Exploring Residential Property Investment Patterns in Somerville, MA:

Tools and Techniques for Practicing Planners

A thesis

submitted by

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ABSTRACT

The City of Somerville, Massachusetts is an urban community of 80,000 residents and 35,000 housing units, all located within four square miles adjacent to the global cities of Boston and Cambridge. Somerville has experienced a tremendous level of investment in its residential real estate during the past decade, presenting both challenges and opportunities for planners and policymakers. The purpose of this study is to enhance understanding of the spatial dynamics of residential property investment, and to assess the implications for existing and future policy interventions at the municipal level. The analysis will utilize publicly-available data on building permits, home sales and affordable housing programs. Geographic Information Systems (GIS) software will be used to perform spatial analyses, present time-series mapping of investment activity, and compare private investment with public spending on affordable housing.

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CHAPTER 1: INTRODUCTION

Locally and nationally, housing rehabilitation represents a tremendous flow of capital into communities, with profound implications for economic activity and social equity. According to the Harvard Joint Center for Housing Studies, American property owners invested nearly $300 billion in housing renovations in 2009. In the City of Somerville, MA, residential improvement projects have totaled more than $30 million annually since 2002, and residential property sales for the same period total more than $200 million annually (City of Somerville 2011b). This study will attempt to better understand patterns of home improvement and investment in Somerville during the last decade, with the goal of increasing awareness of real estate dynamics among planners and policymakers.

An improved understanding of property investment is critical for older industrial cities in Massachusetts like Somerville, which are challenged to strike a balance between economic revitalization and housing affordability. Somerville is an inner-ring suburb of Boston that has experienced significant reinvestment during recent decades, including a major transit extension of the MBTA Red Line subway to West Somerville in 1985. Increased property values and housing prices in the neighborhoods served by the Red Line raised community concerns about gentrification and displacement of low-income residents (City of Somerville 2009). With a second MBTA rail transit expansion through Somerville planned for 2016, local stakeholders have accelerated efforts to protect the City's mixed-income character via policies that promote affordable housing production and preservation.

Somerville is fortunate to have numerous policy tools in place to support preservation and expansion of housing opportunity for low- and moderate-income residents. Direct investment of federal Community Development Block Grant and HOME funds in affordable housing projects has totaled more than $15 million since 2002 (City of Somerville 2011a). However, federal and state resources have decreased since the 2007-2008 recession, and with pessimistic budget projections going forward, the imperative is growing for city officials to achieve maximum efficiency with limited funding. As noted in a recent *Urban Affairs Review* article, "As community development resources become more constrained, so does the need to allocate them strategically" (Thomson 2011, 566). Spatial analysis of building permit and home sales data represents an excellent opportunity for municipal officials to leverage a pre-existing, but often overlooked source of data to inform community development policies in the era of simultaneous increasing need and increasing government austerity.

This research will examine longitudinal data on property investment from publicly-available sources compiled by the City of Somerville's Inspectional Services Division and Assessing Department. It will explore different ways to visualize building permit and home sales data using Geographic Information Systems (GIS) mapping and spatial analysis techniques. Particular emphasis will be placed on evaluating change in density of investment over time, at a highly localized scale. Comparisons across the six planned MBTA Green Line

Extension station areas in Somerville will be made to stimulate further discussion about the relative merits of each as an option for strategic targeting of community development resources.

This thesis is also intended to encourage and facilitate more sophisticated investigations into Somerville's property investment trends. Academic literature has demonstrated that place-based investments can be determined to result in "spillover effects" in surrounding areas, often in the form of changes to property values or home sale prices. This study can contribute to the discourse via data assembly and preparation, literature review, preparation of descriptive statistics, spatial analysis and visualization of results at the citywide and neighborhood scales.

CHAPTER 2: LITERATURE

2.1 Defining the Phenomenon

Academic research has demonstrated that place-based property investments can have measurable effects on investments in nearby properties. Various authors have described this phenomenon using different terms: "spatial lag" (Ding 2000), "neighborhood effects" (Helms 2003), "multiplier effects" (Thomson 2008), "spillover" and "local effects" (Campbell 2009), "indirect effects" (Rogers, 2010) and "externalities" (Kobie 2010). For this literature review, "spillover effects" will be the term utilized to describe off-site impacts of a place-based investment.

Literature dealing with spillover effects utilizes statistical methods that are beyond the scope of this thesis. The field of real estate economics uses an analytical technique known as a "hedonic regression model" to control for the myriad of neighborhood and property factors influencing property values, and to test for the marginal impact of each factor (Rogers 2010). Hedonic modeling has achieved a widely-accepted level of statistical rigor (Meese 1997).

This thesis accepts the findings of the literature on spillover effects, and will examine and select appropriate elements of various research models to design a methodology that is tailored to Somerville's data on building permits and home sales. It will offer a series of descriptive statistics that draw from the academic literature, and will prepare a series of visualizations that can help public officials to better understand the investment trajectory of Somerville's neighborhoods.

2.2 Literature Used to Establish Quantitative Methods

This literature review has not identified any studies examining the spillover effects of housing rehabilitation projects on nearby properties' rehabilitation. Baker and Kaul (2002) came close, using rehabilitation projects as both a dependent and independent variable in their examination of factors influencing housing rehabilitations nationally. While many of their explanatory variables dealt with building characteristics, family types or neighborhood demographics, they also tested for the impact of previous renovation projects undertaken by the owner. Among all the explanatory variables they considered, previous on-site renovation activity was one of only two factors found to be statistically significant.

This scarcity of direct precedent suggests that additional literature types should be consulted in order to define a study methodology. As a result, three distinct bodies of literature will be examined to provide the theoretical basis for this investigation: neighborhood revitalization literature; affordable housing literature, and residential foreclosure literature.

2.3 Neighborhood Revitalization Literature

This body of literature examines the positive impacts of place-based policy interventions (including subsidized housing rehabilitation programs) on neighborhood revitalization. Government and nonprofit agencies have been directly investing in urban housing markets for decades, with the federal Community Development Block Grant (CDBG) funding program the most well-known policy framework. Researchers have sought to understand whether place-based investments contribute to revitalization of neighborhoods via a spillover effect, and if so, how to maximize the efficiency of these investments.

An early examination of spillover was published in 1998 by Simons, Quercia and Maric, who studied home sale prices in Cleveland, Ohio between 1992 and 1994, and whether nearby residential construction or rehabilitation projects may have impacted them. They found a significant price premium for sales near new residential construction, but also found a modest but significant negative impact for sales near rehabilitated properties (Simons et al. 1998).

Ding, Simons and Baku took this research a step forward, publishing a 2000 study on the spillover effects of housing rehabilitations in Cleveland between 1990 and 1997. Their spatial analysis methods were more rigorous than the 1998 study, controlling for a number of distance and neighborhood quality variables. They concluded that for every dollar invested in housing rehabilitation, roughly $0.13 was added to nearby property values (Ding et al. 2000).

Simons, Magner and Baku rely on the 2000 Cleveland study in their 2003 national study of revitalization efforts led by Community Development Corporations (CDC's). Asserting that housing rehabilitation has been demonstrated in the literature to provide positive spillover effects in the vicinity of the rehabilitated property, the researchers apply the $0.13 factor for off-site property value increases demonstrated by the 2000 Cleveland study (Simons et al. 2000).

Galster, Taitan and Accordino tested similar hypothesis in their 2006 study of Richmond, Virginia. During the 1990's, the City of Richmond had adopted a policy of targeting CDBG funds in certain neighborhoods, with the stated objective of stimulating private investment by achieving a critical mass of public expenditures. Galster's study measured the trajectories of home sale prices in test and control neighborhoods, finding that the neighborhoods receiving targeted public investment outperformed control neighborhoods. This finding was used to demonstrate positive spillover from neighborhood revitalization interventions (Galster et al.2006).

Thomson's research focuses on a concept called "Strategic Geographic Targeting", providing extensive literature review and theoretical examination rather than new quantitative analysis in a 2008 article. His summary of existing literature concludes that spillover effects have been well-documented in neighborhood revitalization literature (Thomson 2008). His 2011 analysis of revitalization policies in Detroit reinforced these findings, incorporating additional literature published during 2008, 2009 and 2010 (Thomson 2011).

2.4 Affordable Housing Literature

Another group of studies explicitly examine spillover effects, but within a very different policy framework. These studies generally seek to establish whether scattered-site affordable housing programs are associated with lower property values or sale prices for nearby properties. Historically, public policies on affordable housing have moved away from the model of large, isolated apartment complexes and towards smaller-scale projects that are integrated into mixed-income neighborhoods. Predictably, this policy shift has triggered resistance from residents and property owners in neighborhoods where scattered site projects are located or proposed. Galster, Tatian, Santiago and Cloud have each contributed quantitative studies of neighborhood spillover effects to this body of literature.

Galster, Tatian and Smith studied the neighborhood impacts of Section 8 voucher programs in Baltimore during the 1990's. Although this study did not address physical rehabilitation of residential properties, its methodology of testing for spillover effects is relevant. The research evaluated home sales in various proximities to properties where Section 8 vouchers were being used, finding that positive and negative spillover effects were observable, depending on various proximity and neighborhood variables (Galster et al.1999).

Lee, Culhane and Wachter tested a similar hypothesis in their 1999 study of property values in Philadelphia. This study attempted to draw distinctions between various types of assisted housing programs, including large complexes, scattered-site developments and rehabilitations as well as mobile rental assistance voucher programs. While the study results demonstrated negative spillover effects for most program types, the one exception was rehabilitation projects, which produced positive spillover effects on nearby property values once neighborhood quality was controlled for (Lee et al. 1999).

A 2001 study by Santiago, Galster and Tatian looked at scattered-site subsidized housing and property values in Denver. Home sales between 1987 and

1997 were tested to evaluate whether the presence of small-scale, scattered site affordable housing projects produced significant effects. Small, yet still discernible positive spillover effects were observed, although the authors are quick to note that these results are not necessarily generalizable to other cities due to unique operational characteristics of the Denver Housing Authority (Santiago et al. 2001).

A more recent study of Denver was published by Cloud and Roll, who examined home sales between 2001 and 2006 around a large affordable housing development project. Their results were quite robust, finding significant positive spillover effects on nearby home sales. However, it should be noted that the results may be partly attributable to the fact that this specific case involved demolition of a severely-distressed large public housing complex prior to its replacement with modern, townhouse-style affordable housing (Cloud and Roll 2011).

Ellen and Voicu studied New York City's real estate market during the 1980's and 1990's, seeking to test for spillover effects of publicly-subsidized affordable housing developments on nearby property sales. Their primary focus was to determine whether spillover impacts varied based on whether the affordable housing was produced by a nonprofit or a for-profit developer. Although they found positive spillover effects overall, the magnitude of these effects was demonstrated to vary, with projects produced by for-profit developers exhibiting higher degrees of spillover than projects produced by nonprofits. This study is noteworthy due to the large sample size and extended longitudinal nature of the data record (Ellen and Voicu 2006).

Also in 2006, Schwartz, Ellen, Voicu and Schiller published a second paper on New York City using the same 1980-1999 dataset. They analyzed nearly 300,000 individual property sales and tested for the effects of roughly 66,000 nearby subsidized housing developments during the same period. Their findings confirmed the existence of positive spillover around affordable housing developments, and enhanced the understanding of the New York City data by demonstrating a significant spatial decay in the magnitude of spillover effects as distance from project sites increased (Schwartz et al. 2006).

2.5 Foreclosure Literature

A third important group of studies uses spatial analysis to examine the negative impacts of residential property foreclosures on neighborhood vitality. As the national foreclosure crisis has unfolded, researchers and policymakers have sought to understand how distressed properties erode property values in nearby areas. This body of literature is in some ways the most relevant to my research model. Numerous recent studies have demonstrated negative spillover effects around properties in foreclosure, with quantitative methods repeated and refined across numerous metropolitan areas nationally (Kobie and Lee 2010).

Immergluck and Smith examined spillover effects in Chicago, specifically testing whether foreclosures in 1997 and 1998 impacted nearby home sales in 1999. Their database of home sales included roughly 9,600 transactions. Using a very localized geography of 660 feet, they found a discount of roughly 1% on home sale prices near a property in foreclosure (Immergluck and Smith 2006).

Lin, Rosenblatt and Yao also studied foreclosure and home sale dynamics in Chicago, for the period between 1998 and 2006. Their research also found significant spillover effects, with property sales within 2,700 feet of a foreclosed property selling at discounts ranging from 1.7% to 8.7% compared with a control sale. This study is also noteworthy in that it differentiated these effects between the strong housing market of the early 2000's and the weakening market later in the decade (Lin et al. 2009).

Campbell, Giglio and Pathak analyzed twenty years' worth of home sales data in Massachusetts and tested for the impacts of nearby foreclosures. A remarkable 1.8 million home sales were analyzed for the period from 1987 to 2008, with roughly 50,000 foreclosures for the same period. Their spatial analysis used linear distance measures 1,320 feet, 528 feet and 264 feet. A roughly 1% reduction in a home's sale price was apparent when a foreclosure occurred within 264 feet of the sale, although the discount was not proportional at the 528-foot and 1,320-foot distance measures (Campbell et al. 2009).

Rogers examined foreclosure spillover effects in St. Louis in 2009 and 2010 papers, with a specific focus on identifying variability in the spillover effects as spatial or temporal distance from the foreclosure increases. His dataset includes foreclosures and home sales during the period from 1996-2007. An important finding was that the negative spillover effects of foreclosures are relatively stable even with increasing numbers of foreclosure events (Rogers and Winter 2009). The findings were repeated in the second study (Rogers 2010).

Kobie and Lee looked at foreclosure impacts in Cleveland, bringing a new spatial analysis methodology to bear. Rather than measuring the linear distance between a foreclosed property and a property sale, Kobie and Lee summed their data to a geography they dub the "face block", which includes properties on both sides of the street. Using large datasets for foreclosures and home sales (23,000 records and 37,000 records, respectively) from 2005 to 2007, they found a significant discount of nearly 2% for home sales located on the same face block a foreclosed property (Kobie and Lee 2010).

Interestingly, all of the foreclosure literature examined to date tests for foreclosure impacts on nearby property values or sale prices, rather than the likelihood of additional foreclosures. In other words, the dependent variable in all cases was a continuous, rather than categorical value.

2.6 Methods Articulated in the Literature

Clearly, spillover effects are a topic of interest to the academic community. This section of the Literature Review will describe five common elements of the quantitative analysis methodologies:

- Spatial Thresholds
- Temporal Thresholds
- Event Thresholds
- Magnitude Thresholds

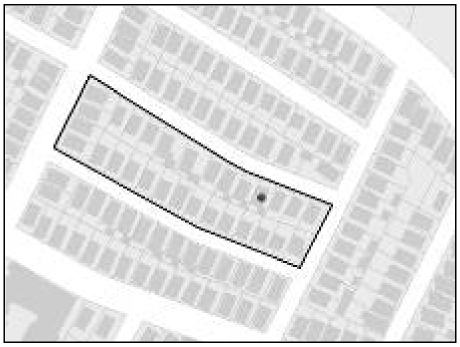
- Neighborhood Determinants

2.6.1 Spatial Thresholds

The first question in designing my research model is related to a debate in the literature regarding appropriate spatial thresholds at which to test for spillover activity. In other words, at what geographic scale should researchers expect investment at one subject property to predict investment activity at a second property? Three major approaches are *city block* models, *concentric ring* models, and *face block* models.

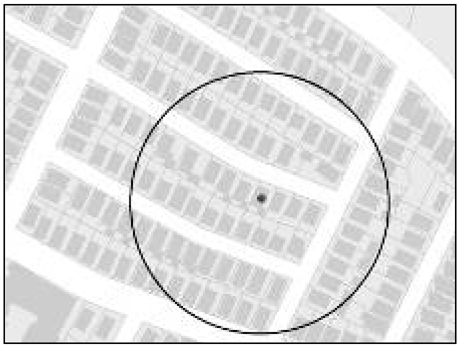
The city block unit of analysis suggests that a row of properties on a street between two cross streets will be grouped together (Figure 1). In an early study of neighborhood revitalization in Cleveland, Simons, Quercia and Maric used a 1-2 block area to test for spillover effects (Simons et al. 1998). City blocks are a standard unit of analysis for demographic data, but have significant limitations for analysis of place-based initiatives. In a subsequent study, Simons, Magner and Baku observe that city blocks can be problematic due to inherent variation in block size, since properties would be grouped together regardless of the linear distance between the two cross streets (Simons et al. 2003). In addition, properties abutting that row to the rear will be included in the unit of analysis, despite the fact that they may be located on a different street.

Figure 1: City Block Unit of Analysis



The concentric ring model generally applies one or more circular buffers around a property and examines impacts on properties located within the ring (Figure 2). This unit of analysis is extremely common across all three literature types, which is likely attributable to the simplicity of automating large-scale spatial analyses using concentric ring buffers. Ding, Simons and Baku use a concentric ring buffer technique in their 2000 study of Cleveland, finding that the impact of housing rehabilitation was most significant within 150 feet of the project site, with no observable spillover effects on neighboring property values beyond 150 feet (Ding et al. 2000).

Figure 2: Concentric Ring Unit of Analysis



Concentric ring models exhibit a wide range of distance parameters. Galster, Tatian and Accordino use the largest concentric ring model encountered in the literature (1,000 2,000, and 5,000 feet) to test the positive impacts of place-based community development projects in Richmond, VA (Galster et al. 2006). Immergluck and Smith's study of foreclosures in Chicago used buffers of 660 and 1,320 feet to test for spillover effects (Immergluck and Smith 2006). Galster, Tatian and Smith tested for spillover effects at a scale of 500 feet in a study of Baltimore (Galster et al. 1999); as did Santiago, Galster and Tatian in their studies of Denver (Santiago et al. 2001). Lin, Rosenblatt and Yao examined foreclosures in Chicago using a 300-foot ring model (Lin et al. 2009).

The face block unit of analysis includes both sides of a street between two cross streets (Figure 3). It represents an improvement over the city block model by capturing properties directly across the street from the subject, thus emphasizing the visual nature of neighborhood identity. It addresses shortcomings in the concentric ring model by excluding properties separated from the subject property by natural or artificial barriers. This model has been effectively articulated and implemented by Kobie and Lee in their study of the impact of residential foreclosures on nearby property values in Cleveland (Kobie and Lee 2010).

Figure 3: Face Block Unit of Analysis

2.6.2 Temporal Thresholds

Previous research provides several alternative thresholds for evaluating the time lag of spillover effects; in other words, where does one draw the line in determining whether a previous event may have influenced a current condition? Baker and Kaul use a two-year window to evaluate improvements occurring at the same property (Baker and Kaul 2002). In a study of CDBG-catalyzed positive neighborhood change, Galster et al utilize a three-year time lag approach (Galster et al. 2005). Galster, Tatian and Accordino utilize a two-year moving average in their study of housing price appreciation in Richmond, VA (Galster et al. 2006).

An important consistency between my research model and most literature sources reviewed involves the direction of the temporal relationship between dependent and independent variable. The vast majority of the literature reviewed to date use property values or sale prices as the dependent variable. This necessarily suggests that the research model will be backward-looking; in other words, the researcher is testing for the presence of a place-based event at some point in the past.

Foreclosure literature provides the most accessible illustration. A home sale or a property value is observed at a point we might call Year 0. A spatial threshold (such as a 1,000-foot concentric ring) is created, and the number of foreclosed properties in the prior year, which might be called Year (-1), is counted. Depending on the study model and the available data, the number of foreclosed properties in Year (-2) and Year (-3) might also be tallied.

2.6.3 Event Thresholds

Some literature sources suggest that event thresholds may exist, meaning that a certain number of occurrences of the independent variable are necessary before spillover effects become observable. Galster, Tatian and Smith establish that a tipping point of six Section 8 vouchers within a 500-foot distance of a home sale must be reached for significant impact on sale price to occur (Galster et al. 1999). Shlay and Whitman tested the impacts of vacant property on home sale prices in Philadelphia, finding that even one vacancy reduced nearby sale prices, and that an increased number of vacant properties was associated with an increase in the negative spillover effects (Shlay and Whitman 2006). However, Rogers and Winter found that foreclosures in St. Louis did not demonstrate any accelerating spillover effects as the number of events increased (Rogers and Winter 2009).

The inverse may also be true, meaning that if a place-based event is particularly prevalent in an area, spillover impacts may become less observable. Kobie and Lee find that Cleveland, where foreclosure rates were quite high even before the current crisis, may have reached a saturation point at which additional events no longer produce measurable spillover effects (Kobie and Lee 2010). Since this thesis will not be testing for statistical significance, event thresholds will not be addressed.

2.6.4 Magnitude Thresholds

The final threshold that must be considered in designing a research methodology is a magnitude threshold. Neighborhood revitalization literature, which seeks to understand the efficiency of public expenditures in promoting positive neighborhood change, has produced results that indicate that investment must meet a certain magnitude threshold for spillover effects to be observable. Drawing from an extensive literature review, Thomson finds that magnitude thresholds are common in studies of spillover activity related to neighborhood revitalization policy (Thomson 2008).

Ding, Simons and Baku tested the relative impacts of publicly-funded revitalization projects at three categorical scales: less than $15,000, between $15,000 and $32,500, and greater than $32,500 (Ding et al. 2000). Galster, Tatian and Accordino began their study of Richmond with the express purpose of testing for magnitude thresholds in investment spillover, since the City of Richmond's policy intervention was designed to stimulate private investment through public improvements. They found that cumulative public investment over a five-year period on a given block needed to exceed $21,000 for neighborhood spillover effects to be observable (Galster et al. 2006).

The affordable housing literature also includes examples of magnitude thresholds: in a study of New York City, Ellen and Voicu (2006) used unit count in new construction projects, rather than dollar values, as a magnitude threshold. Their study found that significant differences in spillover were observable, depending on whether an original project had greater or fewer than 100 units. Testing for magnitude thresholds will not be performed in this thesis, but Somerville's data sources for building permits and home sales do lend themselves to this type of analysis, and as a result it is a recommended area for future research.

2.6.5 Neighborhood Determinants

A general consensus appears to exist in the literature that neighborhood characteristics influence spillover effects. Neighborhood revitalization studies suggest that higher-income neighborhoods are more likely to exhibit significant spillover effects than are lower-income neighborhoods. Simons, Quercia and Maric found significant differences in spillover effects depending on whether the target property was in lower-income East Cleveland or higher-income West Cleveland (Simons et al. 1998). Ding, Simons and Baku added nuance to the understanding of Cleveland's dynamics, controlling based on various socioeconomic indicators (Ding et al. 2000). Lin, Rosenblatt and Yao used zip codes as a proxy for neighborhood characteristics in Chicago (Lin et al. 2009).

Galster, Tatian and Smith found that Section 8 vouchers show positive impact on sale prices in Baltimore's higher-income, less diverse neighborhoods, but show negative impacts in lower-income, more diverse neighborhoods (Galster et al. 1999). This finding was corroborated by Santiago, Galster and Tatian in their study of dispersed public housing developments in Denver (Santiago et al. 2001). However, it is important to note that neighborhood income levels may influence the scale of investment in housing rehabilitation projects, hence skewing the results (Ding et al. 2000).

Foreclosure spillovers have also been demonstrated to be subject to neighborhood determinants. Campbell, Giglio and Pathak found that spillover effects were more pronounced in lower-income Massachusetts neighborhoods compared with higher-income neighborhoods (Campbell et al. 2009).

Physical form can also inform analysis of housing rehabilitation activity. Helms studied renovation trends in Chicago between 1995 and 2000, finding that residential neighborhoods characterized by older small multifamily structures in close proximity tend to exhibit the highest rates of renovation activity (Helms 2003). Physical form was also an important variable in Campbell, Giglio and Pathak's 2009 study of foreclosure trends in Massachusetts. This study found that spillover impacts of foreclosures were influenced by structural characteristics of residential properties. Single family homes and large condominium buildings were subject to greater spillover effects than small multifamily buildings (Campbell et al. 2009).

2.7 Limitations Articulated in the Literature

This literature review identifies several quantitative questions that will not be addressed in this thesis. The most critical involves the type of renovation activity undertaken. Simons, Magner and Baku articulate the difference in visibility between interior renovations compared with exterior rehabilitation, and the resulting public awareness of the work taking place (Simons et al. 2003). Portnov, Genkin and Bartzilay exclude interior renovations altogether in their study of Haifa, Israel (Portnov et al. 2005). Due to incomplete coding of project descriptions in Somerville's building permit databases, my analysis necessarily treats interior and exterior permits the same.

A similar limitation is the distinction between what Simons, Magner and Baku call "functional replacement" projects and "discretionary improvement" projects. An example of a functional replacement is a new roof, which may or may not be viewed as translating to increased value. An update kitchen, or installation of a new bathroom might be considered a discretionary improvement, and would be expected to add value to the property (Simons et al. 2003). While my analysis does not break permitted projects into these two categories, it does differentiate by total project cost.

2.8 Summary of Literature Review

Dozens of academic studies have successfully examined whether place-based investments or disinvestments can be demonstrated to exhibit impacts in surrounding geographical areas. Methods have been applied and refined across many metropolitan real estate markets, and through numerous economic cycles. This thesis accepts the premise that place-based events can produce spillover effects, and seeks to bring many of the same principles of spatial and quantitative analysis to bear to illuminate real estate dynamics in Somerville that are not currently well-understood by policymakers and practitioners.

CHAPTER 3: METHODS

3.1 Data Sources

This study is intended to utilize publicly-available data sources. All data have been secured from the City of Somerville.

3.1.1 Building Permit Data

Building permit data have been acquired from the City of Somerville's Inspectional Services Division (ISD). Complete data records are available for the nine-year period from the beginning of calendar year 2002 to the end of calendar year 2010. A total of 13,823 records are included for analysis.

