a zoning change to its respective census tract based on location, then characterized it according to the type of zoning change experienced (upzoning, downzoning, no change). Through aggregating rezoning cases to the census tract level, it becomes possible to examine their respective demographic characteristics and health outcomes over time.

I selected the City of Atlanta, Georgia, as the study area for understanding the larger relationship between zoning and land-use changes, demographics, and residential health outcomes. It is my hope that Atlanta will serve as a microcosm for all other municipalities across the U.S. that remain vulnerable to the potential misuse and abuse of the powerful tool that is zoning. As one of the largest cities in the South, home to a diversified population, distinct neighborhoods, a rich historical legacy, and now growing as an epicenter for economic opportunity, igniting redevelopment, Atlanta makes for an excellent city to study patterns in rezoning decisions and health outcomes. The City of Atlanta launched a digital geographic information system (GIS) layer in 2000, providing a timestamp of all current and historic rezoning changes of individual land parcels dating back to 1996. The GIS layer also provides information on which rezoning case status, meaning whether they are completed, denied, or remain pending a decision. Prior to 1996, the City of Atlanta recorded zoning changes solely using physical, mylar maps.

Consequently, the analysis period is limited to rezoning cases completed between 1996 and 2021. The rezoning cases documented on the digital GIS layer provide the previous zoning classification of the individual parcel and its new classification. Still, the classifications, known officially as zoning districts, do not readily describe the density and intensity level of the land use activities. Therefore, I created a novel ordinal scale to identify the zoning district designations by order of increasing allowable density and intensity of land use activities to categorize rezoning cases as upzoned, downzoned, or no rezoning change.

Furthermore, I separated the rezoning case period of analysis into four intervals, or time points, to match the rezoned land parcels and their corresponding census tract with their demographic characteristics based on the year the rezoning was approved. As such, I utilized data from the 2000 Decennial Census to match demographic information to rezoning cases completed within the first time point, 1996 – 2004; data from the 2005-2009 ACS 5-Year-Estimates report to match demographic information to rezoning cases completed within 2005-2009; data from the 2010-2014 ACS 5-Year-Estimates report for cases completed within 2010-2014; and finally, data from the 2015-2019 ACS 5-Year-Estimates for cases completed within 2015-2021.

Beyond identifying the distribution of rezoning types and the demographic characteristics of residences experiencing them, this thesis also aims to uncover the impact of upzoning on affected residents' air quality and health outcomes. Since 1996, the Environmental Protection Agency (EPA), through establishing the National Air Toxics Assessment (NATA), records and reports every three years, the air toxics detected at the census tract to a national level. Air toxics, or hazardous air pollutants (HAPs), are air pollutants that are known to cause cancer and severe health issues in humans (Zhou et al. 2015). The Clean Air Act currently lists over 187 HAPs.[1] Most are anthropogenically outputted by "vehicles, factories, refineries, power plants," and even smaller sources, like gas stations and dry cleaners (Weitekamp et al. 2021). By combining source emission data, exposure estimates, and other factors, NATA releases cancer risk estimates for individual HAP, and total HAPs detected at the census tract level. Cancer risk refers to the upper bound probability of an individual developing cancer in their lifetime due to chronic exposure (Apelberg et al. 2005). Therefore, I utilized cancer risk estimates at the census tract level from all available NATA reports, from 1996-2013, with five time points selected for analysis within this period.

Given the accessibility and nature of available data, this thesis attempts to empirically disentangle the role of rezoning type on residential air quality and related health risks and if this relationship disproportionately impacts neighborhoods along demographic lines. Although unequivocally important to understanding the equity of zoning changes, due to limitations in the available time, resources, and data, the determinants of rezoning frequency and type are not examined. While the determinants of where zoning changes occur and the intensity of these changes is critical to understanding residential outcomes in relation to zoning and city planning, I

[1] https://www.epa.gov/AirToxScreen/previous-air-toxics-assessments

unfortunately lack the historical data to pursue this topic. It is widely recognized, however, that zoning and city planning decisions are often politicized, and therefore inequitable, due to pressure from developers, investors, and voters. Therefore, the following questions are established to examine the influence of zoning changes on residential air quality and health risks and if these outcomes disproportionately impact marginalized communities.

- *What are the demographic characteristics of the census tracts within the City of Atlanta that have been largely upzoned to more intensive land use, denser zoning designations from less intensive land use, lower density zoning designations*?
- *What are the demographic characteristics of the census tracts within the City of Atlanta that have been largely downzoned from more intensive land use, denser zoning designations to less intensive land use, lower density zoning designations?*
- *What are the demographic characteristics of the census tracts within the City of Atlanta that have largely experienced no rezoning changes in zoning designations?*
- *How do total cancer risk estimates differ for census tracts that have largely experienced upzonings of their land parcels compared to census tracts that have largely experienced more downzonings of their land parcels within the City of Atlanta?*

It is well-documented that rezonings occur frequently and inequitably across cities in the U.S., perpetuating unevenly distributed land-use intensity and density zoning designations near specific neighborhoods. This uneven distribution of land use activities often creates a pollution burden that falls on some communities more than others (Maantay 2002). However, the available scholarship is largely limited to either studying the connection between the zoning of noxious land uses and their proximity to marginalized communities or the impact of the pollution burden on the health outcomes of these neighborhoods. These two-dimensional studies create a gap of knowledge for understanding the more significant, empirical effects of rezoning in municipalities, such as rezoning type by land use and density, geospatial and demographic patterns in the people they impact, and their related health outcomes. Over time, the systematic connection of zoning changes in race, income, housing tenure, and public health outcomes remains insufficiently mapped, especially during mass redevelopment in cities (Shertzer et al. 2014; Davis 2021).

Given the constantly evolving nature of land use activities and zoning in cities, especially in a growing, gentrifying city like Atlanta, the existing literature struggles to comprehensively examine the public health trends in response to upzoning and downzoning. It is more crucial than ever to evaluate these trends in municipal land use as rezonings become more frequent to meet demands for urban housing and economic development (Davis 2021). Consequently, this thesis' aims to empirically disentangle the causal mechanisms between aggregated zoning changes in land use activity and density, related geospatial and socioeconomic patterns, and the differential air quality and health outcomes of residents impacted using Atlanta as a microcosm for other municipal zoning apparatuses.

Historical Background

The Legacy of Discrimination in City Planning and Zoning

Before the Civil Rights Era in the U.S., segregation and racially discriminatory policies were rampant in the North and the South. The Plessy v. Ferguson (1896) ruling granted federal legal protection to the practice of racial segregation for all private and public facilities (Rhodes 2019). Zoning functioned as a legal mechanism for enforcing segregation in the residential context. It provided a means to directly exclude minorities from living in specific neighborhoods or buying homes on certain blocks (Rothwell 2011). Although the Buchanan v. Warren (1917) ruling officially banned the practice of exclusionary residential policies based on race, citing violations of the 14th amendment, localities continued to use tailored ordinances to segregate minorities (McGrew 1997; Rhodes 2019). McGrew (1997) provides an example of this defiance, citing how southern cities across the U.S., like Atlanta, continued to utilize segregationist zoning systems, often separating neighborhoods into racial districts categorized as “White, colored, or undetermined”. Restrictive covenants, or restrictive clauses included in deeds to forbid sales to minorities, quickly replaced more blatant forms of residential segregation policies and were maintained as constitutional until Shelley v. Kraemar (1948) (Rothwell 2011). The decision upheld the private use of restrictive covenants but deemed state and legal enforcement of them as unconstitutional (Rothwell 2011).

Residential segregation continued to be enormously protected by various governance mechanisms and policies. Many municipalities set mortgage lending standards based on race, allowed real estate agents to refuse service to minorities and looked away when Black residents were violently targeted (Rothwell 2011). While the creation of the Public Works Administration (PWA) in 1933 helped spur public housing construction projects across the U.S., development was guided by neighborhood composition, effectively producing segregated public housing facilities. The Homeowners’ Loan Corporation (HOLC), established around the same time quickly established a neighborhood risk assessment system for cities, grading neighborhoods by racial composition and color-coding them for risk (Nardone et al. 2020). The FHA began to solely insure homes in neighborhoods deemed low risk by the HOLC, while minority residents were shaded red and denied access to the same financial assistance (Nardone et al. 2020). Further aggravating the unjust treatment of minority neighborhoods was the passage of the Federal Highway Act in 1944, which enabled the construction of federal highways and secondary roads. Such construction erased historically Black communities off the map and forced many Black residents to relocate, often near highway construction (Rhodes 2019).

1954 proved to be a turning point for segregation when the Brown v. Board of Education (1954) ruling struck down the "separate but equal" legal doctrine, declaring it unconstitutional. As cities moved slowly to desegregate their facilities and schools, Black residents and families also began to move into formerly all-White neighborhoods, creating racial tension. Simultaneously, the passage of the National Interstate and Defense Highway System in 1956 allowed cities to expand outward, providing urban residents with the ability to move to suburban neighborhoods and commute into cities for work (Rhodes 2019). Millions of American families moved to the suburbs during this period, with the migration later coined the White Flight. The suburbs provided White Americans with perceived safety from the ongoing integration in urban centers. This perception safety arose from the zoning designations of suburban neighborhoods, often solely permitting the development of expensive, large single-family lots, which minority and low-income residents could not afford (Nardone et al. 2020). As many White residents left, Black residents came together to demonstrate and protest in the streets of cities across the U.S., demanding equal rights and protection under the law. Facing pressure and criticism from Americans, especially in the aftermath of the tragic assassination of Dr. Martin Luther King, Jr., President Johnson signed the Fair Housing Act of 1968 into law, prohibiting the discrimination of an interested party during the sale, rental, or financing of a home based on race, sex, ethnicity, or religion (Rhodes 2019).

After the Civil Rights Era, and the new federal laws that emerged, as a result, cities were challenged to find alternative methods of preserving residential segregation. Exclusionary zoning or ordinances to restrict lots' land uses and density levels in neighborhoods presented an effective solution. Previously upheld in the ruling of Village of Euclid v. Amber Realty Co. (1926), exclusionary zoning ordinances allowed local governments to separate homes with single-family designations from two-family or multi-family designations. The ruling prevented the development of more affordable housing in White, single-family neighborhoods. Since single-family designations require more acreage but only limited density, they are not economically feasible for most marginalized Americans, creating residential segregation along socioeconomic lines (Nardone et al. 2020). The ruling in Village of Arlington Heights v. Metro Housing Development Co. (1977) ensured the perpetuation of exclusionary zoning ordinances in the U.S., upholding the constitutional right of cities to implement them (Rhodes 2019). Figure 2.1 demonstrates the evolution of changing legal attitudes toward residential segregation through Supreme Court rulings, federal policies, laws, and historical migration patterns.

Figure 2.1
Historical Timeline of Race and Equity in Zoning and Housing Policies in the U.S.

1896	Plessy v. Ferguson ruling allows for "separate, but equal" facilities for Blacks and Whites. The practice of segregation in the U.S. is legal and constitutional.
1917	Buchanan v. Warley ruling is the first instance of federal action to limit housing discrimination. The Supreme Court finds racial zoning ordinances in violation of the 14th amendment and therefore, unconstitutional. The Court does not prohibit private or individual agreements to ban Black residents from neighborhoods.
1926	Village of Euclid v. Ambler Realty Co. ruling determines that municipal zoning ordinances can organize neighborhoods into commercial or residential zones, allowing restrictions on the development of multi-family homes near single-family homes. This is an attempt to keep marginalized residents out of white neighborhoods.
1933 - 1934	The HOLC is established and creates residential security maps, color-coded grading neighborhoods for risk based on the race of residents in a process later known as redlining. The FHA begins to solely insure homes in neighborhoods graded low risk, meaning only White residents. The Public Works Administration (PWA) is formed and public housing is created based on neighborhood composition, producing segregated public housing.
1944	The Federal Highway Act is passed, encouraging the construction of highways through urban areas, leading to the destruction of many historically Black neighborhoods and the placement of national highways near minority and low-income neighborhoods.
1948	Shelley v. Kraemer decides that private restrictive covenants, or legal clauses added to deeds to prevent sales to certain races, are constitutional. However, the ruling declares that states and courts cannot enforce them as this violates the 14th amendment. The FHA does not comply with this ruling until 1950.
1954	Brown v. Board of Education ruling determines that "separate but equal" laws permitting segregation are unconstitutional and so public facilities must become integrated.
1960s	Following the Brown v. Board ruling and the passage of the 1956 National Interstate and Defense Highway System, spurring simultaneous desegregation and suburbanization, many White families left cities for suburban, single-family exclusionary neighborhoods to maintain separation during what became known as the White Flight.
1968	The Fair Housing Act (FHA) is passed, prohibiting discrimination concerning the sale, rental, or financing of a home on the basis of the race, religion, ethnicity, or sex of any interested party.
1977	Village of Arlington Heights v. Metro Housing Development Corporation ruling upholds that exclusionary zoning is constitutional for the prevention of multi-family housing developments in single-family neighborhoods. The use of exclusionary zoning through density restrictions increases.
Source (Rhodes 2019)	

The Efficacy of the Fair Housing Act of 1968 on Segregation

There is no argument that the Fair Housing Act of 1968 successfully outlawed explicit racial discrimination in housing transactions. It created much-needed protections for marginalized Americans and has worked to reduce residential segregation along racial lines significantly. However, the Act failed to deliver on its promises to integrate communities further, and its subsequent enforcement was largely uneven and incomprehensive (Adams 2018). Municipalities persisted in their abilities to block marginalized residents from White communities by creating thinly-veiled exclusionary ordinances. Rugh et al. (2014) highlight this persistence, examining 287 cities between 1970 and 2010 using multivariate analyses, to find that "Blacks continue to experience high segregation and little progress toward integration in many metropolitan areas while Hispanics display rising levels of segregation." The study affirms that hypersegregation persists in many neighborhoods in most cities despite attempts by the federal government toward integration. Rugh et al. (2014) argue that the post-Civil Rights Era federal government was protective of desegregation and punitive toward intransigent exclusionary zoning practices. Whittemore (2012), however, argues that the federal government did the opposite.

Conversely, through conducting a historical case study of Los Angeles, Whittemore (2012) reveals the persistent pressure by the FHA on municipal governments to maintain lower-density residential designations, such as pricey single-family lots so that prospective homeowners would utilize FHA mortgages. The FHA first pursued its "single-family housing agenda" in 1936 amid a Depression-era housing market to ensure payments from long-term mortgages requiring little money up front (Beyer 2017). Since then, the FHA has insured over 4.8 million single-family home mortgages, which continues to rise today (Beyer 2017). Therefore, exclusionary zoning stands to preserve segregation in neighborhoods and benefit the federal government economically. Rothwell (2011) and McGrew (1997) affirm the findings of Rugh et al. (2014) and Whittemore (2012) that hypersegregation has persisted in the wake of the Federal Housing Act, with density zoning serving as a loophole for White neighborhoods to remain exclusively White.

There are several theories about the mainsprings of exclusionary zoning ordinances in U.S. cities. Oliver (1999) utilizes a cross-level data set from the 1990 Census and Citizen Participation Study to find that exclusionary zoning was a byproduct of America's suburbanization. He argues that as Whites left for the suburbs to find security in single-family neighborhoods, so too did economic power from the inner-city, creating spatially concentrated poverty in metropolitan areas (Oliver 1999). Thus, many inner-cities declined as investment and opportunity left, leaving crumbling infrastructure, high unemployment, high crime, and defunded public schools. Similarly, Rothwell et al. (2009) argue that urban sprawl and suburbanization have allowed exclusionary zoning to engender socio-economic residential segregation by trapping urban residents in areas of divestment, creating a poverty cycle. Penultimately, despite attempts by the federal government to fully integrate communities, the Federal Housing Act was effectively powerless against the larger economic and social forces that have contributed to the divided urban landscape of cities today. The economic deterioration of city centers due to divestment toward the suburbs, coupled with exclusionary zoning ordinances, has contributed to the splintered urban landscape of cities today, with wealthy, single-family neighborhoods juxtaposing areas of concentrated poverty.

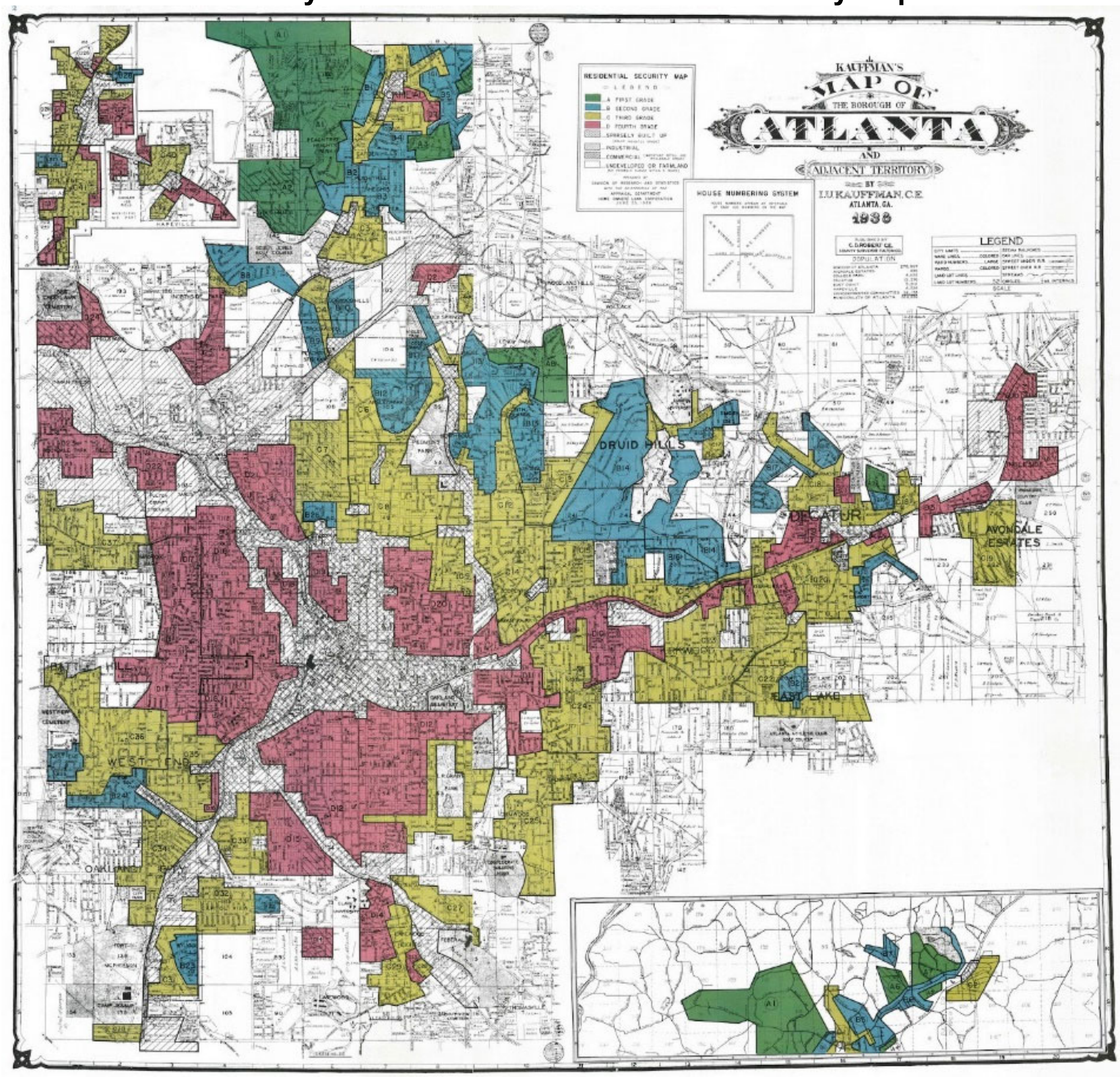
The Historical Development of Zoning Ordinances in Atlanta

