Impacts of CTfastrak on Real Estate and Urban Economic Development: Phase 1

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16. Abstract

CTfastrak, a bus rapid transit service connecting four municipalities (Hartford, West Hartford, Newington, and New Britain) in Central Connecticut (CT), received final funding approval in 2011 and opened for service in March 2015. This new service may be encouraging transit-oriented development (TOD) along the busway, including new retail stores, restaurants, office space and housing. These potential impacts of CTfastrak are expected to affect property values. But, *a priori,* the magnitude of the impact is unknown. The overall aim of this study is to measure the impact of CTfastrak on real estate and urban economic development in these four municipalities. The change in property values and economic development will be analyzed before and after two crucial dates: the announcement of the funding commitment for the project in 2011 and the commencement of service in 2015. The first phase of this project – the focus of this report – involves collecting the necessary data for the second phase, which could encompass a data analysis study on the potential impacts on residential property values, businesses, residents, and towns in the areas surrounding CTfastrak stations over approximately the next five years.

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METRIC CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS				
SYMBOL	**WHEN YOU KNOW**	**MULTIPLY BY**	**TO FIND**	**SYMBOL**
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	Liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	Lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

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Executive Summary

CTfastrak, a bus rapid transit service connecting four central Connecticut (CT) municipalities (Hartford, West Hartford, Newington, and New Britain), received final funding approval in 2011 and opened for service in March 2015. This new service may be encouraging transit-oriented development (TOD) along the busway, including new retail stores, restaurants, office space and housing. These potential impacts of CTfastrak are expected to affect property values. But, *a priori*, the magnitudes of the market impacts are unknown, and they likely require time to materialize.

CTfastrak is unique because most of the 9.4-mile busway was built in former and existing rail right-of-ways. This minimized the construction disruption to existing businesses and residential properties, unlike the complications with new rapid transit services, such as light rail, in other cities (e.g., Vancouver, BC).

The final aim of this two-phase study is to measure the impact of CTfastrak on real estate and urban economic development in the aforementioned municipalities. The change in property values will be analyzed before and after two crucial dates: the announcement of the funding commitment for the project in 2011 and the commencement of service in 2015. Such an analysis could examine and control for a variety of factors, such as property characteristics, location, zoning, vacancies, and other potential determinants of market values.

The first phase of this project, the focus of this report, involves setting the "baseline" and collecting some of the necessary data for the second phase. Phase 2 will include an update of the data and a GIS and data analysis study of the impacts on residential property values, businesses, residents, and towns in the areas surrounding CTfastrak stations. Phase 2 will be completed over the next several years.

Three products have been generated in the first phase of this project: a literature review, a geospatial database, and a visual, written, and quantitative description of the data in the geospatial database. The literature review focuses on other studies examining the real estate impacts of bus rapid transit as well as other forms of rapid transit. The geospatial database contains non-locational, locational and land-use characteristics of parcels in the aforementioned four municipalities. These characteristics include: property values, property sales, walking/driving distance to nearest CTfastrak station, value of travel time savings, metro-area real estate values, tax revenue, rental properties, affordable housing, square footage, current plans or proposals for new real estate development, remediated properties, aerial photographs, and USPS vacancies. This database can be easily analyzed and updated using standard GIS software. The description of the data in the geospatial database outlines the type of information, the source of the data, and in the cases where the data were generated by the authors of this report, the methodology used.

The geospatial database is generated so that it can be used to analyze the impact of the CTfastrak on real estate and economic development in Hartford, West Hartford, Newington, and New Britain. It is recommend that the second phase of this research project should include the analysis of the following factors: property values (assessed and sale values), land values, local property tax rates and revenues, the number of residential and commercial properties (i.e., including single-family, rental and affordable housing), square footage, and current plans or proposals for new real estate development and vacancies. Other factors that may also be considered include the characteristics that play a role in bus rapid transit becoming capitalized into real estate values and urban economic development, such as: urban design and placemaking, changes in travel costs, changes in modal choice, environmental remediation, changes in emissions, and possibly changes in traffic noise. These impacts will be analyzed in two different ways. One is through a visual representation of maps, aerial photography, and state highway photography, to demonstrate how the neighborhoods in and around the CTfastrak stations have changed over time. The other possible methodology for studying these impacts is statistical analysis, such as multivariate regression analysis and/or other statistical techniques. These techniques can be applied to the data stored in the geospatial database, such that annual changes in the aforementioned factors can be analyzed over approximately the next several years for two time periods: before versus after the announcement of the funding commitment in 2011, and before versus after the commencement of CTfastrak service in 2015.

CHAPTER 1 Background

1.1 Introduction

With the final funding commitments in 2011 and the subsequent opening of service in March 2015, a Bus Rapid Transit (BRT) service connecting downtown Hartford with New Britain has become a reality (State of Connecticut, 2017a). This Connecticut Department of Transportation (CTDOT)-owned service, entitled *CTfastrak*, is the first BRT system in Connecticut (State of Connecticut, 2017b). BRT is a system of bus routes that either entirely or primarily run along a bus-only roadway (State of Connecticut, 2017c). CTfastrak is unique because most of the 9.4-mile busway was built in former and existing rail right-of-ways. This minimized the construction disruption to existing businesses and residential properties, unlike the complications with new rapid transit services in other cities, such as the new rail rapid transit line in Vancouver, BC (Cohen and Brown, 2017).

CTfastrak has the capacity to provide quick and frequent service for a large number of passengers to and from ten stations near a multitude of destinations in Hartford, West Hartford, Newington and New Britain (Figure 1). For example, CTfastrak passengers wait less than 10 minutes for a bus during peak periods of traffic and have the ability to walk only a short distance from these BRT sites to many activity points, such as the XL Center, Aetna, Inc., The Mark Twain House & Museum, Central Connecticut State University, West Hartford's Walmart Supercenter, and New Britain City Hall (State of Connecticut, 2017c). An added benefit of this bus service is that CTfastrak routes are also integrated within the larger CTtransit system, which is a CTDOT-owned regular bus service that connects the communities of Waterbury, Cheshire, Southington, Bristol, Plainville, New Britain, Newington, West Hartford, Hartford and Manchester (State of Connecticut, 2017d). Other advantages of this BRT service include (State of Connecticut, 2017c):

- Grade-separated right-of-way
- High-quality vehicles that are easy to board and provide a quiet, clean and comfortable ride
- Pre-paid fare collection to minimize boarding delays
- Integrated fare systems, allowing free or discounted transfers between routes
- Integration with pedestrian and bicycle facilities, taxi services, intercity bus, rail transit and other transportation services
- Excellent customer service
- Effective security for transit users and pedestrians
- High-quality bus stations with Transit-Oriented Development (TOD) in nearby areas

The new service has given many residents and businesses faster and more reliable travel times to and from the urban core. It has also enabled some New Britain area residents who did not have automobiles to now easily commute to the state's capital city. Well-designed mass transit routes have the potential to improve the lives of residents by reducing the financial, temporal, and psychological costs of commuting to work, shopping, and recreation sites. All of these potential impacts of CTfastrak can affect property values and economic development. Furthermore, TOD can lead to a critical mass of economic activity so that agglomeration economies are enhanced, which can result in urban sub-centers, as described by Cohen and Brown (2017) for Vancouver, BC, Canada. Therefore, one way to measure CTfastrak's impact is to examine how property values and economic development have changed before versus after the funding commitment for the project (and/or before versus after the commencement of service).

Although the potential impacts of CTfastrak are expected to affect property values and economic development in the aforementioned four municipalities (Hartford, West Hartford, Newington and New Britain), the *a priori* size of the impacts are unknown. CTfastrak will presumably affect a number of other municipal characteristics related to property values and economic development, including property sales, tax revenue, rental properties, affordable housing units, square footage, current plans or proposals for new real estate development, environmental remediation, and vacancies. Similar to property values and economic development, the degree to which the CTfastrak drives those changes is presently unknown.

Given the fact that CTfastrak received funding approval and opened for service only recently, many of CTfastrak's impacts might still require time to materialize and become evident in photographic records and/or statistical descriptions and analyses. Consequently, documenting the changes in such variables over approximately the next several years will be crucial to understanding the system's effects. To gain a better grasp of the expected changes, a review of the findings from other studies focusing on the impact of BRT on property values and economic development is essential. A review of this literature is presented in the next section.

1.2 Review of Existing Bus Rapid Transit (BRT) Literature

The purpose of this section is to review the existing literature that focuses on the impact of BRT on property values and economic development. This review draws upon sources that are entirely or primarily related to BRT. When appropriate, however, some references pertain to other forms of rapid transit (e.g., light-rail) and the general body of transportation and economics literature. This section is subdivided into two sub-sections. The first sub-section focuses on the findings from studies of factors directly or primarily related to property values and economic development. This section includes a discussion of the effects of BRT on property and land values (i.e., assessed and sales values), local tax revenue, the type and quantity of nearby properties (i.e., residential, commercial, and rental properties as well as affordable housing), square footage, current plans or proposals for new real estate development, and vacancies. The second sub-section focuses on factors that become capitalized into property values, such as changes in travel costs, changes in modal choice, environmental mediation, noise effects and urban design and placemaking.

- **Factors directly or primarily related to property values and economic development**

This subsection reviews the existing literature that focuses on the effects of BRT on a number of factors directly or primarily related to property values and economic development. The general relationship between BRT and these factors is related to the proliferation of individuals, especially urban Millennial workers, who prefer to walk or take public transportation for work, shopping and recreation (Bartholomew and Ewing, 2011; Gose, 2017). Because not all of these individuals can afford housing within walking distance of these activity sites, demand should increase for housing close to public transit stations with access to major points of interest. It is assumed that demand for housing near stations with faster and more frequent forms of public transportation (e.g., bus rapid transit) will increase, raising property values near stations and shifting real estate development plans away from building suburban office parks and towards TOD. Simultaneously, this increasing demand is also expected to have a similar positive relationship with other factors related to property values and economic development. Rapid transit stations are also expected to increase local tax revenue, the quantity of residential housing, the quantity of commercial properties, the quantity of rental properties, the quantity of affordable housing, structural square footage, and plans or proposals for new real estate development, as well as reducing vacancies. The remainder of this section details the findings from other reports on these relationships, which will help to guide our later empirical analysis of benefits associated with the improved accessibility provided by BRT stations.

- **Property and land values (assessed and sales values)**

Multiple studies have found that BRT systems increase property values in North America, Asia and South America (Perdomo-Calvo et al., 2007; Perk and Catala, 2009; Rodriguez and Mojica, 2009; Muñoz-Raskin, 2010; Dubé et al., 2011; Cervero and Kang, 2011; Panero et al., 2012; Revington, 2015; Deng et al., 2016; Hamidi et al., 2016; Calvo, 2017; Gose, 2017). In North America, at least two studies have concluded that property values increased around BRT stations. Perk and Catala (2009) examined the impact on property values of Pittsburgh's East Busway, one of the oldest operating BRT systems in the country. The authors found evidence of higher property values near the stations, but these effects decrease as the distance from the stations increases. Pittsburgh single-family homes within 100 feet from a station experienced an increase in property values of approximately $19.00 per $1000 of market value, while properties as far as 1,000 feet away from stations experienced an increase in property values of only $2.75 per $1000 of market value. Dubé et al. (2011) estimated the economic impact of the introduction of a new bus rapid transit system in Québec and found that the BRT service generated an increase in house prices ranging from 2.9% to 6.9%.

In Asia, at least three studies have found evidence of property values rising around BRT stations in Seoul and Beijing. Cervero and Kang (2011) studied the impact of converting regular bus systems to median-lane BRT services on property values in Seoul, South Korea. Not only did BRT improvements encourage property owners to convert their single-family residences to high-density apartments and condominiums, but also there were estimated land price premiums of up to 10% for residences within 300 meters of BRT stops and estimated land price premiums of more than 25% for areas of retail and other non-residential uses within 150 meters of BRT stops. Jun (2012) analyzed the redistributive effects of BRT on development patterns and property values in Seoul, South Korea. First, BRT systems contributed to the increased development density in urban centers and thus helped to attract suburban firms into the urban core. Second, although the BRT system had little impact on the redistribution of residential activities, it had a more substantial impact on nonresidential activities. Thus, the author concluded that residential locations must be less sensitive to accessibility improvements made by the BRT than are nonresidential locations in Seoul. Third, Seoul's central business district experienced the highest property value gains and the outer urban areas experienced a decline in property values. Another study of BRT in Asia by Deng et al. (2016) analyzed the impact of BRT on residential property values in Beijing, China. The authors found that the new BRT had a positive impact on surrounding properties, with their hedonic price model showing that the asking prices of residential properties increased by 1.32% to 1.39% for every 100-m closer to the BRT station.

In South America, at least five studies found evidence of property values increasing near BRT stations. Perdomo-Calvo et al. (2007) analyzed the impact of the TransMilenio BRT system on land and building prices and found that the residential properties located in the TransMilenio area of influence increased between 5.8% and 17.0%. Rodriguez and Mojica (2008) analyzed the impact of the TransMilenio BRT system extensions on property values. After the BRT extension, the authors found that the asking price increased 15% to 20% for the properties already served by the BRT system before the extension, but not for properties located along corridors without a local BRT station before the extension. Rodriguez and Mojica (2009) later analyzed the impact of the extensions to Bogotá's TransMilenio system on the value of properties already served by the transit system. After controlling for structural, neighborhood and regional accessibility characteristics of each property, the authors found that the asking prices for properties offered during the year in which the extension opened and in subsequent years were 13% to 14% higher than prices for properties in the control area. Additionally, they found that the appreciation was similar for properties within 500 m and properties between 500 m and 1 km of the BRT extension. Muñoz-Raskin (2010) analyzed the impact of the TransMilenio on property values of residences within walking distance to the system in Bogotá, Columbia. The author found that the housing market places value premiums on the properties in the immediate walking proximity of feeder lines. Muñoz-Raskin (2010) also found that middle-income properties were valued more if they were located closer to the system, while the opposite was true for low-income housing. Calvo (2017) studied the effect of BRT infrastructure on property values in Bogotá and Barranquilla, Columbia, between 1999 and 2011. The author found that the public investments associated with the BRT infrastructure caused higher valuations of residential and commercial properties, and therefore argued that this effect is a positive economic externality of the BRT system.

At least two publications have found that the announcement of a new BRT system did not affect property values. Flores-Dewey (2010) estimated the impact of the announced BRT on property values in Ecatepec, Mexico, and found that the announcement of a BRT corridor had no impact on property values. Zhang and Wang (2013) examined the impact of various forms of mass transit on land development in Beijing, China. The authors found no association between the announcement of the BRT system and property value changes.

The findings of these previous two publications are not surprising, given that many studies have found considerable variability in the estimated change in property and land values arising from different types of transit investments (e.g., regular and rapid heavy- and light-rail systems: Vessali, 1996; Baum-Snow and Kahn, 2000; Bowes and Ihlanfeldt, 2001; Brinckerhoff, 2001; Babalik-Sutcliffe, 2002; Cervero and Duncan, 2002; Smith and Gihring, 2006; Hess and Almeida, 2007; Kahn, 2007; Atkinson-Palombo, 2009; Goetz et al., 2010; Bartholomew and Ewing, 2011; Mohammad et al., 2013). These variations have been generally attributed to the nature of the data in previous studies, particularly spatial characteristics, temporal effects and methodology (e.g., type of land use, type of service, the life cycle maturity of the system, the distance to the station, the geographical location, and accessibility to the road: Ryan, 1999; Debrezion et al., 2007; Mohammad et al., 2013). Some have found that the extent to which transit services affect home values depends on a multitude of factors, including the quality of the service (reliability, frequency, speed, etc.), size of the market, quantity of parking for suburban commuters, and the degree to which the service reduces freeway congestion (Landis, et al., 1994). Others have reported that the additional value created in a particular location is influenced by a host of other factors, including the scope of the transit system, real estate market conditions, traffic congestion and other neighborhood qualities (Fogarty et al., 2008). In fact, the Cohen and Brown (2017) rail rapid transit study found variation in the property value impacts within a city, depending on the locations of the properties and the travel times to various landmarks in the city of Vancouver, BC, Canada, before versus after the announcement.

Including the previously mentioned study by Perdomo-Calvo et al. (2007), there were three articles that explored the impact of BRT systems on land values. Perdomo (2011) analyzed residential land values near the TransMilenio BRT system in Bogotá, Columbia. Using various statistical methodologies (including nonparametric approaches such as propensity score matching, and econometric approaches such as spatial hedonic price analyses), they found that access to the BRT system raises land values. Estupiñán and Rodriguez (2008) studied the built environment characteristics related to stop-level ridership for the TransMilenio BRT system in Bogotá, Columbia, and found that better pedestrian environments around TransMilenio stops contributed to higher land values.

- **Local property tax revenue**

As a consequence of rising demand for and value of housing and commercial properties near BRT stations, many communities have experienced increases in local property tax revenue (Fogarty et al., 2008; Cervero and Kang, 2009; Perk and Catala, 2009; Dube et al., 2011; Noland et al., 2012; Panero et al., 2012; Mohammed et al., 2013; Mathur 2015). This is especially true in communities where BRT stations are located near “ratables”, or property that provides tax income for local governments, and not “non-ratables”, such as places of religious worship, parks, and properties in enterprise zones. This added tax revenue is a major selling point for local governments considering investments in BRT services.

Some of the major interest in the newly generated tax revenue comes from the manner in which some BRT systems are funded and the type of communities where BRT systems are built. Similar to other forms of transit and rapid transit, BRT and the surrounding TOD are often funded through a financial strategy known as Tax Increment Financing, known more commonly by the acronym of TIF (Rayle, 2015). TIF is an approach to financing a new project where future gains in property tax generated from that development are leveraged to finance it. Hence, the local communities or state takes on a financial risk and must be able to ensure, or guarantee, that the estimated gains in tax revenue associated with the project materialize in a timely way to justify the request for TIF. Other than recouping tax revenue that funds the initial investments on the BRT projects and related TOD, another reason why tax revenue is a popular subject is that local communities also hope to capitalize on property tax revenue resulting from the BRT to help fund public programs (Panero et al., 2012). Many of these programs are intended to revitalize the communities where BRT systems are built, by improving the quality of life for existing residents and aiding other areas in the municipality that do not directly benefit from the increased access or increased property values and development related to the BRT system.

Many communities not only expect the fiscal benefit of transit being increased property tax revenue, but they also view an increase in tax revenue as a good indicator of TOD success (Fogarty et al. 2008; Perk and Catala, 2009). There are a number of studies that have looked at property tax revenue related to BRT and other transit improvements in this light (Cervero and Kang, 2009; Dube et al., 2011; Noland et al., 2012; Mohammad et al., 2013; Mather, 2015). Almost all of these studies have noted that the new stations have resulted in an increase in tax revenue, including as much as a $5.2M (in 2004 CAD) increase between 1992 and 2004 in Quebec.

Multiple studies have highlighted some important issues regarding the relationship between BRT and tax revenue. Noland et al. (2012) noted that interpretations of changes in tax revenue can be complex. The authors found that property values in communities with high tax rates tend to grow slower and experience slower increases in tax revenue than other areas with lower tax rates. As it pertains to measuring the relationship between BRT and tax revenue, this finding suggests that municipal differences in tax rates may help explain spatial variations in tables or figures depicting estimated tax revenue (i.e., if the tax rate is not otherwise controlled for in any longitudinal descriptions or analyses of changes in tax revenue). For instance, a municipality or intra-urban area (e.g., a neighborhood) with higher tax rates may produce less tax revenue than others, but this statistical difference does not necessarily reflect poor performance of the BRT in generating higher demand and pushing up property values for nearby properties.

Mohammad et al. (2013) provided another notable finding of municipal preferences toward taxing transit catchment areas. These authors found that some cities charge higher tax rates in catchment areas to capitalize on the rising demand for these properties. In terms of descriptions or analyses, this taxing approach might cause researchers to incorrectly measure tax revenue gains related to BRT, especially for nearby stations.

Rayle (2015) highlighted a potential problem that does not necessarily involve researchers' approach to measuring or estimating tax revenue changes associated with BRT or BRT-related TOD. This author concluded that governmental emphasis on tax revenue gains may result in public officials, consciously or unconsciously, targeting their TOD marketing at higher-income residents, potentially displacing lower income residents as rents, property values and taxes rise. This problem is especially relevant for local governments that are cash-strapped, experiencing short or long-term economic stress, or heavily dependent on property taxes to function.

- **Residential, commercial and rental properties including affordable housing**

The quantity of residential properties, commercial properties, rental properties and affordable housing (i.e., with proper government intervention) are all expected to increase near BRT stations in response to the increasing demand for these locations with high transit access. Developers are paying particular attention to this pattern because transit catchment areas, particularly in downtown urban areas, are fetching higher rents and sales values than elsewhere in the urban center and often in surrounding suburbs (Panero et al., 2012). Although the literature suggests that proximity to transit increases property values for and subsequently the supply of all types of properties, multifamily and commercial properties (i.e., including vacant properties that are converted into these types of uses) tend to experience the highest premiums and often dominate the new development or redevelopment in the transit catchment area (Hamidi et al., 2016; Gose, 2017). In fact, despite the fact that many studies focus on the impact of transit on single-family housing, these uses are generally viewed as the least favorable near transit stations because they achieve the lowest premiums (i.e., not as many new homes get built as a result) and the residents who live in these homes typically depend on private automobiles even when public transportation options are available (Billings, 2011). Multi-family units, other rental housing, and commercial properties benefit from a new transit option more than single-family homes. The owners of these properties can more quickly capitalize the changes in their property values. For example, rental owners can profit by raising rents when it comes time to renew leases, whereas single-family homeowners may simply pay more taxes unless they want to sell their property. The renters and some urban stores usually do not need parking spaces beyond what is available on the street. Also, the externalities of being located within walking distance of a station are potentially stronger for renters and business owners than single-family homeowners. For instance, more pedestrian traffic could translate to an increase in customers for a commercial property, but this change might simply entail a less peaceful environment for a single-family homeowner due to the increased vehicle noise and people getting on and off buses during all hours of the day and night.

A recent meta-analysis of the value of transit to single-family homes in the United States found that the average single-family home premium was lower than for other types of properties (e.g., multi-family, rental and commercial) and it was significantly lower than the premium reported in a previous meta-analysis; the current study found a 2.3% premium and the older study found a 4.5% premium (Hamidi et al., 2016). This might explain why one would expect the number of non-single-family properties near BRT and other types of transit stations to increase faster than for single-family homes.

Other than property types, researchers have identified other factors that affect the demand for properties with transit access. One factor was regional compactness. The aforementioned meta-analysis found that the highest transit premiums occurred in compact regions with transit accessibility (Hamidi et al., 2016). The authors also found that regional compactness might explain the relationship between transit premiums and the type of transit technology (e.g., light rail vs. heavy rail vs. BRT). With regard to changes in property values and development trends, the concept of regional compactness might play an important role in relating findings from specific areas to the general literature.

Another important factor in helping to explain the changing demand and supply of properties near BRT and other types of transit is walkability of the station's environment. Hamidi et al. (2016) actually found that incorporating walkability of the station, among other control variables, reveals that transit premiums generally have decreased over time. Duncan (2011) found that the pedestrian environment helps to explain whether communities view proximity to the transit station as an amenity or a disamenity. The author noted that the prices of rental units in a good pedestrian environment sharply declined with station distance, whereas the prices of rental units in a bad pedestrian environment slightly increased with station distance. Hence, there may be more development of rental units in more positive pedestrian environments and less in negative pedestrian environments, since the individuals who value a more typical residential neighborhood place less value on transit access and likely have a greater sensitivity to (real or perceived) effects of station proximity, such as traffic, noise, strangers, and crime.

An additional factor playing a role in the change in quantity and type of properties near transit stations is rent-control or the presence of affordable housing (Bocarejo et al., 2013; Mathur 2015). Although there has been growth of newly built residential units near transit stations and many public officials focus on TOD encouraging mixed-use development, there is concern over the affordability of housing in transit catchment areas for lower income households and even the middle class (Bocarejo et al., 2013; McKenzie, 2015; Renne et al., 2016). Some have found that there are barriers, such as the high cost of land near transit stations, making it difficult to develop and maintain affordable housing within transit-rich neighborhoods (Zuke and Carlton, 2015). Rayle

(2015) noted that some criticize TOD plans for contributing to issues of affordable housing because they tend to push lower income households into more affordable housing but out of transit-accessible areas (e.g., in peripheral areas of the city). Renne et al. (2016) also argued that the amount of non-rent-controlled affordable housing in a TOD would likely decline if the demand for housing in the TOD outpaces the supply, causing the neighborhood to quickly gentrify. An example of this trend is noted by Kahn (2007), who found that some public officials are approving plans to remove older (affordable) single-family homes in current or planned transit catchment areas for luxury condos and townhouse units to capitalize, wholly or in part, on potential tax revenue gains.

Some researchers have pointed out examples where governments have successfully intervened in TOD to ensure affordable housing is built and maintained near transit stations, such as in New Jersey (Noland et al., 2012). Selling development rights has been one approach used to ensure the presence of affordable housing in transit catchment areas (Renne et al., 2016). This strategy has been previously applied in Palm Beach County, FL; Seattle, WA; and New York, NY.

One issue that has been the subject of discussion is how TOD affects the middle class. There is mounting evidence that TOD housing is targeted to the luxury market and/or successfully protected for the subsidized market. However, others have argued that it is often unattainable for the middle class (Renne et al., 2016). Middle-class households are in an odd position because they cannot afford the rising cost of the properties and rents in TOD, yet often they do not qualify for subsidy programs. If they already live in these areas, they may be unable to afford to stay. If they are new to the areas and want to occupy these transit-rich neighborhoods, they may be unable to afford the housing or rental units initially or in the long-run.

- **Square footage**

As the value of the properties with BRT transit access rises due to increasing demand, so does the value of the square footage or each livable unit of the properties. There is an incentive for owners of commercial buildings to expand the square footage of their existing properties or for developers to build new commercial properties (especially office space) to capitalize on the new foot traffic as their market area grows (Bose, 2017). Owners of rental units can charge more rent when they expand the size of units, earn more rent from building more units, or do a combination of the two. Single-family households can likewise add more square footage to their properties (e.g., add additional rooms or expand their kitchens/bathrooms) to capitalize on higher sales values if they are planning to move out of the area.

Although the change in square footage would appear to be an important factor in studies examining the impact of BRT on property values and economic development, it is often only used as a control (Landis et al., 1994; Ryan, 1999; Rodriguez and Targa, 2004; Smith and Gihring, 2006; Debrezion et al., 2007; Perk and Catala, 2009; Munoz-Raskin, 2010; Cervero and Kang, 2011; Bocarejo et al., 2013; Zhang and Wang, 2013; Calvo, 2017). For example, property values are often compared by looking at the ratio of the property value to the square footage. In a survey of studies over approximately the last fifteen years, there is one circumstance where the authors examined the change in built area (i.e., as measured in square meters) as a consequence of a BRT system but not the change in the living area of these properties (Bocarejo et al., 2013).

- **Current plans or proposals for new real estate development**

The demand for residential and commercial properties near transit stations is expanding due to the proliferation of young workers who opt to use public over private transportation to get to work, shopping centers, or recreational sites (Gose, 2017). This rise in demand has increased property values and rents and decreased vacancies in nearby neighborhoods, especially for locations within walking distance of the stations. Consequently, these processes have shifted the priorities and plans of real estate developers (e.g., away from suburban office parks to TOD) in markets of all sizes in the United States and abroad. They currently view big investments in transit infrastructure as a major stimulus for the development of surrounding real estate.

The authors of the New Jersey Transit reports recognized positive and negative effects of transit investments on plans or proposals for new real estate development (New Jersey Transit, 1994; New Jersey Transit, 2003). They found that there is a general perception that the new stations will attract new and more intensive development, particularly in the areas closest to the stations. Many existing residents worry that this potential increase in development will induce many undesirable changes, such as more traffic, more people, and inappropriate developments. Thus, it could threaten or even destroy the very qualities that the community values and from which it derives its identity. Whether this fear plays out in reality seems to vary amongst communities and depends on the level of involvement of the local and/or regional planning departments. Some of the successful planning tactics to avoid these fears becoming reality included: ensuring that the new stations and new development helped to establish and celebrate the local community identity, outlining a rational basis for defining where growth and change should and should not occur, promoting convenient retail that served the community at large and not only transit riders, strengthening connections between the community and stations for walkers and bicyclists, heightening the sense of shared responsibility for the interaction between transit owners/operators and the community, and bolstering the communal sense of security. The types of development, services and uses identified in the reports as having the best potential to simultaneously meet the needs of commuters, residents, and businesses included:

- Residential development near the station
    - Too often the search for “ratables” near transit investments leads to office and retail development, not housing, and when housing was provided, it usually was apartment complexes (i.e., generally not desirable for families and children, two demographics regarded as key to the vitality of any community)
- Information centers about transit service, community activities, events, retail/merchant services, and entertainment/recreational destinations
- Staging areas for a multitude of public events and activities, such as farmer’s markets, arts and craft fairs, concerts, First Night celebrations and other performances
- Essential services and conveniences that facilitate trip-linking (i.e., the ability to visit several destinations during one journey), such as day care centers, dry cleaning shops, coffee shops, newsstands, branch banks, post-offices, health clinics, libraries, police dispatch centers, governmental or municipal centers, pharmacies, auto services, convenience stores, variety stores, grocery stores, bakeries, food take-out

sites and restaurants

- Uses that generate pedestrian activity throughout the day as well as those that are open 24-hours a day (e.g., taxi-stands, all-night delis, and police stations) are preferred because they create a sense of security and surveillance around the station
- Businesses that serve the needs of commuters (e.g., concierge services if the facility size is limited) and play a function relative to other amenities in addition to being easy to use, well-maintained, comfortable for passengers, and welcomed by the community as a source of civic pride
- Safe, clean, vibrant and active mixes of land use centered around the stations, such as retail, housing, private offices, other employment centers, government offices, school and health care facilities, tourist destinations and recreational sites
- Destinations or points of interest that are located in an easy and interesting walking distance from the stations
- Shared parking facilities or regular parking garages (i.e., provided that developers who benefit from this extra parking pay their fair share of the infrastructural improvements and the regular parking garages do not block the line of sight to the station, have drop-off and pick-up areas on the streets, and increase traffic during peak times)
- Development that was focused around the stations in order to lower the impact on traffic

Over the past decade, at least two articles have analyzed whether concerns about the negative effects of transit investment are becoming realized, specifically examining the impact of BRT systems on development patterns. Bocarejo et al. (2013) found that the Bogotá BRT network, TransMilenio, is one of the major contributing factors to the rapid densification of the city during the 2000s and early 2010s. The areas influenced by this system experienced significantly higher increases in density compared to others, especially in the outermost neighborhoods served by feeder routes. However, despite the fact that BRT systems contribute to changes in the land use of nearby areas, such as new major shopping centers around the terminals, they do not induce higher increases in the amount of built areas for commercial, office or even residential land use. A review of the literature shows that there was no specific policy that produced specific developments in areas close to the bus rapid transit system and that changes have been produced by the market. The TransMilenio trunk corridors and feeder routes have had an influence on containing the size of the city by providing adequate access to the central business district and the main employment areas of Bogotá. Other studies have shown that the introduction of this system positively affected commercial property values. Increased accessibility caused the value of properties to rise and this effect declined with increasing distance from the TransMilenio corridor. However, conclusions regarding the residential properties were mixed.