State building code mandates that municipal governments in Massachusetts issue building permits for plumbing, electrical and structural improvements. When a property owner applies for a building permit, ISD staff record the following information into basic spreadsheets:

- Owner's name,
- Address of the property to be improved,
- Whether the subject property is in residential or commercial use,
- Type of modification proposed, and
- Estimated construction cost

After the permitted improvements are completed, a city inspector must perform a cost certification to confirm that the work completed matches the work permitted. Despite this quality-assurance protocol, errors and omissions in the database certainly exist. Some homeowners and contractors have been known to pull building permits for specific, limited work, but actually complete additional improvements that are beyond the scope of the issued permit. Others simply perform work without any permit, risking discovery and costly penalties. No estimates are available on the frequency of these omissions.

3.1.2 Residential Property Sale Data

Residential property sale data have been acquired from the City of Somerville's Assessing Department. Complete data records are available for the same nine-year period from 2002-2010. A total of 4,256 records are included for analysis.

State law mandates that municipal governments in Massachusetts track real property sales as part of the process of setting property tax rates. Each year, the Somerville Assessing Department publishes a database of all real properties in the city, which range from roughly 15,000 records (2000) to 18,000 records (2010). The increase during that period is attributable to the creation of new condominium properties, either through conversion of existing rental units or through new construction. Annual spreadsheets include the following sales data:

- Address of the property sold
- Sale date
- Sale price
- Arms-length sale status
- Gross square footage
- Net square footage (living area)

3.1.3 Affordable Housing Program Data

City housing staff manage numerous programs providing grants and loans for affordable housing acquisition, preservation, renovation and development.

Complete data records are available for the period from 2002-2010. A total of 622 records are included for analysis. When a property owner, prospective homebuyer or nonprofit developer receives a grant or loan from the City, the following information is recorded in a database:

- Address of the property receiving assistance
- Amount of assistance received
- Subsidy program providing funds

3.1.4 Data Cleaning: Building Permits

Significant data cleanup was required to prepare a useable building permit database. Raw data secured from the city included roughly 15,700 individual data records. Selecting permits for residential properties reduced the sample size to just under 14,000 records.

The primary cleanup activity involved address data, which would be necessary for address geocoding. An address locater was created in ArcGIS using tax parcel centroids. Permit records were geocoded based on street address, and quality assurance was performed to ensure that all records were assigned to the correct tax parcel.

In order to facilitate accurate analysis of the value of permitted improvements, project values had to be adjusted for inflation. Since source data from the included fields for permit date, the Consumer Price Index (CPI) could easily be used to adjust all nominal values to real 2011 dollars.

3.1.5 Data Cleaning: Property Sales

Property sales data also required significant cleaning and quality assurance before analysis could begin. For each annual database, records were selected for all residential properties that sold during the calendar year. Non-arms-length deals were eliminated to ensure that only market-rate transactions were analyzed. Sale prices were adjusted for inflation to real 2011 dollars. Finally, inflation-adjusted sale prices were normalized by net square footage (living area) to generate a per-square-foot sale price.

3.2 Descriptive Statistics Analysis

My descriptive statistics methodology is consistent with approaches to spatial thresholds and temporal thresholds found in the literature. Figure 4 provides an illustration of the methodology, whose results are presented in Chapter 5, Sections 5.1, 5.3, 5.5 and 5.7. A permitted renovation project occurs in Year 0, around which concentric rings are established. Permitted renovation projects in the previous year (Year -1) are tallied, and the descriptive statistic "permit count" is determined for Year 0.

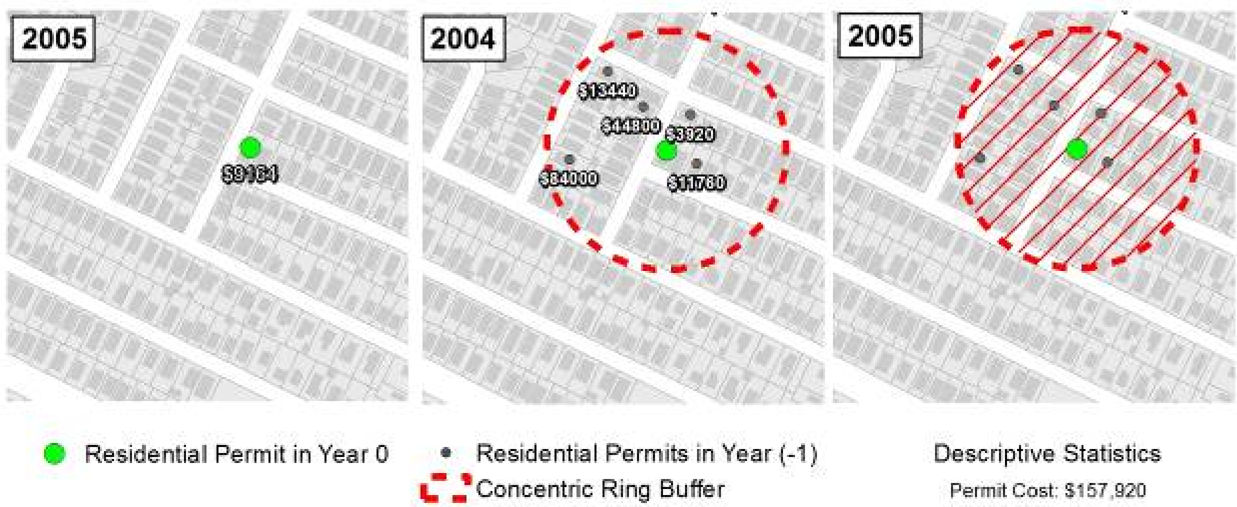
Figure 4: Descriptive Statistics Methodology for Neighborhood Permit Count Activity

To bring this calculation to scale, a descriptive statistic called "mean permit count" is determined. As illustrated in Figure 5, ring buffers are created for multiple permits in Year 0. Permits issued in Year (-1) are summed for each ring buffer. The mean count of permits within all ring buffers is recorded.

Figure 5: Descriptive Statistics Methodology for Mean Neighborhood Permit Count Activity

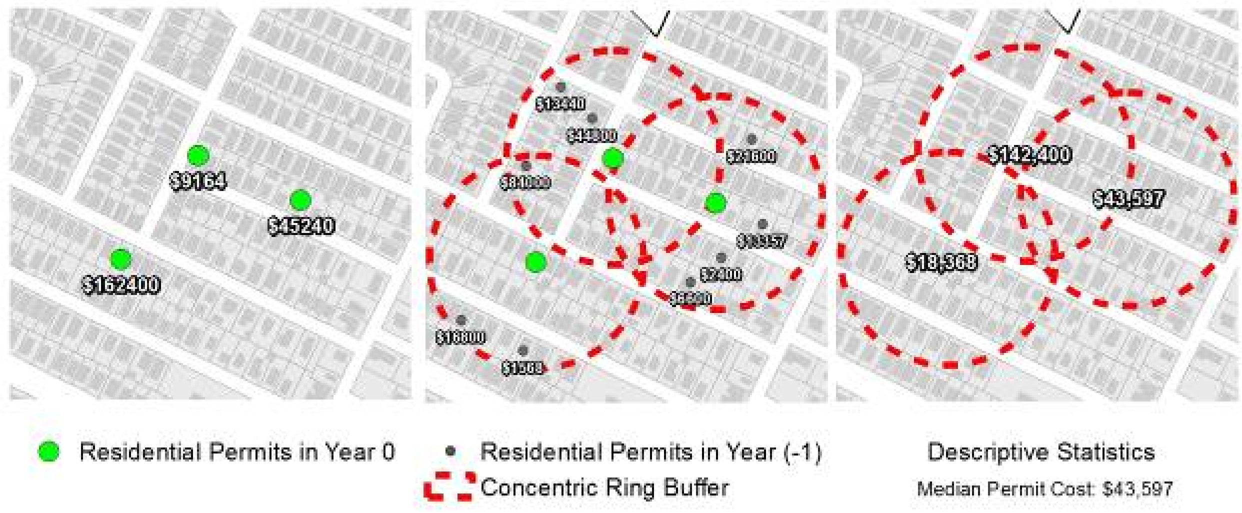
Since the magnitude of investment is a critical element of the research, a descriptive statistic "permit cost" is established. For all Year (-1) permits occurring within the ring buffer of the Year 0 permit, project costs are summed (Figure 6). The total value is then applied back to the Year 0 permit as the "permit cost" descriptive statistic.

Figure 6: Descriptive Statistics Methodology for Neighborhood Permit Cost Activity



The data record includes many permits with extremely high or extremely low costs. As a result, the median, rather than the mean was used to being this calculation to scale. The process for calculating descriptive statistic "median permit cost" is illustrated in Figure 7.

Figure 7: Descriptive Statistics Methodology for Median Neighborhood Permit Cost Activity



3.3 Density Mapping

To facilitate density mapping of building permits and home sales, the methodology will also utilize raster data. Raster data consists of continuous, non-overlapping grid cells that lend themselves to the display of density data. Another advantage of using raster data is analytical: the ArcGIS Spatial Analyst toolbox includes a number of scripts that facilitate the analysis of patterns in large datasets, which would otherwise require time-intensive manual calculations.

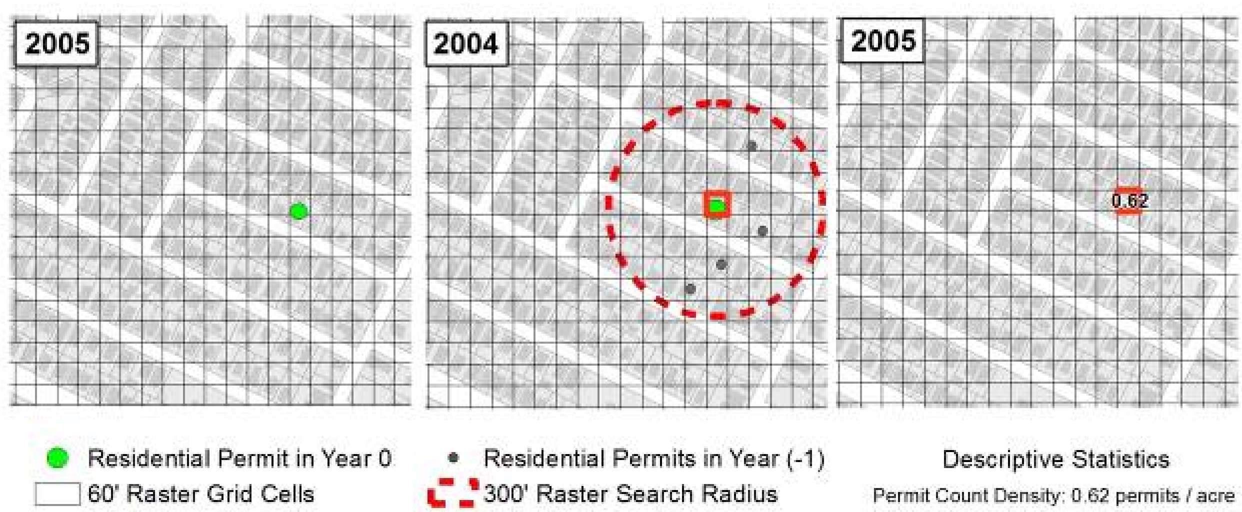
The mean residential lot area in Somerville is roughly 3,600 square feet (slightly less than one-tenth of an acre). Therefore all raster density surfaces will be prepared using a cell size of 60 feet, which roughly mimics the size of an average residential property in Somerville. The ArcGIS “Point Density” tool will be calibrated as follows:

- Cell size………….. 60 feet (3,600 square feet)
- Search radius……. 150 linear feet and 300 linear feet

- Summary units…... acres

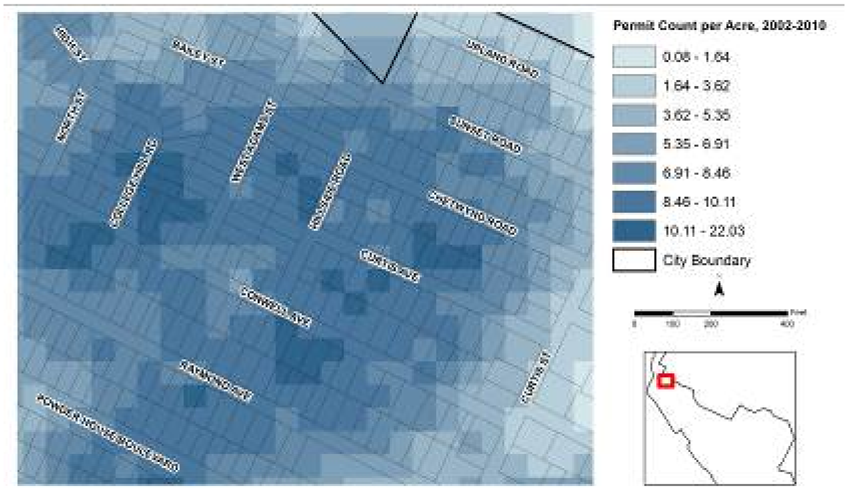
The area covered by a 150-foot circular ring buffer is roughly 1.62 acres. The area covered by a 300-foot circular ring buffer is roughly 6.49 acres. Therefore, density calculations performed by Spatial Analyst tools will occur as illustrated in Figure 8.

Figure 8: Point Density Calculation Using Raster Data



The calculation is repeated for each raster grid cell, yielding continuous raster density surface like the one illustrated in Figure 9.

Figure 9: Permit Count per Acre Calculation, 300 Foot Search Radius



A combination of mean and median values will be used as appropriate. For example, mean values will be used for analysis of permit count activity, due to the small number of permits occurring within each unit of analysis. For analysis of neighborhood permit cost activity, median values will be used to control the skewing effects of outlier projects.

3.4 Summary of Methods

The central question of this research is whether spatial and temporal patterns of residential property improvement in Somerville can be identified using publicly-available, yet previously unexamined data sources. Since controlling for the influence of structural and neighborhood characteristics is beyond the scope of this study, the term “spillover effect” will not be used. Rather, the methodology will seek to quantify eight investment metrics, and track their magnitude over time and across Somerville’s diverse neighborhoods. It is helpful to think of the eight metrics as four pairs:

- *Permit Count Metrics*

a. Mean Neighborhood Permit Count Activity

b. Neighborhood Permit Count per Acre

- *Permitted Construction Cost Metrics*

a. Median Neighborhood Permit Cost Activity

b. Neighborhood Permit Cost per Acre

- *Sale Count Metrics*

a. Mean Neighborhood Sale Count Activity

b. Neighborhood Sale Count per Acre

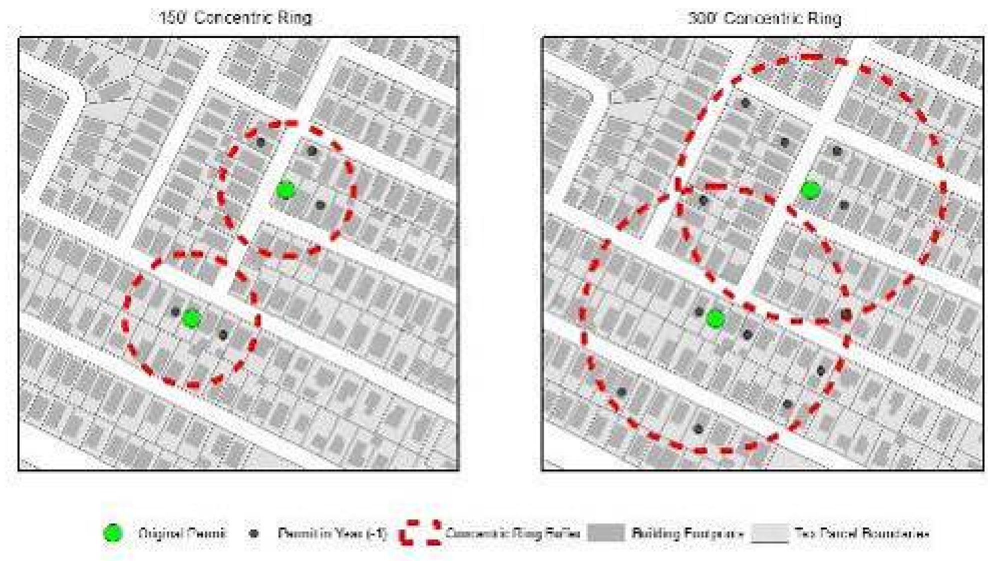
- *Sale Price Metrics*

a. Median Neighborhood Sale Price Activity

b. Neighborhood Sale Price per Acre

To evaluate permit and sale activity, two distance measures will be used: 150 feet and 300 feet. As illustrated in Figure 10, the typical Somerville neighborhood is characterized by lot sizes of roughly 3,600 square feet, indicating that the 150 foot radius will generally capture between 8 and 12 neighboring properties. Most of these are located on the same block as the origin property. A 300 foot radius around a typical residential property in Somerville captures between 40 and 50 neighboring properties. Many of these properties are not located on the same block as the origin property.

Figure 10: 150-Foot and 300-Foot Concentric Ring Unit of Analysis



Finally, public spending on affordable housing will be analyzed using the same methods. To compare private investment and public investment in Somerville's housing stock, raster grid cells will be categorized as having high, medium or low levels of private investment and high, medium or low levels of public investment.

The step-by-step spatial analysis methodology is as follows:

1. Building permit and property sale records will be geocoded by address to produce point data layers.
2. Raster density surfaces depicting residential building permit activity (count and cost) and residential property sales activity (count and price) will be prepared for each year from the point data, using the Point Density tool in ArcGIS.

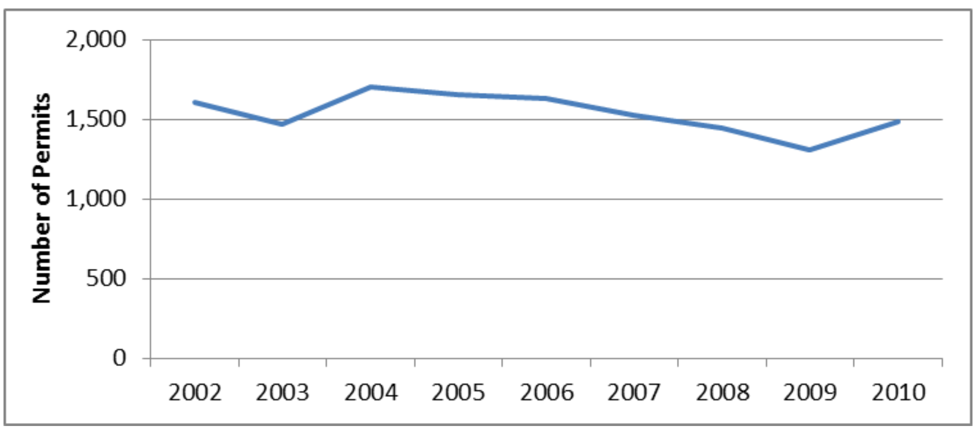
3. Raster calculations will be performed to track differences in density from year to year, subtracting the density in the previous year (Year -1) from the density in the year of the observation (Year 0).
4. The mean and median one-year difference in density will be calculated for all cells for the entire eight-year study period, using the Cell Statistics tool in ArcGIS.
5. Results will be displayed in a series of citywide density maps.
6. Results will be compared across the six MBTA Green Line station areas in Somerville, using the Zonal Statistics tool in ArcGIS and a series of station area maps.
7. The ArcGIS Reclass tool will be used to categorize all cells as having high, medium or low levels of private and public investment
8. Results will be displayed in a series of citywide density maps.

CHAPTER 4: RESULTS

4.1 Understanding Citywide Permit Activity: Permit Count Metrics

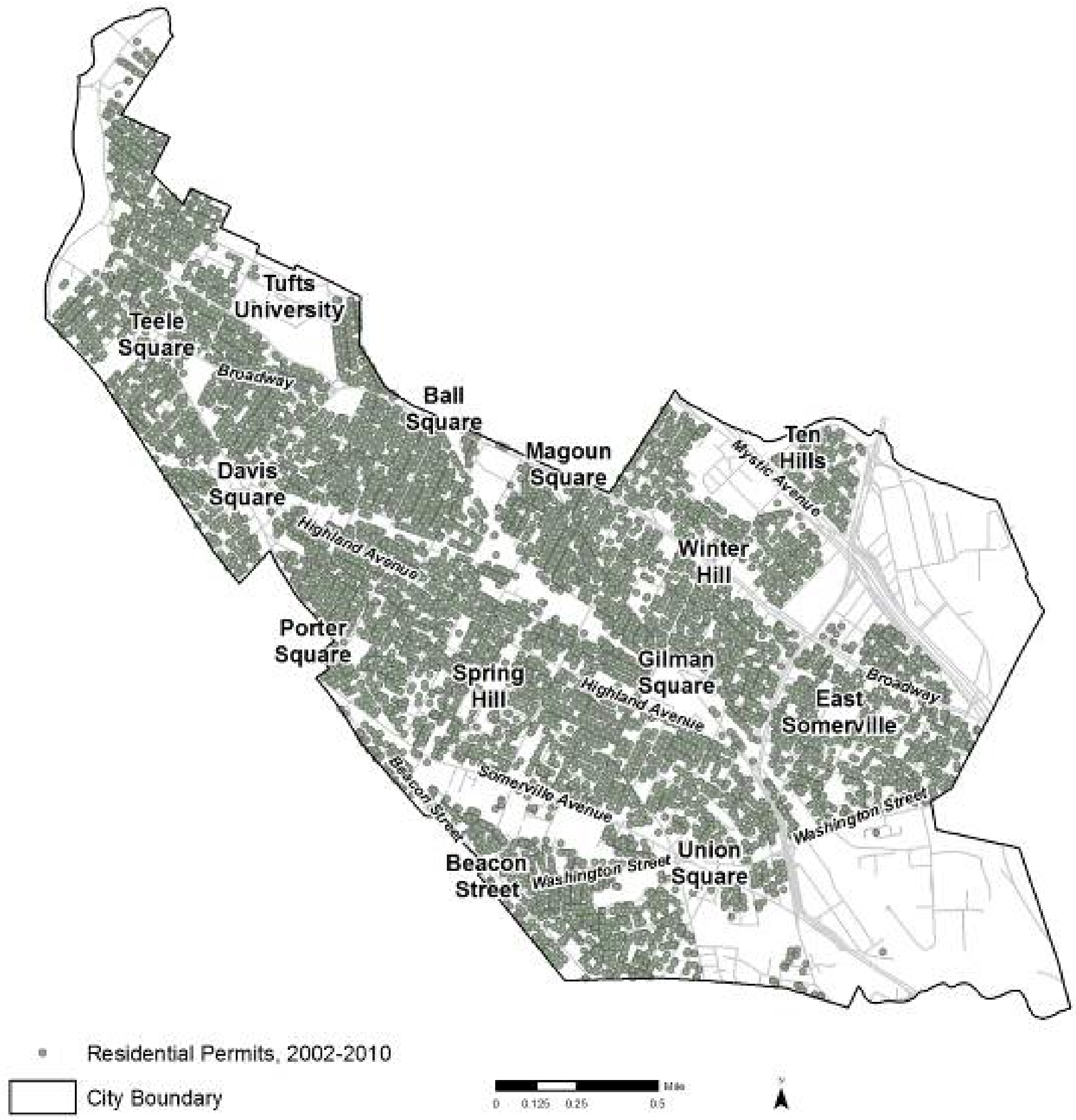
The period from 2002-2010 exhibited a relatively consistent volume of permitted residential improvement projects in Somerville (annual mean = 1,536; annual median = 1,527). As illustrated in Figure 11, a general downward trend in permit volume is evident for the period, nonwithstanding one-year increases from 2003-2004 and 2009-2010. Permit activity peaked in 2004, with 1,699 residential projects permitted. In 2009, only 1,308 residential building permits were recorded.

Figure 11: Annual Residential Permits, City



The 14,000 building permits issued during the study period are widely distributed across Somerville's residential neighborhoods. A basic address geocode of the permit records can be used to visualize the location of permit activity, representing each permit as a distinct point on a citywide map (Figure 12). An obvious limitation of applying a point mapping methodology to the large building permit dataset is the lack of distinction between various residential neighborhoods.

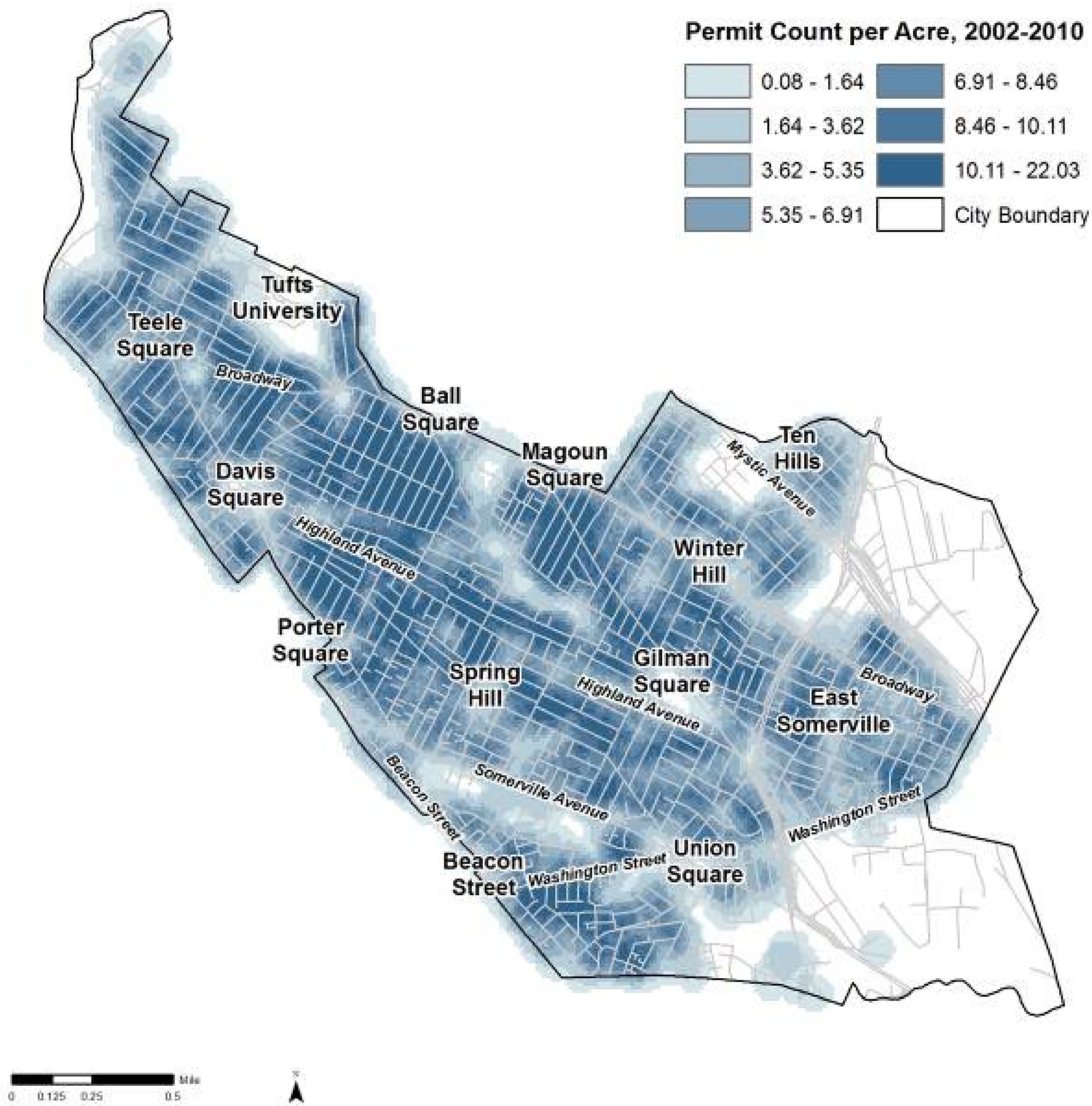
Figure 12: Residential Building Permits, 2002-2010



To improve the visual representation of permit activity, density maps have been prepared, converting the geocoded point data to continuous raster surfaces.