The City of Atlanta was twice as dense in the 1940s than today. The population density was approximately 8,588 people/square mile, a figure 2.5 times larger than that reported in 2018

(Atlanta Dept. of City Planning 2021). This decline in population density and the increase in distance between homes and places are mainly attributable to Atlanta's early implementation of restrictive exclusionary zoning ordinances. Dating back to 1922, the Atlanta City Planning Commission released a segregationist zoning plan that had only two residential zoning categories: “R-1 White Districts” and “R-2 Colored Districts” (Atlanta Dept. of City Planning 2021). However, the Georgia Supreme Court rejected the plan for its racialized language, and so in 1929, Atlanta established its first comprehensive zoning code instead (Atlanta Dept. of City Planning 2021). The 1929 code was very similar to the plan of 1922, except it substituted racially explicit language for density restrictions. As a result, “R-1 White Districts” became “Dwelling House Districts”, which allowed for only two primary homes on a lot, and “R-2 Colored Districts” became designated as “Apartment Houses”, which allowed for multiple dwellings on a lot (Taylor 2021). Simultaneously, redlining compounded this residential segregation, with the FHA solely backing mortgages in White communities graded as green for “best” or blue for “still desirable”, while excluding communities of color from loan programs since they had been graded yellow for “declining” or red for “hazardous” (Atlanta Dept. of City Planning 2021). Figure 2.2 portrays a “residential security map” of Atlanta produced by the HOLC in 1938, with neighborhoods color-coded based on “mortgage risk” (Rhodes 2017).[2]

[2] https://dsl.richmond.edu/panorama/redlining/#loc=13/33.781/-84.368&city=atlanta-ga

Figure 2.2
1938 City of Atlanta HOLC "Residential Security Map"



During the 1970s, the City of Atlanta worked on updating its legal provisions pertaining to zoning, adopting its first zoning ordinance in 1973 and later amending it in 1976. In 1982, The City revised it once more to establish the official 1982 Zoning Ordinance, which is still used today in Atlanta's Code of Ordinances. However, the 1982 revision effectively implemented exclusionary zoning regulations by protecting and separating single-family housing neighborhoods from multi-family housing and commercial activity (Taylor 2021). As a result, many neighborhoods in Atlanta transitioned into becoming exclusively single-family zoned neighborhoods, driving population density down. Today, over 60% of the city is zoned for single-family housing, reducing the availability of affordable housing types like duplexes, multi-family homes, and basement apartments through zoning designations (Taylor 2021). In addition, areas zoned for single-family housing typically restrict the proximity of mixed housing types, thus separating residents along economic lines and eliminating the possibility of shared opportunities such as access to quality schools. Relatedly, single-family residential designations negatively correlate with racial diversity. In 2018, within Atlanta's most racially diverse neighborhoods, the median area designated for single-family density homes was only 15.6%. In contrast, the median area dedicated to single-family housing in the least racially diverse neighborhoods was 78.4% (Atlanta Dept. of City Planning 2021).

Literature Review

Municipal Zoning Laws and the Siting of LULUs (Locally Undesirable Land Uses)

There is a consensus in the literature that locally unwanted land uses (LULUs) that disproportionately cited in or near economically and racially segregated communities in urban areas. However, there is disagreement about whether LULUs were zoned following the establishment of minority and low-income communities or if these residents moved near previously-established LULUs and created communities around them due to cheaper land values. Bowman et al. (1997) argue that while it is clear that neighborhoods with higher levels of minority and low-income residents are likely to live closer to LULUs compared to high-income and White residents, it is unclear if these residents came before or after the establishment of LULUs. Due to the mixed evidence of this “chicken or the egg” paradox in existing literature, Bowman et al. (1997) conducted a statistical analysis to determine if county-level racial and income data correlate to the presence/absence of hazardous waste facilities, penultimately not coming to any conclusive results. The authors utilized an interaction term of per capita income and percent Black residents to county-level data that likely confounded the interpretation of their findings.

Additionally, their use of county-level as their unit of analysis was probably too large to produce meaningful results. In response to Bowman et al. (1997), Maantay (2002), using a case study of zoning and land-use changes in New York City from 1961 to 1998, finds that zoning decisions do not exist in a race-less, class-less vacuum. Instead, Maantay (2002) argues that local leaders typically place industrial and noxious facilities in low-income, minority neighborhoods while protecting affluent and White neighborhoods from these facilities. Bullard (1994) reaffirms this claim, arguing that all of the 46 Black communities studied for their proximity to noxious facilities existed before the siting of LULUs. It is likely, then, that the historical zoning of LULUs by municipalities follows an inequitable pattern of placement near minority and low-income neighborhoods, and that these residents today, who cannot afford to live in single-family, white, wealthier neighborhoods, often distanced from noxious land uses, tend to cluster near LULUs due to affordability, creating a cycle of environmental racism.

Given the legacy of historical discriminatory zoning policies, suburbanization, and divestment from inner-city neighborhoods, we can infer that segregated communities have less economic and political power to resist unwanted land uses than White, wealthier neighborhoods, which remain immune to the placement of LULUs. Maantay (2001), utilizing a case study of New York City, also suggests deindustrialization as a contributing factor in the inequitable placement of LULUS. She suggests that as industry moved away from the inner-city during the 1950s, due to divestment as a result of suburbanization, there was a sharp economic decline in the minority, low-income neighborhoods zoned for higher density, leaving abandoned facilities and economic depression (Maantay 2001). These facilities, however, were then developed into private and public waste facilities, junkyards, wastewater treatment facilities, medical waste disposal facilities, etc., creating high environmental and health costs (Maantay 2001; Shertzer et al. 2014). As a result, these historically established minority communities became "dumped on", forced to bear the health costs of being near noxious facilities. While the siting of LULUs clearly tends to occur along racial and socioeconomic lines, there is a need for more research in the existing scholarship to identify the many contributing factors to their continued inequitable placement in minority urban neighborhoods.

Some scholars disagree on the weight of income status compared to minority status of residents as a predictor for LULU siting. For example, Shertzer et al. (2014) suggest that minorities are more likely to face inequitable treatment in zoning and land-use change decisions than low-income residents, especially in Southern cities. The authors utilize a fine-grained spatial data analysis on pre-existing land uses concerning the location of minority communities in Chicago. They find that neighborhoods with higher levels of Black residents are more likely to be zoned for industrial purposes as these neighborhoods have some of the lowest civic engagement and thus pose less of a political threat to local leaders making those zoning decisions (Shertzer et al. 2014). While the findings of Shertzer et al. (2014) are limited to generalizability outside of Chicago, their statistical validity is strong. Mohoi and Saha (2015) similarly agree, arguing that a neighborhood's racial composition is a stronger predictor for the siting of LULUs than socioeconomic characteristics. However, they argue that minority communities are less able to fend off LULU siting, not due to low voter turnout or limited civic engagement, but instead, because they have less political clout, limited economic resources, and declining social status capital (Mohoi et al. 2015). It is important to note that neither study explicitly details why low-income residents are not as equally vulnerable to the placement of LULUs or industrial zoning compared to minority residents.

Demographic Patterns in Civic Engagement and Local Election Voter Turnout

To examine the role of limited political power and civic engagement of minority and low-income communities as contributing factors to inequitable zoning decisions, we must first uncover these communities' voting habits and political participation trends at the local level. As discussed previously, Oliver (1999) finds a strong correlation between urban residential economic segregation and low levels of civic participation in these neighborhoods. The author argues that pockets of affluence in cities tend to overshadow neighboring low-income residents' political and social interests, causing their disassociation from political involvement (Oliver, 1999). Similarly, Hajnal et al. (2005), utilize simulations of uneven minority turnout in mayoral and city council elections, finding that candidates are least accountable to minority interests when there is low voter turnout in local elections by these communities. They further observe that city council members and mayors are less likely to have a minority, ethnic, or low-income status, contributing to low turnout by minority or low-income communities (Hajnal et al. 2008). Although the findings of Hajnal et al. (2005) lack empiricism due to the synthetic nature of their design, it logically follows that, local politicians, who are less likely to identify as a minority or low-income, would be less accountable to the interests of communities that have low voter turnout rates, and thus, less political pressure.

Furthermore, Fraga (2016), through leveraging a nationwide database of millions of individual registration records and their race estimates, finds that minority residents are more likely to exhibit higher turnout when their ethnic or racial group is in the majority of a district, but unlike Hajnal et al. (2005), argues that the co-ethnic status of a candidate has no effect on turnout by these groups. Einstein et al. (2018) find that minority voters tend to exhibit lower levels of political participation in local elections overall and that these turnout disparities impact electoral and policy outcomes, typically with poorer outcomes for minority residents. Unlike Oliver (1999), who argues that economic segregation is one of the largest driving factors in low turnout rate by minority and low-income communities, both Einstein et al. (2018) and Fraga (2016) argue that the presence of off-cycle elections, midterm elections, gerrymandering, voter suppression, limited candidate donations, among other forces, contribute to the limited turnout by these groups in elections. While there is a clear pattern of low turnout rates by minority residents in location elections, it is of particular interest to discover who participates the most in local elections and, more specifically, who is most engaged in local zoning and planning decisions.

Einstein et al. (2018) observe that the least representative groups (Whites, high-income residents, homeowners, elderly) in a municipality are the most likely to participate in public meetings concerning development and zoning. The researchers observed these findings using a novel data set created by coding thousands of instances of participation in planning and zoning board meetings concerning housing development (Einstein et al. 2018). Through their large sample size, their findings exhibit high statistical validity. Conversely to Einstein et al. (2018), however, Manturuk et al. (2009) disagree with their observation, finding that minority or low-income resident status is positively correlated with local civic engagement, especially for city council meetings and zoning board meetings, so as long as they are homeowners. Manturuk et al. (2009) infer that homeownership is the largest single predictor of local civic engagement. It is important to note, however, that in terms of the average housing tenure of residents, there is a homeownership gap between Whites and minorities, which has widened over the past 50 years, with Whites having a homeownership rate of 76% and Black Americans having a rate of 40.9% (Connley 2020).

There is a plethora of conflict in the literature regarding the local political participation patterns of minority and low-income residents. For example, Hajnal et al. (2003) find that those who participate in municipal elections are extremely skewed, with low turnout typically occurring in racial and ethnic minorities, low-income residents, and residents with limited education. The authors in this study utilize a survey of California cities to examine participation in local elections, with their findings indicating that low voter by minority and low-income residents directly contributes to less accountability by local leaders to these communities (Hajnal et al. 2003; Hajnal et al. 2005; Einstein et al. 2018). However, these findings are limited to the study area of California and have likely changed with time. In direct contrast with this, Hoang (2021) finds that racial status is not a significant factor in predicting civic engagement. Since attending public, municipal meetings does not require citizenship, and unlike voting, minority status does not impact attendance. Rather, Hoang (2021) finds that low-income minorities are less likely to disengage from local politics, citing that “underrepresentation occurs among the economically vulnerable”.

Similarly, Warshaw (2019) argues that renters and low-income residents are the least likely to participate in local politics, with socioeconomic status the most significant predictor. Warshaw (2019) finds that, like voter turnout, older, wealthier, and homeowning residents typically dominate zoning meetings. Resultingly, zoning decisions tend to skew toward the preferences of these privileged residents that participate in these meetings and are civically engaged, with poorer outcomes for low-income and minority residents who tend to exhibit less participation.

Perhaps most illuminating of the relationship of local leader accountability to minority and low-income interests in zoning decisions is the demographic composition of those who make the decisions. Anderson et al. (2008) find that zoning and planning boards are typically dominated in membership by White-collar, professional residents. Moreover, members of these boards are predominately White businessmen, such as investors, attorneys, politicians, and developers, many of whom stand to gain from developmental activity in cities (Anderson et al. 2008). This highlights the political nature of zoning and land-use change decisions, and how inequitable patterns of LULU siting are potentially the result of bias and influence, compounded with the lack of political pressure, from low voter turnout rates which make local politicians less accountable, and limited economic power of minority and low-income communities to prevent discriminatory zoning decisions in the placement of noxious land facilities.

The Pollution Burden and Environmental Racism

After examining the historical relationship between racial and class bias in zoning and land-use decisions and civic engagement trends by minorities and low-income groups, one piece of the puzzle remains unsolved: The impact of these relationships on the pollution burden of low-income and minority residents. Nardone et al. (2020) conducted a historical analysis of nine major cities to examine the correlation between historically redlined areas and their respective urban health outcomes today. The authors find that, on average, these redlined communities experience higher rates of cancer, respiratory illnesses, and poor mental health outcomes compared to areas that were not previously redlined (Nardone et al. 2020). Similarly, utilizing New York City as a case study, Krieger et al. (2020) find that historical redlining remains a structural determinant of the present-day risk of preterm birth resulting from heightened exposure to pollutants. While it appears that redlining continues to negatively impact the present-day health outcomes of residents in those areas, we must uncover why this happens. Wilson (2020) presents the idea that historical redlining created areas of divestment, leading to their devoid of parks, increased exposure to highways, and fossil-fuel burning sources. As a result, these communities tend to have higher mean land surface temperatures and air pollution levels than higher investment, White neighborhoods.

To further uncover the causes behind the pollution burden phenomenon, it is critical to understand the full extent of its impacts. Mikati et al. (2018), utilize facility emission data with demographic data to statistically investigate racial and economic disparities in proximity to air pollution sources. The authors discover that low-income neighborhoods face 1.35 times more pollution exposure, while predominately Black neighborhoods face the highest burden, with their pollution exposure being 1.54 times greater than the overall respective urban population (Mikati et al. 2018). One of the most significant sources of pollution, or specifically air pollution, in these urban neighborhoods is traffic. Houston et al. (2004), relying on an analysis of demographic and traffic data for five counties, find that minority and high-poverty neighborhoods incur twice the traffic density compared to the rest of their respective cities. The authors infer that this increased exposure to noxious vehicle emissions leads to inequitable health outcomes in these neighborhoods, such as higher cancer rates, respiratory illnesses, etc. although their findings are limited to the study area of Southern California.

Relatedly, Pratt et al. (2015) find that exposures to and risks from vehicle emissions are higher on average for minority and low-income neighborhoods than their White, higher-income counterparts. The authors highlight the bitter injustice that the White, high-earning residents are more likely to drive, whereas those near the inner-city, typically low-income and minority residents, are less likely to drive yet are more exposed to the pollutants from the nearby traffic. Regarding air quality in the Atlanta context, Servadio et al. (2018) utilize statistical modeling to uncover the associations between pollution and health outcomes, finding that Black residents in the city experience increased exposure to air pollutants compared to the overall urban population, and as a result, suffer higher levels of cardiovascular and respiratory diseases. The literature outlining the prevalence and impacts of the pollution burden in urban areas is resolute and speaks volumes: Minority and low-income residents are suffering the greatest environmental and health costs due to their increased exposure to pollution sources that are inequitably zoned near their communities, as this biased placement offers the path of least resistance for local leaders.

Existing Studies on Rezoning and Residential Impacts

In recent decades, cities across the U.S. have been experiencing a reversal in population suburbanization trends, resulting in the increased demand for urban housing due to the economic revitalization of many city cores. Municipalities continue to turn towards upzoning as a tool to transform neighborhoods with limited residential density into communities with high-rises and mixed-use condominiums to meet these demands for expanded housing (Davis 2021). There is a plethora of literature evaluating this trend, although the available research tends to divide upzoning into two schools of thought, depicting upzoning as a double-edged sword (Davis 2021). Some scholars posit that upzoning is a means to expand affordable housing, while others, taking a property-based economic development approach, believe upzoning serves as a catalyst for gentrification (Powers 2005; Aravena et al. 2020). Wolf-Powers (2005) conducts an interpretive case study of New York City rezonings during the 1990s to highlight the impacts of the transformation of waterfront mixed-use communities to primarily high-density residential designations. Wolf-Powers (2005) posits that urban governments during the 1970s, faced with the divestment of CBDs due to suburbanization, relied on eminent domain and land use regulation to catalyze commercial and residential reconstruction in urban cores. Zoning, through this view, serves as a means for cities to guide their market to create long-term economic benefits.

Conversely, progressive urban theorists view zoning and property-based economic development as a means for the city to act as a growth machine, in which local officials collaborate with developers to increase land value without regard for the "negative effects of property speculation and displacement of poor and middle-class" urban residents (Wolf-Powers 2005). Wolf-Powers (2005) concludes that the opportunistic development of neighborhoods often correlates to the displacement of lower-income residents who can only afford industrial, mixed-use living environments. Aravena et al. (2020) corroborate his finding by using a fixed-effects regression model to compare upzoned census tracts with non-upzoned tracts to their demographic characteristics from 2000 through 2007 in New York City. The researchers conclude that while upzoning may create new housing units, "the large upzoning is associated with a five-to-nine percentage point increase in the share of White people", despite city-wide stagnation of population growth for White residents, indicating that the new housing created in upzoned areas becomes predominantly occupied by White residents (Aravena et al. 2020).

Furthermore, Davis (2021) highlights this double-edged sword of upzoning by similar to Aravena et al. (2020) and Wolf-Powers (2005), using a case study of upzoning activity and subsequent change in non-Hispanic, White population trends in New York City from 2000 to 2010. Davis (2021) argues that upzoning can serve as a positive tool for denser development, allowing the lifting of restrictions on housing supply over time, but conversely, upzoning can also accelerate the displacement of existing residents. She concludes that the upzoning activity in the period studied is "positively and significantly associated with the odds of a census tract, becoming whiter", suggesting that upzonings "accelerate, rather than temper, gentrification pressures" (Davis 2021). Davis (2021) depicts upzoning, however, as a sort of "necessary evil" for municipalities to unlock the creation of housing units to meet the pressures of population growth in the long run, while conversely, Rodriguez-Pose and Storper (2020) critique this view, arguing that the blanket relaxation of zoning regulations is flawed in its attempts to increase the housing supply. Utilizing an empirical analysis of existing literature and theories on housing development, Rodriguez-Pose and Storper (2020) contend that the blanket changes in zoning do not improve affordable housing access for lower-income households but rather drive gentrification in metropolitan areas and do little to temper income inequality. Rodriguez-Pose and Storper (2020) argue that rather than working to increase the inventory of affordable housing units, upzoning unleashes the "market forces that serve high-income earners" since lower-income households in gentrifying, prospering areas incur "displacement in competing with higher-wage workers" who can afford to occupy newer, higher-quality housing.