Rodriguez et al. (2016) studied the land development impacts of BRT in Bogotá and Quito. The authors found the impacts were heterogeneous in different parts of both cities. The building activity depends on context: the increased building activity in treatment areas occasionally matched the increased building activity in some control areas, but not in others. However, development along road extensions in Bogotá was considerable. The authors also found that the largest impact on development in both cities tended to concentrate near end-of-line terminals and stops built in the early 2000s. Given this evidence, the authors' response to the question of whether BRT stimulates land development depended on a number of institutional factors, including the behavior of developers, market conditions, land availability, and land regulations.

- **Vacancies**

Transit investments are expected to reduce both residential and commercial vacancies due to increased demand for residential properties within walking distance from stations, particularly by Millennials, and the added competitive advantage for firms in recruiting staff who prefer public over private transportation (Hamidi et al., 2016). This increased demand has spurred investment in areas that developers would not have otherwise acquired, such as older abandoned, industrial sites near a transit station (Panero et al., 2012). For example, Cervero and Dai (2014) found that the availability of cheap vacant parcels helps explain high levels of construction near peripheral BRT feeder lines in previously undeveloped areas of Bogota, Columbia.

BRT stations revitalize areas that are not just completely vacant, such as older factory buildings and foreclosed industrial sites with fragmented ownership, but also places with lower occupancy rates and areas that are struggling to find a competitive advantage. Transit stations generally spur lower vacancy rates and high absorption rates of buildings that were partly vacant (Ryan, 1999; Smith and Gihring, 2006). For example, a research report by Jones Lang LaSalle, a global property company, found that office buildings with transit access have approximately 3.7 percentage points lower vacancy rates than offices without transit access (Gose, 2017). A meta-analysis found that transit studies have found vacancy rates near stations as much as 11% lower compared to other areas with similar types of joint development projects (Perk and Catala, 2009). As a consequence of this increasing interest in the vacant land near transit stations, vacant properties are often cited as one of the property types attaining the highest premiums as a result of transit access (Hamidi et al., 2016). For the aforementioned reasons, changes in vacant land are viewed as essential characteristics to monitor when analyzing the effects of new BRT and other transit systems.

- **Factors that play a role in BRT becoming capitalized into real estate values and urban economic development**

This subsection reviews the existing literature that focuses on factors that become capitalized into property values, such as travel costs, modal choice, environmental remediation, noise effects and urban design/placemaking. These factors help explain why BRT might affect property values and economic development. Two of the factors, travel costs, and environmental remediation, will be directly examined as a part of the present research. The other factors (modal choice, emissions, noise and urban design/placemaking) are not directly examined, but are included in this literature review because researchers have noted that they affect the impact of BRT and thus might help contextualize any findings and/or explain variations in the data described or analyzed during subsequent phases of this research.

- **Changes in travel costs**

Examining changes in transit costs is one of the most fundamental components of studying the impact of transit improvements. New transit options often reduce the cost of travel and these savings get capitalized into the value of real estate (Fogarty et al., 2008; Zhang and Wang, 2013; Stokenberga, 2014; Hamidi et al., 2016). The logic of this argument is generally based on location theory (Alonso, 1964; Muth, 1969). A fundamental premise of location theory is that highly accessible places provide travel cost savings, which in turn causes properties in such areas to be more highly valued than areas with less accessibility. In principle, the value of a property increases until the travel cost savings become fully capitalized into the price of the property (Duncan, 2011). Thus, any changes in the accessibility of an area, such as the installation of a new BRT station, would theoretically trigger this capitalization process for nearby properties that achieve transit cost savings. One should expect that the greatest reductions in travel costs and increases in property values generally are associated with high-density neighborhoods that have new transportation options providing a high level of transit connectivity that previously did not exist (McKenzie, 2015).

However, for property values to universally rise (i.e., not depend on local circumstances, such as where each homeowner or renter works), homeowners and renters must obtain transit cost savings to major points of interest (Bose, 2017). Common examples of these points of interest include top employers, city halls, shopping centers, and other recreational sites. Many TOD studies have also emphasized the need to add new transit stations to decrease transportation costs to the city center(s), especially in areas plagued with traffic congestion and urban decline (Kahn, 2007; Bartholomew and Ewing, 2011).

Compared to other forms of transit, BRT is widely recognized as one of the more efficient means of reducing travel time to such points of interest (Vermeiren et al., 2015). Most forms of rapid transit have high travel time savings (Siedler, 2014). Yet, BRT is especially popular due to the lower costs of implementing and maintaining the system compared to other types of rapid transit (e.g., light or heavy rail: Bartels et al. 2016).

Despite the perceived benefit of BRT as a method of reducing travel costs, there are mixed reviews of its effectiveness. For example, Munoz-Raskin (2012) found that some lower-income households often fail to achieve travel time savings because they cannot afford to remain or relocate in areas near BRT stations. Other researchers admit that TOD (i.e., all forms, including TOD related to BRT) are generally more expensive places to buy and rent housing, but contend that the increase in housing prices or rents and reduction in transportation cost cancel each other out and thus do not cause the displacement of current residents (Renne et al., 2016). In fact, Rayle (2015) argued that the critics who discuss issues of displacement primarily focus on the noticeable rise in property values but tend to overlook the associated but less visible transportation savings that accompany these higher housing costs.

- **Changes in modal choice**

Over the past century, but especially during the 1990s, there has been much concern about the shrinking modal share of public transit and the increasing social costs of private automobile traffic (Cervero and Kang, 2011; Dube et al., 2011). Although the concerns remain a popular issue, new forms of public transit have helped counter these trends. Rapid transit, especially BRT, is globally considered one of the more popular means of increasing the modal share of public transportation.

A number of studies have highlighted the ability of BRT to encourage multimodal transportation and to reduce the share of private automobiles and paratransit around the world (Munoz-Raskin, 2010; Hensher et al., 2014; Rodriguez et al., 2016). For example, Bartels et al. (2016) found that BRT is effective at spurring a modal shift for multiple communities, including individuals who before rarely used public transportation, such as those residing in both higher and lower/middle-income suburbs. Delsaut and Rabuel (2016) and Satiennam et al. (2016) argued that the ability of BRT to capture these individuals tends to depend on whether the BRT stations are within walking distance of the users' residences and whether the BRT service offers travel time savings. Thus, spatially examining the interplay of proximity to stations, reduction of travel costs and property values is crucial to understanding the potential usage and impact of a BRT system on modal choice in nearby communities (Hamidi et al., 2016).

- **Environmental remediation**

Environmental remediation can play a role in the implementation of BRT systems and occurs as a result of an effective BRT system. However, the former is rarer and less discussed in the literature than the latter. For example, Connecticut is one of the few states where environmental remediation and construction of the BRT stations and routes occurred around the same time.

Multiple studies have discussed the potential of BRT and other rapid transit systems to help revitalize vacant and formerly noxious areas. Panero et al. (2012) mentioned that BRT is widely viewed as an effective way of renewing interest in otherwise ignored vacant factory buildings and foreclosed industrial sites. Fogarty et al. (2008) also noted the increased interest in investing in not only these properties but entire, often economically depressed, neighborhoods where these sites are located.

Gose (2017) recently shared the results of his interviews with developers about this subject in a *New York Times* article. The author noted repeated accounts of developers indicating the crucial role that new transit stations play in their investment decisions. He shares multiple quotes from developers who state that they would not have otherwise been interested in former industrial buildings and neighborhoods had the transit infrastructure not existed. The author provides case studies of this trend from across the United States, including sites in Boston; Washington, DC; Virginia; Chicago; and Bellevue, Washington.

- **Changes in emissions**

Reducing emissions and air pollution rates through BRT remains a high priority for many public officials and their community members (Perdomo-Calvo et al., 2007; Lindau et al., 2014). A growing body of literature indicates that BRT is considered a catalyst for decreasing these forms of pollution (Estupinan and Rodriguez, 2008; Fogarty et al., 2008; Rodriguez and Mojica, 2008; Cervero and Kang, 2009; Hidalgo and Gutierrez, 2013; Siedler, 2014; Rodriguez et al., 2016). BRT and public transit ridership gains usually result in fewer vehicles on the road, decreases in congestion, noise and emissions and increased quality of life (Panero et al., 2012). In addition to BRT encouraging modal shifts away from the more polluting forms of transportation (e.g., private automobiles and paratransit) and lowering traffic congestion, researchers also cite the requirement of hybrid fueling or low emission buses as a major factor in achieving these emission goals (Dube et al., 2011; Panero et al., 2012; Paget-Seekin, 2015; Rayle, 2015; Cass and Faulconbridge, 2016). Additionally, combinations of these trends are also cited as a means of reducing overall energy consumption (Flores-Dewey, 2010).

However, some critics still question how effective BRT and TOD are as means of reducing emissions and other forms of pollution. Bocarejo et al. (2013) argued that lower property value premiums near some BRT stations can be attributed to negative noise and emission effects of the buses. Duncan (2011) noted that some individuals are still debating the degree to which TOD ameliorates congestion, emissions, energy consumption, inequality of access and sprawl.

To quell some of these naysayers, Gallivan et al. (2015) published a report on the impact of transit on greenhouse gas emissions and energy from the perspective of land use changes. The authors concluded that transit, such as BRT, is an effective means of reducing pollution, finding that greenhouse gas emissions are substantially reduced by transit. The land use effect of transit results in an overall 8% decline in Vehicle Miles of Travel (VMT), transportation fuel use and transportation greenhouse gas emissions in U.S. cities because public transit provides more walking and biking opportunities and reduces the length of car journeys. Gallivan et al. (2015) also found that transit ridership, as a means of transporting people on buses/trains who would otherwise travel by private automobile, has reduced VMT, transportation fuel use and transportation greenhouse gas emissions by 2%, which is relatively high, given that only 4% of passenger trips in U.S. metropolitan areas are currently made by public transit. Compared to a hypothetical scenario without public transit across U.S. urban areas, the authors noted land use benefits of transit range from 1% to 21% reductions in VMT, transportation land use and transportation greenhouse gas emissions. The largest decreases are found in urban areas with denser development, higher route densities of travel, more frequent transit service, and the availability of light rail. Gallivan et al. (2015) additionally highlight the fact that the addition of a new station to a neighborhood without previous transit access generally increased activity density (i.e., a combination of population and employment density) by 9% and decreased VMT, transportation fuel use and transportation greenhouse emissions by 2% within a 1-mile radius of the new station.

- **Noise effects**

The literature contains a mixture of claims and findings regarding the noise effects of BRT. Some individuals argue that BRT helps reduce noise effects by encouraging modal shifts away from private transportation (Estupinan and Rodriguez, 2008; Rodriguez and Mojica, 2008; Panero et al, 2012). Others argue that BRT generates unwanted noise, especially in areas located closer to stations (e.g., within a 5-minute walk from stations: Perdomo-Calvo et al., 2007; Perk and Catala, 2009; Rodriguez and Mojica, 2009; Duncan, 2011; Noland et al., 2012; Delsaut and Rabuel, 2016). Even more common are studies that seem to attribute any negative impacts near stations to noise effects and not to other aspects of station environment (Bartholomew and Ewing, 2011; Cervero and Kang, 2011; Bocarejo et al., 2013; Rodriguez et al., 2016). Often these studies make assumptions about the noise effects without using (or stating that they used) noise data or considering any noise barriers installed at the stations, such as those described by Munoz-Raskin (2010), to support these conclusions. In rare cases, some just do not consider the effect of noise at all (Siedler, 2014).

However, noise - whether its effect is positive, negative or nonexistent - and other aspects of the station environment are potentially important factors when examining the impact of BRT or other transit stations on property values and economic development (Currie, 2006). Some have used noise and other aspects of the station environment to determine which communities are more sensitive to real or perceived disamenities of station proximity (Munoz-Raskin, 2010; Duncan, 2011).

- **Urban design and placemaking**

As noted in the previous section, noise effects and other aspects of the station environment are important to consider as a means of contextualizing unique patterns of property value changes and economic development near stations. Station environment is largely a byproduct of urban design and placemaking. While the present research does not incorporate the urban design and placemaking strategies implemented at each of the CTfastrak stations, this section is included to recognize the potential importance and utility of these subjects to help contextualize findings from subsequent phases of this research. This section largely pulls from information on the crucial role of urban design and placemaking, as it pertains to transit, derived from two major reports completed by New Jersey Transit.

Although New Jersey Transit staff or their collaborators did not specifically analyze the impact of BRT on real estate and economic development, they highlighted a number of expected benefits of transit investments (i.e., including BRT) on urban design and placemaking in at least two major reports (New Jersey Transit, 1994; New Jersey Transit, 2003). The New Jersey Transit staff and other contributors to the reports found that transit stations and nearby public areas have great potential for positively transforming the local communities that may or may not be assessed in quantitative impact analyses of real estate. The authors noted that there are multiple ways for transit investments to improve the quality of life of commuters and the community at large. For example, they stated that the decisions of travelers to opt for public transit over private automobiles increases the activity of the community, helps manage and direct growth and change in the community, maximizes the use of the road systems (more passengers per vehicle lessens the need for new lanes, signal systems, new or widened rights-of-way, etc.), and reduces congestion so that all travelers experience lower travel times and the community receives better air quality. They also discovered evidence that these sites enhance the economic vitality of local areas and help create strong downtown centers. Transit stations can build a sense of community by functioning as a venue for a wide range of community activities and events. Not only do these areas provide a link to other places in a community, but they also have the ability to bring people together by serving as the focus of communal life and a center of civic pride. They shape the image of the community by becoming a visible point of identity for the neighborhoods, districts and/or even municipalities that they serve. Given the appropriate design, these sites provide a sense of orientation, a feeling of safety and security, and an attractive and well-maintained environment that fosters an increased level of civic responsibility and interest for residents, commuters, and workers. The stations themselves tend to encourage modes of transportation in addition to, and even instead of, private automobiles. With the proper planning, these sites can be incorporated into vibrant pedestrian- and bicycling-friendly streetscapes where there is a demand for certain amenities such as bike paths and storage locations. The community members often desire environments around the stations that provide a sense of security and predictability for a positive walking experience, as well as safe and comfortable areas for dropping off and picking up transit users, parking, waiting for transit services, and making direct transfers between transit modes. If these factors are obtained, then these areas become more attractive for the existing community, visitors and developers.

Renne et al. (2016) explored the affordability of some of the aforementioned transit station environments throughout the United States. The authors specifically compared housing and transportation costs in approximately 4,400 fixed-route transit stations across the United States, which included many BRT systems. They classified each station area as transit-oriented development (TOD; station areas with a walk score of 70 or greater and a gross housing density of 8 units per acre or more), transit-adjacent development (TAD; station areas with neither a walk score of 70 or greater or a gross housing density of 8 units per acre or more) or a hybrid of these two types (station areas with either a walk score of 70 or greater or a gross housing density of 8 units per acre or more). Based on this classification system, the authors found that TODs are expensive places to buy and rent housing, but more affordable than hybrid areas and transit-adjacent development because the lower cost of transportation offsets housing costs. As such, housing and transportation officials should prioritize increasing the density and walkability of hybrid and TAD station areas, which account for two-thirds of all station areas across the United States.

1.3 Problem Statement

The costs of bus (and other types of) rapid transit are generally well understood; however, the potential benefits are often more challenging to quantify because they typically depend on local conditions. Therefore, the primary focus of this Phase 1 study is to begin collecting much of the “baseline” data on CTfastrak needed for a future Phase 2 data analysis study on the potential to create “value” for property owners, businesses, residents, and towns in the areas surrounding the stations. In addition to the direct property value effects, this can lead to additional local property tax revenues due to the property value increases, which in turn can induce further public spending (or property tax rate reductions) and another round of property value increases. Since it takes substantial time for these impacts to develop, an understanding of the expected impacts of the property value increases on property tax revenues is deferred until the future Phase 2 part of our study. It is expected that the data analysis for before versus after will be initiated in Phase 2 of this study, approximately five years following the March 2015 commencement date of CTfastrak service and approximately nine years following the 2011 funding commitment date. There are other related benefits, such as brownfield remediation near the stations, and data have been gathered in Phase 1 so that this issue can be studied in Phase 2.

An important first step in achieving the Phase 2 objectives is developing a baseline of conditions existing before the announcement of CTfastrak. The purpose of this Phase 1 is to develop and document this baseline. After several years of annual updating of conditions, a new snapshot of conditions will be developed after five years of service. Then, in Phase 2, all of the collected data will be merged and a set of detailed statistical analyses of CTfastrak impacts on property values will be conducted.

CHAPTER 2 Research Approach

This chapter focuses on the long-term objective of the present research and the necessary steps taken to achieve this objective as a part of the first phase of this project. This section outlines the research approach utilized in Phase 1 of this project; however, detailed descriptions of the data and presentations of selected baseline data maps and tables are contained in Chapter 3: Data and Methodology. A comprehensive array of maps for all variables and CTfastrak stations are too large to present here. Please see Appendix for more information.

2.1 Objectives

- **Long-Term Objective**

Long-term objective: How does CTfastrak become capitalized into property values?

- **Phase 1 Steps in Achieving Objective**

1. Determine availability of data for collection in Phase 1

All of the data sources necessary to complete subsequent phases of this research project have been identified. This includes data from local, state and federal government agencies as well as a few private agencies. This list of data sources includes municipal assessors, municipal economic development agencies, municipal planning departments, Capitol Region Council of Governments (CRCOG), Connecticut Department of Transportation (CTDOT), United States Department of Transportation (USDOT), United States Census Bureau, Lincoln Institute of Land Policy, Federal Housing Finance Authority (FHFA), Connecticut Housing Finance Authority (CHFA), Connecticut Office of Policy and Management (OPM), United States Environmental Protection Agency (EPA), Connecticut Department of Economic Community Development (DECD), Connecticut Department of Energy and Environmental Protection (DEEP), and the United States Postal Service (USPS).

2. Document existing “baseline” conditions prior to 2011 funding commitments and at 2015 commencement of CTfastrak service.

The data identified in the first step have been prepared so as to gain insight into “baseline” conditions of Hartford, West Hartford, Newington and New Britain both prior to the 2011 funding commitments and before the 2015 commencement of CTfastrak service. Data have been prepared on a number of variables already highlighted in the literature review section of this report. This list of variables includes: estimated annual property values, assessed property values, assessed land values, sales values, estimated local property tax revenue, number of single-family properties, number of multifamily properties, number of rental properties (i.e., apartments and condos), number of commercial properties, number of affordable housing properties, square footage, number of vacant properties, value of travel time savings, number of current plans/proposals for new real estate development, and number of environmental remediation projects. In addition to these variables, aerial photography and other photographic evidence (e.g., from the CTDOT State Highways Photolog) have been collected to help illustrate what the CTfastrak station catchment areas looked like before the announcement of funding in 2011 and before the commencement of service in 2015.

3. Collect data to correlate property value changes with proximity to CTfastrak stations

Some property value effects may be apparent due to the “expectations” that potential property owners formed immediately at the 2009 announcement. Therefore, in this “Phase 1” study, property value data have been collected from before the funding securitization date of 2011, and/or at the start of service in March 2015. Estimated annual property values, assessed property values, assessed land values, and sales values have been utilized to collect data on property values over time. The STATA program entitled “osrmtime,” which uses Open Source Routing Machine (OSRM) and open street maps to determine distance and travel time, was used to determine such information about each nearest CTfastrak station. Attention has been focused on properties within a two-mile radius of the CTfastrak stations; and separately, data have been collected for properties that are within a two-mile drive of the stations.

4. Collect data to correlate property value changes with changes in monetary and time costs of travel

Typical assumptions on the value of passenger time, the cost of car ownership, parking costs, and any other relevant costs have been obtained from various Transportation Research Board reports and handbooks (e.g., the U.S. Department of Transportation’s “Guidance on the Valuation of Travel Time in Economic Analysis”). Information on travel time from a given set of properties to downtown Hartford has been gathered. This has been accomplished using “osrmtime” with STATA software to calculate drive time from a given set of properties to downtown Hartford. These properties are those that are located in neighborhoods within a two-mile radius of each of the CTfastrak stations, and separately, a two-mile driving distance from the stations.

5. Collect data to control for general price movements

In examining “repeat sales”, it is necessary to attempt to “control” for general price movements (such as general business cycles or real estate “booms” and “busts”) by adjusting the sales prices by a price index for Hartford-area housing and land in order to isolate the effects of CTfastrak from metro-area wide business cycles. The metro-Hartford area “Land and Property Values” data from the Lincoln Institute of Land Policy and housing price indexes for the Hartford Metropolitan Statistical Area from the Federal Housing Finance Authority (FHFA) have been used as controls. Municipal Fiscal Indicators from 2010-2014, for all 169 Connecticut cities/towns, have also been obtained from the Connecticut Office of Policy and Management (OPM), to help identify and control for general price movements.

6. Collect assessed property values pre- and post-announcement of CTfastrak

Data have been collected on assessed values, which will be needed for Phase 2 analyses similar to those described above. Since properties in Connecticut are generally reassessed every three years, this assessment data will be collected again in Phase 2, to estimate the total wealth effect to landowners as a result of the announcement and/or CTfastrak service. It will also be useful in Phase 2 for studying potential changes in local property tax revenues that may have accrued to the municipalities where the bus stations have been located. Additionally, assessment and sales data from additional surrounding towns have also been collected, which may ultimately be used as control areas in our analysis. Also, he assessed values data, together with the sales data, have been used to obtain estimates of property values in years between revaluations for properties that have not sold. These calculations were made following a procedure similar to that followed by most of the assessors in these towns, by comparing the ratio of the assessed value to the sale price for properties that sold, with the assessed value of properties that did not sell. Assuming this ratio is constant in small geographic areas around the properties that sold, one may use this ratio to obtain an estimate of property value for other nearby properties that did not sell.

7. Collect data on current property tax revenues for municipalities where new bus stations are located

Current levels of local property tax revenues that accrue to the municipalities where the new bus stations are located have been calculated. This has been accomplished by obtaining the “grand lists” from the town assessors where there is CTfastrak service. The “mill rates” for each town have been utilized to determine the expected property tax revenues at the current time. “Equalized mill rates” have been calculated. One or both of these have been used, together with the assessed values data, and property data by tax-exempt status to calculate local property tax revenues. While the town-wide or city-wide tax revenues are given directly in the Connecticut OPM publication, “Municipal Fiscal Indicators” (various years), property tax revenues can be calculated for subsections of cities/towns nearby the CTfastrak stations (see Figures 16 and 17). In Phase 2 this exercise will be repeated, to compare how the tax base has changed over the first several years of CTfastrak service.

8. Document the number and mix of dwelling units (owner-occupied vs. rental, percent “affordable” housing, etc.) within a range of reasonable distances from stations

This task has addressed the questions: What is the number of rental properties within a range of reasonable distances from the stations? What share of these is considered “affordable housing”? This data has been collected from the Connecticut Housing Finance Authority and town officials. Data have been obtained from CRCOG on the land use type of each property, based on occupancy status (owner- vs. renter-occupied). For affordable housing, the affordable housing appeals lists by city/town have been collected. These lists show annual totals for each municipality from Connecticut Housing Finance Authority (CHFA), for 2002-2015; this includes information on the total number of “assisted units” (housing units assisted with special funding) from each municipality. This affordable housing data is available on a municipality-wide level.

9. Collect baseline data on total building square footage within a given radius of bus stations for Phase 2 evaluation of how these measures have changed

The “baseline” square footage of commercial/retail and residential properties have been collected for the municipalities in which the CTfastrak stations are located. Information has been collected on total building square footage within a given radius of the bus stations to develop the baseline for use in Phase 2, when changes in these figures will be examined. This information has been obtained from the municipal assessor offices.

10. Investigate current plans and proposals for new real estate development

This information has been obtained from municipal economic development and other town officials in Hartford, West Hartford, New Britain, and Newington.

11. Collect data for Phase 2 analysis of how land cleanup has affected nearby property values

Data needed for a Phase 2 analysis of environmental remediation effects on property values have been collected. Data needed in Phase 2 to examine how the cleanup of the land where a former police station and welding facility were located has affected nearby property values have been collected. This involved collecting sales price and/or property value data. Lists of all remediated brownfield sites in the four municipalities have been obtained from the Northeast branch of the U.S. Environmental Protection Agency (U.S. EPA) and the Connecticut Department of Economic and Community Development (DECD), and subsequently geocoded. In Phase 2, this data will be utilized (supplemented by updated data from the first five years of service) to conduct a “hedonic” property price analysis (as in McMillen & McDonald, 2004). This analysis in Phase 2 will enable a determination to be made of how prices of properties in proximity to the brownfields have changed, before versus after the CTfastrak announcement date.

12. Collect data on property vacancies

Local-level data on property vacancies from the U.S. Postal Services vacancy database have been compiled.

13. Document “baseline” land use near stations via aerial photography and/or remote sensing

Aerial photographs and maps of the neighborhoods near the CTfastrak stations have been acquired. Photographs of neighborhoods near several of the CTfastrak stations have also be obtained from the CTDOT highway photolog archives (various years). After determining what resources were available in Task 1, collaborative relationships were developed with other organizations, such as the Connecticut Department of Energy and Environmental Protection (DEEP), via the Capital Region Council of Governments (CRCOG). The CTDOT state highway photologs have also been utilized to develop some of the baseline maps and/or photographs. A collage of selected photos from this database has been included in this report as an example of how it can be used to depict a “street view” of CTfastrak stations and the surrounding environment. Other photos from this database are available. Please see Appendix for more information.

14. Compile data in a parcel-level geospatial database to facilitate tracking of use, changes in use, building type, square footage, sales, sale prices, assessed values, etc.

All of the appropriate data has been compiled into a parcel-level geospatial database that can be easily analyzed and updated using standard GIS software. The database facilitates easy tracking of changes in parcels (use, change in use, building type and square footage, sales, sale prices, assessed values, etc.). For example, the assessment data, the location of the CTfastrak stations and other variables of interest (e.g., remediated brownfields) can be superimposed on top of multiple years of aerial photography to make maps that help readers visualize changes in the built environment and property values occurring near the stations over time. In Phase 2, this GIS data can be posted online to allow the public or other stakeholders to visualize built environment changes, calculate statistics, create customizable maps, or download via interactive mapping software. To aid non-GIS users, the data provided in the geospatial database are also included in a separate folder in tabular format, to allow those who are not familiar with GIS to calculate statistics for a multitude of variables based on proximity to each of the CTfastrak stations. Please see Appendix for more information.

CHAPTER 3 Data and Methodology

This chapter focuses on the geographic extent of current studies of the impact of BRT on real estate and economic development, data used in these studies and the associated methodology. The literature reviewed in this section is primarily from peer-reviewed sources. In addition to discussing other studies, this chapter introduces some of the data collected in the first phase of the present research and discusses some methodological recommendations for subsequent phases.

3.1 Geographic Extent of Subject Sites in Current Studies of the Impacts of BRT on Real Estate and Urban Economic Development

Previous research has explored the impact of BRT on real estate in many places around the world. Most studies have focused on BRT systems in North America, Asia, and South America. Examples include the development of BRT in the Columbian cities of Bogotá, Barranquilla, and Quito; the South Korean city of Seoul; the Chinese city of Beijing; the Canadian city of Québec; the American city of Pittsburgh; and the entire United States (Perdomo-Calvo, 2007; Estupiñán and Rodriguez, 2008; Perk and Catala, 2009; Rodriguez and Mojica, 2009; Flores-Dewey, 2010; Muñoz-Raskin, 2010; Cervero and Kang, 2011; Dubé et al., 2011; Perdomo, 2011; Jun, 2012; Bocarejo et al., 2013; Zhang and Wang, 2013; Deng et al., 2016; Rodriguez et al., 2016; Renne et al., 2016; Calvo, 2017). The most researched BRT system is the TransMilenio in Bogotá, Columbia, which is one of the largest BRT systems in the world.

There scant research published on the impact of the CTfastrak on real estate and economic development. The fact that this system recently opened up for service is one of the primary reasons why there is little to no research on this system regarding its effect on property values and other aspects of economic development. There is another reason that is closely associated with the newness of the system that explains why little research exists on this subject: many changes associated with the CTfastrak may not yet have materialized or been fully capitalized into property values. As previously mentioned, these effects are likely to require a few years to develop and thus any current data analysis on the subject (as of the time of writing this report) would be premature.

3.2 Data Sources Used to Study the Impact of BRT on Property Values

The studies focusing on the impact of BRT on property values and economic development have used a variety of data sources. Renne et al. (2016) utilized a combination of Zillow sales and the United States Department of Housing and Urban Development Location Affordability Index. Perk and Catala (2009) analyzed MetroScan® data (a comprehensive database of residential, commercial, industrial and vacant properties). Dubé et al (2011) used data from the Multiple Listing Service, which they acquired from the Chambre Immbiliere de Québec (Québec Real Estate Board). Others relied on a multitude of local sources of property value and sales data. This list of local sources includes a combination of the information from the Columbian National Department of Statistics and Bogotá City Planning Department (Estupiñán and Rodriguez, 2008; Bocarejo et al., 2013; Rodriguez et al., 2016); the Columbian Department of Housing Control (Cervero and Kang, 2011); MetroCuadrado.com (Perdomo-Calvo et al., 2007; Rodriguez and Mojica, 2008; Rodriguez and Mojica, 2009); Instituto De Informacion Geografica, Estadistica Y Catastral Del Estado De Mexico (Flores-Dewey, 2010); annual land surveys from the Seoul Assessor's Office (Cervaro and Kang, 2011); the Bank of Korea Interregional Input-Output Transaction Tables (Jun, 2012); and a combination of data from the Beijing Real Estate Exchange Information Center, Home Search Net and New Wave News (Zhang and Wang, 2013). A few studies, however, did not clearly state the local sources that they used in their research (Perdomo, 2011; Deng et al., 2016; Calvo, 2017).

In the present study, variety of data has been collected mainly from governmental sources and a few private entities if the data were not available from a government agency (e.g., think-tanks, such as the Lincoln Institute of Land Policy). As noted in the previous chapter, our data sources include: municipal assessor offices, municipal economic development agencies, municipal planning departments, Capitol Region Council of Governments (CRCOG), Connecticut Department of Transportation (CTDOT), United States Department of Transportation (USDOT), United States Census, Lincoln Institute of Land Policy, Federal Housing Finance Authority (FHFA), Connecticut Housing Finance Authority (CHFA), Connecticut Office of Policy and Management (OPM), United States Environmental Protection Agency (EPA), Connecticut Department of Economic and Community Development (DECD), Connecticut Department of Energy and Environmental Protection (DEEP), and the United States Postal Service (USPS). Zillow.com® data, specifically their z-estimate data, were initially discussed as a possible source of individual property data; however, the Zillow data were not collected due to administrative hurdles with the Zillow's staff. Instead, annual estimates were generated based on an approach suggested by numerous assessors in the Central Connecticut area. More detailed explanations of these decisions are provided later in the report.