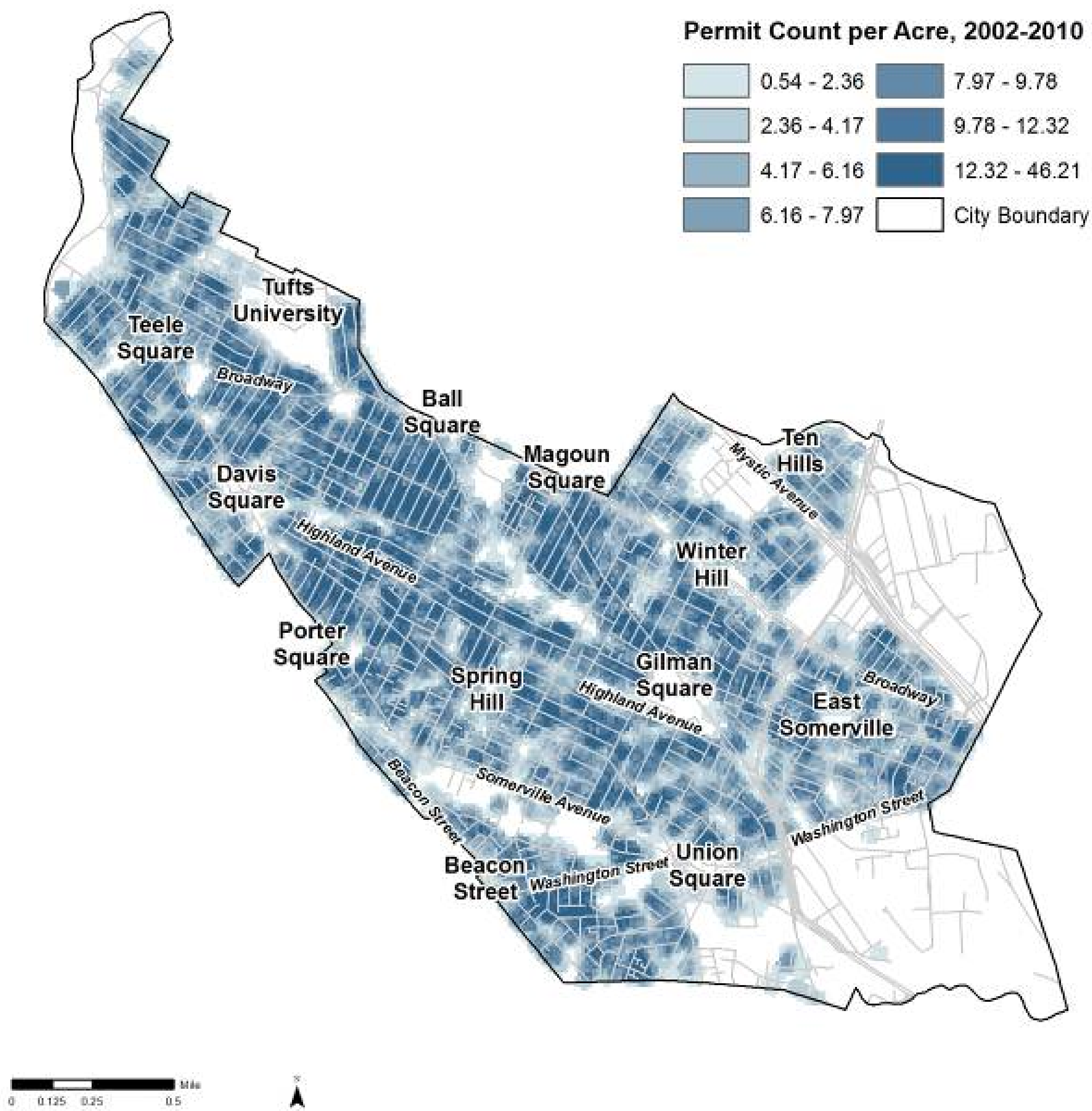
The raster shown in Figure 13 uses a search radius of 300 feet, and the citywide mean density is calculated at roughly six permits per acre. Several large clusters of permit activity above the mean can be identified. The largest of these are located south of Ball Square, south of Magoun Square, and north of Porter Square. Smaller clusters of high permit density appear in Spring Hill along Highland Avenue, near the corner of Beacon Street and Washington Street, and north of Davis Square.

Figure 13: Permit Count per Acre, 300-Foot Search Radius, 2002-2010



An even more nuanced visualization of permit activity can be gained by creating a raster surface using a search radius of 150 feet. After excluding cells with a density value of zero, the mean density value is calculated at roughly seven permits per acre. As illustrated in Figure 14, variations appear in the same neighborhoods that by the previous analysis appeared uniformly dense. For example, the neighborhood south of Ball Square begins to exhibit small clusters of relatively low permit count density.

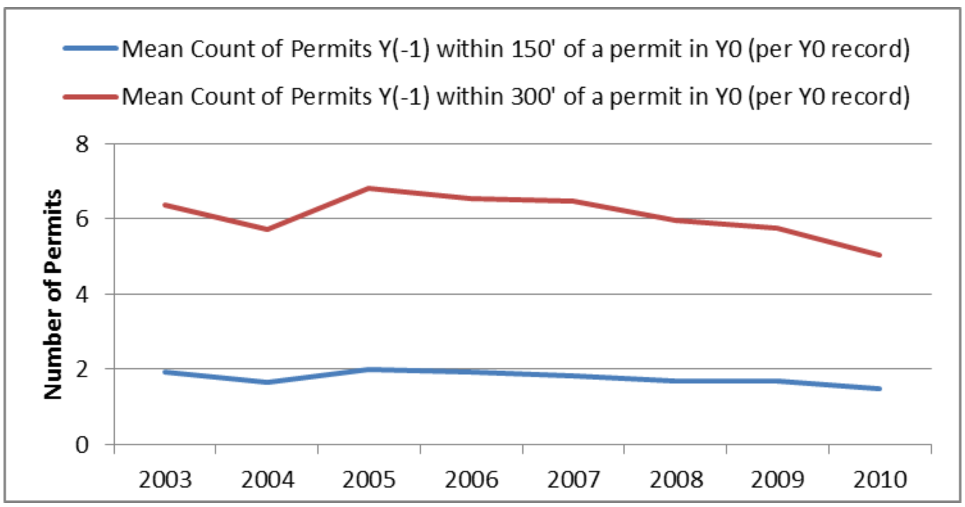
Figure 14: Permit Count per Acre, 150-Foot Search Radius, 2002-2010



4.2 Change Over Time: Permit Count Activity and Density

For the entire study period, the mean neighborhood permit count activity is calculated at 1.78 permits for the 150-foot search radius, and 6.09 permits for the 300-foot search radius. That is to say that for each building permit in the data record, roughly two permits would be expected in the immediate vicinity the prior year, while roughly six permits would be expected in the wider neighborhood the prior year. Figure 15 illustrates the annual mean values. A general downward trend is present in both line graphs, especially between 2005 and 2010.

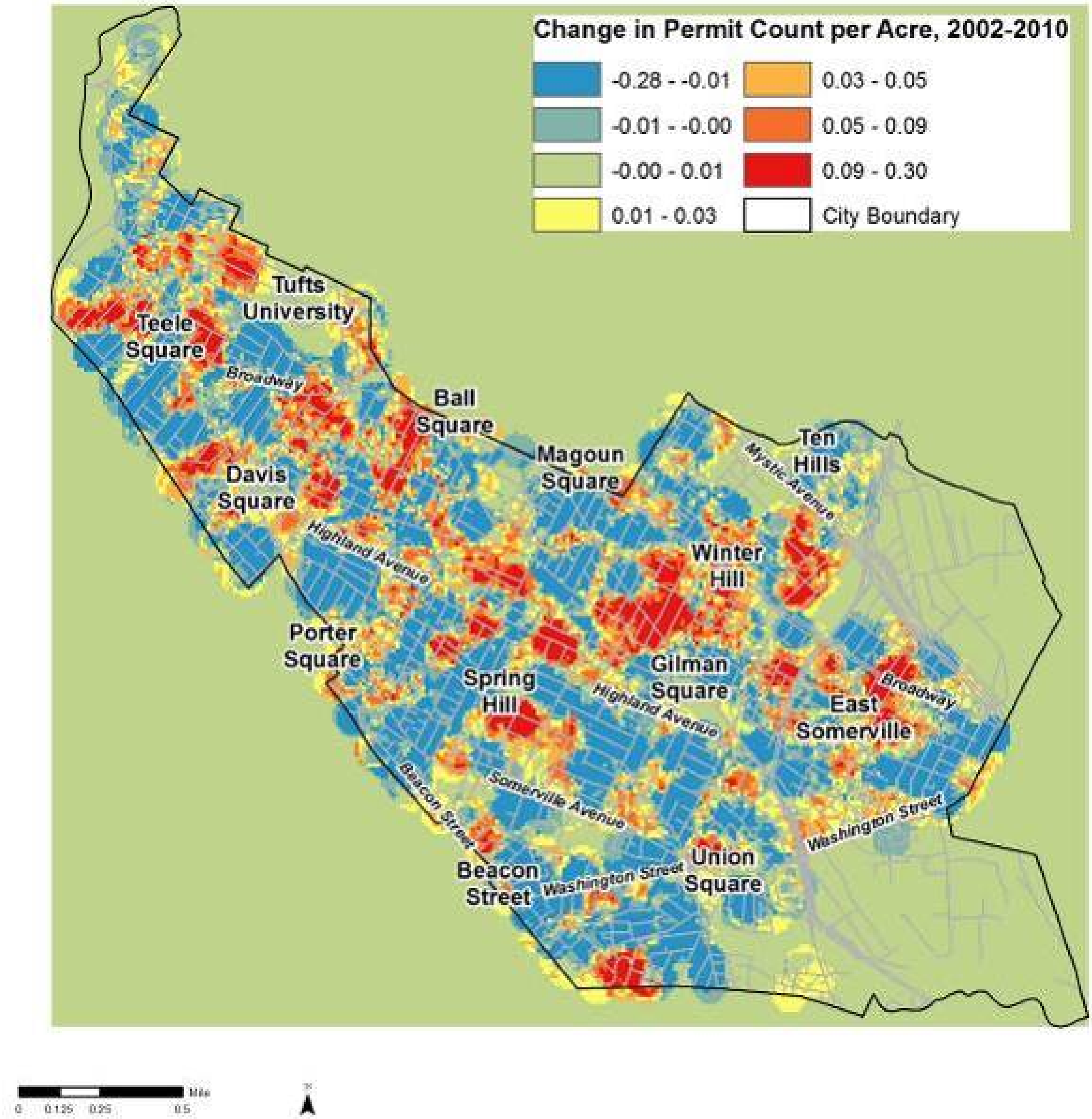
Figure 15: Change in Citywide Mean Neighborhood Permit Count Activity



To illustrate this dynamic in a map, a raster surface has been created that calculates "change in neighborhood permit count per acre", the mean year-to-year difference in permit count density for the entire study period. By this metric, raster grid cells with a value close to zero are assumed to have experienced a relatively stable year-to-year change in permit count activity. Grid cells with a negative value are considered to have experienced an overall decline in the level of permit count activity over time. Cells with a positive value are considered to have experienced an upward trajectory in permit count activity for the study period.

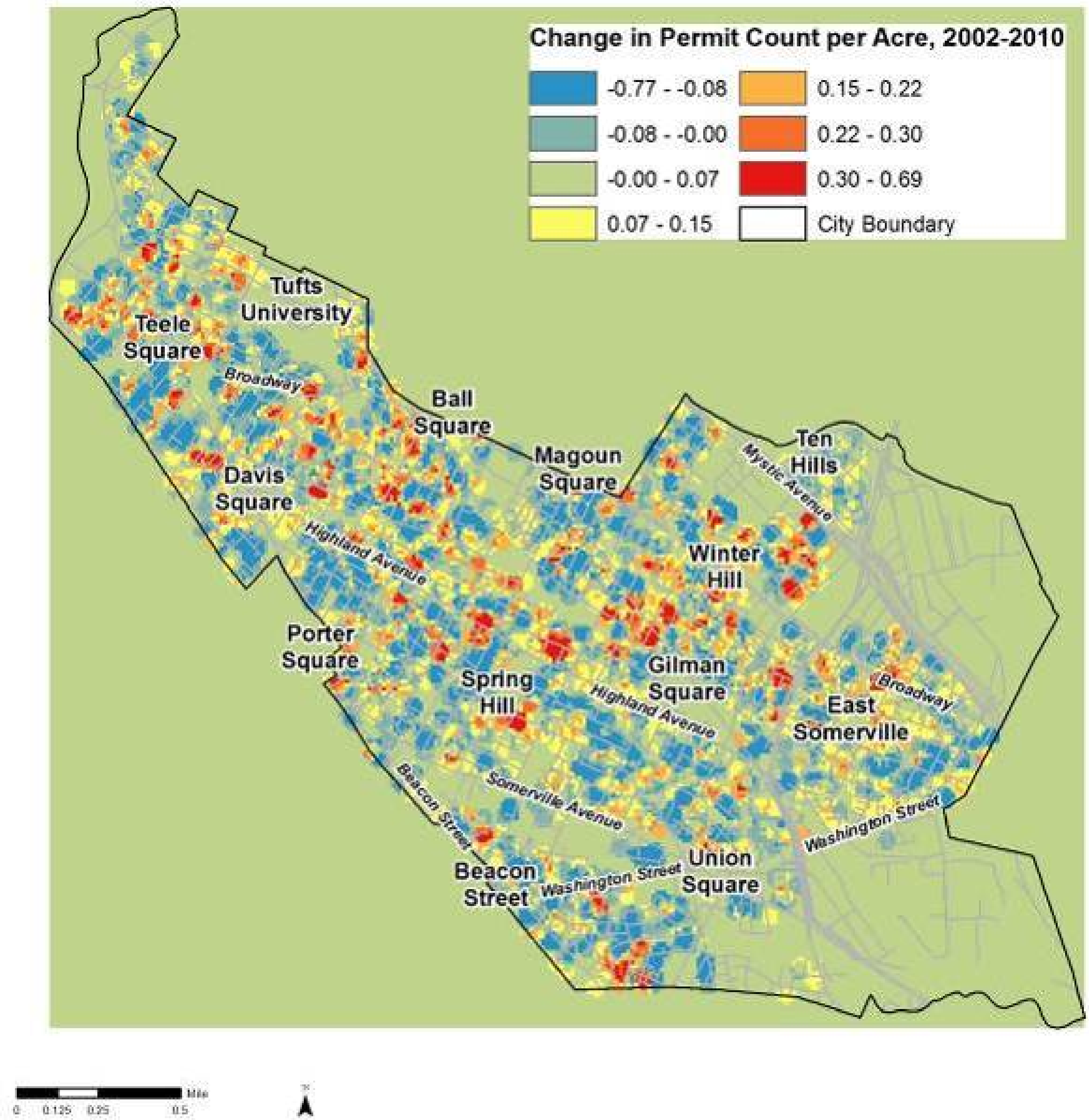
Change in neighborhood permit count per acre appears to exhibit clustering in several parts of Somerville. The clustering pattern is especially pronounced using the 300-foot search radius (Figure 16), since the relatively large search radius allows adjacent grid cells to be coded with similar change values, whether high or low. For example, clusters of positive change in neighborhood permit count density are apparent south of Ball Square, northwest of Gilman Square, and along Highland Avenue in Spring Hill. Clusters of negative change are obvious in East Somerville, north of Porter Square, south of Teele Square and southwest of Union Square.

Figure 16: Change in Neighborhood Permit Count per Acre, 300-Foot Search Radius



At the 150-foot search radius, the spatial patterns become noticeably more fine-grained. Raster grid cells with significantly positive or negative change values remain scattered throughout the city, but the smaller search radius results in smaller clusters of like values (Figure 17). Concentrations of positive change are visible northwest of Gilman Square, along Highland Avenue in Spring Hill and in Winter Hill between Broadway and Mystic Avenue. Significantly negative change is still apparent in East Somerville, north of Porter Square, and south of Teele Square.

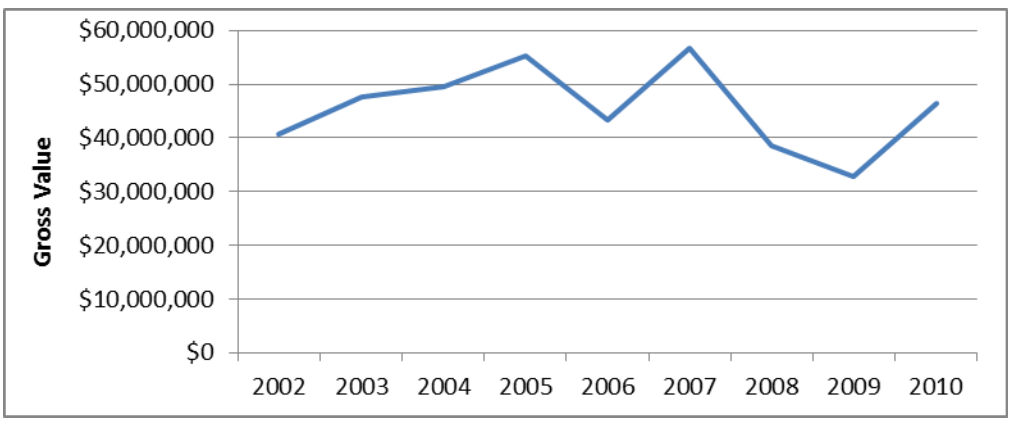
Figure 17: Change in Neighborhood Permit Count per Acre, 150-Foot Search Radius



4.3 Understanding Citywide Permit Activity: Permitted Construction Costs

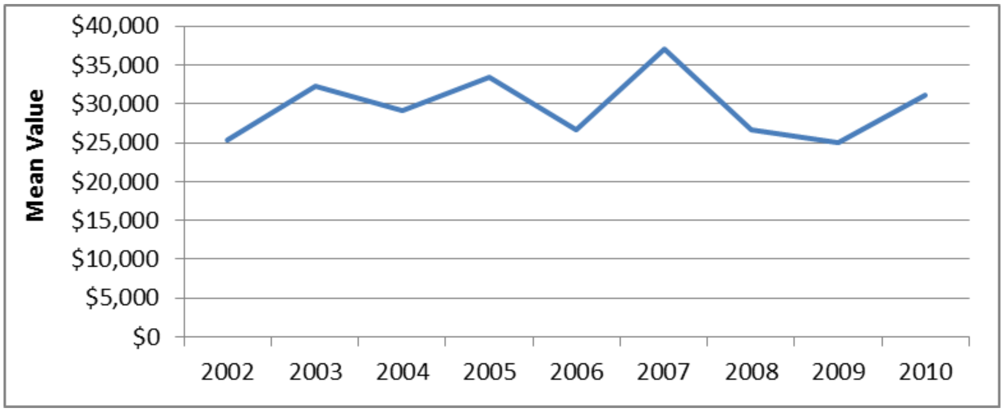
The gross annual value of all permitted construction costs for residential improvement projects in Somerville exhibits a significant range. Figure 18 shows a minimum annual gross value of roughly $33 million (2009) and a maximum of $57 million (2007). The mean annual gross value of all residential permits for this period is $45.6 million. It is important to note that this metric is subject to skewing in the event of individual large development projects. For example, the Somerville Housing Authority was issued a single permit in 2007 for a $16 million construction project along Mystic Valley Parkway in West Somerville. Overall, there were 34 permits in the data record for construction costs valued at more than $1 million.

Figure 18: Gross Value of Residential Permits, City



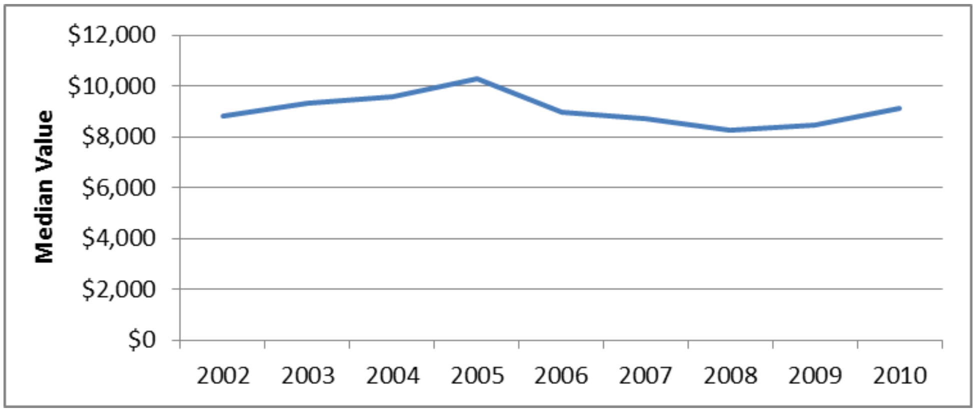
If the mean value of individual permits is graphed (Figure 19), the citywide trend line follows roughly the same slope and the gross value of permits. Annual mean values range from $25,000 (2002, 2009) to $37,000 (2007). Again, it should be noted that large projects have the potential to skew the annual mean values.

Figure 19: Mean Value of Residential Permits, City



A more nuanced picture of property improvement trends is offered by the median value of individual permits (Figure 20). Variation among these median values is much smaller, with annual medians ranging from $8,200 (2008) to $10,200 (2005). Clearly, a large number of relatively modest improvement projects have occurred in Somerville throughout the last decade, with property owners performing basic upkeep and maintenance in spite of the larger economic trends of the study period.

Figure 20: Median Value of Residential Permits, City



A raster density surface has been prepared to illustrate the relative level of permitted construction investment across Somerville's neighborhoods. Using a 300-foot search radius, the mean raster cell density is calculated at roughly $185,000 per acre for the nine-year study period.

As illustrated in Figure 21, significant clustering of high density grid cells suggests that large construction projects continue to drive density calculations. Sizeable "hotspots" appear on the citywide map, and are in many cases attributable to the presence of single large development or rehabilitation projects. The previously noted Somerville Housing Authority development is clearly visible in far northwest Somerville. In cases like this one, raster grid cells that fall just within the 300-foot search radius will be calculated with a high density value, while adjacent cells that fall just outside the search radius might have an extremely low density value, causing a stark visual contrast around the project site.