Kim (2020) adds support to this view, arguing that major U.S. cities utilize upzoning to mainly secure monetary benefits from real estate developments through value capture, the idea that government entities increase property values to receive public benefits and value creation rather than to expand housing affordability and availability. Through analyzing the zoning and entitlement processes of 100 ground-up developments in five major cities, Kim (2020) finds that all cities applied one or more rezoning regulations to extract public benefits from value creation in the form of density or height increases of buildings. Freemark (2020) confirms the findings of Kim (2020) by conducting a case study evaluation of Chicago upzoning, utilizing difference-in-difference (DID) tests on property transaction prices before and after rezoning changes. He discovers robust increases in values for transactions on parcels that received an upzoning in allowable density, indicating the creation of more expensive housing units. However, He discovers no impact on the number of newly permitted dwellings over five years, indicating that housing availability did not expand (Freemark 2020). Like my previous suggestions on where rezonings occur, Gabbe (2017) suggests that upzoning occurs in areas with the least political resistance, such as minority or low-income areas that predominately rent and traditionally demonstrate low voter turnout rates in local elections and lower levels of civic engagement. Utilizing a parcel dataset from Los Angeles, Gabbe (2017) conducts a series of logistic regression models to examine recent parcel upzoning in conjunction with neighborhood political trends. Gabbe (2017) concludes that upzoning follows the path of "developmental opportunity combined with least political resistance", occurring mainly in neighborhoods with high rates of renters and mixed-use designations. On the other hand, Gabbe (2017) posits that upzoning occurs the least in neighborhoods with concentrated homeowners and proximity to high-performing schools, or in other words, wealthier and predominately White neighborhoods.

In terms of a more historical analysis of rezoning changes, Whittemore (2017) conducts an empirical and qualitative analysis of rezonings involving land-use changes in Durham from 1945 to 2017. In Durham, prior to the 1980s, he finds that upzoning to industrial and denser designations occurred in significantly fewer White census tracts than tracts with downzoning to less intensive, less dense designations (Whittemore 2017). Prior to 1985, however, he finds no statistically significant difference in the demographic composition of census tracts where upzoning versus downzoning occurred, but that the census tracts experiencing largely no rezonings were predominantly White (Whittemore 2017). However, it is likely that if

Whittemore (2017) examined the retroactively occurring demographic characteristics of census tracts that experienced upzoning and downzoning, he would have found a correlation between upzoning cases and a trend toward Whiter, high-earning residents (Freemark 2020; Rodriguez-Pose and Storper 2020; Davis 2021). While the bulk of existing research on rezoning cases predominantly focuses on the demographic determinants and impacts of these land use changes, there is a gap in the literature regarding the environmental and health impacts resulting from these changes. However, there is overwhelming evidence that marginalized neighborhoods in residentially segregated cities, separated mainly by means of exclusionary zoning, often face higher exposure to air toxics due to living in areas with land use intensive mixed-use commercial or industrial designations. This phenomenon, as previously discussed, is referred to as the pollution burden. Morello-Frosch and Jesdale (2006) examine the link between residential segregation and ambient air toxics exposure using NATA data to find that the increasing segregation of neighborhoods amplifies average exposure to ambient air toxics through multivariate modeling. Exclusionary zoning, identified as a primary driver of current urban residential segregation, combined with gentrification that contributes to the clustered displacement of minority residents, leads to differential air quality estimates by communities (Morello-Frosch and Jesdale 2006).

Similarly, Qiang et al. (2021) examine the impacts of gentrification on resident displacement and resulting health outcomes by examining the Los Angeles Family and Neighborhood Survey, which documents the movements of lower-income residents over 10 years and compares where residents end up in terms of air toxicity, crime rates, and educational quality. The researchers find that displaced residents, often minorities and renters, are significantly more likely to move to neighborhoods with higher air pollution levels, lower school quality, and higher crime rates (Qiang et al. 2020). However, in conjunction with the demographic characteristics of residents frequently experiencing them, the rezoning type remains relatively unexamined as it relates to the differential impact on air quality and related health outcomes.

Theory, Research Questions, and Hypotheses

Upon evaluating the several existing theories and schools of thought governing the role of municipal rezoning on residential outcomes, I am inclined to argue that many of these proposed theories fit together to create a more complete, empirical picture of the causes and impacts of rezoning. Firstly, it is undoubtedly evident that the urban landscape of neighborhoods today, regarding their arrangement, clustering, and demographic characteristics, is, in part, the result of the legacy of many historical events and phenomena, such as redlining, restrictive covenants, the Fair Housing Act, suburbanization and the deindustrialization of cities during the 1970s, and exclusionary zoning practices, which are still in use today (Wilson 2020; Rugh et al. 2014; Rothwell 2011; Rothwell et al. 2009; McGrew 1997; Whittemore 2012). In conjunction with this legacy, the political nature of municipal zoning and land-use decisions often makes officials accountable and responsive to the residents that hold power and place pressure through their income, homeownership, and racial status, as well as through their civic engagement and participation (Hajnal et al. 2003; Hajnal et al. 2005; Einstein et al. 2018; Manturuk et al. 2009).

As such, minority and low-income communities, which typically demonstrate lower levels of civic engagement and do not have the power and authority that comes with high-income earning status and homeownership, present as areas prime for redevelopment since they offer the least political resistance compared to single-family designated, White, high-income neighborhoods (Oliver 199; Rothwell et al. 2009; Gabbe 2017; Mohoi et al. 2015). Resultingly, low-income and minority communities are more likely to be clustered near noxious land uses, or LULUs, as well as highways or areas with high vehicle emissions, due to historical or current rezonings to allow for mixed-industrial, intensive land use designations (Shertzer et al. 2014; Mohoi and Saha 2015; Bullard 1994). These designations allowing for residential proximity to noxious infrastructure while creating affordability in housing costs, often create a pollution burden for these marginalized communities, resulting in inequity of health outcomes due to high exposure to toxics (Mikati et al. 2018; Houston et al. 2004; Maantay 2001; Shertzer et al. 2014).

However, as urban revitalization and redevelopment skyrockets across many U.S. cities, paired with increasing population growth, the demands for urban housing create pressures for municipalities to upzone areas to allow for more housing development (Davis 2021; Wolf-Powers 2005; Aravena et al. 2021). Historically divested urban cores with deteriorating industrial facilities, which are typically home to Black and low-income residents, offer developers and municipalities an investment opportunity to redevelop, environmentally clean up, and gentrify, to extract public benefits from value creation and value capture (Kim 2021; Gabbe 2017; Oliver 1999; Rothwell et al. 2009). In addition, since land parcels in these marginalized communities typically offer cheaper rents, and municipalities are largely not as accountable to these residents, these communities offer the path of least political resistance with wide-ranging economic opportunity for redevelopment (Houston et al. 2004; Oliver 1999; Rothwell et al. 2009; Gabbe 2017).

Accordingly, upzoning is becoming rapidly more common in cities, which, while policymakers and developers argue is essential to creating more housing to meet population growth demands, predominantly serves to gentrify communities, as the newly constructed, higher-quality mixed-use developments in these areas are typically more expensive (Davis 2021;

Wolf-Powers 2005; Aravena et al. 2021). In these upzoned areas, the resulting increase in rents, mortgages, and taxes over time works to displace lower-income and minority residents who cannot compete with higher-wage workers, driving migration and aggravating income disparities (Wolf-Powers 2005; Rodriguez-Prose and Storper 2020). Additionally, the displacement of these vulnerable communities from upzoned areas often causes these residents to relocate to polluted neighborhoods with lower school quality and higher crime rates due to cheaper rents, creating a poverty cycle due to the lack of affordable housing (Qiang et al. 2021).

When viewed in conjunction, the available scholarly research on rezoning appears to depict a rather complete analysis of its role on residential outcomes, however, separately, these studies appear disjointed and lacking empiricism. Consequently, there are several gaps in the available scholarship regarding the connection between rezoning type, the racial and socioeconomic composition of where these rezonings occur, or do not, and the air quality levels and related health outcomes of these areas. First, while there is an abundance of environmental literature that underscores the tendency for marginalized neighborhoods to have zoning designations permitting higher density and more intensive land use activities, there is a need to further understand the "chicken or the egg" paradox of whether minority communities tend to cluster in areas with high-emitting pollution sources due to affordability or if these communities become later rezoned to allow for more pollution sources (Shertzer et al. 2014; Bowman et al. 1997).

Further, while many previous studies attempt to connect the relationship between upzoning and downzoning frequency to neighborhood demographics, these studies lack consideration on residential health outcomes, an important indicator given that rezonings alter the built environment, and thus pollution levels of neighborhoods (Bullard, 1994; Maantay, 2002; Shertzer, 2014; Mohoi and Saha, 2015). This research objective, therefore, in certain ways, ventures to bridge together several components from many theories regarding upzoning and gentrification, the pollution burden, and the use of exclusionary zoning. While I will not be evaluating the determinants of where rezonings occur, or the resistors that influence where they do not occur, I will be able to understand the role of upzonings, downzonings, or no rezoning changes, within recent decades, on corresponding residential cancer risk outcomes, a health indicator related to air pollution exposure. Furthermore, through matching aggregated rezoning cases to their census tract demographic characteristics, I can determine if marginalized communities disproportionately experience increased exposures to air toxics and thus higher cancer risk estimates. This thesis also utilizes the City of Atlanta as a microcosm for exploring these larger connections in municipal rezoning, which presents a unique case study, as Atlanta, in recent decades, has continually witnessed large increases in population growth and redevelopment.

The research objectives in this thesis are, therefore, as follows:

- *What are the demographic characteristics of the census tracts within the City of Atlanta that have been largely upzoned to more intensive land use, denser zoning designations from less intensive land use, lower density zoning designations*?
- *What are the demographic characteristics of the census tracts within the City of Atlanta that have been largely downzoned from more intensive land use, denser zoning designations to less intensive land use, lower density zoning designations?*
- *What are the demographic characteristics of the census tracts within the City of Atlanta that have largely experienced no rezoning changes in zoning designations?*

- *How do total cancer risk estimates differ for census tracts that have largely experienced upzonings of their land parcels compared to census tracts that have largely experienced more downzonings of their land parcels within the City of Atlanta?*

Since neighborhoods tend to be clustered along racial and socioeconomic lines, there are often observable, distinct boundaries between predominantly White neighborhoods and minority neighborhoods. Through the legacy of redlining, exclusionary zoning, and now the resurgence of urban redevelopment and gentrification, the resulting phenomenon of residential segregation creates the expectation that rezoning cases analyzed in this study will likely occur along demographic lines (Maantay 2001; Rothwell 2011; Rugh et al. 2014; Krieger et al. 2020; Wilson 2020). This expectation of residential segregation, in conjunction with theories on limited municipal accountability to marginalized communities, cause me to suspect that most observed upzonings will likely manifest in minority neighborhoods, such as those around the multi-use BeltLine project, that are now gentrifying due to population and economic growth pressures to create mixed-use residential housing (Davis 2021).

- *H1: On average, census tracts with predominantly low-income and minority residents are more likely than census tracts with predominantly high-income and White residents in the City of Atlanta to have land parcels largely upzoned to more intensive land use, denser zoning designations from less intensive land use, lower density zoning designations.*

Conversely, considering theories on the protections afforded by exclusionary zoning for single-family, White, high-earning neighborhoods, and the tendency for these communities to experience more policy responsiveness from municipal leaders, there is an expectation that these communities will be largely shielded from rezonings (Hajnal et al. 2003; Hajnal et al. 2005; Rugh et al. 2014). I, therefore, predict that census tracts with predominately White and higher-income residents will be less likely to experience upzonings permitting the construction of more intensive land use activities and denser housing, but rather more likely to experience downzonings or no rezoning change.

- *H2: On average, census tracts with predominantly high-income and White residents are more likely than census tracts with predominantly low-income and minority residents in the City of Atlanta to have land parcels largely downzoned from more intensive land use, denser zoning designations to less intensive land use, lower density zoning designations, or to have land parcels largely not rezoned at all.*
- *H3: On average, census tracts with predominantly high-income and White residents are more likely than census tracts with predominantly low-income and minority residents in the City of Atlanta to have land parcels largely not rezoned for different land use and density designations.*

Additionally, there are many theories pointing to the observation of noxious land use concentration in marginalized neighborhoods. Some theories cite this trend being predominately driven by the historical post-industrial restructuring of cities which caused the expansion of unwanted land uses in minority neighborhoods, others argue that contemporary exclusionary zoning measures cluster minorities near high-polluting facilities, and since these communities are less able to "vote with their feet" and move elsewhere, remain trapped in these toxic areas (Maantay 2001; Whittemore 2017). It is therefore my expectation that due to the historical rezoning of marginalized neighborhoods for noxious land uses, and the continuing impact of these noxious land uses in these communities, that predominately minority census tracts in this study will experience higher cancer risk estimates. Furthermore, other theories argue that due to a resurgence in demands for urban housing, pressured municipalities continue to use upzoning in residential areas to allow for the construction of denser, larger, multi-use housing developments (Davis 2021; Wolf-Powers 2005; Aravena et al. 2021). The literature indicates that historically divested urban neighborhoods with cheap land rents, and typically home to marginalized residents, offer municipalities a prime opportunity to economically redevelop with little social and political pushback (Kim 2021; Gabbe 2017; Oliver 1999; Rothwell et al. 2009). Consequently, I expect that for census tracts largely experiencing upzoning, more construction and development will incur as a result, contributing to the presence of HAPs and thus increasing the total cancer risk estimates for these tracts (Checker 2011).

- *H4: On average, census tracts largely upzoned to more intensive land use, denser zoning designations from less intensive land use, lower density zoning designations in the City of Atlanta are more likely to have higher total cancer risk estimates than census tracts largely downzoned from more intensive land use, denser zoning designations to less intensive land use, lower density zoning designations.*

Research Design, Methods, and Data

The Selection of Atlanta for a Case Study

I selected the City of Atlanta, Georgia, as the study area for understanding the larger relationship between zoning and land-use changes, demographics, and residential health outcomes. Atlanta is representative of many other cities across the U.S. that remain vulnerable to the potential misuse and abuse of the powerful tool that is zoning. As one of the largest cities in the South, home to a diversified population, distinct neighborhoods, a rich historical legacy, and now growing as an epicenter for economic opportunity, igniting redevelopment, Atlanta makes for an excellent city to study patterns in rezoning decisions and health outcomes.

Furthermore, I selected Atlanta for analysis as it is one of the largest cities in the Southeastern United States, with a population of almost 500,000 residents, and boasts high diversity in terms of race, income, age, and other demographic characteristics (Servadio et al. 2018). Coined America's "Black Mecca", Atlanta is home to one of the largest populations of Black, middle-class Americans, and was even given the number one spot in Forbes Magazine (2018) for where Black Americans are doing the best economically (Toone 2020). As a historically-significant city during the Jim Crow Era and Civil Rights Movement, Atlanta harbors a deep-rooted legacy of segregation, redlining, activism, integration, and today, progressive, and diversified city leadership (McGrew 1997).

As a former predominantly-industrial city, Atlanta is home to a rich history of commercial and industrial production, namely in manufacturing, which deteriorated greatly during the post-industrial era as a result of urban divestment and White Flight (Wilson 2020; Rothwell et al. 2009). Consequently, many urban cores of Atlanta are fraught with crumbling infrastructure and abandoned railroads from this period (Immergluck 2009). However, due to the resurgence in population growth and urban development in recent decades, investment and opportunity are rapidly returning to the city, bringing along the gentrification of many neighborhoods. One of the largest catalysts for this gentrification is the Atlanta BeltLine project. Created in 1999, the BeltLine is a 25 year-long project, and essentially allows for the redevelopment of abandoned rail lines that encircle the city into parks, light rail transit, mixed-use residential development, retail stores, and office space (Immergluck 2009).

Aside from the BeltLine project, Atlanta approved multiple other redevelopment projects during the same time period, such as the creation of Ponce City Market in the historic, Old Fourth Ward (Sweet Auburn) neighborhood. Formerly an abandoned Sears manufacturing building until purchased by a private real estate investment firm in 2010, the 2.1 million square foot space underwent construction for several years to create its present-day retail, dining, and mixed-use residential complex (Camrud 2021). In response to this development, homes surrounding Ponce City Market spiked in housing value, increasing by millions of dollars for some properties, rapidly becoming unaffordable to the residents of the Old Fourth Ward (Sweet Auburn), which was once an area with the most Section 8 housing in the Southeast (Camrud 2021). In terms of air pollution, the city is known for some of the worst traffic in the U.S., with Atlanta ranking 11th among America's most congested cities, and the American Lung Association grading the city an "F" for air quality (Miller 2019). For these reasons, Atlanta presents a unique opportunity to understand the nexus between race, redevelopment, pollution, and public health.

The Rezoning Process in Atlanta

Governing Atlanta is a set of rules referred to as ordinances and regulations, all of which undergo proposal and adoption by the Atlanta City Council before becoming laws. These municipal laws, contained in the Code of Ordinances of the City of Atlanta, are available through Municode, an online company that electronically publishes municipal codes.[3] Within Atlanta's Code of Ordinances, the Land Development Code contains Part 16, "Zoning", which encompasses the many rules and restrictions on zoning designations, lot sizes, land uses, and historical conservation districts for the city. The Land Development Code separates Atlanta into

[3] https://library.municode.com/ga/atlanta/codes/code_of_ordinances?nodeId=10376

19 general zoning districts. These districts serve to "classify, regulate, and restrict the location of trades and industries…and the location of buildings designed for specific uses…" for parcels of land within a neighborhood (Atlanta Code 1977 § 16-02.002). More specifically, each district places unique restrictions on minimum lot sizes, maximum height limitations, density of buildings, and permitted activities. R-1 through R-4 are single-family residential districts, R-5 is a two-family residential district, R-G is a residential general district, and R-LC is a residential-limited commercial district. The separation of the other general districts occurs based on their office, commercial, central business, industrial, and special public interests (SPIs) designations.

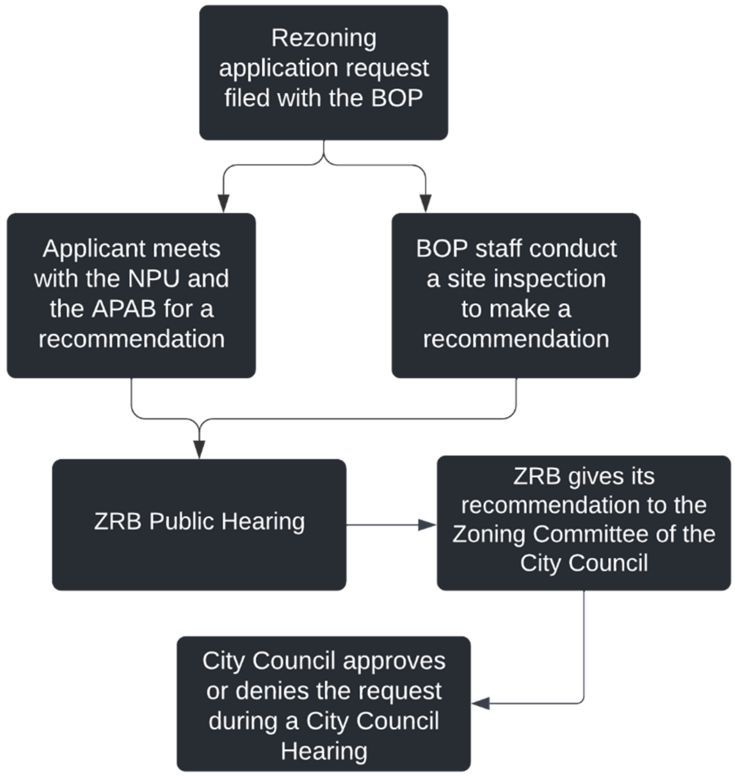
Generally, the restrictiveness of these districts runs from most restrictive to least in the order in which districts appear in the municode for each zoning district category, so for example, "C-2 is less restrictive than C-1" (Atlanta Code 1977 § 16-28.002). There are also PDs, or planned development districts, including PD-H, which is a planned development housing districts that function similarly to R districts, and PD-MU for mixed use, PD-OC for office-commercial, PD-BP for business parks, and PD-CS for conservation subdivision districts. The city also has HC historic and cultural conservation districts, NC neighborhood commercial districts, and affordable workforce housing districts. Table 3.1 lists the 19 general zoning districts established by the City of Atlanta with their corresponding permitted density level and land use activities.