The following paragraphs present a brief description of the data and any calculations that were made to derive the data are outlined if any alterations were made to the original sources. Simultaneously, figures and tables are presented to illustrate the data that have been collected to depict the baseline conditions in Hartford, West Hartford, Newington and New Britain. These figures and tables are also used to illustrate how these characteristics could possibly be documented and analyzed over time in subsequent phases of this project. Local changes as much as possible are focused on in this report because the areas closest to the stations are expected to be affected more than those located further from the stations. However, in some circumstances (e.g., changes in affordable housing), only municipal data is available. Consequently, for these variables, only the figures and tables that focus on the aforementioned four municipalities are shown. Otherwise, for brevity, an extensive set of figures on the characteristics of the communities near one CTfastrak station in New Britain, aptly named the New Britain Station, are presented. The report focuses on this single station for two reasons. First, residents near this station have much to gain in terms of travel time savings in travelling to downtown Hartford, a key employment destination in the region. Second, providing a full set of local maps and figures covering all 11 CTfastrak stations is impractical due to size limitations of this report. A comprehensive set of local figures for all CTfastrak stations are available. Some of the local station maps in figures that show all four towns, and some other supplemental figures, are included in the appendix section of this report. Please see Appendix for more information.

The locations of the CTfastrak stations were obtained from the CTDOT staff involved in maintaining the CTfastrak website (Figure 1). Measures of proximity to these stations were based on the aforementioned latitude and longitude of these stations and the use of the osrmtime tool (Huber, 2016). The locations of the stations extend southwesterly from the center of Hartford through the southeast corner of West Hartford and northwest corner of Newington into the center of New Britain.

Yearly estimated property values (Figures 2-3) are derived from data provided by the municipal assessors' offices. Data pertaining to property values (Figures 4-6; Tables 1-3), land values (Figures 7-9; Tables 4-5), sale price (Figures 10-13; Tables 6-8) and square footage (Figures 13-15; Tables 9-10) were also collected. Yearly estimated property values were calculated by the authors of this report based on a suggested methodology from the assessors in the Central Connecticut area for approximating annual property values in situations where there is no nearby sales price information available. This technique estimates the property value by multiplying the most recent assessed value of a specific property by the ratio of the most recent sales value to the assessed value for all arms-length transactions of the entire municipality or a specific subregion. The assessment data illustrates a wide range of values and sizes of residential properties near the New Britain CTfastrak station. Condominiums and commercial properties, however, are generally valued lower than other areas in New Britain, despite a few high priced sales.

Zillow.com® data were initially viewed as a possible means of determining annual property value changes. However, after discussing this idea with the Zillow staff, it was decided to focus on data that could be obtained from the local assessors and other governmental/nonprofit sources.

Estimated local property tax revenue is calculated using the assessment data and the mill rates from the assessor's office. Two estimates of property tax revenue were calculated. The first is calculated based on the rates listed by the assessor's offices themselves (Figure 16; Figure 18; Tables 11-12). The other estimation is based on the OPM-generated equalized mill rates (Figure 17). Regardless of the mill rate, there is a surprising number of properties generating a relatively high amount of tax revenue near the New Britain CTfastrak station.

The number of single-family properties (Figure 19; Table 13), number of multifamily properties (Figure 20; Table 14), number of rental properties (i.e., apartments, boarding houses and condominiums; Figure 21; Table 15), number of commercial properties (Figure 22; Table 16), and number of affordable housing properties (or equivalently, assisted units; see Figures 23-24) are created from data provided by the municipal assessors' offices, CHFA, and CRCOG. As previously mentioned, only municipal information about affordable housing could be acquired. When mapped, this property type data shows that, for example, the area surrounding the New Britain CTfastrak station is primarily comprised of commercial properties and multi-family homes. Although the number of assisted units is rising between 2009 and 2015 in all four towns, Hartford and New Britain have added more assisted units than West Hartford and Newington.

Quarterly vacancy rate information was acquired and geocoded at the Census tract level, from 2006-2016 (Figures 25-31; Tables 17-18). These data are from the USPS vacancy database, which is also associated with the United States Department of Housing and Urban Development. The data show, for example, that the residential and commercial vacancies are increasing between the first quarter of 2009 and 2015 in the census tract where the New Britain CTfastrak station is located, but not in a number of the adjacent tracts. Additionally, lists of vacant or undeveloped land parcels were obtained from the municipal assessors' offices (Figure 31; Tables 19). There only appears to be one undeveloped parcel in walking distance to the New Britain CTfastrak station.

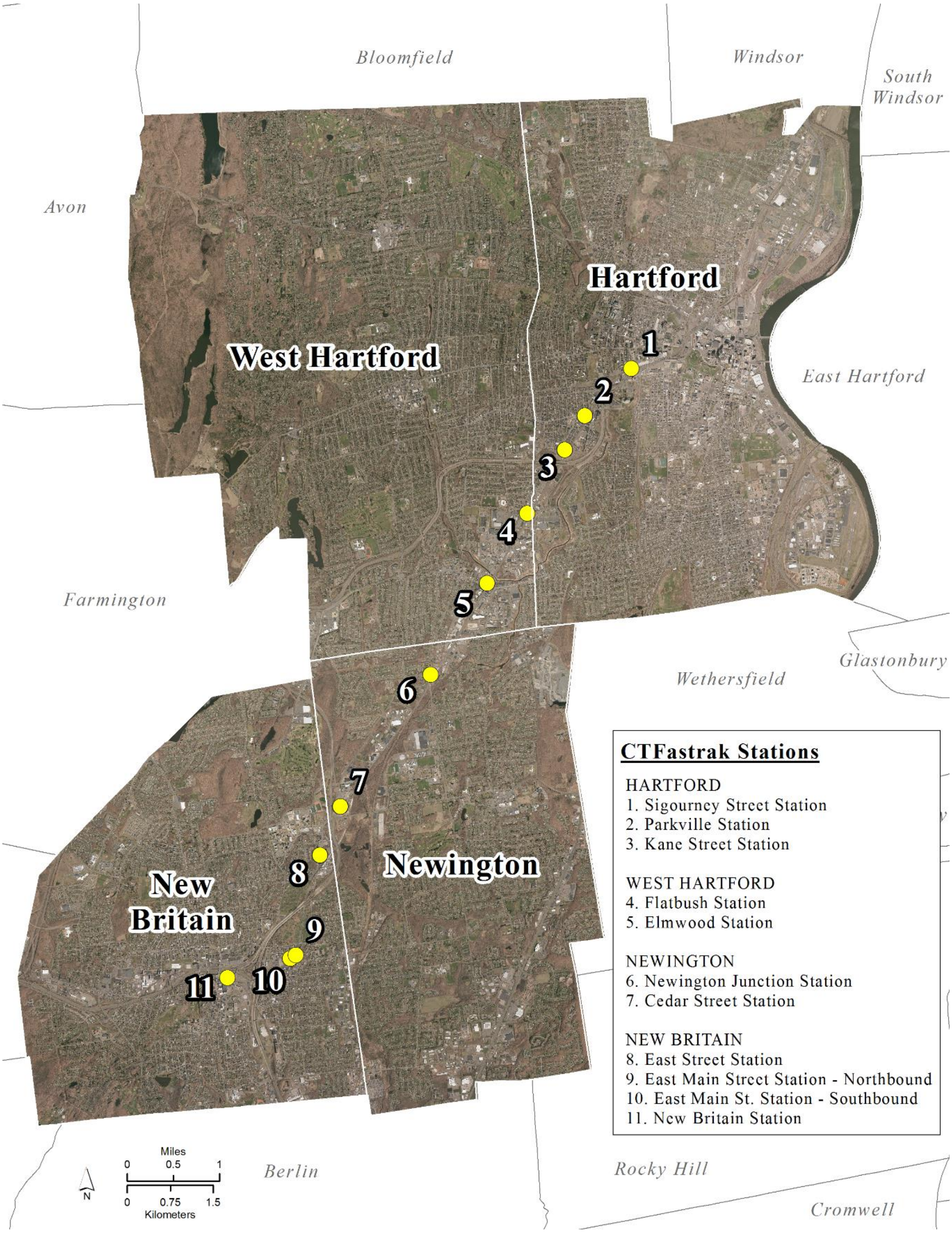


Figure 1 - The locations of the current CTfastrak stations (yellow dots) as of 2017, superimposed on 2016 aerial photography (i.e., the stations identified by the numbers 9 and 10 are considered one station by CTDOT; however, for identification purposes only, they are separately mapped and each is given a unique identifying number; sources: locational data of the CTfastrak from CTDOT and the aerial photography from DEEP)

Figure 2 - Estimated 2015 value (in constant 2015 USD) of residential properties near the New Britain CTfastrak station (yellow star) based on the recent sales to assessed value ratio of residential properties per 2010 census block group, superimposed on 2016 aerial photography (sources: assessment and sales data from New Britain Assessor Office, other calculations made by authors, and aerial photography from DEEP)

Figure 3 - Estimated 2015 value (in constant 2015 USD) of residential properties near the New Britain CTfastrak station (yellow star) based on the recent municipal sales to assessed value ratio, superimposed on 2016 aerial photography (sources: assessment and sales data from New Britain Assessor Office, other calculations made by authors, and aerial photography from DEEP)

Figure 4 – Assessed values (in nominal 2012 USD) of residential properties (i.e., single- and multi-family homes) near the New Britain CTfastrak station (yellow star), superimposed on 2012 aerial photography (sources: assessment data from New Britain Assessor Office and aerial photography from DEEP)

Table 1 – Descriptive statistics of the assessed value (USD) of residential properties as of the most recent revaluation (year of revaluation listed at the end of the CTfastrak station's name; assessment data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford - 2016	Avg.	96,412	131,830	226,879	208,822
	Med.	64,000	36,600	138,600	147,900
	S.D.	222,550	509,679	571,106	424,838
	Min	18,500	7,300	800	800
	Max	1,740,300	7,417,900	9,817,600	9,817,600
Parkville Station Hartford – 2016	Avg.	166,344	195,839	168,071	192,453
	Med.	161,800	156,400	133,000	146,550
	S.D.	53,175	529,894	356,090	371,793
	Min	76,800	25,000	7,300	800
	Max	394,900	9,817,600	9,817,600	9,817,600
Kane Street Station Hartford – 2016	Avg.	168,918	147,497	153,752	187,131
	Med.	166,100	133,300	131,600	143,000
	S.D.	38,841	63,245	313,691	365,334
	Min	106,500	55,000	13,100	800
	Max	331,300	774,700	9,817,600	9,817,600
Flatbush Station West Hartford – 2016	Avg.	47,972	48,161	50,519	67,706
	Med.	47,000	47,000	50,000	58,000
	S.D.	20,182	39,585	39,011	57,852
	Min	350	350	350	140
	Max	140,630	725,000	1,134,000	1,575,000
Elmwood Station West Hartford – 2016	Avg.	105,334	57,589	53,322	63,569
	Med.	53,000	50,000	50,000	58,000
	S.D.	215,868	80,098	57,459	51,386
	Min	40,000	490	140	140
	Max	1,134,000	1,134,000	1,449,000	1,449,000
Newington Junction Station Newington – 2015	Avg.	137,680	140,792	140,431	144,039
	Med.	134,710	135,350	133,490	137,220
	S.D.	24,269	26,614	26,856	31,134
	Min	84,770	80,360	50,400	50,400
	Max	214,630	302,110	304,750	572,680
Cedar Street Station Newington – 2015	Avg.	N/A (no res. prop.)	186,720	154,459	145,610
	Med.	N/A (no res. prop.)	186,720	142,925	138,950
	S.D.	N/A (no res. prop.)	198	43,637	33,914
	Min	N/A (no res. prop.)	186,580	54,600	54,600
	Max	N/A (no res. prop.)	186,860	572,680	572,680
East Street Station New Britain – 2012	Avg.	94,668	95,315	98,460	99,739
	Med.	90,125	91,770	98,770	95,760
	S.D.	25,764	20,847	23,385	26,465
	Min	45,360	45,360	18,760	18,760
	Max	311,850	311,850	346,570	536,270
East Main Street Station New Britain – 2012	Avg.	95,572	98,501	97,412	101,107
	Med.	93,555	95,830	93,590	97,860
	S.D.	23,632	24,795	27,912	27,644
	Min	25,130	25,130	18,760	18,760
	Max	231,630	317,590	388,290	536,270
New Britain Station New Britain – 2012	Avg.	178,885	106,371	103,462	102,019
	Med.	178,885	94,430	95,760	97,370
	S.D.	44,993	50,240	32,733	29,842
	Min	147,070	18,900	18,900	18,760
	Max	210,700	536,270	536,270	536,270

Figure 5 - Assessed values (in nominal 2012 USD) of condominiums near the New Britain CTfastrak station (yellow star), superimposed on 2012 aerial photography (sources: assessment data from New Britain Assessor Office and aerial photography from DEEP)

Table 2 – Descriptive statistics of the assessed value (USD) of condominiums as of the most recent revaluation (year of revaluation listed at the end of the CTfastrak station's name; assessment data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford - 2016	Avg.	38,996	41,781	100,738	89,021
	Med.	30,000	38,400	44,500	51,200
	S.D.	26,918	22,316	270,619	201,247
	Min	20,500	15,000	5,900	4,900
	Max	139,400	139,400	4,938,100	4,938,100
Parkville Station Hartford – 2016	Avg.	256,826	191,544	72,307	90,834
	Med.	101,500	98,300	40,900	51,300
	S.D.	812,048	679,237	306,198	204,062
	Min	69,000	23,000	5,900	4,900
	Max	4,938,100	4,938,100	4,938,100	4,938,100
Kane Street Station Hartford – 2016	Avg.	N/A (no condos)	N/A (no condos)	116,612	92,210
	Med.	N/A (no condos)	N/A (no condos)	61,900	51,400
	S.D.	N/A (no condos)	N/A (no condos)	468,426	206,893
	Min	N/A (no condos)	N/A (no condos)	5,900	4,900
	Max	N/A (no condos)	N/A (no condos)	4,938,100	4,938,100
Flatbush Station West Hartford – 2016	Avg.	N/A (no condos)	N/A (no condos)	N/A (no condos)	20,300
	Med.	N/A (no condos)	N/A (no condos)	N/A (no condos)	141,650
	S.D.	N/A (no condos)	N/A (no condos)	N/A (no condos)	171,615
	Min	N/A (no condos)	N/A (no condos)	N/A (no condos)	20,300
	Max	N/A (no condos)	N/A (no condos)	N/A (no condos)	263,000
Elmwood Station West Hartford – 2016	Avg.	N/A (no condos)	N/A (no condos)	20,300	20,300
	Med.	N/A (no condos)	N/A (no condos)	20,300	20,300
	S.D.	N/A (no condos)	N/A (no condos)	0 (only one condo)	0 (only one condo)
	Min	N/A (no condos)	N/A (no condos)	20,300	20,300
	Max	N/A (no condos)	N/A (no condos)	20,300	20,300
Newington Junction Station Newington – 2015	Avg.	61,601	110,338	119,244	119,244
	Med.	52,520	118,570	95,990	95,990
	S.D.	29,729	36,123	63,299	63,299
	Min	44,820	44,820	44,820	44,820
	Max	247,140	247,140	255,940	255,940
Cedar Street Station Newington – 2015	Avg.	N/A (no condos)	N/A (no condos)	219,504	130,930
	Med.	N/A (no condos)	N/A (no condos)	219,485	118,570
	S.D.	N/A (no condos)	N/A (no condos)	18,443	61,446
	Min	N/A (no condos)	N/A (no condos)	192,770	35,000
	Max	N/A (no condos)	N/A (no condos)	255,940	312,350
East Street Station New Britain – 2012	Avg.	53,815	53,815	49,669	67,698
	Med.	54,950	54,950	50,890	67,480
	S.D.	3,658	3,658	11,509	33,752
	Min	50,050	50,050	15,260	5,110
	Max	68,670	68,670	78,750	252,770
East Main Street Station New Britain – 2012	Avg.	N/A (no condos)	42,737	45,267	52,581
	Med.	N/A (no condos)	53,340	48,650	51m940
	S.D.	N/A (no condos)	18,329	22,830	20,310
	Min	N/A (no condos)	15,260	5,110	5,110
	Max	N/A (no condos)	62,160	169,610	169,610
New Britain Station New Britain – 2012	Avg.	17,809	42,066	47,519	52,769
	Med.	15,715	28,910	43,890	52,780
	S.D.	9,274	29,934	23,163	19,831
	Min	12,250	5,110	5,110	5,110
	Max	55,930	169,610	169,610	169,610

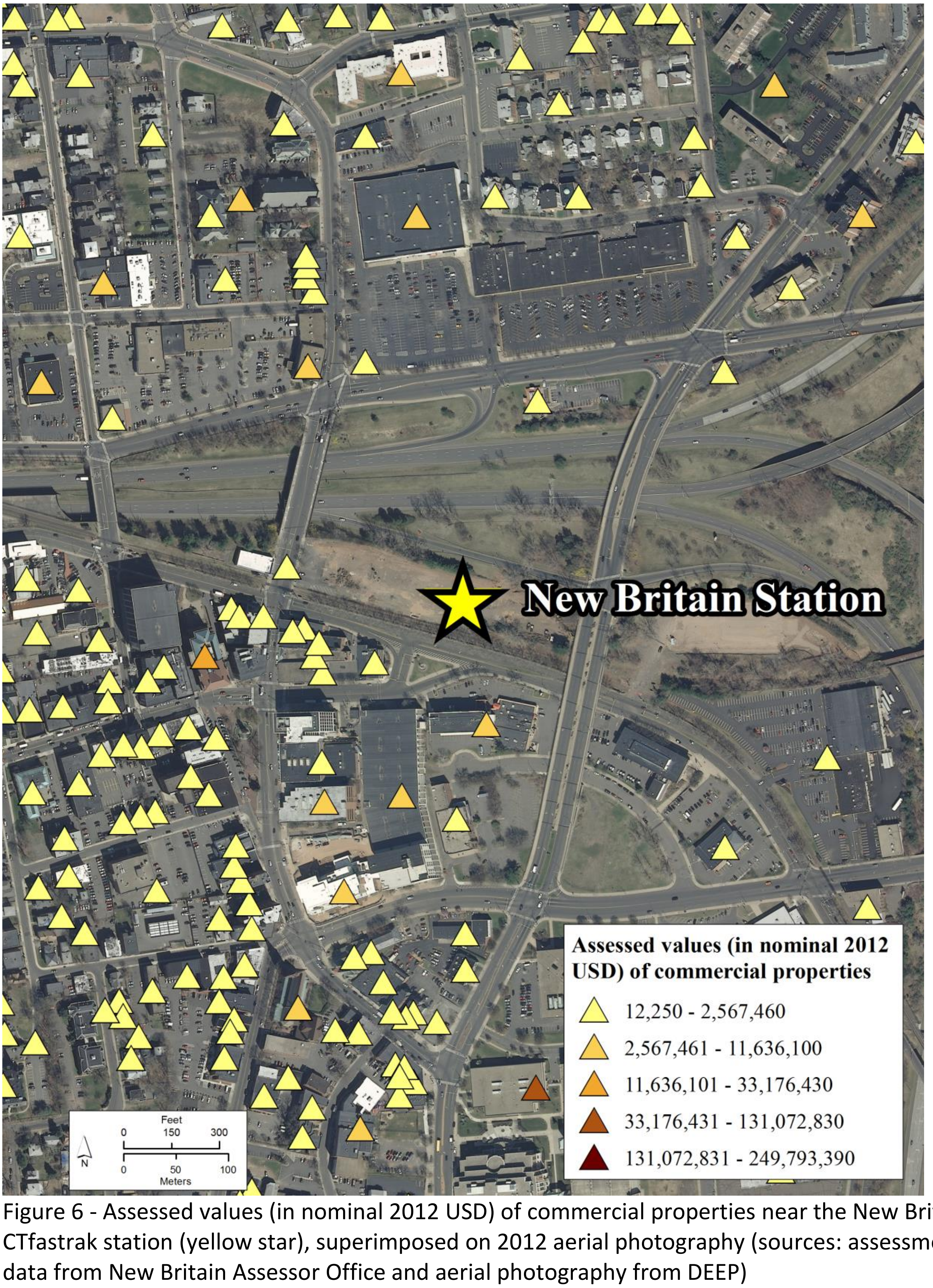


Figure 6 - Assessed values (in nominal 2012 USD) of commercial properties near the New Britain CTfastrak station (yellow star), superimposed on 2012 aerial photography (sources: assessment data from New Britain Assessor Office and aerial photography from DEEP)

Table 3 – Descriptive statistics of the assessed value (USD) of commercial properties as of the most recent revaluation (year of revaluation listed at the end of the CTfastrak station's name; assessment data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford - 2016	Avg.	N/A (no comm. prop.)	8,137,834	6,446,008	4,463,620
	Med.	N/A (no comm. prop.)	435,300	108,200	77,300
	S.D.	N/A (no comm. prop.)	27,869,728	24,859,308	20,343,920
	Min	N/A (no comm. prop.)	34,874	1,688	600
	Max	N/A (no comm. prop.)	109,946,000	114,024,200	133,648,900
Parkville Station Hartford – 2016	Avg.	286,017	900,900	291,320	4,479,942
	Med.	243,300	243,300	85,200	77,300
	S.D.	193,234	1,473,792	989,044	20,372,684
	Min	156,800	117,500	1,688	600
	Max	670,700	4,463,600	14,058,800	133,648,900
Kane Street Station Hartford – 2016	Avg.	3,053,400	1,879,786	1,283,634	2,814,037
	Med.	4,463,600	245,200	287,700	72,700
	S.D.	2,442,538	3,820,121	2,708,427	16,367,667
	Min	233,000	117,500	117,500	1,700
	Max	4,463,600	14,058,800	14,058,800	114,024,200
Flatbush Station West Hartford – 2016	Avg.	112,600	850,848	504,516	450,377
	Med.	117,000	83,000	103,000	117,000
	S.D.	82,948	2,450,009	1,773,198	1,391,489
	Min	29,000	20,000	10,000	10,000
	Max	240,000	8,226,330	8,226,330	8,226,330
Elmwood Station West Hartford – 2016	Avg.	108,714	122,250	505,325	367,704
	Med.	98,000	96,000	103,000	100,500
	S.D.	71,035	96,100	1,772,974	1,462,008
	Min	15,000	15,000	10,000	10,000
	Max	248,000	332,500	8,226,330	8,226,330
Newington Junction Station Newington – 2015	Avg.	497,427	769,414	994,311	1,788,364
	Med.	389,680	379,710	345,950	442,805
	S.D.	455,490	1,220,538	1,628,756	5,876,806
	Min	116,300	130	130	130
	Max	1,706,450	5,670,250	59,124,800	59,124,800
Cedar Street Station Newington – 2015	Avg.	1,920,128	1,459,574	2,931,239	1,306,028
	Med.	506,800	670,365	670,365	363,185
	S.D.	3,133,765	2,261,975	9,819,198	4,384,684
	Min	107,620	107,620	5,510	370
	Max	9,450,000	9,450,000	59,124,800	59,124,800
East Street Station New Britain – 2012	Avg.	186,373	241,980	1,146,987	572,118
	Med.	54,950	55,965	50,890	81,480
	S.D.	579,398	608,512	14,709,453	6,529,282
	Min	50,050	50,050	15,260	12,320
	Max	6,049,190	6,049,190	249,793,390	249,793,390
East Main Street Station New Britain – 2012	Avg.	341,486	459,870	633,187	632,337
	Med.	166,950	115,395	98,385	75,110
	S.D.	550,393	1,230,162	2,556,481	6,846,325
	Min	33,320	15,260	12,320	12,320
	Max	3,003,000	8,832,950	50,039,570	249,793,390
New Britain Station New Britain – 2012	Avg.	1,094,218	781,530	623,776	675,952
	Med.	239,890	164,990	100,590	76,650
	S.D.	2,714,384	3,103,214	4,655,989	6,695,787
	Min	12,320	12,320	12,320	12,320
	Max	17,839,850	50,039,570	131,072,830	249,793,390

Figure 7 – Assessed land value (in nominal 2012 USD) of residential properties (i.e., single- and multi-family homes) near the New Britain CTfastrak station (yellow star), superimposed on 2012 aerial photography (sources: assessment data from New Britain Assessor Office and aerial photography from DEEP)

Table 4 – Descriptive statistics of the assessed land value (USD) of residential properties as of the most recent revaluation (year of revaluation listed at the end of the CTfastrak station's name; assessment data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford - 2016	Avg.	15,475	20,657	40,988	34,754
	Med.	34,000	22,050	22,800	25,031
	S.D.	64,555	111,210	123,806	82,370
	Min	17,336	2,336	774	21
	Max	592,800	1,550,000	2,205,662	2,205,662
Parkville Station Hartford – 2016	Avg.	24,932	31,080	29,937	35,055
	Med.	22,781	22,781	24,225	28,357
	S.D.	10,215	80,732	69,092	77,892
	Min	17,628	14,490	2,336	774
	Max	91,200	1,261,600	1,550,400	2,205,662
Kane Street Station Hartford – 2016	Avg.	25,350	25,934	26,155	35,684
	Med.	22,275	23,906	24,287	28,856
	S.D.	8,906	15,483	52,120	77,235
	Min	18,562	9,777	8,056	774
	Max	68,400	220,400	1,261,600	2,205,662
Flatbush Station West Hartford – 2016	Avg.	29,473	34,146	40,450	67,113
	Med.	29,260	29,820	38,780	103,810
	S.D.	3,891	42,917	42,639	59,821
	Min	560	560	560	560
	Max	40,250	869,400	1,360,800	1,814,400
Elmwood Station West Hartford – 2016	Avg.	110,242	48,623	43,970	61,577
	Med.	45,500	42,490	43,890	71,960
	S.D.	263,190	94,680	58,328	54,564
	Min	24,990	17,360	490	490
	Max	1,360,800	1,360,800	1,814,400	1,814,400
Newington Junction Station Newington – 2015	Avg.	54,654	53,359	52,770	52,836
	Med.	53,020	53,020	52,500	52,500
	S.D.	8,698	4,358	3,256	4,757
	Min	49,340	49,340	43,950	24,150
	Max	131,250	131,250	131,250	245,140
Cedar Street Station Newington – 2015	Avg.	N/A (no res. prop.)	57,650	53,801	52,853
	Med.	N/A (no res. prop.)	57,650	52,500	52,510
	S.D.	N/A (no res. prop.)	297	10,296	5,480
	Min	N/A (no res. prop.)	57,440	15,050	9,810
	Max	N/A (no res. prop.)	57,860	245,140	245,140
East Street Station New Britain – 2012	Avg.	24,611	22,938	22,819	21,847
	Med.	23,660	22,610	21,980	21,210
	S.D.	6,051	4,956	6,133	6,004
	Min	17,430	15,750	5,740	5,740
	Max	71,330	71,330	71,330	80,150
East Main Street Station New Britain – 2012	Avg.	16,314	18,798	18,408	20,265
	Med.	15,890	19,180	19,180	20,020
	S.D.	3,693	3,914	4,603	5,785
	Min	9,100	9,100	5,740	5,460
	Max	25,130	67,270	71,330	111,510
New Britain Station New Britain – 2012	Avg.	13,510	14,841	17,356	21,001
	Med.	13,510	14,420	16,975	20,160
	S.D.	4,554	6,327	5,301	6,559
	Min	10,290	5,460	5,460	5,460
	Max	16,730	72,240	80,150	111,510

Figure 8 – Assessed land value (in nominal 2012 USD) of commercial properties near the New Britain CTfastrak station (yellow star), superimposed on 2012 aerial photography (sources: assessment data from New Britain Assessor Office and aerial photography from DEEP)

Figure 9 – Assessed land value (in nominal 2012 USD) per square foot of commercial properties near the New Britain CTfastrak station (yellow star), superimposed on 2012 aerial photography (sources: assessment data from New Britain Assessor Office and aerial photography from DEEP)

Table 5 – Descriptive statistics of the assessed land value (USD) of commercial properties as of the most recent revaluation (year of revaluation listed at the end of the CTfastrak station's name; assessment data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford - 2016	Avg.	N/A (no comm. prop.)	2,047,575	770,097	556,962
	Med.	N/A (no comm. prop.)	324,826	196,892	216,071
	S.D.	N/A (no comm. prop.)	7,141,244	3,925,680	2,983,012
	Min	N/A (no comm. prop.)	34,874	1,688	645
	Max	N/A (no comm. prop.)	28,126,692	28,126,692	28,126,692
Parkville Station Hartford – 2016	Avg.	58,095	125,213	44,941	557,330
	Med.	56,407	57,516	109,012	203984
	S.D.	26,000	144,156	272,327	2,987.418
	Min	34,075	34,075	1,688	645
	Max	91,415	417,651	4,264,266	28,126,692
Kane Street Station Hartford – 2016	Avg.	329,101	437,570	278,109	339,400
	Med.	417,651	76,190	78,012	172,020
	S.D.	153,374	1,110,856	776,191	2,567,941
	Min	152,000	34,075	34,075	1,688
	Max	417,651	4,264,266	4,264,266	28,126,692
Flatbush Station West Hartford – 2016	Avg.	56,714	82,072	97,580	261,016
	Med.	53,830	57,925	81,095	103,810
	S.D.	43,990	150,065	123,255	600,592
	Min	12,040	12,040	560	560
	Max	126,910	518,350	518,350	3,764,250
Elmwood Station West Hartford – 2016	Avg.	111,570	113,337	99,060	112,271
	Med.	103,810	93,240	81,095	71,960
	S.D.	90,093	87,143	122,359	154,964
	Min	560	560	560	560
	Max	287,350	287,350	518,350	735,350
Newington Junction Station Newington – 2015	Avg.	305,296	341,598	319,524	500,714
	Med.	241,500	155,050	170,100	199,150
	S.D.	299,190	523,339	535,437	924,614
	Min	63,000	130	130	130
	Max	112,000	2,452,250	2,520,000	8,477,870
Cedar Street Station Newington – 2015	Avg.	484,926	514,508	497,653	402,463
	Med.	315,000	346,500	309,510	175,000
	S.D.	529,545	447,828	619,970	644,430
	Min	107,620	80,500	5,510	370
	Max	1,839,600	1,839,600	3,150,000	3,987,660
East Street Station New Britain – 2012	Avg.	23,509	33,115	74,886	69,668
	Med.	64,050	68,600	47,215	39,060
	S.D.	86,182	228,500	508,822	362,850
	Min	24,710	24,710	16,870	9,590
	Max	866,530	2,079,000	7,731,920	7,731,920
East Main Street Station New Britain – 2012	Avg.	48,132	72,141	80,034	59,464
	Med.	26,285	28,140	38,780	37,800
	S.D.	74,687	269,189	239,544	296,194
	Min	9,590	9,590	9,590	8,610
	Max	428,400	2,720,410	2,720,410	7,731,920
New Britain Station New Britain – 2012	Avg.	128,829	87,595	57,089	68,757
	Med.	60,480	37,730	34,790	40,810
	S.D.	300,591	228,500	180,343	318,439
	Min	17,640	8,610	8,610	8,610
	Max	1,424,290	2,079,000	2,720,410	7,731,920

Figure 10 – Sales value (in nominal USD) of residential properties (i.e., single- and multi-family homes) near the New Britain CTfastrak station (yellow star) that sold between 2012 and 2016, superimposed on 2016 aerial photography (sources: sales data from New Britain Assessor Office and aerial photography from DEEP)