Figure 21: Permitted Construction Cost per Acre, 300-Foot Search Radius

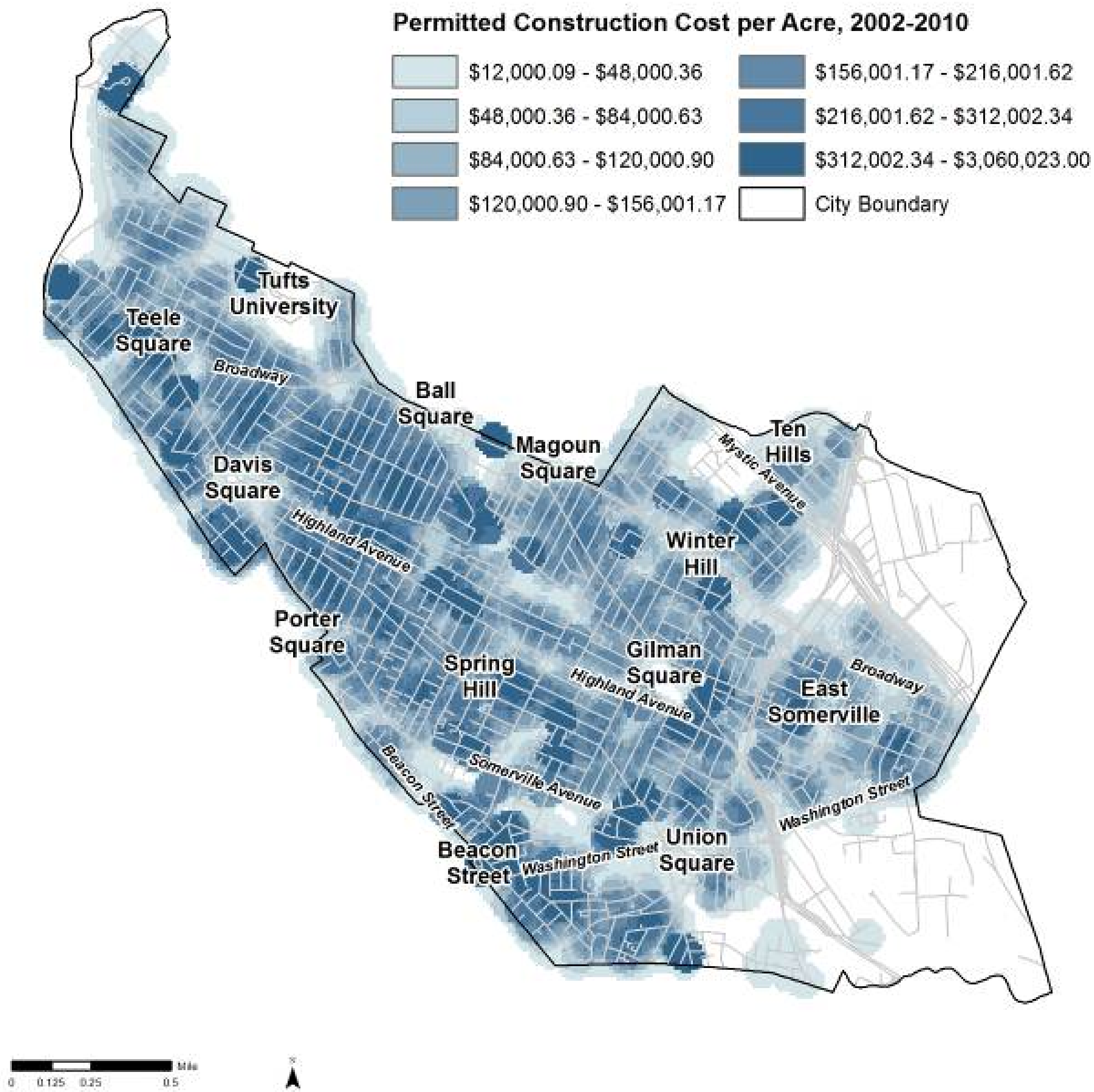
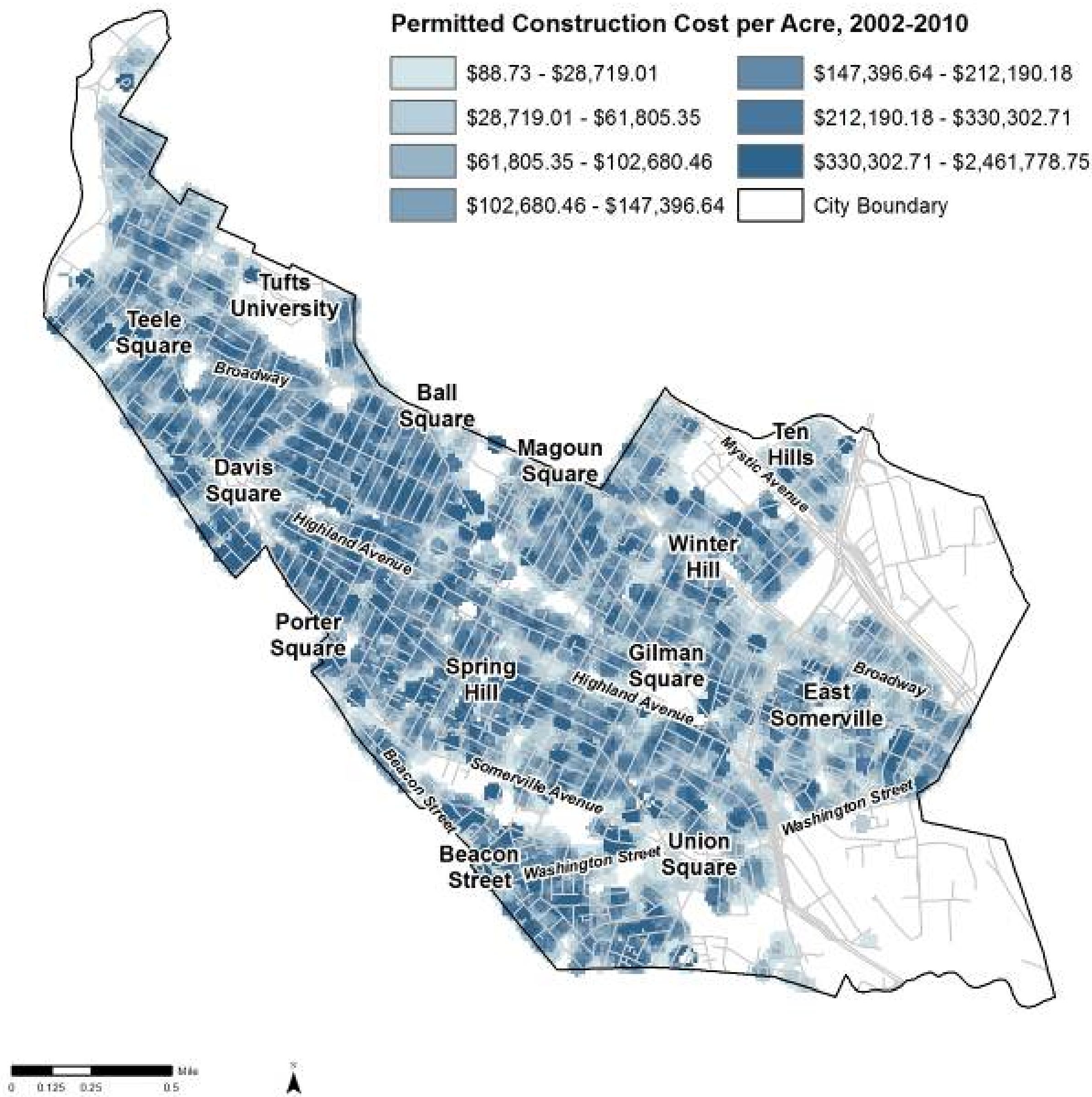


Figure 22 illustrates how a finer-grained raster based on the 150-foot search radius can tell a clearer story about the density of construction costs in

Somerville. The mean density value for this raster dataset is calculated at roughly $190,000.

Since fewer raster cells are assigned a density value that reflects individual projects, greater visual distinction is possible in the density map. The neighborhood northwest of Union Square provides a helpful example of this distinction. Two large projects (a major rehabilitation of 50 Bow Street, and new construction of a townhouse complex at Olive Square) skew the 300-foot density calculation for an wide area stretching from Washington Street northeast past Bow Street. Using the 150-foot search radius allows a pinpointing of the hotspots, separating the influence of large projects from the more typical background investment activity.

Figure 22: Permitted Construction Cost per Acre, 150-Foot Search Radius

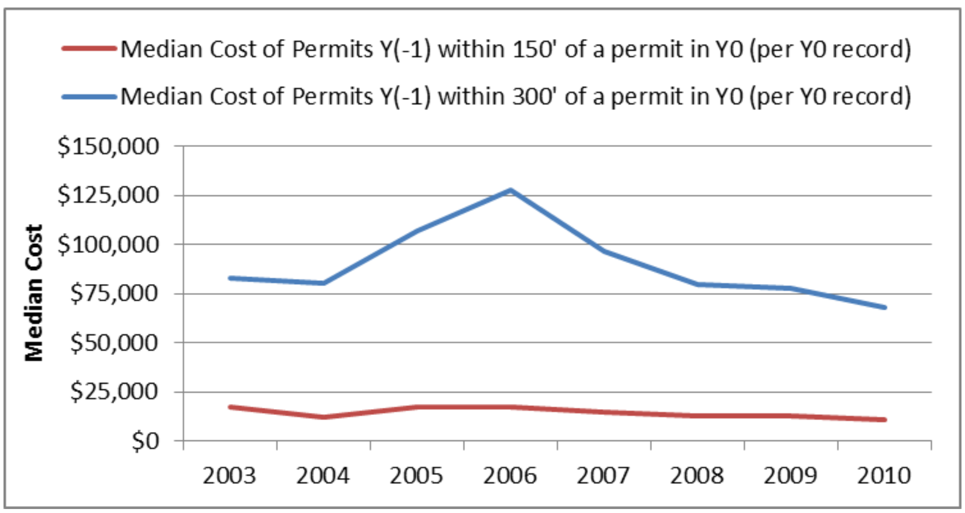


4.4 Change Over Time: Permitted Construction Cost Activity and Density

The second metric to be evaluated is "permit cost activity": the summed cost of permitted construction occurring within the specified distance of an original permit. For the entire study period, the median neighborhood permit cost activity is calculated at $14,316 for the 150-foot concentric ring, and $89,981 for the 300-foot concentric ring.

Whereas many of the descriptive statistics discussed thus far have suggested relatively static levels of permit activity, the median cost of permits issued within the 300-foot concentric ring of permits possesses a certain dynamic quality. As illustrated in Figure 24, the citywide median value climbed steadily between 2004 and 2006, before dropping sharply again during the latter part of the decade.

Figure 23: Neighborhood Median Permit Cost Activity, City, 2002-2010

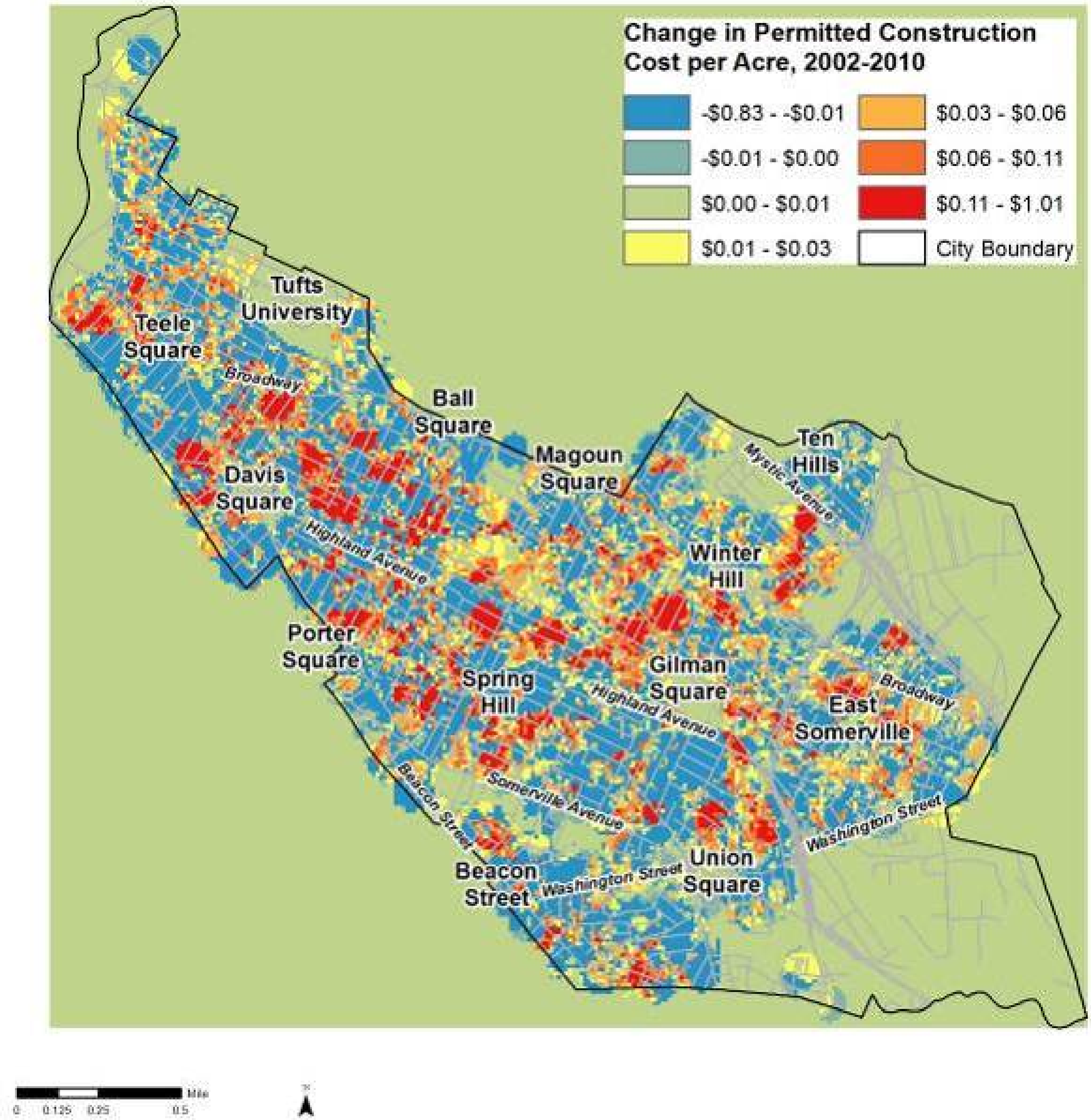


The raster-based cluster analysis is intended to illustrate which parts of Somerville exhibit varying levels of neighborhood permit cost activity. Using Spatial Analyst's "Cell Statistics" function, a density surface is created to represent the median year-to-year change in permit cost density for the entire study period.

Cells with a large, positive median value can be judged to have experienced a consistently positive change in year-to-year investment. Cells with a large, negative median value are interpreted as experiencing a general decline in year-to-year investment. Cells with a median value near zero can be interpreted in one of two ways: either they exhibited very little dynamism, with each year-to-year delta very close to zero, or they could have experienced wide swings between positive and negative change, but in a proportion that allowed the median to be calculated at or near zero.

Figure 24 illustrates the change in density of permitted construction costs. Clusters of positive change are visible in nearly every Somerville neighborhood, with particularly prominent clusters ringing Davis Square, along Highland Avenue in Spring Hill, and northwest of Gilman Square. At the other extreme, areas including Teele Square and much of Union Square appear to exhibit net decreases in permit cost density for the study period.

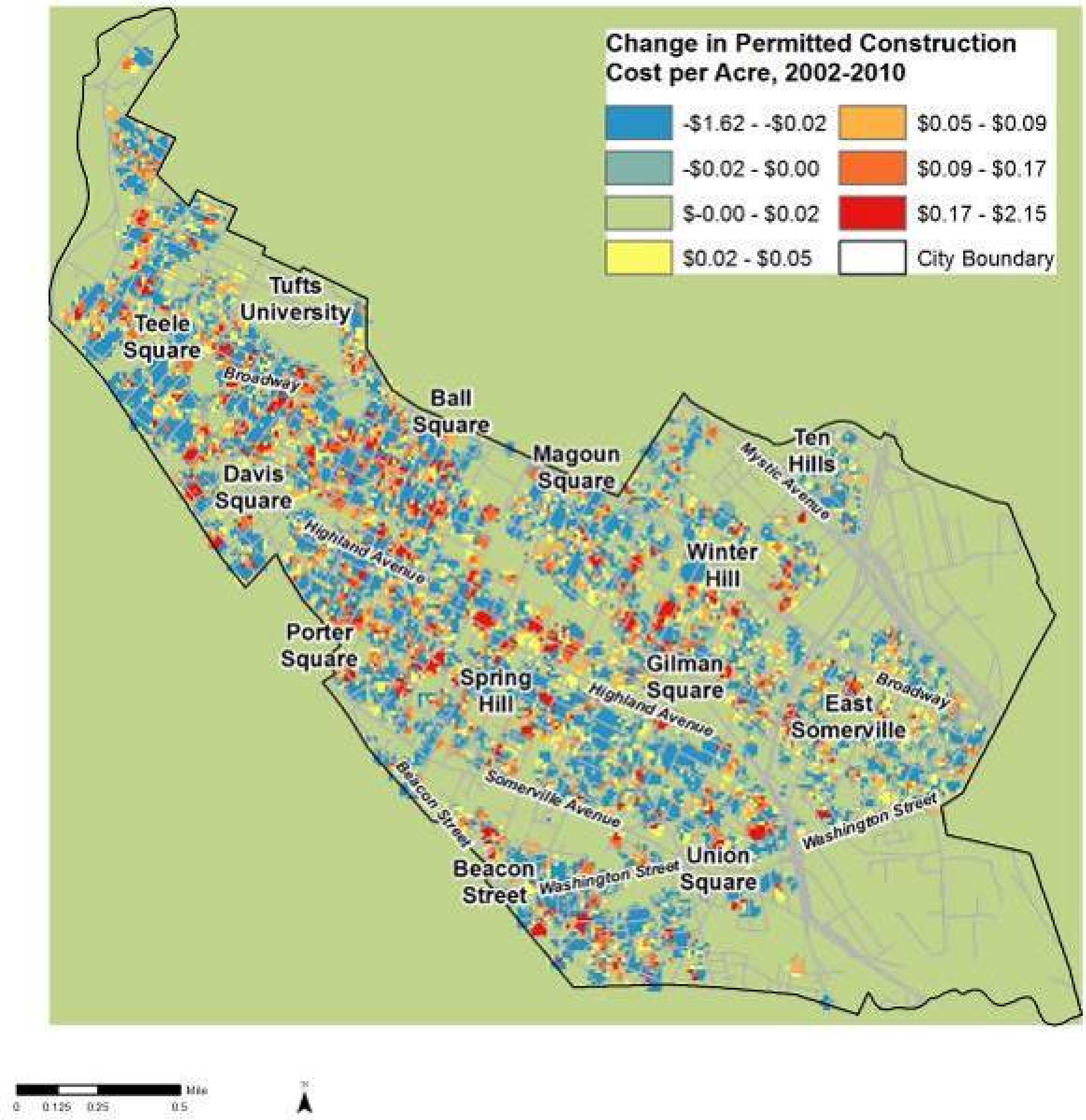
Figure 24: Change in Permitted Construction Cost per Acre, 300-Foot Search Radius



A raster created with a 150-foot search radius yields a density map that is less dramatic, but more telling (Figure 25). Clustering is less pronounced, but the remaining pinpoints of positive change (Davis Square, Gilman Square, Spring Hill) can be more confidently interpreted as experiencing a positive trajectory of investment. Similarly, areas south of Teele Square and northwest of Union

Square continue to demonstrate a negative investment trajectory for the study period.

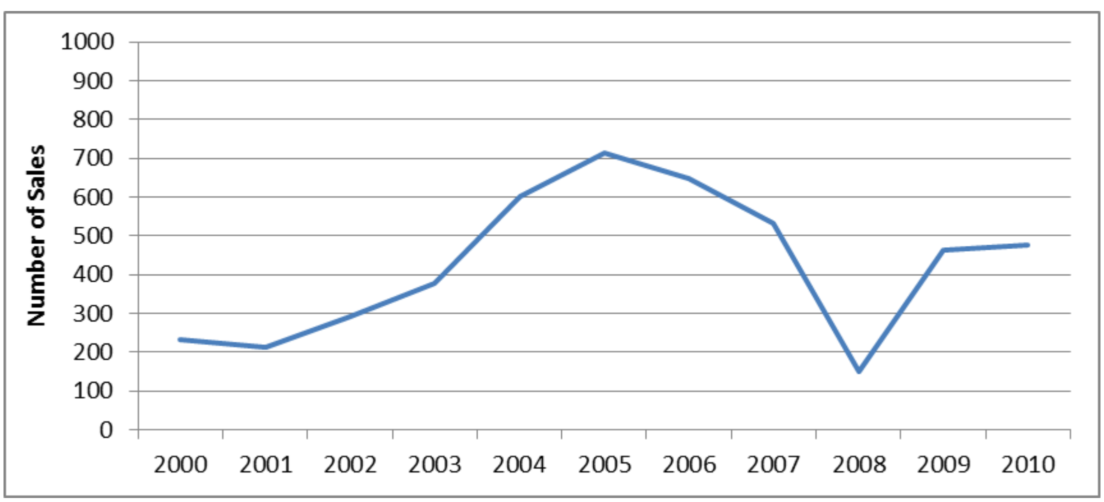
Figure 25: Change in Permitted Construction Cost per Acre, 150-Foot Search Radius



4.5 Understanding Citywide Sales Activity: Sale Count Metrics

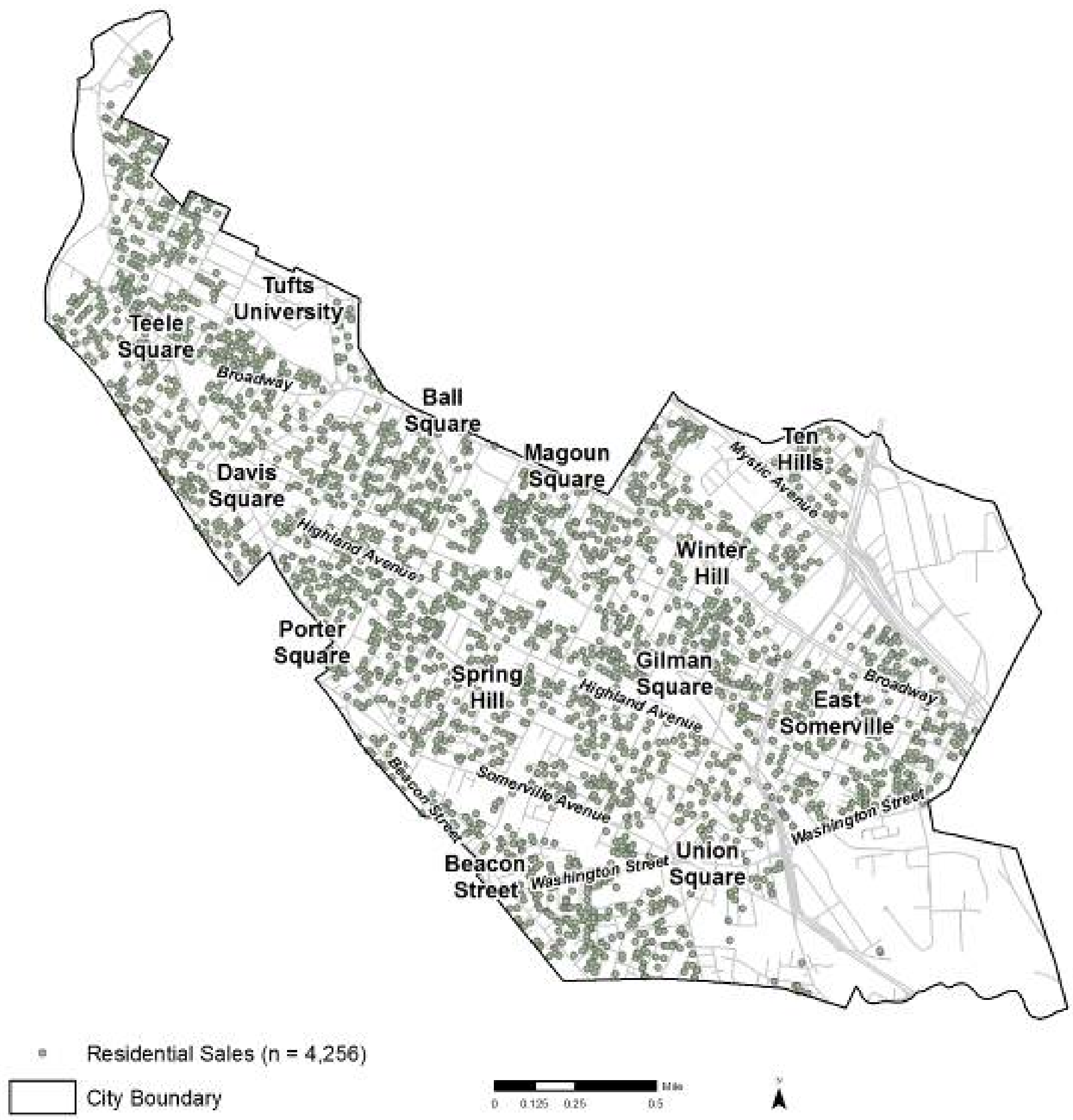
The annual number of residential property sales in Somerville was highly volatile for the study period, tracking closely with larger economic trends. As illustrated in Figure 18, sales volumes ramped up quickly during the economic expansion between 2001 and 2005, reaching an annual peak of 713 sales in 2005. Clearly, the market softened during 2006 and 2007, but even those annual totals (649 and 532, respectively) are significantly elevated compared with the beginning of the decade. Only as the recession became apparent in 2008 did sales slow dramatically. A significant rebound in 2009 and 2010 is visible, illustrating the strength of Somerville's residential real estate market (and possibly the impact of the federal first-time homebuyer tax credit offered as an economic stimulus measure in 2009).