Table 3.1
General Zoning Districts in Atlanta (Code 1977, § 16-02.002)

Atlanta General Zoning District	Maximum Density/Land Use Intensity Level
R-1 Single-Family Residential District	Dwelling unit/2 acres
R-2 Single-Family Residential District	Dwelling unit/1 acre
R-3 Single-Family Residential District	Dwelling unit/18,000 sq ft
R-4 Single-Family Residential District	Dwelling unit/9,000 sq ft
R-5 Two-Family Residential District	Medium density: 2 dwelling units permitted
R-G Residential General District	Mixed density: multi-family dwelling units permitted
R-LC Residential-Limited Commercial District	Mixed residential use, offices, and limited commercial retail activities
O-I Office Institutional District	Mixed residential use, offices, and institutional activities
C-1 Community Business District	Mixed residential use, medium intensity retail activities, and service/repair activities
C-2 Commercial Service District	Mixed residential use, sales, service, and repair activities
C-3 Commercial Residential District	Moderate to high intensity mixed use development
C-4 Central Area Commercial-Residential District	Moderate to high intensity, high density mixed-use development
C-5 Central Business Support District	High intensity, high density employment centers, offices, and service activities
I-1 Light Industrial District	Wholesaling, warehousing, storage, light manufacturing, repair services, and retail
I-2 Heavy Industrial District	High intensity heavy manufacturing
SPI-1 Central Core District	Mixed residential use, offices, institutions, service activities to promote downtown Atlanta's civic and economic center, preservation of historic sites
SPI-2 Fort McPherson District	Mixed residential use, commercial, industrial, recreational activities, preservation of historic sites
SPI-3 English Avenue District	Mixed residential use, commercial, industrial, recreational activities, preservation of historic sites
SPI-4 Ashview Heights District	Mixed residential use, commercial, industrial, recreational activities, preservation of historic sites

When it comes to any intended development project within Atlanta, there are several steps and entities involved in the planning and rezoning approval process. Perhaps at the core of the zoning apparatus are Neighborhood Planning Units (NPUs). Established in 1974 by Atlanta's first Black mayor, Maynard Jackson, NPUs essentially function as residential organizations that amplify and collectivize the opinions of their members on zoning, development, and related topics (Brown 2012). Over 240 neighborhoods are grouped into Atlanta's 25 NPUs, with every unit nominating a representative to serve on the Atlanta Planning Advisory Board (APAB), a board of residents who advise city officials on land use applications and rezoning requests. The Zoning Review Board (ZRB), which consists of several members appointed by the Mayor and City Council, meets bimonthly to publicly consider rezoning requests, accounting for previous recommendations made by the APAB and the NPUs they represent (Atlanta Dept. of City Planning 2022). The ZRB also considers recommendations from the Office of Zoning and Development's Bureau of Planning (BOP) staff, who regulate compliance with established zoning districts. Once the ZRB decides an outcome at a public hearing, they report their recommendation to the Zoning Committee of the City Council. The Zoning Committee then evaluates and provides their own recommendation to the overall City Council, who either approve or deny the request during a public hearing. Figure 3.2 provides an overview of the rezoning application process from submitting a request to a final decision by the City Council.

Figure 3.2
Current Rezoning Approval Process for the City of Atlanta, GA



One of the largest components in the process of rezoning and applications for land use changes are the guidelines set by Atlanta's Comprehensive Development Plan (CDP). The CDP is a factual and policy-based planning document that is required by all municipalities in Georgia following the enactment of The Georgia Planning Act of 1989. In Atlanta, the CDP is updated every 3-5 years and serves to provide information on projected "growth patterns, areas in need of attention, historical preservation, population growth trends, etc." while highlighting the need for redevelopment related to "attractiveness and aesthetics" (Atlanta Community Development Plan 2008). Furthermore, it establishes future land uses within the city based on demand trends for housing, land use, and transportation particularly related to economic development. Although input on the CDP's development and enactment is largely a public process, it is drafted by the Department of Planning and Community Development Staff and penultimately voted on by the

City Council and Mayor (Atlanta Dept. of City Planning 2022). The CDP has a central role in the process of rezoning because any rezoning application that requires a future land use change must "apply for amendment to the adopted CDP" (Atlanta Dept. of City Planning 2022).

Data Sources

In an effort to examine the role of rezonings in Atlanta, I utilized the City of Atlanta's digital geographic information system (GIS) layer, which provides a timestamp for current and historic rezoning cases as well as their status, whether completed, denied or pending approval.[4] However, the digital GIS layer only launched in 2000, whereas prior to that, the City of Atlanta utilized physical, mylar maps to document rezoning cases, which unfortunately due to limitations on time and resources, proved beyond the scope of analysis for this thesis. Retroactively inputted, historical rezoning cases reported through the GIS layer are available dating back to 1996, however, cases prior to that appear unreliably reported. Consequently, I only selected rezoning cases from 1996 onward for analysis. As shown in Table 4.1, there are a total of 1,600 rezoning cases documented on the GIS layer, however, 61 cases fall outside of the study period of analysis (<1996), 202 cases are pending a decision, and 135 cases lack complete information. Resultingly, I end up with only 1,298 rezoning cases for analysis.

[4] https://gis.atlantaga.gov/?page=OPEN-DATA-HUB

Table 4.1
Digital GIS Layer of the City of Atlanta, GA Record of Rezoning Cases by Status for 1996-2021

Rezoning Case Status	Total	Percent (%)
Completed	1,401	84.4
Denied	52	3.13
Pending Approval	202	12.17
Missing Information	5	0.3
Total Cases	1,660	100

The rezoning cases recorded through the digital GIS layer provide the zoning district designation of the land parcel before and after the rezoning change, however, these zoning district designations do not indicate their permitted density level and land use activities. As such, I reviewed and classified each zoning district designation according to its permitted density and land use activities as stated in the Part III of Atlanta's Code of Ordinances, which holds the Land Development Code.[5] Then, I created an ordinal scale of the zoning district designations in order of increasing allowable density levels and intensity of permitted land use activities. The ordinal scale allows for the ability to classify rezoning cases as upzonings or downzonings for analysis. Accordingly, a rezoning case that results in a numerical increase on the scale constitutes an *upzoning* and a rezoning case that results in a decrease on the scale constitutes a *downzoning*. Appendix A includes the novel ordinal scale used to categorize rezoning cases as upzonings or downzonings.

To determine the demographic characteristics of where upzonings, downzonings, or no rezoning change occur, I tagged each rezoned parcel to its respective census tract as census tracts are the smallest unit of analysis available to consistently analyze residential characteristics.

[5] https://library.municode.com/ga/atlanta/codes/code_of_ordinances?nodeId=PTIIICOORANDECO

Additionally, the U.S. Census Bureau establishes census tracts, so their boundaries are known and remain relatively permanent over time. The U.S. Census, which provides reports on the social, economic, health, demographic, and housing information of residents from the census tract level to the nationwide level, unfortunately, is only available every 10 years.[6]

Inaugurated in 2005, the American Community Survey (ACS) is a demographic survey program conducted by the U.S. Census Bureau, that too reports on the social, economic, housing, demographic, and health characteristics of residents. However, unlike the U.S. Census, the ACS records this data every year, providing 5-year estimates, known as "period" estimates that represent data collected over a period of time.[7] The ACS provides demographic information all the way down to the block group scale, however due to smaller sample sizes and greater variability in the ACS estimates for block groups, I only utilized ACS demographic estimates at the census tract level. Accordingly, to match rezoning cases to their demographic characteristics, I utilized data from the U.S. Decennial Census of 2000 for cases decided between 1996 and 2004, then data from the American Community Survey 5-Year-Estimates for 2005 – 2009 for cases decided between 2005 and 2009, then data from the ACS 5-Year-Estimates for 2010-2014 for cases decided between 2010 and 2014, and finally, data from the ACS 5-Year-Estimates for 2015-2019 for cases decided between 2015 and 2021.

To evaluate rezoning impact on air pollution and related health outcomes, I utilized the EPA's National Air Toxics Assessment (NATA), which releases reports every three years on the air toxics detected at the census tract level to the nationwide level.[8] Air toxics are hazardous air pollutants (HAPs) that are known to cause cancer and other severe health impacts in humans, and

[6] https://www.census.gov/programs-surveys/censuses.html
[7] https://www.census.gov/programs-surveys/acs
[8] https://www.epa.gov/AirToxScreen/previous-air-toxics-assessments

so therefore, the EPA reports HAP risk in terms of the number of potentially affected individuals within a population of a million as a result of chronic exposure (Zhou et al. 2015). The anthropological sources of HAPs range from large to small stationary emitters, such as powerplants, gas stations, and dry cleaners, with high-emitting HAP facilities referred to as area sources, and mobile emitters, such as vehicle emissions (Weitekamp et al. 2021). Through combining information on recorded HAP emissions, exposure estimates, weather, population size, and other factors, NATA releases a total cancer risk estimate for the HAPs detected at the census tract level. These total cancer risk estimates provide an upper bound on the probability of residents within a census tract developing cancer over a lifetime of chronic exposure to the HAPs present (Apelberg et al. 2005; Zhou et al. 2015). Due to EPA NATA reporting only beginning in 1996, and the time-intensive modeling required for each assessment, NATA reporting is limited to 1996, 1999, 2002, 2005, 2011, and 2014.[9] Although the Clean Air Act currently lists and regulated over 187 HAPs, the number of HAPs included in NATA reporting is inconsistent, with the 1996 assessment including only 32 HAPs versus the 2011 assessment including 180 HAPs.[10]

In an effort to create consistency among total cancer risk estimates, I identified the most frequently occurring and most carcinogenic HAPs within the U.S. based on research from Zhou et al. (2015). These researchers used various NATA census tract data over time to determine that the most common and deadliest HAPs, those with national cancer risk averages greater than one in a million, are “formaldehyde, carbon tetrachloride, acetaldehyde, and benzene” (Zhou et al. 2015). These HAPs affect public health outcomes more severely than many other commonly found HAPs, with “formaldehyde and benzene contributing to over 60% of all total cancer-related impacts” in the United States (Zhou et al. 2015). Since all NATA reports include

[9] https://www.epa.gov/AirToxScreen/previous-air-toxics-assessments
[10] https://www.epa.gov/AirToxScreen/previous-air-toxics-assessments

estimates of the cancer risk for each HAP detected at the census tract level, I combined these estimates together for detected levels of formaldehyde, carbon tetrachloride, acetaldehyde, and benzene to create a more consistent total cancer risk estimate for analysis regarding census tracts with aggregated rezonings. In addition to utilizing this calculated, combined cancer risk estimate for each tract, I will also provide the total cancer risk estimate calculated by NATA based on the total HAPs recorded in their analysis.

Indicators and Variables

In an attempt to evaluate the role of rezoning type on the environmental quality and health outcomes of impacted residents, there are several social indicators selected to analyze this relationship. Firstly, to uncover any demographic patterns related to rezoning type and related cancer risk estimates, I selected the following demographic characteristics reported in both the ACS and U.S. Census to serve as indicators for the social, demographic, housing, and economic statuses of residents within the surveyed census tracts.[11] The social indicator I selected for analysis is educational attainment level, or the percent of residents in a tract with a high school diploma. The economic indicators I selected for analysis are median household income; median gross rent; and median housing value. The other economic indicators I selected for analysis include homeownership status, or the percentage of residences that own their homes, and poverty status, or the percentage of persons within a tract living in poverty. The demographic indicator I selected for analysis is race, or the percent of non-Hispanic Black residents, non-Hispanic White residents, and Hispanic residents.

In order to evaluate the health outcomes resulting from differential exposure to air pollution as a result of upzoning, downzoning, or no rezoning change, I selected the following

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[11] https://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2020_ACSSubjectDefinitions.pdf

EPA NATA estimates to serve an indicator for public health. All NATA reports provide a total cancer risk estimate based on an assumed linear relationship between the level of exposure and the lifetime probability of developing cancer from an HAP, with these estimates expressed as a dose-response relationship for cancer in terms of a unit risk estimate.[12] NATA reports total cancer risk as an upper-bound estimate of an individual's probability of developing cancer from a lifetime of exposure to a concentration of a pollutant, or the total pollutants detected, aggregating this risk to the population-at-large within a census tract (Apelberg et al. 2005; Zhou et al. 2015). Since NATA inconsistently recorded the number of HAPs for different assessment years, I will utilize and combine their cancer risk estimates for formaldehyde, carbon tetrachloride, acetaldehyde, and benzene, the mostly commonly occurring and carcinogenic HAPs, at the census tract level to create a consistent, combined cancer risk estimate for different time points (Zhou et al. 2015). However, I will evaluate both the NATA-produced total cancer risk estimate and the combined cancer risk estimate for all census tracts analyzed.

Dependent Variable

The **dependent variable** of interest is the total cancer risk estimate.

Independent Variables

The explanatory variables of interest are as follows.

> The **key explanatory variables** are aggregated upzonings and downzonings of land parcels to more (less) intensive land use and more (less) denser zoning designations within a census tract within the City of Atlanta from 1996-2021.
>
> Other **independent variables** of interest are the demographic characteristics of census tracts including educational attainment (percent of high school graduates),

[12] https://19january2017snapshot.epa.gov/national-air-toxics-assessment/nata-frequent-questions_.html#emm10

median household income, median gross rent, median housing value, percent of owner-occupied housing units, poverty status, and race.

Time Period and Units of Analysis

The **units of analysis** for this study are parcels and census tracts within the City of Atlanta.

The **time period** for the study is 1996-2021, with four time points (1996-2004, 2005-2009, 2010-2014, and 2015-2021) for the analysis of zoning outcomes by tract characteristics that match the availability of census and ACS data and five time points for the multivariate analysis of the effects of zoning outcomes on cancer risk (1996-1998, 1999-2001, 2002-2004, 2005-2010, and 2011-2013) that align with the availability of NATA estimates of cancer risk (1999, 2002, 2005, 2011, and 2014).

Research Design and Data Analysis Strategies

One of the largest influences on the research design in this thesis come from Whittemore (2017). Using Durham, North Carolina, as a case study, Whittemore (2017) analyzes the racial and income characteristics of areas experiencing upzonings and downzonings from 1945 to 2014 through a mixed-methods approach. First, by compiling a list of all approved upzonings to any more intensive land use category and then by doing the same for downzonings to any less intensive land use category for the entire period of analysis, Whittemore (2017) then maps the location of these upzonings and downzonings using ArcMap software onto a census tract map from the closest decennial census. After grouping the rezonings into seven 10-year time periods, Whittemore (2017) compares the average percentage of White residents and average median income in all census tracts weighted by the number of upzonings and again weighted by the number of downzonings occurring in these tracts. Finally, by using a one-tailed difference of means test, Whittemore (2017) determines where and when the demographic characteristics of the average citywide census tract greatly differed from those containing upzoning or downzoning cases.

Furthermore, to evaluate the health outcomes as a result of rezoning changes, I based that part of my research design on Morello-Frosch et al. (2006), which examined the link between racial, residential segregation and ambient air toxics exposures using NATA data. Morello-Frosch et al. (2006), through combining pollutant concentration estimates to produce cancer risk estimates by census tract for over 300 metropolitan areas, then by conducting a multivariate analysis to include socioeconomic status measures from the 1990 Decennial U.S Census, discovers the positive relationship between disparities in ambient air toxics exposures and residential segregation.

The research design proposed in this thesis, however, differs significantly from both Whittemore (2017) and Morello-Frosch et al. (2006) in several ways. Firstly, Whittemore (2017) failed to constrain his modeling to within-tract variation and did not take his bivariate analysis findings a step further by using a multivariate analysis. Morello-Frosch et al. (2006), on the other hand, did not empirically research the contributing factors of residential segregation, such as, for example, the potential role of municipal rezoning, in relation to differential total cancer risk estimates.

Consequently, the research design of this thesis involves several components. First, individual land parcels function as the preliminary unit of analysis. Each rezoned parcel is then tagged to its respective census tract and neighborhood statistical area (NSA) based on location. Then, for each rezoned parcel, I append its demographic characteristics, based on its respective census tract and the date of its completion utilizing data from the 2000 U.S. Decennial Census, the 2005-2009 ACS 5-Year Estimates, the 2010-2014 ACS 5-Year Estimates, and the 2015-2019 5-Year-Estimates. I then also match each rezoned parcel to its total cancer risk estimate and re-calculated combined cancer risk estimate based on the four focused HAPs based on its census tract location. Then, I characterize each parcel by the type of zoning change experienced, whether an upzoning, downzoning, or no rezoning change, according to its difference in numerical value along the ordinal scale of zoning district designations, which increases with density and intensity of permitted land use activity. Next, by calculating the weighted means based on the number of rezoned cases per tract, determine the average demographic characteristics for each type of zoning change using the demographic information from the decennial census or ACS extract within the year for which the rezoning occurred.

For the next stage, census tracts serve as the unit of analysis. After aggregating the rezoning cases at the parcel level to their respective census tract, I then analyzed the characteristics of census tracts by type of zoning change using weighted means based on the number of zoning changes of each type for the four time points selected: 1996-2004, 2005-2009, 2010-2014, and 2015-2021.

Finally, I conducted a fixed-effects regression analysis using panel data with census tracts as the units of analysis and five time periods aligned with the availability of NATA cancer risk estimates (1996-1998, 1999-2001, 2002-2004, 2005-2010, and 2011-2013). I selected to utilize this form of multivariate analysis for aggregated census tracts by rezoning type and time point to determine the impact of upzoning on cancer risk estimates, and if these estimates disproportionately impact marginalized communities.

Findings and Interpretation of Results

I began my analysis be examining the rezoning cases by their status (completed, denied, or pending approval) and their distribution among the four time points of analysis. Table 4.2 illustrates this distribution of rezoning cases by status during the four time points. It appears that in the later periods, there are many more rezoning cases compared to earlier periods in which cases are not as frequent. The last period, 2015-2021, showcases a record number of completed cases within the entire period. Additionally, it appears that denied cases are relatively rare compared to total completed cases for the entire period. This signals that the City of Atlanta has taken a pro-development stance from 1996-2021.

Table 4.2
Distribution of Rezoning Cases by Status for the Four Time Periods of Analysis from 1996-2021 in the City of Atlanta, GA

Period	Completed Rezoning Cases	Denied Rezoning Cases	Pending Approval Cases	Total Cases by Period
1996-2004	148	0	0	148
2005-2009	323	17	56	396
2010-2014	242	6	15	263
2015-2021	632	29	131	792
Total Cases by Status	1,345	52	202	1,599

Due to data limitations and rezoning information, however, I analyze only the rezoning cases between 1996 and 2021 where a decision had been made and there was complete information on the original zoning classification and the rezoned classification, yielding a total of 1,298 cases. After using the ordinal scale of increasing allowable density and intensity of land use activities by zoning district designation, I categorized the completed cases as upzoned, downzoned, or no rezoning change. Any rezoning case that resulted in a numerical increase on the scale, and thus an increase in its permitted density and intensity of land use activities constituted an *upzoning*, whereas any rezoning case that resulted in a numerical decrease on the scale, and thus a decrease in its permitted density and intensity of land use activities, constituted a *downzoning*. Furthermore, any rezoning case that resulted in no numerical difference on the scale, and thus no change in its permitted density and intensity of land use activities, constituted a "no change" classification. Table 4.3 showcases the distribution of completed cases by rezoning type according to their respective period. It appears that upzonings are consistently predominant, with the exception of the first period. Downzonings appear to be the second most frequent, and cases with no change in density are rather rare. With the exception of 2010-2014, there is an upward trend in the total cases by period, and since upzonings are predominant, it appears that upzonings are becoming more frequent overtime in Atlanta.