Table 6 – Descriptive statistics of the 2015 sales value (USD) of residential properties (sales data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford	Avg.	N/A (no sales)	121,493	472,577	218,810
	Med.	N/A (no sales)	115,525	139,000	120,000
	S.D.	N/A (no sales)	46,906	1,903,383	958,671
	Min	N/A (no sales)	76,000	2,000	2,000
	Max	N/A (no sales)	203,900	11,550,000	11,550,000
Parkville Station Hartford	Avg.	134,500	1,073,921	376,452	212,957
	Med.	134,500	81,524	110,000	131,001
	S.D.	147,785	3,301,960	1,634,682	895,103
	Min	30,000	2,000	2,000	2,000
	Max	239,000	11,550,000	11,550,000	11,550,000
Kane Street Station Hartford	Avg.	55,000	59,056	384,940	218,849
	Med.	55,000	55,000	106,594	135,000
	S.D.	N/A (one sale)	32,639	1,725,511	908,396
	Min	55,000	25,000	2,000	2,000
	Max	55,000	120,000	11,550,000	11,550,000
Flatbush Station West Hartford	Avg.	N/A (no sales)	214,000	201,250	255,619
	Med.	N/A (no sales)	214,000	214,000	236,000
	S.D.	N/A (no sales)	26,870	36,118	78,639
	Min	N/A (no sales)	195,000	139,000	139,000
	Max	N/A (no sales)	233,000	250,750	480,000
Elmwood Station West Hartford	Avg.	N/A (no sales)	157,000	195,800	238,956
	Med.	N/A (no sales)	157,000	185,000	227,000
	S.D.	N/A (no sales)	25,456	39,620	67,567
	Min	N/A (no sales)	139,000	139,000	139,000
	Max	N/A (no sales)	175,000	266,000	410,000
Newington Junction Station Newington	Avg.	234,500	227,733	213,863	217,703
	Med.	247,500	234,250	204,500	219,000
	S.D.	60,581	43,033	49,448	47,462
	Min	130,000	130,000	130,000	130,000
	Max	285,000	299,900	345,000	345,000
Cedar Street Station Newington	Avg.	N/A (no sales)	N/A (no sales)	219,125	211,472
	Med.	N/A (no sales)	N/A (no sales)	220,250	210,000
	S.D.	N/A (no sales)	N/A (no sales)	56,199	54,470
	Min	N/A (no sales)	N/A (no sales)	129,000	71,000
	Max	N/A (no sales)	N/A (no sales)	329,100	385,000
East Street Station New Britain	Avg.	137,625	150,500	159,188	156,797
	Med.	144,000	160,000	155,000	150,000
	S.D.	38,741	33,021	34,849	44,843
	Min	87,500	87,500	75,000	75,000
	Max	175,000	180,000	253,000	350,000
East Main Street Station New Britain	Avg.	138,788	151,083	149,962	159,623
	Med.	132,500	147,000	147,500	153,950
	S.D.	32,068	46,907	44,513	46,315
	Min	99,900	96,475	66,000	66,000
	Max	192,000	335,000	335,000	350,000
New Britain Station New Britain	Avg.	N/A (no sales)	151,575	164,115	158,987
	Med.	N/A (no sales)	106,600	151,400	151,500
	S.D.	N/A (no sales)	85,498	58,771	47,835
	Min	N/A (no sales)	77,000	66,000	66,000
	Max	N/A (no sales)	300,000	350,000	355,000

Figure 11 - Sales value (in nominal USD) of condominiums near the New Britain CTfastrak station (yellow star) that sold between 2012 and 2016, superimposed on 2016 aerial photography (sources: sales data from New Britain Assessor Office and aerial photography from DEEP)

Table 7 – Descriptive statistics of the 2015 sales value (USD) of condominiums (sales data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford	Avg.	N/A (no sales)	N/A (no sales)	50,821,570	44,738,305
	Med.	N/A (no sales)	N/A (no sales)	159,000	200,000
	S.D.	N/A (no sales)	N/A (no sales)	57,268,278	52,431,384
	Min	N/A (no sales)	N/A (no sales)	52,000	20,000
	Max	N/A (no sales)	N/A (no sales)	113,250,000	113,250,000
Parkville Station Hartford	Avg.	N/A (no sales)	N/A (no sales)	95,702	45,851,763
	Med.	N/A (no sales)	N/A (no sales)	87,000	383,500
	S.D.	N/A (no sales)	N/A (no sales)	34,642	52,606,120
	Min	N/A (no sales)	N/A (no sales)	52,000	20,000
	Max	N/A (no sales)	N/A (no sales)	170,000	113,250,000
Kane Street Station Hartford	Avg.	N/A (no sales)	N/A (no sales)	N/A (no sales)	46,059,485
	Med.	N/A (no sales)	N/A (no sales)	N/A (no sales)	132,500
	S.D.	N/A (no sales)	N/A (no sales)	N/A (no sales)	56,467,305
	Min	N/A (no sales)	N/A (no sales)	N/A (no sales)	20,000
	Max	N/A (no sales)	N/A (no sales)	N/A (no sales)	113,250,000
Flatbush Station West Hartford	Avg.	N/A (no sales)	N/A (no sales)	380,000	380,000
	Med.	N/A (no sales)	N/A (no sales)	380,000	380,000
	S.D.	N/A (no sales)	N/A (no sales)	N/A (one sale)	N/A (one sale)
	Min	N/A (no sales)	N/A (no sales)	380,000	380,000
	Max	N/A (no sales)	N/A (no sales)	380,000	380,000
Elmwood Station West Hartford	Avg.	N/A (no sales)	380,000	380,000	380,000
	Med.	N/A (no sales)	380,000	380,000	380,000
	S.D.	N/A (no sales)	N/A (one sale)	N/A (one sale)	N/A (one sale)
	Min	N/A (no sales)	380,000	380,000	380,000
	Max	N/A (no sales)	380,000	380,000	380,000
Newington Junction Station Newington	Avg.	103,500	135,345	316,500	176,217
	Med.	103,500	136,500	305,000	136,500
	S.D.	9,192	23,308	32,245	100,953
	Min	97,000	97,000	276,500	50,000
	Max	110,000	171,500	376,000	376,000
Cedar Street Station Newington	Avg.	N/A (no sales)	N/A (no sales)	316,500	182,320
	Med.	N/A (no sales)	N/A (no sales)	305,000	139,900
	S.D.	N/A (no sales)	N/A (no sales)	32,245	100,786
	Min	N/A (no sales)	N/A (no sales)	276,500	80,000
	Max	N/A (no sales)	N/A (no sales)	376,000	405,266
East Street Station New Britain	Avg.	103,000	103,000	103,000	150,023
	Med.	103,000	103,000	103,000	130,250
	S.D.	12,728	12,728	12,728	82,121
	Min	94,000	94,000	94,000	43,000
	Max	112,000	112,000	112,000	315,000
East Main Street Station New Britain	Avg.	N/A (no sales)	N/A (no sales)	68,100	74,596
	Med.	N/A (no sales)	N/A (no sales)	68,100	64,000
	S.D.	N/A (no sales)	N/A (no sales)	N/A (one sale)	30,012
	Min	N/A (no sales)	N/A (no sales)	68,100	43,000
	Max	N/A (no sales)	N/A (no sales)	68,100	150,000
New Britain Station New Britain	Avg.	N/A (no sales)	62,267	69,988	74,596
	Med.	N/A (no sales)	61,800	62,000	64,000
	S.D.	N/A (no sales)	1,553	31,194	30,012
	Min	N/A (no sales)	61,000	43,900	43,000
	Max	N/A (no sales)	64,000	150,000	150,000

Figure 12 - Sales value (in nominal USD) of commercial properties (i.e., single- and multi-family homes) near the New Britain CTfastrak station (yellow star) that sold between 2012 and 2016, superimposed on 2016 aerial photography (sources: sales data from New Britain Assessor Office and aerial photography from DEEP)

Figure 13 - Sales value (in nominal 2012 USD) per square foot of commercial properties near the New Britain CTfastrak station (yellow star) that sold between 2012 and 2016, superimposed atop 2016 aerial photography (sources: sales data from New Britain Assessor Office and aerial photography from DEEP)

Table 8 – Descriptive statistics of the 2015 sales value (USD) of commercial properties (sales data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford	Avg.	N/A (no sales)	N/A (no sales)	50,821,570	44,738,305
	Med.	N/A (no sales)	N/A (no sales)	113,250,000	200,000
	S.D.	N/A (no sales)	N/A (no sales)	39,809,216	52,431,384
	Min	N/A (no sales)	N/A (no sales)	85,000	20,000
	Max	N/A (no sales)	N/A (no sales)	113,250,000	113,250,000
Parkville Station Hartford	Avg.	N/A (no sales)	N/A (no sales)	95,702	45,851,763
	Med.	N/A (no sales)	N/A (no sales)	87,000	383,500
	S.D.	N/A (no sales)	N/A (no sales)	34,642	52,606,120
	Min	N/A (no sales)	N/A (no sales)	52,000	20,000
	Max	N/A (no sales)	N/A (no sales)	170,000	113,250,000
Kane Street Station Hartford	Avg.	N/A (no sales)	N/A (no sales)	N/A (no sales)	46,059,485
	Med.	N/A (no sales)	N/A (no sales)	N/A (no sales)	132,500
	S.D.	N/A (no sales)	N/A (no sales)	N/A (no sales)	56,467,305
	Min	N/A (no sales)	N/A (no sales)	N/A (no sales)	20,000
	Max	N/A (no sales)	N/A (no sales)	N/A (no sales)	113,250,000
Flatbush Station West Hartford	Avg.	N/A (no sales)	N/A (no sales)	N/A (no sales)	N/A (no sales)
	Med.	N/A (no sales)	N/A (no sales)	N/A (no sales)	N/A (no sales)
	S.D.	N/A (no sales)	N/A (no sales)	N/A (no sales)	N/A (no sales)
	Min	N/A (no sales)	N/A (no sales)	N/A (no sales)	N/A (no sales)
	Max	N/A (no sales)	N/A (no sales)	N/A (no sales)	N/A (no sales)
Elmwood Station West Hartford	Avg.	N/A (no sales)	N/A (no sales)	N/A (no sales)	N/A (no sales)
	Med.	N/A (no sales)	N/A (no sales)	N/A (no sales)	N/A (no sales)
	S.D.	N/A (no sales)	N/A (no sales)	N/A (no sales)	N/A (no sales)
	Min	N/A (no sales)	N/A (no sales)	N/A (no sales)	N/A (no sales)
	Max	N/A (no sales)	N/A (no sales)	N/A (no sales)	N/A (no sales)
Newington Junction Station Newington	Avg.	146,796	378,599	418,949	636,891
	Med.	146,796	319,000	429,500	350,000
	S.D.	N/A (one sale)	266,645	232,190	690,604
	Min	146,796	146,796	146,796	146,796
	Max	146,796	670,000	670,000	2,590,000
Cedar Street Station Newington	Avg.	N/A (no sales)	N/A (no sales)	1,115,000	605,527
	Med.	N/A (no sales)	N/A (no sales)	540,000	350,000
	S.D.	N/A (no sales)	N/A (no sales)	1,287,682	696,591
	Min	N/A (no sales)	N/A (no sales)	215,000	146,796
	Max	N/A (no sales)	N/A (no sales)	2,590,000	2,590,000
East Street Station New Britain	Avg.	103,000	103,000	69,983	880,799
	Med.	103,000	103,000	59,500	115,000
	S.D.	12,728	12,728	27,067	2,384,397
	Min	94,000	94,000	43,900	43,000
	Max	112,000	112,000	112,000	12,000,000
East Main Street Station New Britain	Avg.	130,000	130,000	805,163	572,460
	Med.	130,000	130,000	207,500	106,000
	S.D.	N/A (one sale)	N/A (one sale)	1,294,526	1,236,960
	Min	130,000	130,000	43,900	43,000
	Max	130,000	130,000	4,424,958	6,531,000
New Britain Station New Britain	Avg.	4,424,958	939,429	535,842	621,943
	Med.	4,424,958	285,000	130,000	113,500
	S.D.	N/A (one sale)	1,451,941	954,669	1,237,502
	Min	4,424,958	61,000	45,500	43,000
	Max	4,424,958	4,424,958	4,424,958	6,531,000

Figure 14 – Gross living area (SF) of residential properties near the New Britain CTfastrak station (yellow star) in 2012, superimposed on 2012 aerial photography (sources: gross living area data from New Britain Assessor Office and aerial photography from DEEP)

Table 9 – Descriptive statistics of the gross living area (SF) of residential properties as of the most recent revaluation (year of revaluation listed at the end of the CTfastrak station's name; gross living area data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford - 2016	Avg.	2,132	3,527	5,191	4,062
	Med.	704	2,649	2,351	2,506
	S.D.	5,306	9,416	16,571	11,054
	Min	335	411	287	287
	Max	41,085	161,664	163,890	163,890
Parkville Station Hartford – 2016	Avg.	3,235	3,527	3,000	3,570
	Med.	3,225	2,649	1,824	2,041
	S.D.	1,351	9,416	6,546	10,230
	Min	616	411	309	287
	Max	9,576	161,664	161,664	163,890
Kane Street Station Hartford – 2016	Avg.	3,054	2,369	2,607	3,370
	Med.	2,871	1,935	1,542	1,716
	S.D.	1,364	1,990	5,900	10,192
	Min	1,212	616	360	287
	Max	7,053	21,600	360	163,890
Flatbush Station West Hartford – 2016	Avg.	621	555	619	659
	Med.	1,152	1,080	1,038	1,008
	S.D.	927	785	788	1,230
	Min	4	4	4	1
	Max	4,032	4,455	12,120	36,207
Elmwood Station West Hartford – 2016	Avg.	417	685	630	608
	Med.	195	975	1,058	1,056
	S.D.	764	816	690	825
	Min	24	12	4	1
	Max	3,420	3,420	4,032	21,756
Newington Junction Station Newington – 2015	Avg.	1,507	1,421	1,409	1,440
	Med.	1,300	1,281	1,307	1,328
	S.D.	604	453	417	440
	Min	720	720	672	558
	Max	3,514	3,514	4,532	4,599
Cedar Street Station Newington – 2015	Avg.	N/A (no res. prop.)	1,952	1,471	1,460
	Med.	N/A (no res. prop.)	1,952	1,322	1,346
	S.D.	N/A (no res. prop.)	101	528	454
	Min	N/A (no res. prop.)	1,880	894	558
	Max	N/A (no res. prop.)	2,023	4,954	5,193
East Street Station New Britain – 2012	Avg.	1,397	1,517	1,709	1,964
	Med.	1,268	1,352	1,499	1,581
	S.D.	635	605	759	1,101
	Min	418	418	418	418
	Max	6,240	6,240	8,280	10,712
East Main Street Station New Britain – 2012	Avg.	2,511	2,409	2,246	2,159
	Med.	2,460	2,268	1,946	1,832
	S.D.	1,070	1,168	1,215	1,133
	Min	825	676	540	418
	Max	7,734	8,964	10,712	10,712
New Britain Station New Britain – 2012	Avg.	5,927	3,052	2,704	2,072
	Med.	5,927	2,701	2,496	1,739
	S.D.	2,616	1,684	1,339	349
	Min	4,077	968	534	840
	Max	7,776	10,712	10,712	2,670

Figure 15 – Gross living area (SF) of commercial properties near the New Britain CTfastrak station (yellow star) in 2012, superimposed on 2012 aerial photography (sources: gross living area data from New Britain Assessor Office and aerial photography from DEEP)

Table 10 – Descriptive statistics of the gross living area (SF) of commercial properties as of the most recent revaluation (year of revaluation listed at the end of the CTfastrak station's name; gross living area data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford - 2016	Avg.	N/A (no com. prop.)	182,611	85,189	73,267
	Med.	N/A (no com. prop.)	3,117	1,157	1,149
	S.D.	N/A (no com. prop.)	627,403	345,136	292,027
	Min	N/A (no com. prop.)	461	461	276
	Max	N/A (no com. prop.)	2,416,538	2,416,538	2,416,538
Parkville Station Hartford – 2016	Avg.	3,212	12,834	3,095	73,326
	Med.	3,106	4,072	923	1,149
	S.D.	798	18,010	8,283	292,586
	Min	1,955	1,110	461	276
	Max	4,072	58,891	67,711	2,416,538
Kane Street Station Hartford – 2016	Avg.	29,101	15,171	13,605	48,174
	Med.	42,426	4,072	5,954	923
	S.D.	23,079	20,630	17,331	258,356
	Min	2,452	1,110	1,110	276
	Max	42,426	67,711	67,711	2,416,538
Flatbush Station West Hartford – 2016	Avg.	N/A*	N/A*	N/A*	N/A*
	Med.	N/A*	N/A*	N/A*	N/A*
	S.D.	N/A*	N/A*	N/A*	N/A*
	Min	N/A*	N/A*	N/A*	N/A*
	Max	N/A*	N/A*	N/A*	N/A*
Elmwood Station West Hartford – 2016	Avg.	N/A*	N/A*	N/A*	N/A*
	Med.	N/A*	N/A*	N/A*	N/A*
	S.D.	N/A*	N/A*	N/A*	N/A*
	Min	N/A*	N/A*	N/A*	N/A*
	Max	N/A*	N/A*	N/A*	N/A*
Newington Junction Station Newington – 2015	Avg.	2,878	7,249	9,226	13,311
	Med.	3,360	3,200	2,303	3,912
	S.D.	2,958	11,107	18,069	33,483
	Min	441	441	441	441
	Max	7,604	47,424	99,848	284,432
Cedar Street Station Newington – 2015	Avg.	16,332	21,245	24,093	11,081
	Med.	14,259	1,967	3,504	3,550
	S.D.	27,707	44,405	55,892	27,934
	Min	1,200	798	798	441
	Max	67,508	178,640	284,432	284,432
East Street Station New Britain – 2012	Avg.	4,015	4,699	4,166	6,447
	Med.	7,004	7,702	5,835	7680
	S.D.	17,555	17,135	15,276	22,349
	Min	694	694	660	380
	Max	180,467	180,467	180,467	513,123
East Main Street Station New Britain – 2012	Avg.	11,255	9,512	11,186	7,931
	Med.	6,905	6,126	7,950	7,367
	S.D.	16,545	20,721	30,354	27,761
	Min	649	338	338	338
	Max	71,999	136,824	513,123	513,123
New Britain Station New Britain – 2012	Avg.	20,873	13,729	9,559	8,536
	Med.	10,717	9,139	7,213	7,200
	S.D.	58,365	34,094	28,185	30,781
	Min	794	794	600	136
	Max	513,123	513,123	513,123	542,561

* No GLA (SF) data for these properties

Travel costs were calculated from each property in the aforementioned four municipalities to specific destinations in order to determine the affordability of the CTfastrak compared to private automobile transportation (Figures 33-34; Tables 20; Appendices 3-4). To do so, a number of assumptions were made: value of travel time savings (VTTS) is estimated at a certain percent of the hourly median household income for the municipalities in which the CTfastrak is located (US DOT 2011); the cost of riding the CTfastrak is $1.75 per day (CTfastrak 2016a); the cost of parking near the CTfastrak is free except for parking at the Downtown New Britain Station (i.e., $40 per month, CTfastrak 2016); the parking rate elsewhere is approximately twenty-five cents for fifteen minute intervals, and the typical annual cost of car ownership in Connecticut is approximately $8,558 (Shay 2016). The VTTS is calculated using the approach outlined in TOD (2011). Using this approach, one can visually depict the VTTS provided by the CTfastrak for those living near the New Britain station to the XL Center in downtown Hartford (Figure 33).

A list of current plans/proposals for new real estate development in each of the four municipalities (Figure 34; Table 21) was generated. This list contains both the number of projects and a brief description of each proposal. The information used to create this list was provided and verified by members of the municipal economic development and planning departments in Hartford, West Hartford, Newington and New Britain. The benefit of mapping this data is that it can start to show evidence of a relationship between the proximity of the station and real estate development. For example, a map of the new plans and proposals near the New Britain CTfastrak station demonstrates increasing interest in the surrounding areas, including two projects near the station and an additional two sites further from the station, but still within walking distance (Figure 34).

A list of all remediated brownfield sites in the four municipalities, from 2006-2016 (Figures 36-42; Table 22), was obtained. All of these sites have been geocoded. These records and coordinates were obtained from DECD and the Northeast branch of the EPA. Between 2006 and 2016, there does not appear to be many examples of brownfield remediation occurring near CTfastrak stations. New Britain might not have many remediated brownfield sites in walking distance to their CTfastrak stations (Figures 38-39); however, this city does have a few remediated brownfield sites in close proximity (i.e., a short drive) from their CTfastrak station (Figures 36-37).

DEEP and CRCOG provided their entire collection of aerial photography (Figures 43-44). Aerial photography is available for all four municipalities in 2004, 2006, 2008, 2009, 2010, 2012 and 2016. The historical aerial photography can be used to illustrate changes in the built environment near CTfastrak stations. For example, a building is demolished between 2008 and 2012 directly east of the New Britain CTfastrak station at 141 Robert Loughery Way (Figures 43-44).

CTDOT also provided other photographic evidence used to document the changes occurring near the CTfastrak stations (Figure 41). The most notable contribution to this collection of photography is the highway data. This CTDOT highway data provides a similar view of the stations as one might see on a Google Street View image of the stations. The photos that were captured before the commencement of service were collected. It is planned to obtain others as they are published. One can use individual photos to capture new developments (e.g., the completion of a new development project, such as the New Britain CTfastrak station, in Figure 44) or use the entire collection to show a time lapse sequence of built environment changes as individuals on the sidewalk or street might see them. The latter provides a different and perhaps more relatable perspective than aerial photography.

Figure 16 – Estimated residential property tax revenue (in constant 2014 USD), calculated using New Britain 2014 mill rate, near the New Britain CTfastrak station (yellow star), superimposed on 2012 aerial photography (sources: assessment data from New Britain Assessor Office and aerial photography from DEEP)

Table 11 – Descriptive statistics of the estimated residential property tax revenue (in constant 2014 USD), calculated using 2014 municipal mill rates and the most recent assessment data (year of revaluation listed at the end of the CTfastrak station's name; gross living area data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford - 2016	Avg.	7,091	9,696	16,686	15,358
	Med.	4,707	2,692	10,194	10,878
	S.D.	16,368	37,485	42,003	31,246
	Min	1,361	537	59	59
	Max	127,994	545,565	722,056	722,056
Parkville Station Hartford – 2016	Avg.	12,234	14,403	12,361	14,154
	Med.	11,900	11,503	9,782	10,778
	S.D.	3,911	38,972	26,189	27,344
	Min	5,648	1,839	537	59
	Max	29,044	722,056	722,056	722,056
Kane Street Station Hartford – 2016	Avg.	12,423	10,848	11,308	13,763
	Med.	12,216	9,804	9,679	10,517
	S.D.	2,857	4,651	23,071	26,869
	Min	7,833	4,045	963	59
	Max	24,366	56,977	722,056	722,056
Flatbush Station West Hartford – 2016	Avg.	1,724	1,731	1,816	2,433
	Med.	1,689	1,689	1,797	2,084
	S.D.	725	1,423	1,402	2,079
	Min	13	13	13	5
	Max	5,054	26,054	40,753	56,601
Elmwood Station West Hartford – 2016	Avg.	3,785	2,070	1,916	2,284
	Med.	1,905	1,797	1,797	2,084
	S.D.	7,758	2,878	2,065	1,847
	Min	1,437	18	5	5
	Max	40,753	40,753	52,073	52,073
Newington Junction Station Newington – 2015	Avg.	4,630	4,735	4,723	4,844
	Med.	4,530	4,552	4,489	4,615
	S.D.	816	895	903	1,047
	Min	2,851	2,703	1,695	1,695
	Max	7,218	10,160	10,249	19,259
Cedar Street Station Newington – 2015	Avg.	N/A (no res. prop.)	6,279	5,194	4,897
	Med.	N/A (no res. prop.)	6,279	4,807	4,673
	S.D.	N/A (no res. prop.)	7	1,468	1,141
	Min	N/A (no res. prop.)	6,275	1,836	1,836
	Max	N/A (no res. prop.)	6,284	19,259	19,259
East Street Station New Britain – 2012	Avg.	4,302	4,331	4,474	4,532
	Med.	4,096	4,170	4,488	4,352
	S.D.	1,171	947	1,063	1,203
	Min	2,061	2,061	853	853
	Max	14,172	14,172	15,749	24,370
East Main Street Station New Britain – 2012	Avg.	4,343	4,476	4,427	4,595
	Med.	4,251	4,355	4,253	4,447
	S.D.	1,074	1,127	1,268	1,256
	Min	1,142	1,142	853	853
	Max	10,526	14,432	17,645	24,370
New Britain Station New Britain – 2012	Avg.	8,129	4,834	4,702	4,636
	Med.	8,129	4,291	4,352	4,425
	S.D.	2,045	2,283	1,488	1,356
	Min	6,683	859	859	853
	Max	9,575	24,370	24,370	24,370

Figure 17 – Estimated residential property tax revenue (in constant 2014 USD), calculated using OPM equalized 2014 mill rate, near the New Britain CTfastrak station (yellow star), superimposed on 2012 aerial photography (sources: assessment data from New Britain Assessor Office and aerial photography from DEEP)

Figure 18 – Estimated commercial property tax revenue (in constant 2014 USD), calculated using New Britain 2014 mill rate, near the New Britain CTfastrak station (yellow star), superimposed on 2012 aerial photography (sources: assessment data from New Britain Assessor Office and aerial photography from DEEP)

Table 12 – Descriptive statistics of the estimated commercial property tax revenue (in constant 2014 USD), calculated using 2014 municipal mill rates and the most recent assessment data (year of revaluation listed at the end of the CTfastrak station's name; gross living area data from municipal assessor offices)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford - 2016	Avg.	N/A (no comm. prop.)	598,514	474,085	328,286
	Med.	N/A (no comm. prop.)	32,015	7,958	5,685
	S.D.	N/A (no comm. prop.)	2,049,738	1,828,330	1,496,236
	Min	N/A (no comm. prop.)	2,565	124	44
	Max	N/A (no comm. prop.)	8,086,209	8,386,149	9,829,489
Parkville Station Hartford – 2016	Avg.	21,036	66,259	21,426	329,487
	Med.	17,894	17,894	6,266	5,685
	S.D.	14,212	108,393	72,741	1,498,352
	Min	11,532	8,642	124	44
	Max	49,328	328,285	1,033,984	9,829,489
Kane Street Station Hartford – 2016	Avg.	224,569	138,253	94,408	206,964
	Med.	328,285	18,034	21,160	5,347
	S.D.	179,642	280,959	199,197	1,203,794
	Min	17,136	8,642	8,642	125
	Max	328,285	1,033,984	1,033,984	8,386,149
Flatbush Station West Hartford – 2016	Avg.	4,047	30,577	18,131	16,185
	Med.	4,205	2,983	3,702	4,205
	S.D.	2,981	88,046	63,723	50,006
	Min	1,042	719	359	359
	Max	8,625	295,630	295,630	295,630
Elmwood Station West Hartford – 2016	Avg.	3,907	4,393	18,160	13,214
	Med.	3,522	3,450	3,702	3,612
	S.D.	2,553	3,454	63,715	52,540
	Min	539	539	359	359
	Max	8,912	11,949	295,630	295,630
Newington Junction Station Newington – 2015	Avg.	16,728	25,875	33,439	60,143
	Med.	13,105	12,770	11,634	14,892
	S.D.	15,318	41,047	54,775	197,637
	Min	3,911	4	4	4
	Max	57,388	190,691	1,988,367	1,988,367
Cedar Street Station Newington – 2015	Avg.	64,574	49,085	98,578	43,922
	Med.	17,044	22,544	22,544	12,214
	S.D.	105,389	76,070	330,220	147,457
	Min	3,619	3,619	185	12
	Max	317,804	317,804	1,988,367	1,988,367
East Street Station New Britain – 2012	Avg.	8,469	10,996	52,123	25,999
	Med.	2,497	2,543	2,313	3,703
	S.D.	26,330	27,653	668,450	296,714
	Min	2,274	2,274	693	560
	Max	274,897	274,897	11,351,511	11,351,511
East Main Street Station New Britain – 2012	Avg.	15,518	20,898	28,774	28,736
	Med.	7,587	5,244	4,471	3,413
	S.D.	25,012	55,903	116,176	311,122
	Min	1,514	693	560	560
	Max	136,467	401,401	2,273,978	11,351,511
New Britain Station New Britain – 2012	Avg.	49,725	35,516	28,347	30,718
	Med.	10,901	7,498	4,571	3,483
	S.D.	123,351	141,021	211,585	304,281
	Min	560	560	560	560
	Max	810,707	2,273,978	5,956,421	11,351,511

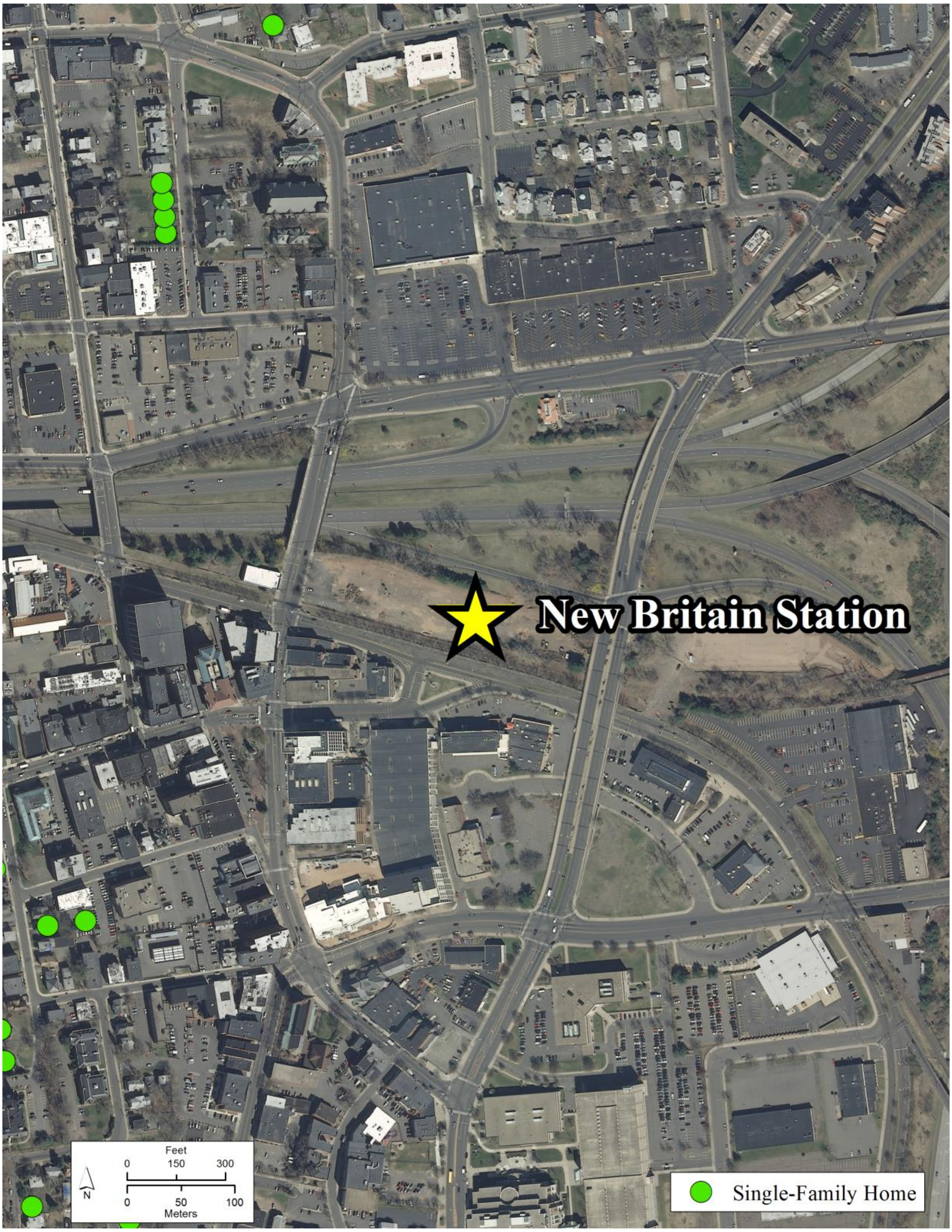


Figure 19 – Single-family homes near the New Britain CTfastrak station (yellow star) in 2012, superimposed on 2012 aerial photography (sources: property data from New Britain Assessor Office and aerial photography from DEEP)