Figure 26: Annual Residential Sales, 2000-2010



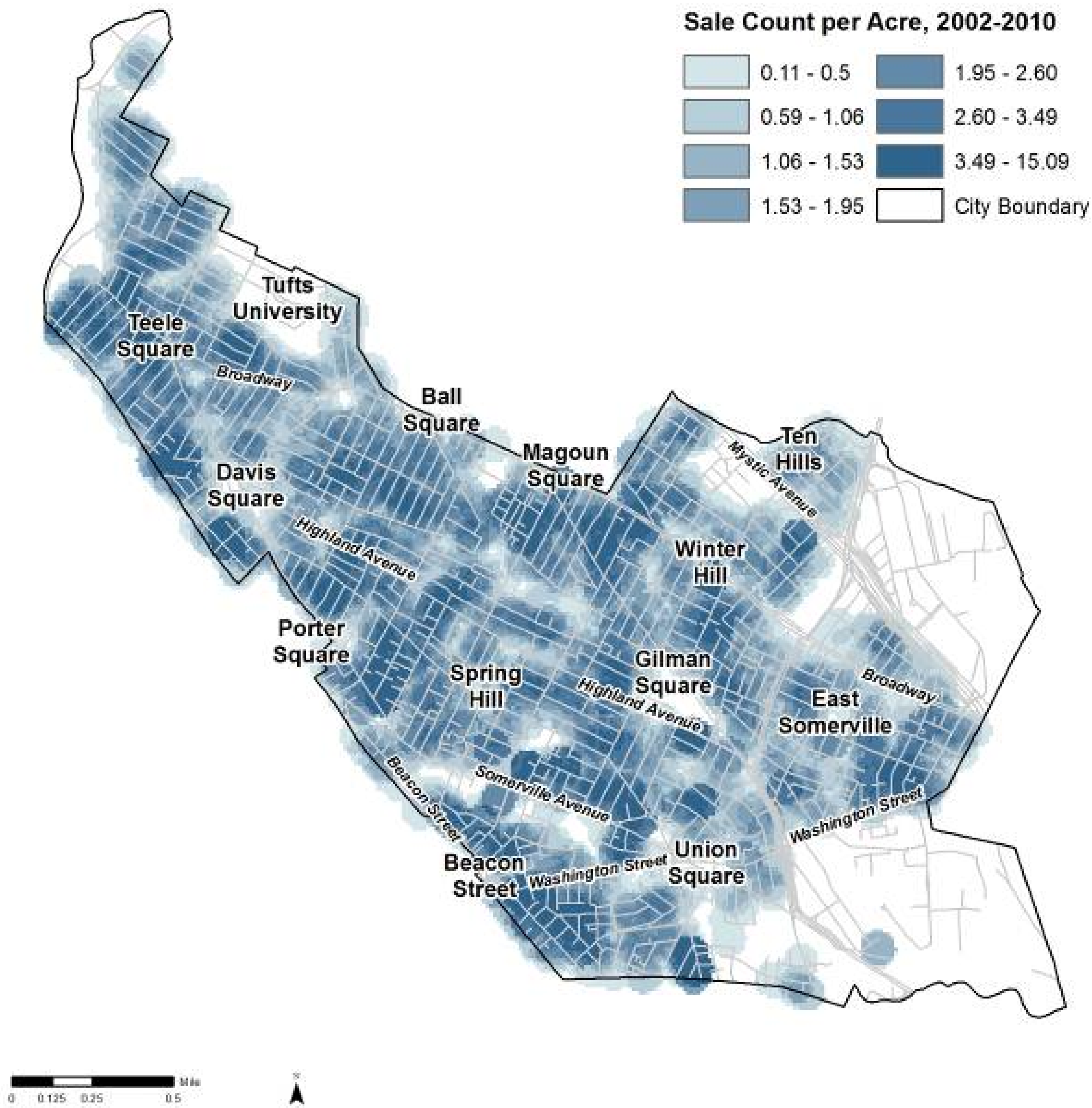
Since there were far fewer residential property sales (n = 4,256) for the study period compared with residential building permits (n = 13,823), deciphering spatial patterns in the citywide map of address-geocoded sale points is difficult (Figure 27). The address geocode technique is particularly problematic for visualizing repeat sales occurring at the same address, and for condominium sales. This is because the automated address geocode script in ArcGIS generally places these types of points on top of one another, masking any true sense of point density.

Figure 27: Residential Property Sales, 2002-2010



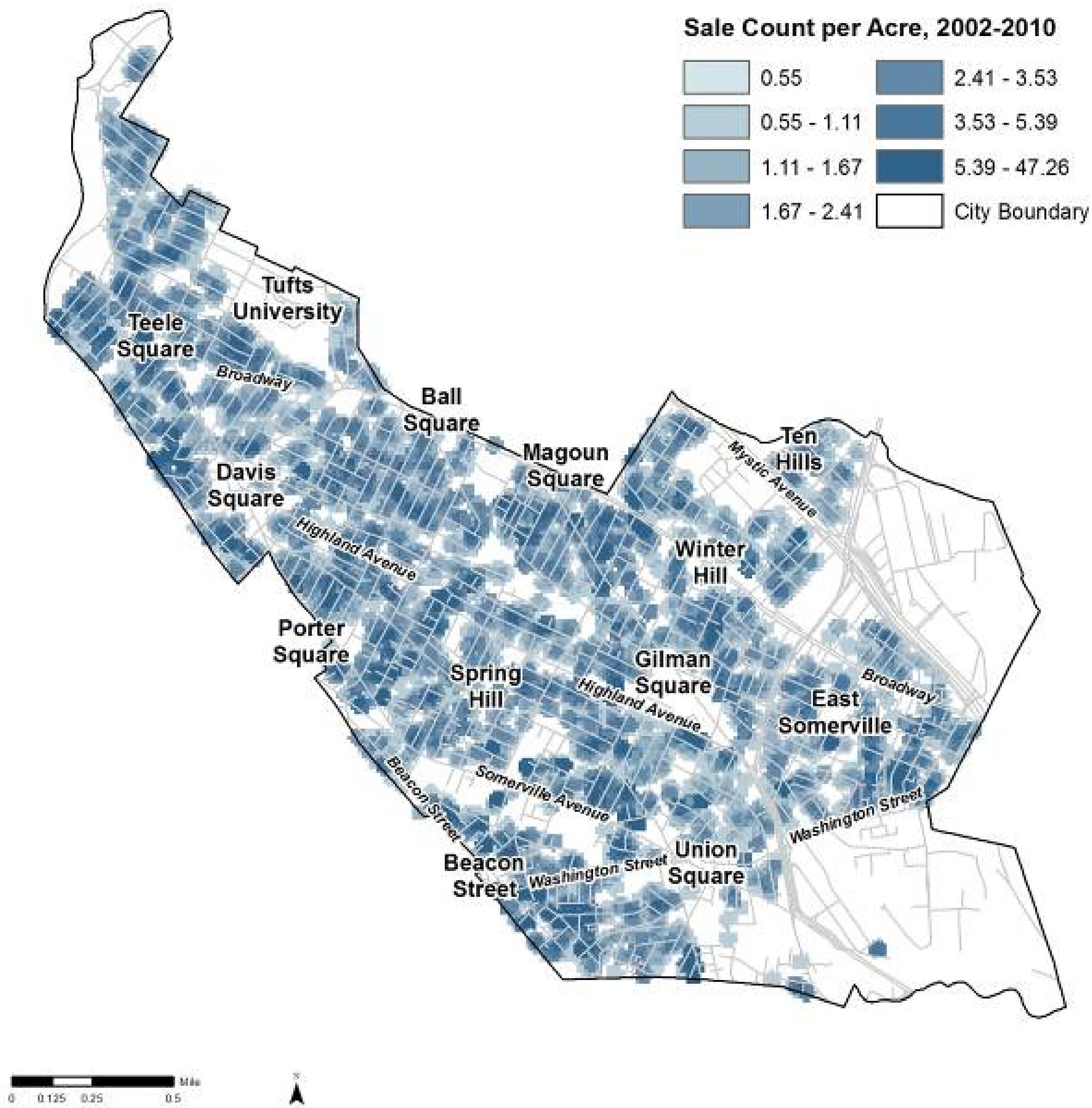
A more useful visual representation is possible by converting the point data to a raster density surface (Figure 28). Using a 300-foot search radius, a raster density surface was created, with a mean density value of roughly 2.6 sales per acre for the nine-year study period. As illustrated in Figure 28, the density of residential sales is particularly high in neighborhoods such as Magoun Square, Union Square and the area around the intersection of Beacon Street and Washington Street. It should be noted that many of these neighborhoods experienced construction or conversion of large condominium buildings during the study period, no doubt contributing to high frequency of property sales.

Figure 28: Sale Count per Acre, 300-Foot Search Radius



Again, it is useful to compare the 300-foot raster surface against a raster surface generated using a 150-foot search radius. As illustrated in Figure 29, greater distinction is provided for neighborhoods like the one east of Porter Square, where several small nodes of activity are apparent that were not visible at the 300-foot scale.

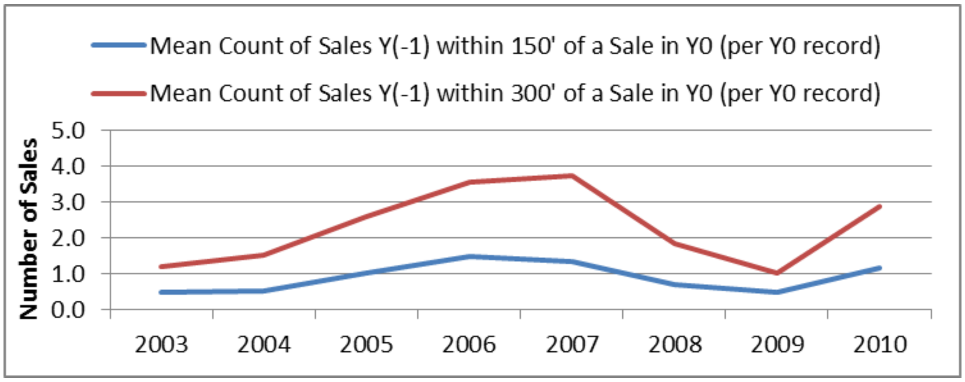
Figure 29: Sale Count per Acre, 150-Foot Search Radius



4.6 Change Over Time: Sale Count Activity and Density

The same pair of metrics will be used to describe spatial and temporal patterns for residential property sale counts in Somerville during the study period. For every home sale during the study period, an average of 0.89 sales was observed in the prior year at the 150-foot search radius. At the 300-foot search radius, an average of 2.29 sales was observed in the prior year. As illustrated in Figure 30, the neighborhood sale count activity metric exhibited significant variation from year to year.

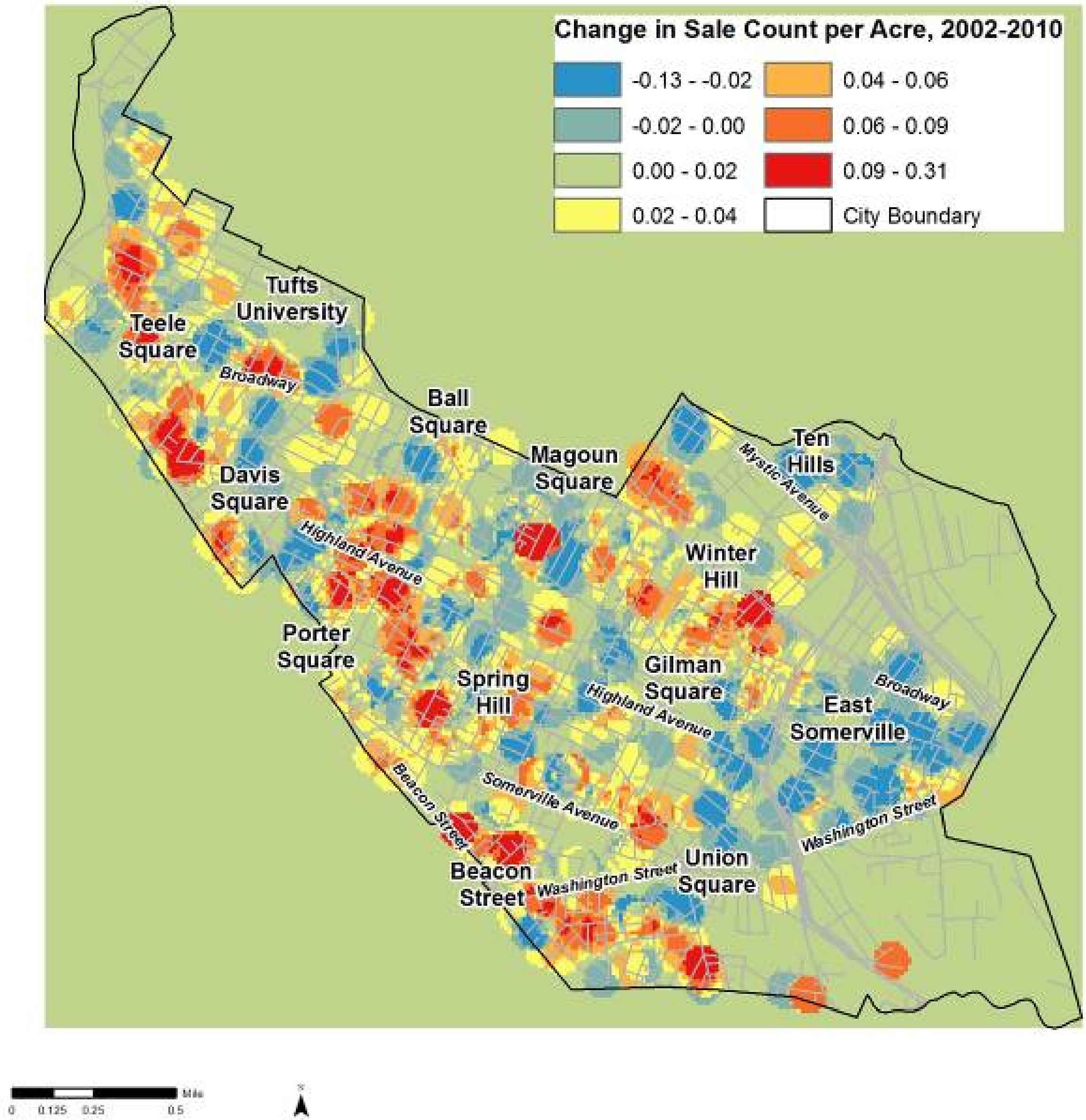
Figure 30: Neighborhood Mean Sale Count Activity, City, 2002-2010



The year-to-year difference in density of home sales in Year 0 and in Year (-1) for the entire study period was calculated using the Cell Statistics tool in ArcGIS. As illustrated in Figure 31, clustering patterns at the 150-foot search radius are quite diffuse, while clustering patterns at the 300-foot search radius are more pronounced.

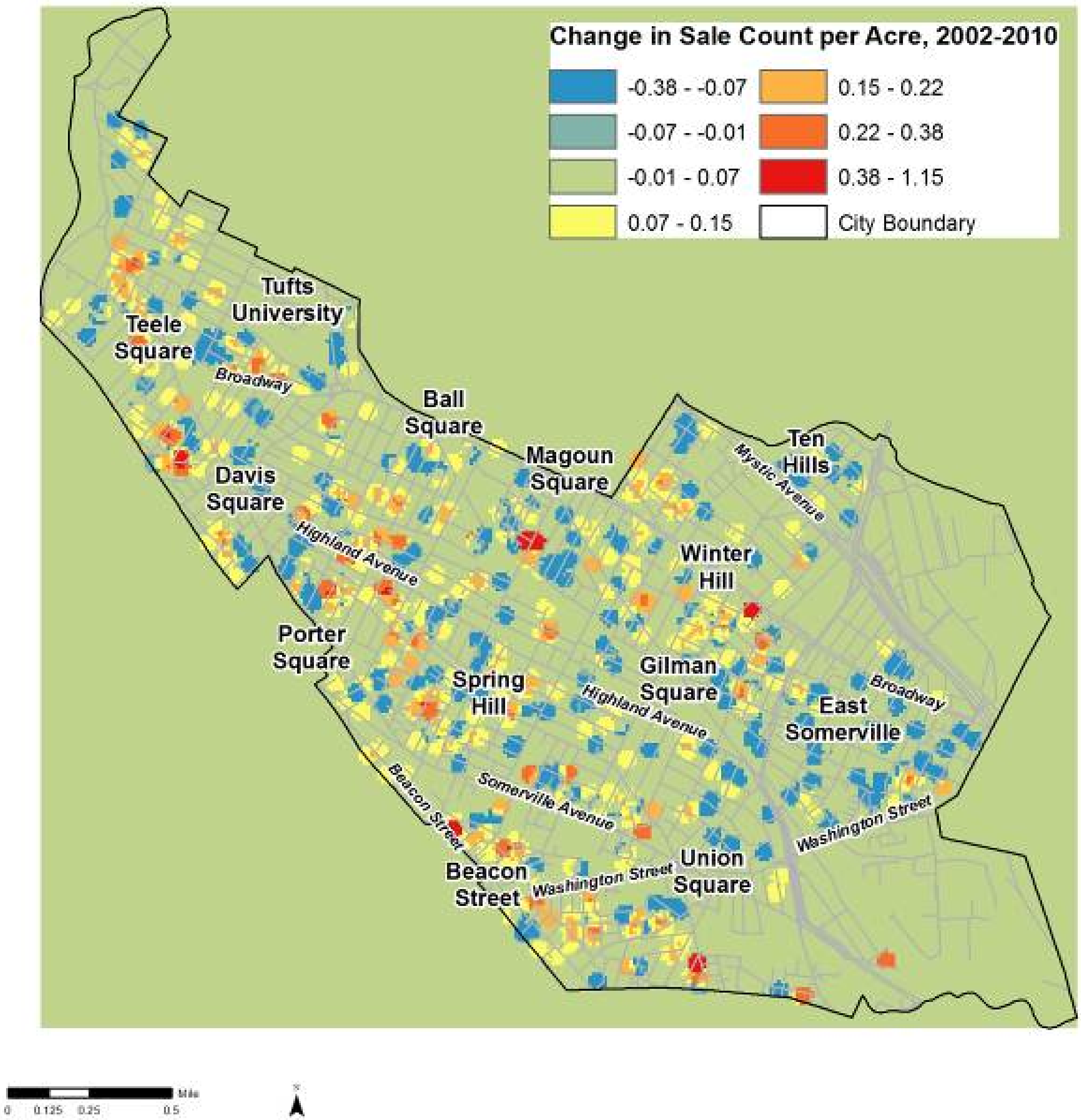
The construction of several large condominium projects during the study period tends to skew the high-end values, particularly to the west of Davis Square (Tannery Brook Lofts), south of Magoun Square (301-303 Lowell Street) and south of Union Square (Union Place condominiums). More telling are the areas where the overall trajectory of home sales for the study period are negative: East Somerville, Prospect Hill and Ten Hills.

Figure 31: Change in Sale Count per Acre, 300-Foot Search Radius



Not surprisingly, the 150-foot search radius adds nuance to the raster density surface (Figure 32). Although the clusters of significantly high or low change are important, this map appears to offer a unique perspective on the extensive areas of Somerville characterized by relatively low rates of change. Areas like the neighborhoods southwest of Ball Square, east of Porter Square and north of Union Square appear subject to relatively stable levels of sale count activity through the study period.

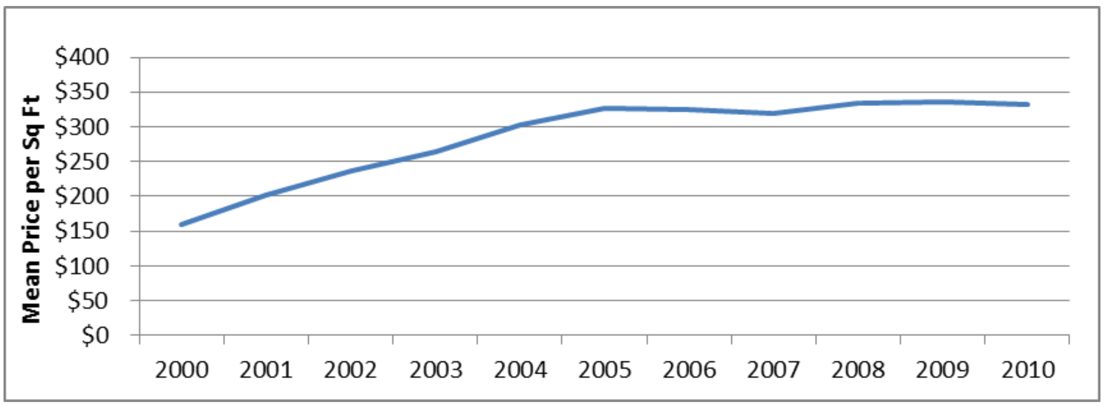
Figure 32: Change in Sale Count per Acre, 150-Foot Search Radius



4.7 Understanding Citywide Sales Activity: Sale Price Metrics

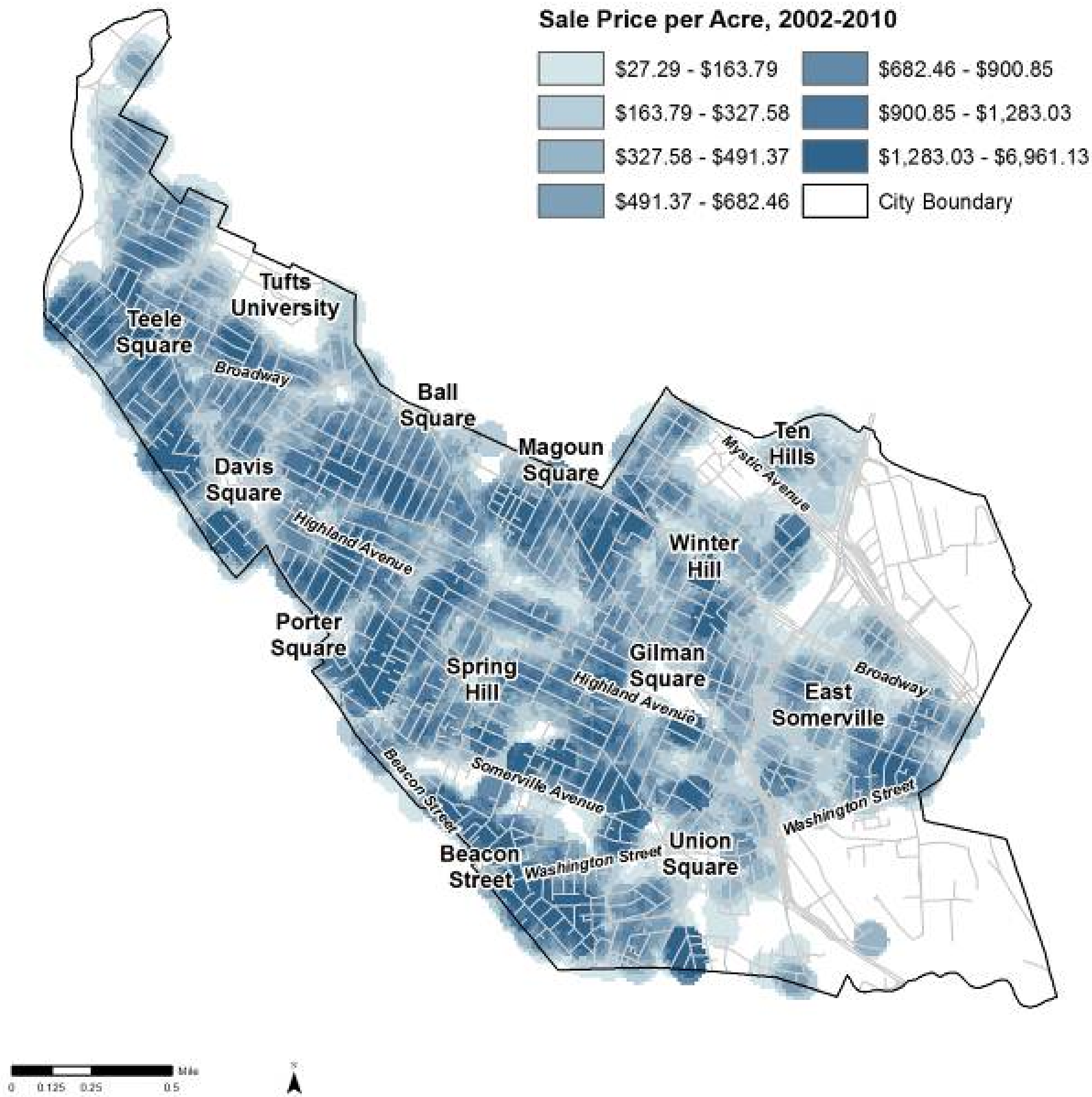
The Boston metropolitan region is widely described as one of the nation's most expensive housing markets. After controlling for inflation and square footage, it is apparent that Somerville experienced a significant increase in home sale prices during the last decade (Figure 33). Mean per-square-foot sale prices across the city doubled between 2000 and 2005, and have largely held steady during the latter part of the decade. For the entire study period, the mean sale price is calculated at $306 per square foot.

Figure 33: Mean Residential Sale Price per Square Foot, 2000-2010



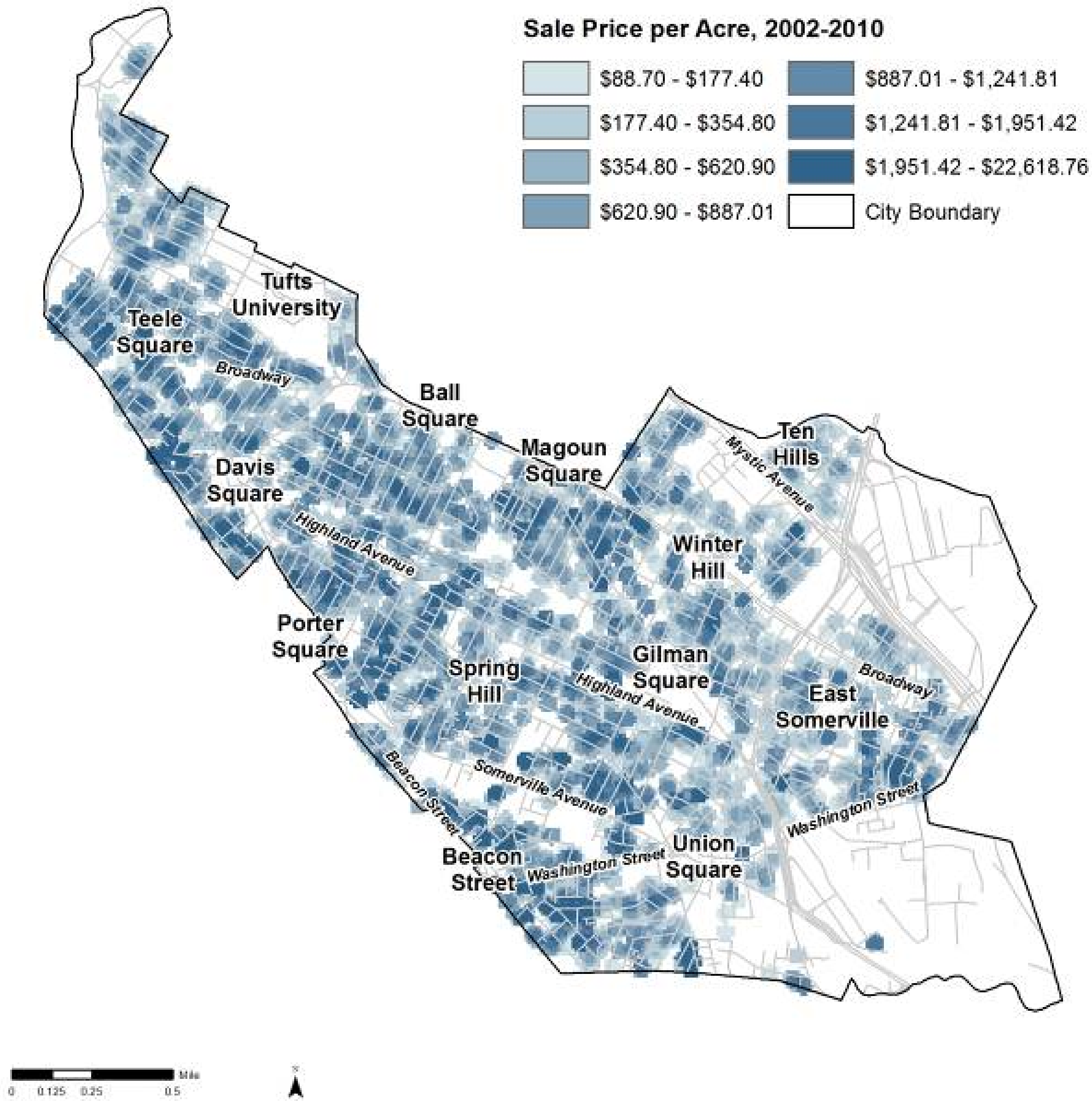
A cluster analysis of home sale prices indicates that pockets of investment are present throughout most Somerville neighborhoods. As illustrated in Figure 34, the Beacon Street and Washington Street neighborhood, the west side of Davis Square, the north side of Somerville Avenue, and the south side of Union Square feature some of the highest density values by this metric. Neighborhoods with particularly low density values include Ten Hills, the east side of the Tufts University campus, and the area around McGrath Highway between East Somerville, Winter Hill and Gilman Square.