Table 4.3
Distribution of Rezoning Cases by Type for the Four Time Periods of Analysis from 1996-2021 in the City of Atlanta, GA

Period	Downzoned Cases	Upzoned Cases	No Change	Total Cases by Period
1996-2004	66	56	11	133
2005-2009	88	189	32	309
2010-2014	72	141	25	238
2015-2021	209	348	61	618
Total Cases by Rezoning Type	435	734	129	1,298

Although labeling cases as upzoned, downzoned, or no change presents a simplified way to analyze them in conjunction with their demographic and health characteristics, it is equally important to understand these cases in terms of the changes to their zoning district designations. I, therefore, analyzed the former zoning district designations of all rezoning cases from 1996-2021, to discover that a substantial portion of the land parcels with approved rezoning changes originally had purely residential zoning district designations. These former zoning district designations included R-4, which made up 11.3% of all former zoning designations, and R-5, which made up 7.5% of all former designations, both of which solely permit either single-family or two-family housing (refer to Table 3.1). After estimating the total number of rezoned parcels with former residential designations, more than one out of three, or 38%, of all approved rezonings were residential. Table 4.4 demonstrates the distribution of total rezoning cases according to their former zoning district designation, whether residential or non-residential.

Table 4.4
Distribution of Rezoning Cases by their Former Zoning District Designation from 1996-2021 in the City of Atlanta, GA

Former Zoning District Designation for all Rezoning Cases	Frequency	Percent of Total Rezoned Cases
Non-Residential District Designation	1,026	61.92%
Residential District Designation	631	38.08%
Total Cases	1,657	100%

For the total 631 rezoned parcels with former residential designations, nearly nine out of 10, or 88%, underwent an upzoning to a denser, more land-use intensive designation. Furthermore, of the total residential parcels with an approved upzoning change, their new designations largely consisted of mixed-use designations. For example, about 10% of all residential parcels with an approved upzoning changed to an MRC-1-C designation, and others largely to PD-H, MRC-3, MRC-2, MR-3 designations, all of which permit mixed-use residential, commercial, office, and service industry development (refer to Table 3.1).

After tagging each rezoned parcel to its census tract and neighborhood statistical area (NSA) based on location, I analyzed the distribution of upzonings by neighborhood for 1996-2021. I discovered that the Old Fourth Ward (Sweet Auburn) neighborhood experienced more upzonings compared to any other neighborhood during the overall study period, with a total of 52 upzonings (see Appendix B for more information). This neighborhood experienced a steady increase in the number of upzonings overtime, starting with five upzonings from 1996-2004, then four upzonings in 2005-2009, 15 upzonings in 2010-2014, and nearly doubled to 28 upzonings in 2015-2021. This upzoning trend correlates to the construction timeline of the BeltLine project and Ponce City Market, which are both located in and around the Old Fourth Ward (Sweet Auburn) neighborhood and underwent the height of their development during 2010-2014 (Immergluck 2009; Camrud 2021). Other areas with disproportionately more upzonings included the neighborhoods west of downtown and in the immediate vicinity of Mercedes Benz stadium (Vine City with 31 upzonings; English Avenue with 26), and the Atlanta University Center neighborhood (23).

Interestingly, the neighborhoods with disproportionately more upzonings from 1996-2021 are largely located near or around the Atlanta BeltLine project. For example, the neighborhoods of the Old Fourth Ward (Sweet Auburn), West End, Cabbagetown/Reynoldstown, Westview, Inman Park/Poncey-Highland, Ormewood Park, Ashview Heights, Peoplestown, and Edgewood, all have a much higher number of approved upzonings than other neighborhoods and are located near the BeltLine (see Appendix B for more information). Figures 5.1, 5.2, 5.3, and 5.4 illustrate the number of approved upzonings by neighborhood for their respective time period, with the dark green line representing the location of the Atlanta Beltline and the darker orange shading representing neighborhoods with a greater number of approved upzonings.

Figure 5.1
Approved Upzonings in the City of Atlanta, GA by Neighborhood for 1996-2004

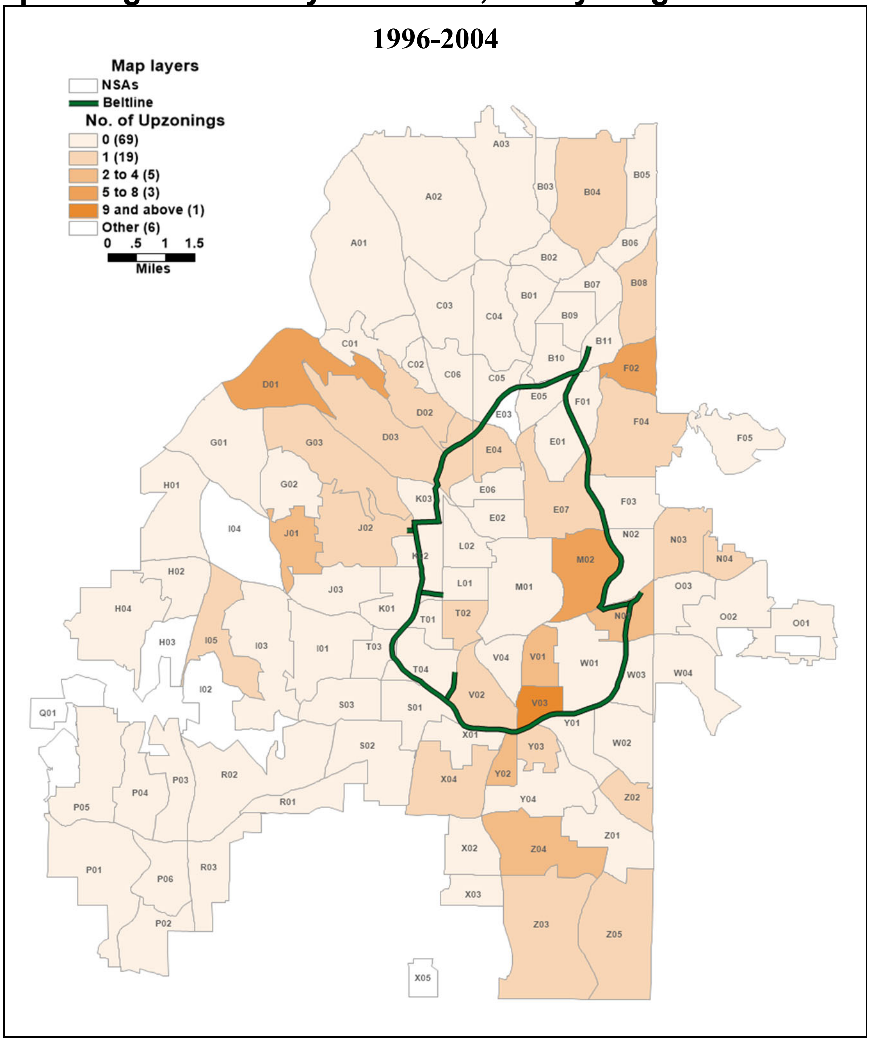


Figure 5.2
Approved Upzonings in the City of Atlanta, GA by Neighborhood for 2005-2009

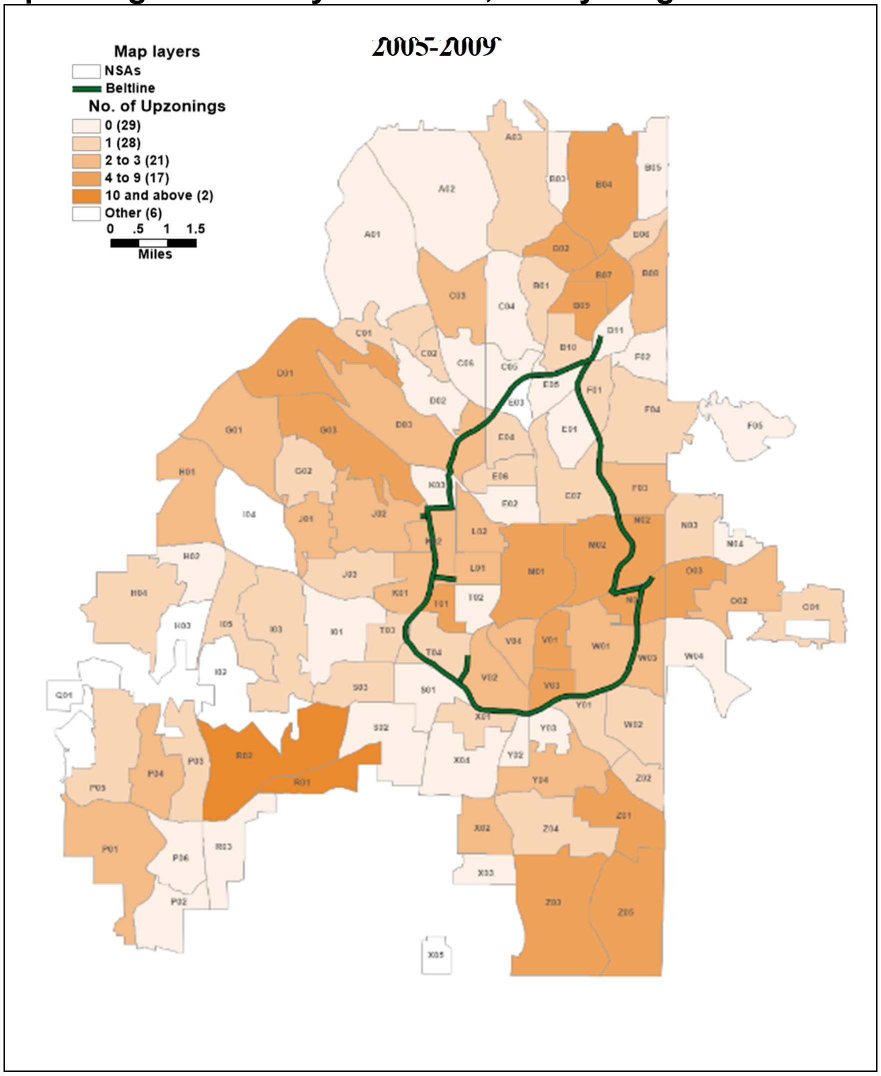


Figure 5.3
Approved Upzonings in the City of Atlanta, GA by Neighborhood for 2010-2014

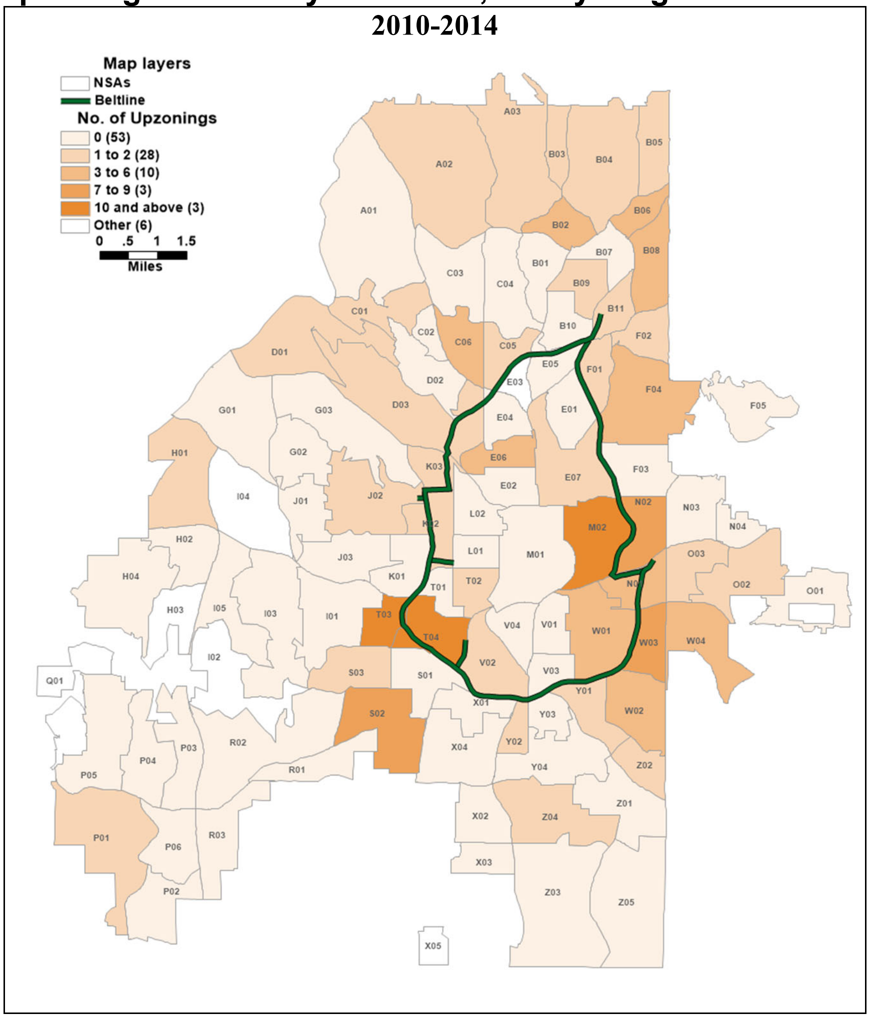
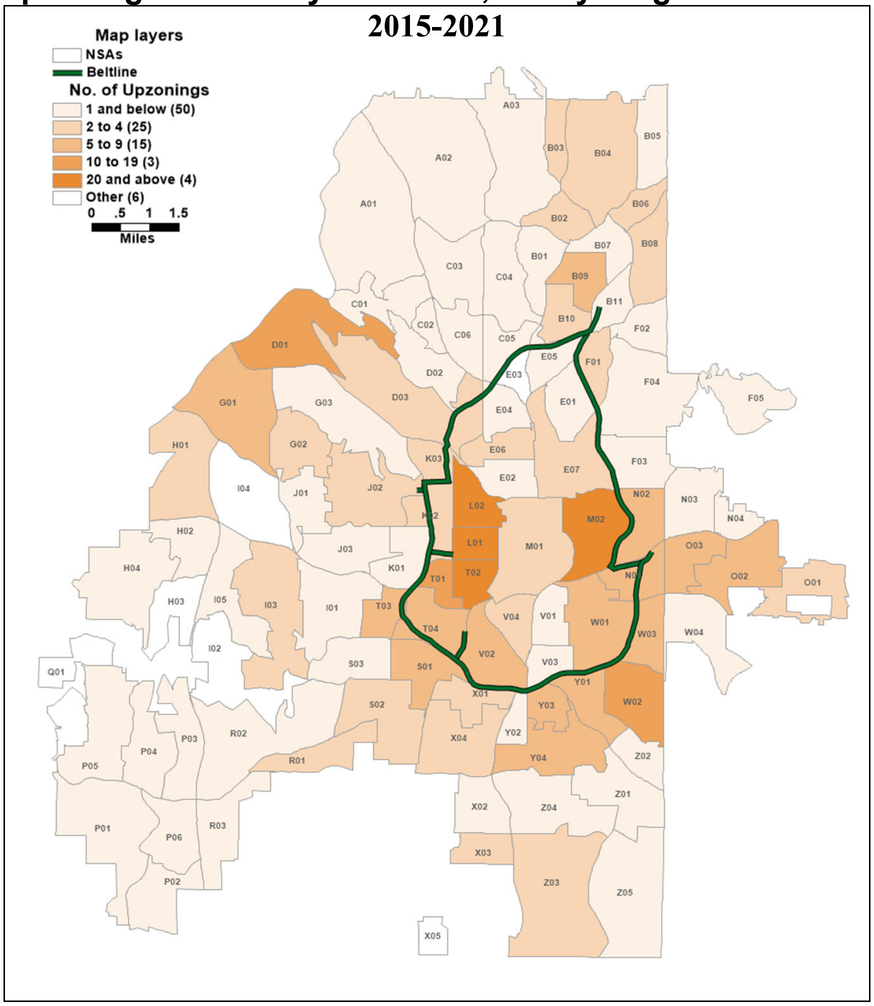


Figure 5.4
Approved Upzonings in the City of Atlanta, GA by Neighborhood for 2015-2021

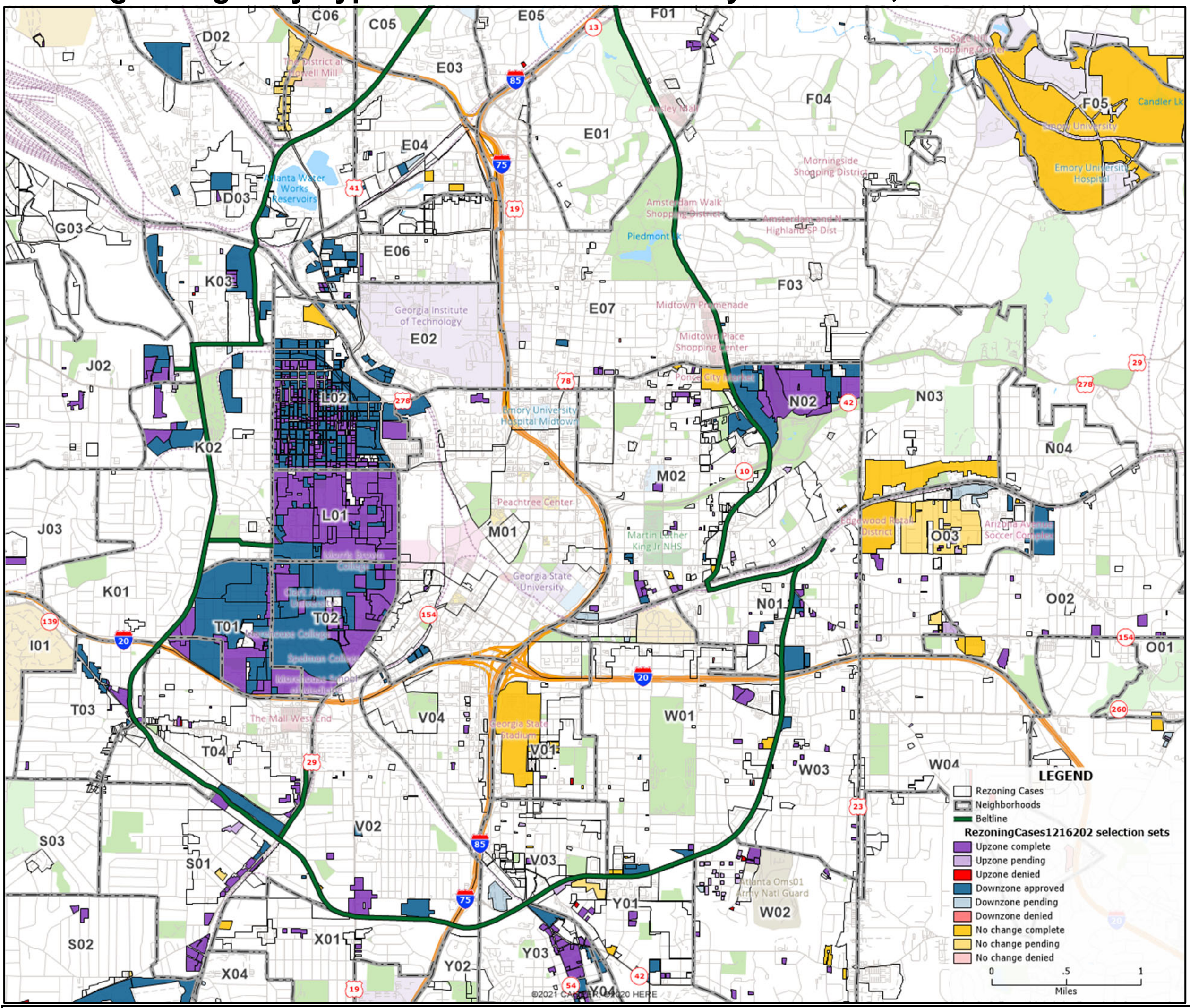


The maps show a consistent pattern of approved upzonings clustering in neighborhoods along the BeltLine. This holds especially true for the later periods, as this would correspond to the more recent construction of private retail space, mixed-use residential, office space, and service industry facilities that the BeltLine project aimed to encourage along it (Immergluck 2009; Camrud 2021). Relatedly, since the neighborhoods with the highest number of upzonings are located in and around the BeltLine, and since 38% of all rezoned parcels had former residential designations, and furthermore, since 80% of all residential parcels with an approved zoning change were upzoned largely to mixed-use designations – it would follow that, most neighborhoods along the BeltLine are experiencing upzonings from low-density residential designations to higher-density mixed-use designations. Additionally, considering that most of these neighborhoods are predominantly, historically Black, the findings suggest that the upzonings during 1996-2021 are following a trend of gentrification and redevelopment (Immergluck 2009; Camrud 2021).