Table 13 – Number of single-family homes in 2012 (sources: municipal assessor offices)

CTfastrak Station	1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford	47	110	635	2,959
Parkville Station Hartford	26	172	1,160	3,751
Kane Street Station Hartford	18	389	1,116	4,173
Flatbush Station West Hartford	91	352	1,534	6,278
Elmwood Station West Hartford	16	308	1,850	6,263
Newington Junction Station Newington	93	506	1,893	3,697
Cedar Street Station Newington	0	2	537	4,927
East Street Station New Britain	147	360	1,620	4,636
East Main Street station New Britain	72	360	1,273	4,767
New Britain Station New Britain	0	54	981	6,785

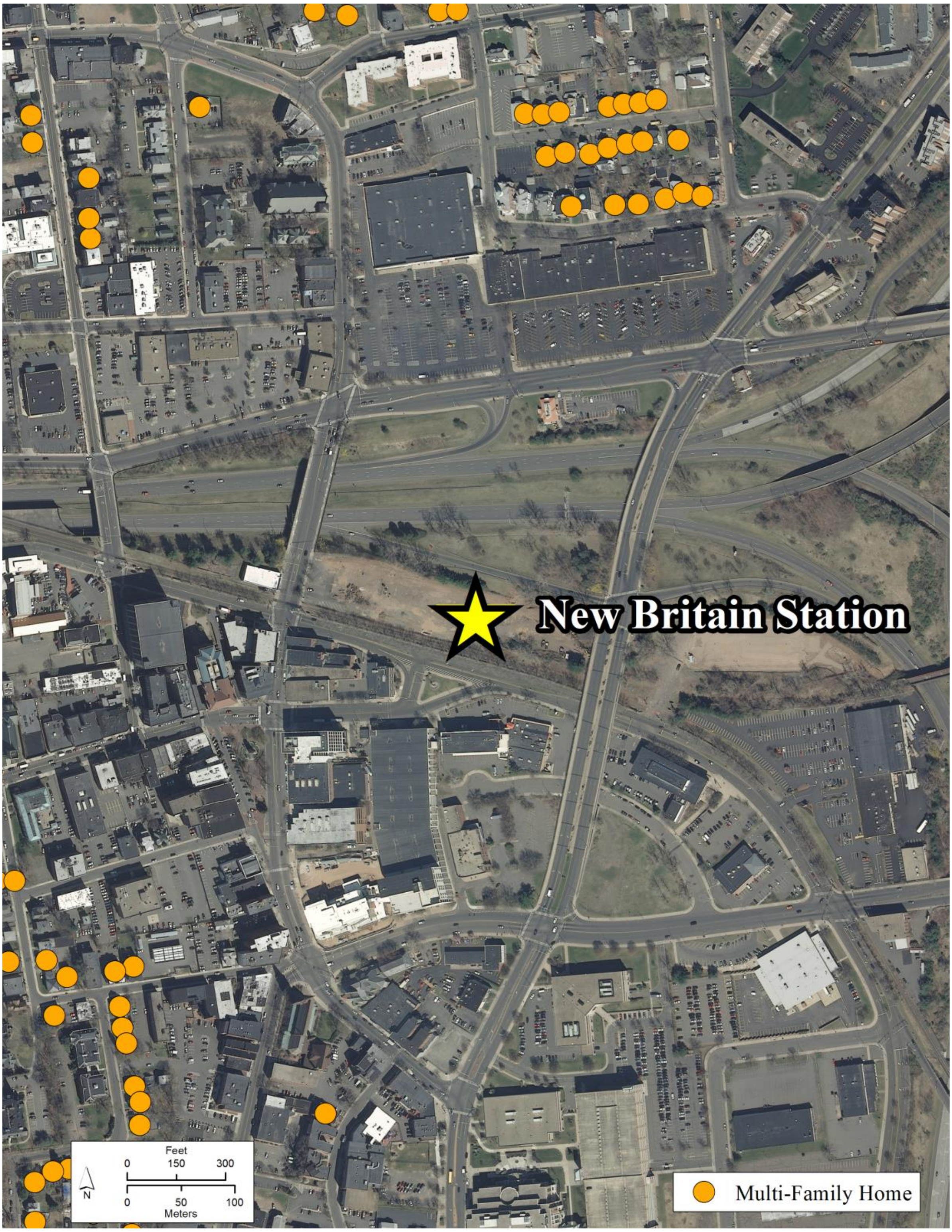


Figure 20 - Multi-family homes near the New Britain CTfastrak station (yellow star) in 2012, superimposed on 2012 aerial photography (sources: property data from New Britain Assessor Office and aerial photography from DEEP)

Table 14 – Number of multi-family homes in 2012 (sources: municipal assessor offices)

CTfastrak Station	1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford	70	347	2,057	5,883
Parkville Station Hartford	195	619	1,899	5,507
Kane Street Station Hartford	84	339	1,434	4,716
Flatbush Station West Hartford	41	106	260	1,183
Elmwood Station West Hartford	7	87	268	824
Newington Junction Station Newington	12	19	30	82
Cedar Street Station Newington	0	0	17	147
East Street Station New Britain	5	40	440	2,838
East Main Street station New Britain	222	747	1,721	4,328
New Britain Station New Britain	1	259	2,578	4,725

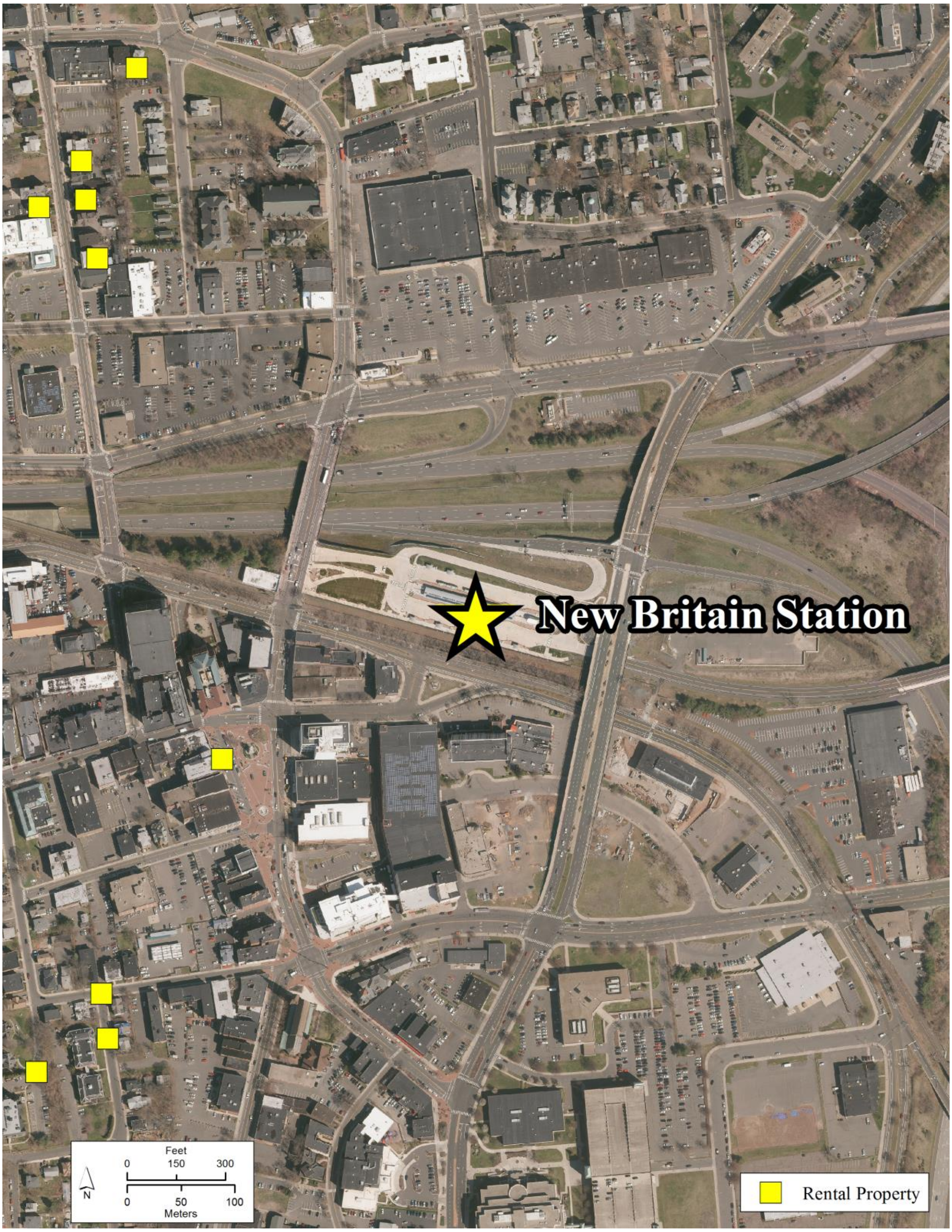


Figure 21 – Rental properties near the New Britain CTfastrak station (yellow star) in 2012, superimposed on 2012 aerial photography (sources: property data from New Britain Assessor Office and aerial photography from DEEP)

Table 15 – Number of rental properties in 2012 (sources: municipal assessor office)

CTfastrak Station	1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford	50	168	591	1,276
Parkville Station Hartford	20	107	473	1,147
Kane Street Station Hartford	11	49	279	998
Flatbush Station West Hartford	0	3	10	79
Elmwood Station West Hartford	2	7	13	43
Newington Junction Station Newington	58	314	691	712
Cedar Street Station Newington	0	0	151	659
East Street Station New Britain	0	0	0	10
East Main Street station New Britain	0	2	8	13
New Britain Station New Britain	0	7	13	13

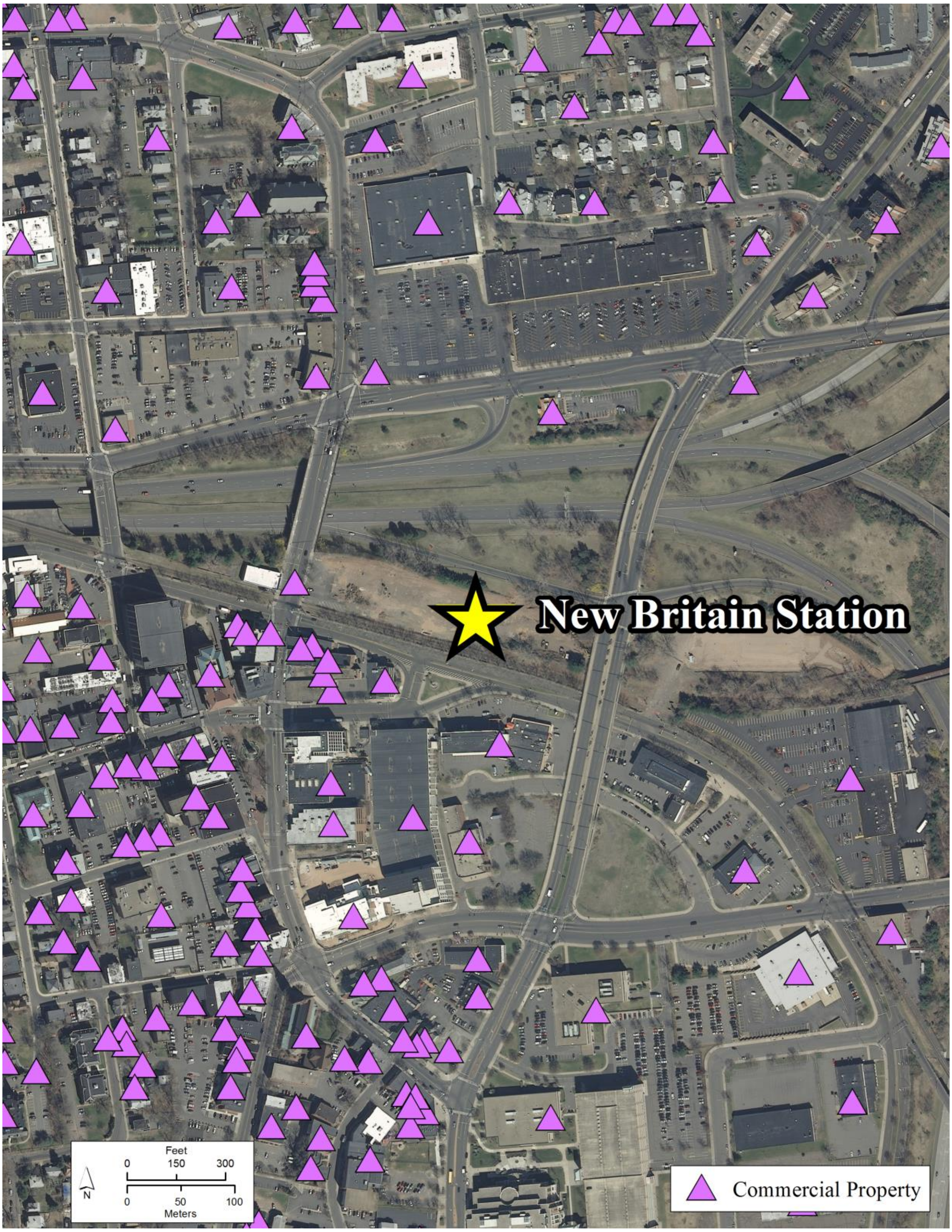


Figure 22 - Commercial properties near the New Britain CTfastrak station (yellow star) in 2012, superimposed on 2012 aerial photography (sources: property data from New Britain Assessor Office and aerial photography from DEEP)

Table 16 – Number of commercial properties in 2012 (sources: municipal assessor office)

CTfastrak Station	1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford	5	34	177	369
Parkville Station Hartford	10	24	87	341
Kane Street Station Hartford	5	22	46	270
Flatbush Station West Hartford	5	8	20	40
Elmwood Station West Hartford	9	12	20	30
Newington Junction Station Newington	11	24	59	204
Cedar Street Station Newington	9	18	36	208
East Street Station New Britain	128	142	289	1,584
East Main Street station New Britain	32	116	590	1,860
New Britain Station New Britain	87	341	973	2,040

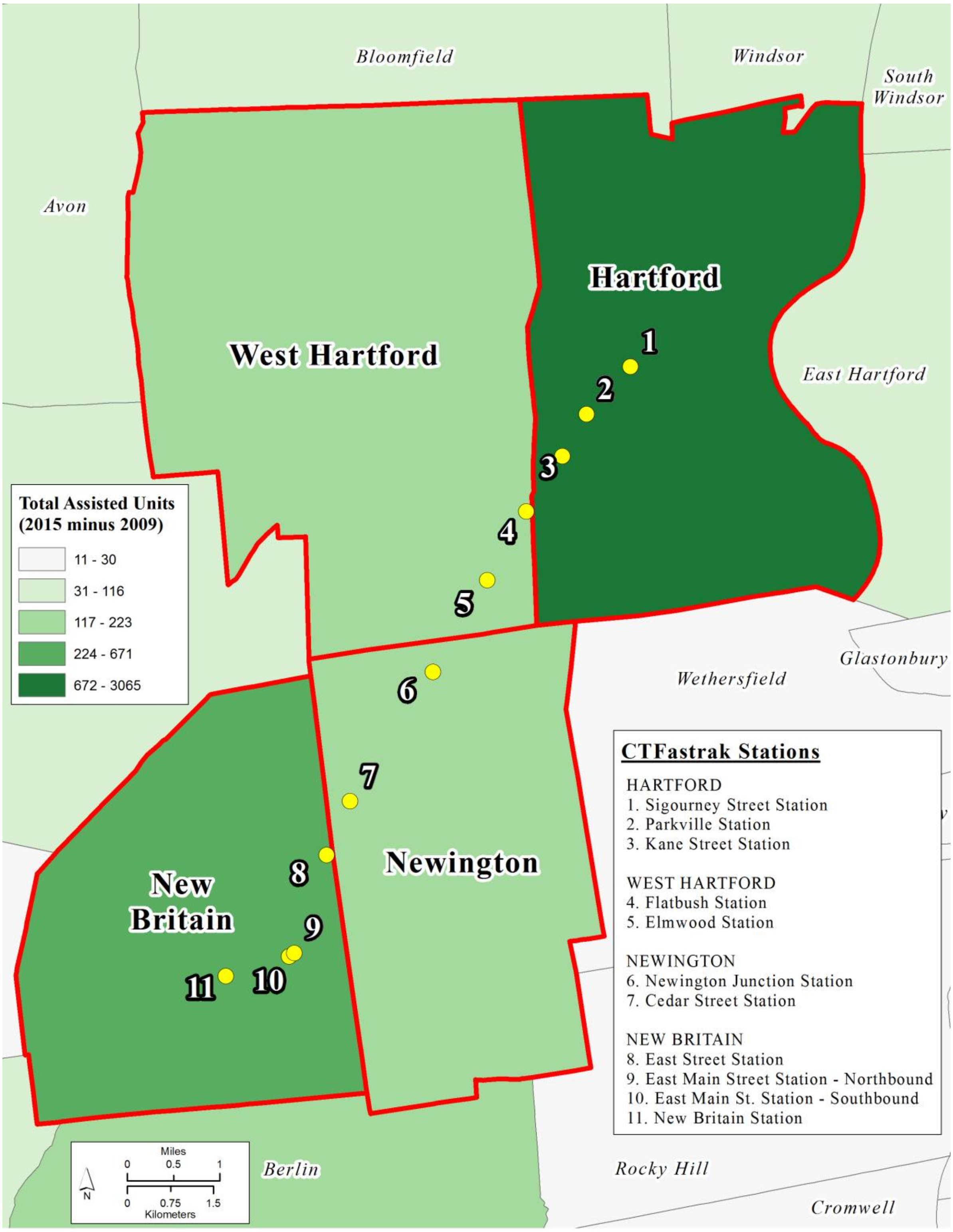
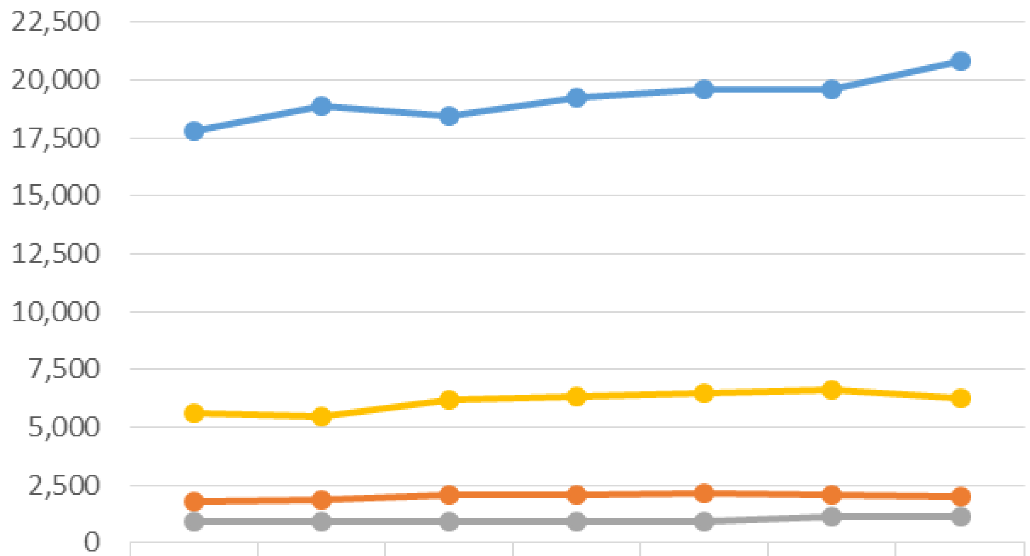


Figure 23 – Change in the number of assisted units between 2009 and 2015 (source: CHFA) and the locations of CTfastrak stations (yellow dots)



	2009	2010	2011	2012	2013	2014	2015
Hartford	17,785	18,859	18,432	19,245	19,588	19,634	20,850
West Hartford	1,800	1,850	2,069	2,075	2,136	2,056	1,981
Newington	918	906	912	933	956	1,111	1,124
New Britain	5,610	5,485	6,189	6,345	6,467	6,597	6,281

Figure 24 – Number of assisted units between 2009 and 2015 (source: CHFA)

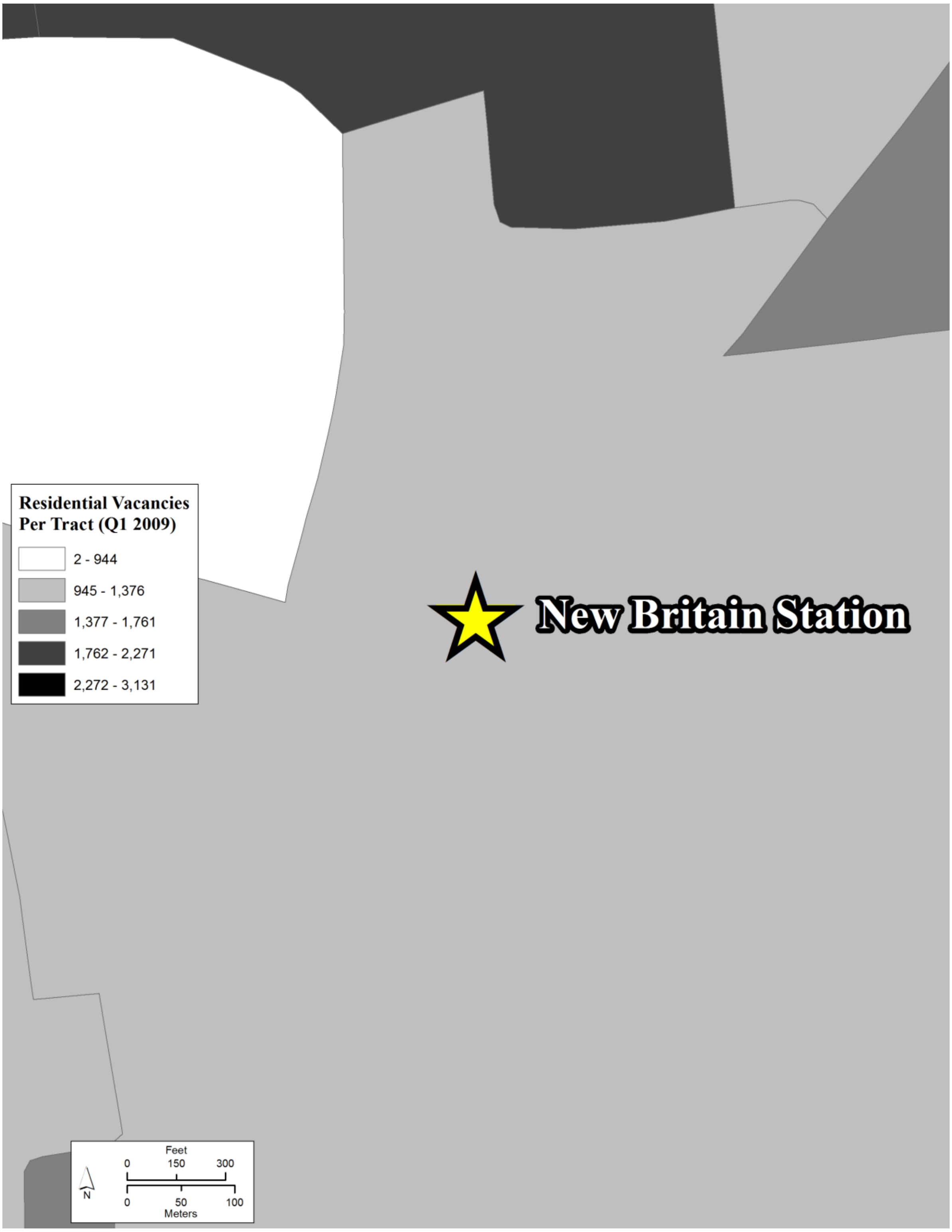


Figure 25 – Residential vacancies per census tract near the New Britain CTfastrak station (yellow star) during the first quarter of 2009 (sources: HUD and USPS)

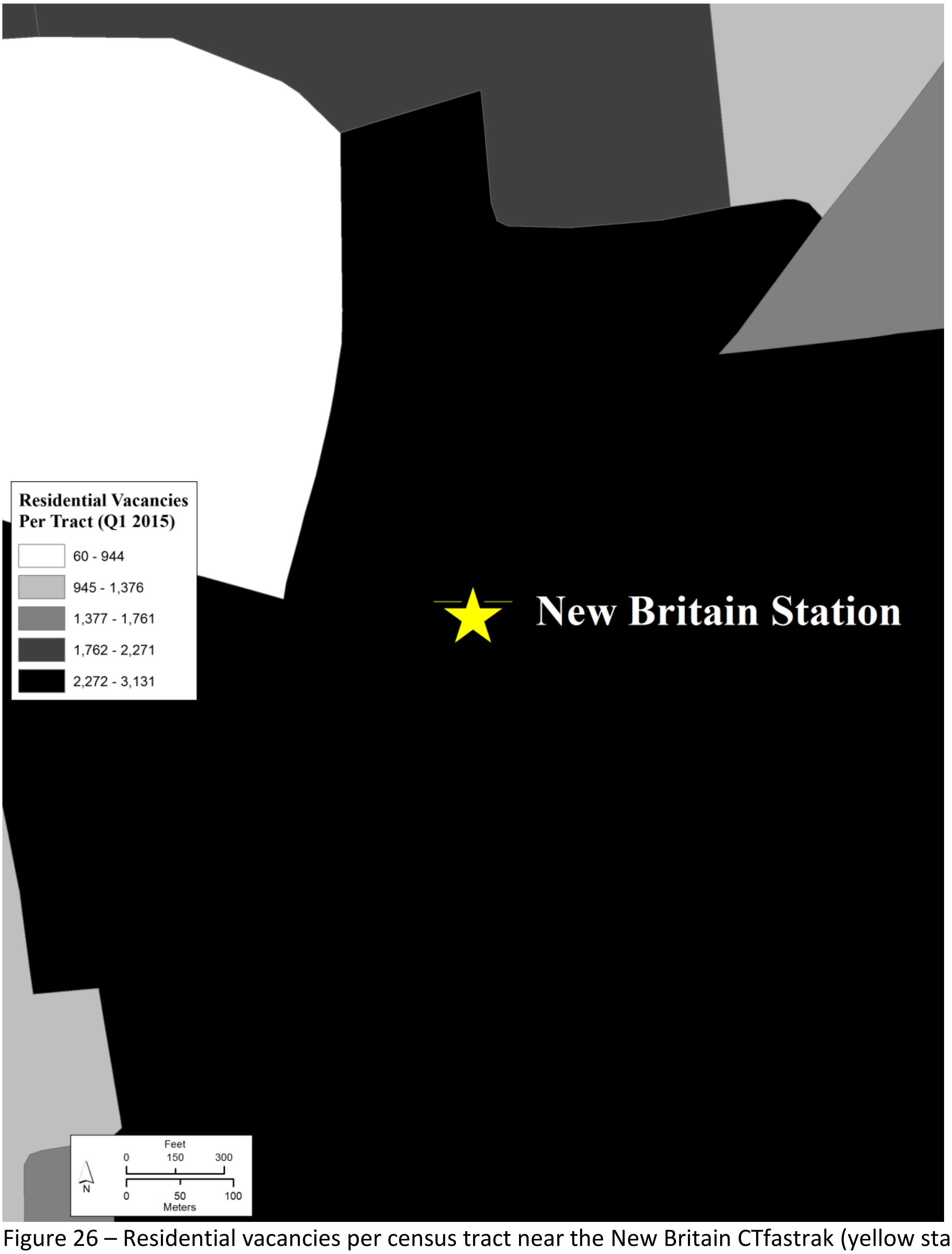


Figure 26 – Residential vacancies per census tract near the New Britain CTfastrak (yellow star) station (yellow star) during the first quarter of 2015 (sources: HUD and USPS)

Figure 27 – Change in the residential vacancies per census tract near the New Britain CTfastrak station (yellow star) between the first quarter of 2009 and the first quarter of 2015 (sources: HUD and USPS)

Table 17 – Change in the number of residential vacancies of the census tract where each CTfastrak station is located between 2009 and 2015 (sources: HUD and USPS)

CTfastrak Station	2009	2015	Difference (2015 minus 2009)
Sigourney Street Station Hartford	3,034	3,026	-8
Parkville Station Hartford	1,200	1,219	19
Kane Street Station Hartford	1,200	1,219	19
Flatbush Station West Hartford	1,120	2,032	912
Elmwood Station West Hartford	1,120	2,032	912
Newington Junction Station Newington	1,624	1,624	0
Cedar Street Station Newington	1,624	1,624	0
East Street Station New Britain	799	809	10
East Main Street station New Britain	950	1,010	60
New Britain Station New Britain	1,070	2,972	1,902

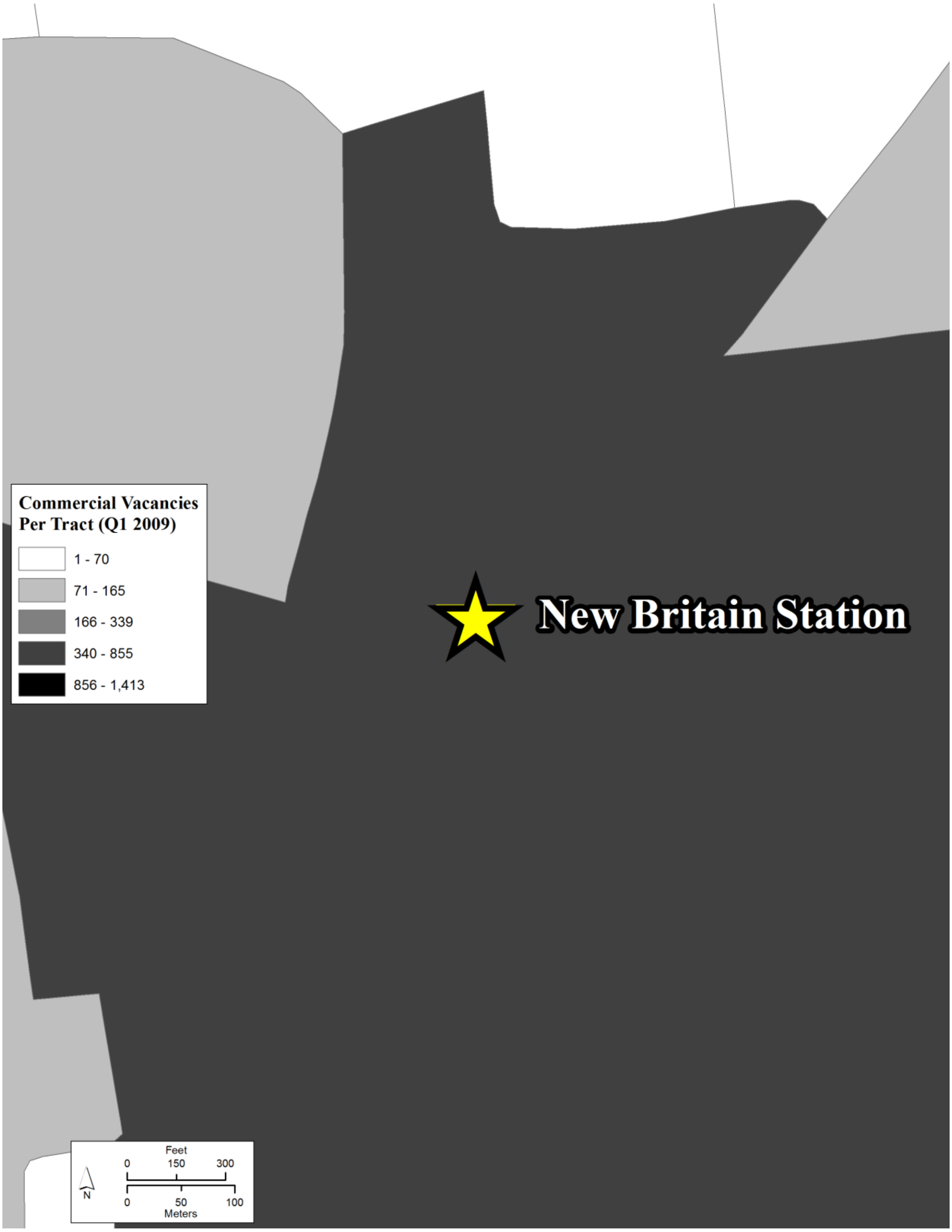


Figure 28 – Commercial vacancies per census tract near the New Britain CTfastrak station (yellow star) during the first quarter of 2009 (sources: HUD and USPS)