Figure 34: Sale Price per Acre, 300-Foot Search Radius



Visual pinpointing of the high-priced blocks becomes possible with the 150-foot raster density surface (Figure 35). For example, in East Somerville, a cluster of high sale price density is visible just north of Washington Street. To the west of Davis Square, the luxury condominium lofts at Tannery Brook can be clearly separated from their surrounding blocks.

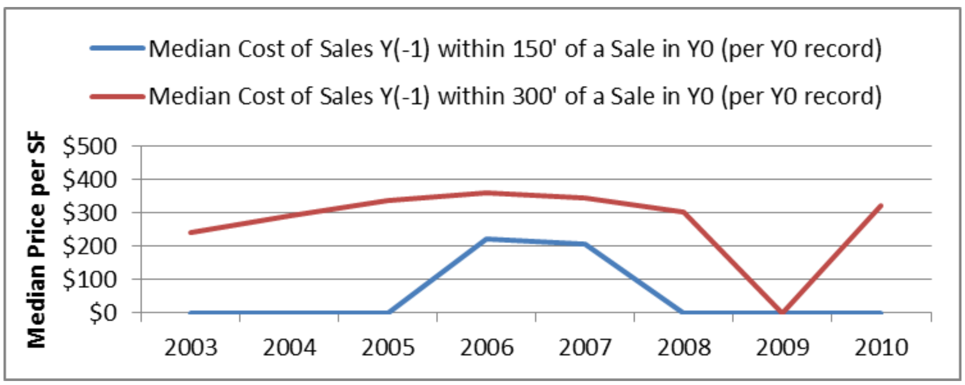
Figure 35: Sale Price per Acre, 150-Foot Search Radius



4.8 Change Over Time: Sale Price Activity and Density

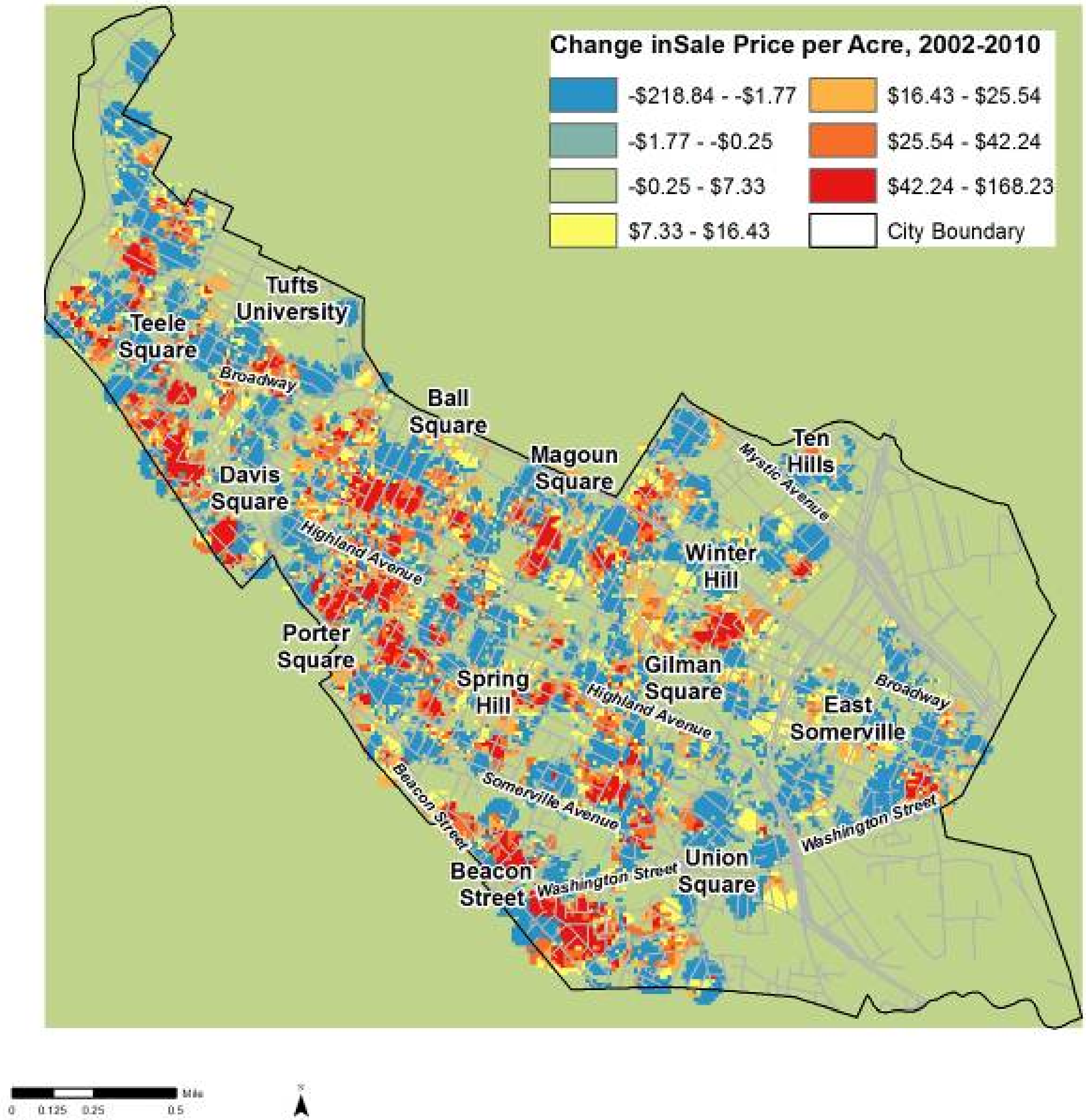
The neighborhood median sale price activity metric is not particularly useful. The relatively low number of annual residential property sales results in numerous annual median prices being calculated at zero, particularly at the 150-foot search radius (Figure 36). At the 300-foot search radius, the median per-square-foot sale price tracks closely with the larger real estate market: increasing gradually during the first half of the study period, then moderating with the economic recession.

Figure 36: Neighborhood Median Sale Price Activity, City, 2002-2010



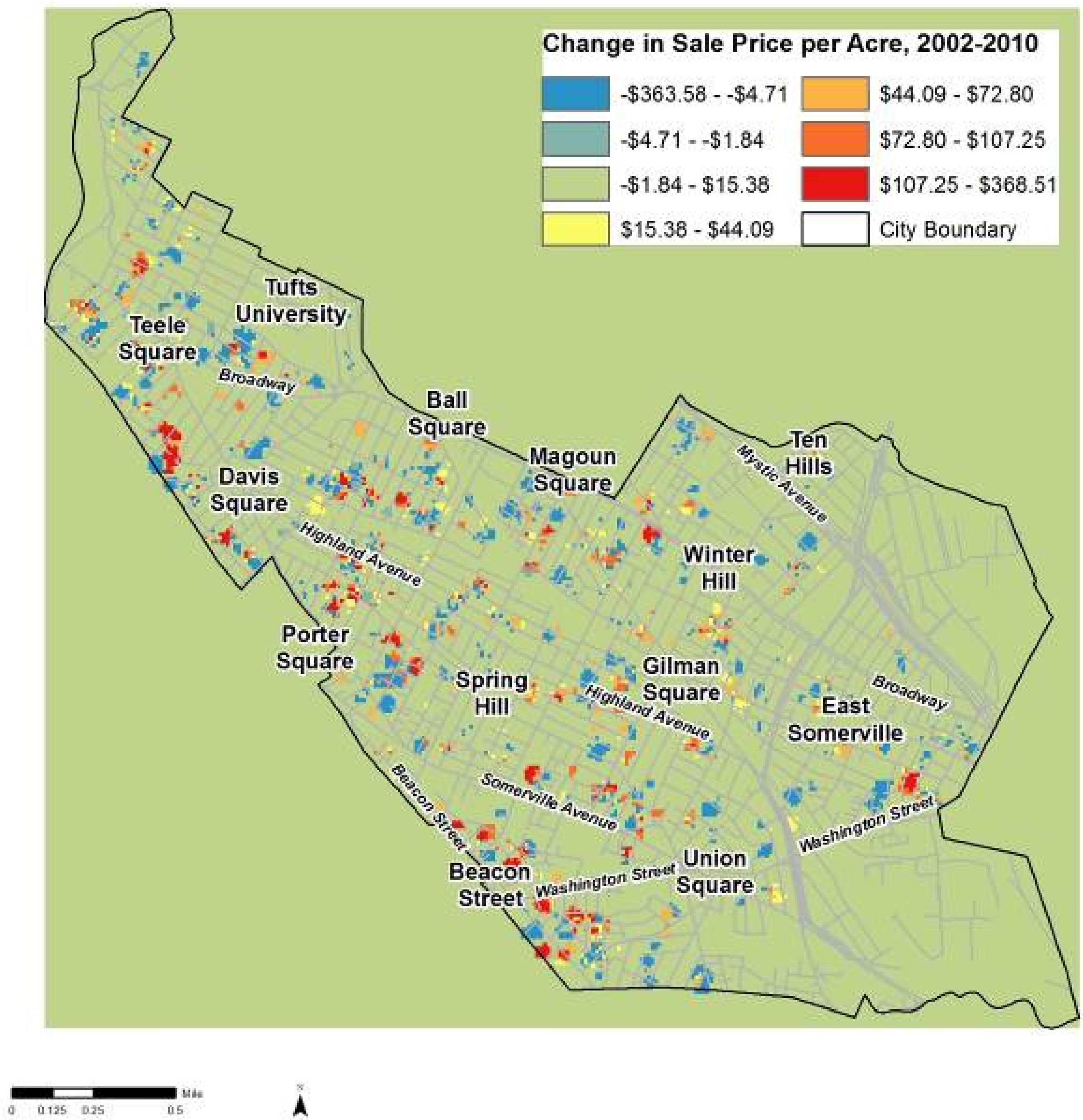
Fortunately, the raster data metrics for change in sale price density provide some of the most important visualizations of the entire study. The coarse-grained clusters illustrated in Figure 37 suggest that sale price appreciation has occurred throughout Somerville, but has been especially pronounced in West Somerville and along the city's southern border. According to this map, prices have softened in interesting locations: just south of Ball Square, in large areas of East Somerville, and throughout the neighborhoods surrounding Union Square.

Figure 37: Change in Sale Price per Acre, 300-Foot Search Radius



Again, the enthusiasm generated by the dynamic visualization of change in sale price density using a 300-foot search radius becomes more tempered, and the understanding becomes more nuanced with the 150-foot search radius. As illustrated in Figure 38, the vast majority of Somerville's neighborhoods are grouped into a middle quantile containing grid cells whose mean change in density ranges from negative $1.84 to positive $15.38 per acre. The remaining grid cells can truly be interpreted as having experienced exceptional appreciation or depreciation in sale prices during the study period.

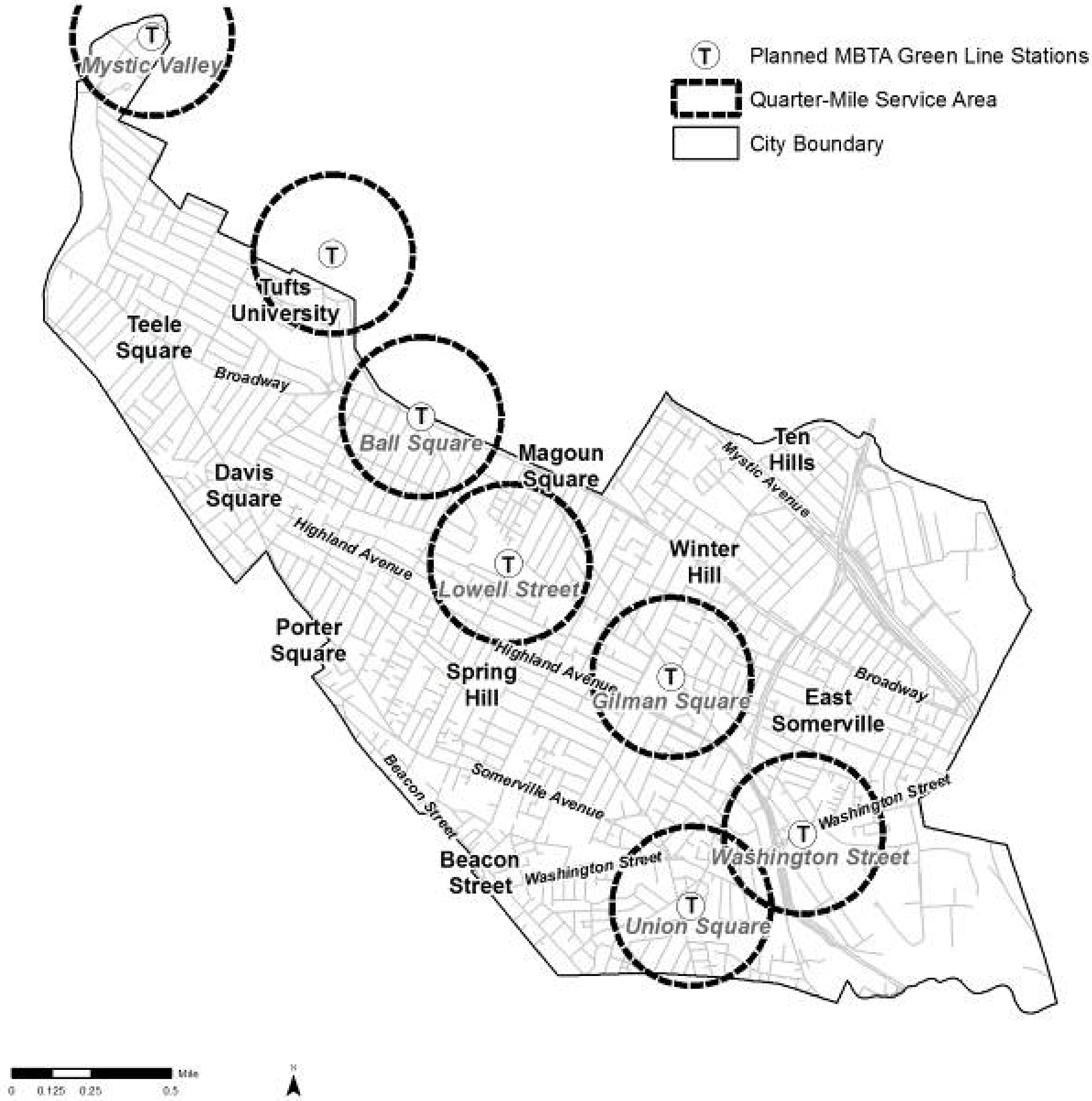
Figure 38: Change in Sale Price per Acre, 150-Foot Search Radius



4.9 Station Area Dynamics: Planning for the MBTA Green Line Extension

Neighborhoods are always changing, but major public investments including rapid transit extension projects are widely perceived to accelerate processes of neighborhood change. The MBTA Green Line Extension is a light rail transit project that will run through Somerville, with station openings planned between 2016 and 2020. The project will result in seven total new stations, six of which are located within Somerville. Station locations are shown in Figure 39.

Figure 39: Planned MBTA Green Line Extension

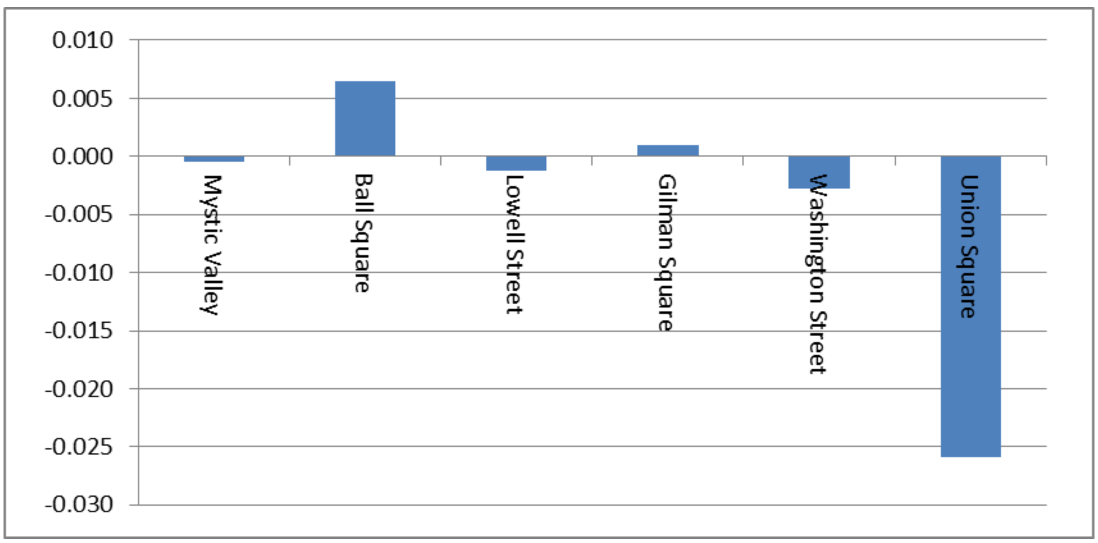


To illustrate varying degrees of activity around the six Green Line stations in Somerville, the Zonal Statistics as Table tool in ArcGIS has been used to normalize raster density surfaces to the 1,320-foot service area (five-minute walk) around each station. Bar graphs will be used to compare each permitting and sales metric across the six station areas, and neighborhood-scale maps will be provided for the highest- and lowest-performing station areas. All density calculations use the 150-foot search radius to provide a fine-grained visualization.

4.10 Station Area Dynamics: Permit Count Density

The citywide mean change in permit count density is calculated at -0.004 permits per acre. As illustrated in Figure 40, four of the six station areas exhibited a change very close to zero. Ball Square experienced a positive change in permit count density for the study period, while Union Square experienced a much larger decrease in permit count density.

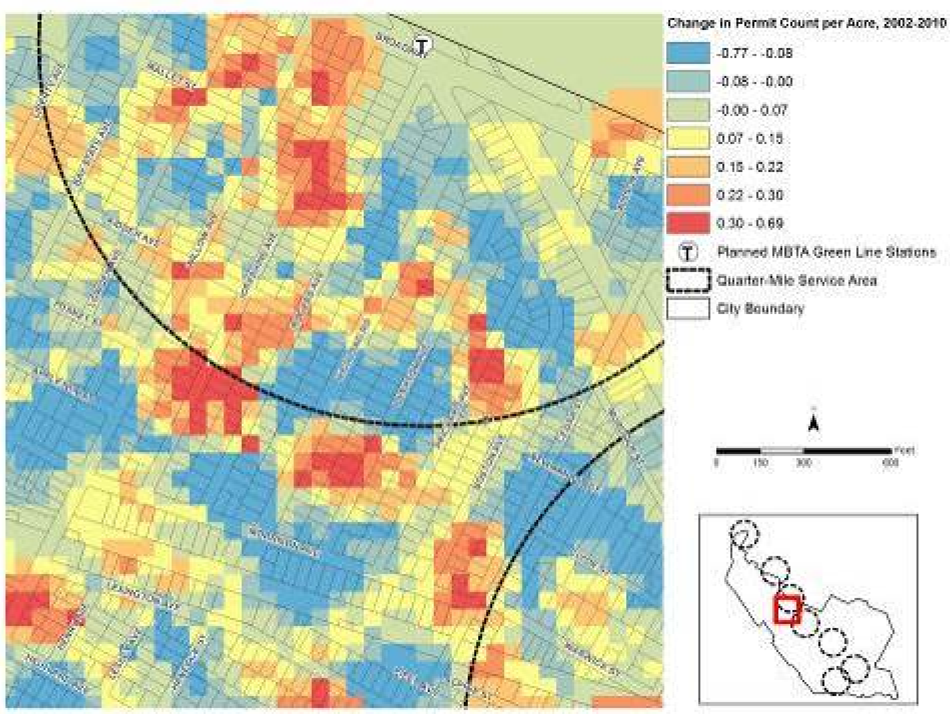
Figure 40: Change in Building Permit Count per Acre by Station Area, 2002-2010



A neighborhood map of the Ball Square station area is provided in Figure 41. Using the 150-foot search radius, fine-grained patterns of change are visible. The regular street grid, along with the homogeneity of residential land uses suggest that this neighborhood provides an excellent test case for the raster-based spatial analysis methodology.

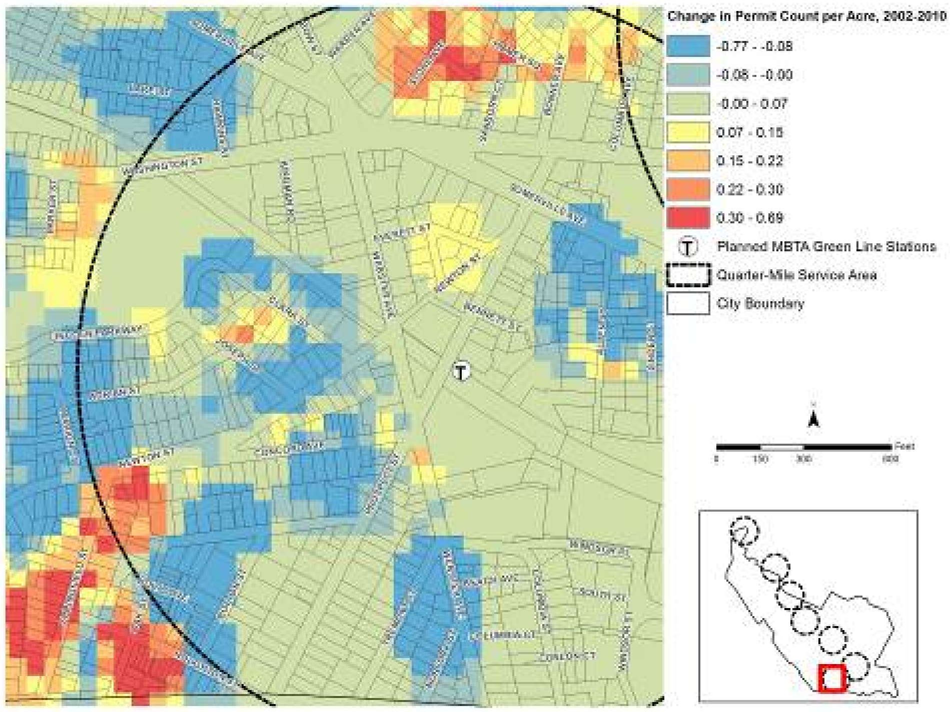
An upward trajectory in permit count density is apparent at two locations along Josephine Avenue, one within the ¼ mile radius, and one just outside. Other clusters of significantly positive change appear along Pritchard Avenue, and between Pearson Avenue and Highland Road. The most striking decreases in permit count density occur in a cluster of cells stretching between Rogers Avenue, Highland Road, Pearson Avenue and Pritchard Avenue just inside the ¼ mile radius. Another important decrease in permit count density is visible along the stretch of Boston Avenue running southeast from the station.

Figure 41: Ball Square Change in Permit Count per Acre, 150-Foot Search Radius



Union Square provides another intriguing neighborhood map of change in permit count density. As illustrated in Figure 42, distinct clusters of negative change are apparent, but in general are not offset by intervening pockets of positive change. Part of the explanation may be the prevalence of non-residential land uses in the immediate vicinity of the Green Line station site: utility infrastructure, metal scrapyards, auto body shops and warehouse uses are widespread, while in the heart of Union Square retail and service uses abound. Nevertheless, the residential neighborhoods around Allen Street and Linden Street northeast of the station, and Concord Avenue/Newton Street to the southwest all exhibit markedly negative trajectories. Two residential neighborhoods just outside the ¼ mile station area provide an interesting contrast: the Lake Street area northwest of Union Square experienced a consistently negative change in permit count density, while the Oak Street/Springfield Street neighborhood to the southwest (on the Cambridge border and in convenient walking distance of the Inman Square business district) exhibited a generally positive trajectory.