I also analyzed the distribution of downzonings, and cases of no change, based on neighborhood over time to better understand how, if at all, these cases cluster with upzonings or whether they are largely located in neighborhoods independent of upzonings. Figure 6.1 zooms into those neighborhoods experiencing the most upzonings and highlights all zoning changes by type and outcome, with darker shades indicating a completed case and lighter shades indicating a pending case, as well as shades of red for denied upzonings for the period of 2015-2021. As per the other figures, the BeltLine is represented by a dark green line.

The data show that downzonings are frequently interspersed with upzonings in the same neighborhood, particularly in the neighborhoods that experienced the greatest number of rezonings. It is important to note that while Inman Park is historically White, Vine City, English Avenue, the Atlanta University Center, the Old Fourth Ward (Sweet Auburn), and Ashview Heights are all historically Black neighborhoods, another indication of rezoning trends correlating with gentrification and redevelopment (Lerner 1991; Immergluck 2009; Camrud 2021).

Figure 6.1
Zoning Changes by Type and Outcome in the City of Atlanta, GA for 2015-2021



Neighborhood Key	
J02 – Grove Park	N02 – Inman Park/Poncey-Highland
K02 – Bankhead/Washington Park	N03 – Candler Park
L01 – Vine City	O03 – Edgewood
L02 – English Avenue	V02 – Adair Park/Pittsburgh
T01 – Ashview Heights	V03 – Peoplestown
T02 – Atlanta University Center/Castleberry Hill	W02 – Benteen Park
M02 – Old Fourth Ward (Sweet Auburn)	Y03 – South Atlanta/Villages of Carver
N01 – Cabbagetown/Reynoldstown	

To further explore if different types of rezonings, specifically upzonings, occur in different types of neighborhoods, I calculated weighted means, based on the number of rezoned cases per census tract, to compare the demographic characteristics for upzonings, downzonings, or cases of no change for each period using information from the decennial census or ACS extract within the year the rezoning case occurred.

Table 7.1 summarizes the demographic characteristics of the four time periods analyzed. Across the different types of rezonings, the demographic characteristics appear relatively comparable, especially for the percent of Hispanic residents, percent of homeowners, percent of high school graduates, median household income, median rent, and poverty rate. However, for the first period, upzonings appear to have the lowest median household income across tracts at $28,738. On average, downzoned tracts appear to be relatively racially aligned with upzoned tracts during this period. No change tracts, however, appear to have the lowest median housing values, lowest median family income, and highest poverty rate. For 2005-2009, like the prior period, the demographic characteristics across rezoning type appear largely comparable, except no change tracts now have the highest median housing value, highest median family income, and highest percentage of White residents and the lowest percentage of Black residents. For 2010-2014, similar to the prior period, no change tracts again have the highest percentage of White residents, the lowest percentage of Black residents, and the highest median housing value. In an almost reversal of the prior period, however, upzoned tracts appear to have, on average, higher median family income and household income levels, as well as higher median housing values than downzoned tracts. For the final period, no change tracts appear to have again, the highest percentage of White residents, lowest percentage of Black residents, and the highest median household income and family income levels by a significant margin compared to the other aggregated tracts.

Overall, the first period of 1996-2004 appears to be different from all the other periods with no change tracts having the lowest median income levels, housing values, and highest poverty rates, whereas for other periods, no change tracts largely have the exact opposite. No change tracts from 2005-2021 consistently have the highest median family income levels, highest median housing values, highest percentage of White residents, and the lowest percentage of Black residents. Similarly, downzoned tracts during the first period also have very different characteristics compared to later periods, averaging the highest family income and household income as well as highest percentage of White residents while having the lowest percentage of Black residents. However, for 2005-2021, upzoned and downzoned tracts appear to be quite comparable.

Table 7.1
Weighted Mean Characteristics of Census Tracts by Rezoning Type for 1996-2021*

1996-2004[13]	Down-zoning	No change	Up-zoning		2005-2009[14]	Down-zoning	No change	Up-zoning
n	66	11	56		n	87	31	175
% Population Change, 00-10	47.2	6.7	38.8		% Population Change, 00-10	33.6	36.9	22.6
% White	32.2	19.7	27.1		% White	36.7	41.9	28.0
% Black	58.5	68.9	63.3		% Black	53.6	45.4	64.2
% Hispanic	4.3	8.7	6.0		% Hispanic	4.4	8.7	4.7
% Owner Housing	33.0	33.5	34.6		% Owner Housing	44.9	50.4	46.2
% High School Graduate	70.6	61.5	70.8		% High School Graduate	83.2	86.8	81.9
% Poverty	32.4	38.5	32.1		% Poverty	26.4	23.5	26.4
Median Household Income	32,468	28,955	28,738		Median Household Income	53,235	52,784	45,236
Median Family Income	48,235	33,560	36,753		Median Family Income	74,157	79,531	64,895
Median Housing Value	173,195	97,091	117,588		Median Housing Value	277,211	288,860	233,797
Median Rent	580	538	532		Median Rent	893	834	821
2010-2014[15]	Down-zoning	No change	Up-zoning		2015-2021[16]	Down-zoning	No change	Up-zoning
n	71	25	136		n	202	60	329
% Population Change, 00-10	5.9	15.3	4.8		% Population Change, 10-19	16.4	9.4	17.9
% White	30.5	51.9	39.5		% White	28.6	44.1	30.3
% Black	58.9	34.3	50.1		% Black	59.4	43.1	60.5
% Hispanic	5.4	5.6	5.5		% Hispanic	4.5	5.1	4.2
% Owner Housing	46.2	45.8	44.9		% Owner Housing	28.6	43.6	36.2
% High School Graduate	85.6	92.3	87.2		% High School Graduate	89.2	91.5	88.3
% Poverty	28.0	19.2	23.6		% Poverty	28.4	21.0	24.8
Median Household Income	47,968	61,758	55,674		Median Household Income	49,311	65,132	55,953
Median Family Income	66,532	95,737	79,215		Median Family Income	71,282	100,557	78,118
Median Housing Value	186,785	249,444	231,233		Median Housing Value	235,989	325,666	267,722
Median Rent	1,024	1,075	1,049		Median Rent	1,103	1,197	1,088
* Means weighted by number of approved rezoning cases								

[13] U.S. Bureau of the Census, Decennial Census of Population, 2000

[14] U.S. Bureau of the Census, American Community Survey, 5-Year Estimates, 2005-2009

[15] U.S. Bureau of the Census, American Community Survey, 5-Year Estimates, 2010-2014

[16] U.S. Bureau of the Census, American Community Survey, 5-Year Estimates, 2015-2019

Furthermore, while I hypothesized that upzoned tracts, on average, would have a higher percentage of Black residents, lower percentage of White residents, lower median household income levels, and lower median family income levels, the opposite appears to be the case. While downzoned and upzoned tracts appear similar in their demographic characteristics from 2005-2021, upzoned tracts during 2010-2021 actually appear slightly higher in their values for median household income, family income, and median housing values compared to downzoned tracts. These findings directly invalidate my first and second hypotheses in which I expected downzonings to occur more frequently in predominantly White, higher-income neighborhoods and upzonings to occur more frequently in predominantly minority, lower-income neighborhoods. However, when viewing Table 7.1 in conjunction with Figures 5.1, 5.2, 5.3, 5.4, and 6.1, which indicate that most rezoning is predominantly occurring along the BeltLine, and with residential upzoning largely occurring in historically Black neighborhoods, such as the Old Fourth Ward (Sweet Auburn), it is likely that gentrification and redevelopment have catalyzed the blending of residents in these rezoned tracts (Lerner 1991; Immergluck 2009; Camrud 2021).

As discussed previously, many theories posit that gentrification often accompanies residential upzoning. Existing research indicates that upzoning activity is positively associated with the tendency for a census tract to become whiter, with the percentage of white residents in these tracts sometimes increasing by “five-to-nine percentage points” (Aravena et al. 2020; Davis 2021). Therefore, if a large portion of rezoning activity in Atlanta is involving the upzoning of residential parcels to mixed-use parcels, specifically in neighborhoods along the BeltLine, it is likely that these census tracts are becoming Whiter and higher-income over time, blending the ratios between Black and White residents as observed in Table 7.1.

On the other hand, regarding my third hypothesis, which posits that tracts with predominantly no rezoning cases are more likely to have White, higher-income residents, it appears that according to Table 7.1, this pattern holds true for the most part, excluding the first period of 1996-2004. For the remaining time of 2005-2021, no change tracts consistently have the highest median family incomes, housing values, and percentages of White residents while simultaneously having the lowest percentage of Black residents. Therefore, it is likely that my third hypothesis is somewhat affirmed given that no change tracts largely appear to have more White residents and higher average income levels.

As illustrated by Figure 6.1, parcels with no rezoning change appear to be rarer in occurrence, and for the few completed cases, they are largely not occurring in gentrifying neighborhoods near the BeltLine, indicating their presence in neighborhoods experiencing no rezonings of any kind. Since parcels with a no change classification are still rezoned parcels, although the rezoning is not to a designation that would increase or decrease their permitted density level and intensity of land use activities, it would make sense that these cases should skew toward Whiter, higher-income neighborhoods that tend to remain protected from rezoning leading to massive redevelopment (Hajnal et al. 2003; Hajnal et al. 2005; Rugh et al. 2014; Einstein 2018).

To evaluate the influence of rezoning type, or specifically upzoning, on cancer risk estimates, and if those cancer risk estimates appear aggregated in marginalized communities, I conducted a fixed-effects regression analysis using panel data with census tracts as the units of analysis and five time periods aligned with the availability of NATA cancer risk estimates (1996-1998, 1999-2001, 2002-2004, 2005-2010, and 2011-2013). For each of the time periods, I included lagged cancer risk estimates, some by two or three years because a change in the cancer risk estimate would not simultaneously arise in response to an immediate zoning change. Since the fixed-effects model controls for any observed or unobserved differences across census tracts, the regression estimates the impact of within tract changes, expressly rezoning and demographic characteristics, on the outcome variable of interest, total cancer risk estimate.[17] It is important to note that this is not a quasi-experimental research design since I do not have a treatment and control group due to the presence of both upzonings and downzonings in the same neighborhoods as well as fluctuations over time in many neighborhoods in the mix of rezonings.

Table 8.1 presents the findings from the fixed-effects regression analysis of the effects of upzonings on cancer risk. The table shows the results for several different specifications. Due to issues related to high multicollinearity between the percentage White and percentage Black, my preferred model and the one I focus on in my summary is Model 1. For upzoning, the results yielded a statistically significant positive coefficient of .4335, meaning that for every additional upzoning case in a census tract, cancer risk estimates increase by .4335 people per million, on average and controlling for the other variables included in the analysis. An alternative interpretation is that for every 10 additional upzonings in a census tract, cancer risk estimates increase by 4.33 people per million.

These findings affirm my fourth hypothesis that census tracts with more upzoned land parcels would have higher cancer risks. However, the findings do not support the second part of my fourth hypothesis, census tracts with more downzoned land parcels would have lower cancer risks than census tracts with more upzoned land parcels. While the coefficient for the number of downzonings is in the predicted direction, it is not statistically significant.

[17] After running both fixed effects and random effects models, the Hausman test results indicated firmly that a fixed-effects approach is the preferred estimation strategy.

Pertaining to the effects of a census tract's demographic characteristics on its cancer risk estimates, there is a statistically significant and positive relationship between the percentage of White residents in a tract and cancer risk.[18] For every percentage point increase in the non-Hispanic White population of a tract, the cancer risk increases by .141, on average and controlling for the other variables in the model. Alternatively, for every ten-percentage point increase in the non-Hispanic White population of a tract, the cancer risk increases by 1.41 people in a million. While this is a relationship I did not initially anticipate, it aligns with the existing research that points to the strong relationship between upzoning, gentrification, construction and development, and the tendency for these areas to become increasingly White (Davis 2021; Wolf-Powers 2005; Aravena et al. 2021; Checker 2021).

Regarding the effects of economic indicators on cancer risk estimates, the median household income of a tract is a statistically significant predictor of cancer risk and has an inverse relationship. For every dollar increase in the median household income of a tract, cancer risk estimates decline by .0000463, or for every $1,000 increase in the median household income of a tract, cancer risk estimates decline by .46 people per million. The findings also show a statistically significant inverse relationship between the percentage of high school graduates in a census tract and cancer risk. For every percentage point increase in the percentage of high school graduates within a tract, cancer risk estimates decline by .214, or a 10 percent increase in the percentage of high school graduates within a tract, cancer risk estimates decline, on average, by 2.14 people per million.

[18] I only include percentage White in the model since the percentage White and Black in a census tract is nearly perfectly correlated (r=-.97). Results are nearly identical when including percent Black in the model instead of percent White though the signs of the coefficients are flipped.

Regarding homeownership, there is a positive, statistically significant effect on total cancer risk, with every percentage point increase in the percentage of homeowners in a tract resulting in a .094 increase in cancer risk estimates. This is likely due to upzoning for the development of denser, mixed-use housing increasing the overall number of housing units available for purchase while boosting construction and the presence of air toxics. The strength of a census tract's rental housing market as measured by its median rent has a statistically significant inverse relationship with cancer risk. Census tracts with higher median rents, on average, have lower cancer risks. The estimation shows that a $100 increase in a tract's median rent, on average, is associated with a decrease in the cancer risk of .704 people per million.

Table 8.1
Factors Contributing to Cancer Risk in Atlanta Neighborhoods
Regression with Fixed Tract and Time Effects, Atlanta Census Tracts, 1996-2014

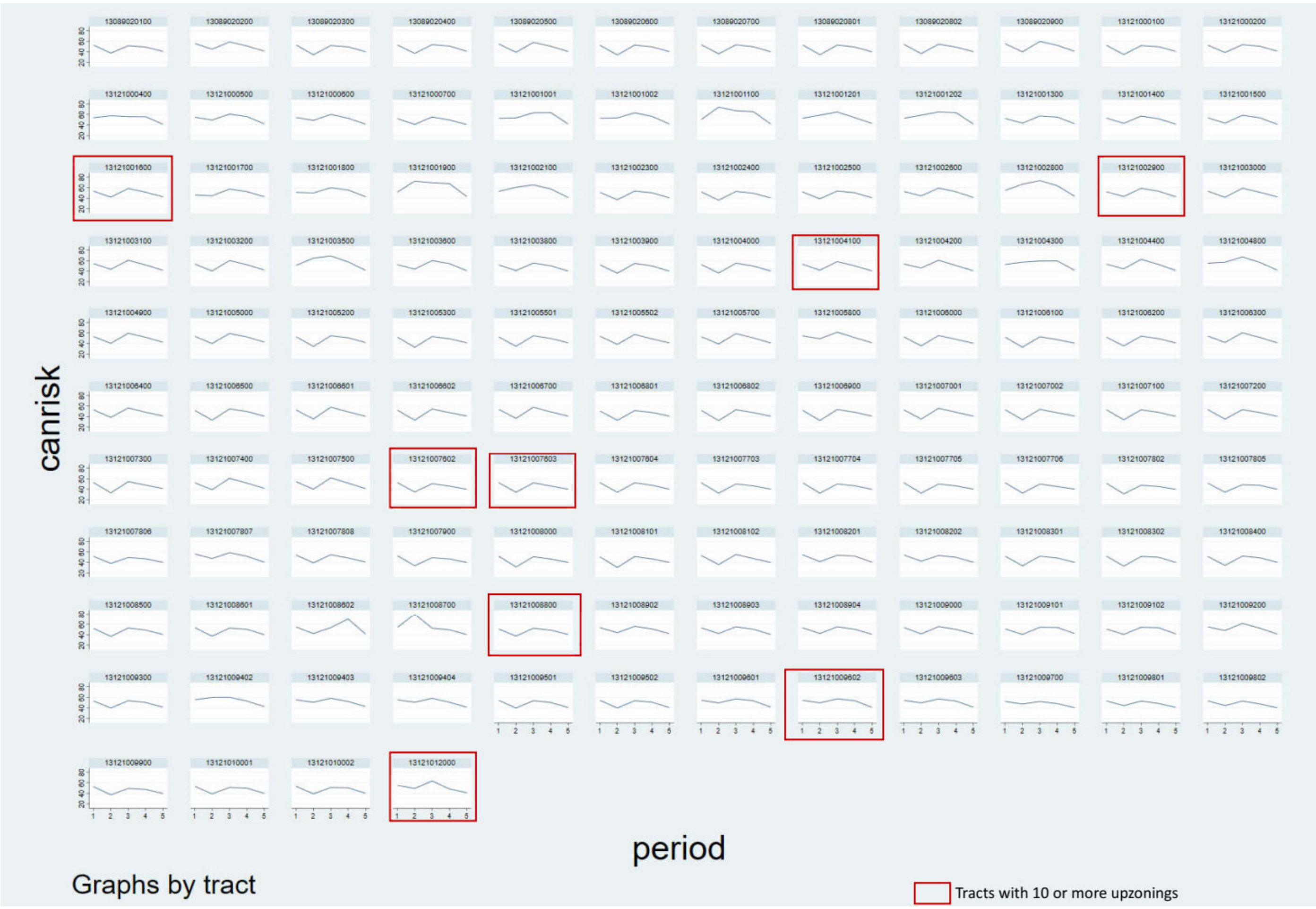
	(1)	(2)	(3)	(4)	(5)
Upzoning	.4335292* (0.2020622)	.440331* (.2026418)	.4320998* (.1989978)	.4216843* (.2036738)	.4234005* (.1997747)
Downzoning	-.0039029 (0.1821827)	-.0128488 (.1836081)	-.0149307 (.1817241)	-.0208308 (.1804515)	.0321551 (.1820981)
Non-Hispanic White	.1405917** (0.0480294)	.1428992** (.047838)	.1337272** (.0479611)	.3614569** (.1262599)	
Non-Hispanic Black				.2340712 (.1285578)	-.0773458 (.0460719)
Hispanic	-.0817036 (0.0885705)	-.0743026 (.085665)	-.0832173 (.0879281)	.1715592 (.1694354)	-.1962341* (.0979487)
High School Graduate	-.214099*** (0.043661)	-.2033932*** (.0416172)	-.2060349*** (.0425896)	-.2079543*** (.0444251)	-.1895021*** (.0431541)
Homeowner	.0941529* (0.0388656)	.0991058** (.0367248)	.0684095* (.0358613)	.0920192* (.0383047)	.1058393** (.038494)
Median Household Income	-.0000463* (0.0000232)	-.0000378 (.0000233)		-.0000382 (.0000233)	-.0000441 (.0000234)
Poverty Rate	-.0400612 (0.0409629)		-.0272051 (.0404418)	-.0435603 (.040734)	-.0414006 (.0402731)
Median Rent	-.0070472** (0.0024712)	-.0073509** (.002478)	-.0081663** (.0023621)	-.0067622** (.0024501)	-.0072254** (.0024894)
Time Period	-.2437968 (0.2214816)	-.3014074 (.2057368)	-.3052741 (.2319119)	-.219565 (.2155912)	-.2856476 (.2240481)
Constant	65.94964*** (3.702509)	63.78792*** (2.515823)	65.34839*** (3.613406)	42.86257** (13.50802)	73.40057*** (5.91565)
Mean dependent variable	48.5959	48.5959	48.5959	48.5959	48.5959
Number of observations	616	616	616	616	616
Number of groups (census tracts)	124	124	124	124	124
Average observations per group	5	5	5	5	5
F-statistic	45.05	50.14	48.28	41.55	43.01
Probability >F	0.0000	0.0000	0.0000	0.0000	0.0000
R-square					
Within	.1488	.1479	.1472	.1530	.1440
Between	.0001	.0002	.0018	.0479	.0616
Overall	.0648	.0682	.0688	.0372	.0394
Rho	.2533	.2480	.2515	.2952	.2725

Table 8.1 includes results from multiple models in which different demographic factors are included as independent variables in regression analysis. For model 1, the poverty rate is

included whereas non-Hispanic Black is not. For Model 2, non-Hispanic Black is not included nor poverty rate as median household income serves as the only economic indicator. For Model 3, median household income and non-Hispanic Black are not included. For Model 4, all demographic characteristics are included whereas for Model 5, non-Hispanic White is not included. It appears that percent non-Hispanic White and non-Hispanic Black are perfectly correlated. For many variables, the correlation coefficient is almost identical between Black and White with only the sign differing. When comparing Model 1 and Model 5, the results for the key variable, upzoning, are pretty similar.