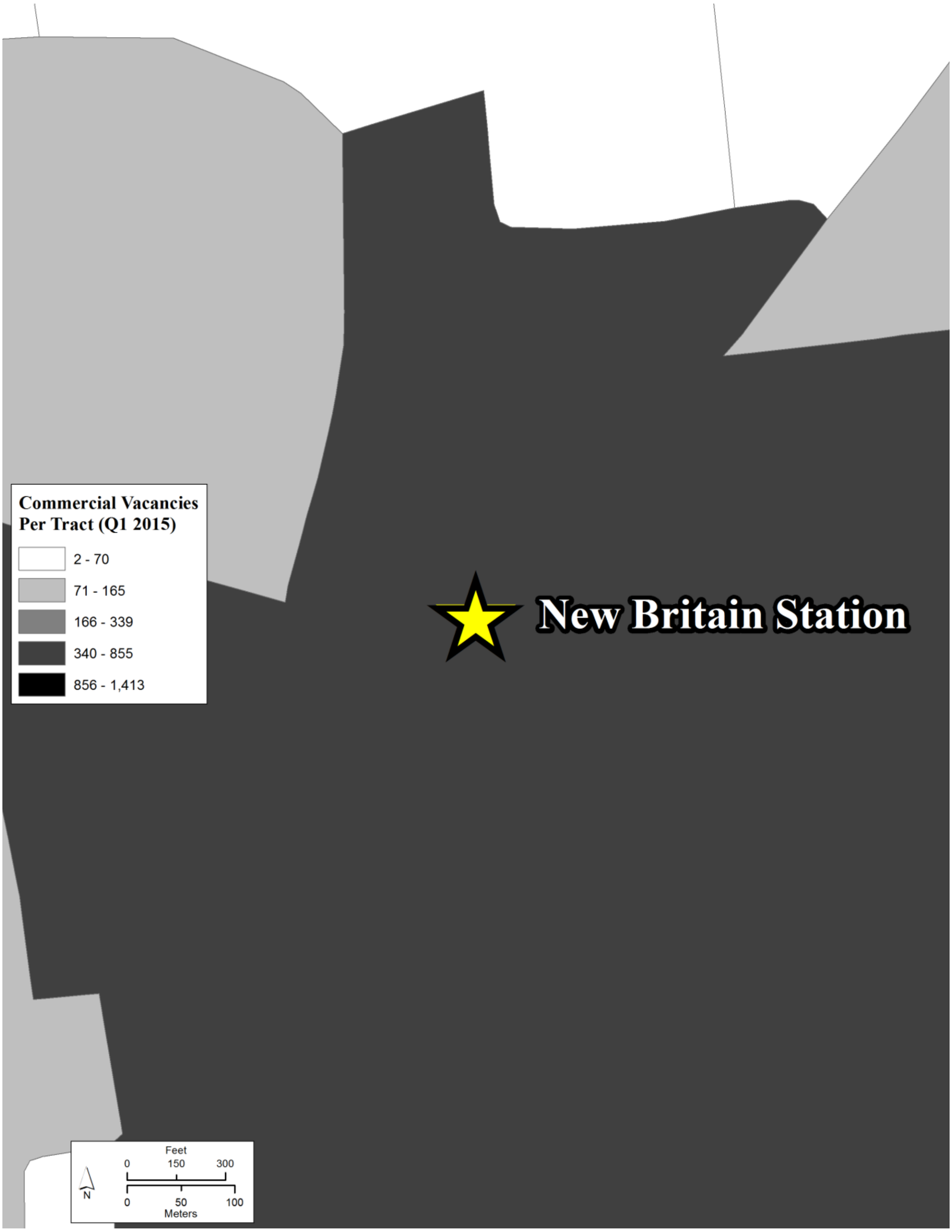


Figure 29 – Commercial vacancies per census tract near the New Britain CTfastrak station (yellow star) during the first quarter of 2015 (sources: HUD and USPS)

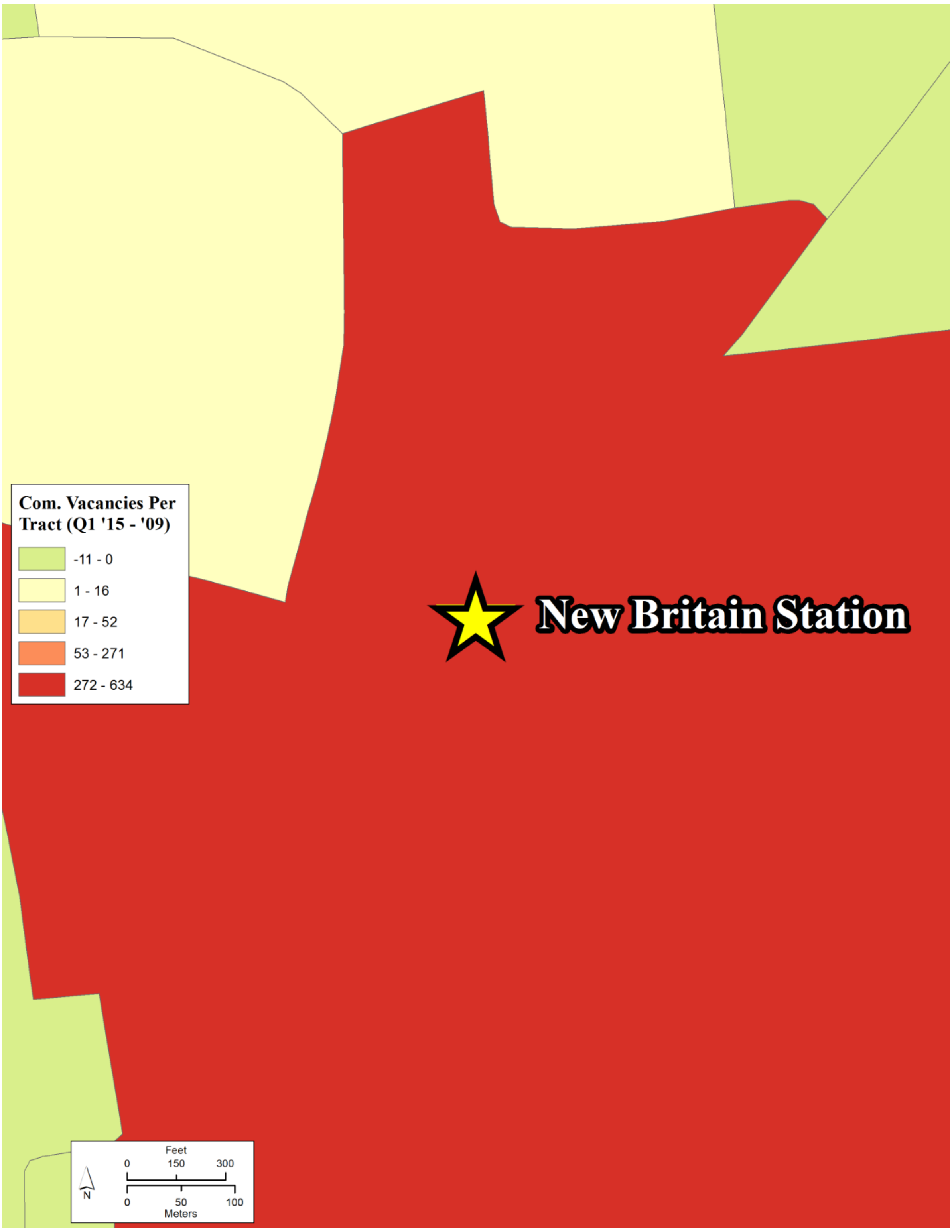


Figure 30 – Change in the commercial vacancies per census tract near the New Britain CTfastrak station (yellow star) between the first quarter of 2009 and the first quarter of 2015 (sources: HUD and USPS)

Table 18 – Change in the number of commercial vacancies of the census tract where each CTfastrak station is located between 2009 and 2015 (sources: HUD and USPS)

CTfastrak Station	2009	2015	Difference (2015 minus 2009)
Sigourney Street Station Hartford	249	259	10
Parkville Station Hartford	230	237	7
Kane Street Station Hartford	230	237	7
Flatbush Station West Hartford	532	855	323
Elmwood Station West Hartford	532	855	323
Newington Junction Station Newington	164	165	1
Cedar Street Station Newington	164	165	1
East Street Station New Britain	29	28	-1
East Main Street station New Britain	87	85	-2
New Britain Station New Britain	417	835	418

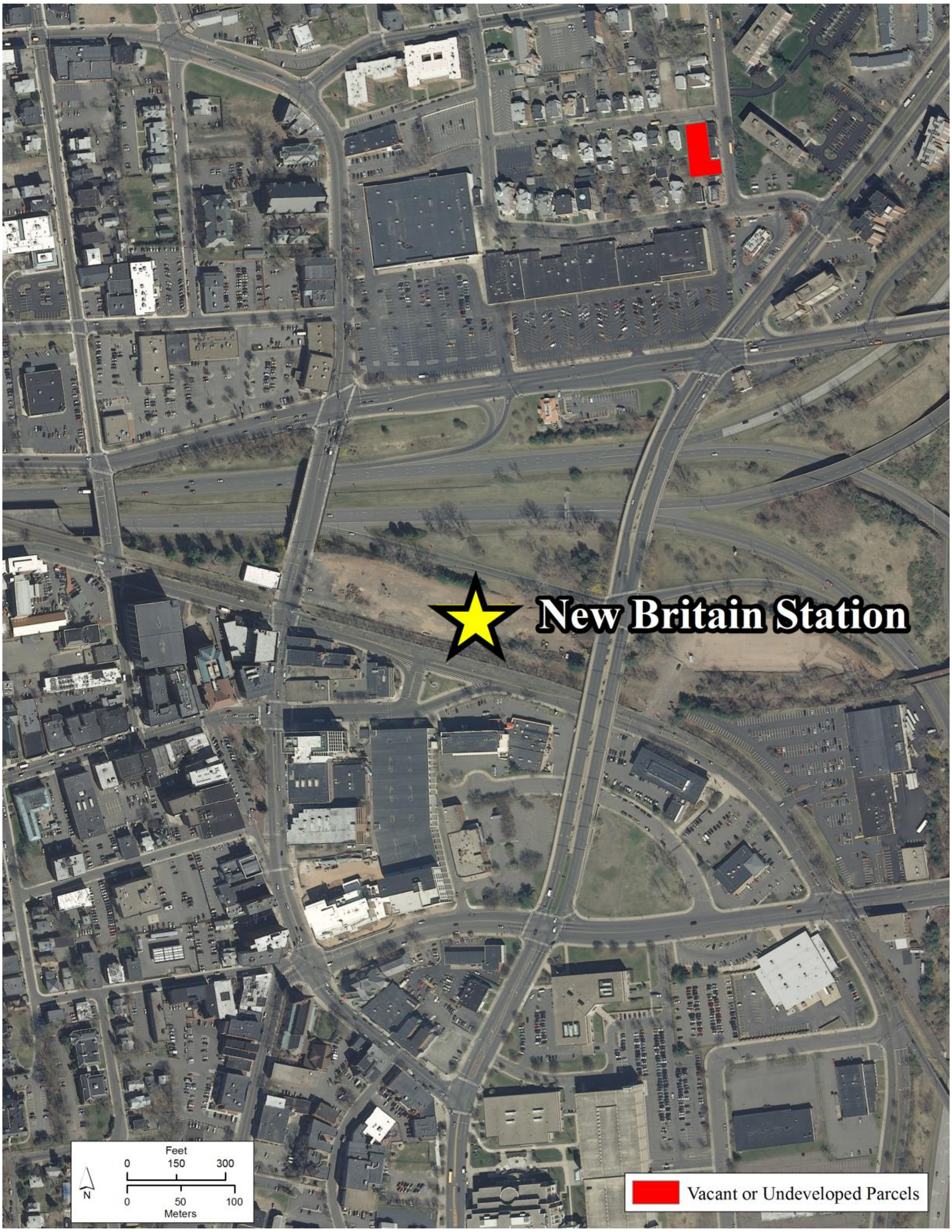


Figure 31 – Vacant or undeveloped parcels within a quarter mile the New Britain CTfastrak station (yellow star) in 2014, superimposed on 2012 aerial photography (sources: CRCOG and municipal assessor offices)

Table 19 – Number of vacant or undeveloped parcels in 2014 (sources: CRCOG and municipal assessor offices)

CTfastrak Station	1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford	0	1	5	62
Parkville Station Hartford	0	3	24	69
Kane Street Station Hartford	0	6	27	65
Flatbush Station West Hartford	1	5	14	76
Elmwood Station West Hartford	1	3	17	94
Newington Junction Station Newington	5	8	19	94
Cedar Street Station Newington	0	2	28	193
East Street Station New Britain	0	8	64	215
East Main Street station New Britain	6	16	84	234
New Britain Station New Britain	0	8	80	238

Figure 32 – Travel time to the XL Center by car for the residential properties near the New Britain CTfastrak station (yellow star) in 2017, superimposed on 2016 aerial photography (sources: locational data from CTDOT, distance measurements from OSRMTIME and aerial photography from DEEP)

Figure 33 – The difference in the value of travel time savings (US DOT, 2011) to the XL Center using the CTfastrak (the cost of driving minus the cost of CTfastrak and walking) for the residential properties near the New Britain CTfastrak station (yellow star) in 2017, superimposed on 2016 aerial photography (sources: locational data from CTDOT, distance measurements from OSRMTIME and aerial photography from DEEP)

Table 20 – Descriptive statistics of the difference in the value of travel time savings (USD per hour) to the XL Center using the CTfastrak (the cost of driving minus the cost of CTfastrak and walking) for the residential properties near the New Britain CTfastrak station in 2017 (sources: CTDOT and OSRMTIME)

CTfastrak Station		1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford - 2016	Avg.	1.20	2.09	1.94	2.53
	Med.	1.21	2.88	1.88	2.17
	S.D.	0.01	1.01	1.23	1.68
	Min	1.20	0.47	0.26	0.26
	Max	1.21	3.21	6.41	13.51
Parkville Station Hartford – 2016	Avg.	0.58	1.89	2.18	3.91
	Med.	0.49	1.86	1.89	2.49
	S.D.	0.28	1.30	1.46	4.50
	Min	0.28	0.26	0.26	0.26
	Max	2.05	5.04	13.51	24.01
Kane Street Station Hartford – 2016	Avg.	1.57	1.91	2.52	4.77
	Med.	1.63	1.73	2.18	2.88
	S.D.	0.30	1.65	1.72	5.52
	Min	1.01	0.28	0.26	0.26
	Max	2.01	13.51	13.51	24.47
Flatbush Station West Hartford – 2016	Avg.	23.97	20.63	14.56	12.39
	Med.	22.98	23.31	8.80	8.05
	S.D.	2.59	6.42	9.37	10.68
	Min	22.48	8.26	1.05	0.95
	Max	30.81	30.81	30.81	53.26
Elmwood Station West Hartford – 2016	Avg.	3.70	4.51	6.24	11.59
	Med.	3.71	3.99	5.81	7.94
	S.D.	0.23	1.50	4.82	9.36
	Min	3.25	2.80	1.74	0.95
	Max	4.37	8.50	30.81	50.08
Newington Junction Station Newington – 2015	Avg.	1.81	2.82	3.80	4.96
	Med.	1.89	3.16	4.03	4.89
	S.D.	0.84	1.14	1.52	1.93
	Min	0.84	0.84	0.84	0.84
	Max	3.77	4.88	7.17	9.84
Cedar Street Station Newington – 2015	Avg.	N/A (no data)	2.75	5.62	6.54
	Med.	N/A (no data)	2.75	5.46	5.79
	S.D.	N/A (no data)	0.04	1.18	3.59
	Min	N/A (no data)	2.72	2.72	0.84
	Max	N/A (no data)	2.77	7.63	19.02
East Street Station New Britain – 2012	Avg.	3.11	3.44	5.39	5.62
	Med.	3.17	3.35	3.78	4.14
	S.D.	0.24	0.51	3.29	3.79
	Min	2.33	2.33	0.93	0.49
	Max	3.48	5.68	15.85	16.04
East Main Street Station New Britain – 2012	Avg.	2.19	3.24	3.50	4.74
	Med.	1.55	3.45	3.52	3.76
	S.D.	0.94	1.01	1.37	3.25
	Min	1.21	0.71	0.49	0.46
	Max	3.89	4.72	7.47	16.04
New Britain Station New Britain – 2012	Avg.	0.52	2.95	3.64	5.59
	Med.	0.52	2.27	3.14	4.45
	S.D.	0.003	2.89	2.76	3.81
	Min	0.52	0.49	0.46	0.46
	Max	0.53	11.91	15.02	16.73

Figure 34 – Planned or proposed redevelopment projects near the New Britain CTfastrak station (yellow star) as of December 2016, superimposed on 2016 aerial photography (sources: redevelopment data from municipal economic development and planning departments and aerial photography from DEEP)

Table 21 – Number of planned or proposed redevelopment projects as of December 2016 (sources: municipal economic development and planning departments)

CTfastrak Station	1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford	3	9	31	71
Parkville Station Hartford	1	2	16	75
Kane Street Station Hartford	1	2	4	52
Flatbush Station West Hartford	1	2	6	23
Elmwood Station West Hartford	2	3	5	9
Newington Junction Station Newington	0	0	0	7
Cedar Street Station Newington	0	0	0	0
East Street Station New Britain	0	0	0	5
East Main Street station New Britain	0	0	9	12
New Britain Station New Britain	2	4	6	6

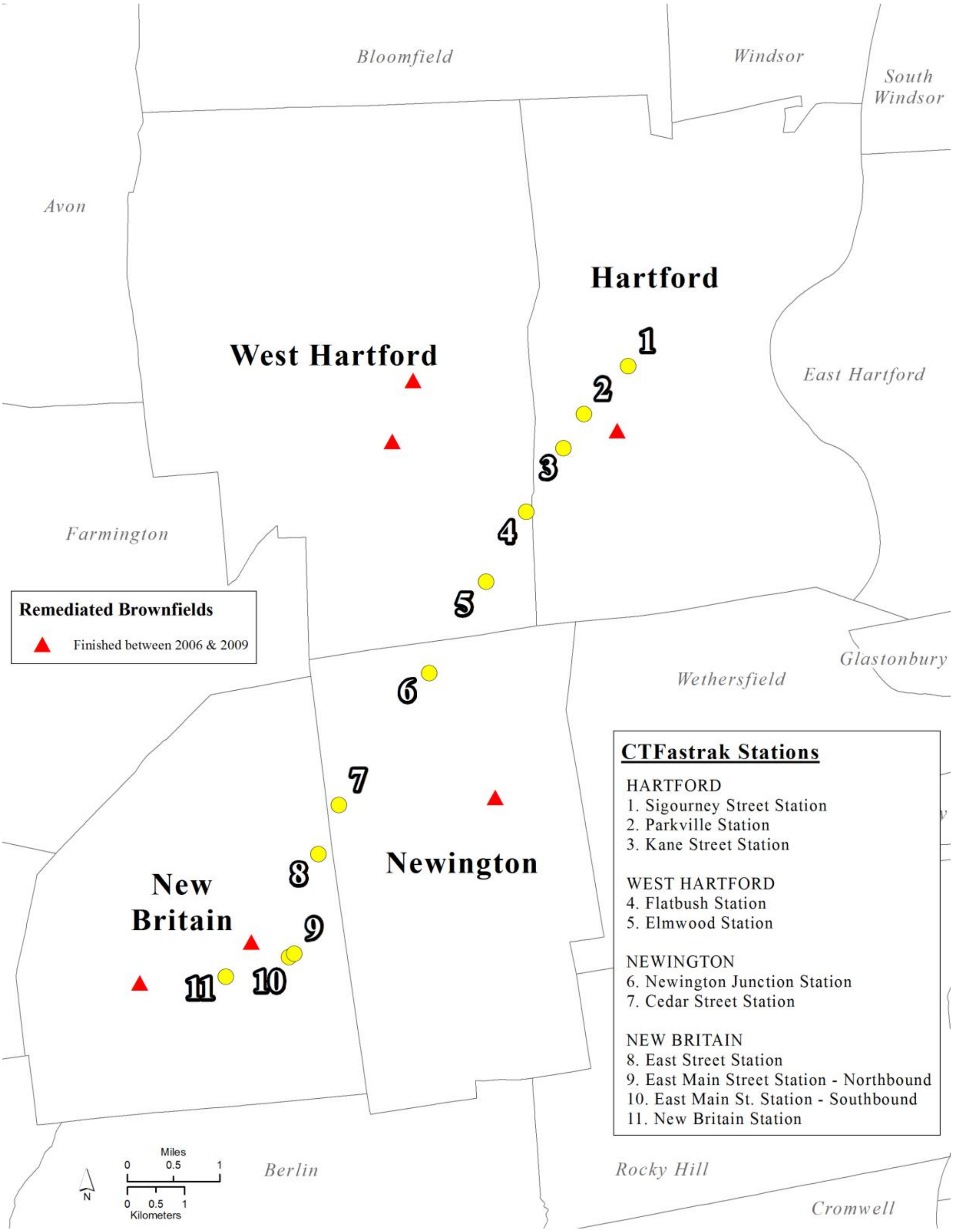


Figure 35 – The proximity of CTfastrak stations (yellow dots) and remediated brownfields (red triangles) between 2006 and 2009 (source: EPA)

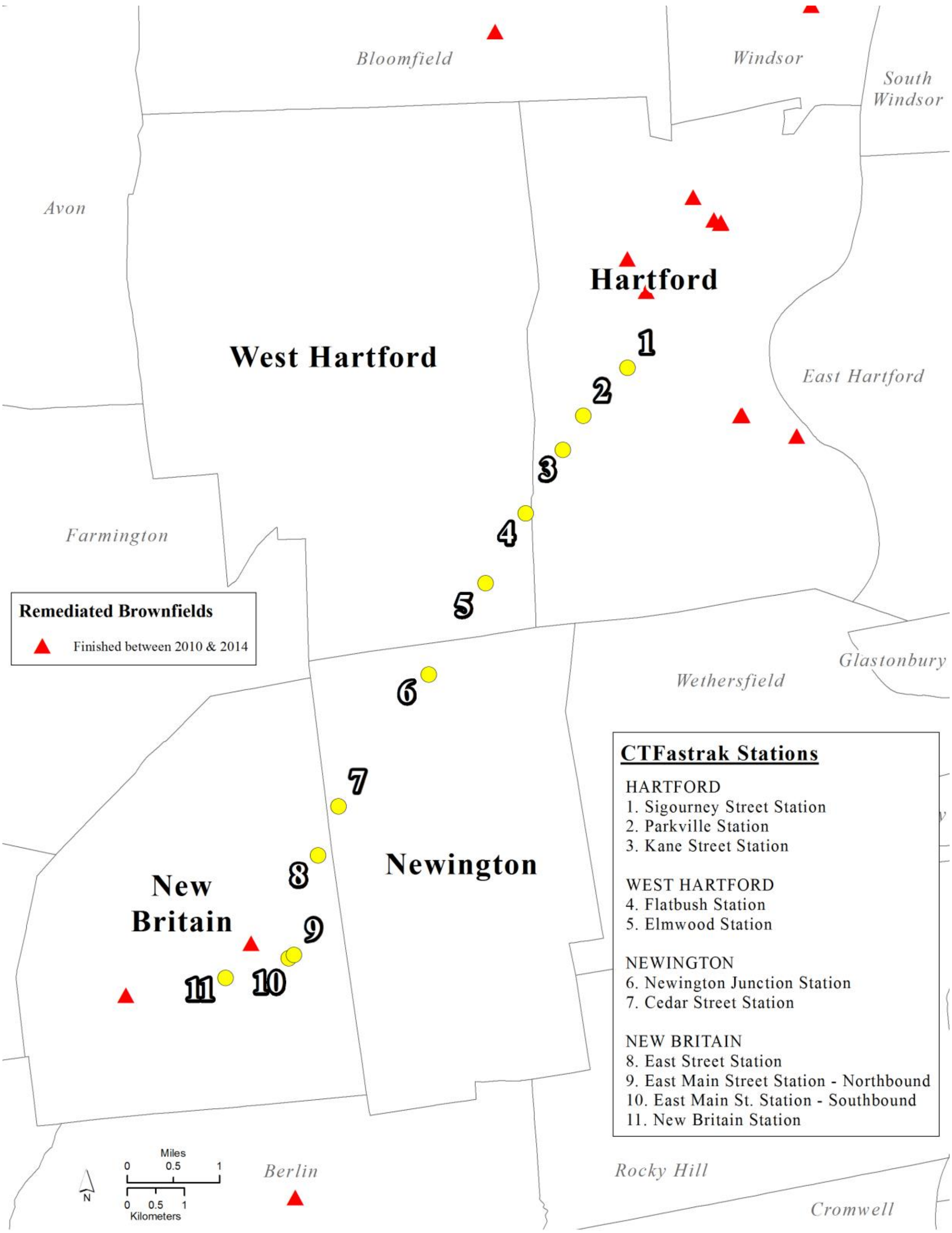


Figure 36 – The proximity of CTfastrak stations (yellow dots) and remediated brownfields (red triangles) between 2010 and 2014 (source: EPA)

Figure 37 – Remediated brownfields near the New Britain CTfastrak station (yellow star) between 2006 and 2009 (i.e., none present within a quarter mile of this particular station during this time period), superimposed on 2006 aerial photography (sources: brownfield remediation data from EPA and aerial photography from DEEP)

Figure 38 – Remediated brownfields near the New Britain CTfastrak station (yellow star) between 2010 and 2014 (i.e., none present within a quarter mile of this particular station during this time period), superimposed on 2012 aerial photography (sources: brownfield remediation data from EPA and aerial photography from DEEP)

Figure 39 – Distance (miles) between remediated brownfields and residential properties near the New Britain CTfastrak Station (yellow star), superimposed on 2012 aerial photography (sources: brownfield remediation data from EPA and aerial photography from DEEP)

Figure 40 – Distance (miles) between remediated brownfields and condominiums near the New Britain CTfastrak Station (yellow star), superimposed on 2012 aerial photography (sources: brownfield remediation data from EPA and aerial photography from DEEP)

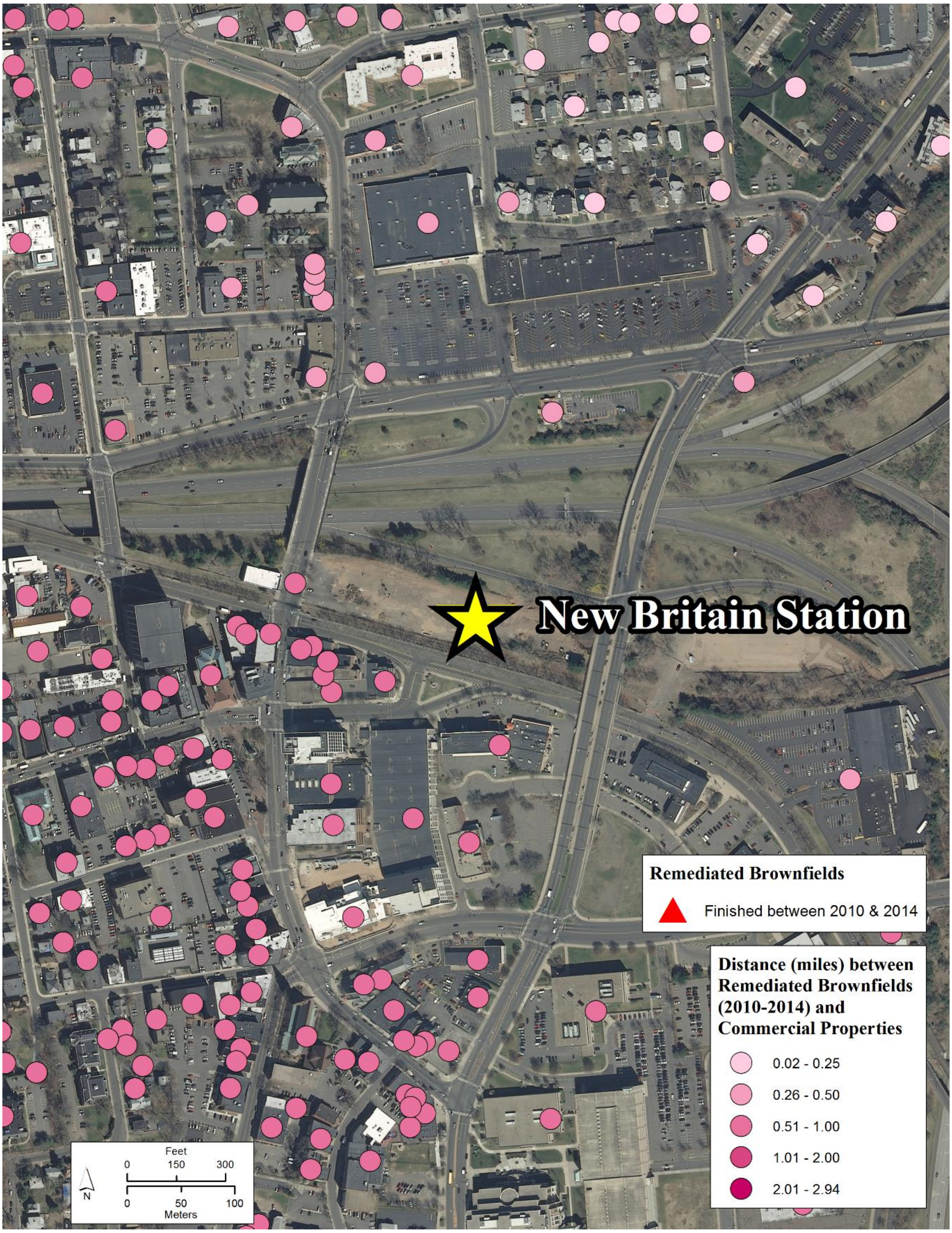


Figure 41 – Distance (miles) between remediated brownfields and commercial properties near the New Britain CTfastrak Station (yellow star), superimposed on 2012 aerial photography (sources: brownfield remediation data from EPA and aerial photography from DEEP)