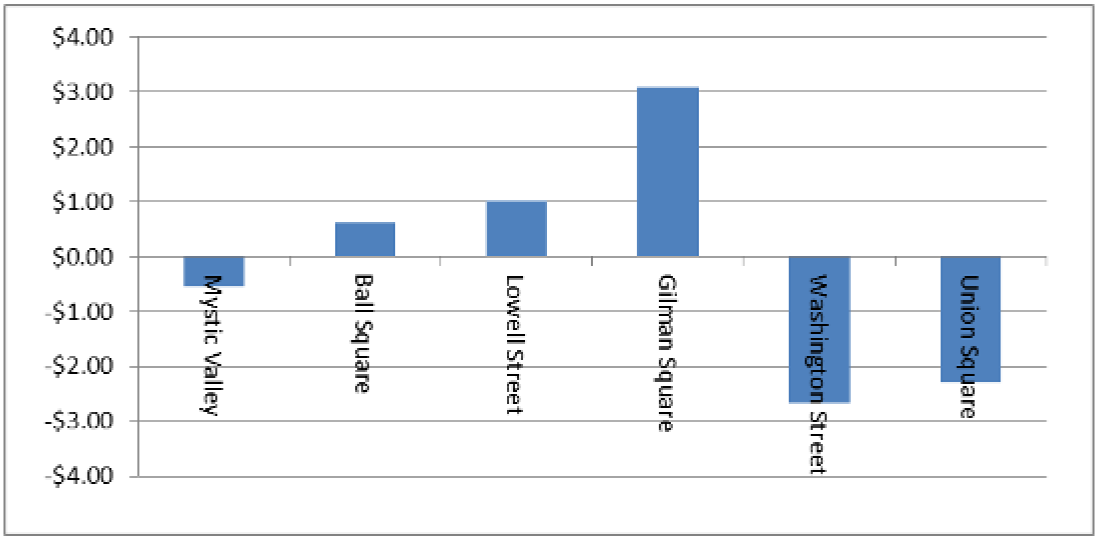
Figure 42: Union Square Change in Permit Count per Acre, 150-foot Search Radius



4.11 Station Area Dynamics: Permitted Construction Cost Density

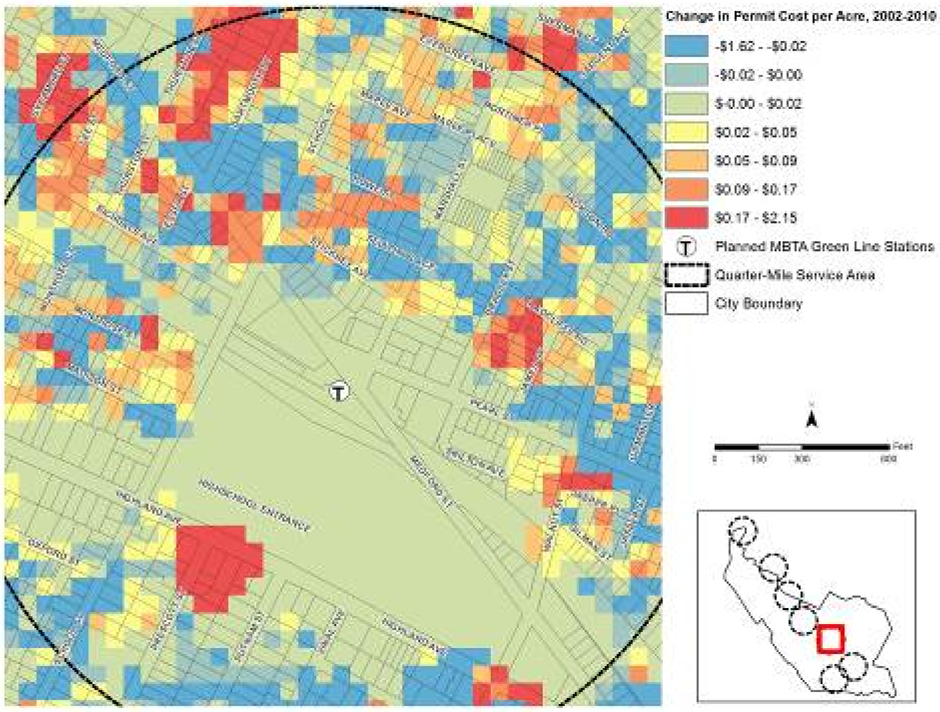
The mean change in density of permitted construction cost for all raster grid cells citywide is calculated at roughly $-0.01 per acre. As illustrated in Figure 43, net change in density of construction cost exhibits a wide variation between station areas, with Mystic Valley, Union Square and Washington Street all experiencing a net decrease in density for the study period, while Ball Square, Gilman Square and Lowell Street experienced a net increase in density. Gilman Square boasts a net increase of roughly $3.00 per acre, a growth rate three times its next nearest competitor (Lowell Street).

Figure 43: Change in Permitted Construction Cost per Acre by Station Area, 2002-2010



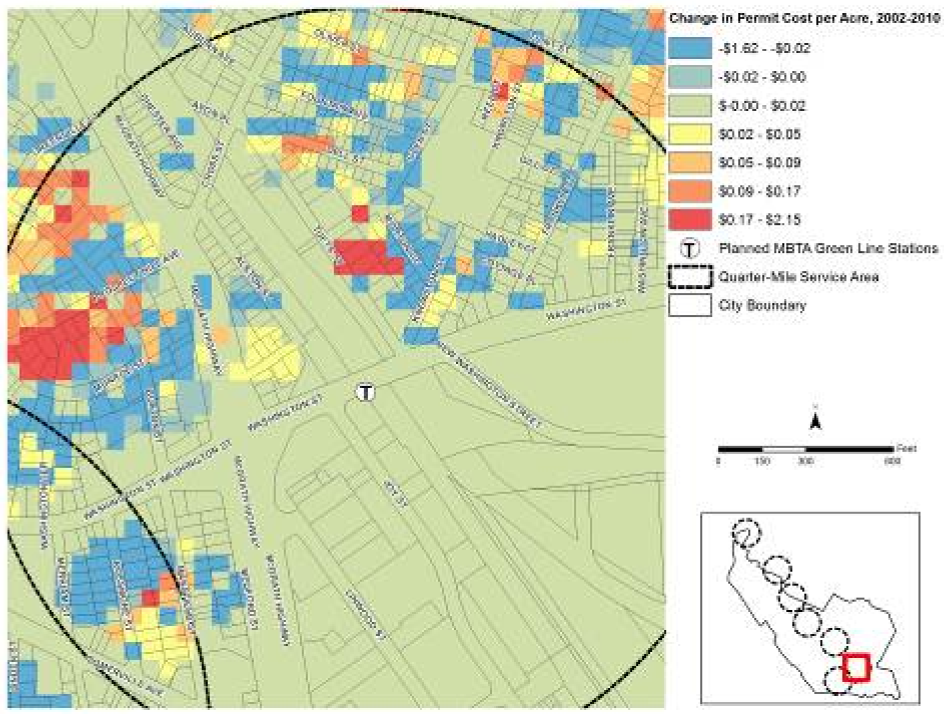
A neighborhood map for Gilman Square is provided in Figure 44. Large clusters of positive change are apparent at the corner of Highland Avenue and between Thruston Street and Dartmouth Street, with smaller clusters occuring along Medford Street west of School Street, and around the corner of James Street and Radcliffe Road.

Figure 44: Gilman Square Change in Permitted Construction Cost per Acre, 2002-2010



With two small exceptions, the Washington Street station area is characterized by negative change in permit cost density. Major clusters of decreasing density include the Merriam Street/Rossmore Street/Mansfield Street neighborhood west of McGrath Highway.

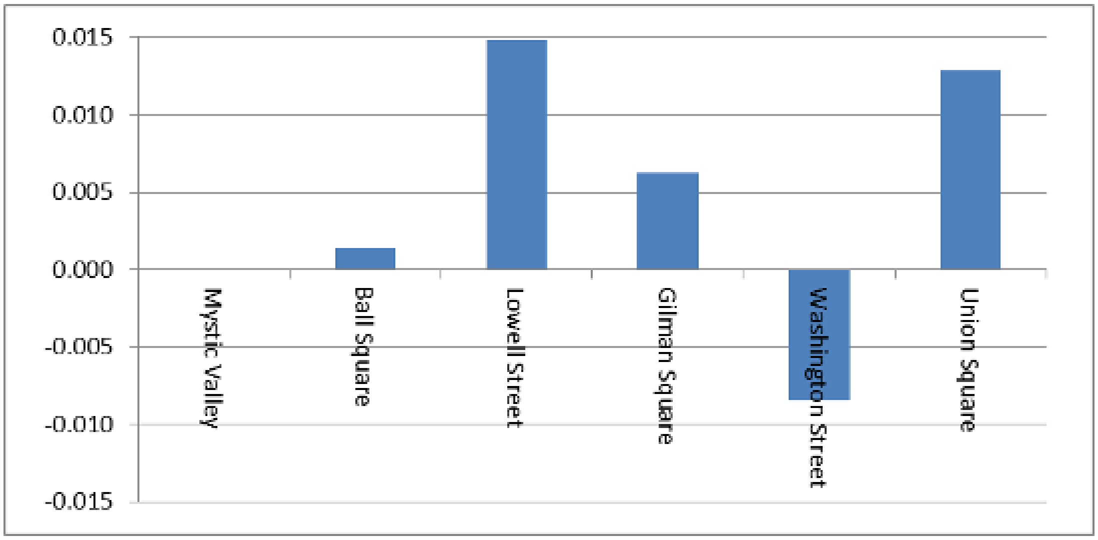
Figure 45: Washington Street Change in Permitted Construction Cost per Acre, 2002-2010



4.12 Station Area Dynamics: Sale Count Density

The citywide mean change in sale count density is calculated at -0.001 sale per acre. By this metric, the Lowell Street and Union Square station areas exhibit the greatest positive change, while Washington Street exhibits the greatest negative change.

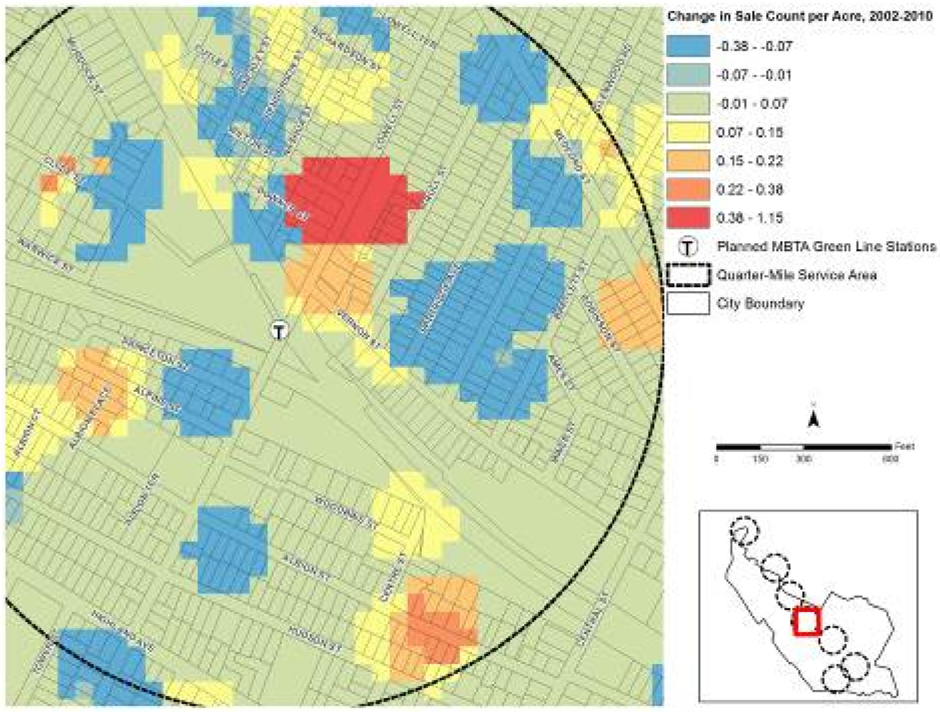
Figure 46: Change in Sale Count per Acre by Station Area, 2002-2010



As illustrated in Figure 47, Lowell Street's positive change in density of sale count is almost entirely attributable to a single cluster of grid cells centered around the 301-303 Lowell Street apartment complex, which converted to condominium ownership between 2008 and 2010. Somerville regulates condominium conversions, and as a result, the property owner has been forced to apply for conversion permits in a slow and steady fashion. Since there are 32 units in the complex, this process has resulted in a steady stream of condo units being put on the market, driving the mean sale count density metric in a positive direction.

It is also worth noting that significant clusters of decreasing sale count density are observable around the Lowell Street Green Line station. The largest is centered around Partridge Avenue and Glenwood Road and Bartlett Street, just north of Vernon Street.

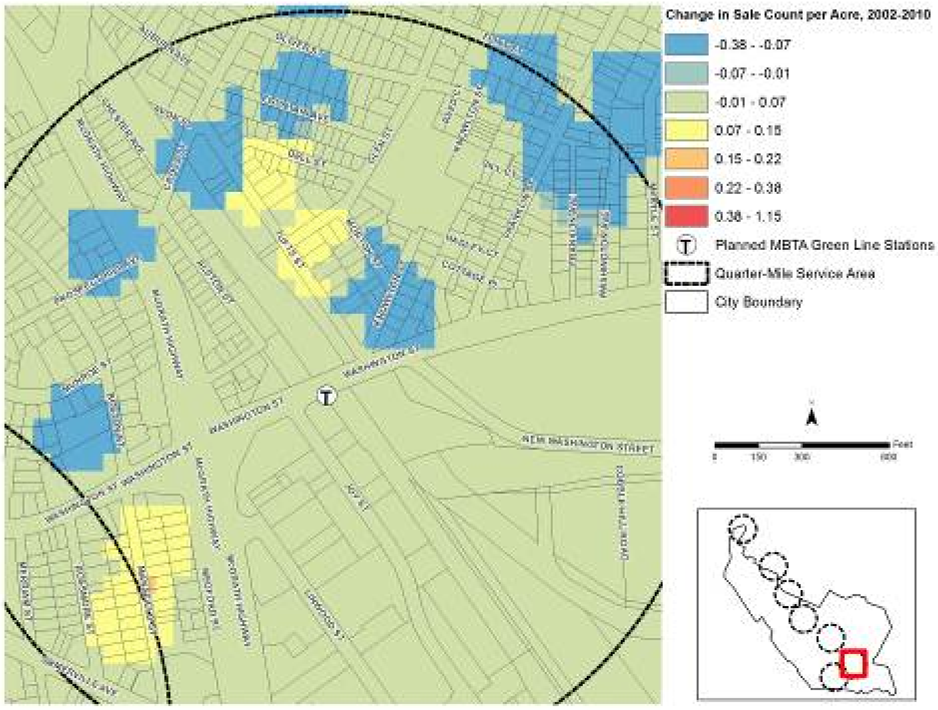
Figure 47: Lowell Street Change in Sale Count per Acre, 2002-2010



The Washington Street station area, by comparison, includes sizable clusters of negative change in sale count density, without clusters of significant positive change. As illustrated in Figure 48, the block of Knowlton Street just north of Washington Street experienced a net decrease in sale count density between 2002 and 2010. A much larger cluster exists stretching from the corner of Franklin Street and Oliver Street east to Myrtle Street.

A dynamic that is the inverse of the Lowell Street experience may be in play: large condominium buildings at 14 Boston Street (just west of McGrath Highway) and 60 Tufts Street were constructed or converted between 2000 and 2002, indicating that a flurry of sales activity may have occurred just prior to the study period, with a relative lull in sale activity since 2002. This suggests that for the sale count density metric, the raster analysis method should be treated with caution.

Figure 48: Washington Street Change in Sale Count per Acre, 2002-2010



4.13 Station Area Dynamics: Sale Price Density

Citywide, the mean change in sale price density is roughly $1.40 per square foot per acre. As illustrated in Figure 49, with the exception of Mystic Valley, the Green Line station areas experienced far greater changes in sale price per acre, ranging from -$350 (Union Square) to $420 (Lowell Street).

Figure 49: Change in Sale Price per Acre by Station Area, 2002-2010

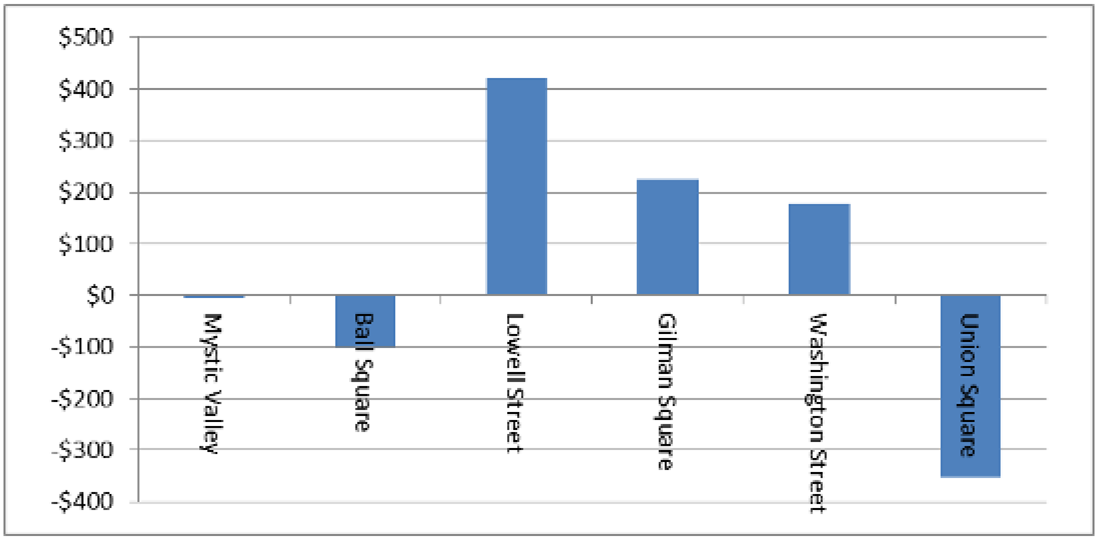


Figure 50: Washington Street Change in Sale Price per Acre, 2002-2010

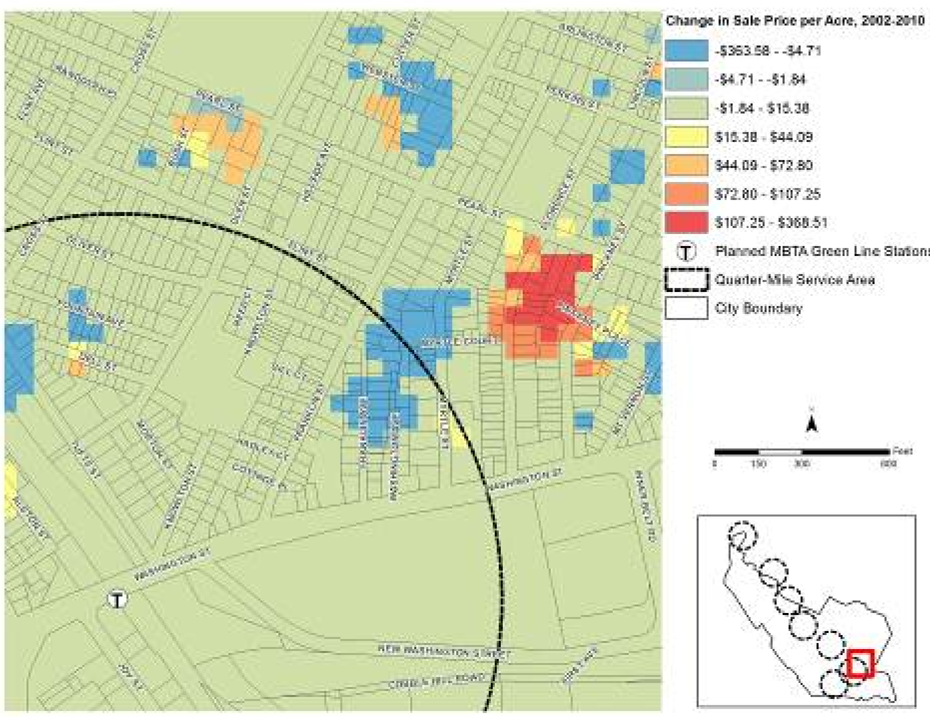
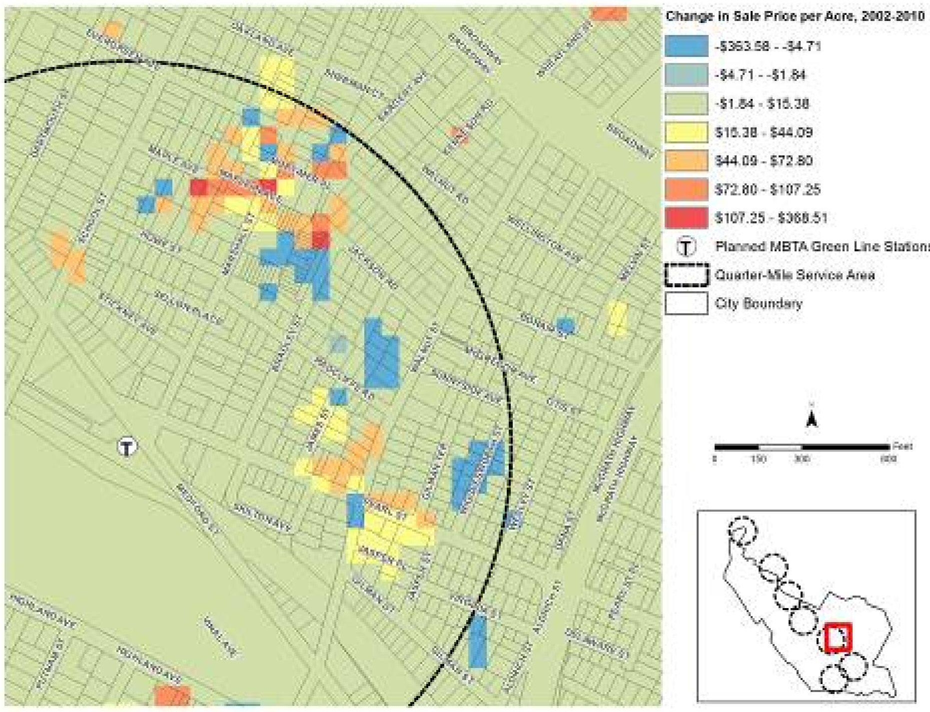


Figure 51: Gilman Square Change in Sale Price per Acre, 2002-2010



4.14 Understanding City Affordable Housing Assistance

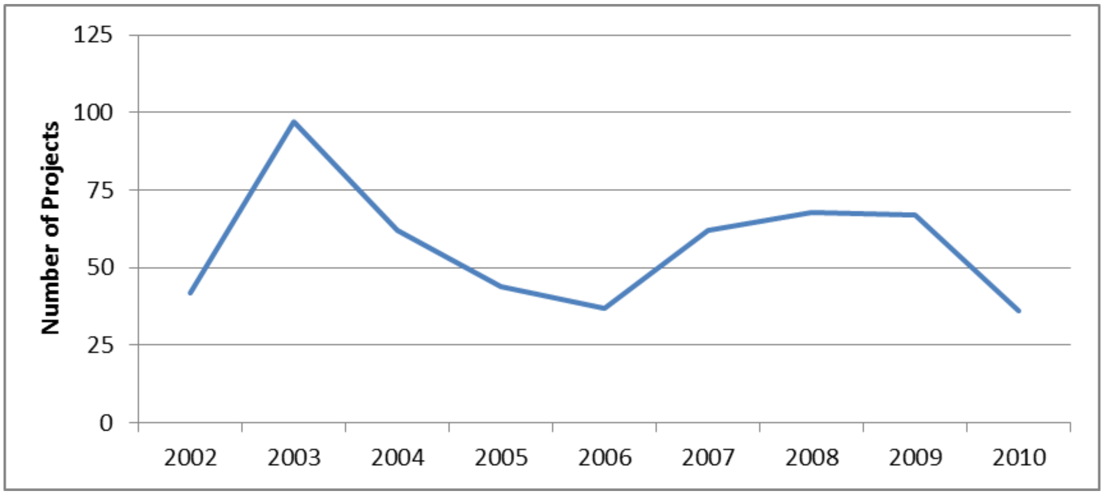
The City of Somerville, its partners in the nonprofit and academic sectors, and ordinary residents are currently engaged in a public dialogue about neighborhood change related to the Green Line Extension. Much of the debate centers around public policy interventions intended to help Somerville retain its mixed-income character in the event of rising housing costs. The City already utilizes many best practices in affordable housing policy, including inclusionary zoning, land banking for affordable housing development, and direct investment into new affordable housing development projects. Existing policies and programs dealing with affordable housing include:

- Housing Rehabilitation Program and Lead Abatement Program, which provide grants and low-cost loans to property owners for physical improvements, in exchange for affordable housing deed restrictions
- First-Time Homebuyer Program and Down Payment/Closing Cost Assistance Program, which provide grants and low-cost loans to income-eligible homebuyers
- Somerville Affordable Housing Trust Fund, which is used to help finance future affordable housing projects and programmatic spending
- Inclusionary Zoning Ordinance, which requires developers of new market-rate housing units to reserve a percentage of the new units as deed-restricted affordable housing, or otherwise provide cash payments to the Affordable Housing Trust Fund
- Affordable Housing Development Assistance, which provides federal, state and city funding for development projects producing deed-restricted affordable housing

4.15 Change Over Time: City Affordable Housing Assistance

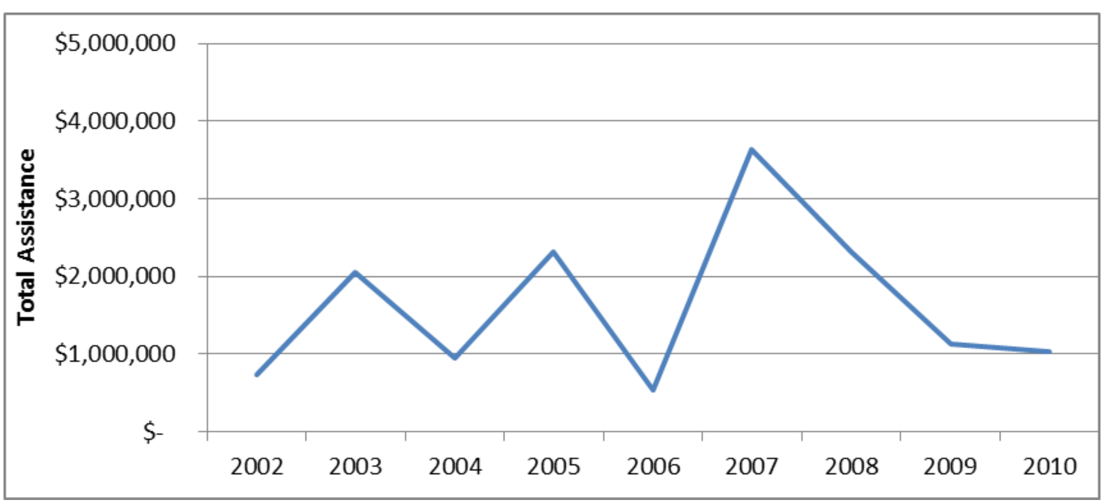
Since 2000, the City has been able to provide housing assistance to more than 600 affordable housing projects, ranging from small-scale rehabilitations of two- and three-family homes to development of large apartment complexes. As illustrated in Figure 52, the annual project counts for the study period range from roughly 30 to 100 assistance projects.