Several variables included in the analysis did not yield any statistically significant effects. These included the percentage of Hispanic residents in a tract, likely due to the relatively small percentage of Hispanic residents in Atlanta, and the poverty rate of tracts. In addition, I included a fixed effect for time (the period variable), although the results show this effect not to be statistically significant, though its coefficient suggests a downward trend in cancer risk. This is likely a result of NATA data collection methods, hazardous air pollutant (HAPs) definitions, and exposure modeling changing over time for different reports. The downward trend in overall cancer risk estimates is illustrated in Figure 8.2, which illustrates the trends in cancer risk for all analyzed census tracts based on the five time points from 1996-2013. Graphs with a red box demarcating them indicate census tracts with 10 or more approved upzonings. These graphs confirm the similarity in cancer risk estimate trends for these tracts.

Figure 8.2
Trends in NATA Total Cancer Risk Estimates based on Five Time Periods from 1996-2013 for Analyzed Census Tracts in the City of Atlanta, GA



In an effort to place these quantitative findings in a more real-world context, I wanted to better understand the political and social mechanisms behind these rezoning trends in Atlanta. Therefore, I met with Mr. Stewart Henderson, a GIS Analyst who has worked for the Department of City Planning in Atlanta for over 8 years, and Ms. Lenise Lyons, an Urban Planner who has worked for the Office of Zoning and Development in Atlanta for several years and asked them both to better clarify the causes and patterns of rezoning and development in recent decades.[19] Both officials mentioned that City Council members, NPU representatives, and ZRB members continually push for the most growth within the city. In some cases, they explained, NPUs that desire a land use change in their communities will sometimes even hire local land use and zoning attorneys to apply pressure.

The drive for economic development in recent years has spurred the massive redevelopment and gentrification of many neighborhoods in Atlanta; Ms. Lyons explained that in the neighborhoods of Summerhill, Mechanicsville, Kirkwood, Edgewood, and Chattahoochee, land parcels that were previously zoned for denser, multi-family and two-family homes on smaller lots, are rapidly becoming downzoned to single-family designations with lower density and larger lot sizes. Ms. Lyons further elaborated that in booming areas such as along the BeltLine and Peachtree Street in Midtown, parcels there were largely zoned for industrial and more intensive land use purposes, but now are quickly being purchased for lower costs and downzoned to mixed-use residential designations. Conversely, Ms. Lyons and Mr. Henderson suggested that most upzoning trends have been occurring in marginalized areas throughout Atlanta, such as Memorial Drive. This gentrification process, according to these officials, has been ongoing for the past 15 to 20 years due to the increase in demand for urban housing and the return of young professionals and families to cities. To mitigate the displacement of residents in marginalized neighborhoods as a result of rising housing costs, the recently adopted 2021 CDP Plan A intends to upzone land parcels in single-family neighborhoods to multi-family designations, but this decision has been met with pushback from wealthier residents, with Buckhead residents even threatening to secede from the City of Atlanta (Mock 2021).

[19] Meeting between Mr. Stewart Henderson, Ms. Lenise Lyons, Dr. Michael Rich, and myself on Friday, March 11th, 2022, at 11:30 A.M. via Zoom.

It is important to understand the entities driving so much of the redevelopment and gentrification that Atlanta has witnessed in recent decades. Zoning is a powerful tool held by municipalities and it is central to all determinations on the future of economic development and growth. Although the City of Atlanta provides many platforms for residents to voice their opinions and provide input in rezoning and land use decisions, such as through participation in NPUs, the APAB, public ZRB and City Council hearings, and local elections, the residents who actually participate in these avenues tend to be skewed toward those that have the time, energy, and money to spend on civic engagement. As mentioned previously, Einstein et al. (2018) and Warshaw (2019) reaffirm this, finding that public municipality meetings, particularly related to development and zoning, tend to be dominated by residents that are White, high-earning, older, and homeowners, groups that can typically afford to take more time away from work to provide input in municipal decisions. Anderson et al. (2008) compound this finding by stating that zoning and planning board members tend to be White-collar, professional residents involved in business, investment, legal industries, residential development, and politics within cities, making them partial to increased development as they largely stand to benefit. In Atlanta, the current members of the ZRB include attorneys, architects, developers, and entrepreneurs, while members of the Board of Zoning Adjustment (BZA), another board of appointed members that decide requests for zoning amendments, include architects, attorneys, developers, and brokers as well (Atlanta Dept. of City Planning 2022).

To be clear, accountability and pressure drive municipal decisions. Aside from personal benefit, local officials are answerable to the residents that participate often and loudly in public matters and consistently vote in municipal elections. As such, members of marginalized neighborhoods, which tend to exhibit lower levels of political participation, are overshadowed by the inputs of wealthier, predominantly White communities that surround them (Einstein et al. 2018; Oliver 1999). Changes in zoning that would negatively affect existing residents, such as through residential upzoning to more intensive, mixed-use developments, potentially compounding environmental costs, would appear to occur in communities that provide the path of least resistance, such as the historically Black neighborhoods around the BeltLine project. The fact that over 60% of neighborhoods in Atlanta are zoned for single-family, larger lot designations, perpetuating residential segregation among income levels, compounded with the simultaneous gentrification of neighborhoods that are being upzoned to multi-use residential space for urban professionals, appear to reflect the desires and needs of a very particular segment of the population (Taylor 2021).

Limitations

One of the major limitations in this study pertains to the measurement of the primary independent and dependent variables of interest. First, not all rezoning cases are alike, with individual parcels experiencing unequal changes in the intensity of upzoning or downzoning occurrences. Since my ordinal scale treats any increase in the permitted density level and intensity of land use activities the same, it is likely that the analyzed upzonings actually vary greatly in terms of their intended construction projects, creating differential environmental impacts. Furthermore, there is potential for human error in regard to my placement of zoning district designations along the ordinal scale in order of increasing density and intensity of land use activities, skewing the number of cases labeled as upzoning compared to downzoning or no change. Regarding measurement issues of the dependent variable of interest, or total cancer risk, NATA reports are available for only estimations between 1996 and 2014, limiting the period of health risk analysis greatly. Additionally, the external validity of this thesis is likely limited by the location and timing of the study parameters, with the applications of my findings being restrained to the City of Atlanta from 1996 to 2021.

An additional limitation is that census tracts may be too big of a geography to understand the demographic characteristics of individual land parcels experiencing zoning changes. However, since census tracts are the smallest scale that NATA cancer risk estimates are available for, it would be very difficult to analyze environmentally-related health risks at any lower level. Moving forward, there is a need to examine health outcomes and demographic characteristics related to zoning changes at a smaller geographic level. Additionally, expanding the time period of analysis may yield additional insights on the changing patterns of rezoning in Atlanta. To do this, hypothetically moving forward, I would likely analyze more historical rezoning cases using the physical, mylar maps from the City of Atlanta Department of Zoning, in which they are documented.

Conclusion

Overall, the research findings in this thesis affirm some of my predictions while invalidating others, largely those related to expectations of demographic patterns in rezonings by type. As illustrated in Table 7.1, there appears to be little variation in the demographic characteristics in the census tracts with aggregated upzonings versus downzonings over time. However, while my findings invalidate my first and second hypotheses in which I expected downzonings to occur more frequently in predominantly White, higher-income neighborhoods and upzonings to occur more frequently in predominantly minority, lower-income neighborhoods, this blending in percentages of Black and White residents is likely due to the ongoing gentrification in Atlanta over the past decades. When viewing Table 7.1 in conjunction with Figures 5.1, 5.2, 5.3, 5.4, and 6.1, which indicate that most upzoning is predominantly occurring along the BeltLine, particularly in historically Black neighborhoods like the Old Fourth Ward (Sweet Auburn), and with a significant number of upzonings involving a change in parcel designations from residential to mixed-use, it is evident that gentrification and redevelopment, as confirmed by Mr. Henderson and Ms. Lyons, is impacting the residential composition of neighborhoods. These upzonings, which are becoming more frequent over time, are often accompanied by construction and development, which would lead to an uptick in the presence of air toxics over time.

Accordingly, there is a positive, statistically significant relationship between the percentage of White residents in a tract and cancer risk estimates, which leads me to suspect that construction due to upzonings, often signaling the gentrification of neighborhoods, is correlated with the number of White, higher-income residents moving in (see Table 8.1). One of the most important findings in this thesis, however, is the positive relationship between upzoning occurrence and total cancer risk estimate, providing evidence that upzonings are associated with an increase in the cancer risk of residents within a tract. Across all census tracts over time, however, there is evidence of a downward trend in cancer risk estimates, potentially signaling some of the latest evidence of environmental justice concerns in U.S. cities, such as Atlanta, due to greater awareness of the pollution burden, increases in protective policies and regulation of pollutants, and expanded surveillance. It is also likely that since my study area is limited to the City of Atlanta, which is largely zoned for residential designations, I am unable to determine if marginalized communities are disproportionately exposed to industrial and commercial pollutants from larger facilities that no longer exist in urban core neighborhoods due to the deindustrialization of the 1970s. However, moving forward, expanding the period of analysis to include more historical rezoning cases would likely signal trends that follow theories on the pollution burden.

To close, the findings of this thesis are significant when applied to the real-world context of municipal zoning decisions across U.S. cities. The zoning and city planning process often becomes political due to pressure from investors, developers, political interests, voters, and others, and it is clear by the very few denied rezoning cases in recent decades, that Atlanta is adopting a pro-growth culture, increasing zoning changes across neighborhoods to allow for more development and construction (see Table 4.2). Municipal planners and zoning boards should re-evaluate their view of land-use changes and redevelopment beyond the scope of economic impacts and value creation. Instead, these officials should consider the implications of rezoning decisions on existing residents, such as unfair increases in housing values, rents, and mortgages, and the social consequences of developmental changes, like historically Black neighborhoods losing their cultural aesthetic and demographic makeup through upzoning and gentrification. Rezoning decisions, furthermore, should not be made in a vacuum of environmental consequences; Cancer risks of residents are extremely impactful and dangerous, and so construction and development should be approved in a way to mitigate exposures to these risks.

Appendix A
Ordinal Scale of Atlanta Zoning District Designations by Increasing Magnitude of Density and Intensity of Land Use Activities

Atlanta Zoning District Designation	Ordinal Rank
PD-CS	1
HBS	2
LBS	3
SPI-7 SA1	4
SPI-5 SA1	5
R-1	6
LD-20A SA3	7
HC-201 SA 1	8
SPI-3 SA1	9
SPI-4 SA1	10
SPI-7 SA2	11
SPI-11 SA6	12
SPI-11 SA7	13
SPI-12 SA3	14
SPI-18 SA5	15
SPI-19 SA6	16
HC-20-O	17
SPI-20 SA1	18
SPI-20 SA6	19
R-2	20
SPI-5 SA2	21
SPI-5 SA3	22
SPI-6 SA1	23
SPI-8	24
SPI-20 SA4	25
Poncey-Highland SA-6	26
R-2A	27
R-2B	28
R-3	29
SPI-2 SA3	30
SPI-2 SA4	31
NC5, R3	32
SPI-12 SA2	33
HC20-U Bonaventure-Somerset HD	34
R-3A	35
R-4	36
SPI-6 SA2	37

Appendix A (Cont'd)
Ordinal Scale of Atlanta General Zoning Districts by Increasing Magnitude of Density and Intensity of Land Use Activities

SPI-12 SA4	38
SPI-18 SA6	39
R-4A	40
R-4B	41
SPI-9 SA1	42
SPI-6 SA3	43
SPI-6 SA4	44
SPI-1 SA4	45
SPI-9 SA1	46
LD-20N SA1	47
HC20P	48
HC20K SA2	49
NC-10 SA-1	50
SPI-2 SA1	51
SPI-2 SA2	52
SPI-9 SA3	53
SPI-9 SA3 & SA2	54
SPI-9 SA4	55
SPI-2 SA5	56
SPI-12 SA1	57
SPI-19 SA1	58
SPI-20 SA2	59
SPI-20 SA3	60
SPI-20 SA5	61
SPI-21 SA5	62
SPI-21 SA8	63
SPI-22 SA4	64
R-4/LBS	65
Poncey-Highland SA-7	66
Poncey-Highland SA-1	67
Poncey-Highland SA-2	68
LD Pratt-Pullman	69
R-5	70
SPI-11 SA5	71
SPI-11 SA8	72
SPI-7 SA3	73
SPI-19 SA5	74
HC20K SA3	75

Appendix A (Cont'd)
Ordinal Scale of Atlanta Zoning District Designations by Increasing Magnitude of Density and Intensity of Land Use Activities

PD-H	76
RG-1	77
SPI-4 SA6	78
SPI-4 SA7	79
RG-2	80
SPI-3 SA2	81
Poncey-Highland SA-3	82
SPI-19 SA10	83
HC-20C SA4	84
RG-3	85
SPI-4 SA11	86
SPI-4 SA2	87
SPI-3 SA3	88
SPI-16 SA2 JSTA	89
SPI-18 SA4	90
SPI-19 SA7	91
SPI-21 SA6	92
RG-4-C/LBS	93
RG-4	94
SPI-11 SA4	95
HC20H	96
NC-12 SA-2	97
RG-5	98
RG-6	99
SPI-4 SA12	100
Poncey-Highland SA-4	101
RL-C	102
SPI-11 SA1	103
SPI-4 SA9	104
SPI-4 SA3	105
SPI-17 SA2, SA3	106
SPI-18 SA3	107
SPI-22 SA3	108
NC-5	109
NC-12 SA-1	110
SPI-11 SA9	111
SPI-14	112
Poncey-Highland SA-5	113

Appendix A (Cont'd)
Ordinal Scale of Atlanta Zoning District Designations by Increasing Magnitude of Density and Intensity of Land Use Activities

SPI-23	114
MR-1	115
SPI-4 SA4	116
MR-2	117
SPI-4 SA5	118
MR-3	119
SPI-3 SA4	120
HC20F	121
LD Mean Street	122
LD Briarcliff Plaza	123
MR-4	124
SPI-3 SA5	125
SPI-3 SA6	126
MR-4A	127
MR-4B	128
MR-5	129
SPI-3 SA7	130
SPI-3 SA9	131
MR-5A	132
MR-5B	133
MR-6	134
MR-MU	135
O-I	136
SPI-11 SA3	137
SPI-1 SA1	138
SPI-1 SA2	139
SPI-1 SA3	140
SPI-11 SA9	141
SPI-11 SA10	142
SPI-11 SA12	143
SPI-22 SA1	144
HC20K	145
LW	146
SPI-9 SA2	147
SPI-13	148
SPI-18 SA1	149
SPI-16 SA1	150
SPI-19 SA2	151

Appendix A (Cont'd)
Ordinal Scale of Atlanta Zoning District Designations by Increasing Magnitude of Density and Intensity of Land Use Activities

SPI-19 SA3	152
SPI-19 SA4	153
SPI-19 SA8	154
SPI-19 SA11	155
HC-20C SA3	156
NC	157
SPI-11 SA2	158
SPI-11 SA11	159
SPI-18 SA10	160
SPI-22 SA2	161
NC-1	162
NC-2	163
NC-3	164
NC-4	165
NC-5	166
NC-6	167
NC-7	168
NC-8	169
NC-9	170
NC-10	171
NC-11	172
NC-12	173
NC-13	174
NC-14	175
NC-15	176
C-1	177
C-2-C/HC-201 SA1	178
C-2	179
C-3	180
SPI-4 SA13	181
C-4	182
SPI-4 SA10	183
C-5	184
MRC-1	185
MRC-2	186
MRC-3-C/LBS	187
MRC-3	188
PD-OC	189

Appendix A (Cont'd)
Ordinal Scale of Atlanta General Zoning Districts by Increasing Magnitude of Density and Intensity of Land Use Activities

PD-MU	190
NC-10 SA-2	191
PD-BP	192
SPI-3 SA8	193
I-MIX	194
SPI-4 SA8	195
I-1 LBS	196
I-1	197
SPI SA1 &I1	198
I-2	199

Appendix B
Distribution of Total Upzonings by Neighborhood for the Four Time Periods of Analysis from 1996-2021 in the City of Atlanta