Table 22 – Number of remediated brownfields between 2006 and 2014 (sources: EPA and CRCOG)

CTfastrak Station	2006-2009				2010-2014			
	1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius	1/4 mile radius	1/2 mile radius	1 mile radius	2 mile radius
Sigourney Street Station Hartford	0	0	1	1	0	0	1	11
Parkville Station Hartford	0	1	1	2	0	0	0	4
Kane Street Station Hartford	0	0	1	3	0	0	0	3
Flatbush Station West Hartford	0	0	0	3	0	0	0	0
Elmwood Station West Hartford	0	0	0	1	0	0	0	0
Newington Junction Station Newington	0	0	0	1	0	0	0	0
Cedar Street Station Newington	0	0	0	2	0	0	0	1
East Street Station New Britain	0	0	0	1	0	0	0	1
East Main Street station New Britain	0	2	2	4	0	2	2	4
New Britain Station New Britain	0	1	2	2	0	1	1	2

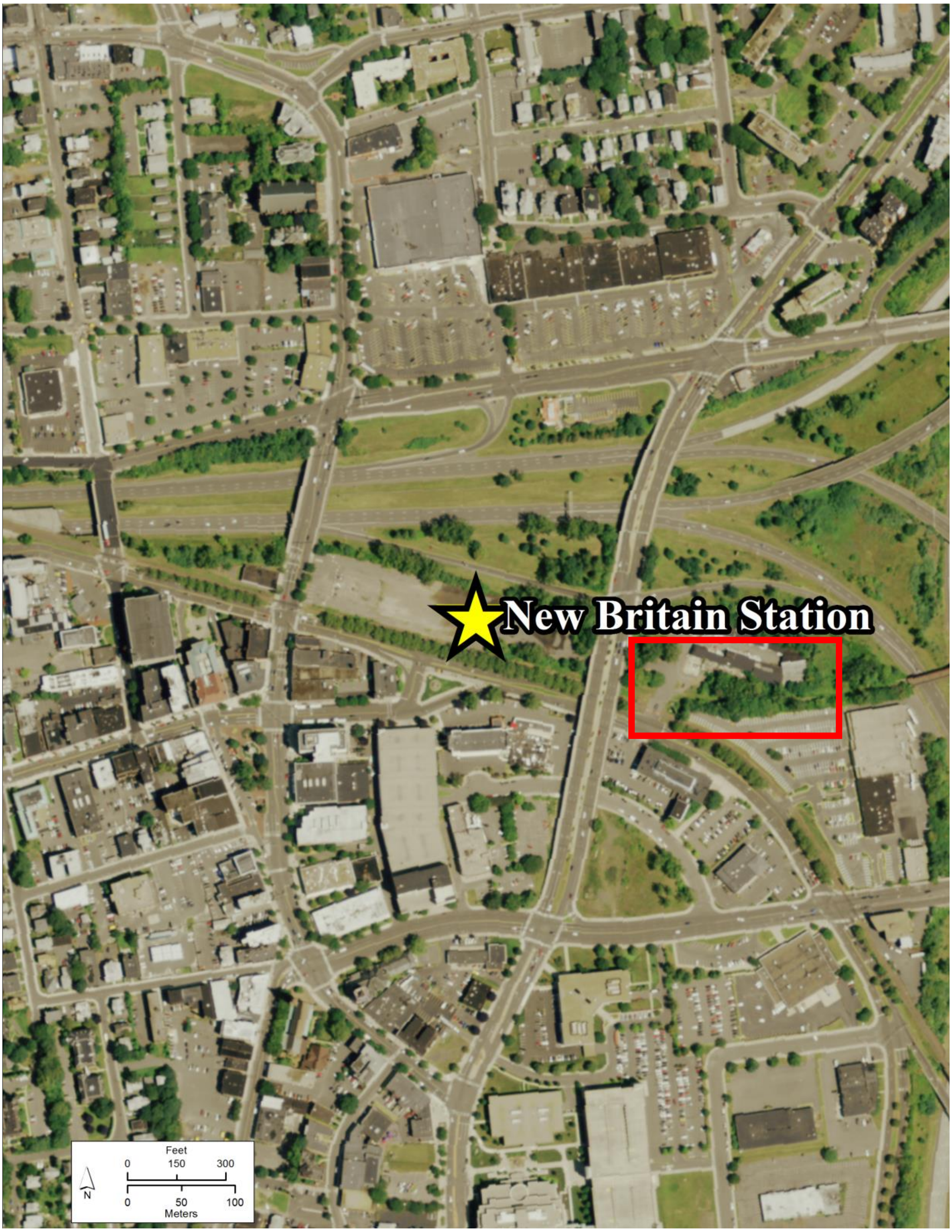


Figure 42 – 2008 aerial imagery near the New Britain CTfastrak station (yellow star), with an example of a change in the built environment between 2008 and 2012 highlighted by a box with a thick red outline (see Figure 43 to see how this area, 141 Robert Loughery Way, changed in 2012; source: aerial photography from DEEP)

Figure 43 – 2012 aerial imagery near the New Britain CTfastrak station, with an example of a change in the built environment between 2008 and 2012 highlighted by a box with a thick red outline (see Figure 42 to see how this area, 141 Robert Loughery Way, differed in 2008; source: aerial photography from DEEP)

Figure 44 – A collage of CTDOT highway photographs of the New Britain CTfastrak station (top right image) and surrounding area circa 2015 (source: CTDOT)

3.3 Techniques Used to Study the Impact of BRT on Property Values

Past research has utilized a variety of techniques to examine the impact of BRT on property values and sales. These methods include: hedonic price modeling (Perk and Catala, 2009; Rodriguez and Mojica, 2009; Flores-Dewey, 2010; Muñoz-Raskin, 2010; Cervero and Kang, 2011; Dubé et al., 2011; Perdomo, 2011; Zhang and Wang, 2013; Deng, 2016; Calvo, 2017), multivariate linear regression (Rodriguez and Mojica, 2008; Perk and Catala, 2009; Rodriguez and Mojica, 2009; Muñoz-Raskin, 2010; Cervero and Kang, 2011; Bocarejo et al., 2013; Zhang and Wang, 2013; Rodriguez et al., 2016), the difference-in-differences approach (Dubé et al., 2011; Bocarejo et al., 2013), propensity score matching (Perdomo-Calvo et al., 2007; Perdomo, 2011), factor analysis (Estupiñán and Rodriguez, 2008; Renne et al., 2016), multi-level modeling (Renne et al., 2016), Urban Simulation Model (SMIUM; Jun, 2012), hot spot analysis (Bocarejo et al., 2013) and the Place Performance Evaluation tool known as the "Placegame" (Project for Public Spaces, 2002 via New Jersey Transit, 2005). Some studies have relied on the incorporation of multiple techniques. This includes a combination of hedonic price modeling and multivariate linear regression (Perk and Catala, 2009; Rodirguez and Mojica, 2009; Muñoz-Raskin, 2010; Cervero and Kang, 2011; Zhang and Wang, 2013); multi-level modeling and factor analysis (Renne et al., 2016); the difference-in-difference approach and hedonic price modeling (Dubé et al., 2011); hedonic price modeling and propensity score matching (Perdomo, 2011); and a combination of the difference-in-difference approach, multivariate linear regression and hot spot analysis (Bocarejo et al., 2013). The most popular approach in the BRT and transit literature to examine the impact of these systems on real estate is either hedonic price modeling or hedonic price regression (first introduced by Rosen, 1974 and used in a number of studies, including: Bowes and Ihlanfeldt, 2001; Cervero and Duncan, 2002; Hess and Almeida, 2007; Atkinson-Palombo, 2009; Goetz et al., 2010; Bartholomew and Ewing, 2011).

To complete an event study (i.e., a before and after analysis) for the CTfastrak in the second phase of this project, the use of hedonic price regression and/or the difference-in-differences approach are recommended. As noted in the previous paragraph, both techniques have a long track record of effectively capturing the impact of new projects on property values and other aspects of economic development. Hedonic regression allows researchers to examine changes in property values and obtain estimates of the contributory value of each constituent characteristic of the analyzed properties. The difference-in-differences approach can examine the effect of any independent variable on property values by comparing the average change over time for a treatment group (i.e., a place where a relationship between the independent variable and dependent variable is supposed to exist) compared to a control group (i.e., a place where a relationship between the independent variable and dependent variable should not exist). Also, the aerial photography and highway photolog images will enable one to visually demonstrate how the changes in various aspects of the neighborhoods near the stations have evolved over time. In "Phase 2" the geospatial database will be embedded in an online tool to facilitate the public's use of these maps, photographs, and data.

CHAPTER 4 Next Steps

The aim of this chapter is to draw conclusions from the first phase of this project and make recommendations for the subsequent phases. Additionally, a suggested work plan for the second phase is proposed. This work plan will outline the steps that need to be completed to address the overarching objective of this research.

4.1 Phase 1 Conclusions and Recommendations for Subsequent Phases

There are three main recommendations for the subsequent phases of this research:

1. Proceed with Phase 2 of this project within a couple of years after completion of Phase 1.

2. Complete an event study (a before-and-after analysis) to document the impact of the CTfastrak on real estate and economic development after a reasonable period of time has elapsed, as noted in the first recommendation.

3. As a part of Phase 2, develop a “macro” within the final updated geodatabase that will enable the users to select certain variables, locations, dates, etc., and generate maps and/or photographs showing the before versus after conditions of those locations.

As noted throughout this report, given the fact that the CTfastrak received funding approval and opened for service within the past few years, the impacts of CTfastrak might require some additional time to materialize and become apparent in both photographic evidence and statistical descriptions/analyses. Consequently, annually documenting the changes in the aforementioned variables in Phase 2 will be important to understanding the ultimate impact of CTfastrak on the four municipalities. This window should be sufficient for the value of travel time savings to become fully capitalized into properties in the CTfastrak catchment areas.

These changes in the CTfastrak catchment areas could easily be illustrated with the information provided in the geodatabase generated in this first phase of the project. Although tables and graphs could be used to show some of the effects, these figures might lack the ability to fully capture the changing geographies of the areas with BRT access. The geospatial database, on the other hand, best lends itself to showing these spatial changes to the catchment areas via photographic evidence (e.g., the CTDOT highway photolog images or aerial photographs of the areas; Figure 39) as well as descriptive maps (Figure 30) and/or maps of analytical results of the statistical analyses (e.g., the hedonic regressions and/or the difference-in-differences).

4.2 Work Plan for Phase 2
Objectives and Work Plan for "Phase 2"

- **Long-Term Objective**

Long-term objective: Determine how CTfastrak becomes capitalized into property values.

- **Phase 2 Steps in Achieving Objective**

There will be several approaches used in Phase 2 to achieve the long-term objective. These will include first updating the data for all of the Phase 1 objectives. Then, the data will be presented in several different formats. One of these is a tabular and graphical summary of the data for the two periods. Another approach will employ maps and photography, based on comparisons over time of the aerial photography and state highway photolog images that are obtained during Phase 1 and Phase 2. In some instances, such as the impacts of brownfield redevelopment on property values, regression analysis will be used to estimate the causal effects of proximity to these remediated brownfields on property values. Finally, the geospatial database that was compiled in Phase 1, and at the end of Phase 2 will continue to be developed in order to deliver an online tool that can be used by the public for data queries based on the maps, photographs, and data that have been compiled throughout Phases 1 and 2.

Below are the proposed specific steps in Phase 2:

1. Determine availability of data for collection in Phase 2

While it is anticipated that most if not all of the data sources from Phase 1 will still be available in Phase 2, it is possible that some of them may no longer be available. Also, some new data sources may become available between now and the start of Phase 2. The first step of Phase 2 will be to inventory the potential data sources.

2. Update existing "baseline" conditions that were documented in Phase 1 for prior to 2011 funding commitments and at 2015 commencement of CTfastrak service.

Assuming all of these variables are still available from the respective data sources, this list of variables includes: estimated annual property values, assessed property values, assessed land values, sales values, estimated local property tax revenue, number of single-family properties, number of multifamily properties, number of rental properties (i.e., apartments and condos), number of commercial properties, number of affordable housing properties, square footage, number of vacant properties, value of travel time savings, number of current plans/proposals for new real estate development, and number of environmental remediation projects. In addition to these variables, aerial photography (depending on availability of updated photo imagery) and other photographic evidence (e.g., from the CTDOT State Highways Photolog) will need to be updated to help illustrate what the CTfastrak station catchment areas looked like before versus after the announcement of funding in 2011, and before versus after the commencement of service in 2015.

3. Update data to correlate property value changes with proximity to CTfastrak stations

Estimated annual property values, assessed property values, assessed land values, and sales values have been utilized to collect data on property values over time. The STATA program entitled “osrmtime” will be used to determine the travel time to the nearest CTfastrak station, using the updated maps for the date at which Phase 2 is undertaken. Note that the distance to the nearest station should not have changed, unless there have been changes in the road networks of the municipalities. For this reason, to be sure, distances based on the most recent road networks will be calculated. Attention will be focused on properties within a two-mile radius of the CTfastrak stations; and separately, updated data will be collected for properties that are within a two-mile drive of the stations.

4. Collect data to correlate property value changes with changes in monetary and time costs of travel

Typical assumptions on the value of passenger time, the cost of car ownership, parking costs, and any other relevant costs have been obtained in Phase 1 from various Transportation Research Board reports and handbooks (e.g., the U.S. Department of Transportation’s “Guidance on the Valuation of Travel Time in Economic Analysis”). Travel times from a given set of properties to downtown Hartford have been gathered in Phase 1, and will be updated in Phase 2. This is accomplished using “osrmtime” with STATA software to calculate drive time from a given set of properties to downtown Hartford. These properties are those that are located in neighborhoods within a two-mile radius of each of the CTfastrak stations, and separately, a two-mile driving distance from the stations.

5. Collect data to control for general price movements

In examining changes in property values in Phase 2, it is necessary to attempt to “control” for general price movements (general business cycles, real estate “booms” and “busts”, etc.) by adjusting the sales prices by a price index for Hartford-area housing and land in order to isolate the effects of CTfastrak from metro-area wide business cycles. The metro-Hartford area “Land and Property Values” data from the Lincoln Institute of Land Policy and housing price indexes for the Hartford Metropolitan Statistical Area from the Federal Housing Finance Authority (FHFA) have been used as controls in Phase 1, and the updated data from these same sources will be obtained in Phase 2 and used as controls.

6. Collect assessed property values pre- and post-announcement of CTfastrak

Data on assessed values were collected in Phase 1, and the values of properties in all intermediate years between assessments were calculated using the ratio of assessed values to sales prices for properties nearby that sold. A procedure similar to that followed by most of the assessors in these towns was used, by comparing the ratio of the assessed value to the sale price for properties that sold, with the assessed value for properties that did not sell. Assuming this ratio is constant in small geographic areas around the properties that sold, one may use this ratio to obtain an estimate of property value for other nearby properties that did not sell.

Since properties in Connecticut are generally reassessed every three to five years, any new assessment data will be collected in Phase 2 for each of the four municipalities, to estimate the total wealth effect to landowners as a result of the announcement and/or CTfastrak service. It will also be useful in Phase 2 for studying potential changes in local property tax revenues that may have accrued to the municipalities where the bus stations have been located. Assessment and sales data have been obtained from additional surrounding towns, which can be updated and ultimately used in Phase 2 as additional control areas in our analysis.

7. Collect data on current property tax revenues for municipalities where new bus stations are located

The levels of local property tax revenues that accrue to the municipalities where the new bus stations are located will be determined in the years after 2016. This will require obtaining the updated “grand lists” from the municipal assessors where there is CTfastrak service, then performing calculations to estimate values in the years between revaluations. The updated “mill rates” for each town will need to be utilized to determine the expected property tax revenues at each point in time. The “equalized mill rates” will need to be updated. One or both of these will be used, together with the assessed values data, and property data by tax exempt status, to calculate local property tax revenues for each year. This will enable one to compare, in Phase 2, how the tax base has changed over the first several years of CTfastrak service.

8. Document the number and mix of dwelling units (owner-occupied vs. rental, percent "affordable" housing, etc.) within a range of reasonable distances from stations

This task has addressed the questions: What is the number of rental properties within a range of reasonable distances from the stations? What share of these properties are considered "affordable housing"? Meeting with individuals at the Connecticut Housing Finance Authority and town/city officials will be needed to gather the updated information. Updated data from CRCOG on the land use type of each property will need to be obtained. Affordable housing appeals list by city/town, annual totals for each municipality from Connecticut Housing Finance Authority (CHFA), for years after 2015 will also need to be collected; this includes information on the total number of assisted units from each municipality. This affordable housing data is expected to still be available on a municipality-wide level.

9. Collect baseline data on total building square footage within a given radius of bus stations for Phase 2 evaluation of how these measures have changed

The square footage of commercial/retail and residential properties will need to be re-estimated, in order to determine how it may have changed over time from the Phase 1 "baseline". Information will be collected on total building square footage within a given radius of the bus stations, to compare with the baseline for use in Phase 2. This information will be obtained from the cities/towns when they share their new assessment data with us.

10. Investigate current plans and proposals for new real estate development

Updated information will be obtained from economic development and other town officials in Hartford, West Hartford, New Britain, and Newington.

11. Phase 2 analysis of how land cleanup has affected nearby property values

Data needed in Phase 2 of the effect of environmental remediation on property values have been collected, which will enable one to examine how the cleanup of the land where a former police station and welding facility were located has affected nearby property values. In Phase 2, the data will be utilized (supplemented by updated data from the first five years of service) to conduct a "hedonic" property price analysis (as in McMillen & McDonald, 2004), using the statistical techniques of regression analysis. This analysis in Phase 2 will determine how values of properties in proximity to the brownfields have changed, before versus after the CTfastrak announcement date, after controlling for other factors that might affect the property values. In addition, visual evidence will be provided to show how prices changed near remediated brownfields through aerial photography and with street-level photos from the State of CT DOT highways photolog.

12. Collect data on property vacancies

Local-level data on property vacancies, from the U.S. Postal Services vacancy database, will be updated.

13. Document the post-“baseline” land use near stations via aerial photography and/or remote sensing

Aerial photographs and maps of the neighborhoods near the CTfastrak stations will be utilized. While it is not clear at this point what new aerial photography will be available moving forward, this issue will be explored with CRCOG and others. Updated photographs of neighborhoods near several of the CTfastrak stations from the Connecticut State Highways Photolog will be obtained (various years).

14. Compile data in a parcel-level geospatial database to facilitate tracking of use, changes in use, building type, square footage, sales, sale prices, assessed values, etc.

In Phase 2, all of the updated data will be compiled into a parcel-level geospatial database, and combine this with the data already compiled into a geospatial database for Phase 1. The database will facilitate easy tracking of changes in parcels (use, change in use, building type and square footage, sales, sale prices, assessed values, etc.).

Moreover, as a part of Phase 2, an electronic query tool will be developed in order to enable users to easily search for various properties near the individual CTfastrak stations, create maps from the data, and superimpose these maps onto aerial and/or highway photographs that may have changed over time. Development of this tool will be a key output of the Phase 2 project, which will facilitate the dissemination of the final data to the public.

Approximate Timeframe for “Phase 2”: 18 months.

Approximate Budget for “Phase 2”: $285,000.

References

Alonso W. 1964. *Location and Land Use: Toward a General Theory of Land Rent*. Cambridge, Mass: Harvard University Press. DOI: 10.4159/harvard.9780674730854.

Atkinson-Palombo C. 2009. "Comparing the Capitalisation Benefits of Light-rail Transit and Overlay Zoning for Single-family Houses and Condos by Neighbourhood Type in Metropolitan Phoenix, Arizona." *Urban Studies* 47(11): 2409-2426. DOI: 10.1177/0042098009357963.

Babalik-Sutcliffe E. 2002. "Urban Rail Systems: Analysis of the Factors behind Success." *Transport Reviews* 22(4): 415-447. DOI: 10.1080/01441640210124875.

Bartels C, Kolbe-Alexander T, Behrens R, Hendricks S, Lambert EV. 2016. "Can the Use of Bus Rapid Transit Lead to a Healthier Lifestyle in Urban South Africa? The SUN Study." *Journal of Transport and Health* 3(2): 200–210. DOI: 10.1016/j.jth.2016.04.003.

Bartholomew K, Ewing R. 2011. "Hedonic Price Effects of Pedestrian- and Transit-Oriented Development." *Journal of Planning Literature* 26(1): 18-34. DOI: 10.1177/0885412210386540.

Baum-Snow N, Kahn ME. 2000. "The Effects of New Public Projects to Expand Urban Rail Transit." *Journal of Public Economics* 77: 241-263. DOI: 10.1016/s0047-2727(99)00085-7.

Bellin J, Ferguson AG. 2013. "Trial by Google: Judicial Notice in the Information Age." *Northwestern University Law Review* 108 (4): 1138-1181.

Billings SB. 2011. "Estimating the Value of a New Transit Option." *Regional Science and Urban Economics* 41: 525-536. DOI: 10.1016/j.regsciurbeco.2011.03.013.

Bocarejo JP, Portilla I, Perez MA. 2013. "Impact of Transmilenio on Density, Land Use, and Land Value in Bogota. *Research in Transportation Economics* 40: 78-86. DOI: 10.1016/j.retrec.2012.06.030.

Bowes DR, Ihlanfeldt KR. 2001. "Identifying the Impacts of Rail Transit Stations on Residential Property Values." *Journal of Urban Economics* 50: 1-25. DOI: 10.1006/juec.2001.2214.

Brinckerhoff P. 2001. "The Effect of Rail Transit on Property Values: A Summary of Studies" *Unpublished Report listed as Project 21439S, Task 7*.

Calvo JAP. 2017. The Effects of the Bus Rapid Transit Infrastructure on the Property Values in Colombia. *Travel Behaviour and Society* 6: 90-99. DOI: 10.1016/j.tbs.2016.08.002.

Cass N, Faulconbridge J. 2016. "Commuting Practices: New Insights into Modal Shift from Theories of Social Practice." *Transport Policy* 45: 1–14. DOI: 10.1016/j.tranpol.2015.08.002.

Cervero R, Dai D. 2014. "BRT TOD: Leveraging Transit Oriented Development with Bus Rapid Transit Investments." *Transport Policy* 36: 127-138. DOI: 10.1016/j.tranpol.2014.08.001.

Cervero R, Duncan M. 2002. "Land Value Impacts of Rail Transit Services in Los Angeles County." *Report prepared for the National Association of Realtors and Urban Land Institute*.

Cervero R, Kang CD. 2011. "Bus Rapid Transit Impacts on Land Uses and Land Values in Seoul, Korea." *Transport Policy* 18: 102-116. DOI: 10.1016/j.tranpol.2010.06.005.

Cherif E, Grant D. 2014. "Analysis of E-Business Models in Real Estate." *Electronic Commerce Research* 14: 25-50. DOI 10.1007/s10660-013-9126-z.

Cohen JP, Brown M. Forthcoming. "Does a New Rail Rapid Transit Line Announcement Affect Various Commercial Property Prices Differently?" *Regional Science and Urban Economics.*

Corcoran C, Liu F. 2014. "Accuracy of Zillow's Home Value Estimates." *Real Estate Issues* 39(1): 45-49.

CTfastrak. 2016a. "Fares." <http://ctfastrak.com/how-to-ride/fares>. Last accessed February 17, 2017.

CTfastrak. 2016b. "Where to Park." <http://ctfastrak.com/how-to-ride/where-to-park>. Last accessed February 17, 2017.

Currie G. 2006. "Bus Rapid Transit in Australasia: Performance, Lessons Learned and Futures." *Journal of Public Transportation* 9(3): 1–22. DOI: 10.5038/2375-0901.9.3.1.

Debrezion G, Pels E, Rietveld P. 2007. "The Impact of Railway Stations on Residential and Commercial Property Value: A Meta-Analysis." *Journal of Real Estate Finance and Economics* 35: 161-180. DOI: 10.2139/ssrn.516742.

Delsaut M, Rabuel S. 2016. "Results of a New Approach in Making Survey on P.T. – New Bus Rapid Transit Service in Nantes." *Transportation Research Procedia* 14: 3274-3283. DOI: 10.1016/j.trpro.2016.05.275.

Deng T, Ma M, Nelson JD. 2016. "Measuring the Impacts of Bus Rapid Transit on Residential Property Values: The Beijing Case" *Research in Transportation Economics*: 1-8. DOI: 10.1016/j.retrec.2016.08.005.

Dubé J, Des Rosiers F, Thériault M, Dib P. 2011. "Economic Impact of a Supply Change in Mass Transit in Urban Areas: A Canadian Example." *Transportation Research Part A* 45 (1): 46-62. DOI: 10.1016/j.tra.2010.09.002.

Duncan M. 2011. "The Impact of Transit-Oriented Development on Housing Prices in San Diego, CA." *Urban Studies* 48(1): 101-127. DOI: 10.1177/0042098009359958.

Estupiñán N, Rodriguez DA. 2008. “The Relationship between Urban Form and Station Boardings for Bogota’s BRT.” *Transportation Research Part A* 42: 296-306. DOI: 10.1016/j.tra.2007.10.006.

Flores-Dewey O. 2011. *The Value of a Promise: Housing Price Impacts of Plans to Build Mass Transit in Ecatepec, Mexico*. Lincoln Institute for Land Policy. Working Paper, Cambridge, MA.

Fogarty N, Eaton N, Belzer D, Ohland G. 2008. “Capturing the Value of Transit.” *Reconnecting America’s Center for Transit-Oriented Development*.

Gallivan F, Rose E, Ewing R, Hamidi S, Brown B. 2015. “Quantifying Transit’s Impact on GHG Emissions and Energy Use: The Land Use Component.” Transit Cooperative Research Program Report 176. DOI: 10.17226/22203.

Gelman IA, Wu N. 2011. “Combining Structured and Unstructured Information Sources for a Study of Data Quality: A Case Study of Zillow.com.” *Proceedings of the 44th Hawaii International Conference on System Sciences*: 1-12. DOI: 10.1109/hicss.2011.115.

Goetz EG, Ko K, Hagar A, Ton H, Matson J. 2010. “The Hiawatha Line: Impacts on Land Use and Residential Housing Value.” *Center for Transportation Studies at the University of Minnesota*.

Gose J. 2017. “Transit Hubs: A Growing Lure for Developers.” *The New York Times*. May 23.

Hamidi S, Kittrell K, Ewing R. 2016. “Value of Transit as Reflected in U.S. Single-Family Home Premiums.” *Transportation Research Record: Journal of the Transportation Research Board* 2543: 108–115. DOI: 10.3141/2543-12.

Hensher DA, Li Z, Mulley C. 2014. “Drivers of Bus Rapid Transit Systems - Influences on Patronage and Service Frequency.” *Research in Transportation Economics* 48: 159-165. DOI: 10.1016/j.retrec.2014.09.038.

Hess DB, Almeida TM. 2007. “Impact of Proximity to Light Rail Rapid Transit on Station-area Property Values in Buffalo, New York.” *Urban Studies* 4 (5/6): 1041-1068. DOI: 10.1080/00420980701256005.

Hidalgo D, Gutierrez L. 2013. “BRT and BHLS around the World: Explosive Growth, Large Positive Impacts and Many Issues Outstanding.” *Research in Transportation Economics* 39: 8-13. DOI: 10.1016/j.retrec.2012.05.018.

Hollas DR, Rutherford RC, Thomson TA. “Zillow’s Estimates of Single-Family Housing Values.” *The Appraisal Journal* 78(1): 26-32.

Huber S, Rust C. 2016. “osrmtime: Calculate Travel Time and Distance with OpenStreetMap Data Using the Open Source Routing Machine (OSRM).” *The Stata Journal* 16(2): 416-423. https://ssrn.com/abstract=2691551

Jun M. 2012. “Redistributive Effects of Bus Rapid Transit (BRT) on Development Patterns and Property Values in Seoul, Korea.” *Transport Policy* 19: 85-92. DOI: 10.1016/j.tranpol.2011.09.003.

Kahn ME. 2007. “Gentrification Trends in New Transit-Oriented Communities: Evidence from Fourteen Cities that Expanded and Built Rail Transit Systems.” *Real Estate Economics* 35(2): 155-182. DOI: 10.1111/j.1540-6229.2007.00186.x.

Landis J, Guhathakurta S, Zhang M. 1994. “Capitalization of Transit Investments into Single-Family Home Prices: A Comparative Analysis of Five California Rail Transit Systems.” *University of California Transportation Center No. 246*. http://escholarship.org/uc/item/80f3p5n1.

Lindau LA, Hidalgo D, Lobo AA. 2014. “Barriers to Planning and Implementing Bus Rapid Transit Systems.” *Research in Transportation Economics* 48: 9-15. DOI: 10.1016/j.retrec.2014.09.026.

Mathur S. 2015. “Sale of Development Rights to Fund Public Transportation Projects: Insights from Rajkot, India, BRTS project.” *Habitat International* 50: 234-239. DOI: 10.1016/j.habitatint.2015.08.041.

McDonald JF, McMillen DP. 2004. “Determinants of Suburban Development Controls: a Fischel Expedition.” Urban Studies 41(2): 341–361. DOI: 10.1080/0042098032000165280.

McKenzie B. 2015. “Transit Access and Population Change: The Demographic Profiles of Rail-Accessible Neighborhoods in the Washington, DC Area.” SEHSD Working Paper No. 2015-023.

Mohammad SI, Graham DJ, Melo PC, Anderson RJ. 2013. “A Meta-Analysis of the Impact of Rail Projects on Land and Property Values.” *Transportation Research Part A* 50: 158-170. DOI: 10.1016/j.tra.2013.01.013.

Muñoz-Raskin R. 2010. “Walking Accessibility to Bus Rapid Transit: Does It Affect Property Values? The Case of Bogota, Colombia.” *Transport Policy* 17: 72-84. DOI: 10.1016/j.tranpol.2009.11.002.

Muth RF. 1969. *Cities and Housing: The Spatial Pattern of Urban Residential Land Use*. Chicago and London: The University of Chicago Press.

New Jersey Transit. 1994. *Planning for Transit-Friendly Land Use: A Handbook for New Jersey Communities*. http://njtod.org/planning-for-transit-friendly-land-use-a-handbook-for-new-jersey-communities/.

New Jersey Transit. 2005. *Building a Transit-Friendly Community*. Dalton, MA: Studley Press.

Noland RB, DiPetrillo S, Lahr ML. 2012. "Residential Property Values and New Jersey Transit Village Program." *Transportation Research Record: Journal of the Transportation Research Board* 2276: 78-88. DOI: 10.3141/2276-10.

Paget-Seekins L. 2015. "Bus Rapid Transit as a Neoliberal Contradiction." *Journal of Transport Geography* 48: 115-120. DOI: 10.1016/j.jtrangeo.2015.08.015.

Panero M, Shin HS, Zendrin A, Zimmerman S, Dowdall E. 2012. "Peer-to-Peer Information Exchange on Bus Rapid Transit (BRT) and Bus Priority Best Practices." Federal Transit Administration 0009.