Figure 52: Annual City Affordable Housing Assistance Projects, 2002-2010



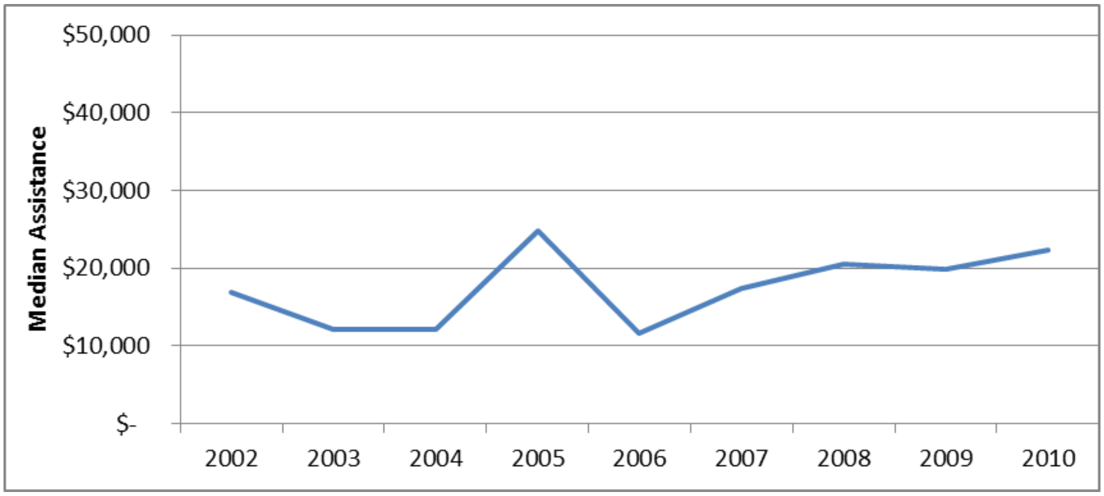
The City of Somerville has invested roughly $15 million in affordable housing between 2002 and 2010. The annual assistance provided through the City's affordable housing programs has ranged from roughly $0.5 million to $3.6 million during the study period. The sharp jumps illustrated in Figure 53 are partly attributable to the two-year cycle that certain federal discretionary grant programs follow.

Figure 53: Annual City Affordable Housing Assistance, 2002-2010



Another way to evaluate City expenditures is to track the median value of project assistance. As illustrated in Figure 54, the median value exhibited a spike in 2005, and a steady upward climb between 2006 and 2010.

Figure 54: Median City Affordable Housing Project Assistance, 2002-2010

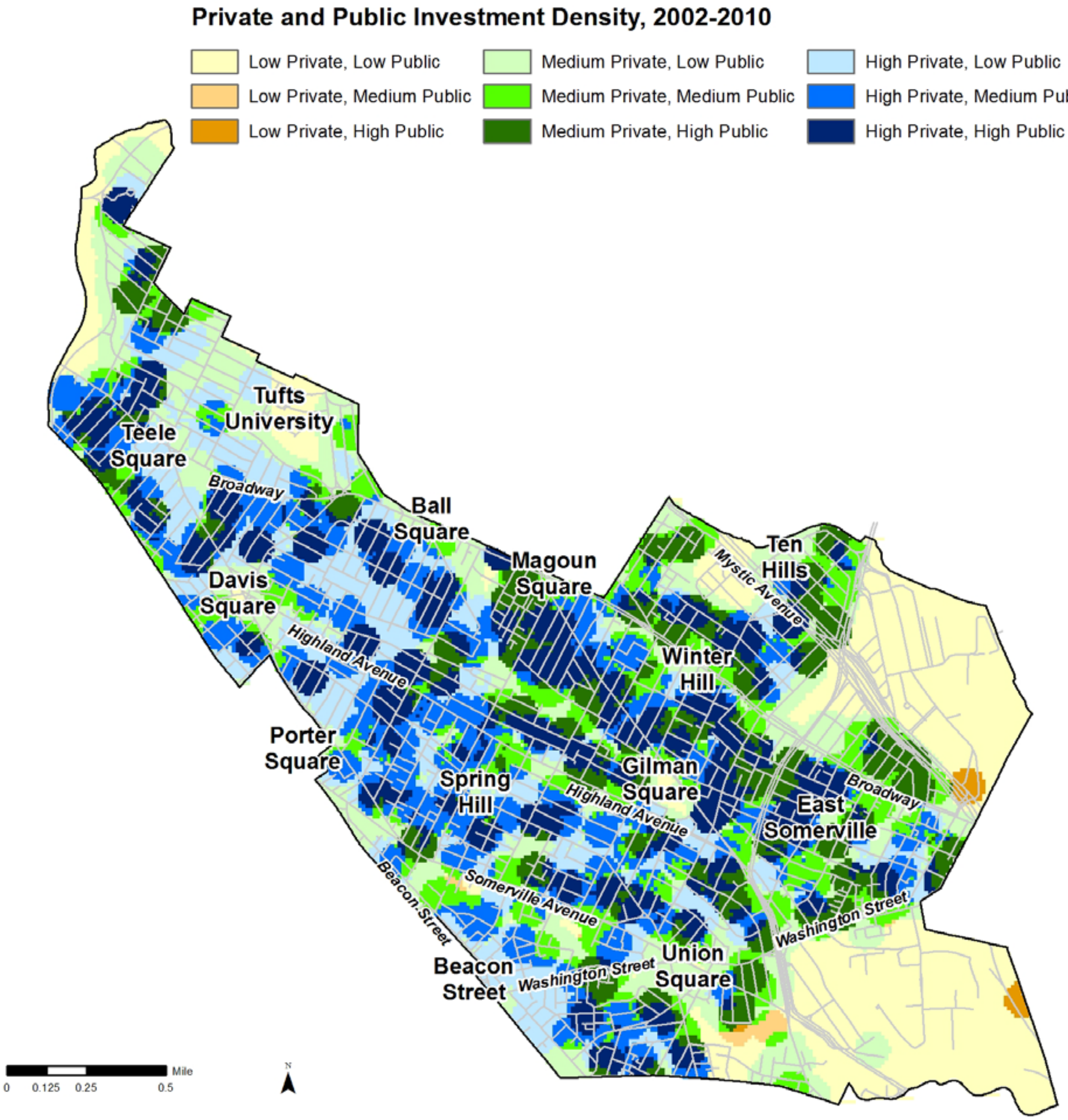


Public interventions in the housing market are always contingent on federal, state and local budgets, and the City's imperative to save costs and achieve efficiencies will grow as federal and state resources dwindle in the coming years. For example, the federal Department of Housing and Urban Development (HUD) recently announced cuts to one of the City of Somerville's major funding programs from roughly $850,000 in fiscal year 2013 to roughly $500,000 in fiscal year 2014, a staggering 40% decrease.

4.16 Comparing Private and Public Investment: Permitted Construction Costs

The analyses of building permit activity and residential property sales activity included in this thesis should be leveraged to identify areas of Somerville that can offer policymakers the greatest return on investment. One way to promote data-driven policymaking is to compare the location of the City's assistance projects with the distribution of private investment across Somerville's residential neighborhoods. Raster density surfaces of the City's affordable housing assistance projects have been created, and can be compared with the density of private investment. As illustrated in Figure 55, neighborhoods around Gilman Square and Magoun Square appear to exhibit high rates of both private and public investment.

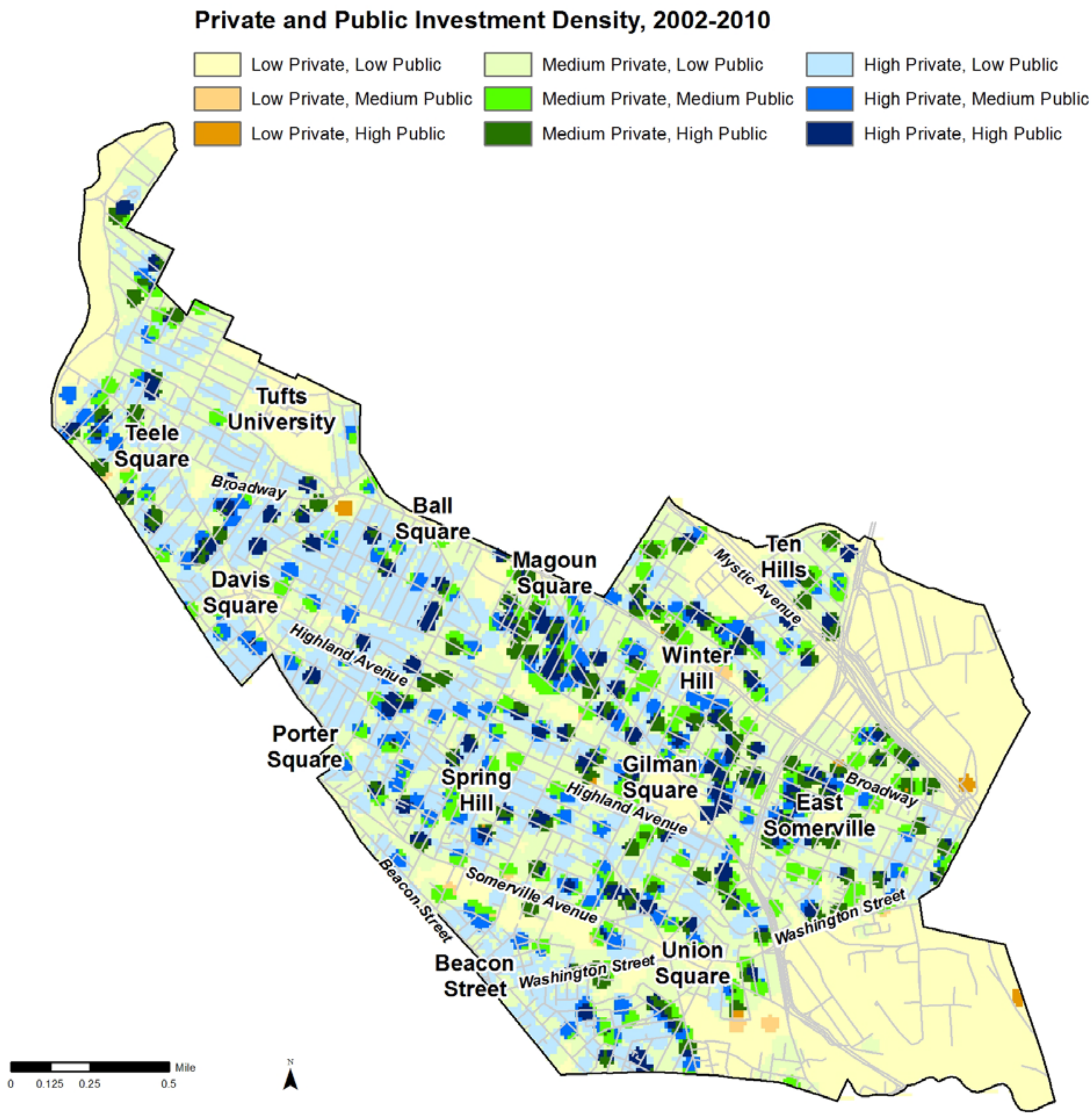
Figure 55: Permitted Construction Costs and City Affordable Housing Assistance, 300-Foot Search Radius



Using the 150-foot search radius, the comparative density map provides additional nuance (Figure 56). Clusters of high private and public investment are visible east of Gilman Square along Walnut Street, and south of Magoun Square.

More telling are the large areas around Ball Square, Beacon Street, Porter Square and Spring Hill where private activity appears high, while public investment has been low.

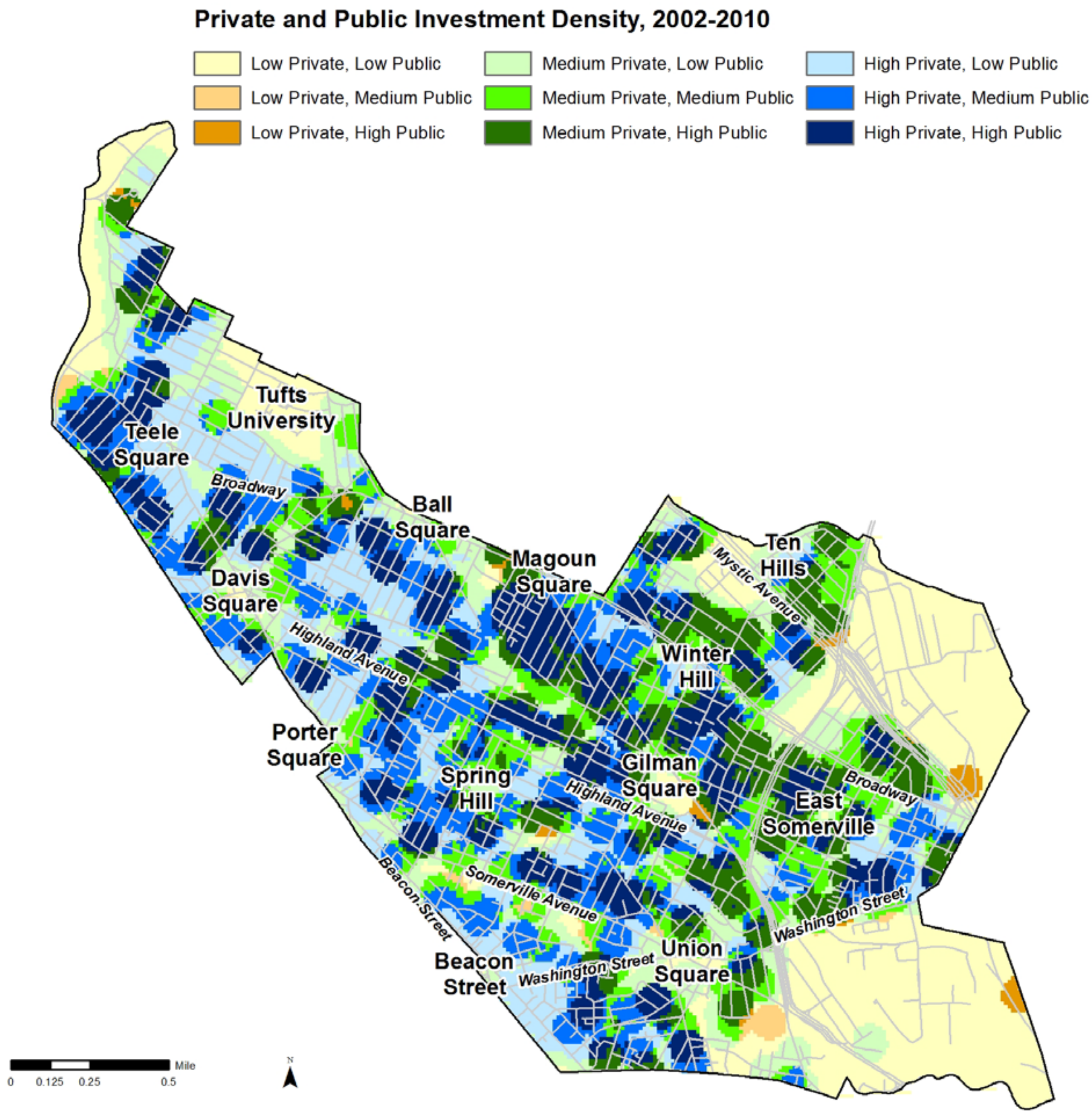
Figure 56: City Affordable Housing Assistance and Permitted Construction Costs, 150-Foot Search Radius



4.17 Comparing Private and Public Investment: Residential Sale Prices

Using residential property sale prices as an indicator of private market activity, the comparative density map in Figure 57 shows a similar pattern. At the crude 300-foot search radius, large swaths of Somerville appear to have experienced high levels of both private and public investment in housing.

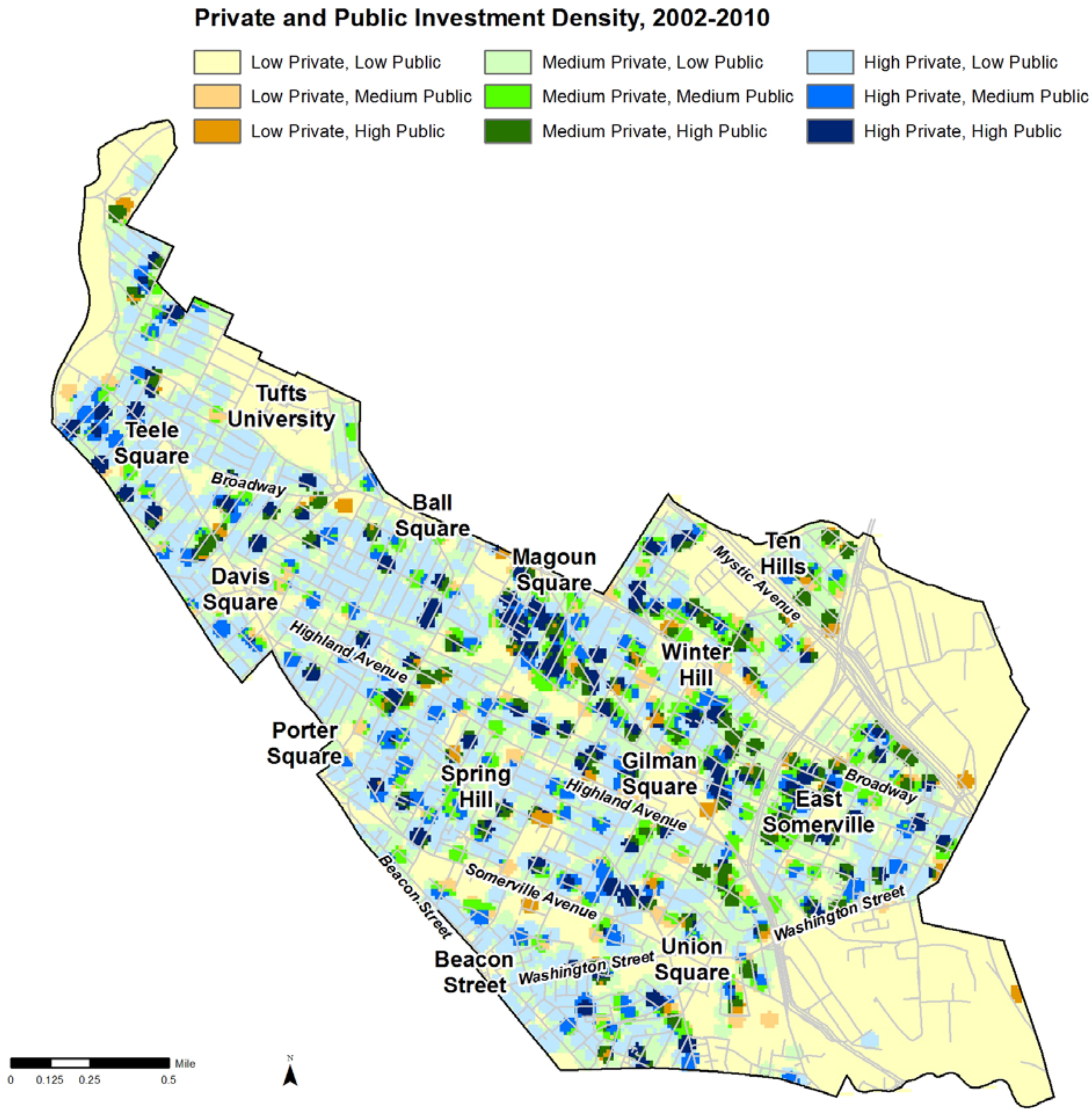
Figure 57: City Affordable Housing Assistance and Residential Sale Prices, 300-Foot Search Radius



A comparative density map created with the 150-foot search radius again provides a finer geographic detail (Figure 58). Although pockets of high public investment are still visible around East Somerville, Gilman Square, Magoun

Square, and Winter Hill, these neighborhoods also feature significant areas of high private/low public investment.

Figure 58: City Affordable Housing Assistance and Residential Sale Prices, 150-Foot Search Radius



CHAPTER 5: POLICY IMPLICATIONS AND RECOMMENDATIONS

5.1 The Importance of Strategic Geographic Targeting

To be most effective, municipal policies and programs such as inclusionary zoning and affordable housing assistance must balance equity and efficiency. They should be ambitious, yet practical. They should be tailored to local market characteristics, and they should be updated periodically (Schuetz et al 2009).

The City of Somerville's regulatory framework is beginning to move in this direction. In 2009, the City's first major rezoning in decades was adopted in Union Square, enabling increased development intensity and a more urban mix of commercial and residential uses to complement the planned MBTA Green Line Extension. To ensure that increased private investment could be appropriately leveraged for public benefit, the standard citywide inclusionary housing requirement of 12.5% was increased to 15%, and in the parts of Union Square where high-rise development was encouraged, the rate was set at 17.5%. One year later, the strategy was replicated in a more modest upzoning of the commercial corridor along Broadway in East Somerville and Winter Hill.

This kind of strategic geographic targeting should be explored in Somerville's residential neighborhoods. Three major examples of potential policy change exist:

- If the City’s goal is to create new affordable housing opportunities in the Green Line station areas, the strategy of targeted upzoning paired with higher inclusionary rates makes sense, since the increased flow of private capital into redevelopment projects can be used to subsidize the construction of permanently-affordable housing units.

- If additional development density is not desirable in residential neighborhoods less accessible to transit, but affordable housing is still needed, targeting of programmatic spending away from commercial corridors and squares and into the interior neighborhoods might be considered, since these programs create housing opportunities for low- and moderate-income residents using existing residential building stock.

- If enough demand exists among property owners for assistance under affordable housing programs such as first-time homebuyer assistance, lead abatement or housing rehabilitation, program managers could be provided with a set of geographic criteria that allow them to target spending into parts of the City characterized by relatively high levels of private investment and relatively low levels of public investment.

5.2 Policy Recommendations

As Somerville strives to balance community reinvestment goals with preservation of neighborhood character and socio-economic diversity, a nuanced understanding of where private investment is occurring and whether it may be spurring additional investment will be crucial. In order to allow the City and its partners to understand investment trends, the following policies should remain in place:

- Building permit data should continue to be digitized into a standardized database that includes property address, estimated project cost, and a description of the permitted improvements.
- Data sharing between the City's Inspectional Services Division, Assessing Department, Housing Division, Planning Division and SomerStat performance management office should continue to be prioritized.
- Advocacy to federal and state officials around the need to preserve and enhance Community Development Block Grant (CDBG) funding and other major entitlement programs should be continued, since federal entitlements provide the majority of funding for affordable housing programs.

In addition, the following new initiatives are recommended:

- Develop public information campaigns to increase awareness of and demand for the City's existing affordable housing programs including Housing Rehabilitation, Lead Abatement, First-Time Homebuyer Assistance and Down Payment/Closing Cost Assistance.

- Create a City-managed Affordable Housing Land Bank to provide City funding for land acquisition and predevelopment for affordable housing development projects. Target funding to project sites around the future MBTA Green Line stations.

- Continue to support the City's newly-created Residential Energy Efficiency program, which provides city funds for property owners to perform energy audits that can identify opportunities to save on maintenance and utility bills by investing in efficiency upgrades. Leverage the current popular enthusiasm for green initiatives to seek funding mechanisms to assist property owners in performing the upgrades recommended during audits, in return for affordable housing restrictions.

Lastly, the following modifications to existing policies and programs are recommended for investigation:

- Explore strategic geographic targeting of the City's existing Inclusionary Housing Ordinance, which requires affordable housing set asides in new development projects. The current "one-size fits-all" policy framework should be customized to provide a menu of options depending on housing needs and opportunities in various Somerville neighborhoods.

5.3 Recommendations for Future Research

Practitioners and policymakers working on issues related to neighborhood change in Somerville can benefit from additional quantitative and spatial analysis of residential permitting and sale trends. The first phase of the Green Line Extension is scheduled to open for service at the Union Square and Washington Street stations in November 2016, while the Gilman Square, Lowell Street and Ball Square stations are scheduled to open around 2019. As these dates approach, continued analysis of permit and sales activity should be prioritized among planners and academics to ensure that public policy can not only respond to, but anticipate a dynamic residential real estate market.

An important metric that is not addressed in this study is residential rent. Roughly 65% of Somerville's 34,000 housing units are renter-occupied, and yet reliable data sources are difficult to find. In order to leverage the kind of spatial analysis methodologies explored in this thesis in support of data-driven housing policy, it will be critical to develop and analyze residential rent data that can be geocoded at the address level, and normalized by square foot of living area.

Lastly, the resources and creativity of the academic community should be enlisted to truly test for spillover effects from residential rehabilitation and home sales. Researchers should take advantage of the wealth of local data available to create hedonic pricing models for Somerville's residential real estate market. The metrics analyzed in this study have exhibited subtle, yet noticeable patterns that would benefit from a more sophisticated econometric analysis. Regression analyses should be performed to control for confounding locational variables, and statistical significance should be tested for the outputs of the various spatial analyses.

5.3 Summary

Somerville's neighborhoods are always changing, and analyses and visualizations of permit activity and sale activity offer a new empirical lens through which community members and City officials can view that change and craft data-driven policy. The City of Somerville has built an international reputation as a leader in public policy innovation over the last decade. By continuing to promote analysis and visualization of residential property investment trends, the City can encourage private market activity while crafting sensitive policy interventions that advance community goals related to social, environmental and economic sustainability.

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