1996-2004 Neighborhood	Total Upzonings	Cumulative Percent		2005-2009 Neighborhood	Total Upzonings	Cumulative Percent
Peoplestown	9	16.1		Adams Park, Laurens Valley, Southwest	11	6.3
Bolton, Riverside, Whittier Mill Village	6	26.8		Campbellton Road, Fort Valley, Pomona	11	12.6
Lindridge/Martin Manor	6	37.5		Castleberry Hill, Downtown	7	16.6
Old Fourth Ward, Sweet Auburn	5	46.4		Garden Hills	6	20.0
Amal Heights, Betmar LaVilla	3	51.8		Buckhead Forest, South Tuxedo Park	5	22.9
Browns Mill Park, Polar Rock	2	55.4		Capitol Gateway, Summerhill	5	25.7
Cabbagetown, Reynoldstown	2	58.9		Carver Hills, Rockdale, Scotts Crossing	5	28.6
Capitol Gateway, Summerhill	2	62.5		Peoplestown	5	31.4
Center Hill, Harvel Homes Community	2	66.1		South River Gardens	5	34.3
Adair Park, Pittsburgh	1	67.9		Ashview Heights, Harris Chiles	4	36.6
Atlanta University Center	1	69.6		Blair Villa/Poole Creek, Glenrose Heights	4	38.9
Atlantic Station, Loring Heights	1	71.4		Bolton, Riverside, Whittier Mill Village	4	41.1
Berkeley Park, Blandtown, Hills Park	1	73.2		Buckhead Village, Peachtree Park	4	43.4
Blair Villa/Poole Creek, Glenrose Heights	1	75.0		Cabbagetown, Reynoldstown	4	45.7
Candler Park, Druid Hills	1	76.8		Edgewood	4	48.0
Carver Hills, Rockdale, Scotts Crossing	1	78.6		Inman Park, Poncey-Highland	4	50.3
Grove Park	1	80.4		Lakewood, Leila Valley, Norwood Manor	4	52.6
Ivan Hill	1	82.1		North Buckhead	4	54.9
Lake Claire	1	83.9		Old Fourth Ward, Sweet Auburn	4	57.1
Midtown	1	85.7		Adair Park, Pittsburgh	3	58.9
Morningside/Lenox Park	1	87.5		Ben Hill Terrace, Kings Forest, Old F..	3	60.6
North Buckhead	1	89.3		English Avenue	3	62.3
Pine Hills	1	91.1		Mechanicsville	3	64.0
South Atlanta, The Villages at Carver	1	92.9		Ormewood Park	3	65.7
South River Gardens	1	94.6				
Sylvan Hills	1	96.4				
Thomasville Heights	1	98.2				
Underwood Hills	1	100.0				

Appendix B (Cont'd)
Distribution of Total Upzonings by Neighborhood for the Four Time Periods of Analysis from 1996-2021 in the City of Atlanta

2010-2014 Neighborhood	Total Upzonings	Cumulative Percent		2015-2021 Neighborhood	Total Upzonings	Cumulative Percent
Old Fourth Ward, Sweet Auburn	15	11.0		Vine City	29	8.8
West End	13	20.6		Old Fourth Ward, Sweet Auburn	28	17.3
Westview	13	30.2		English Avenue	22	24.0
Fort McPherson, Venetian Hills	8	36.0		Atlanta University Center	20	30.1
Inman Park, Poncey-Highland	7	41.2		Bolton, Riverside, Whittier Mill Village	14	34.4
Ormewood Park	7	46.3		Benteen Park, Boulevard Heights	13	38.3
Channing Valley, Memorial Park	5	50.0		Ashview Heights, Harris Chiles	12	42.0
East Atlanta	5	53.7		Atlanta Industrial Park, Bolton Hills	9	44.7
Grant Park, Oakland	5	57.4		Cabbagetown, Reynoldstown	9	47.4
Cabbagetown, Reynoldstown	4	60.3		South Atlanta, The Villages at Carver	9	50.2
Morningside/Lenox Park	4	63.2		Ormewood Park	8	52.6
Benteen Park, Boulevard Heights	3	65.4		Edgewood	7	54.7
Buckhead Forest, South Tuxedo Park	3	67.7		Inman Park, Poncey-Highland	7	56.8
Buckhead Heights, Lenox, Ridgedale Park	3	69.9		Kirkwood	7	59.0
Home Park	3	72.1		Lakewood Heights	7	61.1
Pine Hills	3	74.3		West End	7	63.2
Atlanta University Center	2	75.7		Adair Park, Pittsburgh	6	65.1
Berkeley Park, Blandtown, Hills Park	2	77.2		Chosewood Park, Englewood Manor	6	66.9
Bolton, Riverside, Whittier Mill Village	2	78.7		Garden Hills	6	68.7
Cascade Avenue/Road	2	80.2		Grant Park, Oakland	6	70.5
Chosewood Park, Englewood Manor	2	81.6		Bush Mountain, Oakland City	5	72.0
Kirkwood	2	83.1		Westview	5	73.6
North Buckhead	2	84.6				

References

Adams, Michelle. "The Unfulfilled Promise of the Fair Housing Act." *The New Yorker News Desk*, The New Yorker, 11 Apr. 2018, https://www.newyorker.com/news/news-desk/the-unfulfilled-promise-of-the-fair-housing-act#:~:text=The%20law%20successfully%20made%20these,to%20promote%20and%20further%20integration.

Anderson, Jerry L., et al. "A Study of American Zoning Board Composition and Public Attitudes toward Zoning Issues." *The Urban Lawyer*, vol. 40, no. 4, 2008, pp. 689–745., doi:10.2139/ssrn.1119582.

Apelberg, Benjamin J., et al. "Socioeconomic and Racial Disparities in Cancer Risk from Air Toxics in Maryland." *Environmental Health Perspectives*, vol. 113, no. 6, June 2005, pp. 693–699., https://doi.org/10.1289/ehp.7609.

Atlanta City Design Housing, Atlanta Dept. of City Planning, 15 Mar. 2021, https://storymaps.arcgis.com/stories/e91c43ad299a4634add2bed4cf2eca9d.

"Atlanta Department of City Planning." *City Planning*, City of Atlanta, GA, 2022, https://www.atlantaga.gov/government/departments/city-planning.

Atlanta, Georgia., Code of Ordinances, Part III Land Development Code, Part 16 Zoning, Ch. 2 Official Zoning Map and Application of Regulations § 16-02.001 - § 16-23.008 (1980).

Aravena, Ignacio, et al. "Zoned Out? Examining the Effect of Upzoning on Neighborhood Demographic Trends: A Fixed Effects Analysis ." *New York University* , May 2020, pp. 1–14.

Beyer, Scott. "The Federal Housing Administration (Still) Insures Suburban Sprawl Over Urban Density." *Forbes Business*, Forbes Magazine, 31 July 2017, https://www.forbes.com/sites/scottbeyer/2017/07/31/the-federal-housing-administration-still-insures-suburban-sprawl-over-urban-density/?sh=1bdf13e87080.

Bowman, Ann O'M., and Kelley A. Crews-Meyer. "Locating Southern Lulus: Race, Class, and Environmental Justice." *State and Local Government Review*, vol. 29, no. 2, 1997, pp. 110–119., doi:10.1177/0160323x9702900205.

Bullard, Robert D. *Dumping in Dixie: Race, Class and Environmental Quality*. 2nd ed., Westview Press, 1994.

Bullard, Robert. "The Legacy of American Apartheid and Environmental Racism." *Journal of Civil Rights and Economic Development*, vol. 9, no. 2, 1994, pp. 445–474., doi:10.18772/22019033061.17.

Brown, Carol J., "A Comparative Analysis of Participatory Governance: The City of Atlanta and Neighboring Cobb County, Georgia." *Thesis, Georgia State University*, 2012. https://scholarworks.gsu.edu/geosciences_theses/44.

Camrud, Natalie. "Race, Class, and Gentrification Along the Atlanta BeltLine." *Scripps College Senior Theses*, 2017, pp. 1–63., https://doi.org/http://scholarship.claremont.edu/scripps_theses/947.

Checker, Melissa. "Wiped Out by the 'Greenwave': Environmental Gentrification and the Paradoxical Politics of Urban Sustainabililty." *City & Society*, vol. 23, no. 2, 9 Dec. 2011, pp. 210–229., https://doi.org/10.1111/j.1548-744x.2011.01063.x.

"Code Lists, Definitions, and Accuracy." *American Community Survey*, U.S. Census Bureau, 14 Dec. 2021, https://www.census.gov/programs-surveys/acs/technical-documentation/code-lists.html.

Connley, Courtney. "Why the Homeownership Gap between White and Black Americans Is Larger Today than It Was over 50 Years Ago." *CNBC*, CNBC, 21 Aug. 2020, www.cnbc.com/2020/08/21/why-the-homeownership-gap-between-White-and-Black-americans-is-larger-today-than-it-was-over-50-years-ago.html.

Davis, Jenna. "How Do Upzonings Impact Neighborhood Demographic Change? Examining the Link Between Land Use Policy and Gentrification in New York City." *Land Use Policy*, vol. 103, Apr. 2021, https://doi.org/10.1016/j.landusepol.2021.105347.

Davis, Jenna. "The Double-Edged Sword of Upzoning." *How We Rise*, Brookings, 15 July 2021, https://www.brookings.edu/blog/how-we-rise/2021/07/15/the-double-edged-sword-of-upzoning/.

Einstein, Katherine Levine, et al. "Who Participates in Local Government? Evidence from Meeting Minutes." *Perspectives on Politics*, vol. 17, no. 1, 2018, pp. 28–46., doi:10.1017/s153759271800213x.

Fraga, Bernard L. "Candidates or Districts? Reevaluating the Role of Race in Voter Turnout." *American Journal of Political Science*, vol. 60, no. 1, 2015, pp. 97–122., doi:10.1111/ajps.12172.

Freemark, Yonah. "Upzoning Chicago: Impacts of a Zoning Reform on Property Values and Housing Construction." *Urban Affairs Review*, vol. 56, no. 3, 2019, pp. 758–789., https://doi.org/10.1177/1078087418824672.

Gabbe, C. J. "Why Are Regulations Changed? A Parcel Analysis of Upzoning in Los Angeles." *Journal of Planning Education and Research*, 2017., https://doi.org/10.1177/0739456X17696034

Hajnal, Zoltan L., and Paul G. Lewis. "Municipal Institutions and Voter Turnout in Local Elections." *Urban Affairs Review*, vol. 38, no. 5, 2003, pp. 645–668., doi:10.1177/1078087403038005002.

Hajnal, Zoltan, and Jessica Trounstine. "Where Turnout Matters: The Consequences of Uneven Turnout in City Politics." *The Journal of Politics*, vol. 67, no. 2, 2005, pp. 515–535., doi:10.1111/j.1468-2508.2005.00327.x.

Hoang, Bai Linh. "Racial Disparities in Public Meeting Participation? Examining Past Evidence and Nationally Representative Data." *Urban Affairs Review*, vol. 57, no. 1, 2021, pp. 189–213., doi:10.1177/1078087419844024.

Houston, Douglas, et al. "Structural Disparities of Urban Traffic in Southern California: Implications for Vehicle-Related Air Pollution Exposure in Minority and High-Poverty Neighborhoods." *Journal of Urban Affairs*, vol. 26, no. 5, 2004, pp. 565–592., doi:10.1111/j.0735-2166.2004.00215.x.

Immergluck, Dan. "Large Redevelopment Initiatives, Housing Values and Gentrification: The Case of the Atlanta BeltLine." *Urban Studies*, vol. 46, no. 8, 8 July 2009, pp. 1723–1745., https://doi.org/10.1177/0042098009105500.

Kim, Minjee. "Upzoning and Value Capture: How U.S. Local Governments Use Land Use Regulation Power to Create and Capture Value from Real Estate Developments." *Land Use Policy*, vol. 95, June 2020, https://doi.org/10.1016/j.landusepol.2020.104624.

Lerner, Jonathan. "In the Shade of Old Atlanta." *The Washington Post*, The Washington Post, 22 Sept. 1991, https://www.washingtonpost.com/archive/lifestyle/travel/1991/09/22/in-the-shade-of-old-atlanta/81a54014-a2f7-4317-95b1-19f1acfb90a2/.

Maantay, Juliana. "Zoning Law, Health, and Environmental Justice: What's the Connection?" *Journal of Law, Medicine & Ethics*, vol. 30, no. 4, 2002, pp. 572–593., doi:10.1111/j.1748-720x.2002.tb00427.x.

Maantay, Juliana. "Zoning, Equity, and Public Health." *American Journal of Public Health*, vol. 91, no. 7, 2001, pp. 1033–1041., doi:10.2105/ajph.91.7.1033.

Manturuk, Kim, et al. "Homeownership and Local Voting in Disadvantaged Urban Neighborhoods." *Cityscape*, vol. 11, no. 3, 2009, pp. 213–230., doi:10.2139/ssrn.2066796.

Miller, Andy. "Metro Atlanta Still Struggling with Air Pollution, Report Says." *90.1 FM WABE*, WABE, 24 Apr. 2019, www.wabe.org/metro-atlanta-still-struggling-with-air-pollution-report-says/.

Mikati, Ihab, et al. "Disparities in Distribution of Particulate Matter Emission Sources by Race and Poverty Status." *American Journal of Public Health*, vol. 108, no. 4, 2018, pp. 480–485., https://doi.org/10.2105/ajph.2017.304297.

Mock, Brentin. "The Housing Proposal That's Quietly Tearing Apart Atlanta." *Bloomberg CityLab + Equity*, Bloomberg, 22 Nov. 2021, https://www.bloomberg.com/news/articles/2021-11-22/buckhead-fights-atlanta-s-multifamily-housing-push.

Mohai, Paul, and Robin Saha. "Which Came First, People or Pollution? Assessing the Disparate Siting and Post-Siting Demographic Change Hypotheses of Environmental Injustice." *Environmental Research Letters*, vol. 10, no. 11, 2015, p. 115008., doi:10.1088/1748-9326/10/11/115008.

Morello-Frosch, Rachel, and Bill M. Jesdale. "Separate and Unequal: Residential Segregation and Estimated Cancer Risks Associated with Ambient Air Toxics in U.S. Metropolitan Areas." *Environmental Health Perspectives*, vol. 114, no. 3, 2006, pp. 386–393., doi:10.1289/ehp.8500.

Nardone, Anthony, et al. "Historic Redlining and Urban Health Today in U.S. Cities." *Environmental Justice*, vol. 13, no. 4, 2020, pp. 109–119., doi:10.1089/env.2020.0011.

Oliver, J. Eric. "The Effects of Metropolitan Economic Segregation on Local Civic Participation." *American Journal of Political Science*, vol. 43, no. 1, 1999, p. 186., doi:10.2307/2991790.

Pratt, Gregory, et al. "Traffic, Air Pollution, Minority and Socio-Economic Status: Addressing Inequities in Exposure and Risk." *International Journal of Environmental Research and Public Health*, vol. 12, no. 5, 2015, pp. 5355–5372., doi:10.3390/ijerph120505355.

"Previous Air Toxics Assessments." *Air Toxics Screening Assessment*, Environmental Protection Agency, 4 Mar. 2022, https://www.epa.gov/AirToxScreen/previous-air-toxics-assessments.

Qiang, Ashley, et al. "Displacement and the Consequences of Gentrification." *University of California, Berkeley*, 21 Nov. 2021, pp. 1–48.

Rhodes, Jason. "Geographies of Privilege and Exclusion: The 1938 Home Owners Loan Corporation "Residential Security Map" of Atlanta." *Atlanta Studies*, 7 Sept. 2017, https://doi.org/10.18737/atls20170907.

Rhodes, Wendy. "Segregation." *CNY Vitals*, Central New York Community Foundation, 13 Sept. 2019, https://cnyvitals.org/tag/segregation/.

Rodríguez-Pose, Andrés, and Michael Storper. "Housing, Urban Growth and Inequalities: The Limits to Deregulation and Upzoning in Reducing Economic and Spatial Inequality." *Urban Studies*, vol. 57, no. 2, 2019, pp. 223–248., https://doi.org/10.1177/0042098019859458.

Rothwell, Jonathan T. "Racial Enclaves and Density Zoning: The Institutionalized Segregation of Racial Minorities in the United States." *American Law and Economics Review*, vol. 13, no. 1, 17 Mar. 2011, pp. 290–358., doi:10.2139/ssrn.1161162.

Rothwell, Jonathan, and Douglas S. Massey. "The Effect of Density Zoning on Racial Segregation in U.S. Urban Areas." *Urban Affairs Review*, vol. 44, no. 6, 2009, pp. 779–806., doi:10.1177/1078087409334163.

Rugh, Jacob S., and Douglas S. Massey. "Segregation in Post-Civil Rights America." *Du Bois Review: Social Science Research on Race*, vol. 11, no. 2, 2013, pp. 205–232., https://doi.org/10.1017/s1742058x13000180.

Servadio, Joseph L., et al. "Demographic Inequities in Health Outcomes and Air Pollution Exposure in the Atlanta Area and Its Relationship to Urban Infrastructure." *Journal of Urban Health*, vol. 96, no. 2, 2018, pp. 219–234., doi:10.1007/s11524-018-0318-7.

Sharkey, Patrick. *Stuck in Place: Urban Neighborhoods and the End of Progress toward Racial Equality*. The University of Chicago Press, 2013.

Shertzer, Allison, et al. "Race, Ethnicity, and Discriminatory Zoning." *National Bureau of Economic Research*, May 2014, pp. 2–51., doi:10.3386/w20108.

Taylor, Kendra. "Exclusionary Policies of the Past and Present: How Single-Family Zoning Structures Inequality." *Atlanta Department of City Planning*, Atlanta Department of City Planning, 5 Jan. 2021, https://www.atlcitydesign.com/blog/2021/1/5/exclusionary-policies-of-the-past-and-present-how-single-family-zoning-structures-inequality.

Toone, Stephanie. "Forbes: These Are the Top Cities Where African-Americans Are Doing the Best Economically." AJC, The Atlanta Journal-Constitution, 17 Jan. 2020, https://www.ajc.com/news/the-cities-where-african-americans-are-doing-the-best-economically/aV6HMTUklKq4Hem3dYXQNK/.

Villarosa, Linda. "Pollution Is Killing Black Americans. This Community Fought Back." *The New York Times*, The New York Times, 28 July 2020, https://www.nytimes.com/2020/07/28/magazine/pollution-philadelphia-Black-americans.html.

Warshaw, Christopher. "Local Elections and Representation in the United States." *Annual Review of Political Science*, vol. 22, no. 1, 2019, pp. 461–479., doi:10.1146/annurev-polisci-050317-071108.

Weitekamp, Chelsea A., et al. "An Examination of National Cancer Risk Based on Monitored Hazardous Air Pollutants." *Environmental Health Perspectives*, vol. 129, no. 3, 24 Mar. 2021, https://doi.org/10.1289/ehp8044.

Whittemore, Andrew H. “How the Federal Government Zoned America.” *Journal of Urban History*, vol. 39, no. 4, 2012, pp. 620–642., doi:10.1177/0096144212470245.

Whittemore, Andrew H. “Racial and Class Bias in Zoning: Rezonings Involving Heavy Commercial and Industrial Land Use in Durham (NC), 1945–2014.” *Journal of the American Planning Association*, vol. 83, no. 3, 2017, pp. 235–248., doi:10.1080/01944363.2017.1320949.

Whittemore, Andrew H. “The Experience of Racial and Ethnic Minorities with Zoning in the United States.” *Journal of Planning Literature*, vol. 32, no. 1, 19 Dec. 2016, pp. 16–27., https://doi.org/10.1177/0885412216683671.

Wilson, Bev. “Urban Heat Management and the Legacy of Redlining.” *Journal of the American Planning Association*, vol. 86, no. 4, 2020, pp. 443–457., doi:10.1080/01944363.2020.1759127.

Winkler, Elizabeth. “'Snob Zoning' Is Racial Housing Segregation by Another Name.” *The Washington Post*, WP Company, 29 Apr. 2019, www.washingtonpost.com/news/wonk/wp/2017/09/25/snob-zoning-is-racial-housing-segregation-by-another-name/.

Wolf-Powers, Laura. “Upzoning New York City's Mixed-Use Neighborhoods.” *Journal of Planning Education and Research*, vol. 24, no. 4, 2005, pp. 379–393., https://doi.org/10.1177/0739456x04270125.

Zhou, Ying, et al. “Carcinogenic Air Toxics Exposure and Their Cancer-Related Health Impacts in the United States.” *Public Library of Science (PLOS) One*, vol. 10, no. 10, 7 Oct. 2015, pp. 1–15., https://doi.org/10.1371/journal.pone.0140013.