Perdomo JA. 2011. "A Methodological Proposal to Estimate Changes of Residential Property Value: Case Study Developed in Bogotá." *Applied Economic Letters* 18 (16), 605–610. DOI: 10.1080/13504851.2011.554360.

Perdomo-Calvo JA, Mendoza Álvarez C, Mendieta López, JC, Baquero Ruiz A. 2007. *Study of the Effect of the TransMilenio Mass Transit Project on the Value of Properties in Bogotá, Colombia*. Working Paper No. WP07CA1. Lincoln Institute of Land Policy.

Perk VA, Catala M. 2009. *Land Use Impacts of Bus Rapid Transit: Effects of BRT Station Proximity on Property Values along the Pittsburgh Martin Luther King, Jr. East Busway*. Report to U.S. DOT. Washington: FTA and TRI.

Project for Public Spaces. 2002. Placegame: Place Performance Evaluation Game – A Tool for Initiating the Place-Making Process. https://www.pps.org/pdf/livemem_placegame.pdf.

Renne JL, Tolford T, Hamidi S, Ewing R. 2016. "The Cost and Affordability Paradox of Transit-Oriented Development: A Comparison of Housing and Transportation Costs across Transit-Oriented Development, Hybrid and Transit-Adjacent Development Station Typologies." *Housing Policy Debate* 26(4-5): 819-834. DOI:10.1080/10511482.2016.1193038.

Revington N. 2015. "Gentrification, Transit, and Land Use: Moving Beyond Neoclassical Theory." *Geography Compass* 9(3): 152-163. DOI: 10.1111/gec3.12203.

Rodriguez DA, Mojica CH. 2008. *Land Value Impacts of Bus Rapid Transit: The Case of Bogotá's TransMilenio*. Land Lines, Lincoln Institute of Land Policy.

Rodriguez DA, Mojica CH. 2009. "Capitalization of BRT Network Expansions Effects into Prices of Non-Expansion Areas." *Transportation Research Part A* 43: 560-571. DOI: 10.1016/j.tra.2009.02.003.

Rodriquez DA, Targa F. 2004. Value of Accessibility to Bogota's Bus Rapid Transit System. *Transport Reviews* 24(5), 587–610. DOI: 10.1080/0144164042000195081.

Rodriguez DA, Vergel-Tovar E, Carmargo WF. 2016. "Land Development Impacts of BRT in a Sample of Stops in Quito and Bogotá." *Transport Policy* 51: 4-14. DOI: 10.1016/j.tranpol.2015.10.002.

Rosen S. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *The Journal of Political Economy* 82 (1): 34-55. DOI: 10.1086/260169.

Rosenberg M. 2017. "Zestimates Are Way Off, Data Crunchers Compete To Improve Zillow's Model." StarTribune. June 1.

Ryan S. 1999. "Property Values and Transportation Facilities: Finding the Transportation-Land Use Connection." *Journal of Planning Literature* 13(4): 412-427. DOI: 10.1177/08854129922092487.

Satiennam T, Jaensirisak S, Satiennam W, Detdamrong S. 2016. "Potential for Modal Shift by Passenger Car and Motorcycle Users towards Bus Rapid Transit (BRT) in an Asian Developing City." *IATSS Research* 39(2): 121-129. DOI: 10.1016/j.iatssr.2015.03.002.

Shay J. 2016. "AAA: Cost of Owning a Car Falls to 6-Year Low." *CTPost*. Published April 7.

Siedler CE. 2014. "Can Bus Rapid Transit be a Sustainable Means of Public Transport in Fast Growing Cities? Empirical Evidence in the Case of Oslo." *Transportation Research Procedia* 1(1): 109-120. DOI: 10.1016/j.trpro.2014.07.012.

Smith JJ, Gihring TA. 2006. "Financing Transit Systems through Value Capture: An Annotated Bibliography." *American Journal of Economics and Sociology* 65(3): 751-786. DOI: 10.1111/j.1536-7150.2006.00474.x.

State of Connecticut. 2017a. "HISTORY." ctfastrak.com. http://ctfastrak.com/about/history (accessed June 7, 2017).

State of Connecticut. 2017b. "WHAT IS CTfastrak?" ctfastrak.com. http://ctfastrak.com/about/what-is-ctfastrak (accessed June 7, 2017).

State of Connecticut. 2017c. "WHAT IS BRT." ctfastrak.com. http://ctfastrak.com/about/what-is-brt (accessed June 7, 2017).

State of Connecticut. 2017d. "About." cttransit.com. https://www.cttransit.com/about (accessed June 7, 2017).

Stokenberga A. 2014. “Does Bus Rapid Transit Influence Urban Land Development and Property Values: A Review of the Literature.” *Transport Reviews* 34(3): 276–296. DOI: 10.1080/01441647.2014.902404.

U.S. Department of Transportation (US DOT). 2011. “Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis.” Office of the Secretary of Transportation. Published September 28.

Vermeiren K, Verachtert E, Kasaija P, Loopmans M, Poesen J, Van Rompaey A. 2015. “Who could Benefit from a Bus Rapid Transit System in Cities from Developing Countries? A Case Study from Kampala, Uganda.” *Journal of Transport Geography* 47: 13-22. DOI: 10.1016/j.jtrangeo.2015.07.006.

Vessali KV. 1996. “Land Use Impacts of Rapid Transit: A Review of the Empirical Literature.” *Berkeley Planning Journal* 11(1): 71-105.

Zhang M, Wang L. 2013. “The Impacts of Mass Transit on Land Development in China: The Case of Beijing.” *Research in Transportation Economics* 40, 124-133. DOI: 10.1016/j.retrec.2012.06.039

Zillow Group Inc., 2017. “Zestimate” https://www.zillow.com/zestimate/. Last accessed February 24, 2017.

Zuk M, Carlton I. 2015. “Equitable Transit Oriented Development: Examining the Progress and Continued Challenges of Developing Affordable Housing in Opportunity- and Transit-Rich Neighborhoods.” *PRRAC. http://www.prrac.org/pdf/EquitableTOD.pdf.*

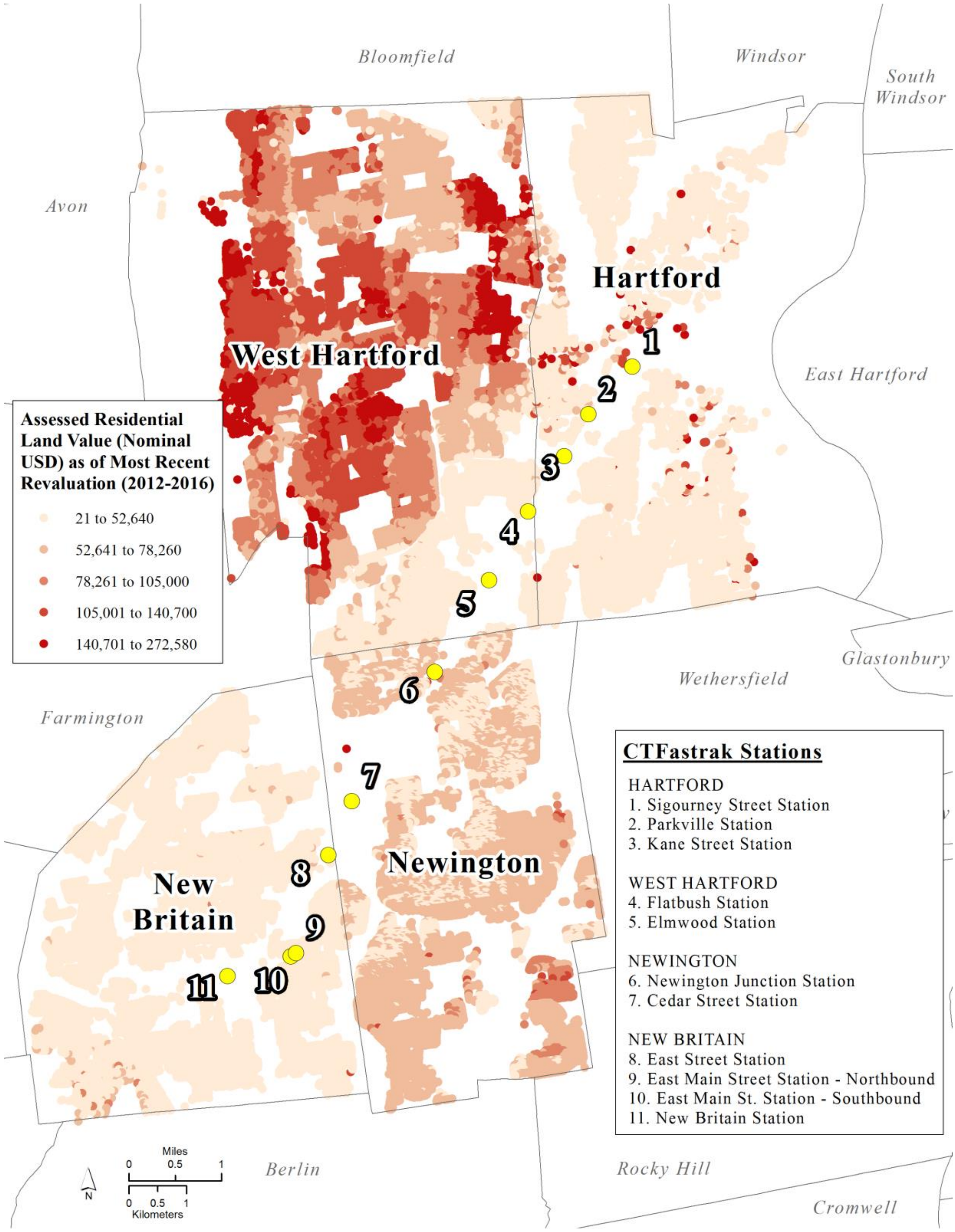
Appendix

This appendix contains several maps of the entire area of the locations of all CTfastrak stations.

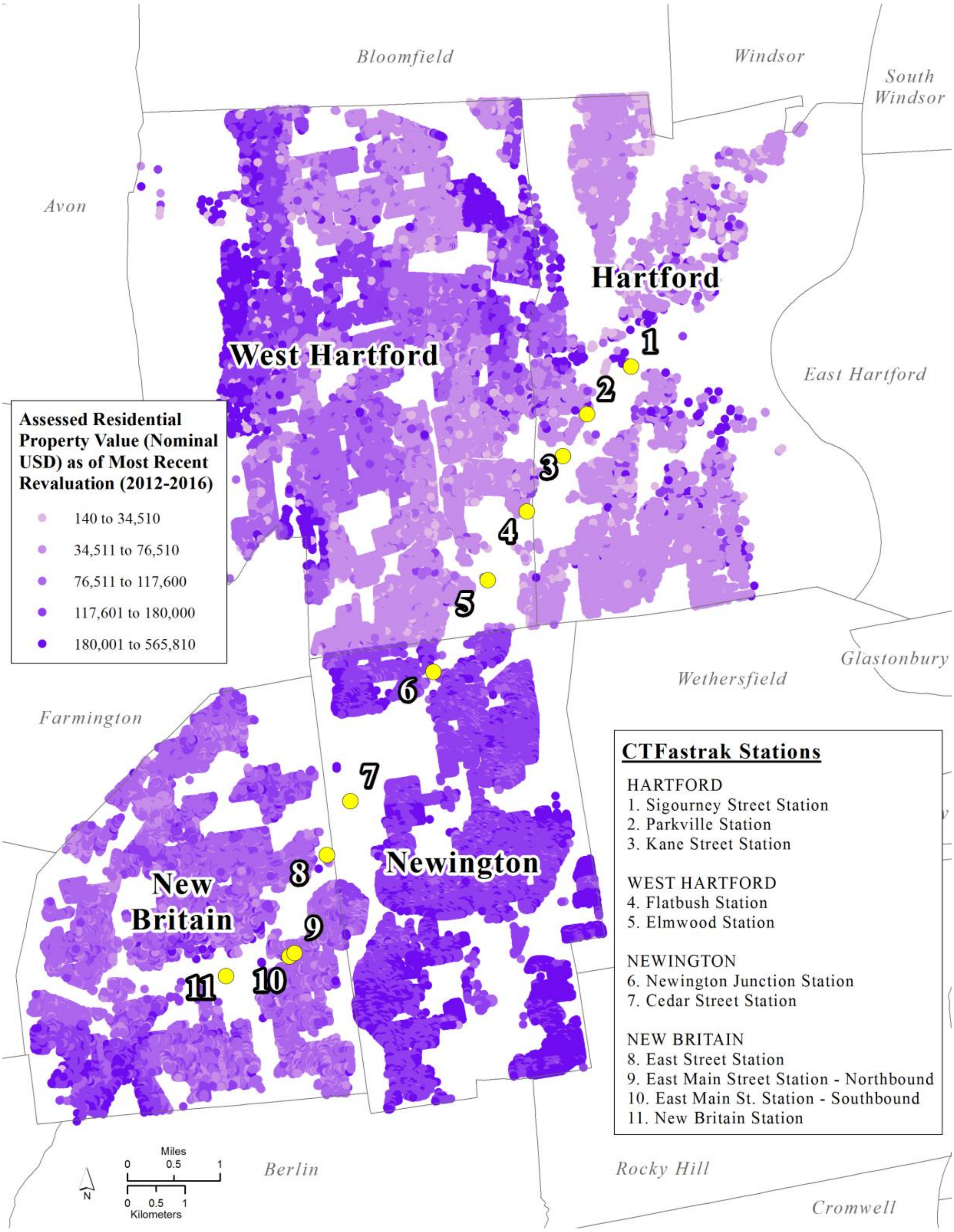
NOTE: The maps in the main body of this report above have focused on the New Britain CTfastrak station, for the purpose of conciseness. A geodatabase and a comprehensive set of additional supplementary maps/photographs for all CTfastrak stations are available. However, the file size of the data for all CTfastrak stations precludes us from providing access to the data through this report. If you need access to the additional data not included in this report, please contact the CTDOT Research Section.

Briefly,
The geospatial database contains all GIS and tabular information gathered and prepared for this project. Examples of this data include: multiple years of aerial photography (2004-2016), GIS shapefiles illustrating the geography of a multitude of variables related to real estate and economic development (e.g., the location of CTfastrak stations, assessed value of properties, recent sales, residential and commercial vacancies, and proposed redevelopment plans); CTDOT highway "street view" photolog; and, all tabular data (i.e., original files obtained from the municipal assessors, price indices to be used as controls in subsequent phases of the project, and NHTS travel survey data).

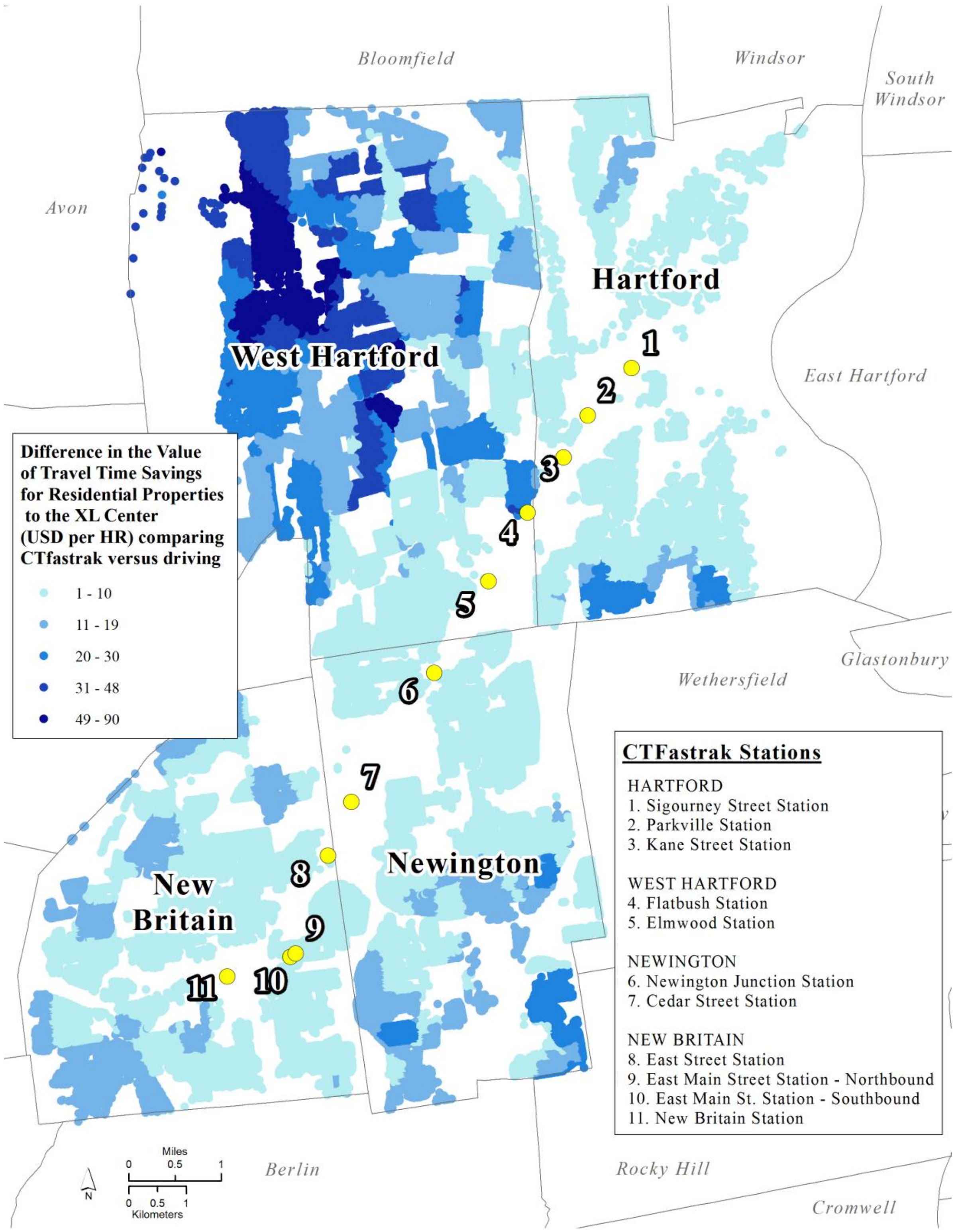
Supplementary maps/photographs for all CTfastrak stations - Over 500 maps were generated as a part of this project. For brevity, not all of these figures were included in the Phase 1 report. However, all of these maps are available, if necessary. These figures and tables have been sorted in two different ways: 1) by CTfastrak station and 2) by task as defined in the objective section in the Phase 1 report. The folder sorted by task contains the maps showing all four towns. The folder sorted by CTfastrak station only shows the changes occurring within a quarter mile (i.e., walking distance) of each station. Otherwise, these folders have identical figures and tables (the title of the figures and tables are slightly different so that they are appropriately sorted). This systematic sorting process was completed to allow users to flip through the figures and tables in a manner in which interests them. For example, if one is interested in a particular station, one can quickly view or grab all of the relevant figures and tables using the folder sorted by CTfastrak station. On the other hand, if one is more inclined to view the data by a particular theme (e.g., sale price), one can opt to use the folder sorted by task. Please contact the CTDOT Research Section to obtain the data.



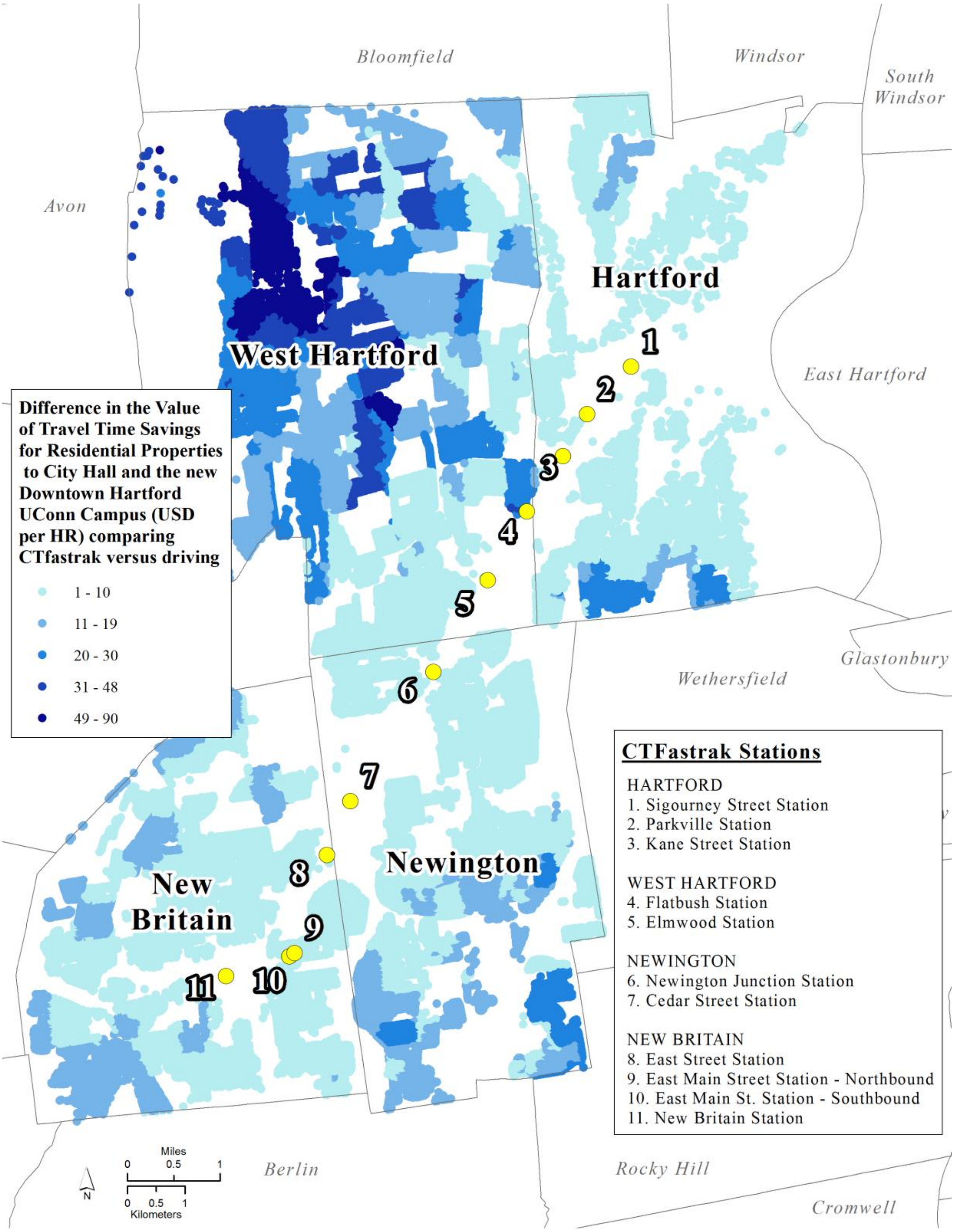
Appendix 1 – Assessed residential land value (nominal USD) as of most recent municipal revaluation and the location of the CTfastrak stations (yellow dots)



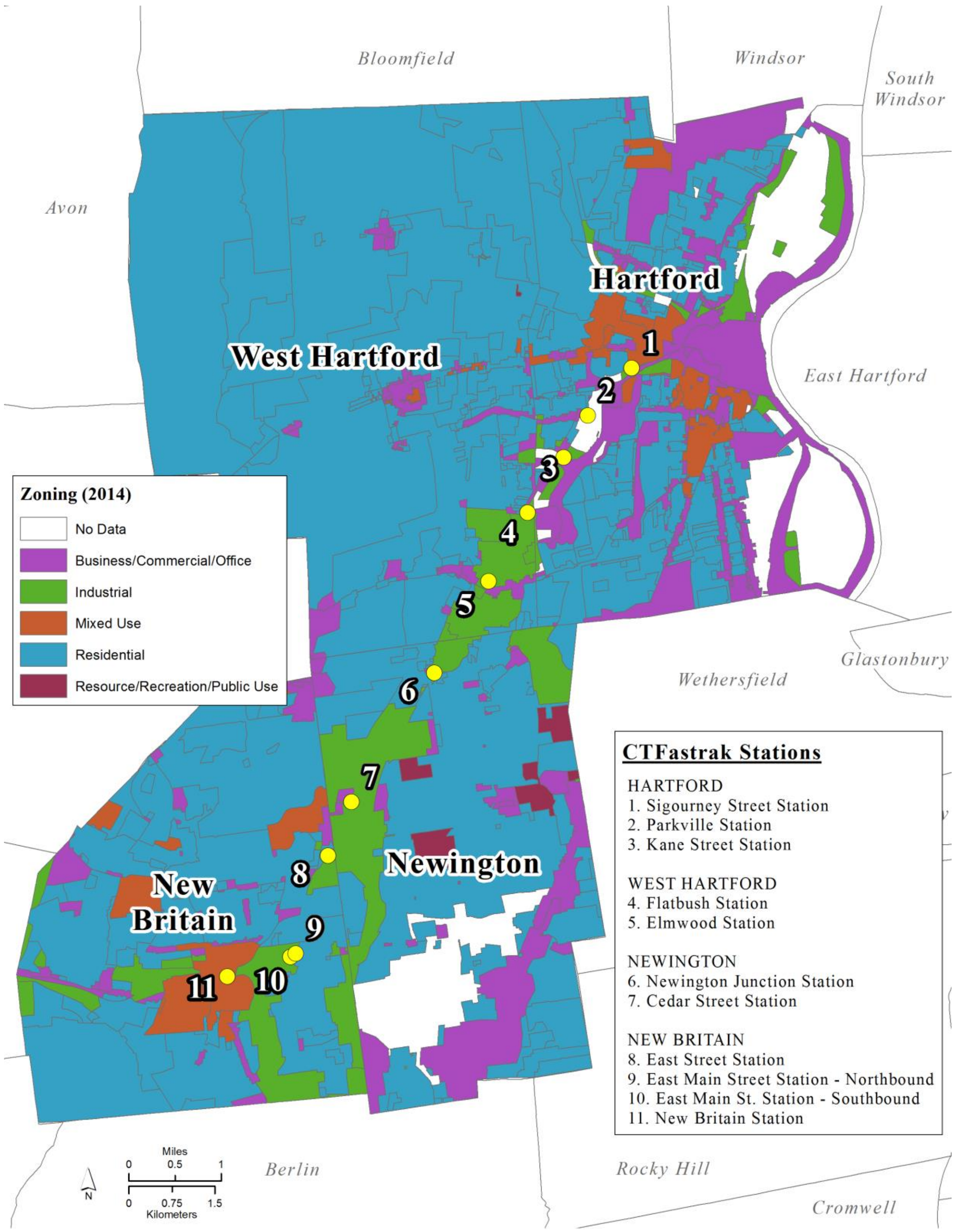
Appendix 2 – Assessed residential property value (nominal USD) as of most recent municipal revaluation and the location of the CTfastrak stations (yellow dots)



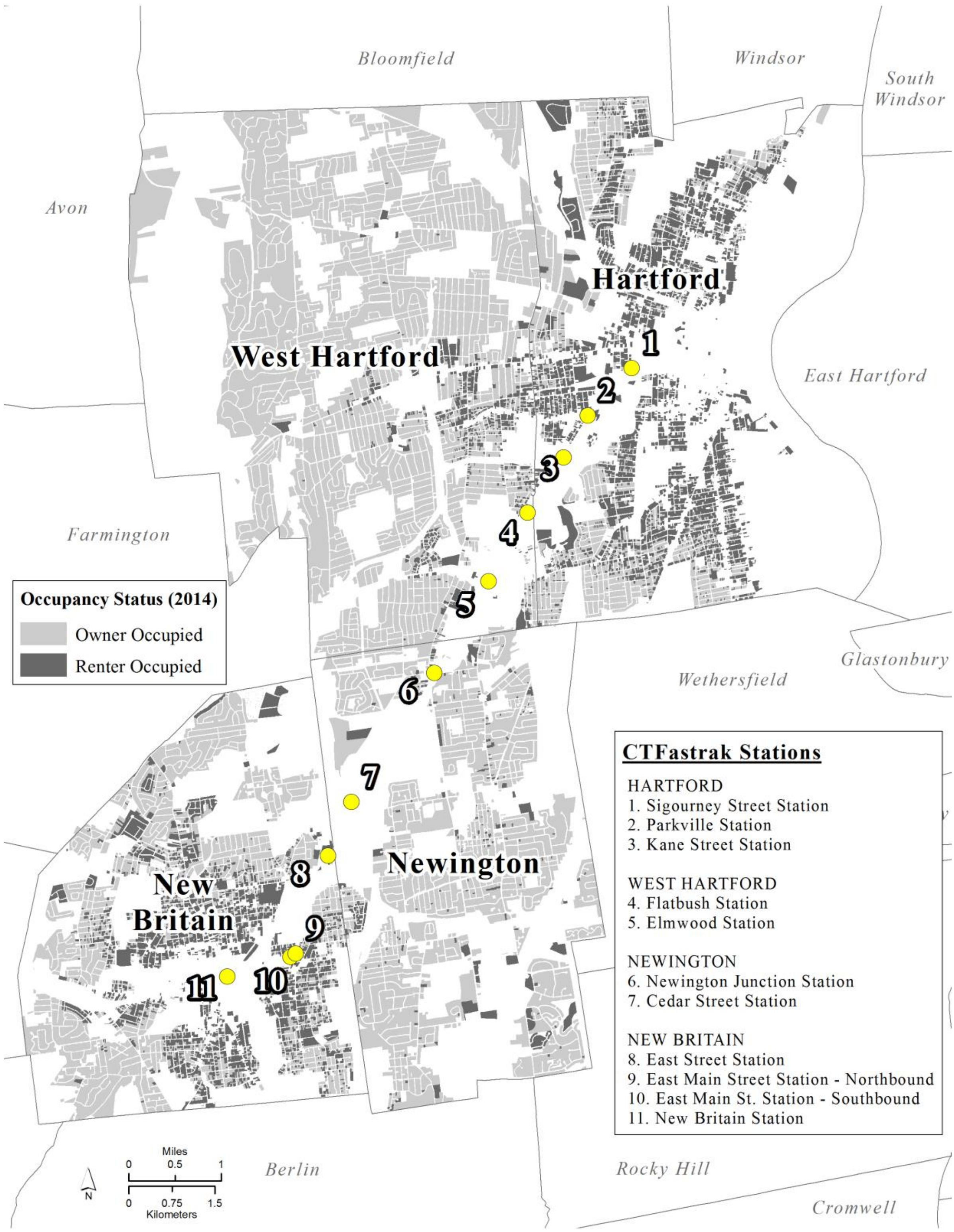
Appendix 3 – The difference in the Value of Travel Time Savings (VTTS; USD per HR) to the XL Center in Hartford comparing CTfastrak versus driving (i.e., VTTS using a CTfastrak minus VTTS using a private automobile only) for residential properties and the location of the CTfastrak stations (yellow dots)



Appendix 4 – The difference in the Value of Travel Time Savings (VTTS) to City Hall and the new Downtown Hartford UConn campus comparing CTfastrak versus driving (i.e., VTTS using a CTfastrak minus VTTS using a private automobile only) for residential properties and the location of the CTfastrak stations (yellow dots)



Appendix 5 – 2014 CRCOG zoning data and the location of the CTfastrak stations (yellow dots)



Appendix 6 – 2014 CRCOG parcels by occupancy status and the location of the CTfastrak stations (yellow dots)